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TESTIMONY

of

KENNETH SCHMIDT, PhD.

on

Water Quantity and

Quality Impacts

Relating to the

La Paz Generating Facility

Submitted on behalf of

Arizona Unions For Reliable Energy

October 19, 2001

Arizona Corporation Commission
DOCKETED

OCT 2 3 2001

DOCKETED BY

Kenneth Schmidt
Kenneth Schmidt & Associates
7227 North 16th Street
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GROUNDWATER QUALITY CONSULTANTS
7227 NORTH 16TH STREET, SUITE 105
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October 19, 2001

Mr. James D. Vieregg
Morrison & Hekler
1850 N. Central Avenue
Suite 2100
Phoenix, AZ 85004-4584

Re: La Paz Generating Facility
Groundwater Conditions

Dear Jim:

Pursuant to your request, I have reviewed the "Water Supply Report for the La Paz Generating Facility" by URS (June 19, 2001), and several supporting documents by Hydro Systems, Inc. Included were the "Harquahala Modeling Report" (June 19, 2001), "Harquahala Valley Numerical Ground-Water Flow Model" (December 2, 1999), the "Vidler Recharge Project at MBT Ranch, Full Scale Underground Storage Facility Permit Application" (August 25, 1999), and the "Completion Report, Allegheny Energy Supply, Monitor Wells AE-1 and AE-2" (August 23, 2000). I also attended the public hearing in Parker on September 4, 2001 and listened to the testimony provided.

My main comments on the Water Supply Report are on the following topics:

1. Subsurface geologic conditions.
2. Aquifer characteristics.
3. Land surface subsidence.
4. Projected drawdowns.
5. Groundwater quality.

Before discussing these topics, I would like to briefly discuss the documentation of the Water Supply Report preparer(s). This report contains no names of the report preparer(s) or their qualifications. Whereas the referenced HydroSystems, Inc. reports are signed and stamped, indicating the names and professional registration in Arizona in geology, no such information was provided for the preparer(s) of the Water Supply Report itself.

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Subsurface Geologic Cross Sections

Subsurface geologic cross sections are a commonly used, highly applicable, visual aide to help report readers visualize vertical trends in subsurface geologic conditions and other factors. The Water Supply Report contains no such cross sections. Rather, subsurface geologic conditions are discussed on Pages B-3-3 and B-3-5 of that report. Regional subsurface geologic conditions are primarily discussed on these pages. There is only a brief discussion of the holes for the two Allegheny Energy on-site monitor wells that were drilled to depths ranging from 800 to 860 feet. The discussion on Pages B-3-3 and B-3-5 is difficult to understand, and some of it is not consistent with the site-specific information.

Four subsurface geologic cross sections were provided in the Harquahala Valley Numerical Ground-Water Flow Model report. Only one of these is near the project site (C-C'). These sections were done prior to installation of the on-site monitor wells. Section C-C' indicates that clay and sandy clay are predominant near the project site, below a depth of about 50 feet and above a depth of about 500 to 600 feet. This is inconsistent with the geologic logs for the two on-site monitor wells (Appendix C of the Completion Report on Monitor Wells AE-1 and AE-2). The appendix indicates that only sand, sandy gravel, or gravel was generally found below a depth of 10 feet, until "volcanics" were encountered at 855 feet (AE-1) and 740 feet (AE-2) in depth. These textural descriptions are very different from those presented in subsurface cross section C-C'. There is also a significant discrepancy between these geologic logs and the subsurface cross section in the Completion Report (Figure 5). This cross section (passing through the monitor wells) shows that clay is predominant within the uppermost 400 to 500 feet beneath the site.

In summary, contradictory information on subsurface geologic conditions was presented in the Water Supply Report and the supporting documents. Because information on subsurface geologic conditions is an essential part of developing the hydrogeologic framework for the project site, this is a serious deficiency in the evaluation.

Aquifer Characteristics

Knowledge of aquifer characteristics is crucial in estimating drawdowns due to pumping of a well or wells. The two most impor-

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tant aquifer characteristics in this sense are the transmissivity and storage coefficient. Transmissivity is best determined from aquifer tests conducted at or near the site. Although aquifer tests were attempted at the two on-site monitor wells, the data obtained did not allow a direct determination of transmissivity (fifth paragraph on Page B-3-12 of Water Supply Report). Instead, values of transmissivity were estimated from the specific capacities obtained from the pump tests on the monitor wells. Experience in Central Arizona groundwater basins indicates that this approach is subject to considerable error. Another problem is that the monitor wells which were pump tested are much shallower than irrigation wells in the area. The irrigation wells are from 850 to 915 feet deep (Table B-3.1 of the Water Supply Report), and tap geologic Units 2 and 3. The deep deposits (below about 700 feet deep) are indicated to be highly productive. This is likely why the irrigation wells were drilled to the depths they were, as opposed to shallower depths (i.e. less than 700 feet deep). The monitor wells were completed to depths of less than 600 feet and tap geologic Unit 2. Thus the monitor wells don't tap the same strata as would most likely be tapped by existing or new large-capacity wells to be used for the La Paz G.S. water supply.

In terms of the storage coefficient, two types of situations are normally considered. For unconfined aquifers (i.e. a water-table situation), the specific yield is used. This is normally estimated from textural descriptions of the deposits tapped by the well, or sometimes is determined from long-term aquifer tests. For confined aquifers, the storage coefficient can generally only be determined correctly by an aquifer test, where at least one observation well is present that taps the same strata as the proposed well. The Water Supply Report discussion on storage coefficient is on Page B-3-5. A specific yield of one percent was mentioned (fifth paragraph) for Unit 2, which was indicated to be the main water-producing unit in the Valley. This value is not consistent with site-specific conditions (i.e. the geologic logs for the monitor wells nor the estimated transmissivities from the pump tests). A reasonable value of storage coefficient for Unit 2 was not provided on Page B-3-5 for Unit 2. Information on the state of confinement of the strata to be tapped by the La Paz G.S. supply wells was not provided.

The deep deposits are likely confined or semi-confined by over-lying less permeable strata. In this case, lower values of the storage coefficient would be applicable (i.e. 0.01 or 0.001, compared to the 0.1 used in the Numerical Ground-Water Flow Model report (Plate 6). Use of the lower value could make drawdowns more than twice what was predicted. On Page 4-29 of that report, it was stated: "Given that the model response is sensitive to this parameter (specific storage), it may be desired to conduct field tests to better determine the specific storage of the deeper sediments for future studies of this basin".

On Page 6-2 of the Numerical Ground-Water Flow Model report, it was stated that: "Only a few data points existed for transmissivity values in the (Harquahala) basin, and only one estimate of storage (coefficient) was known". This latter estimate was for an aquifer test at a site too distant from the project site to be applicable to the proposed project.

Land Surface Subsidence

A detailed evaluation of potential land subsidence was not included in the "Water Supply Report". Rather, a three-sentence long discussion of this topic was presented on Page B-3-11, where earth fissures in the valley were mentioned. Land surface subsidence associated with groundwater pumping in Arizona is commonly associated with compaction of inter-layered fine-grained deposits as water levels decline. Herb Schumann of the U.S. Geological Survey reported that subsidence monitoring began in the Harquahala Valley in about 1980. However, the results of this monitoring and the potential for land surface subsidence due to pumping for the La Paz Generating Station were not discussed. This could be a significant issue, because of the proposed concentrated pumping for the project from wells in a 320-acre area in Section 1, T2N/R11W.

The Water Supply Report (Page B-3-12) indicates that "Allegheny has acquired approximately 2,325 acres of farmland in Harquahala Basin as shown in Figure B-3-5". This illustration indicates that these lands are scattered over an area more than 16 miles long. Pumping of the groundwater formerly pumped on these lands is proposed from an area only about 14 percent in size of the irrigated lands themselves. This results in much greater localized drawdowns and potential for land subsidence than occurred due to pumping for the irrigated lands.

Projected Drawdowns

Although the Harquahala Valley Numerical Ground-Water Flow Model was used to estimate drawdown for the proposed project, there were several factors that were apparently not considered.

1. The Vidler Water Co. project is an underground storage project, whereby stored groundwater would eventually be recovered by pumping. The greatest drawdowns would likely occur during concurrent recovery well pumpage episodes and pumping for the proposed La Paz G.S. project. However, such a situation was not modeled for the project site.

2. At the public hearing in Parker on September 4, 2001, it was mentioned that new developments are possible near the freeway interchange. The interchange is located only slightly more than a mile north of the proposed La Paz G.S. well field. The joint drawdown due to pumping for the La Paz G.S., recovery pumping of Vidler Water Co. stored water, and pumping for this new development should also be evaluated. This probably represents the worst case situation.

3. Water-level rises due to Vidler Water Co. recharge operations were indicated to be a significant mitigating factor for the La Paz G.S. pumpage. However, this underground storage project could stop at any time. Also, there is no evidence that Allegheny is a participant in the Vidler Water Co. project.

4. Greater drawdowns would be projected if the deep groundwater reacts as a confined or semi-confined aquifer, as opposed to an unconfined aquifer as assumed in the groundwater model.

5. Pumping in the absence of intentional recharge, as proposed for the La Paz G.S., would result in almost 200,000 acre-feet of groundwater being pumped, evaporated, and thereby lost to the Harquahala Valley forever during the 30-year life of the project.

6. The Numerical Ground-Water Flow Model report indicates a predevelopment or natural recharge of only about 2,300 acre-feet per year in the entire Harquahala basin. The proposed project calls for pumping of 6,500 acre-feet per year of water from a concentrated, very small part (320 acres) of the basin, without replacing

the pumped water. This could be a precedent for other such projects in Harquahala Valley in the future.

7. Sound groundwater management would call for either using CAP water for the La Paz G.S. or replacing the pumped groundwater. Also, alternative cooling technologies should be more thoroughly evaluated that have the potential to minimize groundwater pumping for the proposed project.

Groundwater Quality

The Completion Report for Monitor Wells AE-1 and AE-2 (Table 2) contains the results of analyses of water samples collected from these wells in April 2000. The nitrate-nitrogen concentration in water from AE-2 was 33 mg/l, greatly exceeding the maximum contaminant level (MCL) of 10 mg/l for drinking water. The fluoride concentration in water from AE-1 was 5.1 mg/l, exceeding the MCL of 4.0 mg/l for drinking water. The fluoride concentration in water from AE-2 was 3.1 mg/l, exceeding the recommended MCL of 2.0 for drinking water in Arizona. The arsenic concentration in water for AE-1 was 12 ppb, which exceeds the proposed new MCL for arsenic in drinking water of 10 ppb. The iron concentration in water from AE-1 was 0.42 mg/l, exceeding the recommended MCL of 0.3 mg/l for drinking water.

The Water Supply Report (page B-3-14) summarized the results of this sampling. However, there was no discussion in the report as to how potable water would be provided for the La Paz G.S. Also, there was no detailed discussion of the suitability of this groundwater for the remaining water use at the G.S. No chemical analyses were provided for silica, which is normally a major constituent of concern for the proposed use of the water.

Evaporation Ponds

Lined evaporation ponds are proposed for wastewater from the G.S. No detailed information was provided on the expected amount or chemical composition of the wastewater. After operation of the plant stops, how would the evaporation ponds be closed? Could wind-blown salt be a problem when water is no longer placed in the evaporation ponds?

A handout at the September 4, 2001, hearing in Parker indicated that the application for the Aquifer Protection Permit (APP) would be filed in October 2001. It would be extremely useful to have this information in order to provide comments on the evaporation ponds and potential impacts of wastewater.

Storm Runoff

Storm runoff from the site is apparently to be discharged to Centennial Wash, but no detailed plans were presented in the available materials. The probable composition of this runoff wasn't discussed in detail.

Groundwater Monitoring

No routine groundwater monitoring plan for the drawdown associated with the well field for the La Paz G.S. nor the evaporation ponds was provided. This is necessary to provide an early indication of potential problems that may occur, so that mitigating measures can be undertaken in a timely fashion.

Summary and Conclusions

Information provided in the Water Supply Report and supporting documents on subsurface geologic conditions was contradictory and did not clearly establish the hydrogeologic framework at the project site. Also, site-specific information on aquifer characteristics was not obtained from aquifer tests. Actual drawdowns due to pumping for the project could be twice as great as estimated from the groundwater model, if site-specific information was available and used. A detailed evaluation of land surface subsidence due to the pumping for the proposed project was not presented in the Water Supply Report or supporting documents. Because of concentrated pumping in a relatively small area for the proposed project, localized drawdown and subsidence could be significant. The worst-case situation is pumping for the project during recovery well pumping for the Vidler Water Company Underground Storage Project, and this was not evaluated at the proposed site. The groundwater impacts due to pumping could be significantly reduced by using CAP water for the proposed project, or by using alter-

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native cooling technologies for the G.S. Evaluation of the impact on groundwater quality of the evaporation ponds was not possible based on the provided information, as the Aquifer Protection Permit (APP) application and supporting hydrologic report were not available for review.

Sincerely yours,

Kenneth D. Schmidt

KDS/jw

PROFESSIONAL EXPERIENCE
KENNETH D. SCHMIDT
AUGUST 1999

Birthplace and Date

Madera, California on November 8, 1942

Degrees

B.S. Geology, Fresno State College, Fresno, California (1964)
M.S. Hydrology, University of Arizona, Tucson, Arizona (1969)
Ph.D. Hydrology, University of Arizona, Tucson, Arizona (1971)

Registration and Certification

Geologist No. 1578 in California (1970)
Geologist No. 8019 in Arizona (1971)
Geologist No. 23685 in Arizona (1989)
Geologist No. G462 in Oregon (1978)
Certified Groundwater Professional No. 193 (1986)

Society Membership

American Water Resources Association (1972)
American Water Works Association (1970)
Arizona Hydrological Society (1984)
Arizona Water and Pollution Control Association (1971)

Professional Experience

August 1978 to Present: Principal, Kenneth D. Schmidt and Associates, Groundwater Quality Consultants, Phoenix, Arizona.

June 1972 to July 1978: Principal, Kenneth D. Schmidt and Associates, Groundwater Quality Consultants, Fresno, California.

January 1969 to May 1972: Hydrologist, Harshbarger & Associates, Consultants in Hydrogeology, Tucson, Arizona.

December 1964 to February 1967: Engineering Geologist, Bookman-Edmonston Engineering, Inc., Arvin, California.

As an engineering geologist with Bookman-Edmonston Engineering, Inc. in Arvin, California from 1964-67, Schmidt's primary duties involved hydrogeologic studies associated with the development and operation of two large-scale recharge and groundwater recovery facilities southeast of Bakersfield. This experience involved the basic aspects of groundwater studies, including preparing a well inventory, water-level measurements, aquifer testing, logging drill cuttings, interpreting geophysical logs, observing well construction, collecting water samples from hundreds of water supply wells for chemical analyses, and data interpretation. He conducted specific studies of land surface subsidence due to groundwater overdrafting and of the occurrence of high boron contents in groundwater northeast of Arvin. Schmidt subsequently completed a Master's thesis at the University of Arizona in 1969 on the boron problem in that area.

As a hydrologist with Harshbarger & Associates in Tucson from 1969-72, Schmidt's primary duties involved detailed water budget studies of the Santa Cruz and San Pedro River basins, in cooperation with the U.S. Geological Survey. In addition, he conducted extensive hydrogeologic studies as part of the FICO vs. Mines litigation south of Tucson. Included were detailed studies of subsurface geologic conditions, evaluation of high nitrates in groundwater beneath irrigated areas, and development and implementation of a comprehensive water quality monitoring program at five mines south of Tucson. He was heavily involved in most of the field activities and data interpretation.

As the principal of his own consulting firm since 1972, Schmidt has conducted and supervised thousands of hydrogeologic investigations in the southwest, primarily in central and southern Arizona and in California. In the mid-1970's, Schmidt worked on development of some of the first national guidelines for groundwater quality monitoring, as a consultant to General Electric TEMPO.

By the late 1970's, Schmidt began to design, develop, and implement some of the earliest groundwater quality monitoring programs at specific sites in the Southwest. His involvement with a number of these has continued through to the present. In addition, he began extensive groundwater studies as part of the EPA-sponsored 208 water quality management program in several areas. One was in Maricopa County, Arizona and was conducted for the Maricopa Association of Governments. Studies in this program focused on the Salt River Valley, where numerous specific monitoring programs involving landfills, storm runoff, dry wells, and irrigation were subsequently undertaken. This program continued into the 1980's, and an EPA-sponsored 205J program was subsequently undertaken. Another 208 program was in the Sahuarita-Continental area and was conducted for the Pima Association of Governments. Studies in this area were completed as part of the Upper Santa Cruz Mines Task Force investigation, and focused on the impacts of copper mine tailings ponds on groundwater and on the high nitrate contents in groundwater beneath irrigated lands.

In about 1980, Schmidt began working on a number of projects to develop new public-supply wells in water quality problem areas. Included were dozens of wells in high fluoride, arsenic, and DBCP and hot water areas in Mesa, high nitrate and salinity areas in Tolleson and in Gilbert, problem areas in Chandler and Queen Creek, and areas of high chromium, arsenic, and fluoride in Paradise Valley. During the past several years, the firm worked on two new wells in Maricopa, one well in the Town of Gilbert, and several wells in the City of Peoria. The firm also participated in development of the groundwater supply for the Lewis Prison, between Buckeye and Gila Bend, and for the Talking Stick Golf Course east of Scottsdale.

Kenneth D. Schmidt and Associates have been involved with a number of groundwater contamination investigations and groundwater reclamation projects in Arizona. Included are the Motorola, Inc. Mesa Bipolar Integrated Circuits Center, and the Tucson Airport Remedial Investigation. The firm is involved with routine groundwater monitoring at a number of semi-conductor facilities, several landfills, and several gasoline contamination sites in Arizona.

The firm has been involved with permitting and monitoring of a number of underground storage and recovery projects, including:

1) Granite Reef Underground Storage Project for City of Mesa.
2) Northwest Water Reclamation Facility for the City of Mesa.
3) Prescott Effluent Recharge Facility.
4) Town of Gilbert Effluent Recharge and Storage (two sites).
5) Ocotillo Project in Chandler.
6) Ninety-First Avenue WWTF Underground Storage Project for SROG.
7) Spook Hill Park Project in east Mesa.
8) Queen Creek sites for the City of Mesa.
9) Rillito Creek project for City of Tucson.
10) City of Chandler Wetlands project, Ocotillo.

The firm has conducted dozens of well interference evaluations for new large-capacity wells, pursuant to ADWR regulations, and has completed numerous evaluations pursuant to ADEQ regulations for groundwater quality protection and aquifer protection permits for landfills and sewage effluent. From 1992-98, Schmidt was a member of the Industrial Advisory Council of the College of Engineering & Mines at the University of Arizona. In 1993, Schmidt was appointed to the Department Advisory Committee for the hydrology program at the University of Arizona, and he has chaired that committee since 1996. In 1995, he received the Distinguished Citizens Award from the University of Arizona College of Engineering. In 1998, he received the Centennial Achievement Award from the Alumni Association of the University of Arizona.

Selected Clientele

Arizona Portland Cement Co., Rillito.
Avis Rent A Car System, Inc., Garden City, New York.
Baron and Budd, Dallas, Texas.
Brown and Caldwell, Phoenix.
Burgess and Niple, Phoenix.
Calmat Co., Phoenix.
Camp, Dresser & McKee, Phoenix.
Carollo Engineers, Phoenix.
Central Avenue Landfill Corporation, Phoenix.
City of Chandler, Public Works Department.
City of Flagstaff.
City of Mesa, Engineering Department and Utility Operations.
City of Phoenix, Department of Water and Sewers.
City of Safford.
City of Tucson, Environmental Management.
City of Wilcox, Dept. of Public Works.
Coe and Van Loo, Phoenix.
Denro, Ltd., Phoenix.
Entranco, Phoenix.
Ferrellgas, Tuba City.
Greeley and Hansen, Phoenix.
Jennings, Strouss & Salmon, Phoenix.
Jones, Skelton & Hochuli, Phoenix.
Lewis and Roca, Phoenix.
Maricopa Association of Governments, Phoenix.
Maricopa Domestic Water Improvement District.
McCauley, Frick & Gilman, Inc., San Francisco, California.
Mechanical Products Co., Jackson, Michigan.
Meyer, Hendricks, Victor, Osborn & Maledon, Phoenix.
Mobile Land Development Corporation, Scottsdale.
Motorola, Inc., Mesa, Tempe, Chandler, and Ocotillo.
Ocotillo Management Group, Chandler.
Pima Association of Governments, Tucson.
Pima County Wastewater Management Department, Tucson.
Quarles and Brady, Phoenix.

Salt River Indian Community, Scottsdale.
Salt River Landfill, Scottsdale.
W.C. Scoutten, Inc., Phoenix.
Snell & Wilmer, Phoenix.
Sorenson Utilities, Fort Mohave.
Southwest Beef, Tolleson.
Town of Gilbert.
U.S. Army Corps of Engineers, Phoenix.
United Metro Materials, Phoenix.
Wilson & Company, Phoenix.

Publications

"The Use of Chemical Hydrographs in Groundwater Quality Studies," in Hydrology and Water Resources in Arizona and the Southwest, vol. 1, Arizona Section AWRA, pp 211-223, 1971.

"Nitrate in Groundwater of the Fresno-Clovis Metropolitan Area, California," Ground Water, vol, 10, No. 1, pp 50-64, 1972.

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"Groundwater Quality in the Cortaro Area Northwest of Tucson, Arizona," Water Resources Bulletin, vol. 9, No. 3, pp 598-606, 1973.

"Nitrates and Groundwater Management in the Fresno Urban Area," Journal AWWA, vol. 66, No. 3, pp 146-148, 1974.

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"Monitoring Groundwater Pollution," Proceedings of the International Conference on Environmental Sensing and Assessment, Groundwater Section, sponsored by EPA, WHO, and University of Nevada, Las Vegas, Nevada, September 1975, The Institute of Electrical and Electronics Engineers, Inc., vol. 1, session 9, No. 4, pp 1-6, 1976.

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"A Groundwater Quality Monitoring Methodology," Journal AWWA, vol. 68, No. 11, pp 586-593, with D.K. Todd, R.M. Tinlin, and L.G. Everett, 1976.

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"Groundwater Monitoring Associated with Water Transfer and Banking Projects", Proceedings of the Symposium on Conjunctive Use of Water Resources: Aquifer Storage and Recovery, American Water Resources Association, Long Beach, California, October 19-23, 1997, pp _____.

DECLARATION OF

I, Kenneth D. Schmidt, declare as follows:

1. I prepared the attached analysis of environmental impacts of the proposed La Paz Generating Facility in La Paz County, Arizona, based on my independent review and my professional experience and knowledge.
2. It is my professional opinion that the analysis is valid and accurate with respect to the issue(s) addressed therein.
3. I am personally familiar with the facts and conclusions related in the analysis, and if called as a witness could testify competently thereto.
4. A copy of my professional qualifications and experience is attached hereto and incorporated by reference herein.

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

Dated: October 19, 2001, at Fresno, California

Kenneth D. Schmidt

Kenneth D. Schmidt

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of

SCOTT B. TERRILL, Ph.D.

on

Biological Resource Impacts

Relating to the

La Paz Generating Facility

Submitted on behalf of

Arizona Unions For Reliable Energy

October 19, 2001

Scott B. Terrill, Ph.D.
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Arizona Corporation Commission
DOCKETED

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TESTIMONY OF SCOTT TERRILL, Ph.D.

I have reviewed the biological sections of, and relevant materials associated with, the application submitted to the Arizona Power Plant and Transmission Line Siting Committee by Allegheny Energy Supply Company, LLC (Docket No. L-00000AA01-0116) for the Natural Gas-fired Generating Facility, Gas and Water Pipelines and Transmission Lines, La Paz County, Arizona (the Application).

I am a vertebrate ecologist with a B.S. and M.S. in Zoology from Arizona State University and a PhD in Biology (Avian Ecology) from the State University of New York at Albany. I am currently Vice President, Wildlife Division Head and Senior Ornithologist for H.T. Harvey and Associates, Ecological Consultants. My approximately 30 years of professional experience includes 7 years of ecological research, surveys, and associated studies throughout Arizona from 1974-1981. H.T. Harvey and Associates Biologists have been working on assessing impacts of, and mitigations for, operations of evaporation basins in arid environments for over a decade now. I have been the project manager, or principal, on those projects since 1992.

The Application proposes the use of evaporation basins to dispose of groundwater used to cool the facility. Based on water quality data in the Application and documented impacts on wildlife from elevated selenium levels in evaporation basins, the operation of such basins should be considered a potential significant impact.

Bioaccumulation of Toxins from Evaporation Ponds Impacts Wildlife

Our experience with the issue spans over a decade of work on agricultural drainwater evaporation basins in California. Evaporation basins have been used to drain salt-laden soils in areas of high ground water in the southern San Joaquin Valley for several decades now (Gordus et al. 1996). This drainage has been necessary to achieve productive farming in the naturally saline soils associated with various areas of the San Joaquin Valley. Because there is no exit outlet for water that flows into the southern San Joaquin Valley, evaporation basins were adopted as the method for disposing of saline drainwater (Tanji and Dahlgren 1990).

The original intent of the resource agencies was to use these evaporation basins to provide habitat for birds and other wildlife (Schuler 1987). However, the now infamous situation at Kesterson Reservoir, in which birds breeding at the reservoir were significantly reproductively impaired by elements, most notably selenium, in the water, has radically changed that approach. In addition to the Kesterson Reservoir, Skorupa (1998) presents 11 other examples of selenium poisoning of fish and wildlife in nature.

Chemicals bioaccumulated through the food chain represent the greatest known potential threat to wildlife using evaporation ponds. Selenium has been the chemical of primary concern in field and laboratory studies and continues to be the chemical monitored to assess impacts and mitigation requirements at evaporation basins in the southern San

Joaquin Valley. The primary pathway for selenium poisoning in birds is dietary. Waterborne selenium is up taken by plants, which, in turn, are consumed by some species of waterbirds and by various invertebrates, which are also consumed by birds (and other vertebrates). The process of transfer of biomass containing selenium up the food change results in tissue bioaccumulation of selenium (Ohlendorf et al. 1990).

Selenium has been experimentally demonstrated to cause reduced viability, hatchability and overt embryonic teratogenesis in birds (e.g., Ohlendorf 1989, Skorupa and Ohlendorf 1991). Although selenium has been the primary contaminant of concern, boron and other constituents (including salinity) may reduce the hatchability of eggs produced by birds consuming contaminated foods. Further, contaminated foods may reduce the growth and survival of young birds.

The majority of the impacts known to be associated with selenium in evaporation basin systems appear to be related to reproduction and development. Thus, little is known about potential effects outside the breeding season, although saline water can encrust feathers and lead to mortality when temperatures drop in winter.

Evaporation Basins Attract Wildlife

There is ample information to indicate that the proposed evaporation basins would attract birds. Water basins in arid environments, including the Arizona deserts, are extremely attractive to birds. Sewage-treatment-plant ponds, sugar beet processing ponds, golf course ponds, etc., are well known for their attractiveness to birds (e.g., see coverage of such areas in the Phoenix region in Witzeman et al., 1997). A number of species breed at such areas in Arizona. Such species include shorebirds such as the Black-necked Stilt (*Himantopus* mexicanus) and Killdeer (*Charadrius vociferus*) and various waterbirds, including grebes, ducks, herons, etc. In addition, bodies of water in Arizona are utilized as migratory stopover sites for resting and feeding by a diverse assemblage of migratory birds, often in relatively large numbers (Monson and Phillips 1981). Finally, the areas also host wintering waterbirds, including many species of waterfowl, shorebirds and other species.

Thus, avian-use patterns of water basins in arid environments, coupled with the potential for accumulation of various salts, notably selenium, concentrated in ground water, provide conditions for potential significant biological impacts.

The Proposed Evaporation Ponds Would Likely Contain Selenium Levels In Excess of Acceptable Risk Thresholds

Skorupa (1998), in reviewing 12 examples of selenium poisoning in nature, concludes that toxic risk to fish and wildlife populations to be associated with <5 μg L (5 ppb), the United States Environmental Protection Agency (EPA) freshwater chronic criterion, selenium in impounded water. Given that selenium levels in groundwater samples presented in Table B-3.2, p. B-3-15 in the Application, reach 4.5 ppb, it is likely that levels will be substantially higher in water concentrated by the cooling and evaporation process. Concentration via cooling and evaporation could well result in substantially elevated selênium levels.

There is significant interspecific variability in the sensitivity of various avian species to selenium. However, Skorupa and Ohlendorf (1991) estimated, based on a regression analysis, that the selenium-risk threshold for waterbirds based on waterborne selenium to be < .5 ppb for background, 2.7 ppb for hatchability effects, and 12 ppb for teratogenesis (embryonic deformity). Teratogenesis is a relatively severe response and therefore analysis of egg viability has been proposed as a more sensitive estimate of the exposure threshold for reproductive toxicity (Skorupa 1998). Based on the largest study undertaken on selenium impacts on avian reproduction and survivorship, which utilized data from the San Joaquin Valley evaporation basins, Skorupa (1998) found an estimated toxicity threshold for Black-necked Stilts of 4 ppb selenium in impounded drainage water and a threshold is somewhat higher than that for the closely related American Avocet. However, he also found that thresholds in dabbling ducks appear to be approximately half of the stilt threshold. Negative effects of elevated selenium are not limited to birds, but impact many taxa. The EPA estimation of the highest concentration of selenium in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect is 5 ppb.

Based on the available information concerning the groundwater quality and research on impacts of elevated selenium at evaporation systems similar to the one proposed for La Paz County, I conclude that there is a relatively high potential for significant impacts to wildlife.

Mitigation Should Be Required

In our interactions with the resource agencies over evaporation basin issues, The United States Fish and Wildlife Service (the Service) has considered reproductive impacts to birds breeding at the basins containing elevated levels of selenium as a significant environmental impact under NEPA and a violation of the Migratory Bird Treaty Act. Thus, the Service's position has been to eliminate impacts or require mitigation for the operation of ponds with elevated levels of selenium.

One possible approach to avoid the potential for these impacts is to render the evaporation system unattractive or unusable by birds and other wildlife. For example, concrete tanks with screen covers, if feasible, would represent such an approach. Another approach would be to eliminate the water by means other than evaporation basins.

If alternatives to evaporation basins are determined infeasible, and ponds are used to dispose of cooling water, the water should be monitored for constituents, including salts, as well as use by wildlife. If relevant salts exceed thresholds and birds and other wildlife use the ponds, mitigation for impacts to wildlife should be implemented.

The United States Fish and Wildlife Service has been extensively involved in the San Joaquin Valley situation since Kesterson The Service and other resource agencies have adopted a number of impact reduction/mitigation programs to address selenium concentrations. These include (1) reducing the attractiveness of the sites to breeders (primarily recurvirostrids at these sites), coupled with (2) daily aggressive hazing throughout the breeding season, in combination with (3) provision of freshwater alternative wetlands located within the functional landscape of the ponds. If it is determined that residual significant impacts are still occurring after these steps are adopted, compensation habitat is provided off site.

The basins in the San Joaquin Valley have been reconfigured to greatly reduce nesting by recurvirostrids (the American Avocet, and Black-necked Stilt) and other species (we have been able to reduce nesting to zero in some years at some ponds). Nevertheless, the basins still typically receive some use by these and other shorebirds (even with extensive hazing). A difficulty with reconfiguring the ponds to reduce the attractiveness to one guild of species (e.g., making the ponds deeper, with steep sides and flat bottoms to discourage shorebird use) is that this increases the attractiveness to other groups (e.g., grebes, ducks, gulls, terns). It should be noted that saline water can be quite productive (brine shrimp, brine flies etc.) and this situation makes it very difficult to eliminate overall avian use of these sites.

We consistently find much higher numbers of birds nesting at the alternative wetlands than at the evaporation basins under this system. Although birds likely feed at both evaporation basins and the adjacent freshwater alternative wetlands, egg-selenium results collected for nearly ten years indicate that the presence of the freshwater habitat significantly reduces overall selenium uptake in these birds.

Based on our experience, impacts to birds at evaporation basins can be greatly reduced, but not eliminated, by adopting the above approach. The only way to eliminate impacts entirely would be to cover the ponds and make them inaccessible (assuming that the water is not sterile due to extreme salinity).

Of course, if ponds do not contain potentially harmful levels of constituents, they do not pose a threat to wildlife. If data on quality of water cycled through the cooling and evaporation basin process indicate that constituents do not represent a potential impact to wildlife, then a water-quality monitoring program could be implemented to ensure that constituents remain under risk thresholds. Appropriate agencies should be contacted on a regular basis for threshold values, as they can be dynamic based on new research. If the water does exceed thresholds, and alternatives to open evaporation basins are not feasible, then a mitigation plan such as the approach outlined above could be implemented.

Potential Off-site Impacts to Habitats

The Application concludes that emissions from the La Paz Generation Facility will not result in any harmful effects on soils or vegetation. However, the potential for adverse impacts to habitat, as a result of plant generated air pollution, for desert tortoise and other species as been raised as an issue associated with another proposed natural gas power plant (California Energy Commission 2001). Monitoring and experimental data demonstrate that air pollution, especially nitrogen and carbon compounds, represent a serious problem with respect to the desert biotic communities and the species associated with them (see California Energy Commission 2001 and references contained therein).

I recommend a more detailed analysis of the potential off-site impacts to habitats, not only as a direct result of the operation of the plant, but on a cumulative basis in the region of the proposed facility.

Avian Mortality As a Result of Collisions with Conductors

Although the Application acknowledges that birds, including raptors such as eagles and hawks "could be injured or killed by colliding with conductors of the proposed transmission line interconnect" it determines that the proposed project would not result in adverse impacts on the biological wealth within the area. There has been rising concern about the loss of birds due to collisions with power lines (California Energy Commission 1995). Large birds, such as raptors are more prone to strike wires than smaller species, although mortality as occurred across a wide spectrum of species. Raptors are, for the most part, top level predators. As such, they are relatively scarce and protected. Direct mortality of raptors striking the wires would represent a significant impact. Thus, I recommend that mitigation to reduce the probability of bird-strikes be incorporated into the project.

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Whitzman, J., S. Demaree, E. Radke. 1997. Birds of Phoenix and Maricopa County, Arrizona. Maricopa Audubon Society, Phoenix Az. 153pp.

SCOTT B. TERRILL
Senior Ornithologist - Principal

EDUCATION
Ph. D. Biology/Ecology, with distinction, State University of New York, Albany. 1986.
M. S. Zoology, Arizona State University. 1981.
B. S. Zoology, Arizona State University. 1978.

AREAS OF EXPERTISE
Ornithology, community ecology, vertebrate behavior, population biology, biological monitoring, risk assessment, mammalogy, statistics.

PROFESSIONAL EXPERIENCE
H. T. Harvey & Associates, 1990 - present.
Associate Adjunct Professor, San Jose State University, 1995 - present.
Alexander von Humboldt Research Fellow, Max-Planck-Institute, Germany, 1987 - present.
Research Director, Coyote Creek Riparian Station, 1991-1995.
Adjunct Professor, State University of New York, 1988-90.
Assistant Professor, Siena College, New York, 1988-90.
Assistant Professor, Siena College, New York, 1986-87.
Lecturer, State University of New York, 1986.

PROFESSIONAL MEMBERSHIPS
American Ornithologists Union
Animal Behavior Society
Association of Field Ornithologists
British Ornithological Society
Cooper Ornithological Society
Ecological Society of America
German Ornithological Society
Raptor Research Foundation
Sigma Xi
Western Field Ornithologists
Wildlife Society
Wilson Ornithological Society

PROFESSIONAL AFFILIATIONS
Alexander Von Humboldt Research Fellow (Max-Planck-Institute)
Director of Research, Coyote Creek Riparian Station
Member, Board of Directors, Coyote Creek Riparian Station
Committee Member, California Bird Records Committee

QUALIFICATIONS
An internationally recognized ornithologist with extensive experience in avian ecology and behavior, Scott has published over 30 scientific papers since 1981, and was the primary contributing author to the 3-volume advanced field guide, the Audubon Society Master Guide to Birding and he serves on the California Bird Records Committee and is a regional editor for North American Birds. He also has a strong background in community ecology and mammalogy. As a professor, Scott has lectured in ornithology, ecology, field biology, vertebrate biology, environmental science, biodiversity, general biology, physiology, scientific writing, and animal behavior. Dr. Terrill has been working with special-

status species, habitat analyzes, biotic inventories, and environmental impact studies since 1974. He designed and managed a major study for an EIS assessing alternative corridors for the placement of power transmission lines across the Lower Colorado River and was involved in a number of other major EIS's (e.g. Orme Dam, Central Arizona Project) in the 1970's. He is well versed in CEQA, FESA and NEPA.

Scott has managed over 400 projects, including a number of major EIR's, environmental risk assessments, hazardous waste clean ups, site characterizations, and endangered species investigations and consultations involving California Least Tern, Salt Marsh Harvest Mouse, California Clapper Rail, San Joaquin Kit Fox, and Bay Checkerspot Butterfly. Dr. Terrill has been working on riparian ecosystems for over two decades and served as Research Director for Coyote Creek Riparian Station, where he is currently on the Board of Directors. Scott has had extensive experience with birds-of-prey (hawks, eagles and owls), and has supervised over one hundred Burrowing Owl surveys and relocations. Dr. Terrill has expertise in all of the major habitats in western North America, including oceanic and desert habitats.

PUBLICATIONS

Spear, L.B., A.G. Gordus, S.B. Terrill and J. Seay. (in prep.). Altering avian use patterns from agricultural evaporation basins to alternative wetlands.

Spear, L.B., S.B. Terrill, C. Lenihan, and P. Delevoryas. Effects of temporal and environmental factors on the probability of detecting California Black Rails. J. Field Ornithol., 70: 465-480.

Erickson, R.A. and S.B. Terrill. 1996. Nineteenth report of the California Bird Records Committee: 1993 Records. Western Birds 27:93-126.

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Stallcup, R. and S.B. Terrill. 1996. Albatrosses and Cordell Bank. Birding 28:106-110.

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Terrill, S.B. 1981. Notes on the avifauna of two riparian sites in northern Sonora, Mexico. Continental Birdlife 2:144-149.

Terrill, S.B. and L.S. Terrill. 1981. On the field identification of Yellow-green, Red-eyed, Philadelphia and Warbling Vireos. Continental Birdlife 2:144-149.

Terrill, S.B. and S. Burge. 1976. Identification of Bendire's and Curve-billed Thrashers. Roadrunner 14:8-9.

Terrill, S.B. 1975. Brief summary of field identification of female Black-chinned and Costa's Hummingbirds. Roadrunner 13:4.

Terrill, S.B. 1975. Field identification of the Chimney Swift. Roadrunner 13:6-7.

PAPERS DELIVERED AT PROFESSIONAL MEETINGS, SYMPOSIA, AND SEMINARS

Terrill, S.B. Bird use of an Evaporation Basin and a Mitigation Wetland (with A. G. Gordus and J. Seay. (Invited) Presented to the North American Water and Environment Congress 1996.

Terrill, S.B. Relative Roles of endogenous and exogenous factors in avian migratory behavior. (Invited) Presented to the San Francisco State Avian Study Group (1994).

Terrill, S.B. Migratory behavior of Passerines. (Invited) Presented to the Western Field Ornithologists (1994).

Terrill, S.B. "Relocation of burrowing owls during the courtship period" (with P. Delevoryas). Presented to the Raptor Research Foundation (1992).

Terrill, S.B. "Habitat use by the Endangered California Clapper Rail in south San Francisco Bay." Presented to the Wildlife Society, San Diego, California (1992).

Terrill, S.B. Developing and implementing Wildlife Monitoring Plans for Riparian Systems. (Invited) Presented to the Riparian Revegetation Study Group (1992).

Terrill, S.B. "Behavioral ecology of bird migration." (Invited) Presented at the Distinguished Biologists Lecture Series, Hartwick College, New York (1990).

Bauer, G. and S.B. Terrill. 1988. "Spischen", eine wirksame Methode zur Anlockung von Singvogeln. Die Vogelwelt 109:25-31.

Berthold, P. and S.B. Terrill. 1988. Migratory behavior, ecophysiology and population growth of Blackcaps wintering in Britain and Ireland: some hypotheses. Ringing and Migration 9:153-159.

Terrill, S.B. "Food availability, migratory behavior and population dynamics of terrestrial migrant birds during the nonreproductive season." (Invited) Presented at the Food Exploitation by Terrestrial Birds symposium, 1988 (California).

Terrill, S.B. "Migratory behavior and population dynamics of migrant birds during the nonreproductive season." (Invited) Humboldt State University, 1988, California.

Terrill, S.B. "The regulation of migratory behavior: interactions between exogenous and endogenous factors." Presented at the International Centennial Meeting of the Deutsche Ornithological-Gesellschaft, 1988, Bonn, Germany.

Terrill, S.B. "Ecophysiological aspects of movement by migrants within the winter quarters." (Invited) Presented at the International symposium on Physiological and Ecophysiological Aspects of Bird Migration in October 1988 (Germany).

Terrill, S.B. "Behavioral ecology of avian migration systems." (Invited) University of Frankfurt, Germany, 1987.

Terrill, S.B. "The role of proximate factors in bird migration." (Invited) Presented at the XIX Congressus Internationalis Ornithologicus in 1986 (Canada).

Terrill, S.B. "The role of social dominance in bird migration." Presented at the International Behavioral Ecology Meetings (1986) in New York.

Terrill, S.B. "Relationship between social dominance, food distribution and Zugunruhe and body weight in Dark-eyed Juncos (Junco hyemalis)." Presented to the A.O.U. in 1985.

Terrill, S.B. "The relative roles of endogenous and exogenous factors in bird migrations." (Invited) Presented to the Animal Behavior Society Northeast Regional Meetings in 1985.

Terrill, S.B. "The role of social and ecological factors in bird migration." (Invited) State Museum of New York, 1985.

Terrill, S.B. 1984. A sight record of the Crescent-chested Warbler (Parula superciliosa) from lowland Sonora, Mexico. Amer. Birds 39:11.

Terrill, S.B. "Effects of social environment upon Zugunruhe in male Dark-eyes Juncos (Junco hyemalis)." Presented to the A.O.U. in 1984.

Terrill, S.B. and R.D. Ohmart. 1984. Facultative extension of fall migration of Yellow-rumped Warblers (Dendroica coronata). Auk 101:427-438.

Terrill, S.B. 1982. "The relationship between a facultative extension of the fall migration and varying suitability of winter habitat for Yellow-rumped Warblers (Dendroica coronata)." Presented to the A.O.U.

JOURNAL AND GRANT REVIEWER

American Midland Naturalist
Animal Behavior
The Auk
Behavioral Ecology and Sociobiology
The Condor
Ecological Monographs
Ecology
Journal of Field Ornithology
Journal of Raptor Research
National Science Foundation Research Grants
Oikos
Wilson Bulletin

ACADEMIC AWARDS

President's Distinguished Doctoral Dissertation Award (State University of New York 1986).
Honors Convocation Award for Outstanding Student Research (State University of New York 1985).
Marcia Brady Tucker Travel Award for outstanding student research (AOU meetings 1982).

TEACHING EXPERIENCE

Lecturer: Evolution, Ecology (with lab), Vertebrate Biology (with lab), Field Biology (with lab) Human Physiology, Biodiversity, General Biology, Scientific Writing, Man and the Environment.

Instructor: Field Ornithology, Desert Ecology.

Teaching Assistant: Animal Behavior, Aquatic Ecology, Ornithology, General Biology.

Research Support:

Alexander von Humboldt Research Fellowship (1987-1988).
Ben Smith Fellowship Award (separate awards 1983, 1984, 1985).
State University of New York Benevolent Association Research Grant (1984).
Sigma-Xi Grant-in-aid of Research (1983).
Frank M. Chapman Memorial Grant (1982).
Arizona State University Department of Zoology Research Grant (1979).

GRADUATE STUDENT EXPERIENCE IN APPLIED ECOLOGY

Principal Researcher, Project Manager:

Ecological evaluation of threatened and endangered plant species on Nature Conservancy preserves in northeastern New York (for the Nature Conservancy, Albany, New York, 1985).

Environmental Assessment: The impact of vegetation clearing on the flora and fauna of the lower Gila River basin, Arizona (with Benham-Blair and Associates, Tulsa, Oklahoma, 1980).

Environmental Assessment: Midvale Farms Project, Santa Cruz River Valley, Arizona - vertebrates (with Arizona Environmental Consultants, Phoenix, Arizona, 1980).

Environmental Assessment: Status, distribution and ecology of Arizona's threatened and endangered vertebrates (with E. Linwood Smith and Associates, Tucson, Arizona, 1980).

Environmental Impact study: The effect of overhead powerlines on birds on the lower Colorado River basin (with E. Linwood Smith and Associates, Tucson, Arizona, 1979-89).

Research Assistant--Field Work and Data Analysis:

Study of Salt River Valley Bald Eagles (for the Salt River Project 1981)

Baseline environmental assessment of all Arizona river systems: Bird species ecology, relative abundance and distribution (for R.D. Ohmart, 1977-78).

Comprehensive study of special-status raptors in Arizona and New Mexico (for R.D. Ohmart, 1977-78).

Ecology, population biology and behavior of southwestern raptors (for R.D. Ohmart, 1976-78).

Historical changes in riparian vegetation along Sonoita Creek, Arizona (for R.L Glinski, 1976-77).

Orme Dam Environmental Impact Study (1975-1976): A community analysis (with emphasis on riparian vegetation) including birds, small mammals and vegetation (funding to Dr. R.D.Ohmart).

DECLARATION

I, Scott B. Terrill, declare as follows:

1 I prepared the attached analysis of environmental impacts of the proposed La Paz Generating Facility in La Paz County, Arizona, based on my independent review and my professional experience and knowledge.

2 It is my professional opinion that the analysis is valid and accurate with respect to the issue(s) addressed therein.

3 I am personally familiar with the facts and conclusions related in the analysis, and if called as a witness could testify competently thereto.

4. A copy of my professional qualifications and experience is attached hereto and incorporated by reference herein.

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

Dated: 15 October, 2001, at San Jose, California:

Scott E. Terrill, Ph.D.

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ORIGINAL

TESTIMONY

of

DAVID MARCUS, M.A.

Regarding The Need

For The

La Paz Generating Facility

Submitted on behalf of

Arizona Unions For Reliable Energy

October 19, 2001

David Marcus, M.A.
P.O. Box 1287
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Arizona Corporation Commission
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Testimony of David Marcus

Q. Please state your name and business address.

A. My name is David Marcus. My business address is P.O. Box 1287, Berkeley, California 94701-1287.

Q. By whom are you employed and in what capacity?

A. I am an independent energy consultant. I have been hired by the Arizona Unions for Reliable Energy (AZURE) to prepare testimony on their behalf in this docket.

Q. Please briefly describe your background, education and work experience.

A. I received a B.A. in Mathematics from the University of California at San Diego in 1973 and an M.A. in Energy and Resources from the University of California at Berkeley in 1977. Prior to becoming an independent consultant I worked for the Bechtel Power Corporation as a scheduling engineer on a nuclear powerplant, for the California Energy Commission as a policy analyst and as an advisor to a Commissioner, and for the Environmental Defense Fund (now Environmental Defense) as an energy economist. I have been self-employed on a full-time basis since 1985. My clients have included a variety of alternative energy developers, environmental groups, electric utilities, unions, the Navajo Nation, the Attorneys General of California and New Mexico, and others. I have testified as an expert on energy matters before the California Energy Commission the public utility commissions of California, New Mexico, and Colorado, and before the U.S. Congress.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to rebut various incorrect and/or misleading assertions in the testimony of Donald L. Mundy regarding the need for the La Paz project.

Q. Please summarize your testimony with regard to errors in Mr. Mundy's testimony.

A. Mr. Mundy fails to adequately distinguish between load growth in Arizona and load growth in the WSCC Arizona/New Mexico/Southern Nevada subregion. He thereby significantly overstates projected Arizona load growth. On the supply side, Mr. Mundy relies on out-of-date information from the WSCC regarding anticipated new generation, and thereby understates projected new generation. Mr. Mundy understates the level of generation already approved by the ACC for construction in Arizona, and overstates the likely cancellation rate for pending Arizona generation projects, leading him to understate the likelihood that already approved projects will more than meet Arizona's reliability needs. Mr. Mundy conflates load growth through 2009 with generation proposals through 2007, further understating the degree to which a generation glut is already developing in Arizona

Q. Please summarize your own conclusions with regard to the contribution of the proposed La Paz project to providing reliable electricity supplies to Arizona.

A. The electric sector is in a time of intense change and stress, as is the whole nation. New powerplants take only about 2 years to construct, once licensed. Licensing powerplants today which will not be needed until 2008 or later forecloses opportunities for cleaner generating technologies or better emissions controls from future technological progress. The La Paz project developer has made no commitment to selling the project output for use by Arizona consumers. To the extent that the La Paz project output will be contractually sold outside of Arizona, it will make no contribution to Arizona reliability. On the other hand, if all generation located physically within Arizona is to be deemed as contributing to Arizona reliability, then the 5735 Mw of projects currently under construction will be sufficient to meet all of Arizona's load growth for a decade. It is unreasonable to think that there will be any significant cancellation rate among projects which are already under construction. In addition, there are another 4300+ Mw of projects which the ACC has already approved, at least one of which is located in a transmission-constrained area and thus will provide local benefits that Allegheny's project cannot. The La Paz project is not needed to provide in-state reliability.

Q. Please summarize your own conclusions with regard to the contribution of the proposed La Paz project to providing reliable electricity supplies to the larger region?

A. Arizona is part of the WSCC's Arizona/New Mexico/southern Nevada subregion. Within that subregion, the WSCC forecasts peak firm load growth of 6957 Mw from 2001 to 2010. The Arizona, New Mexico and southern Nevada projects already under construction for operation in the next 30 months total over 7600 Mw. So projects under construction are already enough to carry the region through the decade,, without even counting any of the 4300 Mw already licensed by the ACC but not yet in construction, or the over 8000 Mw of southern Nevada and New Mexico projects currently in development which are not yet under construction, or any of the other 5000+ Mw of Arizona projects currently before the ACC. The region, like the state, already has more than enough projects under construction to meet load growth for the next decade.

Q. You state that you believe Mr. Mundy has not distinguished between load growth in Arizona and load growth in the WSCC subregion containing Arizona. Please explain.

A. Mr. Mundy refers to a projected growth rate of "3.6% per year over the next 10 years" and deduces from this a need for "regional generating facilities adequate to serve at least 700 Mw of new electrical load annually."[1] Besides being factually inaccurate,[2] Mr.

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[1] Mundy testimony, p. 5.

[2] The 3.6% per year figure comes from an October 2000 WSCC document, and represents average annual load growth for the Arizona/New Mexico/Southern Nevada region from 1999 until 2009, not "the next ten years". See http://www.wscc.com/files/tenyr00.pdf, p. 28. In its August 2001 update of this annual publication, the WSCC estimates load growth for the Arizona/New Mexico/Southern Nevada subregion in 2001-2009 at 3.1 percent per year, dropping to 3.0 percent per year for the 2001-2010 period. See

Mundy ignores the fact that Arizona is only part of the WSCC subregion to which he is referring. If Mr. Mundy means to say that the whole subregion will experience load growth of 700 Mw per year for a decade, then he should expand his analysis of generation development to include the whole subregion as well as the whole decade. Doing so would mean addressing the contribution of the 7950 Mw now in development in southern Nevada and the additional 2336 Mw in development in New Mexico,[3] of which over 1930 Mw are already in construction,[4] and also the 920 Mw increase in regional resources during the year 2000.[5]

On the other hand, if Mr. Mundy is confining his analysis to Arizona, consistent with his supply-side testimony, then 700 Mw per year overstates forecasted future load growth in Arizona. In 2000, the WSCC subregion peak load was 21,724 Mw.[6] Nevada Power and Public Service Company of New Mexico had peak loads in 2000 of 4325 Mw and about 1400 Mw, respectively.[7] So Arizona represents only about 70-75 percent of the regional load, or about 500 Mw per year of load growth based on Mr. Mundy's figures.[8]

Q. You state that Mr. Mundy has understated proposed new generation and ACC-approved generation. Please explain.

A. Mr. Mundy asserts that there are "about 15,000 Mw" that are not yet operating but are "publicly announced, are in some stage of the CEC process, have completed the CEC process, [or] are under construction."[9] Mr. Mundy's 15,000 Mw could include projects which exist only as press releases, and projects which are under construction and only months away from completion. He doesn't provide an actual list, so it's hard to say. But the California Energy Commission has published a list of specific Arizona generation projects which includes 21,275 Mw of not-yet-operating projects.[10] The California Energy Commisson listing excludes publicly announced proposals for three other

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http://www.wscc.com/files/tenyr01.pdf, p. 29. The difference between 3.6% per year and 3.0 percent per year, over a decade, is well over 1000 Mw for this WSCC subregion.

[3] California Energy Commission, 10/16/01, http://www.energy.ca.gov/electricity/WSCC_PROPOSED_GENERATION.XLS, lines 241-244, 247-250, 257, 259, 261-262 (southern Nevada) and lines 263-269 (New Mexico)

[4] California Energy Commission, 10/16/01, http://www.energy.ca.gov/electricity/WSCC_PROPOSED_GENERATION.XLS, lines 244, 259, 262 (southern Nevada) and line 268 (New Mexico).

[5]. See http://www.wscc.com/files/tenyr00.pdf, p. 30 and http://www.wscc.com/files/tenyr01.pdf, p. 31, showing an increase in regional resources of 920 Mw from 1/1/00 to 1/1/01, prior to the addition of new resources within Arizona in 2001.

[6] http://www.wscc.com/files/tenyr01.pdf, p. 44.

[7] California Energy Markets, 7/21/00 at 10; http://www.nmbiz.com/issues/01/Jul/energy.htm. There are also rural electric coops in New Mexico and southern Nevada.

[8] In http://www.wscc.com/files/tenyr01.pdf, p. 45 (August 2001), the WSCC projects regional firm peak load growth of 6957 Mw from 2001 to 2010, or 773 Mw per year. 70-75 percent of that growth corresponds to a 540 – 580 Mw per year share for Arizona.

[9] Mundy testimony, p. 6.

[10] California Energy Commission, 10/16/01, http://www.energy.ca.gov/electricity/WSCC_PROPOSED_GENERATION.XLS; the Arizona section of the CEC publication is attached as Table 1. There are 23,404 Mw of projects, of which 2129 Mw came on-line in 2001, leaving 21,275 Mw of future projects.

projects, totalling 715 Mw.[11] So there are actually about 22,000 Mw of projects in Mr. Mundy's categories, not "about 15,000 Mw."

In a similar vein, Mr. Mundy states that "about 8900 MW...have completed the CEC process."[12] The correct figure is about 1,150 Mw higher, for projects which have their required ACC permits but are not yet operating.[13]

Q. You state that Mr. Mundy has overstated the likely cancellation rate for new Arizona generation projects. Please explain.

A. Mr. Mundy predicts that 7500-9000 Mw of new Arizona-sited generation will come on line in Arizona out of about "15,000 Mw" that are "publicly announced, are in some stage of the CEC process, have completed the CEC process, [or] are under construction." He also asserts that the WSCC "believes" that about 8500 Mw of the same 15,000 Mw will actually come on line in 2002-2009.

With regard to the WSCC, Mr. Mundy's numbers are simply irrelevant, because the WSCC listing of new projects is based on reports from WSCC members, not what the WSCC "believes" will happen. The WSCC does not review the likelihood of particular projects being built or not.[14]

With regard to his own numbers, Mr. Mundy has failed to distinguish between the failure rates for projects at different stages of development. In the particular case of Arizona, there are 5735 Mw already under construction, all of them within 24 months of completion.[15] It is hard to imagine that any of these projects will be abandoned and not completed sometime before 2009. So Mr. Mundy is effectively arguing that only 1765-3235 Mw of projects will be completed in the next 8 years out of all the projects which are already announced but are not yet under construction. By his own terms, there are some 9,265 Mw of such projects.[16] 65-81 percent of them would have to fail for there to be only 700-2200 Mw ultimately brought on line. Such a high failure rate seems unlikely, at least until there is an obvious glut of electricity, and under glut conditions there is no reason to expect or desire the La Paz project either, and certainly no reliability need for it.

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[11] See www.maestrosgroup.com/angs2.htm (2 projects, for 15 Mw and 100 Mw, respectively) and http://www.maricopa.gov/envsvc/AIR/pwrplnt.asp (Montezuma project for 600 Mw).

[12] Mundy testimony, p. 6.

[13] West Phoenix phase 2 (500 Mw), Arlington Valley 1 (580 Mw), Gila River (2080 Mw), Harquahala (1040 Mw), Mesquite (1265 Mw), Kyrene (250 Mw), Redhawk (2120 Mw), Sundance (540 Mw), Gila Bend (845 Mw), and Santan (825 Mw), for a total of over 10,000 Mw.

[14] . The most recent WSCC project list includes 8745 Mw of Arizona projects with on-line dates in the period 2002-2007. It doesn't include La Paz – but that doesn't mean that the WSCC "believes" La Paz won't be built. See http://www.wscc.com/files/tenyr01.pdf, p. 46.

[15] [15] California Energy Commission, 10/16/01, http://www.energy.ca.gov/electricity/WSCC_PROPOSED_GENERATION.XLS; the relevant Arizona section of the CEC publication is attached as Table 1.

[16] "About 15,000 Mw" of post-2001 projects, per Mundy, minus 5,735 Mw in construction, leaves 9,265 Mw not yet under construction. Of course, as already discussed, the actual number of proposed projects is some 6000 Mw larger than Mr. Mundy's testimony states.

Giving out permits because 2/3 to 4/5 of them will go unused seems like bad policy to boot.[17]

Q. You state in your testimony that Mr. Mundy underestimates the growing generation glut in Arizona by looking at supply and demand over different time periods. Please explain.

A. Mr. Mundy estimates load growth at 700 Mw per year over a 10-year period.[18] By referring to 10-year load growth rates, he implies that Arizona needs to add generation to meet 7000 Mw of load growth. However, as the ACC staff has noted, new combined cycle construction periods are closer to 2-3 years.[19] Adding two years for site acquisition and licensing, a power plant whose developer was just starting out today could still be online in time for the summer peak of 2007. Indeed, almost every powerplant proposal publicly identified in Arizona is intended to be in operation by 2007.[20] Thus, when Mr. Mundy talks about "less than 50-60% ... of the projects we hear about are actually completed," he should indicate that we are largely hearing only about projects with on-line dates through the year 2007.

Using Mr. Mundy's numbers, load growth of 700 Mw from 2001-2007 would equate to load growth of 4200 Mw, far less than the 7500-9000 Mw of not-yet-operating projects which Mr. Mundy himself expects to come on line out of 15,000 Mw already identified but not yet operating. So by his own terms, Mr. Mundy's testimony indicates that Arizona can expect up to twice as much new generation as new load in the next 6 years.

When Mr. Mundy's overstatement of demand and understatement of supply are factored in, and compared over the same time period, the disparity between need and pending supply is much greater. The WSCC forecast for Arizona/New Mexico/Southern Nevada growth in peak firm demand from 2001 to 2007 is 4646 Mw.[21] Assuming ¼ of that increase is in Nevada and New Mexico,[22] the Arizona share of 2001-07 load growth would be 3485 Mw. The California Energy Commisson has identified 19,225 Mw of proposed generation additions during 2002-2007, and others have identified another 715 Mw, for a total of 19,940 Mw.[23] Using Mr. Mundy's figure of a 50-60 percent success

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[17] The ACC staff has already remarked that "Transmission Providers are presently encumbered with an endless barrage of power plant interconnection study requests that have distracted them from studying, planning and siting the transmission lines needed to deliver the energy from proposed power plants to local markets." ACC staff, "Adequacy of Arizona's Existing and Planned Transmission Facilities," July 2001, p. 40, in docket E-00000A-01-120, online at http://www.cc.state.az.us/utility/electric/biennialxmn.pdf.

[18] Mundy testimony, p. 5. I have explained earlier in my testimony that a more accurate figure for Arizona would be 540-580 Mw per year during the 2001-10 period. See footnote 8, supra.

[19] ACC staff, "Adequacy of Arizona's Existing and Planned Transmission Facilities," July 2001, p. 40, in docket E-00000A-01-120, available online at http://www.cc.state.az.us/utility/electric/biennialxmn.pdf.

[20] See Table 1. There are three exceptions out of 45 projects.

[21] http://www.wscc.com/files/tenyr01.pdf, p. 45 (August 2001), showing an increase from 22,592 Mw in 2001 to 27,238 Mw in 2007.

[22] The basis of the estimate that Arizona represents no more than 75% of the WSCC subregion peak demand is discussed earlier in my testimony.

[23] See Table 1, the CEC listing, and also the sources cited in footnote 11, supra..

rate, that would mean new generation of 9,970 to 11,964 Mw during 2002-2007. In other words, Arizona will be adding capacity in 2002-07 at almost three times the rate that load is growing, even if only half the proposed projects come on line!

Q. Have you done your own analysis to correct the problems you describe above?

A. Yes.

Q. Please describe your analysis and conclusions with respect to the need for the La Paz project to provide reliability in AZ

A The August 2001 WSCC projections for load growth equate to an Arizona load growth from 2001-2007 of about 3500 Mw. Adding 15 percent for associated reserves, and generously adding another 1000 Mw to increase existing reserve margins, the required 2002-2007 generation additions would be about 5000 Mw. Over 5700 Mw are already under construction in Arizona for operation within two years, and another 4300 Mw are already approved by the ACC. This is twice what the state needs. Even allowing for the fact that some licensed projects may be delayed or cancelled, there is no need to approve additional generation to provide statewide reliability in Arizona.[24] Additional generation will just lead to increased exports out of Arizona to California.

The ACC may wish to permit projects in 2001 that will not be needed until 2008 or far beyond, but if it does it should not do so on the grounds that these projects provide a reliability benefit. The ACC may wish to permit more than three times as many projects as are needed, relying on the market to weed out excess capacity, but if it does so it should feel free to impose strict environmental and land use conditions, knowing that those projects which cannot meet such conditions will be replaced by those which can, without imperiling reliability.

Q. Please describe your analysis and conclusions with respect to the need for the La Paz project to provide reliability in the larger region.

A. The WSCC estimates load growth in Arizona/New Mexico/Southern Nevada from 2001 to 2007 will be 4646 Mw. Adding 15 percent for generating reserves, plus 1250 Mw to increase current reserve margins, required regional resource additions during 2002-2007 are about 6600 Mw. Over 7600 Mw are already under construction within the region, all planned for operation within the next 30 months. By 2004, plants under construction will alone be sufficient to meet load growth and increase reserve margins until 2008. Here too, licensing new generation can only result in increased exports outside of the region.

[24] Site-specific resource additions may still be needed in the next few years to meet local generation needs in transmission-constrained areas. However, La Paz is not located in such an area. Likewise, if new projects currently under construction are contractually committed to export their generation outside of Arizona, generation may be needed which is contractually committed to meet in-state loads. However, as a merchant plant owner, Allegheny has made no such commitment.

Q. Does this complete your testimony.

A. Yes.

TABLE 1 - NEW GENERATION IN ARIZONA, per California Energy Commission

Facility	Technology	Fuel Type	# of Units	Output (MW)	Est Online Date	Company	Notes	Source	Status	$ Millions	County	Updated	Cumulative Mw
Desert Basin Generating		Gas		520	6/1/01	Reliant	Complete. Under 10 year contract with SRP	WEU/CEM	1	263	Pinal	6-Sep-01	520
South Point		Gas		540	6/1/01	Calpine	complete	WEU	1	275	Mohave	12-Jun-01	1060
Tucson CT1		Gas	1	75	6/1/01	Tucson Electric Power	complete	ACC	1		Pima	6-Sep-01	1135
APS Upgrades and Reactivate		Gas		203	7/1/01	Arizona Public Service		ACC	1		Maricopa	13-Jun-01	1338
Tucson CT2		Gas	1	21	8/1/01	Tucson Electric Power	Complete	ACC	1		Pima	6-Sep-01	1359
West Phoenix (Phase 1)	Combined	Gas		120	8/1/01	APS/Calpine	Complete	WEU/PMW/CEM	1	60	Maricopa	6-Sep-01	1479
Griffith Energy Project	Combined	Gas	2-2-1	650	9/15/01	Griffith Energy (PPL & Duke)		mohave news	1		Mohave	6-Sep-01	2129
Kyrene (Oasis)	Combined	Gas	1-2-1	250	4/1/02	Oasis LLC		http://www.kyrenefacts.org/	1		Maricopa	6-Sep-01	2379
Arlington Valley I	Combined	Gas	1-2-1	580	8/1/02	Duke	Under Construction	CEM	1	250	Maricopa	12-Jun-01	2959
West Phoenix (Phase 2)	Combined	Gas		500	9/1/02	APS/Calpine		Website/ACC	1	250	Maricopa	12-Jun-01	3459
Redhawk 1	Combined	Gas	1-2-1	530	1/1/03	APS/Reliant	Merchant/Est Groundbreaking 12/19/00	PMW/ACC	1		Maricopa	12-Jun-01	3989
Redhawk 2	Combined	Gas	1-2-1	530	1/1/03	APS/Reliant	Merchant/Est Groundbreaking 12/19/00	PMW/ACC	1	250	Maricopa	12-Jun-01	4519
Mesquite Power	Combined	Gas		1265	3/1/03	Sempra Energy Resources		Maricopa County Web	1		Maricopa	12-Jun-01	5784
Gila River I	Combined	Gas	4-2-1	520	4/1/03	Panda Energy/TECO		Maricopa County	1	250	Maricopa	29-Aug-01	6304
Gila River II	Combined	Gas	4-2-1	520	4/1/03	Panda Energy/TECO		Maricopa County	1	250	Maricopa	29-Aug-01	6824
Harquahala Generating Station	Combined	Gas	4-1-1	1040	9/1/03	PG&E NEG	Merchant	Maricopa County	1	398	Maricopa	12-Jun-01	7864
Sundance Energy Project 1		Gas		450	6/1/02	PPL Global	ACC Docket # L-00000W-00-0107	EPA Federal Register	2		Pinal	31-Aug-01	8314
Sundance Energy Project 2		Gas		90	9/1/02	PPL Global	ACC Docket # L-00000W-00-0107	EPA Federal Register	2		Pinal	31-Aug-01	8404
Gila River III	Combined	Gas	4-2-1	520	9/1/03	Panda Energy/TECO		Maricopa County	2	250	Maricopa	31-Aug-01	8924
Gila River IV	Combined	Gas	4-2-1	520	9/1/03	Panda Energy/TECO		Maricopa County	2	250	Maricopa	31-Aug-01	9444
Redhawk 3	Combined	Gas	1-2-1	530	6/1/06	APS	Merchant	PMW	2	250	Maricopa	12-Jun-01	9974
Redhawk 4	Combined	Gas	1-2-1	530	12/1/07	APS	Merchant	PMW	2		Maricopa	12-Jun-01	10504
Apache Station GT #4	GT	Gas/FO	11	40	8/1/02	Arizona Elec Power Co-op		Owner	3	30	Cochise	16-Oct-01	10544
Wellton-Mohawk(Yuma Energy)	Combined	Gas		500	6/1/03	Wellton-Mohawk		ACC	3	250	Yuma	12-Oct-01	11044
Arlington Valley II	Combined	Gas		600	7/1/03	Duke		CEM	3		Maricopa	4-Sep-01	11644
Caithness Big Sandy (Phase I)	Combined	Gas	1-2-1	500	8/1/03	Caithness	ACC Docket # L-00000R-00-0100	ACC Website	3		Mohave	6-Sep-01	12144
Toltec Power Station I	Combined	Gas	2-2-1	1000	9/30/03	SW Power Group II	ACC Docket # L-00000YR-01-0112	PMA/ACC	3	500	Pinal	12-Jun-01	13144
Vail Generating (Rita Ranch)		Gas	2	150	12/1/03	Tucson Electric		Power Marketing	3		Pima	4-Sep-01	13294
Signal Peak I	Combined	Gas		580	4/1/04	Reliant	Air cooled condensers	Corp Press Release	3	430	Pinal	6-Sep-01	13874
Gila Bend	Combined	Gas	3-2-1	845	6/1/04	Power Dev Ent	ACC Sited Pending Maricopa County siting	AZ Republic	3	400	Maricopa	12-Jun-01	14719
Springerville Generation I		Coal	1	380	6/1/04	Unisource/Bechtel		PMW	3		Apache	4-Sep-01	15099
Bowie I	Combined	Gas	2-2-1	500	6/30/04	SW Power Group II		ACC	3	300	Cochise	12-Oct-01	15599
La Paz I	Combined	Gas		540	11/1/04	Allegheny		Allegheny website	3	270	La Paz	12-Oct-01	16139
Caithness Big Sandy (Phase II)	Combined	Gas	1-1-1	220	12/1/04	Caithness	ACC Docket # L-00000R-00-0100	ACC Website	3		Mohave	6-Sep-01	16359
Toltec Power Station II	Combined	Gas	2-2-1	1000	3/31/05	SW Power Group II	ACC Docket # L-00000YR-01-0112	PMA/ACC	3	500	Pinal	12-Jun-01	17359
La Paz II	Combined	Gas		540	4/1/05	Allegheny		Allegheny website	3	270	La Paz	12-Oct-01	17899
Santan	Combined	Gas	3-3-1	825	12/1/05	SRP	ACC Sited Pending Maricopa County siting	www.santanfacts.org	3		Maricopa	12-Jun-01	18724
Springerville Generation II		Coal	1	380	12/1/05	Unisource/Bechtel		PMW	3		Apache	4-Sep-01	19104
Bowie II	Combined	Gas	2-2-1	500	12/31/05	SW Power Group II		ACC	3	300	Cochise	12-Oct-01	19604
Littlefield (Beaver Dam)	Combined	Gas		500	6/1/03	Williams Energy		ACC	5		Mohave	12-Jun-01	20104
Ambos Nogales Generating		Gas		500	1/10/07	Maestros Group		ACC	5	430	Santa Cruz	12-Oct-01	20604
Winchester	Combined	Gas		750	6/1/07	Independent Power Tech		ACC	5	0	Cochise	12-Oct-01	21354
Signal Peak II	Combined	Gas		580	1/1/09	Reliant	Air cooled condensers	Corp Press Release	5	310	Pinal	6-Sep-01	21934
Safford		Gas		220	1/1/11	Powergen LLC		ACC	5		Graham	12-Jun-01	22154
White Tank Mountain	Pump Storage	Hydro	5	1250	1/1/11	Arizona Independent Pwr		CEM	5		Maricopa	12-Jun-01	23404

Source: California Energy Commission, 10/16/01, http:// www.c a.energy.go v/electricity/WSCC _PROPOSED_GENERA TION.XLS

DAVID I. MARCUS
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October 2001

Employment

Self-employed, March 1981 - Present

Consultant on energy and electricity issues. Clients have included Imperial Irrigation District, the cities of Albuquerque and Boulder, the Rural Electrification Administration (REA), BPA, EPA, the Attorney Generals of California and New Mexico, alternative energy and cogeneration developers, environmental groups, labor unions, other energy consultants, and the Navajo Nation. Projects have included economic analyses of utility resource options and power contracts, utility restructuring, utility bankruptcy, nuclear power plants, non-utility cogeneration plants, and offshore oil and hydroelectric projects. Experienced user of production cost models to evaluate utility economics. Very familiar with western U.S. grid (WSCC) electric resources and transmission systems and their operation and economics. Have also performed EIS reviews, need analyses of proposed coal, gas and hydro powerplants, transmission lines, and coal mines. Have presented expert testimony before the California Energy Commission, the Public Utility Commissions of California, New Mexico, and Colorado, the Interstate Commerce Commission, and the U.S. Congress.

Environmental Defense Fund (EDF), October 1983 - April 1985

Economic analyst, employed half time at EDF's Berkeley, CA office. Analyzed nuclear power plant economics and coal plant sulfur emissions in New York state, using ELFIN model. Wrote critique of Federal coal leasing proposals for New Mexico and analysis of southwest U.S. markets for proposed New Mexico coal-fired power plants.

California Energy Commission (CEC), January 1980 - February 1981

Advisor to Commissioner. Wrote "California Electricity Needs," Chapter 1 of Electricity Tomorrow, part of the CEC's 1980 Biennial Report. Testified before California PUC and coauthored CEC staff brief on alternatives to the proposed 2500 megawatt Allen-Warner Valley coal project.

CEC, October 1977 - December 1979

Worked for CEC's Policy and Program Evaluation Office. Analyzed supply-side alternatives to the proposed Sundesert nuclear power plant and the proposed Point Concepcion LNG terminal. Was the CEC's technical expert in PG&E et. al. vs. CEC lawsuit, in which the U.S. Supreme Court ultimately upheld the CEC's authority to regulate nuclear powerplant siting.

Energy and Resources Group, U.C. Berkeley, Summer 1976

Developed a computer program to estimate the number of fatalities in the first month after

a major meltdown accident at a nuclear power plant.

Federal Energy Agency (FEA), April- May 1976

Consultant on North Slope Crude. Where To? How?, a study by FEA's San Francisco office on the disposition of Alaskan oil.

Angeles Chapter, Sierra Club, September 1974 - August 1975

Reviewed EIRs and EISs. Chaired EIR Subcommittee of the Conservation Committee of the Angeles Chapter, January - August 1975.

Bechtel Power Corporation (BPC), June 1973 - April 1974

Planning and Scheduling Engineer at BPC's Norwalk, California office. Worked on construction planning for the Vogtle nuclear power plant (in Georgia).

Education

Energy and Resources Group, U.C. Berkeley, 1975 - 1977

M.A. in Energy and Resources. Two year master's degree program, with course work ranging from economics to engineering, law to public policy. Master's thesis on the causes of the 1972-77 boom in the price of yellowcake (uranium ore). Fully supported by scholarship from National Science Foundation.

University of California, San Diego, 1969 - 1973

B.A. in Mathematics. Graduated with honors. Junior year abroad at Trinity College, Dublin, Ireland.

Professional Publications

"Rate Making for Sales of Power to Public Utilities," with Michael D. Yokell, in Public Utilities Fortnightly, August 2, 1984.

DECLARATION OF DAVID MARCUS

I, David Marcus, declare as follows:

1. I prepared the attached analysis of system reliability impacts of the proposed La Paz Generating Facility in La Paz County, Arizona, based on my independent review and my professional experience and knowledge.

2. It is my professional opinion that the analysis is valid and accurate with respect to the issue(s) addressed therein.

3. I am personally familiar with the facts and conclusions related in the analysis, and if called as a witness could testify competently thereto.

4. A copy of my professional qualifications and experience is attached hereto and incorporated by reference herein.

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

Dated: October 19, 2001 , at Berkeley, California:

David Marcus

Name

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on

Air Quality Impacts

Relating to the

La Paz Generating Facility

Submitted on behalf of

Arizona Unions For Reliable Energy

October 19, 2001

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Arizona Corporation Commission
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TESTIMONY OF CAMILLE SEARS

I have reviewed: (a) Application for a Certificate of Environmental Compatibility for the La Paz Generating Facility, submitted to the Arizona Power Plant and Transmission Line Siting Committee (July 3, 2001; and (b) Application for a Class I Permit for the La Paz Generating Facility, including appendices, submitted to the Arizona Department of Environmental Quality (October 2, 2001). The following is my testimony relating to the information provided therein.

I. Hazardous Air Pollutant Impacts Are Significant

The Siting Application incorrectly reports that Hazardous Air Pollutant ("HAP") emissions will not result in significant offsite impacts. (Siting Application, p. B-1-58.) When the HAP emissions are corrected, it is clear that the proposed project toxic emissions will exceed Arizona Ambient Air Quality Guideline ("AAAQG") concentrations.

The project HAP emissions have been reviewed and corrected by Dr. Phyllis Fox.[1] The HAP emissions were revised to incorporate appropriate emission factors and to account for the large increase in HAPs associated with startup activities and the subsequent reduction in turbine performance. Dr. Fox's emission recalculation focused on 12 organic compounds, which are a subset of the total list of HAPs for which there are established AAAQGs. Dr. Fox's recalculated organic compound emissions are presented in the following table. In this table, her emission rates have been converted to units of grams per second for input to a dispersion modeling analysis. This modeling will be used to verify compliance with the AAAQGs for the listed HAPs. The emissions listed are for one combustion turbine generator.

	One-Hour Emissions				Annual Modeling Emissions
	Cold Starts	Warm Starts	Hot Starts	100% Load	
Pollutant	gram/sec	gram/sec	gram/sec	gram/sec	gram/sec
Organics					
1,3-Butadiene	2.02E-05	1.45E-05	1.16E-05	2.07E-05	2.01E-05
Acetaldehyde	6.81E-01	4.86E-01	3.89E-01	1.94E-03	2.20E-02
Acrolein	1.08E+00	7.71E-01	6.16E-01	3.06E-03	3.48E-02
Benzene	3.02E-03	2.16E-03	1.73E-03	5.68E-04	6.26E-04
Ethylbenzene	1.51E-03	1.08E-03	8.63E-04	1.54E-03	1.50E-03
Formaldehyde	1.20E+01	8.58E+00	6.86E+00	3.41E-02	3.87E-01
Hexane	1.20E-02	8.56E-03	6.85E-03	1.22E-02	1.19E-02
Naphthalene	5.99E-05	4.28E-05	3.42E-05	6.12E-05	5.95E-05
PAH	2.26E-04	7.52E-05	3.01E-04	5.37E-04	5.17E-04
Propylene Oxide	5.21E-03	9.64E-04	7.71E-04	1.38E-03	1.36E-03
Toluene	4.29E-02	3.07E-02	2.45E-02	6.26E-03	7.18E-03
Xylenes	3.02E-03	2.16E-03	1.73E-03	3.08E-03	3.00E-03

[1] J. Phyllis Fox, Siting Application Comment V.A.

The annual modeling emissions are simply the sum of the hourly emissions over the course of an 8,760-hour year, including full-load hours and all startups, divided by 8,760 hours. This annual-average emission rate is used as input to the modeling analysis to verify compliance with the annual-average AAAQGs.

One-hour emission rates for the startup and 100% load scenarios were also calculated. These emissions are used in the modeling for verifying compliance with the one-hour and 24-hour AAAQGs. One-hour emission rates from the startup scenarios must include components from both controlled and uncontrolled operations. For cold starts, the hourly emission rate was calculated based on 20 uncontrolled minutes and 40 controlled minutes; for warm starts, the hourly emission rate is based on no controls for the first 10 minutes, and controls for the last 50 minutes; for hot starts, five minutes are controlled, and 55 minutes are uncontrolled. The 100% load emissions are full-load emission rates for the remaining hours when startups are not projected to occur. These emission scenarios are presented in Dr. Fox's comments on the Siting Application.

To estimate air quality impacts for verifying compliance with the AAAQGs, we remodeled these HAP emissions using the same methodology presented in the Siting Application Air Quality Studies and Resources analyses. (Siting Application, Exhibit B-1) We used the ISCST3 dispersion model (v. 00101, downloaded from the EPA SCRAM website and complied with Lahey Fortran 95) with the applicant's source and receptor coordinates, meteorological data, and building downwash parameters. In essence, we used the exact modeling inputs as the Siting Application air quality impact analysis, except we corrected the HAP emission rates that were underestimated by the Applicant. Our modeling results are presented in the following tables, with values exceeding the pertinent AAAQG in bold.

It is important to note that the combustion turbine generator ("CTG") stack parameters (height and diameter, stack gas temperature, and exit velocity) we used in our modeling were obtained from modeling files included in the Siting Application. (Siting Application, Exhibit B-1, Appendix P) These modeling files only contained stack parameters for full-load turbine operations. We used these stack parameters, as values for startup conditions were not available from the Siting Application. Startup conditions will result in lower exit velocities and temperatures, resulting in lower plume rise than we modeled. Thus, our estimates of one-hour and 24-hour impacts resulting from startup operations are underestimated.

I.A. The One-Hour AAAQGs for Acrolein and Formaldehyde are Exceeded

The peak one-hour HAP impacts are presented in the following table. These impacts are from one turbine only (CTG #4), as it was assumed that startups would be sequential and not overlapping. This likely underestimates impacts, unless the Applicant has permit conditions placed so as to prohibit simultaneous startups. When the appropriate HAP emissions are included in the Siting analysis, one-hour acrolein and formaldehyde concentrations easily exceed the AAAQGs and are thus a significant impact.

We identified a peak one-hour acrolein concentration of 207 μg/m^3, which is over 32 times the significance threshold identified in the Siting Application. Actual acrolein concentrations could be up to a factor of ten higher because the method used to measure acrolein in the source tests that were relied on to develop the acrolein emission factor are known to underestimate concentrations.[2] The peak one-hour formaldehyde concentration is about 2300 μg/m^3, which is 92 times the one-hour AAAQG for that pollutant. The peak one-hour impact occurs at the receptor with UTM zone 12 coordinates 281412, 3715113.

Many other locations also exceed the one-hour AAAQGs, including a residence location described by the Siting Application as being about 1.75 miles north of the proposed project. (Siting Application, p. A-3) The Siting Application does not give any other details on this location, so we modeled a point 1.75 miles due north of CTG stack #3 (UTM zone 12 coordinates 281432, 3717829). At this receptor, the one-hour formaldehyde concentration is 27 μg/m^3, which slightly exceeds the one-hour AAAQG of 25 μg/m^3.

Pollutant	One-Hour Impacts (μg/m^3)				1-Hr AAAQG (μg/m^3)
	Cold Starts	Warm Starts	Hot Starts	100% Load	
Organics					
1,3-Butadiene	3.88E-03	2.77E-03	2.22E-03	3.96E-03	5.00E+00
Acetaldehyde	1.31E+02	9.33E+01	7.47E+01	3.71E-01	6.30E+02
Acrolein	**2.07E+02**	**1.48E+02**	**1.18E+02**	5.88E-01	6.30E+00
Benzene	5.80E-01	4.14E-01	3.31E-01	1.09E-01	1.70E+02
Ethylbenzene	2.90E-01	2.07E-01	1.66E-01	2.96E-01	4.50E+03
Formaldehyde	**2.30E+03**	**1.65E+03**	**1.32E+03**	6.55E+00	2.50E+01
Hexane	2.30E+00	1.64E+00	1.31E+00	2.35E+00	5.40E+03
Naphthalene	1.15E-02	8.21E-03	6.57E-03	1.17E-02	6.30E+02
PAH	4.33E-02	1.44E-02	5.77E-02	1.03E-01	--
Propylene Oxide	9.99E-01	1.85E-01	1.48E-01	2.64E-01	3.70E+02
Toluene	8.24E+00	5.89E+00	4.71E+00	1.20E+00	4.40E+03
Xylenes	5.79E-01	4.14E-01	3.31E-01	5.91E-01	5.40E+03

I.B. The 24-Hour AAAQGs for Acrolein and Formaldehyde are Exceeded

The peak 24-hour HAP impacts are presented in the following table. These impacts are from one turbine only (CTG #4), as it was assumed that startups would be sequential and not overlapping. We calculated the 24-hour impacts by dividing the peak one-hour impacts by 24. This underestimates impacts as it assumes that no emissions occur for the other 23 hours of the day. This

[2] R.R. Freeman, (Air Toxics Ltd, 916-985-1000), The Analysis of Acrolein Using CARB Method 430: What Works and What Doesn't Work, A&WMA Proceedings, 1993.

methodology was necessary as the Siting Application has no information on worst-case 24-hour emission scenarios, as are required for verifying compliance with the 24-hour AAAQGs.

Nevertheless, when the appropriate HAP emissions are included in the Siting analysis, 24-hour acrolein and formaldehyde concentrations still exceed the AAAQGs and are thus a significant impact. We identified a peak 24-hour acrolein concentration of 8.62 μg/m³, which is over four times the significance threshold identified in the Siting Application. The peak 24-hour formaldehyde concentration is about 96 μg/m³, which is six times the 24-hour AAAQG for that pollutant. The peak 24-hour impact occurs at the receptor with UTM zone 12 coordinates 281412, 3715113. Many other locations also exceed the 24-hour AAAQGs.

Pollutant	24-Hour Impacts (μg/m³)				24-Hr AAAQG (μg/m³)
	Cold Starts	Warm Starts	Hot Starts	100% Load	
Organics					
1,3-Butadiene	1.62E-04	1.16E-04	9.25E-05	1.65E-04	1.30E+00
Acetaldehyde	5.44E+00	3.89E+00	3.11E+00	1.55E-02	1.70E+02
Acrolein	**8.62E+00**	**6.16E+00**	**4.93E+00**	2.45E-02	2.00E+00
Benzene	2.42E-02	1.73E-02	1.38E-02	4.54E-03	4.40E+01
Ethylbenzene	1.21E-02	8.62E-03	6.90E-03	1.23E-02	3.50E+03
Formaldehyde	**9.60E+01**	**6.86E+01**	**5.49E+01**	2.73E-01	1.60E+01
Hexane	9.58E-02	6.84E-02	5.48E-02	9.78E-02	1.40E+03
Naphthalene	4.79E-04	3.42E-04	2.74E-04	4.89E-04	4.00E+02
PAH	1.80E-03	6.01E-04	2.40E-03	4.29E-03	--
Propylene Oxide	4.16E-02	7.71E-03	6.17E-03	1.10E-02	9.80E+01
Toluene	3.43E-01	2.45E-01	1.96E-01	5.00E-02	3.00E+03
Xylenes	2.41E-02	1.72E-02	1.38E-02	2.46E-02	3.50E+03

I.C. The Annual-Average AAAQG for Formaldehyde is Exceeded

The peak annual-average HAP impacts are presented in the following table. These impacts are from all four combustion turbine emissions combined. When the appropriate HAP emissions are included in the Siting analysis, annual-average formaldehyde concentrations easily exceed the AAAQG and are thus a significant impact. The peak annual-average formaldehyde concentration is about 0.82 μg/m³, which is over 10 times the annual-average AAAQG for that pollutant. The peak annual-average impact occurs at the receptor with UTM zone 12 coordinates 281322.7, 3715113. Many other locations also exceed the annual-average formaldehyde AAAQG. It should be noted that there is no annual-average AAAQG for acrolein. (Siting Application, p. b-1.60)

	Annual Average	Annual

Pollutant	Impacts (µg/m³)	AAAQG (µg/m³)
Organics		
1,3-Butadiene	4.28E-05	3.60E-03
Acetaldehyde	4.68E-02	4.50E-01
Acrolein	7.41E-02	--
Benzene	1.33E-03	1.20E-01
Ethylbenzene	3.19E-03	--
Formaldehyde	**8.25E-01**	7.60E-02
Hexane	2.54E-02	--
Naphthalene	1.27E-04	--
PAH	1.10E-03	--
Propylene Oxide	2.90E-03	2.70E-01
Toluene	1.53E-02	--
Xylenes	6.39E-03	--

II. Construction Air Quality Impacts are Significant

The Siting Application established a number of significance criteria for air quality impacts. (Siting Application, p. B-1.59.) However, the Siting Application did not evaluate whether construction emissions would comply with any of them. In fact, the Siting Application sidestepped construction activities entirely, thus requiring our analysis to use previously estimated emissions from a surrogate project. We estimated air quality impacts for construction emissions, using construction emission inventories and schedules for the La Paloma Generating Project.[3] This underestimates impacts as the proposed La Paz Generating Facility is much larger than the La Paloma Project, and will have correspondingly greater construction activities and emissions.

The Siting Application's significance criteria include exceedances of the ambient air quality standards ("AAQS") and the Prevention of Significant Deterioration ("PSD") increments. (Siting Application, p. B-1.59.) As demonstrated below, air quality impacts from construction are significant.

Exhaust emissions from general construction activities would cause exceedances of the 24-hour PM10, 1-hour and 8-hour CO, and 3-hour and 24-hour SO_2 ambient air quality standards. These emissions would also cause exceedances of the 24-hour PM10 and 3-hour and 24-hour SO_2 Class II PSD increments. Fugitive dust emissions from earthmoving activities would cause exceedances of 24-hour PM10 ambient air quality standard and the 24-hour Class II PSD PM10 increment.

[3] Woodward-Clyde Consultants, Application for Certification, La Paloma Generating Project, Submitted to California Energy Commission, July 1998. Copy available upon request.

These are significant impacts that were not addressed in the Siting Application. The Siting Application should be modified to discuss these impacts and additional mitigation included in the project to reduce construction emissions.

II.A. Construction Exhaust Emissions

Construction exhaust impacts are often estimated using guidance developed by the Santa Barbara County Air Pollution Control District. This guidance recommends that construction exhaust emissions be modeled as volume sources with a vertical dimension of no more than 10 meters due to the uncertainties in construction equipment location and variable plume rise within a given hour. Further, the exhaust from construction equipment is vented through horizontal or gooseneck stacks, parallel to the ground. Thus, there is no momentum plume rise. The dimensions of the volume sources are chosen to contain the horizontal extent of construction activity and the vertical component of the source emissions. (SBCAPCD 10/87.[4])

The Siting Application does not contain construction emissions or a construction equipment inventory and schedule, which are required to calculate emissions. Therefore, we used construction emission estimates for a similar project, the La Paloma Generating Project. (Woodward Clyde Consultants, July 1998) La Paloma was built on a 23-acre site, compared to 40 acres for La Paz without the pond, which adds an additional 60 acres and the 500 kV switchyard that adds 20 acres. (Siting Application, pp. APP-2, A-3/4.) La Paloma does not have any ponds. La Paloma includes a 13.6 to 14.2 miles long transmission line, a 4.3-mile raw water canal, and 1.5 miles of water pipeline, compared with a 5.5-mile natural gas pipeline and 1.75-mile 500 kV transmission line for La Paz. (*Id.*, pp. APP-6, A-4.) Thus, construction emissions from La Paz would be substantially greater than from La Paloma.

Therefore, we modeled the La Paloma construction emissions with a 142-meter by 142-meter (5 acres) square volume source, which is an area where construction emissions would most likely occur in a given day. The vertical extent of the volume source was assumed to be 10 meters, which is sufficient to contain the plume rise from the construction emissions, as recommended by the Santa Barbara guidance and based on observations at construction sites. (SBCAPCD 10/87, p. 6-20.) The following construction combustion emissions were modeled: PM10 - 64 lb/hr, NOx - 918 lb/hr, CO - 512 lb/hr, and SOx - 60 lb/hr, assuming that construction occurs 10 hours per day, 5 days per week. (Woodward Clyde Consultants, July 1998)

We assessed the ambient air quality impacts from combustion exhaust emissions using ISCST3 (v. 00101) with one year of on-site meteorological data collected by the applicant. The 5-acre volume source was centered at CTG Stack #3, (UTM Zone 12 coordinates 281432, 3715013). The emissions from this volume source were modeled as being released 10 hours per day, from 7:00 a.m. through 5:00 p.m. The results of our analysis are as follows:

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[4] Santa Barbara County Air Pollution Control District, Authority to Construct Permit Processing Manual, Air Quality, Impact Analysis (Inert Modeling), October 10, 1987.

Pollutant	Averaging Period	Modeled Concentration (μg/m^3)	NAAQS (μg/m^3)	PSD Class II Increment (μg/m^3)	Easting Coordinate (m)	Northing Coordinate (m)
CO	1-hr	45225	40000	--	281501	3715113
CO	8-hr	16772	10000	--	281412	3715113
SO_2	3-hr	3085	1300	512	281412	3715113
SO_2	24-hr	739	365	91	281323	3715113
PM10	2nd high 24-hr	653	150	30	281412	3715113

These results indicate that the following significance criteria would be exceeded during construction by significant amounts: 1-hour and 8-hour CO, 3-hour and 24-hour SO_2, and 24-hr PM10 ambient air quality standards as well as the 24-hour PM10 and the 3-hour and 24-hour SO_2 Class II PSD increments. These are significant air quality impacts for CO, SO_2, and PM10 that were not addressed in the Siting Application and which should be mitigated.

II.B. Construction Fugitive Dust Emissions

We also assessed the 24-hour PM10 impacts from fugitive dust generated during construction activities. The modeling methodology we used is identical to the construction exhaust modeling described above, except that we used an area source instead of a volume source. The area source height was 3.0 meters and the source location was offset to provide the southwest corner coordinates as required by ISCST3. Fugitive dust PM10 emissions of 25.5 lb/hr were modeled.

Construction fugitive dust emissions were estimated based on a Midwest Research Institute ("MRI") study conducted in 1996 to improve EPA emission factors used to estimate PM10 emissions from construction activity. This study developed emission factors for seven typical construction projects in desert areas similar to the project site in Las Vegas, Coachella Valley, South Coast, and the San Joaquin Valley.[5] Each site was visited, equipment inventoried, and limited monitoring conducted.

The results of the MRI study indicate that the hourly-uncontrolled PM10 emissions average 229 lb/hr and range up to 712 lb/hr (5.1 lb/acre-hr) for a site with heavy earthmoving using scrapers. (MRI 1996, Table ES-1, Table 2.) Thus, for the 5-acre area source, the uncontrolled PM10 emissions would be 25.5 lb/hr (5.1 lb/acre-hr x 5 acres). We used an uncontrolled emission factor because the Siting Application does not require any mitigation for dust control.

The results of our fugitive PM10 modeling are as follows:

[5] Midwest Research Institute (MRI), Improvement of Specific Emission Factors (BACM Project No. 1), Final Report, March 29, 1996. Copy available upon request.

Pollutant	Averaging Period	Modeled Concentration ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	PSD Class II Increment ($\mu g/m^3$)	Easting Coordinate (m)	Northing Coordinate (m)
PM10	2nd high 24-hr	402	150	30	281412	3715113

This table shows that the 24-hour PM10 standard would be exceeded by over a factor of two and the 24-hour PM10 Class II PSD increment (30 $\mu g/m^3$) by over a factor of 13 during uncontrolled earthmoving activities. Although Allegheny claims it will use water to control fugitive dust on roads, disturbed sites and stockpiles, use covered trucks, and revegetate when possible, this is not explicitly required. (Allegheny Response to AZURE Data Request 8.) Regardless, the proposed measures would only reduce about 50% of the fugitive PM10 emissions. The controlled emissions would still result in exceedances of the NAAQS and Class II PSD Increment. This is a significant air quality impact that was not identified or discussed in the Siting Application.

The 24-hour PM10 impacts from fugitive dust will actually occur simultaneously with the construction PM10 exhaust emissions described above and thus are approximately additive. We chose not to add these two impacts together, as the exact combination is currently unknown and may occur in different locations. As a result, our model results may significantly underestimate construction PM10 impacts.

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EDUCATION

- M.S., Atmospheric Science, University of California, Davis, 1980.
- B.S., Atmospheric Science, University of California, Davis, 1978.

PROFESSIONAL EXPERIENCE

More than 19 years of regulatory and private-sector experience in air quality issues.

AIR TOXICS

- Performed more than 300 health risk assessments of major air toxics sources in California. These assessments were prepared for AB 2588 (the Air Toxics "Hot Spots" Information and Assessment Act of 1987), Proposition 65, and other exposure analysis activities. More than 90 of these exposure assessments were prepared for Proposition 65 compliance verification. The ISCST, ISCST2, ISCST3, ISC2ACE, and ISC3ACE dispersion models and the ACE2588, ACE2, and ACE3 exposure assessment programs were primarily used in preparing these analyses.

- Reviewed approximately 300 health risk assessments of toxic air pollution sources in California. Review programs include AB 2588, Proposition 65, the California Environmental Quality Act, and other exposure analysis activities. Clients include the California Attorney General's Office, the Los Angeles County District Attorney's Office, the Santa Barbara County Air Pollution Control District (SBAPCD), the South Coast Air Quality Management District, numerous environmental and community groups, and several plaintiff law firms.

- Experienced in assessing public health risk from continuous, intermittent, and accidental releases of toxic emissions. Experienced in assessing individual and population exposure from inhalation and noninhalation pathways. Experienced in generating graphical presentations of risk results, and communicating risks from carcinogenic and acute and chronic noncarcinogenic pollutants.

- Air Toxics Program Coordinator for the SBAPCD. Duties included: developing and managing the District air toxics program; supervising District staff assigned to the air toxics program; developing District air toxics rules, regulations, policies and procedures; management of all District air toxics efforts, including AB 2588, Proposition 65, and federal activities; developing and tracking the SBAPCD air toxics budget.

- Manager of the SBAPCD AB 2588 program. Activities included: working member of the AB 2588 Criteria and Guidelines Regulation, Technical Guidance, Fee Regulation, and California Air Pollution Control Officer's Association (CAPCOA) Risk Prioritization, Risk Assessment, and Risk Notification committees; supervision and guidance to staff responsible for implementing the requirements for AB 2588 industry-wide inventories, emission inventory plans and reports, fee collection, source-testing, risk prioritization, risk assessment, and risk notification; overall responsibility for coordinating industry and agency efforts and ensuring that the program proceeds on schedule.

- While at the SBAPCD, designed the ACE2588 model - the first public domain multi-source, multi-pathway, multi-pollutant risk assessment model. Developed the structure of the ACE2588 input and output files, supervised the coding of the model, tested the model for quality assurance, and provided technical support to over 200 users of the model. Responsible for updating the model each year and ensuring that it is consistent with CAPCOA Risk Assessment Guidelines.

- ACE2588 Risk Assessment Model Support for CAPCOA. Tasks include: updating the ACE2588 risk assessment model Fortran code to increase user efficiency and to maintain consistency with the CAPCOA Risk Assessment Guidelines; modifying the Fortran code to the EPA ISCST2 and COMPLEX-I models to interface with ACE2588; writing utility programs to assist ACE2588 users; updating toxicity data files to maintain consistency with the CAPCOA Risk Assessment Guidelines; developing the distribution and installation package for ACE2588 and associated programs; providing technical support for all users of ACE2588 (through phone and fax).

- Developed and coded the ISC2ACE and ACE2 programs for distribution by CAPCOA. These programs are widely used in California for preparing AB 2588 and other program health risk assessments. ISC2ACE and ACE2 contain "compression" algorithms to reduce the hard drive and RAM requirements compared to ISCST2/ACE2588. Developed ISC3ACE/ACE3 to incorporate the revised ISCST3 dispersion model requirements.

- Experienced with Proposition 65 and AB 2588 requirements for toxic air pollutants. Informed on the toxicity of the pollutants in these programs, including carcinogenic and acute and chronic noncarcinogenic health effects.

- While at the SBAPCD, developed and coded the "HotSpot" system - a series of Fortran programs to expedite the review of air toxics emissions data, to prepare air quality modeling and risk assessment inputs, and to prepare graphical risk presentations.

- Customized ACE2588 and Developed a Mapping System for the SBAPCD. Tasks include: modifying the ACE2588 Fortran code to run on an Intel I-860 RISC workstation; updating programs that allow SBAPCD staff to continue to use the "HotSpot" system -- a series of programs that streamline preparing AB 2588 risk assessments; developing a risk assessment mapping system based on MapInfo for Windows; linking the MapInfo mapping package to the "HotSpot" system and associated staff training.

- Developed software for electronic submittal of all AB 2588 reporting requirements for the Santa Barbara County Air Pollution Control District. As an update to the "HotSpot" system software, created software that allows facilities to submit all AB 2588 reporting data, including that needed for risk prioritization, exposure assessment, and presentation mapping. The data submitted by the facility is then reformatted to both ATDIF and ATEDS formats for transmittal to the California Air Resources Board.

- Prepared "Modeling Exposures of Hazardous Materials Released During Transportation Incidents" report for the California Office of Environmental Health Hazard Assessment (OEHHA). This report examines and rates the ADAM, ALOHA, ARCHIE, CASRAM, DEGADIS, HGSYSTEM, SLAB, and TSCREEN models for transportation accident consequence analyses of a priority list of 50 chemicals chosen by OEHHA. The report includes a model selection guide for adequacy of assessing priority chemicals, averaging time capabilities, isopleth generating capabilities, model limitations and concerns, and model advantages.

- Developed methods to estimate and verify source emission rates using air toxics measurements collected downwind of the emitting facility, local meteorological data, and dispersion models.

- Experienced in developing emission inventories of toxic air pollutants. Developed procedures and programs for quantifying emissions from many air toxics sources, including: landfills, diesel exhaust sources, natural gas combustion, fugitive hydrocarbons from oil and gas facilities, dry cleaners, auto body shops, ethylene oxide sterilizers, etc.

- Major contributor to the SBAPCD ethylene oxide control rule. Developed original drafts of the rule and specified many requirements of the final rule; coordinated with the California Air Resources Board in the development of the state-wide ethylene oxide control rule; performed risk assessments for several sources of ethylene oxide in Santa Barbara County.

- While at the SBAPCD, provided technical support (as an expert witness on ethylene oxide risks) to the California Department of Justice, Attorney General's Office. Support included: verifying emission inventories and release data, ISCST modeling, risk assessment review, and several depositions.

- Developed and coded Fortran programs for AB 2588 risk prioritization; both batch and interactive versions of the program were created. These programs are used by several air pollution control districts in California.

- Instructed approximately 20 University Professors through the National Science Foundation Faculty Enhancement Program. Instruction topics included: dispersion modeling, meteorological data, environmental fate analysis, toxicology of air pollutants, and air toxics risk assessment; professors were also trained on the use of the ISC2ACE dispersion model and the ACE2 exposure assessment model.

- Instructor of the Air Pollution and Toxic Chemicals course for the University of California, Santa Barbara, Extension certificate program in Hazardous Materials Management. Topics covered in this course include: detailed review of criteria and noncriteria air pollutants; air toxics legislation and regulations; quantifying toxic air contaminant emissions; criteria and noncriteria pollutant monitoring; air quality modeling; health risk assessment procedures; health risk management; control/mitigating air pollutants; characteristics and modeling of spills and other short-term releases of air pollutants; acid deposition, precipitation and fog; indoor/occupational air pollution; the effect of chlorofluorocarbons on the stratospheric ozone layer. Taught this course for five years.

- Experienced in communicating risks for Proposition 65 and AB 2588. Presented risk assessment results in many public settings -- to industry, media, and the affected public.

- Developed SBAPCD Policies and Procedures on carcinogenic and noncarcinogenic risk management levels.

GEOGRAPHIC INFORMATION SYSTEMS AND PRESENTATION MAPPING

- ArcView GIS: Experienced in preparing presentation and testimony maps using ArcView v. 3.2. Developed methods to convert AutoCAD DXF files to ArcView polygon theme shape files for use in map overlays.

- MapInfo for Windows: Prepared numerous presentation maps including exposure isopleths, streets and highways, sensitive receptors, labels, and titles. Developed procedures for importing Surfer isopleths in AutoCAD DXF format as a layer into MapInfo.

- Atlas GIS for Windows and DOS: Experienced in preparing presentation maps with both the Windows and DOS versions of Atlas GIS. In addition to the MapInfo capabilities, Atlas GIS is used to aggregate census data (at the block group level) within exposure isopleths to determine the number of individuals living and working within exposure zones. Experienced in geocoding large numbers of addresses and performing statistical analyses of exposed populations.

- Experienced in preparing large-scale graphical displays. Own a Hewlett-Packard 350C Design Jet plotter that produces color plots up to Architectural-E size (36" by 48"). These plots have been used in trial testimony, public meetings, and other litigation support.

LITIGATION AND ENVIRONMENTAL SUPPORT

- Proposition 65 Litigation Support. Tasks include: reviewing AB 2588 risk assessments and other documents to assist verifying compliance with Proposition 65; preparing exposure assessments consistent with Proposition 65 Regulations for carcinogens and reproductive toxicants; using a geographic information system (Atlas GIS) to prepare exposure maps that display areas of required warnings; calculating the number of residents and workers exposed to levels of risk requiring warnings (using the GIS); preparing declarations, providing staff support, and other expert services as required.

- Proposition 65 Litigation Support Clients: California Attorney General's Office, Los Angeles County District Attorney's Office, As You Sow, California Community Health Advocates, Center for Environmental Health, California Earth Corps, Communities for a Better Environment, Environmental Defense Fund, Environmental Law Foundation, and People United for a Better Oakland. Reviewed scores of assessments for verifying compliance with Proposition 65; prepared over 90 exposure assessments for Proposition 65 analyses.

- Private-Sector Environmental Review and Plaintiff Litigation Support. Activities focus on providing support to law firms representing private interest air pollution projects; representation has included reviewing and commenting on environmental compliance documents, preparing revised exposure assessments, and providing expert services in support of litigation. Primary clients include: Adams, Broadwell Joseph & Cardozo, Girardi & Keese, and Engstrom, Lipscomb & Lack.

- Experienced in preparing declarations and providing expert testimony in depositions and trials.

- Prepared numerous exposure assessments of methyl bromide and chloropicrin emissions in California. Prepared audits of regulatory buffer zones designed to protect public health using meteorological data from Anaheim, Pico Rivera, El Rio, Santa Maria, Fresno, and Union City.

GENERAL REGULATORY

- Project manager for the Santa Barbara County Air Quality Attainment Plan Environmental Impact Report (EIR). Duties included: preparing initial study; preparation and release of the EIR Notice of Preparation; conducting public scoping hearings to obtain comments on the initial study; managing contractor efforts to prepare the draft EIR.

- Experienced with air pollution law, including EPA, California Air Resources Board (ARB), California Energy Commission (CEC), California Coastal Commission, and local air pollution control district regulations and procedures. Also experienced with California Environmental Quality Act and National Environmental Policy Act requirements.

- As a supervising engineer for the SBAPCD, managed the air quality permitting process for major offshore and onshore energy development projects. Duties included: directing and supervising SBAPCD atmospheric scientists, engineers and contractors; preparing notices of preparation for joint federal/state EIS/Rs; preparing request for proposals for contractor support; selecting contractor(s); providing technical support during preparation of permit-decision documents; reviewing air quality documents, emission calculations and modeling results; interfacing with applicants and other responsible agencies; developing permit conditions; developing and implementing appropriate mitigation actions to satisfy permit condition requirements; providing expert testimony to Santa Barbara County Planning Commission and Board of Supervisors; making staff recommendations concerning permit issuance.

- Provided air quality support services to CEC staff in the review of Applications for Certification for major power plants proposed to be sited in California. Prepared staff assessments of the air quality impacts from the proposed projects.

IMPACT MODELING

- As senior air quality modeler, developed the SBAPCD protocol on air quality modeling. Developed extensive modeling capabilities for the SBAPCD on VAX 8600 and Intel I-860 computer systems; acted as systems analyst for the SBAPCD air quality modeling system; served as director of air quality analyses for numerous major energy projects; performed air quality impact analyses using inert and photochemical models, including EPA, ARB and private-sector models; performed technical review and evaluating air quality and wind field models; developed software to prepare model inputs consistent with the SBAPCD protocol on air quality modeling for OCD, OCDCPM, MPTER, COMPLEX-I/II and ISCST.

- Skilled in computer operation and programming, with an emphasis on Fortran 90 and Realizer-Basic for Windows programming.

- Experienced in downloading EPA dispersion models, modifying them for system-specific input and output, and compiling the code for personal use and distribution. Own and am experienced in using the following Fortran compilers: Lahey Fortran 95, Lahey Fortran 90 DOS-Extended; Lahey F77L-EM32 DOS-Extended; Microsoft Power Station 32-bit DOS-Extended; and Microsoft 16-bit.

- Provided detailed review and comments on the development of the Minerals Management Service OCD model. Developed the technical requirements for and supervised the development of the OCDCPM model, a hybrid of the OCD, COMPLEX-I and MPTER models.

- Provided technical support to the Joint Interagency Modeling Study and South Central Coast Cooperative Aerometric Monitoring Program. Provided technical comments on analyses performed with the EKMA, AIRSHED, and PARIS models. Developed emissions inventory for input into regional air quality planning models.

AIR QUALITY/METEOROLOGICAL MONITORING

- Developed technical requirements for the Santa Barbara County Air Quality/Meteorological Monitoring Protocol. Developed and implemented protocol for siting of pre- and post-construction air quality and meteorological PSD monitoring systems. Determined requirements, designed and sited over 30 PSD monitoring systems. Responsible for data acquisition and quality assurance for an offshore meteorological monitoring station.

- Coordinated with consultants performing air monitoring for verifying compliance with Proposition 65 and other regulatory programs. Wrote software to convert raw meteorological data to hourly-averaged values formatted for dispersion modeling input.

OTHER TECHNICAL

- Configured and operated an Intel I-860 based workstation for the SBAPCD toxics program. Created batch files and recoded programs to run risk assessments in the 64-bit I-860 environment.

- Developed emission reduction strategies and identified appropriate offset sources to mitigate project emissions liability. Developed and implemented procedures to account for reactivity of organic compound species for ozone impact mitigation.

- Responsible for tracer study design, review and evaluation. Performed engineering evaluations for oil and gas production facilities.

AFFILIATIONS

- American Meteorological Society (former president, Ventura/Santa Barbara County Chapter).

PUBLICATIONS

- Correlations of Total, Diffuse, and Direct Solar Radiation with the Percentage of Possible Sunshine for Davis, California. *Solar Energy* 27(4): 357-60, 1981.
- Contributions to over 100 Environmental Impact Statements/Reports and other technical documents required for regulatory decision-making.
- Prepared two software review columns for the *Journal of the Air and Waste Management Association.*

EMPLOYMENT HISTORY

• Self-Employed Air Quality Consultant	1992 to 2001
• Santa Barbara County APCD Air Toxics Program Coordinator	1988 to 1992
• URS Consultants Senior Scientist	1987 to 1988
• Santa Barbara County APCD Air Quality Engineer	1983 to 1987
• Dames and Moore Meteorologist	1982 to 1983

DECLARATION

I, Camille Sears, declare as follows:

1. I prepared the attached analysis of environmental impacts of the proposed La Paz Generating Facility in La Paz County, Arizona, based on my independent review and my professional experience and knowledge.

2. It is my professional opinion that the analysis is valid and accurate with respect to the issue(s) addressed therein.

3. I am personally familiar with the facts and conclusions related in the analysis, and if called as a witness could testify competently thereto.

4. A copy of my professional qualifications and experience is attached hereto and incorporated by reference herein.

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

Dated: 10/19/2001, at Ojai, California:

Camille Sears
Name

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DOCUMENT CONTROL

ORIGINAL

TESTIMONY

of

STEVEN R. RADIS, M.A.

on

Air Quality And Public Health Impacts

Relating to the

La Paz Generating Facility

Submitted on behalf of

Arizona Unions For Reliable Energy

October 19, 2001

Steven R. Radis, Principal
Global Environment & Risk Practice
Arthur D. Little, Inc.
3916 State Street, Suite 2a
Santa Barbara, CA 93105

Arizona Corporation Commission
DOCKETED
OCT 23 2001
DOCKETED BY [signature]

TESTIMONY OF STEVEN RADIS

I have reviewed the following materials submitted by Allegheny Energy Supply, LLC ("applicant"): (a) Application for a Certificate of Environmental Compatibility for the La Paz Generating Facility, submitted to the Arizona Power Plant and Transmission Line Siting Committee (July 3, 2001; and (b) Application for a Class I Permit for the La Paz Generating Facility, submitted to the Arizona Department of Environmental Quality (October 2, 2001). The following is my testimony relating to the information provided therein.

The reader should note that section-specific tables and figures are presented in or following each section of my testimony. They accordingly are numbered sequentially, beginning at 1, in each section.

VISIBILITY

I. The Proposed La Paz Generating Facility Will Adversely Impact Visibility in Nearby Wilderness Areas

The proposed project is surrounded by seven Class II wilderness areas. Air pollutant emissions from the proposed project could potentially degrade visibility in these wilderness areas beyond a threshold that is considered acceptable by the U.S. Forest Service, which is the Federal Land Manager for these wilderness areas.

The Applicant prepared a Level 1 visibility screening analysis for the following seven wilderness areas (Figure 1):

- Eagletail Mountains Wilderness Area
- Big Horn Mountains Wilderness Area
- Hummingbird Springs Wilderness Area
- Harquahala Mountains Wilderness Area
- Harcuvar Mountains Wilderness Area
- New Water Mountains Wilderness Area
- Signal Mountains Wilderness Area

Results of the Applicant's Level 1 visibility screening analysis showed that the Delta E (color difference) and Contrast screening criteria were exceeded at all seven wilderness areas, thus indicating the potential for significant visibility degradation as a result of project air pollutant emissions.

The Applicant also prepared a refined Level 2 visibility screening analysis for the project that showed the project would meet the Delta E and Contrast screening criteria, thus indicating that the project would not cause significant visibility degradation. However, there are numerous flaws in the Applicant's analysis, which have led to erroneous results for most of the wilderness areas. The flaws in the Applicant's analysis are summarized below.

I.A Meteorological Conditions

A level 1 visibility screening analysis assumes a uniform worst-case meteorological condition that may not occur at a given location. As part of the Level 2 visibility screening analysis, site specific meteorological conditions are evaluated to establish worst-case conditions that would actually occur at the site.

The Applicant evaluated meteorological data that was collected at the site to establish worst-case conditions following the methodology established by the Environmental Protection Agency (EPA) in their "Workbook for Plume Visual Impact Screening and Analysis" (EPA Visibility Workbook). However, there are substantial discrepancies between the worst-case meteorological conditions selected by the Applicant and the site-specific meteorological data. These discrepancies have led to an under-prediction of potential visibility impacts. It is unclear how the Applicant derived their worst-case meteorological conditions, but it appears that several factors let to a misidentification of worst-case meteorological conditions including:

- Exclusion of all hours where the wind speed was less than 1.0 m/s, which is defined as "calm" for the ISCST dispersion modeling, but would still be considered a valid condition for the visibility modeling.
- Exclusion of pre-dawn hours from the frequency distribution. While visibility impairment is not estimated for nighttime hours, the EPA Visibility Workbook notes that pollutant transport at night can result in visibility impairment at sunrise, and in cooler seasons, well into the morning hours. Therefore, the EPA recommends that nighttime hours be included in the frequency distribution.
- The Applicant used only a single wind direction in identifying the worst-case condition. In many cases, a range of wind conditions can result in pollutant transport over the wilderness area. The worst-case wind direction should have been used in the analysis.

Worst case meteorological conditions were re-evaluated to identify the worst-case dispersion conditions for the seven wilderness areas as shown in Tables 1-7 The worst-case dispersion conditions identified in these tables were used in a revised visibility screening analysis as discussed below.

I.B Screening Criteria

The EPA Visibility Workbook specifies visibility screening criteria to evaluate changes in observed color differences (Delta E) and plume sky/terrain contrast. The Federal Land Managers also specify the same criteria in their guidance publication "Federal Land Managers' Air Quality Related Values Workgroup (FLAG) Phase I Report" The screening criteria recommended by both the EPA and Federal Land Managers are as follows:

- Delta E 2.0
- Contrast 0.05

The Applicant used these values for their Level 1 screening analysis, but used substantially greater values for some of their Level 2 analyses. Specifically, the Applicant's screening criteria were as high as 11.44 for Delta E and 0.29 for Contrast. Had the correct screening criteria been used for the Level 2 visibility screening analysis, the results would have shown that the proposed project would not pass the screening test and would have the potential to adversely impact regional visibility in several of the nearby wilderness areas.

1.C Background Visual Range

The Applicant's analysis followed the EPA Visibility Workbook procedure for selecting a background visual range of 110 km. However, as noted in the EPA Visibility Workbook, "In cases where there is more applicable onsite data, source owners should consult with the Federal Land Manager for the Class I [or Class II] area in question concerning the appropriate regional background visual range values for input to VISCREEN or other plume visibility models." Had the Applicant consulted the applicable Federal Land Manager, they would have been required to use more representative background visual range values for their Level 1 and 2 visibility screening analysis.

Figures 2 and 3 provide regional visual range values for the project area. For the Level 1 visibility screening analysis it would be appropriate to use the 90th percentile background visual range of about 260 km as representative of the project area. For the Level 2 visibility screening analysis, the 50th percentile background visual range would be appropriate, which is about 160 km for the project area. These background visual range values were used in the revised Level 1 and 2 visibility screening analyses that are provided in the following section.

1.D Revised Level 2 Visibility Analysis

Based on the comments listed above, the Level 2 visibility screening analysis was revised to incorporate the re-evaluated worst-case meteorological conditions, representative background visual range and correct screening criteria. With the exception of corrections to the worst-case meteorological conditions, screening criteria and background visual range, all other input parameters were identical to the Applicant's analysis. The results of the Level 2 visibility screening analysis are provided in Tables 8 through 14 and indicate that the proposed project has the potential to significantly degrade visibility in the regional wilderness areas as follows:

Wilderness Area	***Screening Results***
Eagletail Mountains Wilderness Area	Failed Screening
Big Horn Mountains Wilderness Area	Failed Screening
Hummingbird Springs Wilderness Area	Failed Screening
Harquahala Mountains Wilderness Area	Failed Screening
Harcuvar Mountains Wilderness Area	Passed
New Water Mountains Wilderness Area	Passed
Signal Mountains Wilderness Area	Failed Screening

Based on these results, it appears that the proposed project has the potential to degrade visibility in most of the surrounding wilderness areas. Therefore, additional measures are needed to reduce air pollutant emissions from the proposed project to protect regional visibility.

Figure 1
Class II Wilderness Areas Near the Project Site

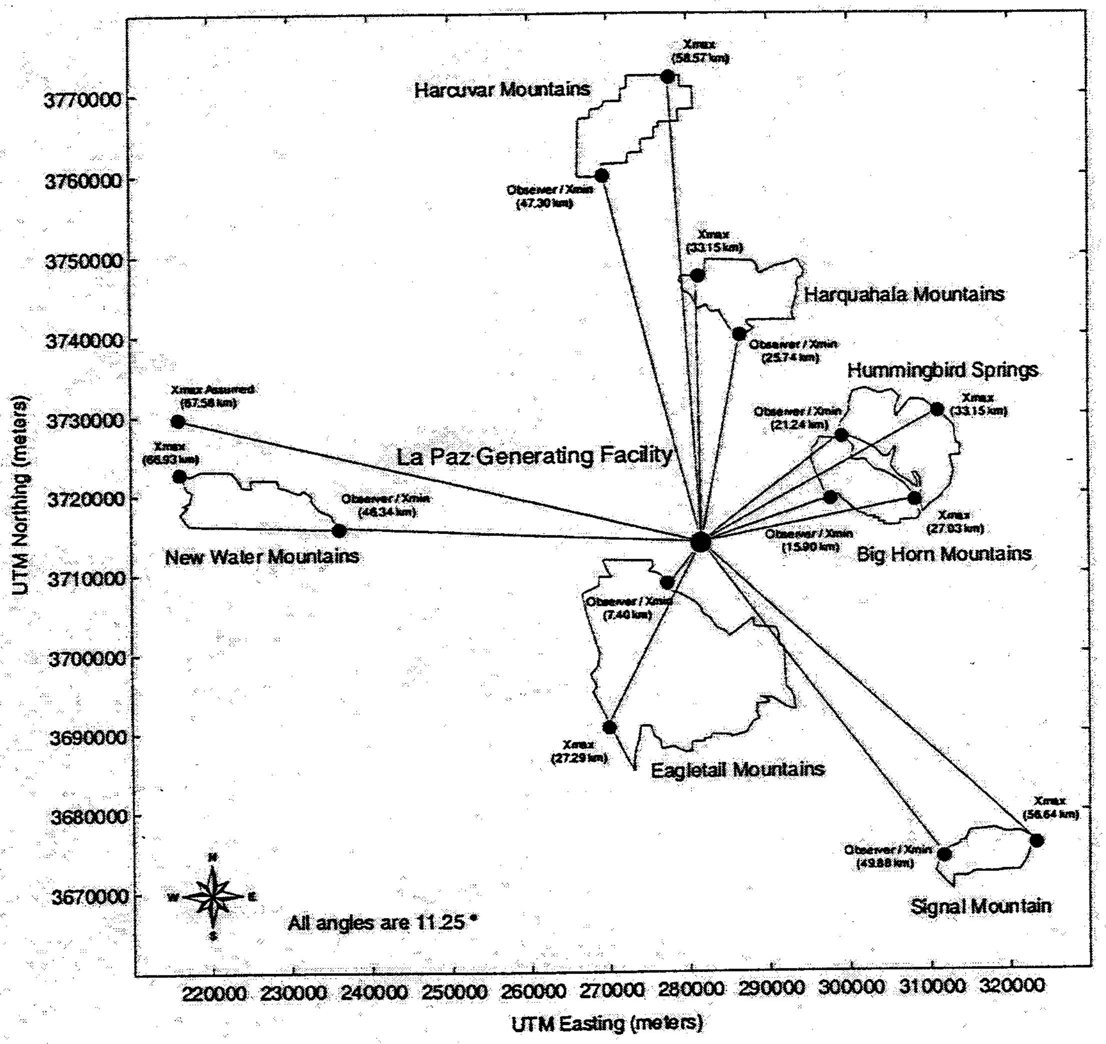
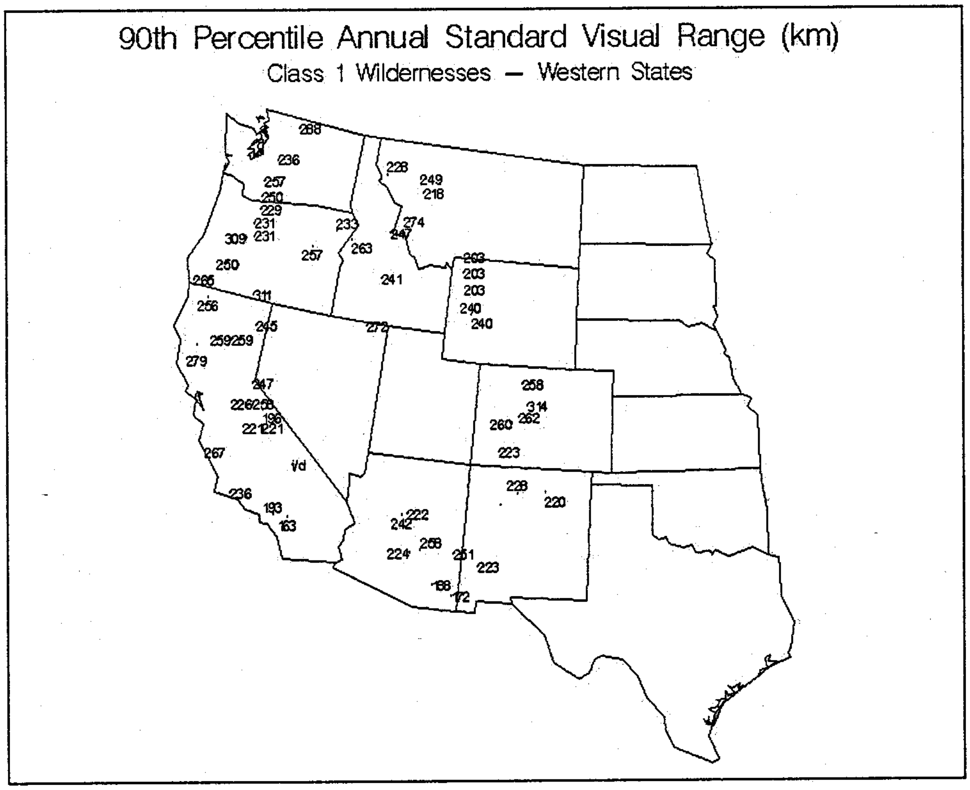


Figure 2
Background Visual Range Values for the Western United States



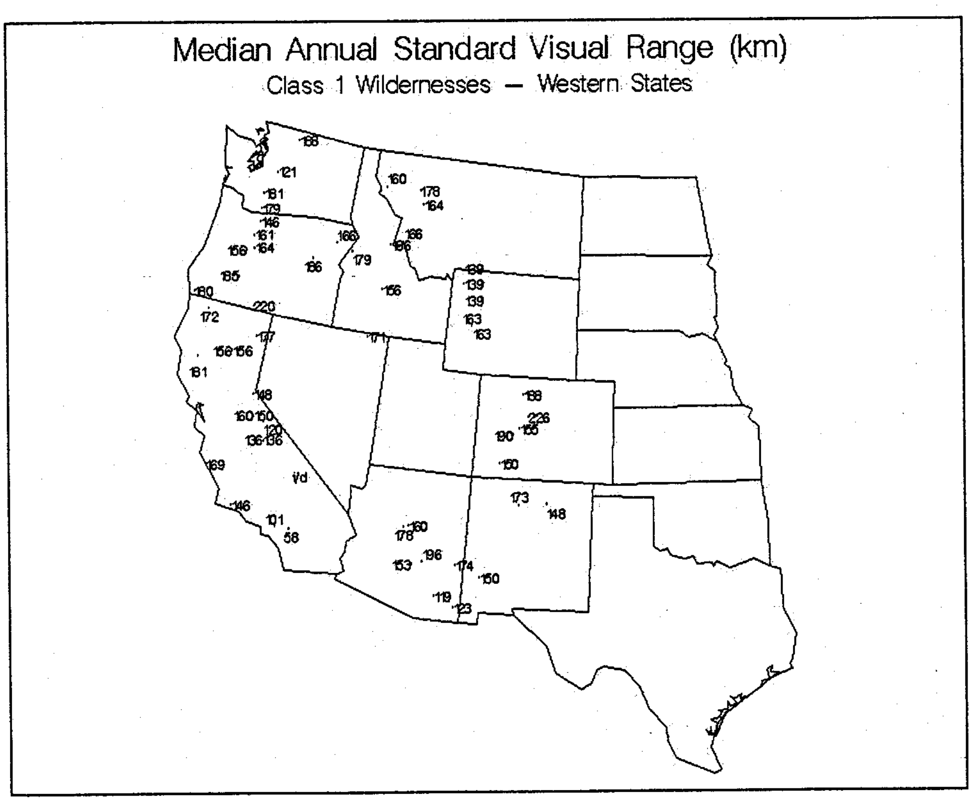


Table 1

Analysis of Worst-case Meteorological Conditions for Level 2 Visibility Screening Eagletail Mountains Wilderness Area

		Cumulative Frequencies of Occurrence of Given Dispersion Condition Associated with Worst-Case Wind Direction and Time of Day (percent)							
		00-06		06-12		12-18		18-24	
Dispersion Condition	**Transport Time (hours)**	**f**	**cf**	**f**	**cf**	**f**	**cf**	**f**	**cf**
F-1	2.1	0.2	0.2	0.0	0.0	0.0	0.0	0.1	0.1
F-2	1.0	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.2
F-3	0.7	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.3
E-1	2.1	0.1	0.5	0.0	0.0	0.0	0.0	0.1	0.3
E-2	1.0	0.2	0.7	0.0	0.0	0.0	0.0	0.3	0.6
E-3	0.7	0.2	0.9	0.0	0.0	0.0	0.0	0.2	0.8
D-1	2.1	0.1	**1.0**	0.1	0.1	0.0	0.1	0.1	0.8
E-4	0.5	0.1	1.1	0.0	0.1	0.0	0.1	0.1	0.9
E-5	0.4	0.0	1.2	0.0	0.1	0.0	0.1	0.0	0.9
D-2	1.0	0.2	1.4	0.1	0.2	0.0	0.1	0.1	**1.0**
D-3	0.7	0.2	1.6	0.0	0.2	0.0	0.1	0.1	1.2
D-4	0.5	0.1	1.7	0.1	0.3	0.0	0.2	0.1	1.3
D-5	0.4	0.0	1.8	0.0	0.3	0.0	0.2	0.0	1.3
D-6	0.3	0.0	1.8	0.0	0.3	0.0	0.2	0.0	1.3
D-7	0.3	0.0	1.8	0.0	0.3	0.0	0.2	0.0	1.3
D-8	0.3	0.0	1.8	0.0	**0.4**	0.0	**0.3**	0.0	1.3

Minimum Distance to Class II Area (km): 7.4
Maximum Distance to Class II Area (km): 27.29

f = frequency
cf = Cumulative Frequency

Table 2

Analysis of Worst-case Meteorological Conditions for Level 2 Visibility Screening

Big Horn Mountains Wilderness Area

		Cumulative Frequencies of Occurrence of Given Dispersion Condition Associated with Worst-Case Wind Direction and Time of Day (percent)							
		00-06		06-12		12-18		18-24	
Dispersion Condition	**Transport Time (hours)**	**f**	**cf**	**f**	**cf**	**f**	**cf**	**f**	**cf**
F-1	4.4	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1
F-2	2.2	0.1	0.2	0.0	0.0	0.0	0.0	0.1	0.2
F-3	1.5	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.2
E-1	4.4	0.1	0.4	0.0	0.0	0.0	0.0	0.1	0.3
E-2	2.2	0.3	0.7	0.0	0.0	0.0	0.0	0.4	0.8
E-3	1.5	0.3	<u>1.0</u>	0.0	0.0	0.1	0.1	0.7	<u>1.4</u>
D-1	4.4	0.1	1.1	0.1	0.1	0.0	0.1	0.1	1.6
E-4	1.1	0.4	1.5	0.0	0.1	0.2	0.3	0.7	2.3
E-5	0.9	0.1	1.6	0.0	0.1	0.0	0.3	0.2	2.5
D-2	2.2	0.4	2.0	0.2	0.4	0.1	0.4	0.3	2.7
D-3	1.5	0.4	2.4	0.2	0.6	0.1	0.5	0.6	3.3
D-4	1.1	0.1	2.6	0.2	0.8	0.1	0.6	0.3	3.6
D-5	0.9	0.1	2.7	0.1	<u>1.0</u>	0.2	0.8	0.2	3.8
D-6	0.7	0.1	2.8	0.1	1.0	0.1	0.9	0.1	3.9
D-7	0.6	0.0	2.8	0.0	1.1	0.1	<u>1.0</u>	0.0	3.9
D-8	0.6	0.0	2.8	0.0	1.1	0.1	1.0	0.0	3.9

Minimum Distance to Class II Area (km): 15.9
Maximum Distance to Class II Area (km): 27.03

f = frequency
cf = Cumulative Frequency

Table 3
Analysis of Worst-case Meteorological Conditions for Level 2 Visibility Screening
Hummingbird Springs Wilderness Area

		Cumulative Frequencies of Occurrence of Given Dispersion Condition Associated with Worst-Case Wind Direction and Time of Day (percent)							
		00-06		06-12		12-18		18-24	
Dispersion Condition	**Transport Time (hours)**	**f**	**cf**	**f**	**cf**	**f**	**cf**	**f**	**cf**
F-1	5.9	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1
F-2	3.0	0.1	0.2	0.0	0.0	0.0	0.0	0.1	0.2
F-3	2.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.2
E-1	5.9	0.1	0.4	0.0	0.0	0.0	0.0	0.1	0.3
E-2	3.0	0.3	0.7	0.0	0.0	0.0	0.0	0.4	0.8
E-3	2.0	0.3	**1.0**	0.0	0.0	0.1	0.1	0.7	**1.4**
D-1	5.9	0.1	1.1	0.1	0.1	0.0	0.1	0.1	1.6
E-4	1.5	0.4	1.5	0.0	0.1	0.2	0.3	0.7	2.3
E-5	1.2	0.1	1.6	0.0	0.1	0.0	0.3	0.2	2.5
D-2	3.0	0.4	2.0	0.2	0.4	0.1	0.4	0.3	2.7
D-3	2.0	0.4	2.4	0.2	0.6	0.1	0.5	0.6	3.3
D-4	1.5	0.1	2.6	0.2	0.8	0.1	0.6	0.3	3.6
D-5	1.2	0.1	2.7	0.1	**1.0**	0.2	0.8	0.2	3.8
D-6	1.0	0.1	2.8	0.1	1.0	0.1	0.9	0.1	3.9
D-7	0.8	0.0	2.8	0.0	1.1	0.1	**1.0**	0.0	3.9
D-8	0.7	0.0	2.8	0.0	1.1	0.1	1.0	0.0	3.9

Minimum Distance to Class II Area (km): 21.4
Maximum Distance to Class II Area (km): 33.15

f = frequency
cf = Cumulative Frequency

Table 4
Analysis of Worst-case Meteorological Conditions for Level 2 Visibility Screening Harquahala Mountains Wilderness Area

		Cumulative Frequencies of Occurrence of Given Dispersion Condition Associated with Worst-Case Wind Direction and Time of Day (percent)							
		00-06		06-12		12-18		18-24	
Dispersion Condition	**Transport Time (hours)**	**f**	**cf**	**f**	**cf**	**f**	**cf**	**f**	**cf**
F-1	7.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
F-2	3.6	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
F-3	2.4	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
E-1	7.2	0.0	0.2	0.0	0.0	0.0	0.0	0.1	0.2
E-2	3.6	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.3
E-3	2.4	0.0	0.3	0.0	0.0	0.0	0.1	0.3	0.7
D-1	7.2	0.0	0.3	0.0	0.0	0.0	0.1	0.1	0.7
E-4	1.8	0.0	0.4	0.0	0.0	0.0	0.1	0.1	0.9
E-5	1.4	0.0	0.4	0.0	0.0	0.0	0.1	0.0	0.9
D-2	3.6	0.0	0.4	0.0	0.0	0.0	0.1	0.2	**1.1**
D-3	2.4	0.1	0.5	0.0	0.1	0.1	0.3	0.3	1.4
D-4	1.8	0.1	0.5	0.0	0.1	0.1	0.4	0.5	1.9
D-5	1.4	0.0	0.6	0.0	0.1	0.1	0.5	0.4	2.4
D-6	1.2	0.0	0.6	0.1	0.2	0.4	0.9	0.2	2.6
D-7	1.0	0.0	0.6	0.0	0.2	0.2	**1.1**	0.1	2.7
D-8	0.9	0.0	**0.6**	0.0	**0.2**	0.0	1.2	0.0	2.7

Minimum Distance to Class II Area (km): 25.74
Maximum Distance to Class II Area (km): 33.15

f = frequency
cf = Cumulative Frequency

Table 5
Analysis of Worst-case Meteorological Conditions for Level 2 Visibility Screening
Harcuvar Mountains Wilderness Area

			Cumulative Frequencies of Occurrence of Given Dispersion Condition Associated with Worst-Case Wind Direction and Time of Day (percent)							
			00-06		06-12		12-18		18-24	
Dispersion Condition	**Transport Time (hours)**		**f**	**cf**	**f**	**cf**	**f**	**cf**	**f**	**cf**
F-1	13.1	*	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F-2	6.6		0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1
F-3	4.4		0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1
E-1	13.1	*	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1
E-2	6.6		0.1	0.2	0.0	0.0	0.0	0.0	0.1	0.1
E-3	4.4		0.1	0.3	0.0	0.0	0.0	0.1	0.1	0.3
D-1	13.1	*	0.0	0.3	0.0	0.0	0.0	0.1	0.0	0.3
E-4	3.3		0.0	0.3	0.0	0.0	0.0	0.1	0.0	0.3
E-5	2.6		0.0	0.3	0.0	0.0	0.0	0.1	0.0	0.3
D-2	6.6		0.1	0.4	0.0	0.0	0.0	0.1	0.1	0.4
D-3	4.4		0.1	0.5	0.0	0.1	0.1	0.2	0.1	0.6
D-4	3.3		0.0	0.6	0.0	0.1	0.1	0.4	0.1	0.7
D-5	2.6		0.0	0.6	0.0	0.1	0.1	0.5	0.1	0.8
D-6	2.2		0.0	0.6	0.1	0.2	0.1	0.6	0.1	0.8
D-7	1.9		0.0	0.6	0.0	0.2	0.0	0.6	0.0	0.9
D-8	1.6		0.0	<u>0.6</u>	0.0	<u>0.2</u>	0.0	<u>0.6</u>	0.0	<u>0.9</u>

Minimum Distance to Class II Area (km): 47.3
Maximum Distance to Class II Area (km): 58.57

f = frequency
cf = Cumulative Frequency
* - Indicates that transport time exceeded 12 hours and frequency was not included in cumlative total.

Table 6

Analysis of Worst-case Meteorological Conditions for Level 2 Visibility Screening New Water Mountains Wilderness Area

			Cumulative Frequencies of Occurrence of Given Dispersion Condition Associated with Worst-Case Wind Direction and Time of Day (percent)							
			00-06		06-12		12-18		18-24	
Dispersion Condition	**Transport Time (hours)**		**f**	**cf**	**f**	**cf**	**f**	**cf**	**f**	**cf**
F-1	12.9	*	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F-2	6.4		0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
F-3	4.3		0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
E-1	12.9	*	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
E-2	6.4		0.1	0.2	0.0	0.0	0.0	0.0	0.1	0.1
E-3	4.3		0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.1
D-1	12.9	*	0.1	0.3	0.1	0.0	0.0	0.0	0.0	0.1
E-4	3.2		0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.1
E-5	2.6		0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.1
D-2	6.4		0.2	0.5	0.1	0.2	0.1	0.1	0.0	0.2
D-3	4.3		0.1	0.6	0.0	0.2	0.0	0.1	0.0	0.2
D-4	3.2		0.0	0.6	0.0	0.2	0.0	0.1	0.0	0.2
D-5	2.6		0.0	0.6	0.0	0.2	0.0	0.1	0.0	0.2
D-6	2.1		0.0	0.6	0.0	0.2	0.0	0.1	0.0	0.2
D-7	1.8		0.0	0.6	0.0	0.2	0.0	0.1	0.0	0.2
D-8	1.6		0.0	<u>0.6</u>	0.0	<u>0.2</u>	0.0	<u>0.2</u>	0.0	<u>0.2</u>

Minimum Distance to Class II Area (km): 46.34
Maximum Distance to Class II Area (km): 66.93

f = frequency
cf = Cumulative Frequency
* - Indicates that transport time exceeded 12 hours and frequency was not included in cumlative total.

Table 7
Analysis of Worst-case Meteorological Conditions for Level 2 Visibility Screening Signal Mountains Wilderness Area

Dispersion Condition	Transport Time (hours)	Cumulative Frequencies of Occurrence of Given Dispersion Condition Associated with Worst-Case Wind Direction and Time of Day (percent) 00-06 f	00-06 cf	06-12 f	06-12 cf	12-18 f	12-18 cf	18-24 f	18-24 cf
F-1	13.9 *	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0
F-2	6.9	0.2	0.3	0.0	0.0	0.0	0.0	0.1	0.3
F-3	4.6	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.3
E-1	13.9 *	0.2	0.2	0.0	0.0	0.0	0.0	0.2	0.1
E-2	6.9	0.4	0.6	0.0	0.0	0.0	0.0	0.4	0.5
E-3	4.6	0.9	1.5	0.0	0.0	0.0	0.0	0.6	1.1
D-1	13.9 *	0.1	1.5	0.1	0.0	0.0	0.0	0.1	1.1
E-4	3.5	0.7	2.1	0.0	0.0	0.0	0.1	0.5	1.6
E-5	2.8	0.0	2.2	0.0	0.0	0.0	0.1	0.0	1.6
D-2	6.9	0.6	2.8	0.1	0.2	0.1	0.1	0.3	1.9
D-3	4.6	0.7	3.5	0.3	0.4	0.1	0.2	0.6	2.5
D-4	3.5	0.2	3.7	0.1	0.6	0.0	0.2	0.2	2.6
D-5	2.8	0.0	3.7	0.0	0.6	0.1	0.3	0.0	2.7
D-6	2.3	0.0	3.7	0.1	0.7	0.1	0.4	0.0	2.7
D-7	2.0	0.0	3.7	0.1	0.7	0.1	0.5	0.0	2.7
D-8	1.7	0.0	3.7	0.0	0.7	0.0	0.5	0.0	2.7

Minimum Distance to Class II Area (km): 49.88
Maximum Distance to Class II Area (km): 56.64

f = frequency
cf = Cumulative Frequency
* - Indicates that transport time exceeded 12 hours and frequency was not included in cumlative total.

Table 8
Level 2 Visibility Screening Analysis for Eagletail Mountains Wilderness Area

Visual Effects Screening Analysis for
Source: La Paz Generating Facility
Class I Area: Eagletail Mountains Wilderness

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

Input Emissions for

Particulates	535.20	TON/YR
NOx (as NO2)	411.60	TON/YR
Primary NO2	.00	TON/YR
Soot	.00	TON/YR
Primary SO4	.00	TON/YR

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:	160.00 km
Source-Observer Distance:	7.40 km
Min. Source-Class I Distance:	7.40 km
Max. Source-Class I Distance:	27.29 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.	165.	27.3	4.	2.00	15.158*	.05	.286*
SKY	140.	165.	27.3	4.	2.00	3.925*	.05	-.139*
TERRAIN	10.	165.	27.3	4.	2.00	27.528*	.05	.274*
TERRAIN	140.	165.	27.3	4.	2.00	4.948*	.05	.108*

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.	2.	1.0	167.	2.00	40.019*	.05	.940*
SKY	140.	2.	1.0	167.	2.00	12.851*	.05	-.401*
TERRAIN	10.	2.	1.0	167.	2.00	70.292*	.05	.676*
TERRAIN	140.	2.	1.0	167.	2.00	18.462*	.05	.298*

Table 9
Level 2 Visibility Screening Analysis for Big Horn Mountains Wilderness Area

```
Visual Effects Screening Analysis for
                 Source: La Paz Generating Facility
                 Class I Area: Big Horn Mountains Wilderness

               *** User-selected Screening Scenario Results ***
 Input Emissions for

    Particulates    535.20  TON/YR
    NOx (as NO2)    411.60  TON/YR
    Primary NO2        .00  TON/YR
    Soot               .00  TON/YR
    Primary SO4        .00  TON/YR

               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:         160.00 km
     Source-Observer Distance:         15.90 km
     Min. Source-Class I Distance:     15.90 km
     Max. Source-Class I Distance:     27.03 km
     Plume-Source-Observer Angle:      11.25 degrees
     Stability:   5
     Wind Speed:   3.00 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. 154.   27.0    15.  2.00  4.511*   .05   .085*
  SKY      140. 154.   27.0    15.  2.00  1.267    .05  -.041
  TERRAIN   10.  84.   15.9    84.  2.00  9.270*   .05   .049
  TERRAIN  140.  84.   15.9    84.  2.00   .560    .05   .006

          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 22.783*   .05   .479*
  SKY      140.   1.    1.0   168.  2.00  6.107*   .05  -.213*
  TERRAIN   10.   1.    1.0   168.  2.00 40.675*   .05   .407*
  TERRAIN  140.   1.    1.0   168.  2.00  8.079*   .05   .161*
```

Table 10
Level 2 Visibility Screening Analysis for Hummingbird Springs Wilderness Area

Visual Effects Screening Analysis for
Source: La Paz Generating Facility
Class I Area: Hummingbird Springs Wilderness

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

Input Emissions for

Particulates	535.20	TON/YR
NOx (as NO2)	411.60	TON/YR
Primary NO2	.00	TON/YR
Soot	.00	TON/YR
Primary SO4	.00	TON/YR

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:	160.00 km
Source-Observer Distance:	21.40 km
Min. Source-Class I Distance:	21.40 km
Max. Source-Class I Distance:	33.15 km
Plume-Source-Observer Angle:	11.25 degrees
Stability:	5
Wind Speed:	3.00 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.	150.	33.2	19.	2.00	3.355*	.05	.063*
SKY	140.	150.	33.2	19.	2.00	.917	.05	-.031
TERRAIN	10.	84.	21.4	84.	2.00	6.762*	.05	.040
TERRAIN	140.	84.	21.4	84.	2.00	.415	.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	20.984*	.05	.424*
SKY	140.	1.	1.0	168.	2.00	5.324*	.05	-.189*
TERRAIN	10.	1.	1.0	168.	2.00	33.644*	.05	.348*
TERRAIN	140.	1.	1.0	168.	2.00	7.084*	.05	.158*

Table 11
Level 2 Visibility Screening Analysis for Harquahala Mountains Wilderness Area

Visual Effects Screening Analysis for
Source: La Paz Generating Facility
Class I Area: Harquahala Mountains Wilderness

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

Input Emissions for

Particulates	535.20	TON/YR
NOx (as NO2)	411.60	TON/YR
Primary NO2	.00	TON/YR
Soot	.00	TON/YR
Primary SO4	.00	TON/YR

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:	160.00 km
Source-Observer Distance:	25.74 km
Min. Source-Class I Distance:	25.74 km
Max. Source-Class I Distance:	33.15 km
Plume-Source-Observer Angle:	11.25 degrees
Stability:	4
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.	136.	33.2	32.	2.28	1.700	.05	.032
SKY	140.	136.	33.2	32.	2.00	.493	.05	-.016
TERRAIN	10.	84.	25.7	84.	2.16	4.429*	.07	.028
TERRAIN	140.	84.	25.7	84.	2.00	.274	.07	.004

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.	0.	1.0	168.	2.00	20.165*	.05	.394*
SKY	140.	0.	1.0	168.	2.00	4.970*	.05	-.175*
TERRAIN	10.	0.	1.0	168.	2.00	29.729*	.05	.313*
TERRAIN	140.	0.	1.0	168.	2.00	6.644*	.05	.157*

Table 12
Level 2 Visibility Screening Analysis for Harcuvar Mountains Wilderness Area

Visual Effects Screening Analysis for
Source: La Paz Generating Facility
Class I Area: Harcuvar Mountains Wilderness

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

Input Emissions for

Particulates	535.20	TON/YR
NOx (as NO2)	411.60	TON/YR
Primary NO2	.00	TON/YR
Soot	.00	TON/YR
Primary SO4	.00	TON/YR

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:	160.00 km
Source-Observer Distance:	47.30 km
Min. Source-Class I Distance:	47.30 km
Max. Source-Class I Distance:	58.57 km
Plume-Source-Observer Angle:	11.25 degrees
Stability:	4
Wind Speed:	8.00 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 NOT Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	132.	58.6	37.	2.00	.255	.05	.005
SKY	140.	132.	58.6	37.	2.00	.065	.05	-.002
TERRAIN	10.	84.	47.3	84.	2.00	.500	.05	.004
TERRAIN	140.	84.	47.3	84.	2.00	.035	.05	.001

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.	0.	1.0	169.	2.00	4.724*	.05	.069*
SKY	140.	0.	1.0	169.	2.00	.976	.05	-.034
TERRAIN	10.	0.	1.0	169.	2.00	5.918*	.05	.060*
TERRAIN	140.	0.	1.0	169.	2.00	1.260	.05	.033

Table 13
Level 2 Visibility Screening Analysis for New Water Mountains Wilderness Area

Visual Effects Screening Analysis for
Source: La Paz Generating Facility
Class I Area: New Water Mountains Wilderness

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

Input Emissions for

Particulates	535.20	TON/YR
NOx (as NO2)	411.60	TON/YR
Primary NO2	.00	TON/YR
Soot	.00	TON/YR
Primary SO4	.00	TON/YR

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:	160.00 km
Source-Observer Distance:	46.34 km
Min. Source-Class I Distance:	46.34 km
Max. Source-Class I Distance:	66.93 km
Plume-Source-Observer Angle:	11.25 degrees
Stability:	4
Wind Speed:	4.00 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 NOT Exceeded

					Delta E		Contrast	
Backgrnd	Theta	Azi	Distance	Alpha	Crit	Plume	Crit	Plume
SKY	10.	146.	66.9	23.	2.00	.640	.05	.011
SKY	140.	146.	66.9	23.	2.00	.144	.05	-.005
TERRAIN	10.	84.	46.3	84.	2.00	1.021	.05	.008
TERRAIN	140.	84.	46.3	84.	2.00	.072	.05	.001

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.	0.	1.0	169.	2.00	8.822*	.05	.133*
SKY	140.	0.	1.0	169.	2.00	1.886	.05	-.064*
TERRAIN	10.	0.	1.0	169.	2.00	10.505*	.05	.109*
TERRAIN	140.	0.	1.0	169.	2.00	2.460*	.05	.064*

Table 14
Level 2 Visibility Screening Analysis for Signal Mountains Wilderness Area

```
Visual Effects Screening Analysis for
                 Source: La Paz Generating Facility
                 Class I Area: Signal Mountains Wilderness


               *** User-selected Screening Scenario Results ***
 Input Emissions for

    Particulates    535.20  TON/YR
    NOx (as NO2)    411.60  TON/YR
    Primary NO2        .00  TON/YR
    Soot               .00  TON/YR
    Primary SO4        .00  TON/YR


               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:          160.00 km
     Source-Observer Distance:          49.86 km
     Min. Source-Class I Distance:      49.86 km
     Max. Source-Class I Distance:      56.64 km
     Plume-Source-Observer Angle:       11.25 degrees
     Stability:    5
     Wind Speed:    3.00 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. 117.   56.6    51.  2.00  1.207    .05   .022
  SKY      140. 117.   56.6    51.  2.00   .328    .05  -.011
  TERRAIN  10.   84.   49.9    84.  2.00  2.512*   .05   .021
  TERRAIN 140.   84.   49.9    84.  2.00   .187    .05   .004


          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.   0.    1.0   169.  2.00 13.927*   .05   .216*
  SKY      140.   0.    1.0   169.  2.00  3.114*   .05  -.096*
  TERRAIN  10.    0.    1.0   169.  2.00 14.654*   .05   .154*
  TERRAIN 140.    0.    1.0   169.  2.00  4.139*   .05   .104*
```

AMMONIA RISKS

II. Ammonia Transportation: Risk Analysis and Mitigation Measures

The La Paz Generating Facility ("La Paz" or "Project") would use 19% aqueous ammonia in a selective catalytic reduction ("SCR") system to remove nitrogen oxides from exhaust gases. About 150 7,500-gallon tanker trucks per year would deliver this ammonia to the Project site. The ammonia would likely be distributed from a local supplier in Phoenix that would receive their ammonia from California.

I performed an analysis that evaluates the risks and consequences of transporting aqueous ammonia to the proposed La Paz project. The proposed project would require at least 150 ammonia deliveries per year, which would likely originate in the Phoenix metropolitan area. My analysis indicates that, in the absence of additional safety measures, the proposed project would create a significant risk during ammonia transport, mainly in the greater Phoenix area.

The risk analysis only evaluates the risks associated with aqueous ammonia transportation directly related to the project. It does not evaluate the transportation of ammonia to regional suppliers, nor does it consider cumulative risks associated with other recently proposed and/or approved projects.

In order to reduce the potential risks associated with the proposed project, the following safety measures should be implemented:

- Require the Applicant to implement a driver hiring and training -- reduces the accident rate by 30 percent and the spill rate by 20 percent.

- Require the Applicant to implement a truck inspection and maintenance program -- reduces the accident rate by 10 percent.

- Require the Applicant to transport ammonia only during weekend and holiday daylight hours --reduces the number of people potentially exposed by about 75 percent along the transportation routes. However, a larger storage capacity might be required at the La Paz facility because the weekend delivery volume would have to be roughly doubled. Alternatively, half of the loads could be delivered on weekend days and the other half on weekday mid-days when traffic is light.

- Require the Applicant to use MC-331 trucks -- reduces the frequency of large spills by 50 percent and small spills by 17 percent.

Alternatively, the CEC should encourage the Applicant to consider alternatives to aqueous ammonia, either through alternative emission control technologies, such as SCONOx, or through alternative ammonia technologies. SCONOx does not require the use of ammonia, thereby avoiding all risk associated with ammonia transportation. Alternative ammonia technologies, such as an "Ammonia on Demand" system, uses urea to generate ammonia onsite. Urea is shipped as a solid and would not pose any substantial risk to the public in the event of a truck accident or accidental spill.

II.A Transportation Risk Analysis Methods

Significance thresholds have been developed by other regulatory agencies to define the severity of potential ammonia hazards. The California Energy Commission (CEC) staff use significance thresholds for hazardous materials of one in 100,000 for 10 exposed individuals and of one in 1,000,000 for 100 exposed individuals. In other words, if an accident occurs that has a probability of occurrence of greater than one in 100,000 and it exposes 10 or more individuals to significant concentrations of ammonia, that accident is considered to be significant. Similarly, if an accident occurs that has a probability of occurrence greater than one in 1,000,000 and it exposes 100 or more individuals to significant concentrations, it too is significant. The following data shows the ammonia concentration values that the staff uses and corresponding exposure durations to establish significance for three categories of consequences – injury, serious injury and fatality.

Consequence	*Concentration (ppm)*	*Exposure Duration (min)*
Injury	75	30
Serious Injury	200	60
Fatality	2000	30

These concentrations represent the lower threshold concentration for each consequence category. The 75 ppm injury threshold is used by CEC staff to represent potentially significant impacts if the probability exceeds one in 100,000 for 10 exposures and one in 1,000,000 for one exposure. Given the potentially long duration associated with an aqueous ammonia spill, the fatality level was modeled using a 60-minute exposure at a concentration of 1,000 ppm, which is also equivalent to the ERPG-3 level.

Therefore, to evaluate whether an ammonia transportation risk is significant, one must estimate two numbers: 1) the probability that a consequence (e.g., injury or fatality) will occur from a transportation accident and 2) the number of individuals that will be exposed to ammonia concentrations that exceed staff's significance levels under such accidents.

These two numbers were calculated using the standard procedures described in the Guidelines for Chemical Transportation Risk Analysis (CCPS, 1995). The first number, the probability that an incident outcome (i.e., a fatality or injury) will occur is given by:

$$F_{g,i,k} = T \cdot A \cdot R_i \cdot L_g \cdot P_{i,k} \quad (1)$$

where:

$F_{g,i,k}$ = frequency of incident outcome k for release size i on segment g
T = trips per year
A = accident rate per mile

R_i = release probability for release size i
L_g = length of segment g in miles
$P_{i,k}$ = probability of incident outcome k for release size i
g = segment counter
i = release size counter
k = incident outcome counter

The second number, the associated consequences or number of persons exposed, is given by:

$$N_{g,i,k} = CA_{i,k} \cdot PD_g \cdot PF_{i,k} \quad (2)$$

where:

$N_{g,i,k}$ = number of fatalities (or injuries) for incident outcome k for release size i on segment g
$CA_{I,k}$ = consequence area associated with incident outcome k for release size i
PD_g = population density for segment g
$PF_{I,k}$ = probability of injury/fatality for incident outcome k for release size i
g = segment counter
i = release size counter
k = incident outcome counter

The following sections discuss each input variable used in this analysis for deriving these two equations and the result of the analysis. (These two equations are referred to below as Equation One and Equation Two.)

II.A.1 Trips Per Year (Eq. 1, T)

The first variable ("T") in Equation One requires an estimate of the number of ammonia delivery trips per year to the Project site. The Project would require annually 150 tanker deliveries of 7,500 gallons for 19% aqueous ammonia. Risk estimates are based on one-way trips only, when the tanker truck would be fully loaded. Return trips, when trucks would be empty, were not considered in the analysis.

II.A.2 Truck Accident Rates Per Mile (Eq. 1, A)

Route-specific accident rates for each of the seven segments of the ammonia route were developed on an annual basis in units of truck accidents per truck miles.

Information on both truck traffic and truck accidents is available from the Center for Chemical Process Safety (CCPS of the American Institute of Chemical Engineers (AIChE). Truck accident rates and spill probabilities are provides in the CCPS "Guidelines for Chemical Transportation Risk Analysis."

In our analysis, the proposed route was broken down by individual highway. Information provided by the CCPS database was detailed enough to further break down each highway by individual land use and population density.

When merging the accident rate segments with the population density survey, there were times when the land use did not change, but the accident rate did. In this case a weighted average was calculated for that segment based on the two different accident rates and the length of the segment. This rate was then applied to only that one segment. Table 1 provides the route-specific accident rates for each segment.

Table 1 Transportation Route Accident Rates

Segment	Route	Length (miles) L_g	Accident Rate (mile-year) A	Accident Probability (per year) $P_{i,k}$	Population Density (per sq.mi.) PD_g
A	Local Roads	0.4	1.39E-05	5.57E-06	10,000
B	SR-87	5.0	2.18E-06	1.09E-05	10,000
C	U.S. 60 to I-10	7.0	2.18E-06	1.53E-05	10,000
D	I-10 Urban	28.0	2.18E-06	6.10E-05	10,000
E	I-10 Suburban	13.0	2.18E-06	2.83E-05	5,000
F	I-10 Rural	44.0	2.15E-06	9.46E-05	3,000
G	Avenue 75	1.0	2.19E-06	2.19E-06	1,000

II.A.3 Release Probability (Eq. 1, R_i)

The next step for Equation One was to estimate the probability that a transportation accident would result in a release of ammonia. We made this estimate based upon a review of two major sources of data on hazardous material accidents.

The first source reviewed was a study of hazardous material accidents on highways over the five-year period, 1981 through 1985, done by MRI (Midwest Research Institute). This study concluded that, based on truck accidents reported to the Bureau of Motor Carrier Safety (BMCS) of the Federal Highway Administration, 15.2 percent of accidents involving hazardous material-carrying vehicles resulted in a release. Accidents involving tank trucks resulted in releases 16.6 percent of the time based on 1984-1985 BMCS-reported accident data.

The second source reviewed was data reported during the eleven-year period 1976 through 1986, by the Hazardous Materials Information System of the Department of Transportation. During this time, 1,154 releases of gasoline occurred on the highway due to accidents, or an average of 105 per year. Most of these accidents are assumed to have involved MC-306 trucks, although some may have been MC-307 trucks. The distribution of these releases by size indicates that small releases (1-1,000 gallons) account for 35 percent of all spills; and large releases (> 1,000 gallons) account for 65 percent of all spills. The relatively low number of small releases is likely the result of underreporting of such incidents.

Accordingly, for purposes of this analysis, we assumed that the total conditional spill probability for MC-306 tank trucks, given an accident involving a loaded truck, is equal to 16 percent. The conditional release probability for small spills is taken as 9 percent, and for large spills, 7 percent for MC-306 trucks.

We used the MC-306 truck release probabilities to develop an assumption for MC-307 tank trucks, the trucks that Applicant proposes to use. The release probability for MC-307 trucks is less than for MC-306 trucks since tank trucks constructed to the MC-307 specifications generally have thicker tank shells and heads to provide the required strength for 25 psig internal working pressures. (The MC-306 specification requires only that the shell and head be constructed to withstand the fully loaded static pressure head.) Accordingly, the resistance to external punctures, shell failures, etc. of the MC-307 is expected to be greater than for the MC-306. Other specifications, which relate to valves, fittings, closures, piping, etc., are similar for these two tank specifications.

Based on these differences in tank construction, we assumed that the release probability for large spills was 5 percent for the MC-307 tank truck and 9 percent for small spills, although small spills were not included in the risk analysis due to the relatively low risk associated with small aqueous ammonia spills.

II.A.4 Segments of the Proposed Route and Associated Lengths (Eq. 1, L_g)

Equation One requires that the route be divided into segments and the length specified for each segment. Figure 1 shows the ammonia delivery route for this Project. The proposed route shown in Figure 1 was divided into seven segments (A through G) based on road type and population density characteristics. Table 1 sets forth the assumed length and characteristics of each segment.

The transportation analysis was performed for each route segment *g*. We evaluated the entire route, from Phoenix, where a majority of the State's aqueous ammonia supply originates, to the project site. Alternative routes and suppliers were not explicitly evaluated since most of the ammonia supplied to the project site would result in additional ammonia transportation from Phoenix to the supplier's location. In many cases, this would involve the transport of anhydrous ammonia between California and a supplier, where the aqueous ammonia would be produced.

II.A.5 Conditional Probabilities (Eq. 1, $P_{i,k}$; Eq. 2, $PF_{i,k}$)

Conditional probabilities are included in the risk analysis to define the probability of an incident outcome (i.e., an injury or fatality) given an exposure to ammonia at levels equal to or greater than the exposure criteria. Generally, not all individuals would experience the same health effect at the same concentration or, in other words, not all individuals would be injured or die if exposed to the injury and fatality levels as defined in Section 1.0. In addition, not all individuals would remain in the area of an accidental release long enough to receive the full dosage necessary to experience adverse health effects. Therefore, it was assumed in this analysis that only 10 percent of the potentially exposed population would actually experience the adverse health effect as defined by the three exposure criteria for injury, serious injury and fatality.

II.A.6 Population Densities (Eq. 2, PD_g)

Table 1 summarizes the population densities applied in this analysis. A population density of 10,000 per square mile was assumed for two segments (A through D) and a population density of 1,000 per square mile was assumed for segments F and G. We assumed a population density of 3,000 per square mile for the remaining four segments.

While a release at any one point may involve a density somewhat different than that shown, these values represent reasonable expected conditions. Moreover, they have been applied uniformly across the various routes evaluated. The population on the roadways (in transit) is included in these categories since such population could not reliably be addressed separately. The following discussion explains how each of these densities was derived.

Each route segment was characterized not only by its length and applicable accident rate, but also in terms of the surrounding population and their activities. The general categories were:

Commercial
Residential
Mixed use
Industrial
Rural/Farm
Recreational
Unpopulated

Only one category was assigned per segment based on a weighted average of the population density for each category. Specific population densities were then assigned to each category based on 2000 U.S. Census data.

The high level for commercial, residential and mixed uses was set at 10,000 people per square mile based on statistics for California. While this does not represent the absolute maximum possible density, it does represent a reasonable maximum over a 24-hour period and for any significant distance. Moreover, if the higher density is due to numbers of high-rise apartment or office building, not all levels will necessarily be impacted by an accident at or near ground level (i.e., elevated highway).

The medium value of 3,000 in residential areas was increased to 5,000 in commercial areas to account for the increased density possible in office settings instead of homes, as a result of the smaller space requirements per person and a greater density of buildings themselves.

Industrial areas generally have more open space surrounding buildings, and involve one- or two-story buildings. As a result, they were assigned a density of 2,000 per square mile - midway between the low and medium values for mixed use or residential.

Unpopulated areas were given a density of five people per square mile, to account for potential motorist population on the roadway. Recreational areas may see great variability in their population levels, depending on the season, the weather, the time of day, and whether it is a weekday or weekend. An average of 100 people per square mile has been used.

II.A.7 Consequence Area (Eq. 2, $CA_{i,k}$)

When a spill occurs, the ammonia vapors travel away from the accident site and mix with surrounding air. This process is referred to as "dispersion," and the area occupied by the resulting plume is estimated with a dispersion model. The SLAB dispersion model developed by Lawrence Livermore National Laboratory (Ermak, 1989) was used to estimate the "consequence area," or the area affected by a spill. This model is widely used for consequence analyses, is available in the public domain, has been subjected to scientific peer review, and has been verified in several field experiments. A number of input variables are required to run this model, including spill characteristics, meteorological conditions, size of spill, and ammonia significance concentrations. Each of these variables is discussed below.

Spill Characteristics

The spill characteristics include release rate, spill area and spill temperature. Arthur D. Little's SuperChems™ model was used to estimate aqueous ammonia spill characteristics. This SuperChems™ spill model was used to calculate a time dependent solution of the evaporation/boiling rate of liquid pools spreading symmetrically on flat surfaces. The spreading is based on conservation equations for incompressible fluid flow. Initially, the flow is dominated by gravity effects and at later stages by gravity-viscous effects. A heat balance is solved simultaneously with the spreading liquid to calculate pool temperature and liquid regression rate. The heat balance takes into account evaporative cooling, ground conduction, solar radiation, etc. The model also accepts time dependent volumetric flow rates, diking information, multicomponent spills and chemical reactions. The model was run to determine spill characteristics for a 19% aqueous ammonia solution.

Meteorological Conditions

The dispersion of ammonia is controlled by wind speed and atmospheric stability. These variables are inputs to the SLAB dispersion model discussed in Section 1.7. Meteorological data from the onsite monitoring station was used for the analysis.

Size of Spill

In evaluating the consequences of an aqueous ammonia spill, only large spills were considered in the modeling analysis for the meteorological conditions presented above. Therefore, it was assumed that the complete contents of the truck (7,500 gallons) would be lost over a 10-minute period following an accident. As noted previously, the probability of an accidental spill was adjusted to reflect only large spills. Small spills were excluded from the analysis based on the low consequences and risk associated with small spills of aqueous ammonia.

II.B Ammonia Significance Concentrations

The affected area varies, depending on the concentration of ammonia (e.g., ppm). As noted earlier, we analyzed three types of consequences (injury, serious injury and fatality) based on three different concentration levels (75, 200, and 1,000 ppm, respectively). Our analysis likewise reviewed three different concentration levels. Given the potentially long duration associated with an aqueous ammonia spill, the fatality level was modeled using a 60-minute exposure at a concentration of 1,000 ppm, which is also equivalent to the ERPG-3 level.

II.C Area Affected By Release

The area that would be affected by an ammonia release, based on the SLAB modeling, is summarized in Table 2. The results are expressed in terms of downwind distance to a given concentration and the area of the plume that would exceed a given concentration over the corresponding averaging time.

Table 2 Modeling Results for 19 percent Aqueous Ammonia

		75 ppm		*200 ppm*		*1000 ppm*	
Scenario (Stability/WS)	*Frequency (percent)*	*Distance (m)*	*Area (m^2)*	*Distance (m)*	*Area (m^2)*	*Distance (m)*	*Area (m^2)*
A2	3.46	298	4.02E+04	142	1.32E+04	0	0.00E+00
B2	6.62	556	8.13E+04	277	2.82E+04	66	2.94E+03
C3	12.75	745	1.03E+05	398	4.16E+04	140	8.56E+03
D3	41.11	900	1.14E+05	445	3.95E+04	102	4.69E+03
E2	27.27	980	1.21E+05	492	4.58E+04	160	9.91E+03
F1	8.79	2,463	3.68E+05	1,023	1.02E+05	264	1.56E+04

II.D Risk Analysis Results

Based on our analysis, we present below three separate risk profiles. These three profiles illustrate societal risk from ammonia transportation associated with the project for three types of consequences: injury (based on the criterion of 75 ppm), serious injury (based on the criterion of 200 ppm), and fatality (based on the criterion of 2000 ppm, modeled as 1,000 ppm over 1 hour). The results of the risk analysis are plotted in Figures 2 through 4. (These figures plot the number of injuries, or $N_{g,i,k}$ calculated from Equation Two, versus the probability that the accident will exceed a given ammonia significance threshold (Sec. Section 1.7.4), e.g., the probability of injury or $F_{g,I,k}$, calculated from Equation One.)

In evaluating the results of this risk analysis, we have reviewed both the exposure criteria typically used by the CEC staff as well as criteria used elsewhere.

As noted at the beginning of this Appendix, two exposure criteria to establish the potential significance of risk:

- A threshold of 1 in 100,000 for a risk of 10 exposures to the threshold of 75 ppm ammonia.

- A threshold of 1 in 1,000,000 for a risk of 100 exposures to the threshold of 75 ppm ammonia.

Internationally, several governments have developed risk acceptability criteria. The United Kingdom Health and Safety Executive (UK HSE) and Netherlands Government have established risk guidelines and thresholds. These guidelines are generally accepted throughout the European Union. These guidelines have also been accepted by several U.S. governmental agencies such as the California Coastal Commission, California State Lands Commission, Santa Barbara County, and the South Coast Air Quality Management District. The risk profiles of ammonia transportation for the La Paz project have been plotted against these guidelines, referred to as the "Societal Risk Guidelines", resulting in three risk regions. The first region is "De Manifestis," defined as an area of unacceptable risk. Risk in the De Manifestis area must be mitigated, under the Societal Risk Guidelines. The second region is the "Grey Region," where mitigation is required, based upon economic considerations. The third region is "De Minimis," where the risk is considered to be acceptable without mitigation. These bands are shown on all risk profile figures.

As shown in Figure 2, the risk associated with ammonia transportation from the La Paz project would be considered significant and unacceptable under the Societal Risk Guidelines summarized above.

Figure 3 also indicates that La Paz project ammonia transportation risks would be considered significant for serious injuries. Under the Societal Risk Guidelines, additional mitigation should be implemented.

Finally, Figure 4 also indicates that La Paz project ammonia transportation risks would be considered significant for fatalities under the Societal Risk Guidelines and would require additional mitigation to avoid potential fatalities. Given the relatively low volatility of aqueous ammonia, the formation of a large vapor cloud with concentrations exceeding fatality levels is rare, as demonstrated by the fatality risk profiles.

II.E Potential Measures to Reduce the Risks of Ammonia Transportation Accidents

This section discuses six measures that could be used to mitigate the risks identified in Section 2.0. These measures were quantitatively analyzed to determine their impact on the risks calculated in Section 2.0.

Although the CEC does not have direct jurisdiction over some of the mitigation measures that we discuss below, it can require that the Applicant review and audit the policies, practices, accident histories, and safety records of potential carriers and their drivers and select a supplier based on its record. Annual audits should also be required.

The six different mitigation measures that were quantitatively evaluated are:

- Improved Driving Hiring and Training,
- Improved Inspection and Maintenance,
- Weekend/Daytime Deliveries Only,
- Measures to Improve Trailer Design,
- Use of MC-331 Tank Trucks,
- Improved Emergency Responses.

Table 4 lists these six measures, identifies the parameters in Equations One and Two affected by each measure, and indicates the percent reduction in each parameter for each measure. Each of these mitigation measures is discussed below.

II.E.1 Measures to Improve Driver Hiring and Training

The truck carriers in their roles can implement a number of potential risk mitigation measures in planning their trucking operations and in hiring and training drivers. The Applicant can in turn impose contractual conditions and requirements on the carrier or ammonia supplier. These measures include, as examples, strict hiring policies, driver training programs for familiarization with both the vehicles and the routing, programs to prevent drug use or alcohol abuse, and an on-board vehicle management system (VMS).

The importance of the driver in safe transport operations is clear: over 60 percent of truck accidents, according to the most recent study by the Office of Technology Assessment are due to human error. Specific programs for hiring and training drivers have been developed and used by several trucking companies, both large and small. One example outlines the hiring approach and the scope of a training program of a major hazardous material and bulk transportation company. This company has generally experienced truck accident rates substantially below (about one-half) the national average.

Table 4 Quantification of Risk Reducing Measures

	Risk Reducing Measure	Parameter Impacted	Percent Reduction
A.	Improved Driver Hiring and Training	• Accident Rate • Likelihood of a release given an accident.	30% 20%
B.	Improved Inspection and Maintenance	• Accident Rate	10%
C.	Weekend/Daytime Deliveries Only	• Number of People Exposed	75%
D.	Use of MC-331 Tank Trucks	• Frequency of Large Spills • Frequency of Small Spills	50% 17%
E.	Improved Emergency Response	--	--

Another hiring process, which has been tested at several trucking companies, is the Henken Safety Evaluation Technique developed by Dr. Bernard Henken. This approach, based on personality profiles, is potentially applicable as both a diagnostic and therapeutic tool, aimed at weeding out unsafe drivers. At one of the test companies, accidents have reportedly been reduced by 75 percent over an eleven-year period. Currently, most companies are using the Department of Transportation (DOT) guidelines for hiring which do not require a rigorous screening of drivers.

Similarly, the California Fertilizer Association ("CFA") has implemented an anhydrous ammonia transportation safety program. The program trains and certifies driver to safely transport anhydrous ammonia. Most major anhydrous ammonia distributors and local suppliers in California currently only hire certified carriers. The program is voluntary and is less common for aqueous ammonia. Therefore, requiring only CFA-certified carriers could reduce the risks of transporting aqueous ammonia to the project site.

Familiarization with the vehicle and with the transportation routings provides information on handling of specific truck and trailer types and with specific routes and their alternatives, high risk segments, and safe parking areas for rest, fuel or food stops. Because of their size and relatively high center-of-gravity, aqueous ammonia trailers require careful handling at turns and ramps to prevent overturning accidents, as an example. This information and behavior can best be learned "hands on" during a training and indoctrination period with an accompanying experienced driver.

A vehicle management system (VMS) monitors the truck speed, and together with appropriate speed limit policies by the truck carrier, can be an important measure to reduce the accident frequency and the likelihood of a release, given an accident. For example, one study showed that 14 percent of truck accidents involved excessive speed as a primary cause.

Overall, based on the percentage of accidents due to poor driver training, our estimate is that appropriate hiring and training programs and installation of a VMS would reduce the likelihood of highway accidents by as much as 30 percent compared to national truck/trailer accident rates. The likelihood of releases, given an accident, would be reduced by as much as 20 percent based on the distribution of accidents associated with poor driving.

II.E.2 Measures to Improve Inspection and Maintenance

Increases in truck inspections and improved maintenance procedures by truck carriers are measures that can significantly reduce the likelihood of highway accidents. Truck inspection and accident data compiled over a ten-year period (1976-1985) by the California Highway Patrol indicates a strong inverse relationship between inspections and accidents. Inspections for the 1976-1979 period averaged 27 per million vehicle miles while truck-at-fault accidents averaged 86 per 100 million miles during this period. For the 1980-1985 period, inspections increased to an average of 37 per million miles (a 37 percent increase), while accidents decreased to 59 per 100 million miles (a 31 percent decrease).

Similar results would be reasonable to expect from improved and more frequent inspection and maintenance procedures by the carrier. Additional benefits would result from requiring visual inspection of trucks and tanks by the shipper prior to loading. The visual inspection would include checking for leaky valves, corrosion on tanks, dents or cracks on tank, etc.

Overall, based on the percentage of accidents that result from poor truck maintenance, our estimate is that a thorough and timely inspection/maintenance program for the critical truck safety and operations systems would reduce the frequency of truck-at-fault accidents by 30 percent, and the overall accident rate by 10 percent.

II.E.3 Measures to Restrict Deliveries to Weekends and Daytimes

An evaluation of the data used to construct the risk profiles presented in Figures 2 through 4 shows that a majority of the risk associated with aqueous ammonia transportation occurs in the Phoenix area during periods of poor dispersion (i.e., E and F stability classes which typically occur at night).

Modifying the route to avoid high-density areas and modifying the delivery time to avoid times when sensitive receptors are present or traffic is heavy can reduce population exposures. It is quite possible to modify project routes and deliveries to minimize the probability of potential accidents, as well as the population that would be exposed in the event of an accident. The vicinity of the ammonia supplier experiences substantially differing population densities between holidays, weekdays, weekdays off hours, and weekends. Daytime weekend and holiday ammonia deliveries would substantially reduce potential exposure to the surrounding population by more than 90 percent.

II.E.4 Use of MC-331 Tank Trucks

Accident consequences can be reduced by specifying a more rugged truck than the minimum required by law for aqueous ammonia. Tanks on trucks are designed to meet specifications issued in 49 Code of Federal Regulations (CFR). Aqueous ammonia is often transported in MC-307 tanks, while anhydrous ammonia is typically transported in MC-331 tanks. For the reasons discussed below, I recommend that this be upgraded to an MC-331.

MC-307 tank trucks typically have an 8,000-gallon capacity tank and are made out of aluminum steel or stainless. The MC-331 type containers, on the other hand, are designed for moving anhydrous ammonia. These tanks have greater wall thickness to accommodate the higher vapor pressures associated with anhydrous ammonia. This measure has the potential to reduce the likelihood of a spill given an accident since the MC-331 truck is considerably stronger than the MC-307 currently used to move aqueous ammonia.

This risk reducing measure is projected to reduce the likelihood of both small and large spills of aqueous ammonia given that an accident has occurred. Based upon historical accident data involving releases from MC-331s and MC-307s , it is projected that the probability of a small spill would be reduced by 17 percent, and the probability of a large spill would be reduced by 50 percent.

II.E.5 Measures to Improve Emergency Response

Improved communication between the truck and the dispatch center can result in quicker response to an emergency. This can reduce the severity of the consequences of a release and can also help in evacuation of people, if needed, on a timely basis. (However, many of the events analyzed in this study do not provide adequate time for effective response.)

Methods are now feasible for providing such improvements in communications by satellite-based systems. The Geostar system, for example, is currently operational and technologically feasible for use in transport systems. Another system, currently being developed under funding by the Gas Research Institute and NASA, is primarily focused on real-time detection of pipeline leaks and monitoring of rights-of-way, but could likely be utilized in a highway or rail transport system. Carriers that use these types of systems should be given priority over those who do not.

The effectiveness of such a measure is difficult to quantify, but clearly would be potentially beneficial in reducing the consequences of major release accidents, and in providing emergency response information in the shortest possible time. However, for this analysis no reduction in risk was quantified.

II.F Results of the Mitigated Risk Assessment

In estimating the effect of the various mitigation measures described above on ammonia transportation risk, the effect of each measure on various model inputs was determined and is listed in Table 5. The computer models were then rerun to estimate the absolute values of risk assuming the various mitigation measures. These new risk values were then compared with the base case risk values discussed in Section 2.0 to determine the relative changes in risk. While the absolute values of risk represent very conservative estimates, the relative risks are considered to be more reliable estimate of risk reduction.

The following summarizes the four mitigation measures quantitatively analyzed and the resulting impact on risk:

- Improved hiring and training -- reduces the accident rate by 30 percent and the spill rate by 20 percent.

- Increased inspections and maintenance -- reduces the accident rate by 10 percent.

- Transport only during weekend and holiday daylight hours --reduces the number of people potentially exposed by about 75 percent along the transportation routes. However, a larger storage capacity would be required at the La Paz facility because the weekend delivery volume would have to be roughly doubled. Alternatively, half of the loads could be delivered on weekend days and the other half on weekday mid-days when traffic is light.

- Using MC-331 trucks -- reduces the frequency of large spills by 50 percent and small spills by 17 percent.

Figures 5 and 6 show the effectiveness of the five risk reduction measures summarized above. Adoption of the five measures would certainly reduce risk significantly. However, as shown in Figure 5, even if all five risk reductions are adopted, the risk associated with ammonia transportation would still be significant, based on the Societal Risk Guidelines: Under the Societal Risk Guidelines, the risk would still be in the "Grey Region" which would indicate that additional mitigation should be implemented if possible. However, if additional mitigation cannot be identified, potential impacts would be considered acceptable. This would imply that all four risk reduction measures would need to be implemented.

No risk profile has been presented for fatalities, since under the mitigated scenario, no fatalities were projected to occur (i.e., the risk model only calculated a fraction of an individual fatality). While fatalities are still possible under the mitigated scenario, the probability of a fatality is lower than the criteria used to classify risk (i.e., the expected number of affected individuals is well less than one).

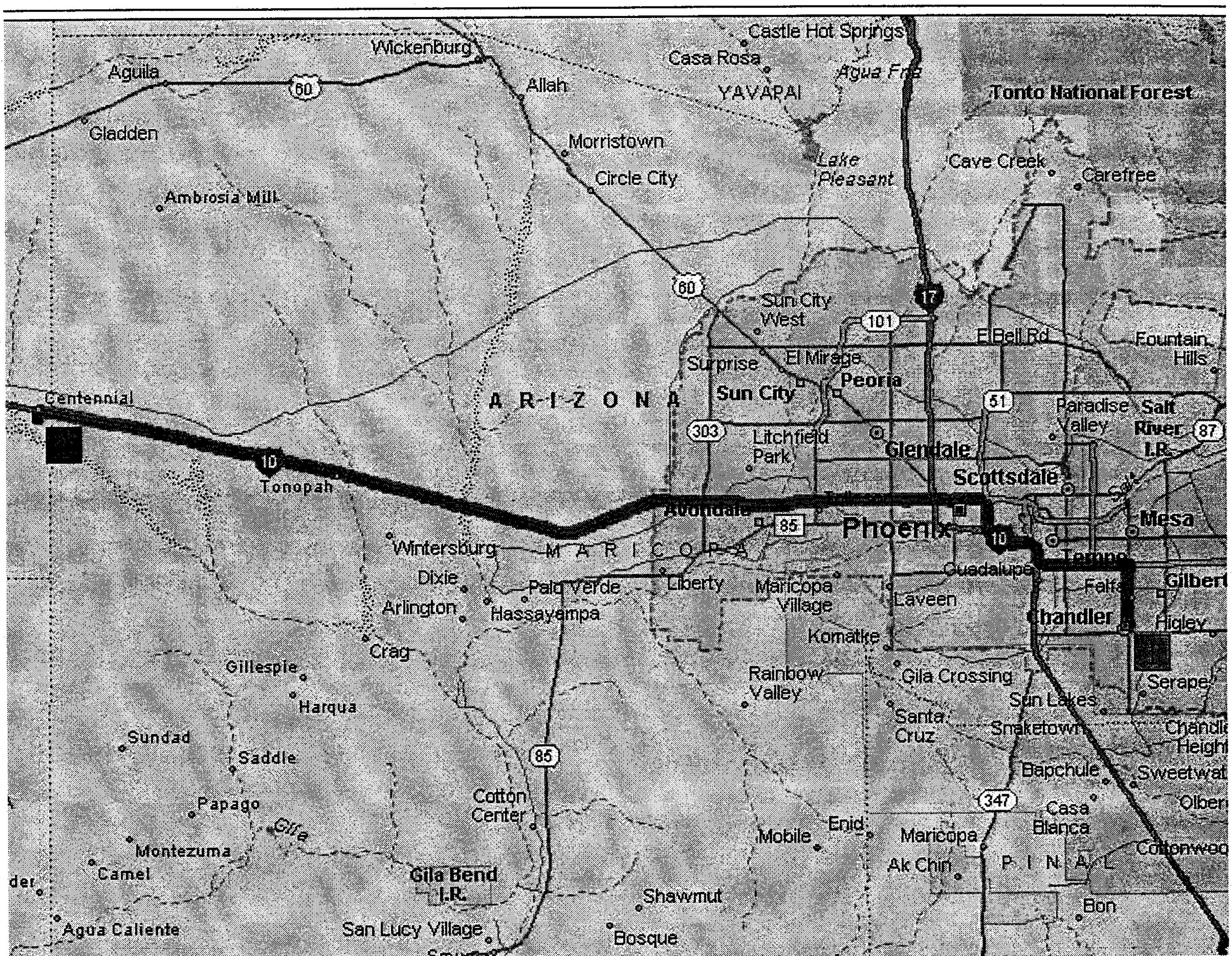


Figure 1 Aqueous Ammonia Delivery Route

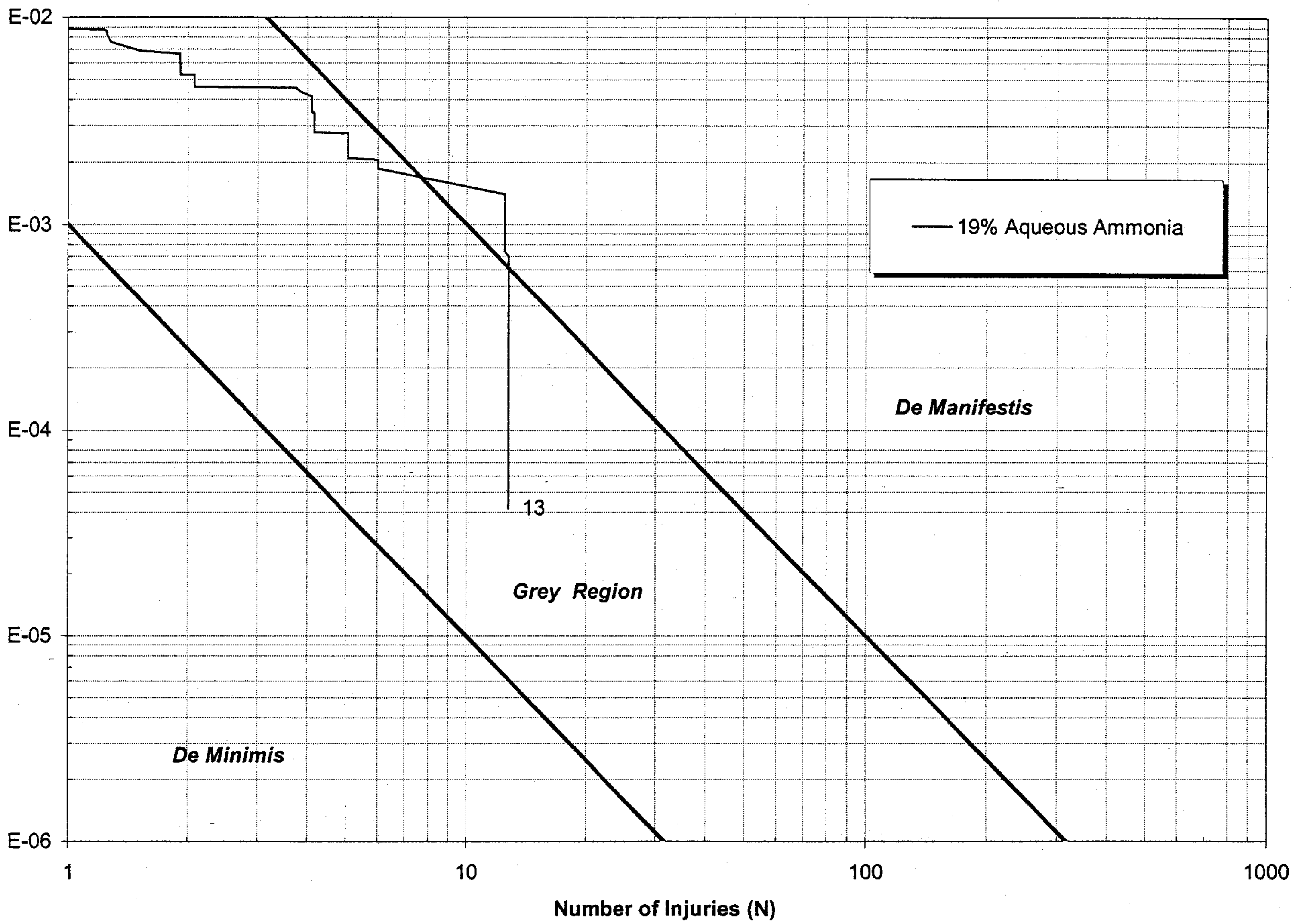


Figure 2 Transportation Injury Risk Profile (75 ppm Criteria)

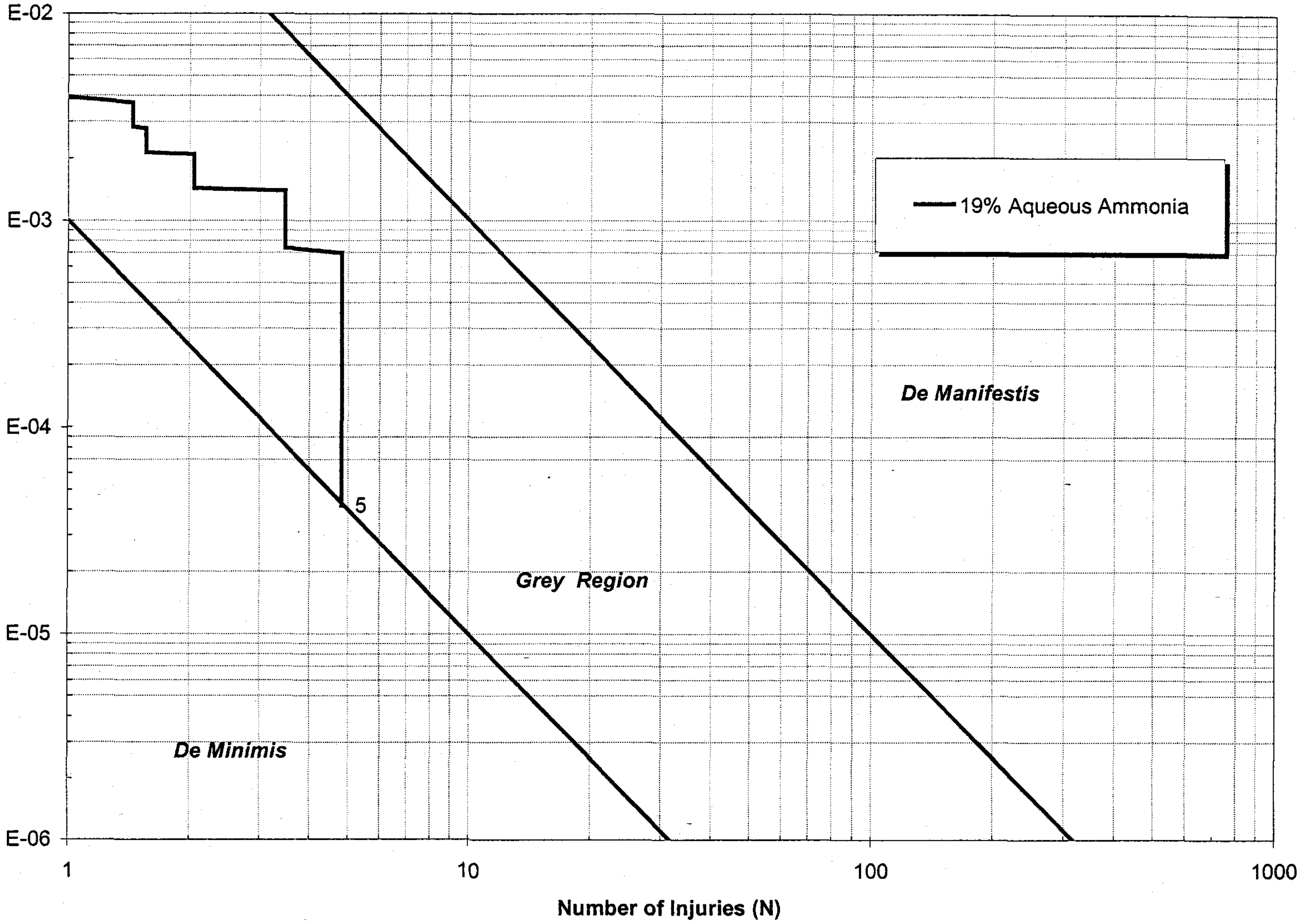


Figure 3 Transportation Serious Injury Risk Profile

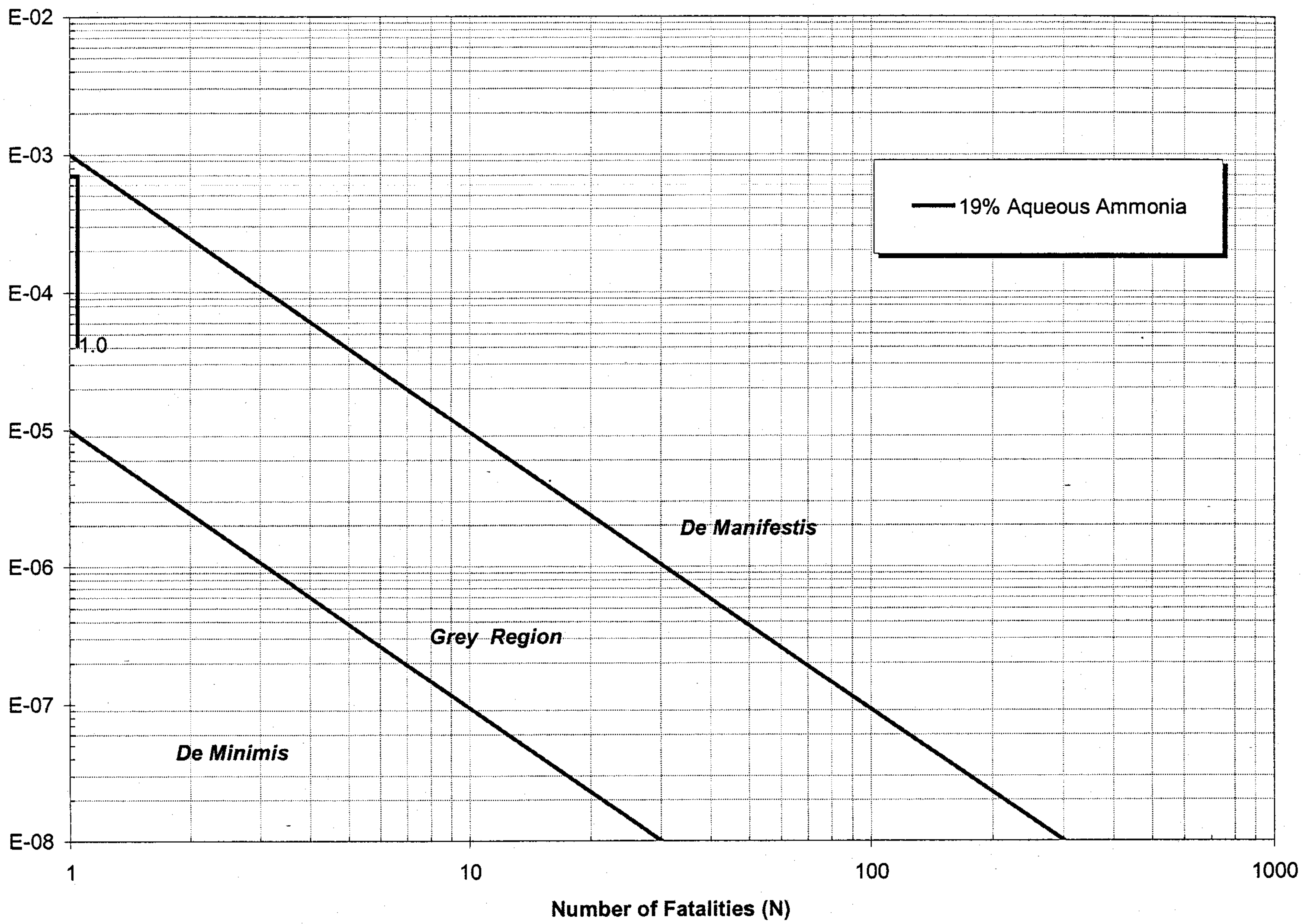


Figure 4 Transportation Fatality Risk Profile

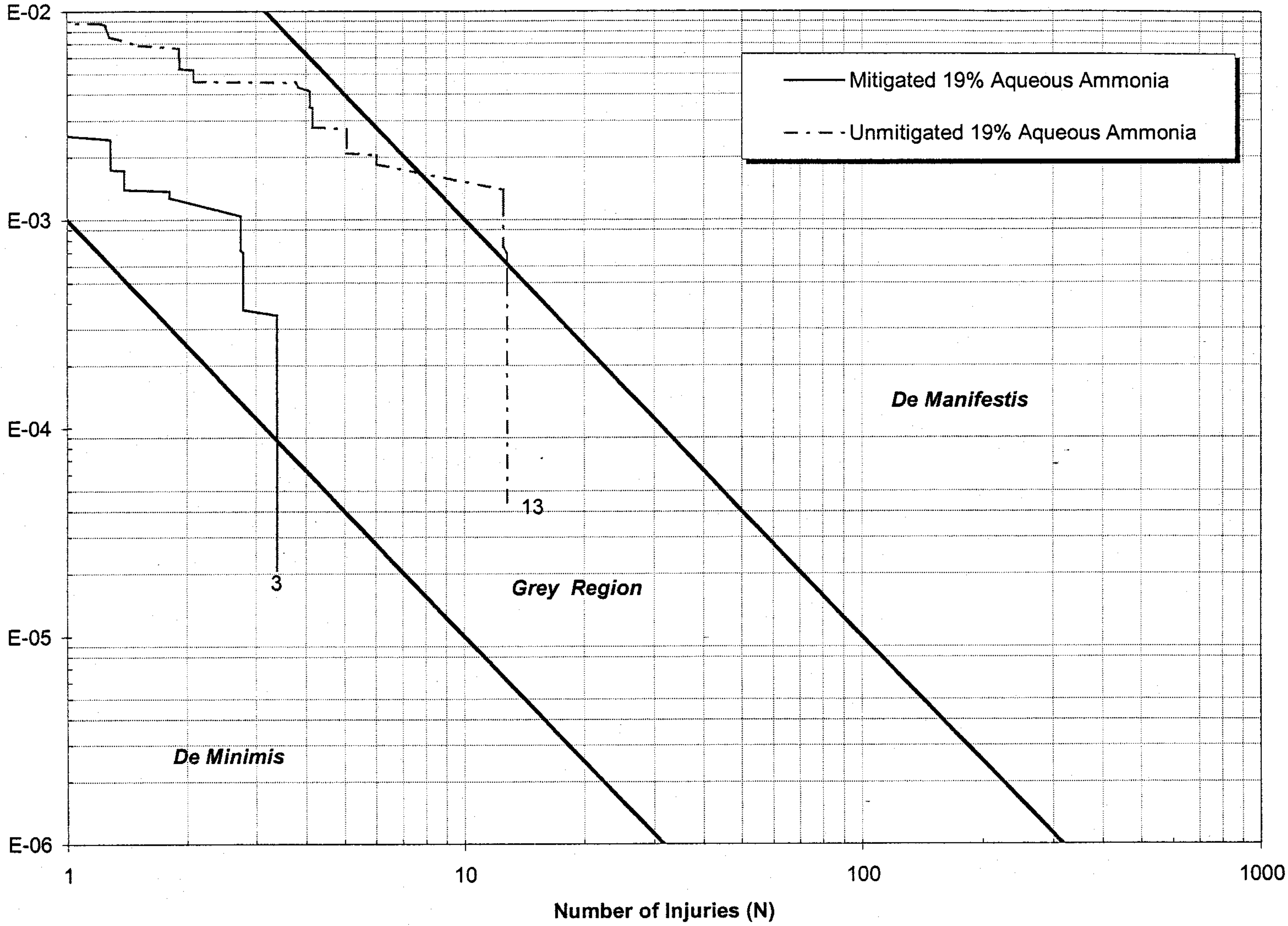


Figure 5 Mitigated Transportation Injury Risk Profile (75 ppm Criteria)

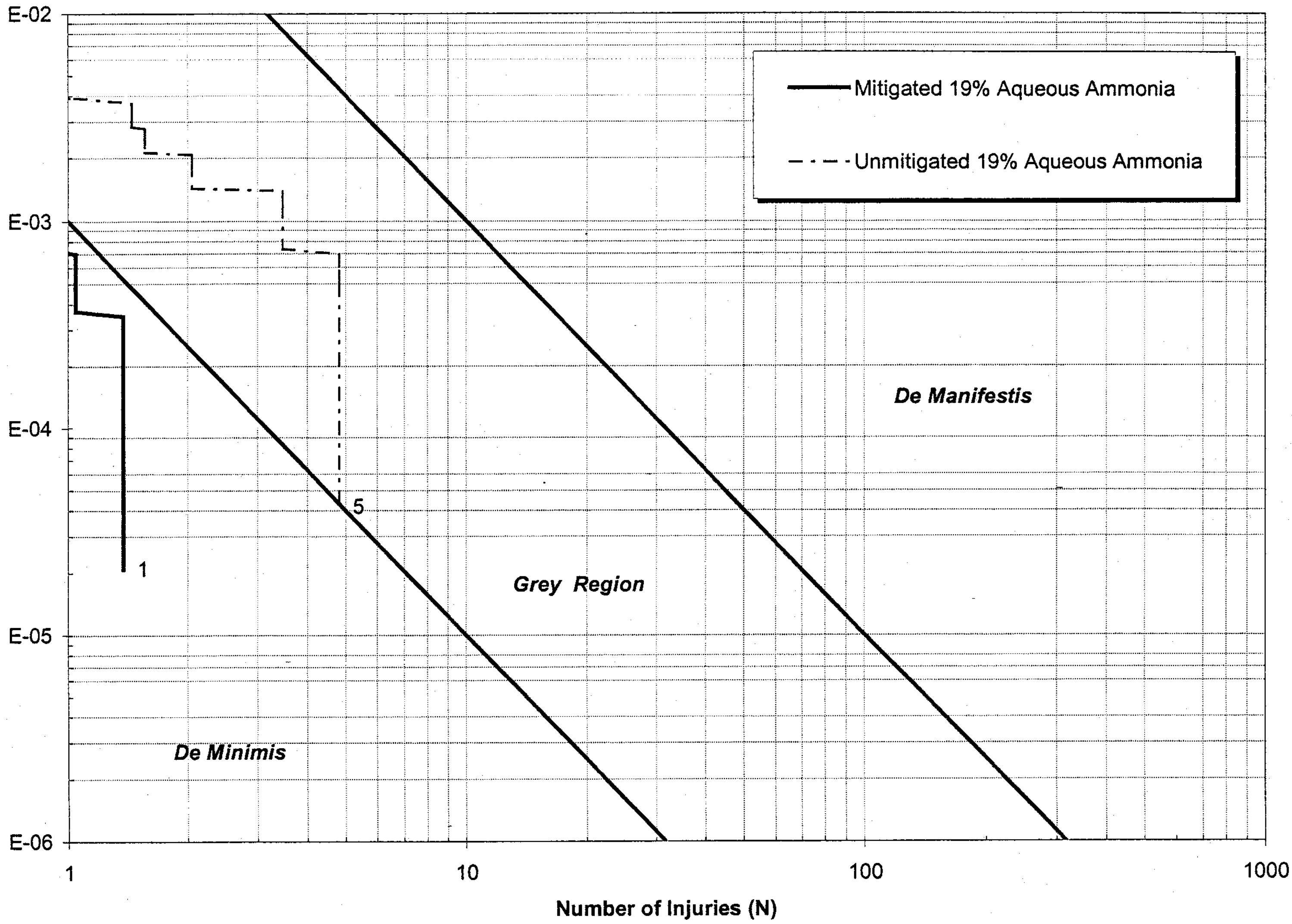


Figure 6 Mitigated Transportation Serious Injury Risk Profile

III. Proposed La Paz Project Ammonia Storage Facilities May Pose a Significant Risk

The Applicant has indicated that they intend to utilize two 12,000 gallon ammonia storage tanks. These vessels would be surrounded by a containment dike "....of adequate height to contain 15% of the volume of the tank(s)." (Allegheny Response to AZURE Data Request 37.) This containment system is not adequate to protect the public in the event of an accidental spill from the ammonia storage tanks and is not consistent with existing codes regarding the containment of hazardous materials.

Several measures can be implemented to reduce the risk associated with the storage of aqueous ammonia as discussed in the following sections.

III.A Buried Ammonia Storage Tank

A subsurface ammonia storage tank would essentially eliminate the risk associated with an ammonia storage vessel failure. First, subsurface soil temperatures surrounding the underground storage tank would keep aqueous ammonia temperatures relatively cool, even during periods of hot weather. This ability to keep temperatures cool would significantly reduce the aqueous ammonia vapor pressure. Small releases would be detected by a leak detection system, thus minimizing the potential for a larger release. Routine maintenance and internal inspection would detect vessel corrosion and integrity problems. Second, the likelihood of a catastrophic release would be minimized since the surrounding soil would effectively protect the vessel from external forces, such as projectiles. Third, the surrounding soil would absorb any released ammonia, preventing its release into the atmosphere.

Overall, the consequences associated with a vessel failure would be reduced by more than 90 percent due to reductions in aqueous ammonia vapor pressure and decreases in the volume of ammonia that would reach the atmosphere. The probability of a large release would also be reduced due to protection from external forces.

III.B Improved Ammonia Vessel Design

The Applicant proposes to use a single-walled vessel. One measure that could be taken to nearly eliminate potential releases from the storage vessel would be to use a double-walled vessel. The effectiveness of double-walled containment is well known and has been demonstrated to significantly reduce the probably of an accidental release. Typically, sensors are placed in the annular space between the inner and outer shells of the double-walled vessel to detect leaks in the inner shell. Further, double-walled containment has been required for several recently licensed projects in California, including the Sutter, Delta, Pastoria, Los Medanos, and High Desert powerplants.

The use of a double-walled vessel would effectively reduce the probability of a release by the square of the single-walled failure rate for most release events (e.g., corrosion, material defect, etc.), since a failure of one wall would not result in a release. A double-walled vessel also significantly reduces potential failures due to external forces. Overall, the failure rate for a double-walled vessel would be approximately three orders of magnitude lower than for a single-walled vessel based on the near elimination in the failure modes noted above and a significant reduction in damage due to an external event.

III.C Improved Ammonia Vessel Enclosure

Placing the ammonia vessels in an enclosure would minimize the potential for ammonia releases to the atmosphere. For enclosure to be effective in preventing ammonia releases to the atmosphere, a scrubber should be required on the enclosure vent stack. While this would not be as effective as a double-walled vessel due to the potential failure of the scrubber being greater than the secondary vessel wall, it may represent a more cost-effective solution than a double-walled vessel.

Other options are preferable because, depending on the level of maintenance and testing of the ammonia detectors and scrubber, it is possible that the scrubber would not activate. Based on previous studies of scrubber reliability and effectiveness, it has been estimated that there is a one in one hundred chance that the scrubber system would either fail to detect the ammonia release or fail to activate on demand. Therefore, the effectiveness of a scrubber in preventing an atmospheric release of ammonia was assumed to be two orders of magnitude lower than the baseline scenario (i.e., single-walled vessel with no scrubber), and about an order of magnitude higher than the failure rate for a double-walled vessel.

III.E Suggested Mitigation Measures

At a minimum, the CEC should require the following measures to ensure that accidental aqueous ammonia spills are contained onsite:

1. The aqueous ammonia storage facility shall be designed to either the ASME Pressure Vessel Code and ANSI K61.6 or to API 620. In either case, the storage tank shall either be buried or be protected by a secondary containment basin and enclosed in a structure equipped with a scrubber capable of reducing scrubber exhaust ammonia levels to less than 75 ppm. Alternatively, the aqueous ammonia storage facility could utilize a double-walled storage vessel designed to either the ASME Pressure Vessel Code and ANSI K61.6 or to API 620. The storage tank shall be protected by a secondary containment basin capable of holding 150% of the storage volume plus the volume associated with 24 hours of rain assuming the 25-year storm.

2. The project owner shall provide a covered secondary containment basin to passively contain any spill during the delivery of aqueous ammonia to the storage facility. The enclosure shall be equipped with a scrubber capable of reducing scrubber exhaust ammonia levels to less than 75 ppm.

Implementation of these measures would substantially reduce potential hazards associated with the onsite storage of aqueous ammonia.

Steven R. Radis, M.A., Principal
Global Environment & Risk Practice

Arthur D. Little, Inc.
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Qualifications:

Mr. Radis is a Principal in Arthur D. Little's Santa Barbara office. His expertise includes meteorological modeling and analysis, consequence and risk analysis, fire and explosion dynamics, hazard evaluation, external events analysis, fault tree analysis and model development. Mr. Radis joined Arthur D. Little, Inc. in 1990.

Prior to joining Arthur D. Little, Inc., Mr. Radis worked for Dames & Moore as a Senior Meteorologist, Radian Corporation as an Atmospheric Scientist, Southern California Edison Company as a Research Meteorologist and California State University, Northridge as a technical assistant. He has more than seventeen years of numerical modeling experience and over 21 years of experience in conducting meteorological and climatological studies.

Mr. Radis has worked on a wide variety of studies for commercial and government clients involving meteorological modeling, quantitative risk assessments, health risk assessments, consequence analysis, risk management, air quality modeling (inert/photochemical pollutants, toxic air contaminants) and environmental impact reports/statements.

- Mr. Radis has participated in several power plant certification projects in the areas of air quality, public health and hazardous materials. These projects included numerous Applications for Certification and Small Power Plant Exemptions for projects such as: Sycamore, Omar, Midway Sunset, Hanford, U.S. Borax, Santa Maria Aggregate, AES Placertia and several others. Mr. Radis has also prepared air quality, public health and hazardous materials analyses for most generating stations formerly operated by Southern California Edison and San Diego Gas and Electric.

- For a large Southern California utility, Mr. Radis evaluated the feasibility and system safety of converting a fuel oil pipeline distribution network into a regional crude oil and petroleum product storage and distribution system. An analysis of safety and environmental issues was prepared for the California Public Utilities Commission and the South Coast Air Quality Management District. Both agencies approved the conversion project which is now operating at full capacity. An expansion of the pipeline system is currently being evaluated to increase overall system pipeline throughput capacity, as well as to accommodate unit train and VLCC tanker deliveries.

- For the Center for Chemical Process Safety (CCPS) of the American Institute of Chemical Engineers (AIChE), Mr. Radis co-authored a book entitled *Guidelines for Postrelease Mitigation Technology in the Chemical Process Industry*. As part of this effort, Mr. Radis quantitatively evaluated the effectiveness of a variety of mitigation technologies.

- As part of an Environmental Impact Report/Statement, Mr. Radis prepared a dispersion modeling analysis and health risk assessment of potential remedial alternatives for the Unocal Avila Beach Cleanup Project. This dispersion modeling and health risk assessment included the evaluation of acute and chronic health hazards associated with site contamination and a variety of cleanup strategies including air sparging/bioventing, solidification/stabilization, solvent flooding, steam stripping, excavation, and thermal desorption. Leaking Unocal Marine Terminal pipelines have resulted in approximately 400,000 gallons of petroleum hydrocarbon contamination beneath the town of Avila Beach and the adjacent beach and intertidal zone. Mr. Radis also served as the Project Manager for the preparation of the Environmental Impact Report/Statement.

- Mr. Radis prepared a multipathway health risk assessment of the Lone Star Cement Kiln Dust Disposal Site to evaluate onsite and offsite health risks. As part of this project, Mr. Radis developed a model to evaluate fugitive dust emissions, dispersion, and particle deposition. This model evaluated fugitive dust emissions based on site-specific soil characteristics such as soil moisture, particle size distribution, particle adhesion characteristics, and particle aerodynamic behavior. The results of the dispersion and deposition modeling analyses were used in a multipathway health risk assessment to evaluate potential health risks associated with baseline conditions and a wide variety of remedial alternatives. The analysis also evaluated the effectiveness of several interim dust control strategies, such as the use of chemical dust suppressants.

- As part of an Environmental Impact Report/Statement, Mr. Radis prepared a dispersion modeling analysis and health risk assessment of potential remedial alternatives for the Unocal Guadalupe Oil Field Remediation and Abandonment Project. This dispersion modeling and health risk assessment included the evaluation of acute and chronic health hazards associated with site contamination and a variety of cleanup strategies including air sparging/bioventing, hot water and steam flooding, excavation, and thermal desorption. The Guadalupe Oil Filed has been contaminated with between eight and 40 million gallons of diluent, which is a petroleum hydrocarbon similar to diesel fuel that was injected into production wells for enhanced crude oil recovery. Mr. Radis was also responsible for the evaluation of worker and public safety associated with site remediation and abandonment activities.

- Mr. Radis has been involved in the preparation of Environmental Impact Reports/Statements for a wide variety of facilities including power generating facilities (coal, fuel oil, natural gas, geothermal, hazardous waste), hazardous waste disposal facilities (chemical and nuclear), crude oil and natural gas transmission pipelines and distribution networks, oil and gas development projects, and military development or conversion projects. Mr. Radis has managed a majority of these projects and was also responsible for the system safety, public health, and air quality issue areas.

- Mr. Radis prepared a health risk assessment to evaluate remedial alternatives for the Chevron Pond Closure Project in Richmond, California. The Chevron settling ponds contained a wide variety of pesticides and contaminated soil. A coupled fugitive dust emission and dispersion model was applied to evaluate soil and meteorological-specific particle suspension and dispersion.

- Mr. Radis prepared an analysis potential health risks associated with various landfill gas disposal options for the Simi Valley landfill. This analysis evaluated potential air quality impacts and health risks associated with the landfill gas recovery collection and disposal systems. An evaluation of different landfill gas disposal alternatives, including venting, flaring and energy generation, were evaluated.

- Mr. Radis prepared an analysis potential health risks associated with various landfill gas disposal options for the BFI Sunshine Canyon landfill. This analysis evaluated potential air quality impacts and health risks associated with the landfill gas recovery collection and disposal systems.

- Mr. Radis has been involved in the preparation of Environmental Impact Reports/Statements for a wide variety of facilities including power generating facilities (coal, gas, geothermal, hazardous waste), hazardous waste disposal facilities (chemical and nuclear), crude oil and natural gas transmission pipelines and distribution networks, oil and gas development projects and military development or conversion projects. Mr. Radis managed several of these projects and was also responsible for the system safety, public health, air quality and noise issue areas.

- Mr. Radis has prepared health risk assessments for a variety of facilities including power plants, oil and gas projects, hazardous waste sites (both State and Superfund listed sites), chemical milling facilities, the mining industry and waste disposal sites.

- Mr. Radis has worked on the development of several models including the development or revisions to several accidental release models, an oil spill model, a multi-component pool model, atmospheric diffusion models, an integrated human exposure and health risk assessment model, and several meteorological models.

- For four Local Emergency Planning Committees (LEPCs) in Alaska, he helped develop emergency response planning procedures through the preparation of a comprehensive regional hazard and risk analysis.

- Mr. Radis has conducted more than 50 offsite consequence analyses as part of California's Risk Management and Prevention Program (RMPP) in addition to managing the preparation of more than a dozen RMPPs.

- For the Cities of Los Angeles and Vernon, Mr. Radis has served as an expert reviewer of Risk Management and Prevention Programs (RMPP).

- Mr. Radis has conducted system safety and reliability studies for several oil and gas projects for the County of Santa Barbara. These studies included hazard identification, external event and offsite consequence analyses. Quantitative risk assessments were prepared for several of the projects.

- For a large engineering company, Mr. Radis prepared a quantitative risk assessment for a liquefied natural gas (LNG) marine terminal and power plant project in Puerto Rico. The project included conducting a hazard assessment, fault tree analysis, consequence analysis and quantitative risk analysis. An analysis of external events that could potentially affect the proposed facility was also conducted.

- Mr. Radis conducted accident investigations and numerical simulations of the consequences related to two different refinery explosions and resulting fires (confidential clients).

- For a Texas-based law firm, Mr. Radis prepared an analysis of external events and provided expert testimony to the Texas Water Commission related to the safety of a hazardous waste disposal facility proposed for the Houston Ship Channel. This study included a review of past external events in the region and centered on hurricane, tornado and storm surge hazards. The study required the development of a wind field model to simulate hurricanes passing over the site and to estimate potential maximum wind speeds and wind load on the proposed equipment.

- Mr. Radis has conducted oil spill modeling simulations for several oil and gas projects in California. These analyses included the simulation of multicomponent land based spills, spills to rivers and creeks, as well as ocean and harbor spills.

- For several power generating projects and oil and gas facilities, Mr. Radis has conducted photochemical modeling simulations to assess potential impacts on regional air quality.

Mr. Radis earned an M.A. and B.A in Climatology from California State University, Northridge. He is a member of the American Meteorological Society, and the Air and Waste Management Association. He has also periodically served as a guest lecturer at the University of California Santa Barbara in the areas or meteorology and atmospheric diffusion modeling.

DECLARATION OF STEVEN R. RADIS

I, Steven R. Radis, declare as follows:

1. I prepared the attached analysis of environmental impacts of the proposed La Paz Generating Facility in La Paz County, Arizona, based on my independent review and my professional experience and knowledge.

2. It is my professional opinion that the analysis is valid and accurate with respect to the issue(s) addressed therein.

3. I am personally familiar with the facts and conclusions related in the analysis, and if called as a witness could testify competently thereto.

4. A copy of my professional qualifications and experience is attached hereto and incorporated by reference herein.

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

Dated: 16 October 2001, at Santa Barbara, California:

Steven R. Radis