2.2 NEARBY INDUSTRIAL, TRANSPORTATION AND MILITARY FACILITIES

This section of the U.S. EPR FSAR is incorporated by reference with the following supplements.

The U.S. EPR FSAR includes the following COL Item in Section 2.2:

> A COL applicant that references the U.S. EPR design certification will provide site-specific information related to the identification of potential hazards stemming from nearby industrial, transportation, and military facilities within the site vicinity, including an evaluation of potential accidents (such as explosions, toxic chemicals, and fires).

This COL Item is addressed as follows:

{This section also establishes whether the effects of potential accidents in the vicinity of the CCNPP Unit 3 site from present and projected industrial, transportation, and military installations and operations should be used as design basis events for plant design parameters related to the selected accidents.

Significant facilities and activities within 5 mi (8 km) and major airports within 10 mi (16 km) of the CCNPP site were identified. These facilities and activities, and significant facilities at greater distances, were evaluated in accordance with Regulatory Guide 1.206 (NRC, 2007b), Regulatory Guide 1.91 (NRC, 1978a), Regulatory Guide 4.7 (NRC, 1998), and relevant sections of both 10 CFR Part 100 (CFR, 2007d) and 10 CFR Part 50 (CFR, 2007b).

2.2.1 Location and Routes

The investigation of potential external hazard facilities and operations within 5 mi (8 km) of the CCNPP Unit 3 site identified one significant industrial facility; one airport, two helipads; three marinas; and a natural gas pipeline for further evaluation. CCNPP Units 1 and 2, and its associated onsite chemical storage facilities, were identified as an internal hazard facility for further evaluation. An evaluation of major transportation routes within the vicinity of the CCNPP site identified: one highway with commercial traffic; two airways within the vicinity of the CCNPP; and a navigable waterway for further evaluation.

Figure 2.2-1 is a site vicinity map that shows the location of the following facilities and transportation routes within 5 mi (8 km) of the CCNPP Unit 3 site:

- Dominion Cove Point Liquid Natural Gas (DCPLNG) Terminal
- DCPLNG Pipeline
- DCPLNG Helipad
- Maryland State Highway 2/4 - MD 2/4
- Mears Creek Airfield
- CCNPP Units 1 and 2
- CCNPP Corporate Helipad
- Vera's White Sands Marina

- Flag Harbor Yacht Haven

An evaluation of nearby facilities and transportation routes within 10 mi (16 km) of the CCNPP Unit 3 site identified one military installation, Patuxent River Naval Air Station, which is significant enough to be identified as a potential hazard facility for CCNPP Unit 3. Including the Patuxent River Naval Air Station, there are three airports located between 5 and 10 mi (8 and 16 km) of CCNPP Unit 3 with significant operations: Captain Walter Francis Duke Regional Airport, and Chesapeake Ranch Airpark, and Trapnell field at the Patuxent River Naval Air Station.

Figure 2.2-2 illustrates the following identified airports and airway routes within 10 mi (16 km) of the CCNPP site, including:

- CCNPP Corporate Helipad
- DCPLNG Helipad
- Patuxent River Naval Air Station
- Chesapeake Ranch Airpark
- Captain Walter Francis Duke Regional Airport
- Mears Creek Airfield
- Airway V-31
- Airway V-93
- Airway V16-157-213-229
- Airway J-191

There are no identified facilities, routes, or activities greater than 10 mi (16 km) from the CCNPP site that represent hazards of sufficient significance to be included for further evaluation.

2.2.2 Descriptions

Descriptions of the industrial, transportation, and military facilities located in the vicinity of the CCNPP Unit 3 site are provided in this section. The facilities described include those facilities identified in Section 2.2.1 that could represent potential hazards for the CCNPP site.

Sections 2.2.2.1 through 2.2.2.8 are added as a supplement to the U.S. EPR FSAR.

2.2.2.1 Description of Facilities

In accordance with 10 CFR 50.34 (CFR, 2007c) and Regulatory Guide 1.206 (NRC, 2007b), three facilities, along with the onsite chemicals and chemical storage facilities associated with Unit 3 were identified for review: CCNPP Units 1 and 2; DCPLNG; and Patuxent River Naval Air Station, a military installation.

Table 2.2-1 provides a concise description of these facilities, including the primary functions and major products, as well as the number of persons employed. A more detailed description is provided in Section 2.2.2.2.1 through Section 2.2.2.2.5.

2.2.2.2 Description of Products and Materials

A more detailed description of each of these facilities, including a description of the products and materials regularly manufactured stored, used, or transported is provided in the subsequent sections.

2.2.2.2.1 CCNPP Units 1 and 2

The centerline of the existing CCNPP Unit 1 and 2 reactors is located approximately 2,371 ft (723 m) and 2,187 ft (667 m) north, respectively, and 1,165 ft (355 m) and 981 ft (299 m) west, respectively, of the centerline for CCNPP Unit 3. CCNPP Unit 1 and Unit 2 are both pressurized water reactors (PWRs) licensed by the NRC. CCNPP Unit 1 has a generating capacity of 825 MWe, and has been in commercial operation since 1975. CCNPP Unit 2 has a generating capacity of 835 MWe, and CCNPP Unit 2 has been in commercial operation since 1977. The chemicals identified for possible analysis and their locations associated with CCNPP Units 1 and 2 are presented in Table 2.2-2. The analysis of these chemicals is addressed in Section 2.2.3, and the disposition of hazards associated with these chemicals is summarized in Table 2.2-5.

2.2.2.2.2 Dominion Cove Point Liquefied Natural Gas Facility

The Dominion Cove Point Liquefied Natural Gas (DCPLNG) facility is located approximately 3.2 mi (5 km) south of the facility. The DCPLNG site receives liquefied natural gas (LNG) from LNG tanker ships at its offshore dock. The facility stores the LNG onshore in tanks, then transforms it back to gas and delivers it to a pipeline for distribution.

The DCPLNG facility includes an offshore pier; and five double-walled, insulated LNG storage tanks that are maintained at -260°F (-162°C) and 2 psig (14 kPa-gauge). One tank has a capacity of 850,000 barrels (35.7 million gallons, or 135,000 m^3), and the remaining four tanks have a capacity of 375,000 barrels (15.75 million gallons, or 59,600 m^3). The pipeline, known as the Cove Point pipeline, extends approximately 88 mi (142 km) from the LNG terminal to connections with several interstate pipelines (Dominion, 2007) (MDNR, 2006). The pipeline and offshore pier are described in more detail in Section 2.2.2.3 and Section 2.2.2.4.2.

The Federal Energy Regulatory Commission (FERC) has approved an application for expansion of the DCPLNG facility. The scope of this expansion is described in more detail in Section 2.2.2.4.2.

2.2.2.2.3 Patuxent River Air Station

The Patuxent River Naval Air Station is located approximately 10 mi (16 km) south of the CCNPP site. Facilities at the Patuxent River Naval Air Station include (CLUI, 2006):

- more than 19 hangers where aircraft are serviced, modified, and subjected to a variety of tests,
- radar-cross section test facilities,
- aircraft carrier deck test facilities,
- a manned flight simulator,

- a large aircraft anechoic chamber,
- an air combat environment test and evaluation facility; and
- an extensive test range and target areas.

The Naval Air Station is the largest employer in the community with approximately 17,000 employees (Military, 2006). The facility is located greater than 5 mi (8 km) from the CCNPP site. There are no live bombing ranges on the station. Weapons separation testing is performed approximately 3 to 5 mi (5 to 8 km) east of the airport; however, live ordnance is not used for this activity.

The Naval Air Station is the only major aviation facility in the area. It operates all types of Naval aircraft in test and development oriented missions. Anticipated future activities including the use of unmanned aerial vehicles. Most of the aircraft operate in specified restricted areas to the east and south of the Naval Air Station; hence, their flight paths would be in these directions and away from the site. Visual Flight Rules for local traffic are in effect within a 5 mi (8 km) radius of the airport at either 1,500 ft or 1,000 ft (457 or 305 m), depending upon the type of aircraft.

Information related to hazardous material inventories was obtained from the Patuxent River Naval Air Station. A review of the list did not identify any hazardous materials that were stored in significant quantities, or that were not bounded by the effects of potential events involving the same or similar chemicals at locations that are closer to CCNPP Unit 3 (e.g., onsite, highway, and waterway transport).

Aircraft arriving or departing under Instrument Flight Rules follow preset routes. During a radar approach, the aircraft is vectored by a ground controller. However, in the event of loss of radar contact with the aircraft (and in training runs for such scenarios) some instrument approach and takeoff patterns pass at a 10 nautical-mile (11.5 mile, or 18.5 km) radius from the Patuxent River Naval Air Station, which could place aircraft overhead of the CCNPP site. The Patuxent River Naval Air Station has indicated that routing of training flights within 5 mi (8 km) of CCNPP is not performed on a routine basis and only occurs infrequently.

Although these patterns pass over the site, it is unlikely that the aircraft come within 3 mi (4.8 km) of the CCNPP site because pilots are directed to take a 3 mi (4.8 km) bypass route to avoid flyovers of the CCNPP site. Instrument Flight Rule departures turn shortly after takeoff and proceed to navigational facilities away from the site.

Available information indicates about there are about 52,630 takeoffs and landings per year at the Patuxent River Naval Air Station, with a peak of about 300 per day. The heaviest transient military aircraft routinely visiting the base would be a Lockheed E-6A, which has a maximum gross take-off weight of 240,000 lbs (109,000 kg).

2.2.2.2.4 Marinas

Calvert County has approximately 2,281 boat slips, located in 16 commercial marinas (CALCO, 2004). Vera's White Sands Marina, located in Lusby, and Flag Harbor Yacht Haven, located in St. Leonard, are located within 5 mi (8 km) of the CCNPP site (CALCO, 2007). These marinas are primarily used by recreational and small commercial craft with little or no cargo handling occurring.

Hazardous materials on the craft at these marinas are limited to those typically found in personal vehicles such as fuel, lubricants, etc. A review of the Superfund Amendments and Reauthorization Act (Sara) Title III, Tier II reports for Calvert and St. Mary's Counties identified that the typical hazardous materials stored at marinas in Calvert County include: gasoline, number 2 fuel oil, and propane.

The reported quantities of gasoline stored on the CCNPP site and transported on the Chesapeake Bay are both larger than the quantity of gasoline reported for nearby marinas, and are located closer to the CCNPP site and safety-related structures. Similarly, the reported quantity of number 2 fuel oil stored onsite at CCNPP is greater than the amount stored at the identified marinas, and is located closer to the CCNPP site and safety-related structures. As such external events involving gasoline and fuel oil inventories at local marinas are bounded by other events. Transportation events involving propane on (MD) 2/4 bound the storage of propane at the identified marinas. Therefore, the identified marinas do not require further analysis.

2.2.2.2.5 Mining Activities

There are no mining activities within 5 mi (8 km) of the CCNPP site.

2.2.2.3 Pipelines

DCPLNG facility operates a pipeline corridor within 5 mi (8 km) of the CCNPP site as depicted in Figure 2.2-1. The Cove Point pipeline extends approximately 88 mi (142 km) from the Liquefied Natural Gas (LNG) terminal to connections with several interstate pipelines in Loudon and Fairfax Counties, Virginia. The DCPLNG facility has a peak send-out capacity of 1 billion ft^3/d (28.3 million m^3/d).

The FERC has recently approved an expansion project for the pipeline that allows construction and operation of an additional 47 mi (76 km) of 36 in (91 cm) diameter loop pipeline in Calvert County, Prince George's County, and Charles County in Maryland. Of the 47 miles (76 km) of additional pipeline; 36 mi (58 km) will run alongside the existing pipeline corridor. Additionally, the FERC granted Cove Point authority to refurbish and reactivate two existing waste heat vaporizers to provide for an additional 0.25 billion ft^3/d (7.1 million m^3/d) send-out capacity to ensure that the Cove Point can deliver up to its current peak-day capabilities of 1 Bcf/day of send-out capacity on a year-round basis (EPA, 2001) (FERC, 2006a) (FERC, 2006b) (Williams, 2000) (MDNR, 2006).

The Cove Point pipeline carries natural gas and is not expected to carry a different product in the future.

2.2.2.4 Description of Waterways

CCNPP Unit 3 will be located about 1,000 ft (305 m) from the western shore of Chesapeake Bay. The Chesapeake Bay is a large estuary and home to many marinas and facilities along its shores. Located along the navigable waterways are two facilities which may contribute to the transportation of potentially hazardous cargo along the Chesapeake Bay, and in the vicinity of the CCNPP site: (1) the Port of Baltimore, and (2) the DCPLNG facility.

The Port of Baltimore is located about 60 mi (97 km) north of the CCNPP site on the Patapsco River, a tributary that flows into the Chesapeake Bay. The DCPLNG facility located 3.2 mi (5.1 km) south of the CCNPP site, and has a terminal with an off shore pier. More detailed information about the transportation of potentially hazardous material as a result of these facilities is presented in the following sections.

At its greatest depth in the vicinity of the CCNPP site, the Chesapeake Bay shipping channel is approximately 101 ft (31 m) deep (NOAA, 2005). The navigable waterways of the Chesapeake Bay are represented by the U.S. Army Corps of Engineers as those waters with a depth greater than the 47 ft (14.3 m) contour (USACE, 2006). Applying this definition, the CCNPP Unit 3 intake structure will be within approximately 11,678 ft (2.2 mi, or 3,560 m) of a navigable waterway. The U.S. Coast Guard has committed to establish approach and docking procedures for the DCPLNG facility to keep LNG vessels outside a 3.4 mi (5.5 km) radius from the CCNPP site (NRC, 2004b).

Makeup water for the CCNPP Unit 3 comes from the Chesapeake Bay. The CCNPP Unit 3 inlet area is located in a protected area along the shoreline just south of the CCNPP Units 1 & 2 intake channel. The Unit 3 inlet area is an approximate 9,000 square foot (836 square meters) wedge shaped pool area formed by a sheet pile wall extending approximately 180 feet from the shoreline to the baffle wall and approximately 90 feet channelward from the mean high water shoreline. The CCNPP Unit 3 intake piping consists of two runs of 60-inch diameter safety-related pipe approximately 490 feet (144.4 m) long. These pipes convey water from the CCNPP Unit 3 inlet area to a common forebay structure with the bottom at Elevation -22 feet 6 inch (-6.86 m) NGVD 29 and vertical sheet pile sides extending to Elevation 10 feet (3.05 m) NGVD 29. A rip-rap seawall extending approximately 75 feet (22.9 m) north from the shoreline, east of the pipeline entrance, rip-rap along the shoreline, and a trash rack provide additional protection to the intake system.

2.2.2.4.1 Port of Baltimore

The Port of Baltimore consists of number of privately owned marine terminals and six public terminals with significant marine traffic, much of which passes in the vicinity of the CCNPP site. Cargo data specific to the Chesapeake Bay is not available; however, data for the Port of Baltimore and the Patuxent River is published by the U.S. Army Corps of Engineers (USACE, 2004a) (USACE, 2004b).

The Chesapeake Bay and Port of Baltimore can be accessed via the bay inlet to the south and the Chesapeake and Delaware Canal near the headwaters of the bay. The conservative assumption that all Port of Baltimore cargo passes by the CCNPP site was used in the description and analyses in this section; however a fraction of the cargo is transported via the canal to the north, circumventing the area of the plant site.

There were a total of 6,860 inbound trips and 6,829 outbound trips recorded for vessels to and from the Port of Baltimore during 2004. These vessels transported a total of over 47 million tons (43 million MT) of commodities. These commodities included: coal (14.2 million tons (12.9 million MT)); petroleum (10.5 million tons (9.5 million MT)); chemicals and related products (1.2 million tons (1.1 million MT)); crude materials, inedible, except fuels (11.1 million tons (10.0 million MT); manufactured goods (4.7 million tons (4.2 million MT)); food and farm products (1.6 million tons (1.5 million MT)); and manufactured equipment, machinery and products (3.6 million tons (3.3 million MT)). Table 2.2-3 details the total quantities of petroleum, hazardous chemicals, and related products identified as potential hazards transported on freight traffic, inbound and outbound, for the Port of Baltimore (USACE, 2004a) (USACE, 2004b).

Additionally, the FERC has been notified that a commercial entity intends to construct and operate a new LNG Terminal at Sparrows Point, which is located north of the CCNPP site, in the Port of Baltimore (DOE, 2006b). Operation of this proposed facility would be likely to result in increased LNG tanker traffic in the Chesapeake Bay in the vicinity of CCNPP Unit 3. While this expansion may result in additional LNG tankers transiting the Chesapeake Bay past the CCNPP site, the consequences and effects of events involving LNG tankers from the Sparrows Point Terminal in the vicinity of CCNPP Unit 3 will be no different than those already analyzed for LNG tanker events.

2.2.2.4.2 Dominion Cove Point Liquefied Natural Gas Facility

As described in Section 2.2.2.2.2, the DCPLNG facility is located along the shores of the Chesapeake Bay, approximately 3.2 mi (5.1 km) south of the CCNPP site and has a terminal with an off shore pier. It is estimated that up to 90 LNG tankers per year currently transit the Chesapeake Bay to the facility.

The Federal Energy Regulatory Commission (FERC) has approved an application for expansion of the DCPLNG facility. The FERC has authorized an expansion of the DCPLNG facilities that would add two new storage tanks, bringing the total number at the site to seven. Each of the new tanks will be capable of storing or 1.0 million barrels (42.3 million gallons, or 160,000 m^3) of LNG, increasing the storage capacity at the terminal to approximately 4,350,000 barrels (182.7 million gallons, or 691,600 m^3) of natural gas (MDNR, 2006).

As part of the DCPLNG expansion, the FERC has authorized construction and operation of two air separation units, a liquid nitrogen storage tank, an electric generation unit, and associated support facilities for injection of additional nitrogen into the gas distributed from the DCPLNG site (FERC, 2006a) (FERC, 2006b) (Dominion, 2007).

With the planned expansion of the DCPLNG facility, nearly 200 LNG tankers per year with a typical capacity of 91,557 to 183,113 yd^3 (70,000 to 140,000 m^3) will transit the Bay to this facility's north and south piers. Transfer of the LNG product to the onshore facility will occur through a 6,400 ft (1,951 m) submerged pipeline tunnel carrying two, 32 in (81 cm) liquid lines and two, 14 in (36 cm) vapor return lines. (MDNR, 2006) The offshore pier, from which the LNG is off loaded, is located in the Chesapeake Bay where the depth is approximately 43 ft (13 m). The offshore pier is accessible from the facility only through an underwater tunnel (NOAA, 2005). The hazards from the LNG product stored and transported at the DCPLNG facility are bounded by the LNG pipeline that is described in Section 2.2.2.3. The pipeline is considered the greater risk due to its pressure, diameter and closer proximity to the CCNPP Unit 3. Furthermore, the risk zones presented in the PPRP report show that the pipeline has the greatest potential risk impact on operations at the CCNPP (MDNR, 2006).

2.2.2.5 Highways

Calvert County has one main four-lane road, MD 2/4, bisecting the County north to south with smaller roads running from the main road to the water on each side. Very few of the smaller roads off MD 2/4 connect with each other; therefore, this highway services the bulk of the traffic for the length of the County. MD 2/4 runs adjacent to the CCNPP site and provides the main access to the site. Access to the site is via Calvert Cliffs Parkway and Road B from MD 2/4.

CCNPP Unit 3 is located approximately 1.2 mi (2.0 km) from MD 2/4 at its closest approach. In order to ascertain what hazardous materials may be transported on MD 2/4, Superfund Amendments and Reauthorization Act (SARA) Title III, Tier II reports were reviewed for Calvert and St. Mary's counties. Because Calvert County is a peninsula, it is unlikely that hazardous material will be transported through Calvert County on MD 2/4 if the hazardous material is not intended to be stored or delivered in either Calvert or St. Mary's counties.

Table 2.2-6 details the hazardous materials identified in the SARA reports that are potentially transported on MD 2/4, and summarizes the disposition of each of these chemicals with respect to the analyses performed in Section 2.2.3 (RAND, 2003) (BGE, 2006).

2.2.2.6 Railroads

There are no railroads within 5 mi (8 km) of the CCNPP site.

2.2.2.7 Aircraft and Airways

Regulatory Guide 1.70 (NRC, 1978b), Regulatory Guide 1.206 (NRC, 2007b), and NUREG-0800 (NRC, 2007a) identify that the risks due to aircraft hazards should be sufficiently low. In accordance with Regulatory Guide 1.206 and Regulatory Guide 1.70, one airport (Mears Creek Airfield) and two helipads (CCNPP Corporate Helipad and DCPLNG Helipad) were identified within a 5 mi (8 km) radius of the CCNPP site. Additionally, Regulatory Guide 4.7 (NRC, 1998) requires that major airports within 10 mi (16 km) be identified. There are an additional three airports located within 5 to 10 mi (8 to16 km) from the CCNPP site.

A more detailed description of each of these airports is presented in the subsequent sections, including distance and direction from the site, number and type of aircraft based at the airport, largest type of aircraft likely to land at the airport facility, runway orientation and length, runway composition, hours attended, and yearly operations where available. Information pertaining to airports located within 10 mi (16 km) of the site is presented in tabular form in Table 2.2-4. An evaluation of the closest major airports in the region is also presented in this table to ascertain whether these airports are or may be of significance in the future.

2.2.2.7.1 Airports

2.2.2.7.1.1 Mears Creek Airfield

Mears Creek Airfield is a privately owned airport for personal use located approximately 3 mi (5 km) southwest of the CCNPP site. Runway 15/33 is 1,600 ft (488 m) long by 60 ft (18 m) wide and is turf (GCR, 2006). Recent observations in October 2006 identified a wind sock and a maintained grassy field. Airport operations are characterized as sporadic and, as such, further evaluation is not warranted.

2.2.2.7.1.2 CCNPP Corporate Helipad

The CCNPP site operates its own corporate helipad. The helipad is located at the northern end of the CCNPP site, and is 3,500 ft (1,067 m) from the northern edge of the CCNPP Unit 3 site. This helipad is typically used for emergencies and corporate flights. Use of the corporate helipad is sporadic with most of the flights originating from the Constellation Energy corporate headquarters, which is located about 50 mi (80 km) north of the plant, near Baltimore, Maryland.

There are no specific flight paths or exclusion areas for helicopter flights in the vicinity of the plant; however, flight paths over the plant are generally not used unless weather conditions warrant such a route to ensure a safe landing or takeoff. There have been no helicopter accidents within the vicinity of the CCNPP site. No further analysis of this facility is warranted.

2.2.2.7.1.3 Dominion Cove Point Liquefied Natural Gas Helipad

The DCPLNG facility, which is located approximately 3.2 mi (5.1 km) south of the CCNPP site, has a corporate heliport. The heliport is a 50 ft by 50 ft (15 m by 15 m) concrete pad, and is reserved for private use. (Airnav, 2006) Use of the heliport is considered sporadic and no further analysis is warranted.

2.2.2.7.1.4 Chesapeake Ranch Airpark

The Chesapeake Ranch Airpark is a private community airport located about 6 mi (10 km) southwest of the CCNPP site. The airport provides direct access to Chesapeake Ranch Estates for non-commercial and small civil aircraft. The Chesapeake Ranch Airpark has a paved runway that is 2,500 ft (762 m) long and 50 ft (15 m) wide, with radio-operated runway lights, a lighted windsock, and clear approach zones.

The runway heading is 130 degrees (Runway 13) and 310 degrees (Runway 31). Alongside the paved runway is a parallel mowed grass strip that is 1,800 ft (549 m) long and 100 ft (30 m) wide. This serves double duty as a taxiway to the paved runway, and also as an alternate runway for pilots of small vintage aircraft. Air traffic is about 5 to 10 aircraft movements per day. There are approximately 25 occupied fly-in home sites with hangars adjacent to the airport common property with 27 single engine planes and 1 multi engine plane (GCR, 2006).

Due to the proximity of the Chesapeake Ranch Airpark to controlled airspace belonging to the Patuxent River Naval Air Station, which is approximately 4 mi (6 km) to the southwest, ultralight aircraft are not allowed to use the Chesapeake Ranch Airpark. The Chesapeake Ranch airpark includes an emergency MEDEVAC helicopter shuttle provided by the Maryland State Police to hospitals throughout the region. (POACRE, 2005) The number of operations at this airport falls below the significance factor provided in Regulatory Guide 1.206 (NRC, 2007b) therefore, further analysis is not required.

2.2.2.7.1.5 Captain Walter Francis Duke Regional Airport

The Captain Walter Francis Duke Regional Airport is located in Leonardtown, Maryland. The airport is approximately 10 mi (16 km) southwest of the CCNPP site. The airport is open to the public and has an asphalt runway 4,150 ft (1,265 m) long by 75 ft (23 m) wide. The runway heading is 112 magnetic, 102 true (Runway 11) and 292 magnetic, 282 true (Runway 29).

There are approximately 100 aircraft based on the field, including: 86 single engine airplanes, 8 multi engine airplanes, 3 helicopters; 1 glider; and 2 ultralights. Aircraft operations totaled 52,618 flights for the 12 months ending April 6, 2006 with 2,390 of the operations attributed to air taxis, 50,200 attributed to local and itinerant general aviation, and 28 attributed to military. There were also 2 ultralight operations logged in for this time period (Airnav, 2006) (GCR, 2006) (FAA, 2007).

2.2.2.7.1.6 Patuxent River Naval Air Station, Trapnell Field

The Patuxent River Naval Air Station (Trapnell Field) is located about 10 mi (16 km) south of the CCNPP site. The U.S. Navy owns the airport, and the airport is for private use, with permission required prior to landing. There are three runways:

- Runway 6/24 is an asphalt runway that is 11,807 ft (3,599 m) long and 200 ft (61 m) wide and a heading of 059 magnetic, 049 true (Runway 6) and 239 magnetic, 229 true (Runway 24). There are seven instrument approach paths for Runway 6/24 dependent upon the navigational system. Of these approach paths, four of the approach paths pass within the vicinity of the CCNPP site.

- Runway 14/32 is a concrete runway 9,742 ft (2,969 m) long and 200 ft (61 m) wide with a heading of 136 magnetic, 126 true (Runway 14) and 316 magnetic, 306 true (Runway

32). There are six instrument approach paths for Runway 14/32. Of these approach paths, two of the approach paths pass within the vicinity of the CCNPP site.

- Runway 2/20 is an asphalt runway 5,021 ft (1,530 m) long and 75 ft (23 m) wide with a heading of 018 magnetic, 008 true (Runway 2) and 198 magnetic, 188 true (Runway 20).

The traffic pattern for each of the runways is left (Airnav, 2006). The number of operations for 2005 totaled 52,626 and no major changes in the number of air operations or the size of aircraft are anticipated.

2.2.2.7.2 Aircraft and Airways

Regulatory Guide 1.70, Regulatory Guide 1.206, and NUREG-0800 indicates the risks due to aircraft hazards should be sufficiently low. Further, aircraft accidents that could lead to radiological consequences in excess of the exposure guidelines of 10 CFR 50.34(a)(1) with a probability of occurrence greater than 1E-7 per year should be considered in the design of the plant.

NUREG-0800, Section 3.5.1.6 provides a three part acceptance criteria test for concluding the probability of aircraft accidents to be less than 1E-7 per year: (1) meeting plant-to-airport distance and projected annual operations criteria; (2) plant is at least 5 mi (8 km) from military training routes; and, (3) plant is at least 2 statute mi (3.2 km) beyond the nearest edge of a federal airway.

There exist two airports presented in the preceding sections, Captain Walter Francis Duke Regional Airport and the Patuxent River Naval Air Station, located between 5 to 10 mi (8 to 16 km) from the CCNPP site that have projected annual operations greater than the plant-to-airport distance acceptance criteria (significance factor). Both airports are approximately 10 mi (16 km) from the CCNPP site, giving each a significance factor of 50,000 annual operations, as determined by the methodology provided in Regulatory Guide 1.206. The Captain Walter Francis Duke Regional Airport has approximately 52,618 annual operations, while the Patuxent River Naval Air Station has approximately 52,626 annual operations.

Additionally, as shown in Figure 2.2-2, the centerline of Airway V31 is approximately 2.2 mi (3.5 km) west of the CCNPP site, and the centerline of Airway V93 is about 4.6 mi (7.3 km) east of the CCNPP site (FAA, 2006). The width of a federal airway is typically 8 nautical mi (14.8 km), 4 nautical mi (7.4 km) on each side of the centerline. When airway width is considered, both airways pass closer than 2 statute mi (3.2 km) to the nearest edge of the CCNPP site.

The centerline of V16-157 is approximately 7.5 mi (12.1 km) from CCNPP Unit 3, placing the airway further than 2 mi (3.2 km) from the nearest edge. The edge of the closest high altitude airway, J-191, is also located further than 2 mi (3.2 km) from CCNPP Unit 3.

Due to the close proximity of the airways V31 and V93 to the CCNPP site, the acceptance criteria identified in Section 3.5.1.6 of NUREG-0800, requiring the plant to be at least 2 statute mi beyond the nearest edge of a federal airway, is not met. A calculation to determine the probability of aircraft accidents which could potentially result in radiological consequences for the U.S. EPR at the CCNPP site was conducted following the methodology presented in Department of Energy (DOE) Standard, DOE-STD-3014-2006 (DOE, 2006a). The analysis provided an estimate of the total aircraft impact frequency for the facility of 6.79E-6/yr.

Because the impact frequency is calculated to be greater than 1E-7 for both airport operations criteria and property to airways, a probabilistic risk assessment which takes into account the core damage frequency and containment release frequency, is presented in Section 19.1.5.

2.2.2.8 Projections of Industrial Growth

A review of Calvert County's Comprehensive Plan indicates that the current industrial zoning totals 2,234 acres (904 ha), with two major industries, CCNPP Units 1 and 2 and Dominion Cove Point Liquefied Natural Gas, owning 1,486 acres (601 ha), or 66%, of these acres. Most of this land is buffer and cannot be developed. The remaining 748 acres (303 ha) includes 227 acres (92 hectares) of the Calvert County Industrial Park, which is nearly fully developed (CALCO, 2004). The Calvert County Industrial Park is located just west of Prince Frederick on Route 231, approximately 11 mi (18 km) from the CCNPP site.

Significant industrial facilities located within 5 mi (8 km) of the CCNPP site are shown on Figure 2.2-1, and a concise description of these facilities is provided in Table 2.2-1. A review of county planning documents does not indicate any future projections of major industrial, military, or transportation facilities located within the vicinity of the CCNPP site with the exceptions of the future development of CCNPP and the DCPLNG site. Planned expansions of these facilities were described in the preceding sections.}

2.2.3 Evaluation of Potential Accidents

The U.S. EPR FSAR includes the following COL Item in Section 2.3:

> A COL applicant that references the U.S. EPR design certification will provide information concerning site-specific evaluations to determine the consequences that potential accidents at nearby industrial, transportation, and military facilities could have on the site. The information provided by the COL applicant will include specific changes made to the U.S. EPR design to qualify the design of the site against potential external accidents with an unacceptable probability of severe consequences.

This COL Item is addressed as follows:

{On the basis of the information provided in Section 2.2.1 and Section 2.2.2, the potential accidents to be considered as design-basis events and the potential effects of those accidents on the nuclear plant, in terms of design parameters (e.g., overpressure, missile energies) or physical phenomena (e.g., impact, flammable or toxic clouds) were identified in accordance with 10 CFR 20 (CFR, 2007a), 10 CFR 52.79(a)(1)(vi) (CFR, 2007g), 10 CFR 50.34 (CFR, 2007c), 10 CFR 100.20 (CFR, 2007e) 10 CFR 100.21 (CFR, 2007f), Regulatory Guide 1.70 (NRC, 1978b), Regulatory Guide 1.78 (NRC, 2001), Regulatory Guide 1.91 (NRC, 1978a), Regulatory Guide 1.206 (NRC, 2007b), and Regulatory Guide 4.7 (NRC, 1998). The events are discussed in the following sections.

Sections 2.2.3.1 and 2.2.3.2 are added as a supplement to the U.S. EPR FSAR.

2.2.3.1 Determination of Design-Basis Events

Design-basis events internal and external to the nuclear plant are defined as those accidents that have a probability of occurrence on the order of magnitude of 1E-7 per year, or greater, with the potential consequences serious enough to affect the safety of the plant to the extent that the guidelines in 10 CFR Part 100 (CFR, 2007d) could be exceeded. The following accident categories were considered in selecting design-basis events: explosions, flammable vapor clouds (delayed ignition), toxic chemicals, fires, collisions with intake structure, liquid spills, and radiological hazards. The postulated accidents that would result in a chemical release were analyzed at the following locations:

- Nearby transportation routes MD 2/4, the Chesapeake Bay navigable waterway, and DCPLNG Pipeline
- Nearby chemical and fuel storage facilities (DCPLNG)
- Onsite chemical storage (CCNPP Units 1, 2, and 3)

With regard to the DCPLNG facility and Dominion Cove Point LNG pipeline, the Maryland Power Plant Research Program (PPRP) commissioned an independent risk study (i.e., hazard study), "Cove Point LNG Terminal Expansion Risk Study," to assess the risks associated with the expansion of the DCPLNG facility and associated pipeline to nearby residential communities and the CCNPP site.

The probability of occurrence of a fatality at CCNPP from hazardous events associated with the existing DCPLNG facility is estimated to be 2.3E-9 per year. The probability of occurrence of physical damage to CCNPP is estimated to be lower still. Further, the probability of occurrence for a fatality involving the proposed expansion of the DCPLNG facility is estimated to be 6.6E-9 per year at CCNPP, with the risk of physical damage to the CCNPP estimated to be even smaller (MDNR, 2006).

The quantified risks to CCNPP presented in the PPRP study are below the threshold of acceptable risks defined by the U.S. Nuclear Regulatory Commission (i.e., less than 1E-7 per year). Where more specific analyses are available for individual accident categories than are provided in the PPRP study (e.g., jet fire, flash fire), those results will be presented in the following sections.

2.2.3.1.1 Explosions

Accidents involving detonations of high explosives, munitions, chemicals, or liquid and gaseous fuels were considered for facilities and activities in the vicinity of the plant or onsite, where such materials are processed, stored, used, or transported in quantity. The effects of explosions are a concern in analyzing structural response to blast pressures. The effects of blast pressure from explosions from nearby railways, highways, navigable waterways, or facilities to critical plant structures were evaluated to determine if the explosion would have an adverse effect on plant operation or would prevent a safe shutdown.

The allowable and actual distances of hazardous chemicals transported or stored were determined in accordance with NRC Regulatory Guide 1.91, Revision 1, Evaluations of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plants (NRC, 1978a). Regulatory Guide 1.91 cites 1 psi (6.9 kPa) as a conservative value of peak positive incident overpressure, below which no significant damage would be expected. Regulatory Guide 1.91 defines this safe distance by the relationship $R \geq kW^{1/3}$ where R is the distance in feet from an exploding charge of W pounds of TNT; and the value k is a constant. The TNT mass equivalent, W, was determined following guidance in NUREG-1805 (NRC, 2004a), where $W=M_{Vapor} * \Delta H_C * Y_f/2000$ and M_{Vapor} is the flammable vapor mass, ΔH_C is the heat of combustion and Y_f is the explosion yield factor.

Conservative assumptions were used to determine a safe distance, or minimum separation distance, required for an explosion to have less than 1 psi (6.9 kPa) peak incident pressure. In each of the explosion scenario analyses, an explosion yield factor of 100 percent was applied to account for an in-vessel confined explosion. The yield factor is an estimation of the available combustion energy released during the explosion as well as a measure of the explosion confinement (NRC, 2004a). This is a conservative assumption because a 100 percent yield factor is not achievable (FMIC, 2005):

- For atmospheric liquids (i.e., gasoline, toluene, etc.) the storage vessel was assumed to contain the quantity of fuel vapors in air at the upper explosive limit. This is conservative because this scenario produces the maximum flammable mass given that it is the fuel vapor, not the liquid fuel that explodes (NRC, 2004a). These assumptions are consistent with those used in Chapter 15 of NUREG-1805 (NRC, 2004a).

- For compressed or liquefied gases (i.e., propane, hydrogen), it was conservatively assumed that the entire content of the storage vessel will be between the upper and lower explosive limits, given that the instantaneous depressurization of the vessel would result in vapor concentrations throughout the explosive range at varying pressures and temperatures that could not be assumed. Therefore, the entire content of the storage vessel was considered as the flammable mass.

The onsite chemicals (Table 2.2-5), hazardous materials potentially transported on (MD) 2/4 (Table 2.2-6), and hazardous materials transported on navigable waterways (Table 2.2-7) were evaluated to ascertain which hazardous materials had the potential to explode, thereby requiring further analysis. The effects of selected explosion events from internal and external sources are summarized in Table 2.2-8 and in the following sections relative to the release source.

Pipelines

The DCPLNG facility operates a pipeline corridor that passes with in the vicinity of the CCNPP site. Section 2.2.3 addresses the overall risk from the OCPLNG facility and pipeline. Experiments have indicated that detonations of mixtures of methane (greater than 85%) with air do not present a credible outdoor explosion event. (FMIC, 2005) Further, there have been no reported vapor cloud explosions involving natural gas with high methane content-there have been numerous reports of vapor clouds igniting resulting in flash fires without overpressures. (FMIC, 2005) Therefore, an outdoor natural gas explosion resulting from a ruptured gas pipeline is considered an unlikely event. Thus, the ignition of a natural gas cloud within a confined or congested space, such as woodlands, which may produce damaging explosion overpressures, was considered the bounding event and is presented in Section 2.2.3.1.2. Therefore, it was concluded that damaging overpressures from an explosion from a rupture in the DCPLNG pipeline would not adversely affect the operations of CCNPP Unit 3.

Waterway Traffic

The nearest safety related structure for CCNPP Unit 3, which is the Ultimate Heat Sink makeup intake structure, is located approximately 11,678 ft (3.6 km) at its closest distance to potential waterway traffic. This assumption is very conservative, as it is more likely that waterway traffic will be traveling toward the center of the channel where it is deeper (approximately 3 mi (4.8 km) from CCNPP Unit 3). The hazardous materials transported on barges or chemical parcel tankers that were identified for further analysis with regard to explosion potential were gasoline, benzene, and toluene. Anhydrous ammonia was not included as a point source hazard because ammonia is extremely hard to ignite. Studies have demonstrated that an ammonia-air mixture does not ignite at less than 1562 °F (ANSI, 1989). The U.S. Coast Guard designates anhydrous ammonia as "not flammable under conditions likely to be encountered" (USCG, 2006).

The maximum quantity of gasoline, benzene, and toluene assumed to be carried on a vessel was 5.2 million pounds (2.4 million kg) (CRS, 2005). Using the conservative methodology described in Section 2.2.3.1 (i.e, greater than 1 psi (6.9 kPa) peak incident pressure), the nearest safety-related CCNPP Unit 3 structure (i.e., Ultimate Heat Sink makeup intake structure) to a point on the navigable waterway where potential waterway traffic may pass is outside of the minimum separation distance (i.e., safe distance) where peak incident pressures may be assumed to result in damage to structures.

Therefore, an explosion from any of the identified chemicals potentially transported on navigable waters in the Chesapeake Bay, would not adversely affect the safe operation of CCNPP Unit 3. The minimum separation distance for gasoline is 1,222 ft (372 m); for benzene 1,076 ft (328 m); and for toluene, 1,072 ft (327 m) (Table 2.2-8).

Highways

Table 2.2-6 details the hazardous materials potentially transported on MD 2/4 (RAND, 2003) (BGE, 2006). The materials that were identified for further analysis for explosion potential were: gasoline, gasoline (aviation), and liquid propane. The maximum quantity of the identified chemicals assumed to be transported on the roadway was 50,000 pounds (22,680 kg).

An analysis of the identified chemicals was conducted using TNT equivalency methodologies, as described in Section 2.2.3.1.1. The results indicate that the minimum separation distances (i.e., safe distances) are less than the shortest distance to a safety-related CCNPP Unit 3 structure from any point on MD 2/4. The closest safety-related CCNPP Unit 3 structure is located approximately 6,119 ft (1.9 km) from MD 2/4. The minimum separation distance for gasoline was calculated to be 263 ft (80.1 m); for aviation gasoline 260 ft (79.2 m); and for liquid propane, 3,559 ft (1.1 km). (Table 2.2-8). Therefore, an explosion involving potentially transported hazardous materials on MD 2/4, would not adversely affect operation of CCNPP Unit 3.

Onsite Chemicals

The hazardous materials stored onsite that were identified for further analysis with regard to explosion potential were: gasoline, hydrazine (35% solution), dimethylamine (2% solution), and hydrogen stored at Units 1 & 2. One of the water treatment chemicals, a non-oxidizing biocide containing ethanol, and gas cylinders containing argon-methane, hydrogen, and oxygen stored near Unit 3 were also analyzed for explosion potential.

The 4,000 gallon (15,140 L) onsite gasoline tank is an underground storage tank. Therefore, it was assumed that the explosion would be bounded by an event involving a 3,500 gallon (13,250 l) gasoline delivery tanker, either in route, or during or following a filling operation. A conservative analysis using TNT equivalency methods as described in Section 2.2.3.1 was used to determine safe distances for the storage of the identified hazardous materials.

Oxygen is not explosive by ignition, however gas cylinders have the potential for explosion due to overpressure. Therefore, the equivalent mass of TNT from oxygen was calculated using this methodology (NRC, 1985).

The results using this methodology indicate that the minimum separation distances (i.e., safe distances) are less than the shortest distance to a safety-related CCNPP Unit 3 structures and the storage location of any of the identified chemicals. Therefore, an explosion from any of the onsite hazardous materials evaluated would not adversely affect operation of CCNPP Unit 3. The safe distance for gasoline is 196 ft (60 m); for hydrazine (35% solution), 114 ft (35 m); for dimethylamine (2% solution), 85 ft (26 m); for hydrogen, 224 ft (68 m). Gasoline is stored approximately 310 ft (94 m); hydrazine (35% solution) approximately 891 ft (272 m); dimethylamine (2% solution) approximately 462 ft (141 m); and hydrogen 745 ft (227 m); from the nearest safety-related structure for CCNPP Unit 3 (Table 2.2-8). The non-oxidizing biocide containing ethanol and the argon-methane gas, hydrogen gas, and oxygen gas cylinders are stored at distances greater than those reported in Table 2.2-8.

Nearby Facilities

The Dominion Cove Point Liquefied Natural Gas (DCPLNG) facility operates within the vicinity of the CCNPP site. As described in Section 2.2.2.4.2 the DCPLNG facility is bounded for explosions by the LNG pipeline. Furthermore, Section 2.2.3 addresses the overall risk from the DCPLNG facility. Blast overpressure impacts were taken into account in developing the risk analysis. Damaging overpressures from an explosion resulting from a complete tank failure at the DCPLNG facility would not adversely affect the operations of CCNPP Unit 3 (MDNR, 2006).

Explosion Related Impacts Affecting the U.S. EPR Design

The U.S. EPR design is acceptable for any site when reasonable qualitative arguments can demonstrate that the realistic probability of severe consequences from any external accident is less than 1E-6 per year. Regulatory Guide 1.91 (NRC, 1978a) cites 1 psi (6.9 kPa) as a conservative value of peak positive incident overpressure, below which no significant damage would be expected. Safety-related CCNPP Unit 3 structures are designed to withstand a peak positive overpressure of at least 1 psi without loss of function.

The analyses presented in this section demonstrate that a 1 psi (6.9 kPa) peak positive overpressure will not be exceeded at a safety-related structure for any of the postulated explosion event scenarios. As a result, postulated explosion event scenarios will not result in severe consequences.

2.2.3.1.2 Flammable Vapor Clouds (Delayed Ignition)

Flammable gases in the liquid or gaseous state can form an unconfined vapor cloud that could drift toward the plant before ignition occurs. When a flammable chemical is released into the atmosphere and forms a vapor cloud it disperses as it travels downwind. The parts of the cloud where the concentration is within the flammable range, between the lower and upper flammability limits, may burn if the cloud encounters an ignition source. The speed at which the flame front moves through the cloud determines whether it is a deflagration or a detonation. If the cloud burns fast enough to create a detonation an explosive force is generated.

The potential onsite chemicals are shown in Table 2.2-5. Hazardous materials potentially transported on MD 2/4 are shown on Table 2.2-6, and hazardous materials transported on navigable waterways are shown on Table 2.2-7. These chemicals were evaluated to ascertain which hazardous materials had the potential to form a flammable vapor cloud or vapor cloud explosion. For those chemicals with an identified flammability range, the Areal Locations of Hazardous Atmospheres (ALOHA) air dispersion model was used to determine the distances where the vapor cloud may exist between the upper flammability limit (UFL) and the lower flammability limit (LFL), presenting the possibility of ignition and potential thermal radiation effects (ALOHA, 2007).

The identified chemicals were also evaluated to determine the possible effects of a flammable vapor cloud explosion. ALOHA was used to model the worst case accidental vapor cloud explosion, including the safe distances and overpressure effects at the nearest safety-related CCNPP Unit 3 structure. To model the worst case in ALOHA, ignition by detonation was chosen for the ignition source. The safe distance was measured as the distance from the spill site to the location where the pressure wave is at 1 psi (6.9 kPa) overpressure.

Conservative assumptions were used in both ALOHA analyses with regard to meteorological inputs and identified scenarios. Sensitivity analyses were performed to determine the worst case combination of stability class and wind speed–unless otherwise noted, the determined worst case meteorological conditions from the sensitivity analysis, were: Pasquill stability class F (stable), with a wind speed of 1 m/sec. Along with the determined worst case meteorological condition, the following meteorological assumptions were used as inputs to the computer model, ALOHA: ambient temperature of 25°C; relative humidity 50%; cloud cover 50%; and an atmospheric pressure of 1 atmosphere. For each of the identified chemicals, it was conservatively assumed that the entire contents of the vessel leaked forming a 1 cm thick puddle. This provides a significant surface area to maximize evaporation and the formation of a vapor cloud.

The analyzed effects of flammable vapor clouds and vapor cloud explosions from internal and external sources are summarized in Table 2.2-9 and are described in the following sections relative to the release source.

Pipelines

The DCPLNG facility operates a pipeline corridor that passes within the vicinity of the CCNPP site. At its closest distance, this pipeline passes within approximately 1.54 mi (2.48 km) of CCNPP Unit 3.

The Maryland Power Plant Research Program commissioned an independent risk study (i.e., hazard study) that addressed the overall risk from the facility and pipeline (MDNR, 2006). Looking specifically at the rupture of the gas pipeline, the study indicates that the frequency of occurrence is 3.60E-3 for the existing site (based on 13.1 mi (21.1 km) of existing gas export pipeline) and 7.48E-3 for the expanded site (based on 13.1 mi (21.1 km) of existing and 14.1 mi (22.7 km) of new gas export pipeline).

Therefore, a vapor cloud explosion analysis, was conducted In order to obtain the safe distance. The result indicate that the safe distance, the minimum distance required for an explosion to have less than a one psi peak incident pressure, is much less than the shortest distance to the nearest safety related structure for CCNPP Unit 3. The safe distance for the natural gas pipeline is 1.1 mi (1.8 km).

Further, the Maryland Power Plant Research Program's independent risk study analyzed the consequences of both a jet and pool fire from the rupture of the gas pipeline. The safe distance for exposure to thermal consequences resulting from a rupture of the gas pipeline or for jet fires is 2,362 ft (720 m), or 0.45 mi (0.72 km). The safe distance is identified as the maximum distance where thermal radiation heat flux exceeds 10,000 Btu/hr-sq ft (980 kJ/hr-sq m). At a thermal flux of 10,000 Btu/hr-sq ft (980 kJ/hr-sq m), a high thermal dose is achieved rapidly, offering little chance of escape for exposed individuals. The maximum range for flash fires is 722 ft (220 m), or 0.14 mi (0.22 km), and is measured as the distance to the LFL (MDNR, 2006).

The overpressure, jet fire and flash fire safe distances are significantly less than the distance from the pipeline to the CCNPP site. Therefore, a flammable vapor cloud ignition or explosion from a rupture in the DCPLNG pipeline would not adversely affect operation of CCNPP Unit 3. The results of flammable vapor cloud ignition analyses are summarized in Table 2.2-9.

Waterway Traffic

CCNPP Unit 3 is located about 1,000 ft (305 m) from the west bank of the Chesapeake Bay. The plausible chemicals identified for further analysis due to their capability of forming a vapor cloud with delayed ignition and possibly exploding are: gasoline; benzene; toluene; ammonia; and liquefied natural gas. Despite its poor ability to ignite, anhydrous ammonia is conservatively evaluated as a potential flammable vapor cloud. Studies have demonstrated that an ammonia-air mixture does not ignite at less than 1562°F (ANSI, 1989). If spilled, ammonia would immediately vaporize and form a vapor cloud at a rate far greater than gasoline, benzene or toluene.

As detailed in Section 2.2.2.4.2, the DCPLNG facility operates a liquefied natural gas facility with an offshore terminal located approximately 3.2 mi (5.2 km) south of the CCNPP site. It is estimated that approximately 90 LNG tankers per year currently transit the Chesapeake Bay to the DCPLNG terminal. With the planned expansion of the DCPLNG facility, nearly 200 LNG tankers per year will transit the Bay to this facility. Section 2.2.3 addresses the overall risks associated with the DCPLNG facility for both the current and planned expansion, including its terminal, to the CCNPP site (MDNR, 2006).

The specific hazards associated with LNG tankers in the vicinity of the CCNPP site are presented in Table 2.2-9. The greatest consequence range presented, 13,943 ft (4,250 m), or 2.64 mi (4.25 km), was for the scenario where a total loss of LNG tanker inventory occurred. This maximum range is less than the distance from the postulated accident site to the CCNPP site. It is also less than the 3.4 mi (5.5 km) exclusion zone the U.S. Coast Guard committed to establish for LNG tankers in the vicinity of the CCNPP site (NRC, 2004b).

An analysis was conducted for the remaining identified hazardous materials, gasoline, benzene, toluene, and ammonia. The conservative methodology presented in Section 2.2.3.1 was used to determine the distance the formed vapor cloud could travel prior to ignition (the lower flammability limit (LFL) boundary) utilizing the ALOHA dispersion modeling. The maximum quantity of gasoline, benzene and toluene spilled on the water was assumed to be 5.2 million pounds (2.4 million kg) (CRS, 2005). For these cases, the maximum allowable surface area of the spill that ALOHA would allow 31,400 m^2 (337,987 ft^2) was used.

Using data from the U.S. Army Corps of Engineers for the Port of Baltimore, the quantity of ammonia transported annually in proximity to the CCNPP site is 2.0 million pounds (0.9 million kg) (USACE, 2004a) (USACE, 2004b). The frequency of transport was not available; consequently, it was conservatively assumed that the entire 2.0 million pounds (0.9 million kg) was transported in one shipment and released.

For the analysis of ammonia, a partition coefficient of 0.6 was applied to the 2.0 million pounds (0.9 million kg) to account for the high rate at which ammonia dissolves in water as ALOHA does not account for this phenomena (Raj, 1974). The quantity of ammonia assumed in the analysis of distance to the LFL and the minimum separation distance (i.e., safe distance) was 1.2 million pounds (0.54 million kg).

For the identified chemicals, the distances to the LFL, which is the safe distance for: gasoline, 1,464 ft (446 m); benzene, 2,172 ft (662 m); toluene, 1,302 ft (397 m); and ammonia, 6,864 ft (2,092 m). Each of these distances is less than the minimum distance to the nearest safety related CCNPP Unit 3 structure from a probable release point on a navigable portion of the Chesapeake Bay. Therefore, a flammable vapor cloud with the possibility of ignition from a transported hazardous material on the Chesapeake Bay, would not adversely affect the safe operation of CCNPP Unit 3.

Additionally, because each of the identified chemicals has the potential to explode, a vapor cloud explosion analysis was performed as described in Section 2.2.3.1.2. The results of the vapor cloud explosion analysis indicate that the safe distances, the minimum distances, with drift taken into consideration, required for an explosion to have less than a 1 psi (6.9 kPa) peak incident pressure, are less than the shortest distance to the nearest safety related structure for CCNPP Unit 3, the intake structure, and a probable release point on the Chesapeake Bay. The safe distance for gasoline is 3,312 ft (1,009 m); for benzene, 4,095 ft (1,248 m); for toluene, 2,604 ft (794 m); and for ammonia, 10,032 ft (3,058 m). (Table 2.2-9) Therefore, a flammable vapor cloud with the possibility of explosion from a transported hazardous material on the Chesapeake Bay would not adversely affect the safe operation of CCNPP Unit 3.

The results of flammable vapor cloud ignition and explosion analyses are summarized in Table 2.2-9.

Highways

The closest safety-related CCNPP Unit 3 structure is located approximately 6,119 ft (1.9 km) from MD 2/4. The hazardous materials potentially transported on MD 2/4 that were identified for further analysis were: gasoline, gasoline (aviation), and liquid propane. The methodology presented previously in Section 2.2.3.1.2 was used for determining the safe distance for vapor cloud ignition and delayed vapor cloud explosion. Consistent with Regulatory Guide 1.91 (NRC, 1978a), it was conservatively estimated that the transport vessel carried and released 50,000 pounds (22,700 kg) of the identified chemical.

The results for the selected hazardous materials indicate that any plausible vapor cloud that may form and mix sufficiently under stable atmospheric conditions will be below LFL concentrations (i.e., the safe distance for the possibility of ignition and potential thermal radiation effects) prior to reaching the CCNPP Unit 3 site boundary. The distance to the LFL boundary for gasoline is 393 ft (120 m); for aviation gasoline, 414 ft (126 m); and for propane, 2,361 ft (720 m). Therefore, a flammable vapor cloud ignition involving hazardous materials with the potential to be transported on MD 2/4, would not adversely affect the safe operation of CCNPP Unit 3.

Each of the identified hazardous materials was also evaluated, using the methodology presented previously in this section, to determine the effects of a possible vapor cloud explosion. The minimum separation distances (i.e., safe distance) for gasoline is 999 ft (304 m); for aviation gasoline, 1,002 ft (305 m); and for liquid propane, 4,185 ft (1,276 m). The minimum separation distances for explosions involving the identified chemicals to have less than a 1 psi (6.9 kPa) peak incident pressure from a drifted vapor cloud are less than the shortest distance to safety-related CCNPP Unit 3 structures and any point on MD 2/4. Therefore, a delayed flammable vapor cloud explosion involving the identified hazardous material with the potential to be transported on MD 2/4, would not adversely affect the safe operation of CCNPP Unit 3.

The results of flammable vapor cloud ignition and explosion analyses are summarized in Table 2.2-9.

Onsite Chemicals

The hazardous materials stored at the CCNPP Units 1 and 2 site that were identified for further analysis with regard to the potential of delayed ignition and explosion of flammable vapor clouds were: gasoline; hydrazine (35% solution); dimethylamine (2% solution); and hydrogen. One of the water treatment chemicals, a non-oxidizing biocide containing ethanol, and argon-methane and hydrogen gas cylinders stored at Unit 3 were identified for further analysis.

As described previously in Section 2.2.3.1.2, the ALOHA dispersion model was used to determine the distance a vapor cloud can travel before reaching the LFL boundary (i.e., the safe distance for exposure to thermal radiation heat flux) once a vapor cloud has formed from release of the identified chemical. The distances to the LFL boundary from the release point for the identified chemicals are: gasoline, 234 ft (71 m); hydrazine (35% solution), less than 33 ft (10 m); dimethylamine (2% solution), 45 ft (14 m); hydrogen; 492 ft (150 m); argon-methane gas cylinder 69 ft (21 m); and hydrogen gas cylinder 75 ft (23 m). Each of these distances is less than the distance from a potential release site to the nearest safety-related CCNPP Unit 3 structure. The non-oxidizing biocide containing ethanol and the argon-methane gas and hydrogen gas cylinders are stored at distances greater than those reported in Table 2.2-9.

A vapor cloud explosion analysis was also performed using the methodology described in Section 2.2.3.1.2 to obtain minimum separation distances (i.e., safe distances) for the identified chemicals. With the exception of a postulated release from a gasoline tanker, the results indicate that the minimum separation distance (i.e., the distance required for an explosion to have less than a 1 psi (6.9 kPa) peak incident pressure) are less than the shortest distance to a safety-related CCNPP Unit 3 structure from the storage location of these chemicals.

The minimum separation distance for the 3,500 gallon (13,250 l) gasoline tank truck is 648 ft (198 m). Minimum separation distance for other identified chemicals are: hydrazine (35% solution), N/A (no explosion can occur at resulting concentrations); dimethylamine (2% solution), 180 ft (55 m); hydrogen, 738 ft (225 m); argon-methane gas cylinder 126 ft (38 m); hydrogen gas cylinder 138 ft (42 m). Except for gasoline, each of these chemicals is stored further away from CCNPP Unit 3 than the minimum separation distance. The filling operation for gasoline occurs approximately 310 ft (95 m) from the nearest safety-related CCNPP Unit 3 structure, which is the Ultimate Heat Sink. The storage of other identified chemicals stored at CCNPP Units 1 and 2 relative to the nearest safety related CCNPP Unit 3 structure, which is the Ultimate Heat Sink makeup intake structure, are: hydrazine, approximately 891 ft (272 m); dimethylamine (2% solution), 462 ft; and hydrogen, 745 ft (227 m).

The evaluation of the vapor cloud explosion events was performed for each of the identified chemicals to determine if the safe distances meet the guidance established in Regulatory Guide 1.91 (NRC, 1978a) and if any qualified as a design-basis event; that is, an accident that has a probability of occurrence on the order of magnitude of 1E-07 per year, or greater, with potential consequences serious enough to affect the safety of the plant to the extent that the guidelines in 10 CFR Part 100 could be exceeded. The expected rate of occurrence for exceeding the guidelines in 10 CFR Part 100 (on the order of magnitude of 1E-06 per year) is acceptable if, when combined with reasonable qualitative arguments, the realistic probability can be shown to be lower.

In evaluating the gasoline tanker spill, the following inputs were used in the ALOHA model:

- Pasquill Stability Class F selected to represent the most limiting 5% of meteorological conditions observed.
- A low wind speed of 1 meter per second selected to represent the most limiting 5% conditions. Low wind speed conditions prevent the vapor cloud from dispersing as it travels.
- The time of day selected was 12:00 pm on July 1, 2006. This day and time were chosen because temperatures are highest in the summer during the midday. Higher temperatures lead to a higher evaporation rate, and thus, a larger vapor cloud.
- The tank was filled to capacity and a catastrophic tank failure was assumed where the total amount of the substance leaked forming a 1 cm thick puddle. A 1 cm thick puddle allows for greater evaporation, and thus, a larger vapor cloud.

A probabilistic analysis was then performed for each identified chemical that was analyzed to have significant potential impacts that could exceed the guidelines in 10 CFR Part 100. Gasoline was the only identified chemical analyzed that merited a probabilistic analysis. The probabilistic analysis for gasoline assumed that each accident that occurred would result in a significant incident, an explosion.

For a gasoline refueling tanker, the probability of an accident occurring involving a truck within the exposure distance from the ultimate heat sink was identified as 2.03E-7 per year. This accident rate is based upon Maryland State Highway Administration large truck accident data for Calvert County, Maryland (MSHA, 2004). Large trucks are defined as over 10,000 pounds (4,540 kg) gross vehicle rating. The actual accident rate for gasoline delivery tankers in the vicinity of the CCNPP Unit 3 facility would be expected to be somewhat lower than the cited accident rate, given that vehicle operation speeds on the CCNPP site are considerably lower than they are on highways.

Therefore, a flammable vapor cloud ignition or vapor cloud explosion involving the identified chemicals would not adversely affect the safe operation of CCNPP Unit 3.

The results of flammable vapor cloud ignition and explosion analyses are summarized in Table 2.2-9.

Nearby Facilities

The DCPLNG facility is located approximately 3.2 mi (5.1 km) from the CCNPP site. As described in Section 2.2.2.4.2 the DCPLNG facility is bounded for flammable vapor clouds by the LNG pipeline. Furthermore, Section 2.2.3 addresses the overall risk from the DCPLNG facility. This risk evaluation included a worst case scenario where a total loss of the storage tanks was considered. The consequence distance for a pool fire under this worst case scenario is 1,188 ft (362 m) and for flash fires 5,413 ft (1,650 m), both of which are less than the distance from the storage tanks to CCNPP Unit 3. These distances are measured as the distance to the LFL for a flash fire, and a thermal flux of 10,000 Btu/hr-sq ft (980 kJ/hr sq m) for a pool fire or jet fire (MDNR, 2006).

Flammable Vapor Cloud (Delayed Ignition) Related Impacts Affecting the U.S. EPR Design

The U.S. EPR design is acceptable for any site when reasonable qualitative arguments can demonstrate that the realistic probability of severe consequences from any external accident is less than 1E-6 occurrences per year. Regulatory Guide 1.91 (NRC, 1978a) cites 1 psi (6.9 kPa) as a conservative value of peak positive incident overpressure, below which no significant damage would be expected. Safety-related CCNPP Unit 3 structures are designed to withstand a peak positive overpressure of at least 1 psi without loss of function.

The analyses presented in this section demonstrate that a 1 psi (6.9 kPa) peak positive overpressure will not be exceeded at a safety-related structure for any of the postulated flammable vapor cloud, delayed ignition event scenarios, except for gasoline. For the vapor cloud, delayed ignition event involving gasoline, it was demonstrated that the event probability is less than 1E-6. As a result, each of the postulated vapor cloud, delayed ignition event scenarios has been demonstrated to either not result in severe consequences, or to have an event frequency that is less than 1E-6 per year.

2.2.3.1.3 Toxic Chemicals

Accidents involving the release of toxic or asphyxiating chemicals from onsite storage facilities and nearby mobile and stationary sources were considered. Toxic chemicals known to be present on site or in the vicinity of the CCNPP site, or to be frequently transported in the vicinity were evaluated. NRC Regulatory Guide 1.78, Revision 1, Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release (NRC, 2001), requires evaluation of control room habitability after a postulated external release of hazardous chemicals from mobile or stationary sources, offsite or onsite.

The potential onsite chemicals are identified in Table 2.2-5; hazardous materials potentially transported on MD 2/4 are identified in Table 2.2-6; and hazardous materials transported on navigable waterways are identified in Table 2.2-7. These chemicals were evaluated to ascertain which hazardous materials were subsequently analyzed with respect to their potential to form a toxic or asphyxiating vapor cloud after an accidental release.

The ALOHA air dispersion model was used to predict the concentrations of toxic or asphyxiating chemical clouds as they disperse downwind. In the case of a toxic vapor cloud, the maximum distance a postulated vapor cloud would travel before it dispersed enough to fall below the associated National Institute of Occupational Safety and Health (NIOSH) defined Immediately Dangerous to Life and Health (IDLH) threshold value or other defined toxicity limit concentration in the vapor cloud was determined. Asphyxiating chemicals were evaluated to determine the maximum distance an asphyxiating cloud would travel prior to falling below a concentration which could result in the displacement of a significant fraction of the control room air. The ALOHA model was also used to predict the post-release chemical concentrations in the control room to ensure that under a worst case scenario event the control room operators will have sufficient time to take appropriate action.

The IDLH is defined by the NIOSH as a situation that poses a threat of exposure to airborne contaminants when that exposure is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment. The IDLH values determined by NIOSH are established such that workers are able to escape such an environment without suffering permanent health damage. Where an IDLH value was unavailable for a toxic chemical, the time weighted average or short term exposure limit, promulgated by OSHA or adopted by the American Conference of Governmental Hygienists, was used as the concentration level.

Each postulated event involving a toxicity/asphyxiation analysis conducted using the ALOHA model was evaluated over a spectrum of meteorological conditions. These meteorological sensitivity analyses were performed to determine the worst case combination of meteorological stability class and windspeed for each postulated event. The selected worst case meteorological condition was based upon those meteorological conditions yielding the highest concentration in the control room during each postulated event. Unless otherwise noted, the worst case meteorological conditions from the sensitivity analysis were: Pasquill stability class F (stable), with a wind speed of 1 m/sec. Along with the determined worst case meteorological conditions, the following meteorological assumptions were used as inputs to the computer model, ALOHA: ambient temperature of 25°C; relative humidity of 50%; cloud cover, 50%; and an atmospheric pressure of 1 atmosphere. For each of the identified chemicals, it was conservatively assumed that the entire contents of the vessel leaked to form a 1 cm thick puddle and toxic vapor cloud. Where applicable for sources that are described using the ALOHA model, a control room air exchange rate of 0.45 air changes per hour was used. This air exchange rate was calculated from the control room volume and the rate of air intake. U.S. EPR FSAR Section 9.4.1 provides a description of the Control Room HVAC System. Under normal operation, outside air is brought in through two air intakes in order to maintain the control room envelope at a positive pressure. The control room envelope has a volume of approximately 200,000 ft^3 and the flow rate of outside air through the two air intakes is as much as 1000 cfm (total). Using this information results in an effective air change rate (based on outside air) of:

(1000 cfm * 60) / 200,000 ft^3 = 0.3 air changes per hour Eq. 2.2.3-1

The evaluation of toxic chemical hazards used a value of 1484 cfm for the outside air flow rate. Use of this value results in an effective air change rate (based on outside air) of:

(1484 cfm * 60) / 200,000 ft^3 = 0.45 air changes per hour Eq. 2.2.3-2

Therefore, the use of this value (i.e., 1484 cfm) in the toxic chemical hazards evaluation results in a conservative estimation of the chemical concentration in the control room.

The effects of toxic chemical releases from internal and external sources are summarized in Table 2.2-10 and are described in the following sections relative to the release source.

Pipelines

The only pipeline within the vicinity of the CCNPP site is the DCPLNG pipeline. The DCPLNG pipeline carries natural gas and is not expected to carry a different product in the future. There is no IDLH value or other toxicity limit present for natural gas.

Waterway Traffic

The CCNPP site is located about 1000 ft (305 m) from the west bank of the Chesapeake Bay with potential waterway traffic passing within the navigable waterway approximately 11,701 ft (3,566 m) from CCNPP Unit 3. The plausible chemicals transported on the Chesapeake Bay identified for further analysis are: gasoline; benzene; toluene; and ammonia.

An analysis of toxic chemical release consequences was conducted using the methodology outlined in Section 2.2.3.1.3. The U.S. Army Corps of Engineers report, "Waterborne Commerce of the United States" (USACE, 2004a) (USACE, 2004b) was reviewed to determine the possible quantity of these chemicals shipped on the Chesapeake Bay. This report provides the total quantity of the hazardous material shipped annually.

Regulatory Guide 1.78 (NRC, 2001) provides a screening criteria for mobile sources, which defines shipments of more than 50 per year within a 5 mi (8 km) radius of a nuclear power plant as being frequent for barge traffic. Hazardous materials that are not transported frequently may be screened from further consideration. It was therefore conservatively assumed for the consequence analysis that the hazardous materials selected for toxic evaluation made 50 trips per year with the annual quantity being equally divided among each trip.

Using data from the U.S. Army Corps of Engineers for the Port of Baltimore, the combined quantity of benzene and toluene transported annually in proximity to the CCNPP site is 56 million pounds (25 million kg) (USACE, 2004a) (USACE 2004b). It is conservatively assumed that they are shipped in equal quantities 28 million pounds per year (13 million kg per year) and that they each have the minimum 50 shipments per NRC Regulatory Guide 1.78, Revision 1(NRC, 2001), and that each shipment contains the same quantity. The quantities of benzene and toluene assumed in the analysis of toxic control room habitability were 560,000 pounds (254,000 kg).

Using data from the U.S. Army Corps of Engineers for the Port of Baltimore, the quantity of ammonia transported annually in proximity to the CCNPP site is 2 million pounds (0.9 million kg) (USACE, 2004a) (USACE 2004b). It is conservatively assumed that there are a minimum of 50 shipments per NRC Regulatory Guide 1.78, Revision 1 (NRC, 2001), and that each shipment contains the same quantity 40,000 pounds (18,100 kg). A partition coefficient of 0.6 was applied to the individual shipment quantity to account for the high rate at which ammonia dissolves in water as ALOHA does not account for this phenomena (Raj, 1974). The quantity of ammonia assumed in the analysis of toxic control room habitability was 16,000 pounds (7,300 kg). The results of the toxic chemical releases are summarized in Table 2.2-10.

Except for gasoline, the total quantity of the shipment was assumed to be released into the water into a 1 cm thick pool. Due to the large quantity of gasoline spilled, 5.2 million pounds, a 1 cm thick puddle is not realistic. Spilling this quantity over a 1 cm thick puddle would essentially diffuse the vapor cloud over a very large area. Thus, for gasoline, a surface area of 31,400 square meters was assumed for consistency with the maximum allowable surface area provided by the ALOHA model. In each case, under the worst case meteorological conditions, the control room would remain habitable. And, with the exception of ammonia, the distance the cloud traveled prior to dispersing enough to fall below the identified toxicity limit was less than the distance from the spill site to the control room for CCNPP Unit 3.

An evaluation was performed to determine whether a barge spill involving ammonia qualified as a design-basis event. That is, an accident that has a probability of occurrence on the order of magnitude of 1E-7 per year, or greater, and potential consequences serious enough to affect the safety of the plant to the extent that the guidelines in 10 CFR Part 100 could be exceeded. The expected rate of occurrence exceeding the guidelines in 10 CFR Part 100 (on the order of magnitude of 1E-6 per year) is acceptable if, when combined with reasonable qualitative arguments, the realistic probability can be shown to be lower.

Regulatory Guide 1.78 (NRC, 2001) states that releases of toxic chemicals that have the potential to result in a significant concentration in the control room need not be considered for further evaluation if the releases are of low frequencies (1E-6 per year or less) because the resultant low levels of radiological risk are considered acceptable. Regulatory Guide 1.78 also provides a screening criteria for mobile sources, which defines shipments of more than 50 per year within a 5 mi (8 km) radius of a nuclear power plant as being frequent for barge traffic.

Release events involving mobile sources that do not meet this criteria (i.e., 50 or fewer shipments annually, and therefore not frequent) are not required to be evaluated for control room habitability. This frequency is based on transportation accident statistics and conditional spill probability given an accident. The U.S. Army Corps of Engineers estimates that there are less than 5 shipments per year of ammonia passing within the vicinity of the CCNPP site.

Given that the frequency of ammonia shipments is less than 50 per year passing within the vicinity of the CCNPP site, the probability of an accident occurring involving a barge within the exposure distance from the control room is below the screening criteria established by Regulatory Guide 1.78 (NRC, 2001).

Therefore, the ammonia spill event does not qualify as a design-basis event for CCNPP Unit 3, and toxic vapor clouds formed from the chemicals analyzed would not adversely affect the safe operation of Unit 3.

Highways

The CCNPP Unit 3 control room is located 6,531 ft (2.0 km) from MD 2/4 at its closest approach. The hazardous materials potentially transported on MD 2/4 that were identified for further analysis with regard to the potential of forming a toxic vapor cloud after an accidental release and traveling to the control room were: ammonium hydroxide (19% solution), gasoline, gasoline (aviation), and liquid propane.

The methodology presented in Section 2.2.3.1.3 was used to determine the distance from the release site to the point where the toxic vapor cloud reaches the IDLH limit boundary. For gasoline and gasoline (aviation) the time weighted average (TWA) and short term exposure (STEL) toxicity limits were conservatively used since no IDLH value is available for either of these hazardous materials. The TWA is the average value of exposure over the course of an 8 hour work shift. The STEL is a 15 minute TWA concentration that may not be exceeded, even if the 8 hour TWA is within the standards.

The maximum concentration of the evaluated chemicals attained in the control room, under worst case meteorological conditions, during the first hour of the release was also determined for the identified hazardous materials. In each scenario, it was conservatively estimated that the transport vehicle lost the entire contents, 50,000 pounds (22,680 kg), as provided in Regulatory Guide 1.91 (NRC, 1978a). The results indicate that any toxic vapor clouds that form after an accidental release on MD 2/4 and travel toward the control room will not cause an airborne concentration above the IDLH limit (or TWA/STEL in the case of gasoline or aviation gasoline) in the control room.

Therefore, toxic vapor clouds resulting from chemical spills on MD 2/4 will not adversely affect the safe operation of CCNPP Unit 3. The effects of toxic chemical releases are summarized in Table 2.2-10.

Onsite Chemical Storages

The hazardous materials stored onsite that were identified for further analysis with regard to the potential of the formation of toxic vapor clouds formed after an accidental release are:

gasoline; ammonium hydroxide (28% solution); sodium hypochlorite; hydrazine (35% solution); monoethanolamine; dimethylamine (2% solution); hydrochloric acid (30% solution); carbon dioxide; hydrogen (asphyxiant) and liquid nitrogen (asphyxiant). Two water treatment chemicals, a non-oxidizing biocide containing ethanol and sodium hypochlorite, gas cylinders stored at CCNPP Unit 3 containing argon, argon-methane, hydrogen, and nitrogen, which are all asphyxiants, were identified for further analysis for the formation of toxic/asphyxiating vapor clouds.

As described in Section 2.2.3.1.3, the identified hazardous materials were analyzed utilizing the ALOHA dispersion model to determine whether the formed vapor cloud will reach the control room intake and what the concentration of the toxic chemical will be in the main control room after an accidental release. The worst case release scenario in these analysis included either a total loss of the largest vessel into an unconfined puddle or direct release over 10 minutes under determined worst case meterological conditions.

Hydrogen and liquid nitrogen concentrations were determined at the control room after a release of the largest vessel. In each case, the concentration at the CCNPP Unit 3 control room of the asphyxiants located at CCNPP Unit 1 and 2, (53.0 ppm for hydrogen, and 635 ppm for liquid nitrogen), would not displace enough oxygen for the CCNPP Unit 3 main control room to become an oxygen-deficient environment. Similarly, the asphyxiants associated with the gas cylinder storage at CCNPP Unit 3, are stored farther than the determined safe distance (the distance to where the vapor cloud would travel prior to falling below a concentration which could result in the displacement of a significant fraction of the control room air--defined by the OSHA) under worst case meteorological conditions (42 ft for argon gas and argon-methane gas cylinders, 39 ft for hydrogen gas cylinders, and 36 ft for nitrogen gas cylinders).

For each toxic chemical evaluated, with the exception of the 3,500 gallon (13,250 l) gasoline delivery truck, the remaining chemical analyses indicate that the control room would remain habitable for the worst case release scenario.

The evaluation of toxic chemical release events was performed for each of the identified chemicals to determine if any of these events would qualify as a design-basis event. That is, an accident that has a probability of occurrence on the order of magnitude of 1E-7 per year, or greater, with potential consequences serious enough to affect the safety of the plant to the extent that the guidelines in 10 CFR Part 100 could be exceeded.

An expected rate of occurrence for exceeding the guidelines in 10 CFR Part 100 (on the order of magnitude of 1E-6 per year) is acceptable if, when combined with reasonable qualitative arguments, the realistic probability can be shown to be lower. Further, Regulatory Guide 1.78 (NRC, 2001) provides that releases of toxic chemicals that have the potential to result in a significant concentration in the control room need not be considered for further evaluation if the releases are of low frequencies (1E-6 per year, or less) because the resultant low levels of radiological risk are considered acceptable. In evaluating the gasoline tanker spill, the following inputs were used in the model (a confirmatory meteorological sensitivity analysis was conducted that demonstrated the inputs represented the worst case):

- Pasquill Stability Class F selected to represent the most limiting 5% of meteorological conditions observed.

- A low wind speed of 1 meter per second selected to represent the most limiting 5% conditions. Low wind speed conditions prevent the vapor cloud from dispersing as it travels.
- The time of day selected was 12:00 pm on July 1, 2006. This day and time were chosen because temperatures are highest in the summer during the midday. Higher temperatures lead to a higher evaporation rate, and thus, a larger vapor cloud.
- The tank was filled to capacity and a catastrophic tank failure was assumed where the total amount of the substance leaked forming a 1 cm thick puddle. A 1 cm thick puddle allows for greater evaporation, and thus, a larger vapor cloud.

A probabilistic analysis was then performed for any identified chemicals that were analyzed to have significant potential consequences that could exceed the guidelines of 10 CFR Part 100. The evaluations identified one chemical, gasoline that merited probabilistic analysis.

The evaluation of the gasoline tanker spill event was performed in accordance with Regulatory Guide 1.91 (NRC, 1978a). The probability of an accident occurring involving a truck within the exposure distance from the control room for CCNPP Unit 3 was identified as 2.66E-7 per year. This analysis was based upon Maryland State Highway Administration large truck accident data for Calvert County, Maryland (MSHA, 2004). Large trucks are defined as over 10,000 pounds (4,540 kg) gross vehicle rating. The actual accident rate for gasoline delivery tankers would be expected to be somewhat lower than the cited accident rate given that vehicle operation speeds in the vicinity of CCNPP Unit 3 are considerably lower than on the highways.

With the exception of gasoline, the identified chemicals had analyzed consequences that were below the guidance provided in 10 CFR Part 100. The gasoline spill event was evaluated and has an event probability that is below the 1E-6 criteria provided in Regulatory Guide 1.78 (NRC, 2001). Therefore, toxic vapor clouds resulting from chemical spills of onsite chemicals will not adversely affect the safe operation of CCNPP Unit 3. The effects of toxic chemical releases are summarized in Table 2.2-10.

Toxic Chemical Related Impacts Affecting the U.S. EPR Design

The U.S. EPR design is acceptable for any site when reasonable qualitative arguments can demonstrate that the realistic probability of severe consequences from any external accident is less than 1E-6 per year. The analyses presented in this section demonstrate that toxic chemical concentrations that could present an immediate hazard to plant personnel will not result from postulated chemical releases, with the exception of gasoline and ammonia. For gasoline and ammonia, it was demonstrated that the event probability is less than 1E-6. As a result, each of the postulated toxic chemical release scenarios has been demonstrated to either not result in severe consequences, or to have an event frequency that is less than 1E-6 per year.

2.2.3.1.4 Fires

Accidents leading to high heat fluxes or smoke, and non-flammable gas or chemical bearing clouds from the release of materials, as the consequence of fires in the vicinity of the plant were considered. Fires in adjacent industrial plants and storage facilities, oil and gas pipelines, brush and forest fires, and fires from transportation accidents were evaluated as events that could lead to high heat fluxes or to the formation of such clouds.

The nearest industrial site is the DCPLNG facility, which is located approximately 3.2 mi (5.1 km) from CCNPP Unit 3. The Maryland Power Plant Research Program (MDNR, 2006) commissioned an independent risk study (i.e., hazard study) to assess the risks associated with the expansion of the DCPLNG facility and associated pipeline to the CCNPP site as described in Section 2.2.3.

The quantified risks to the CCNPP site presented in this study are within the threshold of acceptable risks defined by the U.S. Nuclear Regulatory Commission (1E-7). The evaluation of these risks included such events as ruptures in the gas pipeline and escalation events, involving total loss of the storage tanks, which lead to a jet or pool fire. Therefore, it is not expected that there would be any hazardous effects from fires or heat fluxes associated with the operations of the DCPLNG facility and pipeline.

Further, the potential for brush, forest or woodland, and onsite fires from storage facilities were evaluated. The Maryland Department of Natural Resources recommends that a fuel break of at least 30 ft (9 m), 75 ft (23 m) for pine forest be maintained around structures for protection against wildfires. Similarly, California has adopted regulations requiring a fire break of at least 30 ft (9 m) and a fuel break to 100 ft (31 m) for wildfire protection of structures (CCR, 2005).

An area of woodlands surrounds the CCNPP site. A cleared area at least 1,500 ft (457 m) wide extends to the north, south, and west of CCNPP Unit 3, and provides a substantial defensible zone in the unlikely event of a fire originating in the woodlands or spreading to the woodlands as result of on or offsite activities. The protected area to the east of the CCNPP Unit 3 powerblock site includes a cleared area of at least 260 ft (79 m), and the area surrounding the safety-related intake structure is cleared area for at least 160 feet. These cleared zones are of sufficient size to afford substantial protection in the event of a fire, and it is not expected that there would be any hazardous effects from fires or heat fluxes associated with wild fires, fires in adjacent industrial plants or from onsite storage facilities.

Fire Related Impacts Affecting the U.S. EPR Design

The U.S. EPR design is acceptable for any site when reasonable qualitative arguments can demonstrate that the realistic probability of severe consequences from any external accident is less than 1E-6 occurrences per year. The use of cleared fuel breaks around safety-related CCNPP Unit 3 structures will ensure that external fire related impacts will not have severe consequences.

2.2.3.1.5 Collisions with Intake Structure

Because CCNPP is located on a navigable waterway an evaluation was performed which considered the probability and potential effects of impact on the plant cooling water intake structure and enclosed pumps. The U.S. EPR system design contains a circulating water system/auxiliary cooling water system, and an essential service water system. Makeup water for the circulating water system (CWS) and the emergency makeup to the ultimate heat sink (UHS) are supplied from the Chesapeake Bay through two intake pipes located on a protected section immediately south of the existing Units 1 and 2 intake structure. The intake pipes empty into a forebay that supplies the CWS and UHS makeup water pumps.

Makeup water for the circulating water system/auxiliary cooling water system is pumped through a common header to the cooling tower basins. The essential service water system is used for normal operations, refueling, shutdown/cooldown, anticipated operational events, design basis accidents and severe accidents. Makeup water to the essential service water system is normally supplied from the plant potable water system (desalinization plant). Under post-accident conditions, lasting longer than 72 hours, makeup water may be supplied from the (UHS) makeup water system. The nonsafety-related CWS intake structure and the safety-related UHS makeup water intake structure are situated at opposite ends of the common forebay.

The CCNPP Unit 3 inlet area is located in a protected area along the shoreline. The Unit 3 inlet area is an approximate 9,000 square foot (836 meters) wedge shaped pool area formed by a sheet pile wall extending approximately 180 feet from the shoreline to the baffle wall and approximately 90 feet channelward from the approximate mean high water shoreline. To provide additional protection to the pipeline entrance point, circulating and service water intake structure and pumphouse, rip-rap structures are located outside the inlet area. A rip-rap seawall extending approximately 75 ft (22.9 m) north from the shoreline is located east of the pipeline entrance. Rip-rap is also provided along the shoreline for additional protection. The CCNPP Unit 3 intake piping consists of two runs of 60-inch diameter safety-related underground pipe approximately 490 feet (144.4 m) long. These pipes convey water from the CCNPP Unit 3 inlet area to a common forebay structure with the bottom at Elevation -22 feet 6 in (-6.86 m) NGVD 29 and vertical sheet pile sides extending to Elevation 10 feet (3.05 m) NGVD 29. It is unlikely that a collision would occur involving the intake structure or associated piping as the intake structure and associated piping are well protected. Additionally, the portion of the Chesapeake Bay in the vicinity of the intake system is sufficiently shallow that any vessel of significant size that could possibly cause damage to the intake system would most likely run aground before it could impact the intake structure.

Intake Structure Collision Impacts Affecting the U.S. EPR Design

The U.S. EPR design is acceptable for any site when reasonable qualitative arguments can demonstrate that the realistic probability of severe consequences from any external accident is less than 1E-6 occurrences per year. The location of the safety-related ultimate heat sink makeup water intake system for CCNPP Unit 3 is well protected, and the depth of the inlet area in the vicinity of the intake entrance piping is sufficiently shallow that any vessel of significant size that could possibly cause damage to the intake system would most likely run aground before it could impact the intake system. As a result, vessel impacts with the safety-related ultimate heat sink makeup intake structure will not result in severe consequences.

2.2.3.1.6 Liquid Spills

The accidental release of oil or liquids that may be corrosive, cryogenic, or coagulant were considered to determine if the potential exists for such liquids to be drawn into the plant's intake structure and circulating water system or otherwise affect the plant's safe operation. The CCNPP Unit 3 intake for the pipes supplying the CWS and UHS intake forebay for CCNPP Unit 3 are located in a protected section of the shoreline adjacent to the south side of the existing pipeline entrance for Units 1 and 2. The CCNPP Unit 3 intake piping is submerged at an approximate Elevation -21 feet 6 inch (6.6 m) NGVD 29. Present at the entrance to the inlet area is a boom that prevents any floating pollutants, such as petroleum products, from entering the inlet area.

In assessing the chemicals that are transported on the Chesapeake Bay which may spill into the waterway, other than asphalt and sulfuric acid, each of the chemical liquids have a specific gravity of less than one, meaning they will float on the surface of the Chesapeake Bay water. Therefore, these liquids if spilled would not only be diluted by the large quantity of Chesapeake Bay water, but would float on the surface and consequently would not likely be drawn into the intake system.

In the unlikely event of an asphalt spill into the Chesapeake Bay, the asphalt would solidify in the waterway and would be removed by the bar screen or traveling screen in the intake structure system.

In the event a sulfuric acid spill, the acid would not only be diluted by the large quantity of Chesapeake Bay water, but with the intake structure set back from the shore, most of the spilled chemical would travel past the structure with the current.

Liquid Spill Impacts Affecting the U.S. EPR Design

The U.S. EPR design is acceptable for any site when reasonable qualitative arguments can demonstrate that the realistic probability of severe consequences from any external accident is less than 1E-6 occurrences per year. In the case of liquid spills, the location of the CCNPP Unit 3 intake structures is well protected. With the exception of asphalt, the identified chemicals would either be sufficiently diluted before reaching the safety-related CCNPP Unit 3 UHS Makeup Water intake structure, or would be swept downstream of the intake structure by the Chesapeake Bay current. Asphalt would be removed by the traveling screens on the intake structure. In each case, there would be no significant damage to the safety-related CCNPP Unit 3 UHS Makeup Water intake structure. As a result, liquid spills will not result in severe consequences.

2.2.3.1.7 Radiological Hazards

The release of radioactive material from CCNPP Units 1 and 2 as a result of normal operations or an unanticipated event would not threaten the safety of the plant or personnel at CCNPP Unit 3. The control room habitability system for the U.S. EPR provides the capability to detect and protect main control room personnel from external fire, smoke, and airborne radioactivity. In addition, safety-related structures, systems, and components for the U.S. EPR have been designed to withstand the effects of radiological events and the consequential releases that would bound the contamination from a release from either of these potential sources.

Radiological Hazard Impacts Affecting the U.S. EPR Design

The U.S. EPR design is acceptable for any site when reasonable qualitative arguments can demonstrate that the realistic probability of severe consequences from any external accident is less than 1E-6 occurrences per year. In the case of radiological hazards, the control room habitability system for the U.S. EPR provides the capability to detect and protect main control room personnel from external fire, smoke, and airborne radioactivity. In addition, safety-related structures, systems, and components for the U.S. EPR have been designed to withstand the effects of radiological events and the consequential releases that would bound the contamination from a release from either of these potential sources. As a result, radiological hazards will not result in severe consequences.

2.2.3.2 Effects of Design-Basis Events

As concluded in the previous sections, the only event requiring further analysis for consideration as a design-basis is related to the frequency of aircraft impact in the vicinity of the CCNPP site. A probabilistic analysis which presents the probability of aircraft accidents which could potentially result in radiological consequences for the U.S. EPR at the CCNPP site is presented in Section 19.2. In conclusion, based on the analysis of the effects of Design-Basis Events which describes the hazards surrounding the site in Chapter 2.0, “Site Characteristic," and Chapter 2.2, “Nearby Industrial, Transportation and Military Facilities” no impediment was found to hamper, limit, or not allow an adequate physical security plan to be developed for CCNPP Unit 3.}

2.2.4 References

{**Airnav, 2006.** Airnav.com, Website: http://www.airnav.com/airports/, Date accessed: June 28, 2006

ALOHA, 2007. Areal Locations of Hazardous Atmospheres (ALOHA) Version 5.4.1, NOAA, February 2007, Website: http://www.epa.gov/ceppo/cameo/aloha.htm, Date accessed: June 24, 2007.

ANSI, 1989. American National Standards Safety Requirement for the Storage and Handling of Anhydrous Ammonia, ANSI K61.1, American National Standards Institute, 1989.

Beerens, 2006. The Use of Generic Failure Frequencies in QRA: The Quality and Use of Failure Frequencies and How to Bring Them Up to Date, Journal of Hazardous Materials, Volume 130, Issue 3, March 31, 2006, Pages 265-270, H. Beerens, J. Post and P. Uijt de Haag.

BGE, 2006. Application for License Renewal, Appendix B, Updated Final Safety Analysis Report Supplement CCNPP, Baltimore Gas and Electric Company, April 8, 2006, Website: http://www.nrc.gov/reactors/operating/licensing/renewal/applications/calvert-cliffs/ccv3.pdf, Date accessed: May 14, 2007.

Caltex, 2002. Material Safety Data Sheet for Petroleum Jelly, Caltex, Sydney, Australia, Website: http://www.caltex.com.au/products_oil_detail.asp?id=140, Date accessed: May 12, 2007.

CALCO, 2004. 2004 Comprehensive Plan Calvert County, Maryland Approved and Adopted December 2004, Calvert County, Website: http://www.co.cal.md.us/residents/building/planning/documents/compplan/default.asp, Date accessed: May 9, 2007.

CALCO, 2007. Calvert County Marinas, Calvert County, Website: http://www.calvertcountymd.us/calvert-county-marinas.html, Date accessed: June 21, 2007.

CCR, 2005. California Code of Regulations, Title 14 CCR, Division 1.5, Chapter 7 Fire Protection, Subchapter 3, Article 3. Fire Hazard Reduction Around Buildings and Structures Defensible Space. Section 1299, Website: http://www.fire.ca.gov/CDFBOFDB/pdfs/DefensibleSpaceRegulationsfinal12992_17_06.pdf, Date accessed: May 9, 2007.

CFR, 2007a. Standards for Protection Against Radiation, Title 10, Code of Federal Regulations, Part 20, U. S. Nuclear Regulatory Commission, 2007.

CFR, 2007b. Domestic Licensing of Production and Utilization Facilities, Title 10, Code of Federal Regulations, Part 50, U. S. Nuclear Regulatory Commission, 2007.

CFR, 2007c. Contents of Applications; Technical Information, Title 10, Code of Federal Regulations, Part 50.34, U. S. Nuclear Regulatory Commission, 2007.

CFR, 2007d. Reactor Site Criteria, Title 10, Code of Federal Regulations, Part 100, U. S. Nuclear Regulatory Commission, 2007.

CFR, 2007e. Factors to be Considered when Evaluating Sites, Title 10, Code of Federal Regulations, Part 100.20, U. S. Nuclear Regulatory Commission, 2007.

CFR, 2007f. Non-seismic Site Criteria, Title 10, Code of Federal Regulations, Part 100.21, U. S. Nuclear Regulatory Commission, 2007.

CFR, 2007g. Contents of Applications; Technical Information in Final Safety Analysis Report, Title 10, Code of Federal Regulations, Part 52.79, U. S. Nuclear Regulatory Commission, 2007.

CLUI, 2006. Patuxent River Naval Air Station, The Center for Land Use Interpretation, Website: http://ludb.clui.org/ex/i/MD3141/, Date accessed: June 21, 2007.

CRS, 2005. Marine Security of Hazardous Chemical Cargo, Congressional Research Service (CRS), August 26, 2005, Website: http://www.ncseonline.org/NLE/CRSreports/05aug/RL33048.pdf, Date accessed: May 9, 2007.

DOE, 2006a. Accident Analysis For Aircraft Crash Into Hazardous Facilities, DOE Standard, DOE-STD-3014-2006, U.S. Department of Energy, May 2006.

DOE, 2006b. AES Sparrows Point LNG, LLC and Mid-Atlantic Express, LLC; Notice of Intent To Prepare an Environmental Impact Statement for the Proposed Sparrows Point Project, Request for Comments on Environmental Issues and Notice of a Joint Public Meeting, Federal Register Volume 71, Number 100, p 29941-29944, U.S. Department of Energy, Federal Energy Regulatory Commission, May 24, 2006, Website: http://frwebgate.access.gpo.gov/cgi-bin/getpage.cgi?dbname=2006_register&position=all&page=29941, Date accessed: June 24, 2007.

Dominion, 2007. Dominion Cove Point LNG, Cove Point Expansion, Website: http://www.dom.com/about/gas-transmission/covepoint/expansion/index.jsp, Date accessed: May 9, 2007.

EPA, 2001. Cove Point LNG Limited Partnership; Notice of Intent to Prepare an Environmental Assessment for the Proposed Cove Point LNG Project, Request for Comments on Environmental Issues, and Notice of Public Meeting and Site Visit, U.S. Environmental Protection Agency, Federal Register Volume 66, Number 37, p 11286-11288, February 23, 2001, Website: http://www.epa.gov/fedrgstr/EPA-IMPACT/2001/February/Day-23/i4510.htm, Date accessed: June 26, 2007.

FAA, 2006. Sectional and Terminal Aeronautical Chart East, Federal Aviation Administration, National Aeronautical Charting Office, July 2006.

FAA, 2007. FAA Terminal Area Forecast: National Forecast 2006 (1) – Airport Operations, Federal Aviation Administration, May 15, 2007.

FERC, 2006a. Press Release: June 15, 2006, Commission authorizes three new LNG import terminals, expansions of two other LNG import facilities/ Dominion Cove Point LNG, Federal Energy Regulatory Commission, Website: http://www.ferc.gov/press-room/press-releases/2006/2006-2/06-15-06-C-4.asp, Date accessed: May 9, 2007.

FERC, 2006b. LNG- Environmental Impact Statements (EISs), FERC staff issues Final FERC, 2006. Environmental Impact Statement on Dominion Cove Point Expansion Project (Docket No. CP05-310-000 et al.), April 28, 2006, Federal Energy Regulatory Commission, Website: http://www.ferc.gov/industries/lng/enviro/eis/2006/04-28-06-eis-cove.asp, Date accessed: May 9, 2007.

FMIC, 2005. Guidelines for Evaluating the Effects of Vapor Cloud Explosions Using a TNT Equivalency Method, Factory Mutual Insurance Company, May 2005.

GCR, 2006. Airport IQ5010, Airport Master Records and Reports, GCR and Associates, Inc., Website: http://www.gcr1.com/5010web/, Date accessed: June 21, 2007.

INCHEM, 2002. Material Safety Data Sheet for Coal Pitch Tar, International Programme on Chemical Safety, March 2002, Website: http://www.inchem.org/documents/icsc/icsc/eics1415.htm, Date accessed: May 9, 2007.

MBI, 2004. MSDS for Sodium Thiosulfate, MSDS Number S5230, Mallinckrodt Baker, Inc., Website: http://www.jtbaker.com/msds/englishhtml/S5230.htm, Date accessed: May 12, 2007.

MBI, 2006. MSDS for Sodium Carbonate, MSDS Number S3242, Mallinckrodt Baker, Inc., Website: http://www.jtbaker.com/msds/englishhtml/S3242.htm, Date accessed: May 12, 2007.

MDNR, 2006. Cove Point LNG Terminal Expansion Project Risk Study, Maryland Power Plant Research Program Report PPRP-CPT-01/DNR 12-7312006-147, Maryland Department of Natural Resources, June 28, 2006, Website: http://esm.versar.com/pprp/bibliography/PPRP-CPT-01/CovePt_FINAL_Aug2006.pdf, Date accessed: May 9, 2007.

Military, 2006. Millitary.com Installation Guide, Website: http://benefits.military.com/misc/installations/Base_Content.jsp?id=3115, Date accessed: June 21, 2007.

MSHA, 2004. Maryland Traffic Safety Facts 2003, Maryland State Highway Safety Administration, December 2004, Website: http://www.sha.state.md.us/Safety/oots/Factbook2003April15.PDF, Date accessed: June 25, 2007.

NOAA, 2005. Booklet Chart for Chesapeake Bay, Chart 12280, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service Coast Survey, Updated through July 2005, Website: http://ocsdata.ncd.noaa.gov/BookletChart/12280_BookletChart.pdf, Date accessed: May 10, 2007.

NOAA, 2007. CAMEO Toolkit, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Website: http://archive.orr.noaa.gov/cameo/dr_aloha/chemquiz/answers.html, Date accessed: May 9, 2007.

NRC, 1978a. Evaluations of Explosions Postulated To Occur on Transportation Routes Near Nuclear Power Plants, Regulatory Guide 1.91, Revision 1, U. S. Nuclear Regulatory Commission, February, 1978.

NRC, 1978b. Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants, Regulatory Guide 1.70, Revision 3, U. S. Nuclear Regulatory Commission, November, 1978.

NRC, 1985. Safety Implications Associated with In-Plant Pressurized Gas Storage and Distribution Systems in Nuclear Power Plants, NUREG/CR-3551, U. S. Nuclear Regulatory Commission, May, 1985.

NRC, 1998. General Site Suitability Criteria for Nuclear Power Stations, Regulatory Guide 4.7, Revision 2, U. S. Nuclear Regulatory Commission, April, 1998.

NRC, 2001. Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release, Regulatory Guide 1.78, Revision 1, U. S. Nuclear Regulatory Commission, November, 2001.

NRC, 2004a. Fire Dynamics Tools (FDTs) Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program, NUREG-1805, U. S. Nuclear Regulatory Commission, December 2004.

NRC, 2004b. Letter, Guy S. Vissing, U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, to George Vanderheyden, Baltimore Gas and Electric, Safety Evaluation Regarding the Effect of Modification of Liquefied Natural Gas Facility on Safety of Calvert Cliffs Nuclear Power Plant, Units 1 and 2, U. S. Nuclear Regulatory Commission, January 2004.

NRC, 2007a. Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, NUREG-0800, U. S. Nuclear Regulatory Commission, March 2007.

NRC, 2007b. Combined License Applications for Nuclear Power Plants, Regulatory Guide 1.206, Revision 0, U. S. Nuclear Regulatory Commission, April, 2007.

OP, 2003. Material Safety Data Sheet for Towerbrom, Occidental Petroleum, 2003, Website: http://msds.oxy.com/DWFiles/M31041_NA_EN%2EPDF, Date accessed: May 9, 2007.

OSHA, 2005. Exposure Limits (STEL value for gasoline), Pocket Guide to Chemical Hazards: Gasoline, NIOSH Publication No. 2005-149, National Institute for Occupational Safety and Health (NIOSH), September 2005, Website: http://www.osha.gov/dts/chemicalsampling/data/CH_243100.html, Date accessed: June 22, 2007.

POACRE, 2005. Property Owners Association Chesapeake Ranch Estates, Airport Committee Charter 2004-2005, Website: http://www.poacre.org/Amenities/Airport.html, Date accessed: June 25, 2007.

Raj, 1974. Prediction of Hazards of Spills of Anhydrous Ammonia on Water, P. Raj, J. Hagopian, and A. Kalelkar, Arthur D. Little Inc, March 1974.

RAND, 2003. Delaware Maryland Highways and Interstates map, Rand McNally, 2003.

Solutia, 1999. MSDS for Polychlorinated Biphenyls, Solutia, St. Louis, Missouri, Website: http://www2.itap.purdue.edu/MSDS/docs/9943.pdf, Date accessed: May 12, 2007.

Supresta, 2006. Material Safety Data Sheet for Fyrquel EHC, Supresta, Ardsley, 2006, Website: http://phosphorusus.com/pdfs/FYRQUEL%20150-MSDS.pdf, Date accessed: May 9, 2007.

USACE, 2004a. Waterborne Commerce of the United States, Calendar Year 2004, Part 1—Waterways and Harbors Atlantic Coast, IWR-WCUS-04-1, U.S. Army Corps of Engineers, Institute for Water Resources, 2004.

USACE, 2004b. Waterborne Commerce of the United States, Calendar Year 2004, Part 2—Waterways and Harbors Gulf Coast, Mississippi River System and Antilles, IWR-WCUS-04-2, U.S. Army Corps of Engineers, Institute for Water Resources, 2004.

USACE, 2006. National Waterway Network (line), U.S. Army Corps of Engineers, Navigation Data Center, 2006.

USCG, 2006. Chemical Hazards Response Information System Manual, U.S. Coast Guard, Website: http://www.chrismanual.com, Date accessed: May 9, 2007.

Williams, 2000. Williams to Purchase Cove Point LNG Facility, May 3, 2000, Website: http://www.williams.com/newsmedia/newsreleases/rel519.html, Date accessed: June 25, 2007.}

Table 2.2-1— {Description of Facilities, Products, and Materials}

Site	Concise Description	Primary Function	Number of Persons employed	Major Products or Materials
Dominion Cove Point Liquefied Natural Gas (DCPLNG)	DCPLNG receives LNG tankers at its offshore dock, stores the LNG onshore, then transforms it to gas and delivers it into a pipeline.	LNG Import Facility	<100	Liquid and Gaseous Natural Gas
Calvert Cliffs Nuclear Power Plant Units 1&2 (CCNPP)	CCNPP Units 1 and 2 are an 825 MWe and an 835 MWe, respectively, Combustion Engineering pressurized water reactors licensed by the Nuclear Regulatory Commission.	Nuclear Power Generator	~1000	Electrical Power
Patuxent River Naval Air Station	Patuxent River Naval Air Station is a naval air station which provides research, development, testing and evaluation of aircraft.	Military Installation	~16,700	N/A – Military Installation

Table 2.2-2— {CCNPP Units 1, 2 and 3 Onsite Chemical Storage}

(Page 1 of 3)

Material	Toxicity Limit (IDLH)	Quantity	Largest Container	Location	Shipping Mode	Annual Frequency
CCNPP Units 1 and 2						
Ammonium Hydroxide (28% solution)	300 ppm as Ammonia	8500 gal (32,000 l)	8,500 gal (32,000 l)	Tank Farm	Ground	1/year
Boric Acid	None established	40,000 lbs (18,000 kg)	450 lb drum (200 kg)	Warehouse and 27 foot Aux. Bldg.	Ground	2/year
Number 2 Diesel Fuel	None established	350,000 gal (1.3E6 l)	125,000 gal (4.7E5 l)	Transportation Shop, 11, 21 & 1A FOST	Ground	6/year
Gasoline	300 ppm (TWA)/ 500 ppm (STEL)	4,000 gal (15,000 l)	4,000 gal (15,000 l) / 3,500 gal (13,000 l) tank truck (see Note 1)	Transportation Shop	Ground	Monthly
Towerbrom microbicide	None established	8,000 lbs (3600 kg)	(will no longer use)	Waterfront	Ground	2/year
Sodium Hypochlorite	10 ppm for chlorine	500 gal (1900 l)/ 8,500 gal (38,600 l)	8,500 gal (38,600 l)	Intake Building, OTF Well water house & 12 foot NSB	Ground	4/year
Hydrazine (35% solution)	50 ppm	3,000 gal (11,000 l)	350 gal (1300 l) totes	Warehouse and 12 foot NSB	Ground	4/year
Lubricating Oil	None established	30,000 gal (110,000 l)	10,000 gal (38,000 l)	Tank Farm, Turbine Bldg., and Warehouse	Ground	12/year
Liquid Nitrogen	Asphyxiant	11,300 gal (42,800 l)	11,300 gal (42,800 l)	Tank Farm	Ground	2/year
Mineral Oil	2,500 mg/m^3	150,000 gal (570,000 l)	19,300 gal (73,000 l)	Main Transformers	Ground	1/year
Polychlorinated Biphenyl (PCB) Oil	5 mg/m^3 (NIOSH)	4,700 gal (18,000 l)	336 gal (1270 l)	Switchgear rooms & 27 ft NSB Mezzanine	Ground	1/year
Sodium Hydroxide (50% solution)	None established	26,000 gal (98,000 l)	26,000 gal (98,000 l)	12 foot NSB	Ground	2/year
Sulfuric Acid (98% solution)	15 mg/m^3	12,000 gal (45,000 l)	12,000 gal (45,000 l)	Tank Farm	Ground	2/year
Fyrquel EHC fluid	1000 mg/m^3 as Triphenyl Phosphate	1,700 gal (6400 l)	800 gal (3000 l)	Turbine Bldg. & Warehouse	Ground	1/year
Sodium Thiosulfate	None established	2,000 lbs (900 kg)	50 lb (23 kg) bags	STP	Ground	2/year
Aluminum Sulfate	None established	2,000 lbs (900 kg)	50 lb (23 kg) bags	STP	Ground	2/year
Monoethanolamine	30 ppm	350 gal (1300 l)	350 gal (1300 l)	12 foot NSB	Ground	3/year
Dimethylamine (2% solution)	500 ppm	350 gal (1300 l)	350 gal (1300 l)	12 foot NSB	Ground	2/year
Hydrogen	None established	460 cu ft (13 cu m)	460 cu ft (13 cu m)	Tank Farm	Ground	8-10/year

Table 2.2-2— {CCNPP Units 1, 2 and 3 Onsite Chemical Storage}
(Page 2 of 3)

Material	Toxicity Limit (IDLH)	Quantity	Largest Container	Location	Shipping Mode	Annual Frequency
Carbon Dioxide	40,000 ppm	8,000 lbs (3,629 kg)	8,000 lbs (3,629 kg)/ 50,000 lb (22,680 kg) delivery truck (Note 4)	12 foot Turbine Bldg.	Ground	1-4/year
Soda Ash (Sodium Carbonate)	None established	2,000 lbs (907 kg)	50 lb (23 kg) bags	STP	Ground	2/year
Hydrochloric Acid	50 ppm	5,000 gal (19,000 l)	3,000 gal (11,000 l)	Tank Farm	Ground	4/year
CCNPP Unit 3						
Argon (gas cylinder)	Asphyxiant	270 scf (7.65 Nm^3) (see Note 2)	1.76 cu ft cylinders (see Note 2)	Central Gas Supply Systems Building	N/A (see Note 3)	N/A (see Note 3)
Argon-Methane (gas cylinder)	Asphyxiant	282 scf (7.99 Nm^3) (see Note 2)	1.76 cu ft cylinders (see Note 2)	Central Gas Supply Systems Building	N/A (see Note 3)	N/A (see Note 3)
Hydrogen (gas cylinder)	Asphyxiant	278 scf (7.87 Nm^3) (see Note 2)	1.76 cu ft cylinders (see Note 2)	Central Gas Supply Systems Building	N/A (see Note 3)	N/A (see Note 3)
Nitrogen (gas cylinder)	Asphyxiant	235 scf (6.65 Nm^3) (see Note 2)	1.76 cu ft cylinders (see Note 2)	Central Gas Supply Systems Building	N/A (see Note 3)	N/A (see Note 3)
Oxygen (gas cylinder)	Asphyxiant	282 scf (7.99 Nm^3) (see Note 2)	1.76 cu ft cylinders (see Note 2)	Central Gas Supply Systems Building	N/A (see Note 3)	N/A (see Note 3)
Sodium Hypochlorite	10 ppm as Cl_2	20,000 gal (75,700 l) Plant Intake / 40,000 gal (151,400 l) CW / (2) 2,000 gal (7,600 l) UHS	40,000 gal (15,000 l)	CW Cooling Tower	N/A (see Note 3)	N/A (see Note 3)
Sulfuric Acid	15 mg/m^3	25,000 gal (94,600 l) CW / 7,500 gal (28,400 l) Desalination Building	25,000 gal (94,600 l)	CW Cooling Tower	N/A (see Note 3)	N/A (see Note 3)
Sodium Bisulfite	5 mg/m^3 (TLV-TWA)	5,000 gal (18,900 l) CW / (2) 350 gal (1,300 l) UHS / 1,000 gal (3,800 l) Desalination Building	5,000 gal (18,900 l)	CW Cooling Tower	N/A (see Note 3)	N/A (see Note 3)
Scale Inhibitor / Dispersant (2-Phosphono-1,2,4-butane tricarboxylic acid)	None established	10,000 gal (37,900 l) CW / (2) 350 gal (1,300 l) UHS	10,000 gal (38,000 l)	CW Cooling Tower	N/A (see Note 3)	N/A (see Note 3)

Table 2.2-2— {CCNPP Units 1, 2 and 3 Onsite Chemical Storage}
(Page 3 of 3)

Material	Toxicity Limit (IDLH)	Quantity	Largest Container	Location	Shipping Mode	Annual Frequency
Non-Oxidizing Biocide (ethanol)	3,300 ppm as ethanol	1,000 gal (3,800 l) CW / (2) 350 gal (1,300 l) UHS	1,000 gal (3,800 l)	CW Cooling Tower	N/A (see Note 3)	N/A (see Note 3)
Antiscalant (Sodium Hexametaphosphate)	None established	350 gal (1,300 l) Desalination Building	350 gal (1,300 l)	Desalination Building	N/A (see Note 3)	N/A (see Note 3)

Notes:

TWA: Time weighted average exposure limit

STEL: Short Term Exposure Limit

FOST: Fuel oil storage tank

OTF: Office training facility

STP: Sewage treatment plant

NSB: Northern service building

scf: standard cubic feet

Nm^3: normal cubic meter

Note 1: The 4,000 gal (15,000 l) gasoline tank is an underground tank. Therefore, the toxicity event is bounded by the 3,500 gal (13,000 l) gasoline delivery truck.)

Note 2: Quantities for compressed gas cylinders are reported at standard temperature and pressure (25°C and 1 atmosphere). The container volume is the inside volume of the cylinder.

Note 3: Shipping mode and annual frequency is not available because chemical is not currently stored on-site, but will be stored at CCNPP Unit 3.

Note 4: The toxicity event for the 8,000 lb storage tank in the Turbine Bldg. is bounded by the 50,000 lb delivery truck

Table 2.2-3— {Hazardous Chemical Waterway Freight, Port of Baltimore}

Material	Toxicity Limit (Immediately Dangerous to Life or Health)	Total Quantity 1E3 t (1E3 MT) (Note 1)
Gasoline	300 ppm (TWA)/ 500 ppm (STEL)	1,497 (1,358)
Kerosene	100 mg/m^3 (TLV -TWA)	39 (35.4)
Distillate Fuel Oil	None established	1,375 (1,247)
Residual Fuel Oil	None established	1,404 (1,274)
Lube Oil and Greases	None established	25 (22.7)
Petroleum Jelly and Waxes	None established	56 (50.8)
Naphtha & Solvents	1,000 ppm	71 (64.4)
Petroleum Coke	None established	403 (365.6)
Asphalt and Tar Pitch	80 mg/m^3 as coal tar pitch volatiles	748 (678.6)
Liquid Natural Gas	None established	4,877 (4,424.3)
Nitrogen Fertilizers	None established (Note 2)	249 (225.9)
Benzene & Toluene	500 ppm	28 (25.4)
Sulfuric Acid	15 mg/m^3	4 (3.6)
Ammonia	300 ppm	1 (0.9)
Sodium Hydroxide	None established	119 (108)
Inorganic Elementary Oxides & Halogen Salts	None established (Note 3)	198 (179.6)

Notes:

TLV-TWA: Threshold Limit Value-Time-Weighted Average

STEL: Short term exposure limit

IDLH: Immediately Dangerous to Life and Health threshold value

MT = Metric Tonne

Note 1: The quantities shown represent the total quantity in thousand short tons transported along the Chesapeake Bay into the Port of Baltimore on an annual basis.

Note 2: There are no established toxicity limits for broad categories. Further, no fertilizer mixtures are known to present specific explosion hazards without combining them with other commodities.

Note 3: There are no established toxicity limits for broad categories.

Table 2.2-4— {Aircraft Operations - Significant Factors}

Airport	Number of Operations	Distance from Site	Significance Factor (Note 1)
CCNPP Helipad	Sporadic	3500 ft 1.1 km	N/A
Dominion Cove Point LNG Helipad	Sporadic	3.2 mi 5.1 km	N/A
Mears Creek Airfield	Sporadic	3 mi 4.8 km	N/A
Chesapeake Ranch Airpark	3,650	6 mi 9.7 km	18,000
Captain Walter Francis Duke Regional Airport	52,618	10 mi 16.1 km	50,000
Patuxent River Naval Air Station	52,626	10 mi 16.1 km	50,000
Reagan National Airport	277,456 (2005) 303,552 (2025 projected)	44 mi 70.8 km	1,936,000
Washington Dulles International Airport	588,712 (2005) 898,456 (2025 projected)	66 mi 106.2 km	4,356,000

Note 1: $500d^2$ movements per year for sites within 5 to10 mi (8 to 16 km) and $1000d^2$ movements per year for sites outside 10 mi (16 km)

Table 2.2-5— {Onsite Chemicals Disposition}

(Page 1 of 3)

Material	Toxicity Limit (IDLH)	Flammability	Explosion Hazard?	Vapor Pressure	Disposition
			CCNPP Units 1 and 2		
Ammonium Hydroxide (28% solution)	300 ppm as Ammonia	Not flammable	None listed	Not available	Toxicity Analysis
Boric Acid	None estab.	Not flammable	None listed	N/A-solid	No further analysis required
Number 2 Diesel Fuel	None estab.	1.3-6.0%	None listed	0.100 psi @ 100°F/ 0.7 kPa @ 37.8°C	No further analysis required-low vapor pressure (Note 1)
Gasoline	300 ppm (TWA)/ 500 ppm (STEL)	1.4-7.4%	Vapor may explode	7.4 psia/ 51 kPa	Toxicity Analysis Flammability Analysis Explosion Analysis
Towerbrom microbicide	None estab.	Negligible	None listed, only if wet	N/A-solid	No further analysis required
Sodium Hypochlorite	10 ppm for chlorine	Not flammable	None listed	Not available	Toxicity Analysis
Hydrazine (35% solution)	50 ppm	4.7-100%	Vapor may explode	0.567 psi @ 100°F/ 3.9 kPa @ 37.8°C	Toxicity Analysis Flammability Analysis Explosion Analysis
Lube Oil	None estab.	Not flammable	None listed	0.100 psi @ 100°F/ 0.7 kPa @ 37.8°C	No further analysis required
Liquid Nitrogen	Asphyxiant	Negligible	None listed, if exposed to heat	760 mm Hg @ -196°C	Toxicity-consider as asphyxiant
Mineral Oil	2,500 mg/m^3	Not flammable	None listed	0.100 psi @ 100°F/ 0.7 kPa @37.8°C	No further analysis required-low vapor pressure (Note 1)
Polychlorinated Biphenyl (PCB) Oil	5 mg/m^3 (NIOSH)	Not flammable	None listed	0.001 mm Hg	No further analysis required-low vapor pressure (Note 1)
Sodium Hydroxide (50% solution)	None estab.	Not flammable	None listed	Not available	No further analysis required
Sulfuric Acid (98% solution)	15 mg/m^3	Not flammable	None listed	<0.00120 mm Hg	No further analysis required- low vapor pressure (Note 1)
Fyrquel EHC fluid	1,000 mg/m^3 as Triphenyl Phospate	Not flammable	None listed	0.17 mm Hg @ 68°F (20°C)	No further analysis required- low vapor pressure (Note 1)
Sodium Thiosulfate	None estab.	Not flammable	None listed	N/A-solid	No further analysis required
Aluminum Sulfate	None estab.	Not flammable	None listed	N/A-solid	No further analysis required
Monoethanolamine	30 ppm	5.5-17%	None listed	0.022 psi @ 100°F/ 0.15 kPa @ 37.8°C	Toxicity Analysis

Table 2.2-5— {Onsite Chemicals Disposition}

(Page 2 of 3)

Material	Toxicity Limit (IDLH)	Flammability	Explosion Hazard?	Vapor Pressure	Disposition
Dimethylamine (2% solution)	500 ppm	2.8-14.4%	May explode	37.21 psi @ 85ºF/ 257 kPa @ 29.4ºC	Toxicity Analysis Flammability Analysis Explosion Analysis
Hydrogen	None estab.	4.0-75%	Vapor may explode	29.030 @ -418ºF/ 200 kPa @ -250ºF	Toxicity-consider as asphyxiant Flammability Analysis Explosion Analysis
Carbon Dioxide	40,000 ppm	Not flammable	None listed	833 psi @ 68ºF 5,743 kPa @ 20ºC	Toxicity Analysis
Soda Ash (Sodium Carbonate)	None estab.	Not flammable	None listed	N/A-solid	No further analysis required
Hydrochloric Acid	50 ppm	Not flammable	None listed	7.929 psi @ 100ºF/ 54.7 kPa @ 37.8ºC	Toxicity Analysis
CCNPP Unit 3					
Argon	None estab.	Not flammable	None listed	Not available	Toxicity-consider as asphyxiant
Argon-Methane (considered as methane)	None estab.	5-15%	May explode	31.580 psi @ 240ºF/ 217 kPa @ 115.5ºC	Toxicity-consider as asphyxiant Flammability Analysis Explosion Analysis
Hydrogen	None estab.	4.0-75%	Vapor may explode	29.030 @ 418ºF/ 200 kPa @ 214ºC	Toxicity-consider as asphyxiant Flammability Analysis Explosion Analysis
Nitrogen gas	None estab.	Not flammable	None listed	65.820 psi @ 294ºF/ 453.8 kPa @ 145.5ºC	Toxicity-consider as asphyxiant
Oxygen	None estab.	Not flammable	May explode	36.260 psi @ 280ºF/ 250 kPa @ 137.8ºC	Explosion Analysis
Sodium Hypochlorite	10 ppm as Cl_2	Not flammable	None listed	17.5 mmHg @ 68F	The 20,000 gallon tank located at the plant intake is bounded by the 40,000 gallon tank located at the CW Tower (The 20,000 gallon tank is further away from the control room HVAC intakes.)
Sulfuric Acid	15 mg/m^3	Not flammable	None listed	0.001 mmHg @ 68F	No further analysis required-low vapor pressure (Note 1)
Sodium Bisulfite	5 mg/m^3 (TLV-TWA)	Not flammable	None listed	N/A-solid in a solution	No further analysis required.

Table 2.2-5— {Onsite Chemicals Disposition}
(Page 3 of 3)

Material	Toxicity Limit (IDLH)	Flammability	Explosion Hazard?	Vapor Pressure	Disposition
Scale Inhibitor /Dispersant (2-Phosphono-1,2,4-butane tricarboxylic acid)	None estab.	Not flammable	None listed	N/A-solid in a solution	No further analysis required.
Non-Oxidizing Biocide (ethanol)	3,300 ppm as ethanol	3.3-19%	Vapor may explode	44 mmHg @ 68F	Toxicity Analysis Flammability Analysis Explosion Analysis
Antiscalant (Sodium Hexametaphosphate)	None estab.	Not flammable	None listed	N/A-solid in a solution	No further analysis required.

TLV-TWA: Threshold Limit Value-Time-Weighted Average

STEL: Short term exposure limit

IDLH: Immediately Dangerous to Life and Health threshold value

Chemical information was obtained from the CHRIS on-line manual (USCG, 2006), except for Fyrquel EHC (Supresta, 2006), Towerbrom (Occidental, 2003), Polychlorinated Biphenyls (Solutia, 1999), Sodium Carbonate (Mallinckrodt, 2006) Petroleum Jelly (Caltex, 2002), Sodium Thiosulfate (Mallinckrodt, 2004), Argon (NIOSH, 2003) and the STEL value for gasoline (OSHA, 2005).

Note 1: Chemicals with vapor pressures less than 10 torr (0.193 psi, or 0.13 kPa) were not considered. Chemicals with vapor pressures this low are not very volatile. That is, under normal conditions, chemicals cannot enter the atmosphere fast enough to reach concentrations hazardous to people and, therefore, are not considered to be an air dispersion hazard (NOAA, 2007).

Table 2.2-6— {Hazardous Material, Roadway Transportation, Disposition}
(Page 1 of 2)

Material	Toxicity Limit (IDLH)	Flammability	Explosion Hazard?	Vapor Pressure	Disposition
Gasoline	300 ppm (TWA) / 500 ppm (STEL)	1.4-7.4%	Vapor may explode	7.4 psia/ 51 kPa	Toxicity Analysis Flammability Analysis Explosion Analysis
Gasoline (Aviation)	300 ppm (TWA) / 500 ppm (STEL)	1.2-7.1%	Vapor may explode	Not available	Toxicity Analysis Flammability Analysis Explosion Analysis
Diesel Fuel	None established	1.3-6.0%	None listed	0.100 psi @ 100°F/ 0.7 kPa @ 37.8°C	No further analysis required-low vapor pressure (Note 1)
Number 2 Fuel Oil	None established	Not flammable	None listed	0.535 psi @ 100°F/ 3.7 kPa @ 37.8°C	No further analysis required
Number 4 Fuel Oil	None established	1.0-5%	None listed	0.100 psi @ 100°F/ 0.7 kPa @ 37.8°C	No further analysis required-low vapor pressure (Note 1)
Number 6 Fuel Oil	None established	1-5%	None listed	0.100 psi @ 100°F/ 0.7 kPa @ 37.8°C	No further analysis required-low vapor pressure (Note 1)
Ammonium Hydroxide (19% solution)	300 ppm for Ammonia	Not flammable	None listed	Not available	Toxicity Analysis
Lube Oil	None established	Not flammable	None listed	0.100 psi @ 100°F/ 0.7 kPa @ 37.8°C	No further analysis required
Liquid Nitrogen	Asphyxiant	Negligible	None listed, only if exposed to heat	760 mm Hg @ -196°C	Toxicity-consider as asphyxiant (Note 2)
Non-PCB Transformer Oil	None established	Not flammable	None listed	0.100 psi @ 100°F/ 0.7 kPa @ 37.8°C	No further analysis required-low vapor pressure (Note 1)
Propylene Glycol	None established	Not flammable	None listed	Not available	No further analysis required
Sodium Hydroxide (25% solution)	None established	Not flammable	None listed	Not available	No further analysis required
Mineral Oil	2,500 mg/m^3	Not flammable	None listed	0.100 psi @ 100°F/ 0.7 kPa @ 37.8°C	No further analysis required-low vapor pressure (Note 1)
Kerosene	100 mg/m^3	0.7-5%	None listed	0.100 psi @ 100°F/ 0.7 kPa @ 37.8°C	No further analysis required-low vapor pressure (Note 1)
Ethylene Glycol	None established	3.2%-no UEL listed	None listed	0.0005 psi @ 100°F/ 0.0034 kPa @ 37.8°C	No further analysis required-low vapor pressure (Note 1)
Sulfuric Acid	15 mg/m^3	Not flammable	None listed	<0.00120 mm Hg	No further analysis required-low vapor pressure (Note 1)
Urea Liquid Solution	None established	Not flammable	None listed	Not available	No further analysis required

Table 2.2-6— {Hazardous Material, Roadway Transportation, Disposition}
(Page 2 of 2)

Material	Toxicity Limit (IDLH)	Flammability	Explosion Hazard?	Vapor Pressure	Disposition
Propane	2,100 ppm	2.2-9.5%	Vapor may explode	25.4 psi @ -20°F/ 175 kPa @ -6.7°C	Toxicity Analysis Flammability Analysis Explosion Analysis

TLV-TWA: Threshold Limit Value-Time-Weighted Average

STEL: Short term exposure limit

IDLH: Immediately Dangerous to Life and Health threshold value

Chemical information was obtained from the Chemical Hazards Response Information System Manual (USCG, 1998) and the STEL value for gasoline/gasoline (aviation) (OSHA, 2005).

Note 1: Chemicals with vapor pressures less than 10 torr, 0.193 psi, were not considered. Chemicals with vapor pressures this low are not very volatile. That is, under normal conditions, chemicals cannot enter the atmosphere fast enough to reach concentrations hazardous to people and, therefore, are not considered to be an air dispersion hazard (NOAA, 2007).

Note 2: Bounded by the on-site storage of liquid nitrogen.

Table 2.2-7— {Hazardous Material, Navigable Waterway Transportation, Disposition}

Material	Toxicity Limit (IDLH)	Flammability	Explosion Hazard?	Vapor Pressure	Disposition
Gasoline	300 ppm (TWA)/ 500 ppm (STEL)	1.4-7.4%	Vapor may explode	7.4 psia/ 51.0 kPa	Toxicity Analysis Flammability Analysis Explosion Analysis
Kerosene	100 mg/m^3 (TLV-TWA)	0.7-5%	None listed	0.099 psi @ 100°F/ 0.7 kPa @ 37.8°C	No further analysis required-low vapor pressure (Note 1)
Distillate Fuel Oil	None established	Not flammable	None listed	0.535 psi @ 100°F/ 3.7 kPa @ 37.8°C	No further analysis required
Residual Fuel Oil (#6)	None established	1-5%	None listed	0.099 psi @ 100°F/ 0.7 kPa @ 37.8°C	No further analysis required-low vapor pressure (Note 1)
Lube Oil and Greases	None established	Not flammable	None listed	0.099 psi @ 100°F/ 0.7 kPa @ 37.8°C	No further analysis required
Petroleum Jelly and Waxes	None established	Not flammable	None listed	N/A-solid	No further analysis required
Naptha & Solvents	1,000 ppm	0.8-5%	None listed	0.124 psi @ 100F/ 0.85 kPa @ 37.8°C	No further analysis required-low vapor pressure (Note 1)
Petroleum Coke	None established	No flammability class	Dust/air mixtures may ignite/explode	Negligible-soli d	No further analysis required
Asphalt and Tar Pitch	80 mg/m^3 as coal tar pitch volatiles	Not flammable	None listed	<0.01 kPa @ 20°C (Note 2)	No further analysis required- low vapor pressure1
Liquid Natural Gas	None established	5.3-14%	Vapor may explode	31.92 psi @ -240°F/ 220 kPa @ -151°C	Utilizing PPRP Study
Nitrogen Fertilizers	None established (Note 3)	Not applicable (Note 3)	Not applicable (Note 3)	Not applicable (Note 3)	No further analysis required
Benzene	500 ppm	Benzene: 1.3-7.9%	Vapor may explode	3.227 psi @ 100°F/ 22.2 kPa @ 37.8°C	Toxicity Analysis Flammability Analysis Explosion Analysis
Toluene	500 ppm	Toluene: 1.27-7.0%	Vapor may explode	1.033 psi @ 100°F/ 7.1 kPa @ 37.8°C	Toxicity Analysis Flammability Analysis Explosion Analysis
Sulfuric Acid	15 mg/m^3	Not flammable	None listed	<0.00120 mm Hg	No further analysis required-low vapor pressure (Note 1)
Ammonia	300 ppm	15.5-27%	None listed	171.199 psi @ 85°F/ 1,180 kPa @ 29.4°C	Toxicity Analysis Flammability Analysis
Sodium Hydroxide	None established	Not flammable	None listed	Not available	No further analysis required

TLV-TWA: Threshold Limit Value-Time-Weighted Average

STEL: Short term exposure limit

IDLH: Immediately Dangerous to Life and Health threshold value

The vapor pressure for Coal-Tar Pitch was obtained from INCHEM. (INCHEM, 2002)

There are no established toxicity limits for broad categories. Further, no fertilizer mixtures are known to present specific explosion hazards without combining them with other commodities.

Chemical information was obtained from the Chemical Hazards Response Information System manual (USCG, 1998), except for the STEL value for gasoline (OSHA, 2005).

Note 1: Chemicals with vapor pressures less than 10 torr, 0.193 psi, were not considered. Chemicals with vapor pressures this low are not very volatile. That is, under normal conditions, chemicals cannot enter the atmosphere fast enough to reach concentrations hazardous to people and, therefore, are not considered to be an air dispersion hazard.

Table 2.2-8— {Explosion Event Analysis}

Source	Pollutant Evaluated	Quantity	Heat of Combustion (Btu/lb)/ (kJ/kg)	Distance to Nearest CCNPP Unit 3 Safety Related Structure	Distance at 1 psi (6.9 kPa) Peak Incident Pressure
Maryland Route 2/4	Gasoline (Note 1)	8,500 gal/ 32,000 l	18,720/ 43,514	6,119 ft/ 1.9 km	263 ft/ 50.2 m
	Gasoline (aviation) (Note 1)	8,500 gal/ 32,000 l	18,720/ 43,514		260 ft/ 79.2m
	Propane (Note 2)	50,000 lbs/ 22,679 kg	19,782/ 45,982		3,559 ft/ 1.1 km
Pipeline-DCPLNG	Liquefied Natural Gas (Note 3)				
Navigable Waterway	Gasoline (Notes 1 and 4)	5,200,000 lbs/ 2,400,000 kg	18,720/ 43,514	11,678 ft/ 3.6 km	1,222 ft/ 372.5 m
	Benzene (Notes 1 and 4)	5,200,000 lbs/ 2,400,000 kg	17,460/ 40,585		1,076 ft/ 328 m
	Toluene (Notes 1 and 4)	5,200,000 lbs/ 2,400,000 kg	17,430/ 40,572		1,072 ft/ 326.7 m
On-Site (CCNPP Units 1 & 2)	Gasoline (Notes 1 and 5) (3,500 gal (15,900l) tank truck) (Notes 1 and 3)	3,500 gal/ 13,250 l	18,720/ 43,514	310 ft/ 94.5 m	196 ft/ 59.7 m
	Hydrazine (35% solution) (Note 1)	350 gal/ 1,325 l	8,345/ 19,397	891 ft/ 271.6 m	114 ft/ 34.7 m
	Dimethylamine (2% solution) (Note 1)	350 gal/ 1,325 l	16,800/ 39,051	462 ft/ 140.8 m	85 ft/ 25.9 m
	Hydrogen (Note 2)	460 cu ft/ 13 cu m	50,080/ 116,411	745 ft/ 271.6 m	224 ft/ 68.3 m
On-Site (CCNPP Unit 3)	Argon-Methane (considered as methane (Note 2)	282 scf/ 7.99 Nm^3	21,517/ 50,029	(Note 9)	119 ft / 36.2 m
	Hydrogen (Note 2)	278 scf/ 7.87 Nm^3	50,080/ 120,000	(Note 9)	133 ft/ 40.5 m
	Oxygen (Note 2)	282 scf/ 7.99 Nm^3	N/A (Note 6)	(Note 9)	41 ft / 13 m
	Non-Oxidizing Biocide (ethanol) (Note 7)	1,000 gal/ 3,800 l	11,570/ 26,880 kJ/kg	(Note 9)	58 ft / 17.7 m
	Non-Oxidizing Biocide (ethanol) (Note 8)	350 gal/ 1,300 l	11,570/ 26,880 kJ/kg	(Note 9)	41 ft / 12.5 m
Nearby Facilities	DCPLNG (associated hazards) (Note 3)				

scf: Standard cubic feet

Nm^3: Normal cubic meter

Note 1: For atmospheric liquids, the storage vessel was assumed to contain the quantity of fuel vapors in air at the upper explosive limit.

Note 2: For compressed or liquefied gases, the entire content of the storage vessel was conservatively assumed as the flammable mass.

Note 3: The DCPLNG pipeline explosion and all explosive hazards from the DCPLNG facility are bounded by the DCPLNG pipeline vapor cloud explosion.

Note 4: The maximum quantity shipped per shipment for gasoline, benzene, and toluene was not available. Therefore, it was assumed that the maximum quantity was 5.2 million lbs. (2.4 million kg) (CRS)

Note 5: The 4,000 gallon gasoline tank is an underground storage tank. The toxicity event is bounded by the 3,500 gallon gasoline delivery tank truck.

Note 6: Oxygen is not explosive by ignition and has no reported heat of combustion; therefore it was analyzed for explosion by overpressure (USCG, 2007).

Note 7: The actual quantity of ethanol analyzed (10 percent by weight of non-oxidizing biocide) was 122 gal/ 462 l.

Note 8: The actual quantity of ethanol analyzed (10 percent by weight of non-oxidizing biocide) was 42.66 gal/ 161.3 l.

Note 9: The evaluated pollutant is stored at a distance greater than the reported safe distance (the minimum distance required for an explosion to have less than 1 psi peak incident pressure).

Table 2.2-9— {Flammable Vapor Cloud Events (Delayed Ignition) and Vapor Cloud Explosion Analysis}
(Page 1 of 2)

Source	Pollutant Evaluated & Quantity	Distance to Nearest Safety Related CCNPP Unit 3 Structure	Distance to UFL	Distance to LFL	Safe Distance for Vapor Cloud Explosions	Peak Over pressure at Nearest Safety Related CCNPP Unit 3 Structure
Maryland Route 2/4	Gasoline (8,500 gal)/ 32,176 l (Note 7)	6,119 ft/ 1,865 m to Ultimate Heat Sink (UHS)	234 ft/ 71.3 m	393 ft/ 119.8 m	999 ft/ 304.5 m	Not Significant (Note 5)
	Gasoline (aviation) (8, 500 gal)/ 32,176 l (Note 7)		237 ft/ 72.2 m	414 ft/ 126.2 m	1,002 ft/ 305.4 m	Not Significant (Note 5)
	Propane (50,000 lbs)/ 22,680 kg (Note 8)		1,167 ft/ 356 m	2,361 ft/ 720 m	4,185 ft/ 1,276 m	0.526 psi/ 3.63 kPa
Waterway (Chesapeake Bay)	Gasoline (5,200,000 lbs)/ 2,360,000 kg (Note 6)	11,678 ft/ 3,560 m to UHS makeup intake water structure	783 ft/ 239 m	1,464 ft/ 446 m	3,312 ft/ 1,009 m	0.159 psi/ 1.10 kPa
	Benzene (5,200,000 lbs)/ 2,360,000 kg (Note 6)		951 ft/ 290 m	2,172 ft/ 662 m	4,095 ft (1,284 m)	0.209 psi (1.44 kPa)
	Toluene (5,200,000 lbs)/ 2,360,000 kg (Note 6)		696 ft/ 212 m	1,302 ft/ 397 m	2,604 ft (794 m)	0.115 psi (0.793 kPa)
	Ammonia (1,200,000 lbs)/ 544,311 kg (Note 3)		4,746 ft/ 1,447 m	6,864 ft/ 2,092 m	10,032 ft/ 3,058 m	0.684 psi/ 4.72 kPa
On-site (CCNPP Units 1 & 2)	Gasoline (3,500 gal)/ 13,249 l (Note 4)	310 ft/ 94.5 m	144 ft/ 44 m	234 ft/ 71 m	648 ft/ 198 m	5.62 psi/ 38.7 kPa (Note 1)
	Hydrazine (35% solution) (350 gal)/1,325 l	891 ft/ 272 m	<33 ft/ <10.1 m	<33 ft/ <10.1 m	No explosion	No explosion
	Dimethylamine (Note 9) (2% solution) (350 gal)/1,325 l	462 ft/ 141 m	<33 ft/ <10.1 m	45 ft (14 m)	180 ft/ 55 m	0.282 psi/ 1.94 kPa
	Hydrogen (460 cu ft)/ 13 cu m	745 ft/ 227.1 m	108 ft/ 33 m	492 ft/ 150 m	738 ft/225 m	0.984 psi/ 6.78 kPa
On-site (CCNPP Unit 3)	Argon-Methane (Note 10) (282 scf)/ 7.99 Nm^3 (considered as Methane)	(Note 15)	39 ft/ 11.9 m	69 ft/ 21 m	126 ft/ 38 m	(Note 15)
	Hydrogen (Note 11) (278 scf)/ 7.87 Nm^3	(Note 15)	< 33 ft/ <10.1 m	75 ft/ 23 m	138 ft/ 42 m	(Note 15)
	Non-Oxidizing Biocide (ethanol) 1,000 gal/ 3,800 l (Note 12)	(Note 15)	(Note 13)	< 33 ft/ < 10 m	36 ft/ 11 m	(Note 15)
	Non-Oxidizing Biocide (ethanol) / 350 gal/ 1,300 l (Note 14)	(Note 15)	(Note 13)	< 33 ft/ < 10 m	< 33 ft/ < 10 m	(Note 15)
DCPLNG Nearby Facility and Pipeline Scenario for Flammable Vapor Clouds (Note 2)						

Table 2.2-9— {Flammable Vapor Cloud Events (Delayed Ignition) and Vapor Cloud Explosion Analysis}
(Page 2 of 2)

Scenario	Frequency per year (Existing)	Frequency per year (Expansion)	Distance to Nearest Safety Related Structure	Maximum Consequence Range
Total loss of ship's tank en route (off CCNPP)	2.18×10^{-7}	2.84×10^{-7}	3.4 mi/ 17,925 ft	1,558 ft- Pool Fire / 13,943 ft- Flash Fire 475 m—Pool Fire/ 4,250 m—Flash Fire
DCPLNG Gas Pipelines	3.60×10^{-3}	7.48×10^{-3}	1.54 mi 8,131 ft	5,808 ft-overpressure/2,362 ft-Jet Fire / 722 ft-Flash Fire 1,770 m-overpressure/720 m—Pool Fire/ 220 m—Flash Fire
Escalation Event-Total loss of all storage tanks	4.00×10^{-6}	4.00×10^{-6}	3.2 mi/ 16,896 ft	1,188 ft-Pool Fire / 5,413 ft- Flash Fire 362 m—Pool Fire/1,295 m—Flash Fire

scf: Standard cubic feet

Nm^3: Normal cubic meter

Note 1: This event was determined not to be a credible event based on an event probability of less than 1 E-7. Refer to Section 2.2.3.2.4 for the analysis of this event.

Note 2: Overall risk of fatality from DCPLNG facility and associated pipeline to CCNPP Site was evaluated to be 2.3E-9 per year (present operations) and 6.6E-9 per year (planned expansion). (The risk of physical damage to CCNPP Unit 3 is lower) The impact from blast overpressures was taken into account in developing this risk.

Note 3: The annual quantity of ammonia transported in proximity to the CCNPP Unit 3 site is 2.0 million pounds (0.9 million kg). The frequency of transport was not available; consequently, it was conservatively assumed that the entire 2.0 million pounds (0.9 million kg) was transported in one shipment and released. A 0.6 reduction factor was applied to the 2.0 million pounds (0.9 million kg) in the analysis to account for the high rate at which ammonia dissolves in water as ALOHA does not account for this phenomena.

Note 4: The 4,000 gallon gasoline tank is an underground storage tank. Therefore, the toxicity event is bounded by the 3,500 gallon gasoline delivery tank truck.

Note 5: ALOHA output results indicate "not significant" when the peak overpressure is <0.1 psi.

Note 6: The maximum quantity shipped for gasoline, benzene, and toluene was not available. Therefore, it was assumed that the maximum quantity was 5,200,000 lbs. (CRS, 2005)

Note 7: Gasoline and aviation gasoline were modeled in ALOHA as n-heptane. N-heptane is used as a substitute for gasoline because the molecular weight and physical properties are similar.

Note 8: The worst case combination of stability class and wind speed is F stability and a wind speed of 3 m/sec for propane.

Note 9: The worst case combination of stability class and wind speed is E stability and a wind speed of 1 m/sec for dimethylamine.

Note 10: The worst case combination of stability class and wind speed is E stability and a wind speed of 1 m/sec for argon-methane.

Note 11: The worst case combination of stability class and wind speed is E stability and a wind speed of 1 m/sec for the CCNPP Unit 3 hydrogen.

Note 12: The actual quantity of ethanol analyzed (10 percent by weight of non-oxidizing biocide) was 122 gal/ 462l.

Note 13: The concentration is never reached in the vapor cloud.

Note 14: The actual quantity of ethanol analyzed (10 percent by weight of non-oxidizing biocide) was 42.66 gal/ 161.3 l.

Note 15: The evaluated pollutant is stored at a distance greater than the reported safe distance for either the flammable vapor cloud accident category (the distance to the outer edge of the LFL section of the vapor cloud) or the reported safe distance for the vapor cloud explosion accident category (the minimum distance required for an explosion to have less than 1 psi peak incident pressure should a vapor cloud detonate).

Table 2.2-10— {Toxic Vapor Cloud Analysis}
(Page 1 of 3)

Source	Chemical	Quantity	IDLH	Distance to CCNPP Unit 3 Control Room Intake	Distance to IDLH (Note 1)	Maximum Control Room Concentration (Note 2)
Maryland 2/4	Gasoline	8,500 gal/ 32,200 l	300 ppm TWA / 500 ppm STEL (Note 3)	6,531 ft/ 1,991 m	1,752 ft/ 534 m	9.44 ppm (Note 4)
	Gasoline (aviation)	8,500 gal/ 32,200 l	300 ppm TWA / 500 ppm STEL (Note 3)		1,752 ft/ 534 m	9.45 ppm (Note 4)
	Propane	50,000 lbs/ 22,700 kg	2,100 ppm		5,022 ft/ 1,531 m	114 ppm
	Ammonium Hydroxide (19% solution)	50,000 lbs/ 22,700 kg	300 ppm for ammonia		8,448 ft/ 2,575 m	70.9 ppm (Note 5)
Waterway (Chesapeake Bay)	Gasoline	5,200,000 lbs/ 24,000,000 kg	300 ppm TWA / 500 ppm STEL (Note 7)	11,701 ft/ 3,566 m	6,336 ft/ 1,931 m	18.5 ppm (Note 4)
	Benzene (Note 6)	560,000 lbs/ 254,000 kg	500 ppm		5,808 ft/ 1,770 m	33.0 ppm (Note 4)
	Toluene (Note 6)	560,000 lbs/ 254,000 kg	500 ppm		4,551 ft/ 1,387 m	19.7 ppm (Note 4)
	Ammonia	16,000 lbs/ 7,257 kg (Note 7)	300 ppm		18,480 ft/ 5,633 m	83.5 ppm (Notes 5 and 8)
On-site (CCNPP Units 1 & 2)	Ammonium Hydroxide (28% solution)	8,500 gal/ 32,176 l	300 ppm as ammonia	2,994 ft/ 913 m	6,864 ft/ 2,092 m	194 ppm (Note 15)
	Gasoline (Note 10)	3,500 gal/ 13,250 l	300 ppm TWA / 500 ppm STEL	617 ft/ 188 m	1,230 ft/ 375 m	343 ppm (Note 9)
	Sodium Hypochlorite	8,500 gal/ 32,176 l	10 ppm as chlorine	2,472 ft/ 753 m	174 ft/ 53 m	0.049 ppm (Note 4)
	Hydrazine (35% solution)	350 gal/ 1,325 l	50 ppm	1,489 ft/ 454 m	1,197 ft/ 365 m	10.1 ppm (Note 5)
	Monoethanolamine	350 gal/ 1,325 l	30 ppm	2,889 ft/ 881 m	135 ft/ 41 m	0.0784 ppm (Note 5)
	Dimethylamine (2% solution)	350 gal/ 1,325 l	500 ppm	2,889 ft/ 881 m	288 ft/ 88 m	0.743 ppm
	Hydrochloric Acid (30% Solution)	3,000 gal/ 11,360 l	50 ppm	2,994 ft/ 913 m	3,102 ft/ 945 m	14.1 ppm (Note 5)
	Hydrogen	460 cu ft/ 13 cu m	Asphyxiant	2,994 ft/ 913 m	Asphyxiant	53.0 ppm
	Carbon Dioxide	50, 000 lb 22,680 kg	40,000 ppm	900 ft/ 274 m	1,749 ft/ 533 m	25,300 ppm (Note 16)
	Liquid Nitrogen	11,300 gal/ 42,775 l	Asphyxiant	2,994 ft/ 913 m	Asphyxiant	635 ppm (Note 5)

Table 2.2-10— {Toxic Vapor Cloud Analysis}
(Page 2 of 3)

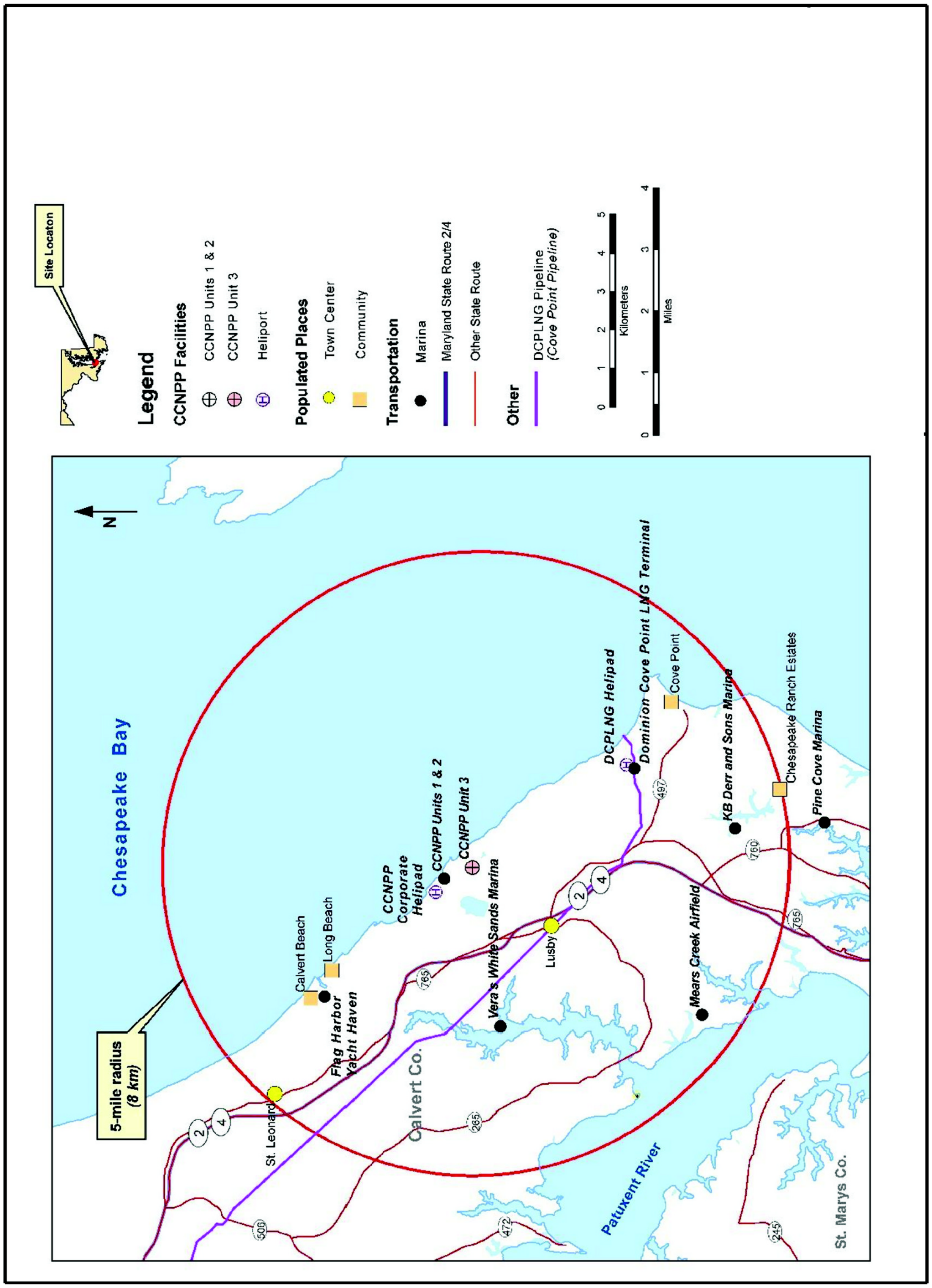
Source	Chemical	Quantity	IDLH	Distance to CCNPP Unit 3 Control Room Intake	Distance to IDLH (Note 1)	Maximum Control Room Concentration (Note 2)
On-site (CCNPP Unit 3)	Argon	270 scf/ 7.64 Nm^3	Asphyxiant	(Note 14)	Asphyxiant 42 ft/13 m	(Note 11)
	Argon-Methane (considered as Methane)	282 scf/ 7.99 Nm^3	Asphyxiant	(Note 14)	Asphyxiant 42 ft/13 m	(Note 11)
	Hydrogen	278 scf/ 7.87 Nm^3	Asphyxiant	(Note 14)	Asphyxiant 39 ft/12 m	(Note 11)
	Nitrogen	235 scf/ 6.65 Nm^3	Asphyxiant	(Note 14)	Asphyxiant 36 ft/11 m	(Note 11)
	Sodium Hypochlorite	40,000 gal/ 150,000 l	10 ppm as Cl_2	(Note 14)	396 ft/ 121 m	(Note 14)
	Sodium Hypochlorite	2,000 gal/ 7,600 l	10 ppm as Cl_2	(Note 14)	93 ft/ 28 m	(Note 14)
	Non-Oxidizing Biocide (ethanol)	1,000 gal/ 3,800 l (Note 12)	3,300 ppm as ethanol	(Note 14)	75 ft/ 23 m	(Note 14)
	Non-Oxidizing Biocide (ethanol)	350 gal/ 1,300 l (Note 13)	3,300 ppm as ethanol	(Note 14)	45 ft/ 14 m	(Note 14)

Table 2.2-10— {Toxic Vapor Cloud Analysis}
(Page 3 of 3)

Source	Chemical	Quantity	IDLH	Distance to CCNPP Unit 3 Control Room Intake	Distance to IDLH (Note 1)	Maximum Control Room Concentration (Note 2)

TLV-TWA: Threshold Limit Value-Time-Weighted Average
STEL: Short term exposure limit
IDLH: Immediately Dangerous to Life and Health threshold value
scf: Standard cubic feet
Nm^3: Normal cubic meter
Note 1: The reported value for the distance to the IDLH (or other determined toxicity limit) is the resultant distance to the IDLH for the determined worst case meteorological conditions for each postulated event. The worst case meteorological conditions were based upon those meteorological conditions yielding the highest concentration in the control room during a postulated event.
Note 2: The concentrations reported represent indoor concentrations. The air exchange rate of 0.45 air exchanges per hour that was used in the ALOHA model was calculated from the control room volume and the rate of fresh air intake. Unless noted, the worst case combination of stability class and wind speed is F stability and a wind speed of 1 m/sec.
Note 3: For gasoline and gasoline (aviation) the time weighted average (TWA) and short term exposure limit (STEL) were conservatively used as no IDLH is available for either of these hazardous materials.
Note 4: The worst case combination of stability class and wind speed is F stability and a wind speed of 3 m/sec.
Note 5: The worst case combination of stability class and wind speed is F stability and a wind speed of 2 m/sec.
Note 6: For benzene, and toluene a combined total of 28,000 short tons/year are shipped by barge. It is conservatively assumed that they are shipped in equal quantities (14,000 short tons per year each) and that they each have the minimum 50 shipments (Regulatory Guide 1.78) and each shipment contains the same quantity, 560,000 lbs each.
Note 7: The amount of ammonia transported by barge near the plant is 1,000 short tons. It is conservatively assumed that there are 50 shipments per year (Regulatory Guide 1.78), with each shipment, therefore, containing 40,000 lbs. This quantity was reduced further because of the high rate at which ammonia dissolves in water. A 0.60 partition coefficient was assigned, reducing the volume to16,000 lbs.
Note 8: This event was evaluated to not be a credible event based on screening criteria for event frequency in accordance with Regulatory Guide 1.78. Refer to Section 2.2.3.1.3 for the analysis of this event.
Note 9: An additional probabilistic evaluation was conducted for this postulated event and this spill event was determined not to be a credible event, in accordance with Regulatory Guide 1.78 risk frequency evaluation requirements. Refer to Section 2.2.3.1.3 for the analysis of this event.
Note 10: The 4,000 gallon gasoline tank reported in Table 2.2-2 is an underground storage tank. Therefore, the toxicity event is bounded by the 3,500 gallon gasoline delivery tank truck.
Note 11: The reported distance to the IDLH for this asphyxiant is the distance at which the concentration outside the control room is such that enough oxygen may become displaced to create an oxygen deficient atmosphere.
Note 12: The actual quantity of ethanol analyzed (10 percent by weight of non-oxidizing biocide) was 122 gal/ 462 l.
Note 13: The actual quantity of ethanol analyzed (10 percent by weight of non-oxidizing biocide) was 42.66 gal/ 161.3 l.
Note 14: The evaluated chemical is stored at a distance greater than the reported safe distance (the distance the chemical cloud could travel before it disperses enough such that the concentration in the vapor cloud falls below the IDLH limit, other determined toxicity limit concentration, or at a level where an oxygen deficient atmosphere is plausible). For these evaluated chemicals the control room air exchange rate was not accounted for in the analyses.
Note 15: Because the ammonium hydroxide (28%) is stored at the tank farm and must travel directly over/around structures to reach the control room air intake, a ground roughness value of 50 cm was entered.
Note 16: The toxicity event for the 8,000 lb storage tank Bldg. is bounded by the 50,000 lb delivery truck.

Figure 2.2-1— {5 mi (8 km) Site Vicinity Map}



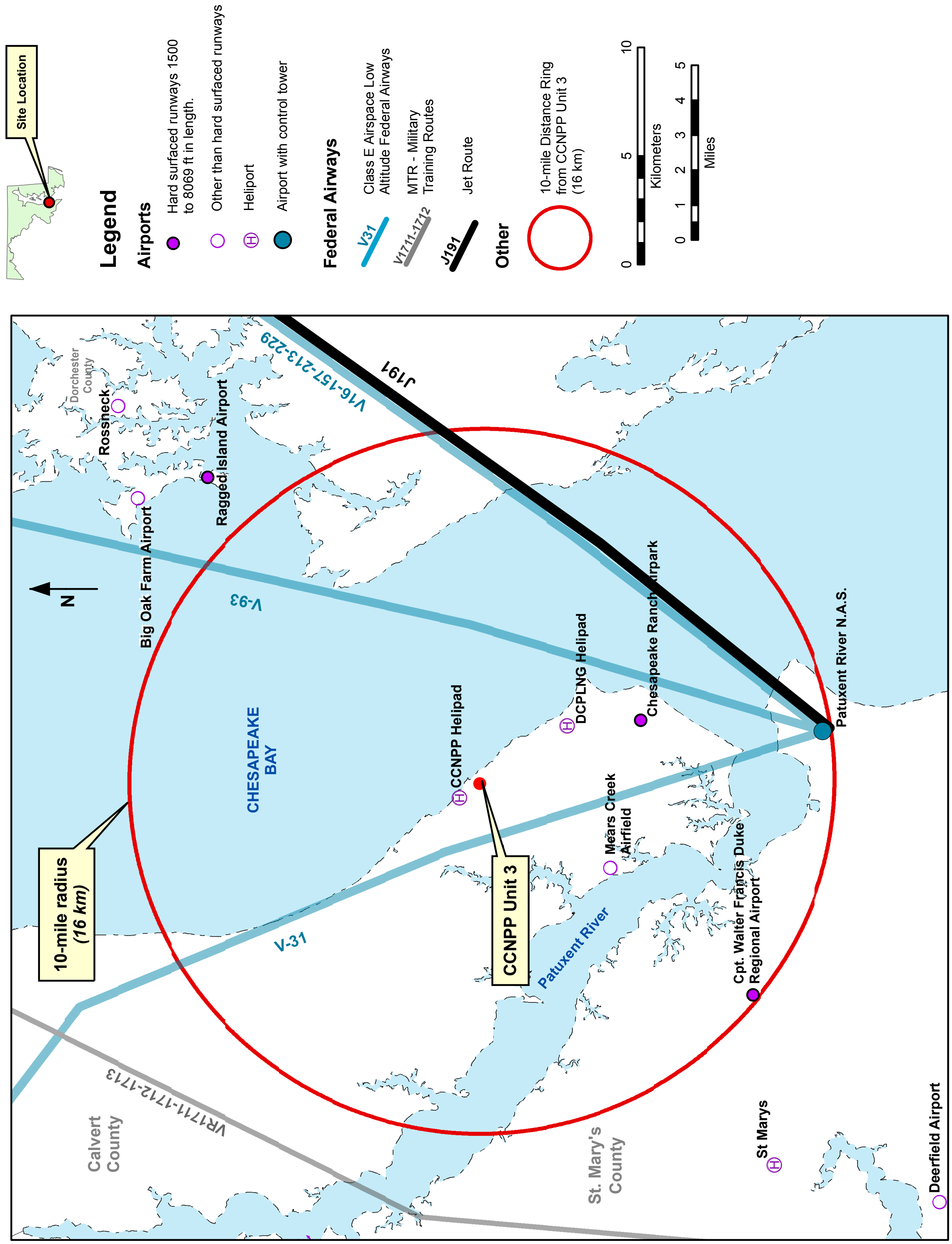


Figure 2.2-2— {Airports/Airways Within 10 mi (16 km) of Site}