APPENDIX 8.12A

Offsite Consequence Analysis

LSP South Bay, LLC Replacement Project Ammonia Offsite Consequence Analysis

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Background

The South Bay Replacement Project (SBRP) will use ammonia in the selective catalytic reduction system (SCR) to reduce oxides of nitrogen emissions to diatomic nitrogen and water. The use, storage, and handling of ammonia in concentrations above 20 percent are regulated by the federal government in quantities above 10,000 pounds. California also regulates ammonia (any concentration) in quantities above 500 pounds. The SBRP is proposing to store approximately 24,000 gallons of a 19 percent solution of ammonia, which exceeds the state regulatory threshold, requiring the preparation of a California Accidental Release Program Plan for the safe use, storage, and handling of ammonia.

The California Energy Commission (CEC) siting process requires the impacts of hazardous materials use and storage be analyzed. The CEC siting regulations require the worst-case impacts associated with the use of a hazardous material be analyzed by preparing an Offsite Consequence Analysis (OCA) for the potential worst-case ammonia release. This document is intended to satisfy the requirements of the CEC.

SBRP Offsite Consequence Analysis Methodology

CH2M HILL conducted an OCA to determine any potential constraints relative to siting the ammonia storage tank. The worst case release assumptions for the OCA are presented below.

- Ammonia storage volume – 2, 12,000 gallon tanks
- Tank Design - Single walled tanks
- Maximum Ambient Air Temperature – 102 °F (per the EPA RMP guidance, the highest temperature recorded over the last 3 years is to be used)
- Worst-Case Accident - Release of entire contents of one storage tank, with a volume of (10,200 gallons)
- Passive Mitigation – None
- Secondary Containment Area – 25.3 feet by 60 feet or 1520 square feet

Emissions of aqueous ammonia were calculated pursuant to the guidance given in *RMP Offsite Consequence Analysis Guidance, EPA, April 1999* and using the 'evaporation calculator' provided by the National Oceanic and Atmospheric Administration (http://archive.orr.noaa.gov/cameo/evapcalc/evap.html). Release rates for ammonia vapor from an evaporating 19-percent solution of aqueous ammonia were calculated assuming mass transfer of ammonia across the liquid surface occurs according to principles of heat transfer by natural convection. The initial ammonia evaporate rate was estimated to be 0.642 kilograms/second (approximately 5,095 pounds per hour). This value, along with the storage tank design data presented above, was used to model the potential worst case offsite ammonia impacts using the SLAB[1] model.

Table 1 presents the meteorological parameters used in the analysis.

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, °F	102

An initial ammonia evaporation rate was calculated and assumed to occur for at least one hour. For concentrated solutions, the initial evaporation rate is substantially higher than the evaporation rate averaged over time periods of a few minutes or more, since the concentration of the solution immediately begins to decrease as evaporation begins.

The release of the entire contents of the storage tank was assumed to be the worst case scenario, based on the USEPA Risk Assessment Guidance on performing Offsite Consequence Analysis. The failure of the tank would cause the aqueous ammonia to be released into the containment area and ammonia gas would be emitted due to evaporation.

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

An analysis of a tank loading hose failure with a leak below the excess flow valves activation set-point and the subsequent impacts was also considered. This analysis would normally be completed under typical or average meteorological conditions for the area. However, after review of the possible failure modes, it was determined that the impact of this leak would be bracketed by the complete tank failure as a worst-case for the hose failure.

[1] An Atmospheric Dispersion Model for Denser-Than-Air Releases, D. E. Ermak, Lawrence Livermore National Laboratory, June 1990

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, as follows: (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 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 about 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 2,500 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. The CEC significance level for ammonia concentrations was also based on a one-hour exposure or averaging time.

Modeling Results

The results of the OCA are presented in Table 2, which displays the distance to the four benchmark criteria. The results of the modeling analysis indicates that using the project design criteria presented above, the maximum downwind distance to the CEC significance value of 75 ppm under a worst-case release scenario would not exceed 68 feet. Figure 1 presents the ammonia isopleths for the OCA results.

TABLE 2
Results of the SBEF Preliminary OCA

Scenario	Distance in Feet to 75 ppm	Distance in Feet to of 150 ppm	Distance in Feet to 300 ppm	Distance in Feet to 2,000 ppm
0 meters AGL	56.9	55.1	53.9	48.3
1.6 meters AGL	67.6	64.9	64.0	58.1

Assessment of the Methodology Used

Numerous conservative assumptions were used in the above analysis of the tank failure. 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.
  - Worst case stability class was used, which almost exclusively occurs during nighttime hours, but the maximum ambient temperature of 102°F was used, which would occur 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 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 occurrence, population densities near the project site, meteorological conditions, and the process design. Considering the results of this analysis, the probability of a catastrophic storage tank failure resulting in the modeled ammonia concentrations, and the probability of a tank failure occurring under low wind speeds, maximum potential air temperatures and F class atmospheric stability, the risk posed to the public from the storage of aqueous ammonia at the SBRP site is insignificant.

As described above, numerous conservative assumptions have been made at each step in the analysis. This compounding of conservative assumptions has resulted in a significant overestimation of the probability of an ammonia release at the SBRP site and the predicted distances do not extend off the project site and pose no threat to public receptors. Therefore, it is concluded that the risk from exposure to aqueous ammonia due to the SBRP is less than significant.

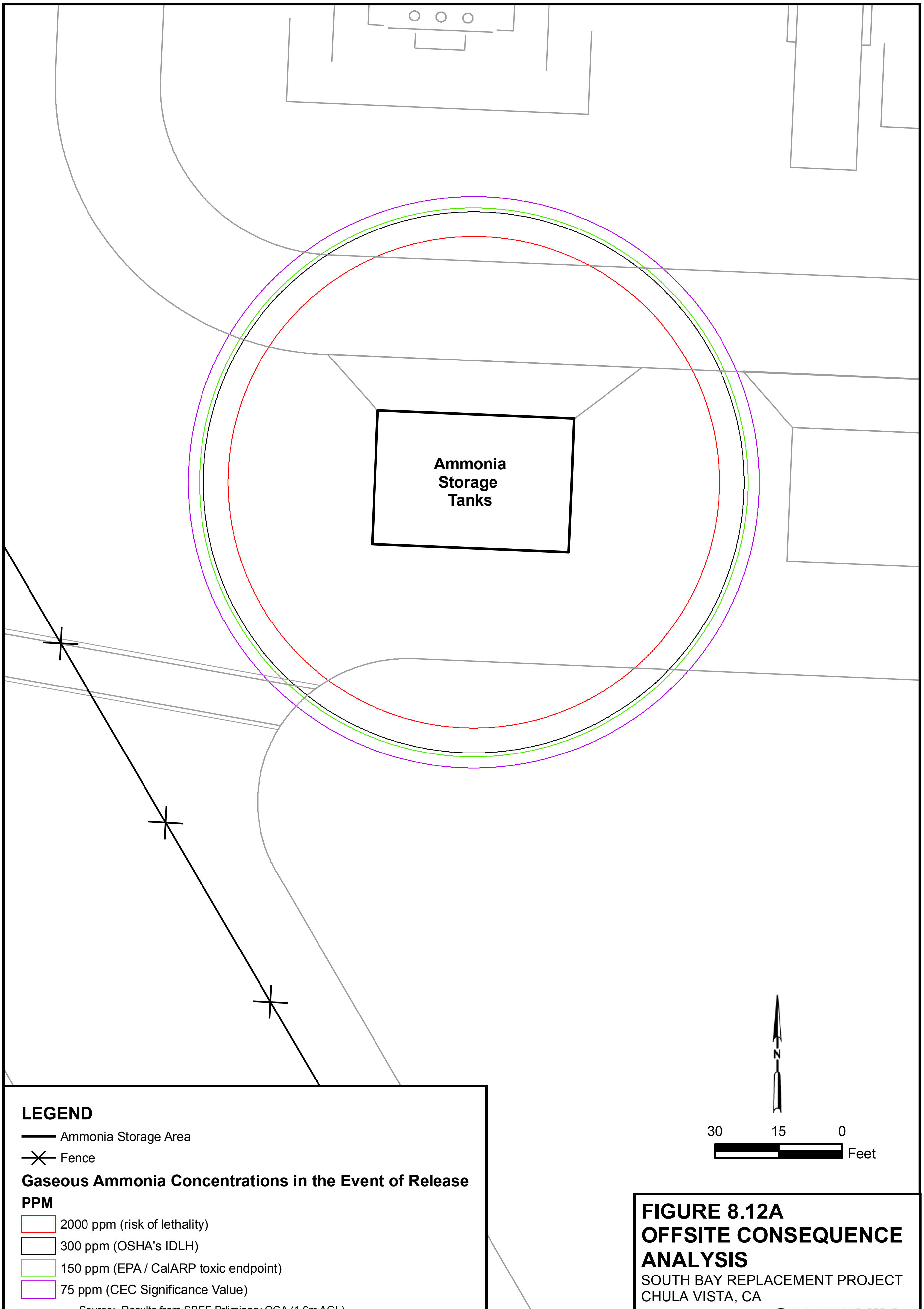

FIGURE 8.12A
OFFSITE CONSEQUENCE ANALYSIS
SOUTH BAY REPLACEMENT PROJECT
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