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September 3, 2010

Mr. Pierre Martinez
Siting Project Manager
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814

Subject: Oakley Generating Station Project (09-AFC-4)
Technical Memorandum – Oakley Generating Station Off-site Consequence Analysis dated August 25, 2010

Dear Mr. Martinez:

Please find attached one hardcopy of the Technical Memorandum – Oakley Generating Station Off-site Consequence Analysis, dated August 25, 2010, for the Oakley Generating Station (09-AFC-4).

If you have any questions regarding this document, please contact me at (916) 286-0278.

Sincerely,

CH2M HILL

Douglas M. Davy, Ph.D.
AFC Project Manager

cc: POS List
Project File

Oakley Generating Station Off-site Consequence Analysis

PREPARED FOR: Radback Energy

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DATE: August 25, 2010

The Oakley Generating Station (OGS or project) will be a natural gas-fired, combined-cycle electrical generating facility rated at a nominal generating capacity of 624 megawatts (MW) in Oakley, Contra Costa County, California. The proposed OGS includes: two GE Frame 7FA combustion turbines equipped with dry low-NO_x combustors to control NO_x and evaporative coolers for reducing inlet air temperatures; two HRSGs with SCR and oxidation catalyst equipment to control NO_x, carbon monoxide, and volatile organic compound emissions, respectively; a single GE D-11 condensing STG; an air-cooled condenser; and associated support equipment.

Nitrogen oxide (NOx) emissions from the generators will be controlled using selective catalytic reduction (SCR). The SCR control system proposed for OGS uses ammonia as the reduction reagent. Aqueous ammonia (ammonium hydroxide at 29.4-percent nominal concentration by weight) will be vaporized and injected into the flue gas stream from the engines, then passed through a catalyst bed. In the presence of the catalyst, the ammonia (NH_3) and NO_X react to form nitrogen (N_2) and water vapor (H_2O) thereby reducing the NOx emissions.

The OGS facility will store 29.4-percent aqueous ammonia solution in a stationary aboveground storage tank capable of storing 18,000 gallons. The tank will be surrounded by a 1,500 ft^2 secondary containment structure capable of holding the full contents of the tanks, plus rainwater. The bottom of secondary containment structure will be lined with multiple layers of polymer balls which, in the event of a spill, will float on the top of the aqueous ammonia reducing the exposed surface area by a minimum of 79 percent, and thereby reducing the evaporation rate of the spilled liquid. The secondary structure is located approximately 87 feet (26.5 meters) from the nearest property boundary.

The California Energy Commission requested an offsite consequence analysis (OCA) be conducted for the accidental release of aqueous ammonia at OGS. The analysis consists of a worst-case spill scenario involving the failure and complete discharge of the contents of the aqueous ammonia storage tank into the secondary containment structure.

Analysis

An analysis of a tank failure and subsequent release of aqueous ammonia was prepared using a numerical dispersion model. The analysis assumed the complete failure of the storage tank, the immediate release of the contents of the tank and the formation of an evaporating pool of aqueous ammonia within the secondary containment structure. Evaporative emissions of ammonia would be subsequently released into the atmosphere. Meteorological conditions at the time of the release would control the evaporation rate, dispersion, and transport of ammonia released to the atmosphere. Maximum temperatures combined with low wind speeds and stable atmospheric conditions would be expected to result in the highest ammonia concentrations at the furthest distance downwind of the release site.

For purposes of this analysis, the meteorological data were set to U.S. Environmental Protection Agency (USEPA) default (worst case) meteorological data as defined by 19 CCR 2750.2. (Table 1). The ambient temperature was set to the maximum daily temperature recorded during the past three calendar years (i.e., 108°F or 315.4 Kelvin, measured in Concord, CA).

TABLE 1
Meteorological Input Parameters

Parameter	Worst Case Meteorological Data
Wind Speed meters/second	1.5
Stability Class	F
Relative Humidity, Percent	50
Ambient Temperature, Kelvin (°F)	315.4 (108°F)

The modeling was conducted based on an evaporating pool release caused by the complete failure of a single tank, using the meteorological data presented in Table 1. Modeling was conducted using the SLAB numerical dispersion model. A complete description of the SLAB model is available in *User's Manual for SLAB: An Atmospheric Dispersion Model for Denser-Than-Air Releases, D. E. Ermak, Lawrence Livermore National Laboratory, June 1990*. The SLAB user manual contains a substance database, which includes chemical-specific data for ammonia. These data were used without exception or modification.

Emissions of ammonia from an aqueous solution were calculated using ambient temperature and wind speed pursuant to the guidance given in *RMP Offsite Consequence Analysis Guidance, EPA, April 1999* and using the emission calculation tool for evaporating solutions provided in the Area Locations of Hazardous Atmospheres (ALOHA) model provided by the EPA. (http://www.epa.gov/ceppo/cameo/index.htm

The release rate for ammonia vapor from an evaporating 29.4-percent solution of aqueous ammonia was calculated assuming mass transfer of ammonia across the liquid surface occurs according to principles of heat transfer by natural convection. The ammonia release rate was calculated using ALOHA, meteorological data displayed in Table 1, and an emission reduction of 79% due to the implementation of a passive mitigation system.

During the worst case scenario, an initial ammonia evaporation rate was calculated for a 1-hour averaging period. This is a conservative estimate of time, as EPA guidance suggests that the majority of the toxic component would be released during the first 10 minutes after the release. For concentrated solutions, the initial evaporation rate is substantially higher than the rate averaged over time periods of a few minutes or more since the concentration of the solution immediately begins to decrease as evaporation begins.

Although the edge of the tank containment area is raised above ground level, the release heights used in the model were set at 0 m above ground level (AGL) to maintain the conservative nature of the analysis. Downwind concentrations of ammonia were calculated at heights of 0 and 1.6 meters above ground level. Reported distances to specified toxic endpoints are the maximum distances for concentrations at 0 and 1.6 meters above ground level. The California Office of Environmental Health Hazard Assessment (OEHHA) has designated 1.6 meters as the breathing zone height for individuals.

Toxic Effects of Ammonia

With respect to the assessment of potential impacts associated with an accidental release of ammonia, four offsite "bench mark" exposure levels were evaluated: (1) the lowest concentration posing a risk of lethality, 2,000 ppm; (2) the Occupational Safety and Health Administration's (OSHA) Immediately Dangerous to Life and Health (IDLH) level of 300 ppm; (3) the Emergency Response Planning Guideline (ERPG) level of 150 ppm, which is the American Industrial Hygiene Association's (AIHA) updated ERPG-2 for ammonia; and (4) the level considered by the California Energy Commission (CEC) staff to be without serious adverse effects on the public for a one-time exposure of 75 ppm (*Preliminary Staff Assessment-Otay Mesa Generating Project, 99-AFC-5, May 2000)*.

The odor threshold of ammonia is approximately 5 ppm, and minor irritation of the nose and throat will occur at 30 to 50 ppm. Concentrations greater than 140 ppm will cause detectable effects on lung function, even for short-term exposures (0.5 to 2 hours). At higher concentrations of 700 to 1,700 ppm, ammonia gas will cause severe effects; death occurs at concentrations of 2,000 to 7,000 ppm.

The ERPG-2 value is based on a one-hour exposure or averaging time; therefore, the modeled distance to ERPG-2 concentrations are presented in terms of one-hour (or 60 minute) averaging time. The ERPG-2 is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action. OSHA's IDLH for ammonia is based on a 30-minute exposure or averaging time; therefore, the IDLH modeling concentrations at all offsite receptors will be given in terms of a 30-minute averaging time.

Modeling Results

Table 2 shows the modeled distance to the four benchmark criteria concentrations: lowest concentration posing a risk of lethality, (2,000 ppm), OSHA's IDLH (300 ppm), AIHA's ERPG-2 (150 ppm), and the CEC significance value (75 ppm).

TABLE 2
Distance to EPA/CalARP and CEC Toxic Endpoints (ammonia)

Scenario	Distance in Meters to 2,000 ppm	Distance in Meters to IDHL (300 ppm)	Distance in Meters to AIHA's ERPG-2 (150 ppm)	Distance in Meters to CEC Significance Value (75 ppm)
0 m AGL	10.0	10.7	10.8	10.8
1.6 m AGL	11.5	12.4	12.6	12.7

The model input file and the output files are available upon request.

As previously stated, the secondary containment structure is located approximately 26.5 meters from the property boundary. Therefore, the results of the off-site consequence analysis for the worst case release scenario of ammonia at OGS indicate that the concentrations above the most stringent benchmark criteria (CEC's significance value of 75 ppm) would not extend off the project site.

Assessment of the Methodology Used

Numerous conservative assumptions were used in the above analysis of the release scenario. These include the following:

- Modeling & Meteorology
  - Worst case of a constant mass flow, at the highest possible initial evaporation rate for the modeled wind speed and temperature was used, whereas in reality the evaporation rate would decrease with time as the concentration in the solution decreases.
  - In the case of the tank rupture, worst case stability class was used which almost exclusively occurs during nighttime hours, but the maximum ambient temperature of 108°F was used, which occurred during daylight hours.
  - Again worst-case meteorology corresponds to nighttime hours, whereas the worst-case release of a tank failure would most likely occur during daytime activities at the power plant. At night, activity at a power plant is typically minimal.

Risk Probability

Accidental releases of aqueous ammonia in industrial use situations are rare. Statistics compiled on the normalized accident rates for RMP chemicals for the years 1994-1999 from *Chemical Accident Risks in U.S. Industry-A Preliminary Analysis of Accident Risk Data from*

U.S. Hazardous Chemical Facilities, J.C. Belke, Sept 2000, indicates that ammonia (all forms) averages 0.017 accidental releases per process per year, and 0.018 accidental releases per million pounds stored per year. Data derived from *The Center for Chemical Process Safety, 1989*, indicates the accidental release scenarios and probabilities for ammonia in general are shown in Table 3.

TABLE 3
General Accidental Release Scenarios and Probabilities for Ammonia

Accident Scenario	Failure Probability
Onsite Truck Release	0.0000022
Loading Line Failure	0.005
Storage Tank Failure	0. 000095
Process Line Failure	0.00053
Evaporator Failure	0.00015

Conclusions

Several factors need to be considered when determining the potential risk from the use and storage of hazardous materials. These factors include the probability of equipment failure, population densities near the project site, meteorological conditions, and the process design. Considering the results of the above analysis, and accounting for the probabilities of a tank failure resulting in the modeled ammonia concentrations at the conditions modeled, the risk posed to the local community from the storage of aqueous ammonia at OGS is less than significant.

The results of the catastrophic scenario analysis indicate that the probability of a complete storage tank failure in combination with the conservatively modeled meteorological conditions would pose an insignificant threat since ammonia concentrations above the CEC threshold of 75 ppm at both ground level and breathing height would not extend offsite.

As described above, numerous conservative assumptions have been made at each step in this analysis. The conservative nature of these assumptions has resulted in a significant overestimation of the probability of an ammonia release at the OGS site, and the predicted distances to toxic endpoints do not pose a threat to the public. Therefore, it is concluded that risk from exposure to aqueous ammonia due to OGS is not significant.

BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA
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APPLICATION FOR CERTIFICATION FOR THE *OAKLEY GENERATING STATION*

Docket No. 09-AFC-4
PROOF OF SERVICE
(Revised 8/13/2010)

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DECLARATION OF SERVICE

I, Mary Finn, declare that on September 3, 2010, I served and filed copies of the attached Oakley Generating Station Project (09-AFC-4) Technical Memorandum – Oakley Generating Station Off-site Consequence Analysis dated August 25, 2010. The original document, filed with the Docket Unit, is accompanied by a copy of the most recent Proof of Service list, located on the web page for this project at: **[http://www.energy.ca.gov/sitingcases/contracosta/index.html].** The document has been sent to both the other parties in this proceeding (as shown on the Proof of Service list) and to the Commission's Docket Unit, in the following manner:

(*Check all that Apply*)

For service to all other parties:

X sent electronically to all email addresses on the Proof of Service list;

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For filing with the Energy Commission:

X **sending an original paper copy and one electronic copy, mailed and emailed respectively, to the address below (preferred method);**

OR

_____depositing in the mail an original and 12 paper copies, as follows:

CALIFORNIA ENERGY COMMISSION
Attn: Docket No. 09-AFC-4
1516 Ninth Street, MS-4
Sacramento, CA 95814-5512
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I declare under penalty of perjury that the foregoing is true and correct, that I am employed in the county where this mailing occurred, and that I am over the age of 18 years and not a party to the proceeding.

Mary Finn