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2.2 Nearby Industrial, Transportation, and Military Facilities

2.2.1 Location and Routes

The purpose of this section is to establish whether the effects of potential accidents onsite or in the vicinity of the site, from present and projected industrial, transportation, and military installations and operations, should be considered as design basis events for plant design parameters once a plant design is selected. Potential hazard facilities and routes within the 5-mile vicinity of the VCS site and airports within 10 miles of the VCS site are identified along with significant facilities at a greater distance in accordance with RG 1.206, RG 1.91, RG 4.7, RG 1.78, and relevant sections of 10 CFR Parts 50, 52, and 100.

An investigation within 5 miles of the VCS site of the potential hazard facilities and operations identified the following for further analysis:

- No significant industrial facilities
- Ten active and two abandoned natural gas transmission pipelines
- One gasoline/diesel fuel pipeline
- One ethylene/cyclohexane pipeline
- Four active natural gas gathering pipeline systems
- Six major natural gas and/or oil fields with active extraction wells (References 2.2-1 through 2.2-6)

Figures 2.2-1, 2.2-3, and 2.2-4 illustrate the following identified natural gas and chemical pipelines located within 5 miles of the VCS site:

Natural Gas Transmission Pipelines (Reference 2.2-5)

- Gulf South Pipeline Co., L.P.
    - Koch Gateway Pipeline System
- Kinder Morgan Texas Pipeline, L.P
    - Tom O'Connor FL – Missouri City Jct. System
- Natural Gas Pipeline Company of America, LLC
    - Gulf Coast Mainline System – Mainline #1

- Gulf Coast Mainline System – Mainline #2
- South Texas Lats. System – Petrotex Lat.

- Transcontinental Gas Pipeline Corp.
  - Mainline 26-0100 System
- Tennessee Gas Pipeline Company
  - TGP 100 System – 100-1
  - TGP 100 System – 100-2
  - TGP 100 System – 100-3
  - TGP 100 System – Coleto Creek Line
- Aquila Southwest Pipeline Corp. – Mary Simmons System (abandoned)
- Enterprise Products Operating, LLC – System 390 (abandoned)

Chemical Pipelines (Reference 2.2-5)

- Citgo Products Pipeline Company Casa Pipeline System – Nueces Station to Victoria Station (gasoline/diesel fuel)
- United Brine Pipeline Co., LLC – Ingleside to Bloomington System (ethylene/cyclohexane)

Natural Gas Gathering Pipeline Systems (Reference 2.2-5)

- Apache Corporation – McFaddin Gathering System
- Southcross Gulf Coast Trans, LTD – Gulf Coast Transmission System
- Enerfin Field Services, LLC – McFaddin and Refugio Gathering System
- Gulf South Pipeline Co. L.P. – Victoria Gathering System

Figure 2.2-5 illustrates the following active natural gas and/or oil extraction fields located within 5 miles of the VCS site:

Natural Gas/Oil Extraction Fields (Reference 2.2-6)

- McFaddin

- Kay Creek
- Anaqua
- Johnstone
- Wildcat
- Huff

An evaluation of major transportation routes within the 5-mile vicinity of the VCS site identified one navigable waterway, one road, and one railway for assessment (References 2.2-7 through 2.2-10).

A site vicinity map (Figure 2.2-1) details the following identified transportation routes within a 5-mile radius of the power block area:

- Victoria Barge Canal
- U.S. Highway 77
- Union Pacific Railway

The evaluation of industrial facilities and transportation routes within the vicinity of the VCS site included a review of relevant hazardous material storage and transportation data. To determine facilities for consideration within 5 miles of the VCS site, the Texas Department of State Health Services was contacted to obtain Superfund Amendments and Reauthorization Act (SARA) Title III, Tier II reports to evaluate chemical storage and transportation within the vicinity of the VCS site. The U.S. EPA's Envirofacts/Enviromapper database was also queried to ascertain if other facilities of significance existed in addition to the facilities identified after evaluating the SARA reports. As indicated, there were no external facilities identified within 5 miles of the VCS site with hazardous material storage in quantities identified as meeting SARA Title III, Tier II reporting requirements or identified in the U.S. EPA's Envirofacts/Enviromapper database. (References 2.2-1 through 2.2-4)

As stipulated in RG 1.206, facilities and activities at distances greater than 5 miles should be considered as appropriate for evaluation based on their significance. The review of SARA reports encompassing an area extending out from the VCS site with a minimum radius of approximately 10.5 miles out to a maximum radius of approximately 45 miles (inclusive of the following zip codes: 77905, 77951, 77963, 77973, 77979, 77990, and 78377) was conducted to determine if there are facilities or storage locations that could have a significant impact on the VCS site. The evaluation for those facilities located at distances greater than 5 miles from the VCS site was based on identifying whether any of those facilities stored highly toxic or highly volatile chemicals with large EPA Risk Management Program (RMP) endpoints, not bounded by an evaluation of that chemical whose transportation route or storage location is in closer proximity and where the evaluation would include a larger quantity than the storage quantity at that facility. (References 2.2-1 through 2.2-4, and 2.2-66)

The explosive nature of the hazardous materials stored at distances greater than 5 miles would not be a consideration unless a facility involved in the production or handling of substances specifically intended for the use of munitions or explosives was identified. Regulatory Position C.1 of RG 1.91 specifies that if explosives approach vital structures of a nuclear facility no closer than distances computed using Figure 1, Radius to Peak Incident Pressure of 1 PSI, no further consideration need be given to the effects of blast in plant design. Figure 1, Radius to Peak Incident Pressure of 1 PSI, depicts safe distances for several scenarios involving the immediate detonation of a cargo. The maximum safe distance depicted for the immediate detonation of a 5000-ton vessel with a TNT mass equivalence of 10^7 pounds, yields a safe distance of 10,000 feet (approximately 2 miles). (For solid substances not intended for use as explosives but subject to accidental detonation, it is conservative to use a TNT equivalence of one in establishing safe standoff distances—that is, the mass of the substance in question will produce the same blast effect as a unit mass of TNT.) Thus, except for facilities involved in the production/use of munitions or explosives, where the material may have a TNT equivalency much greater than one, safe distances exceeding 5 miles are unlikely. Therefore, in terms of vapor cloud formation for the toxicity, flammable vapor cloud, and vapor cloud explosion accident categories evaluated, the volatility of chemicals at distances this great is the determining factor.

Six industrial facilities within 5 to 10 miles of the VCS site were identified for evaluation to determine whether they are significant enough to be considered for further analysis (Figure 2.2-1). They are:

- Air Liquide America Corporation
- INVISTA-DuPont
- Equistar Chemicals
- Gavilon Fertilizer, LLC
- Inergy Propane, LLC
- Tennessee Gas Pipeline – Station 9

Figure 2.2-1 also illustrates one active mining and quarrying operation within 10 miles of VCS, Fordyce, Ltd., Briggs Plant – Sand and Gravel Dredging (Reference 2.2-13).

Four additional roads and one railway are located within 5 to 10 miles of the VCS site (Reference 2.2-7). However, these are not considered significant enough to be identified as potential hazards.

Potential hazard analyses of airports within 10 miles of the VCS site are identified along with airway and military operation areas. Figure 2.2-6 illustrates the following identified airports, airway routes, and military operation areas within 10 miles of VCS (References 2.2-11, 2.2-12 and 2.2-20):

- Kingsville Military Operations Area

The Green Lake Ranch Airport is situated just outside of the 10-mile radius of the VCS site. However, due to its close proximity to the 10-mile radius it was included for consideration.

There are no identified roads, railways, navigable waterways, or activities at a distance greater than 10 miles that are significant potential hazards. The Victoria Regional Airport is situated approximately 18 miles northeast of the VCS site (Reference 2.2-14), and the closest military base is Ingleside Naval Station located in Ingleside, Texas, approximately 55 miles south of the VCS site (Reference 2.2-15).

2.2.2 Descriptions

Descriptions of the industrial, transportation, and military facilities identified in Subsection 2.2.1 are provided in the subsequent subsections in accordance with RG 1.206.

2.2.2.1 Description of Facilities

In addition to potential onsite chemical storage, six facilities are identified for further review and disposition:

- Air Liquide America Corporation
- INVISTA-DuPont
- Equistar Chemicals
- Gavilon Fertilizer, LLC
- Inergy Propane, LLC
- Tennessee Gas Pipeline–Station 9

Table 2.2-1 provides a concise description of each facility evaluated, including its primary function and major products, as well as the number of employees.

2.2.2.2 Description of Products and Materials

A more detailed description of the associated chemicals for each of the previously cited facilities for consideration and disposition are provided in the following subsections. This description includes information about the products and materials regularly manufactured, stored, used, and transported in the VCS vicinity. As specified in RG 1.206, facilities and activities associated with chemical storage at distances greater than 5 miles from the VCS site are not considered unless they are determined to have a significant impact on the site.

2.2.2.2.1 Onsite Chemicals

The maintenance of proper water chemistry at the VCS site will require treatment of well water and river water to be used in various plant systems such as circulating water, service water, potable water, and demineralized water. Water treatment will be provided for biofouling, scaling, and suspended matter with acceptable biocides, antiscalants, and dispersants, respectively. Dependent on the chosen technology, it is also expected that there will be gas storage for plant operations at the VCS site. As such, these potentially toxic, flammable, and/or explosive hazardous materials to be stored onsite will be identified and evaluated for possible impact on the new units at the VCS site in the COL application, when a technology is selected.

2.2.2.2.2 Industrial Facilities

Air Liquide America Corporation

Air Liquide America Corporation is located approximately 7.0 miles east of the VCS site. Air Liquide has two separation units that produce oxygen, nitrogen and argon for use in the food and medical industries as well as for other industrial applications. At the 30-acre Air Liquide Victoria County plant, there are ten employees. This facility reduced the storage of all regulated substances below the threshold quantities for EPA's RMP reporting requirements and is now deregistered. The last RMP submission was June 1999. (Reference 2.2-16) A review of the 2008 SARA Title III, Tier II report indicates that this facility stores anhydrous ammonia in small amounts—two containers with listed quantities of 392 gallons and 538 pounds. (Reference 2.2-1)

Air Liquide receives and ships materials primarily by truck. Products and materials are shipped and received via State Highway 185, McCoy Road, and Old Bloomington Road. The truck transport route does not approach within 5 miles of the VCS site. The analysis of the storage of anhydrous ammonia at Air Liquide America Corporation is bounded by the transportation analyses of anhydrous ammonia. Two scenarios identified involve the transport of anhydrous ammonia within 5 miles of the VCS site, (1) the transport of anhydrous ammonia along the Victoria Barge Canal located approximately 4.9 miles from the VCS power block area, and (2) the transport of anhydrous ammonia on U.S. Highway 77 located approximately 0.56 miles from the VCS power block area (typical vessel quantities for water way and highway transport are 10 million and 50,000 pounds, respectively). Additionally, given the storage quantity of anhydrous ammonia and the distance from the plant, as substantiated in RG 1.78, if a release were to occur at such a distance (greater than 5 miles), atmospheric dispersion would dilute and disperse the incoming plume to such a degree that the concentration would be below the toxic/flammable limits prior to reaching a control room/safety related structure. In addition, the probability of a plume remaining within a given sector for a long period of time is quite small.

INVISTA-DuPont

The center of the INVISTA-DuPont Victoria plant is located approximately 6 miles northeast of the VCS site. At its closest point, the INVISTA-DuPont Victoria plant is approximately 5.5 miles northeast of the VCS power block area. The facility, formerly DuPont Textiles and Interiors, was purchased by INVISTA, a private company owned by a subsidiary of Koch Industries in April of 2004, except for the Ethylene Copolymers operations (Reference 2.2-19). The ethylene copolymers portion of the plant is still operated by DuPont which acts as a tenant at the larger INVISTA facility. The DuPont ethylene copolymers plant consists of 38 acres and produces low-density polyethylene resins. The DuPont Victoria plant employs approximately 90 people. (Reference 2.2-18)

The INVISTA site consists of 4500 acres; approximately 1100 acres are used for manufacturing and waste treatment, and the remaining land is wildlife habitat. The facility produces nylon intermediates including hexamethylenediamine, adipic acid, and dodecanedioic acid and employs approximately 555 personnel. (Reference 2.2-19)

The most direct truck route to this facility is via State Highway 185. The most direct rail transport route is on the Union Pacific Railway, which travels north to Victoria and south to Bloomington. The Victoria Barge Canal also serves as a transport route for materials to/from the INVISTA-DuPont facility. The truck and railway routes do not approach within 5 miles of the VCS site. At its closest approach, the Victoria Barge Canal is approximately 4.9 miles from VCS; therefore, chemicals transported by INVISTA-DuPont along the Victoria Barge Canal are considered in an analysis of waterway transport hazards.

The 2008 SARA Title III, Tier II report for INVISTA indicates that anhydrous ammonia and hydrogen fluoride, both highly volatile chemicals with large RMP endpoint distances are stored at the INVISTA facility. The 2008 SARA Title III, Tier II report indicates that the total quantity of ammonia stored at INVISTA is between 10 and 50 million pounds-which includes storage in seven above ground tanks, one tank wagon, and two storage containers listed as “other”. The 2008 SARA Title III, Tier II report indicates that the total quantity of hydrogen fluoride stored at the site is between 1000 and 9999 pounds with an average daily storage amount of 0-99 pounds. (Reference 2.2-1)

The analysis of the storage of anhydrous ammonia and hydrogen fluoride at INVISTA is bounded by the transportation analysis for both anhydrous ammonia and hydrogen fluoride. Anhydrous ammonia is transported along the Victoria Barge Canal located approximately 4.9 miles from the VCS power block area (a typical vessel quantity for waterway transport is 10 million pounds). Additionally, two transportation scenarios involve the transport of hydrogen fluoride within 5 miles of the VCS site, (1) the transport of hydrogen fluoride along the Union Pacific Railway located approximately 3.8 miles from the VCS power block area, and (2) the transport of hydrogen fluoride on U.S. Highway 77 located approximately 0.56 miles from the VCS power block area (typical vessel quantities for railway and highway transport are 132,000 and 50,000 pounds, respectively).

In addition, as substantiated in RG 1.78, at distances this great, the probability of a plume remaining in a given sector for a long period of time is quite small. Further, at the INVISTA facility, monitoring and mitigation systems such as detectors, dikes, and deluge systems are in place to minimize the impacts of a chemical release. There is also an emergency response plan in place to notify community members and emergency responders as appropriate (Reference 2.2-19). Therefore, with the exception of those materials transported along the Victoria Barge Canal, no further analysis is required.

Equistar Chemicals

Equistar Chemicals, a subsidiary of the Lyondell Chemical Company, is located approximately 6.0 miles northeast of the VCS site. The Equistar Victoria Plant covers approximately 33 acres and has 92 full-time employees (Reference 2.2-1). Equistar is a producer of high-density polyethylene (HDPE) resins that are used to make housewares, building supplies, automotive parts, food packaging, personal care items, and grocery bags. (Reference 2.2-21)

The most direct truck route to the facility is via State Highway 185. The most direct rail transport route is on the Union Pacific Railway that travels north to Victoria and south to Bloomington. The Victoria Barge Canal also serves as a transport route for materials to/from the Equistar facility. The truck and railway routes do not approach within 5 miles of the VCS power block area. At its closest approach, the Victoria Barge Canal is approximately 4.9 miles from the VCS power block area; therefore, chemicals transported by Equistar along the Victoria Barge Canal are considered in an analysis of waterway transport hazards.

The 2008 SARA Title III, Tier II report for Equistar indicates that chlorine, a highly volatile chemical with a large RMP endpoint distance, is stored at the Equistar facility with a total between 1000 and 9999 pounds (Reference 2.2-1). The analysis of the storage of chlorine is bounded by the transportation analysis of chlorine. Two transportation scenarios involve the transport of chlorine within 5 miles of the VCS site, (1) the transport of chlorine along the Union Pacific Railway located approximately 3.8 miles from the VCS power block area, and (2) the transport of chlorine on U.S.

Highway 77 located approximately 0.56 miles from the VCS power block area (typical vessel quantities for railway and highway transport are 132,000 and 50,000 pounds, respectively). Additionally, given the storage quantity of chlorine and the distance from the plant, as substantiated in RG 1.78, if a release were to occur at such a distance, atmospheric dispersion would dilute and disperse the incoming plume to such a degree that the concentration would be below the toxic limits prior to reaching a control room or there would be sufficient time for appropriate action to be taken. In addition, the probability of a plume remaining within a given sector for a long period of time is quite small. Therefore, with the exception of those materials transported along the Victoria Barge Canal, no further analysis is required.

Gavilon Fertilizer, LLC

Gavilon Fertilizer formerly ConAgra International Fertilizer is located approximately 7.5 miles northeast of the VCS site. The Gavilon facility has four full-time employees and produces liquid fertilizer solutions for agricultural use (References 2.2-1 and 2.2-22).

Gavilon ships and receives materials by truck, rail, and barge. Trucks transport materials from State Highway 185 to FM 1432. The Union Pacific Railway from Bloomington to Victoria is used to transport phosphoric acid and anhydrous ammonia. The Victoria Barge Canal also serves as a transport route for liquid fertilizer products shipped from the Gavilon facility. The truck and railway routes do not approach within 5 miles of the VCS site. At its closest approach, the Victoria Barge Canal is approximately 4.9 miles from the VCS power block area; therefore, chemicals transported by Gavilon along the Victoria Barge Canal are considered in an analysis of waterway transport hazards.

The 2008 SARA Title III, Tier II report for Gavilon Fertilizer indicates that anhydrous ammonia, a highly volatile chemical with a large RMP endpoint distance, is stored at the Gavilon facility with a total quantity between 100,000 and 999,999 pounds-with the maximum storage listed as 260 tons (520,000 pounds). (Reference 2.2-1) The analysis of the storage of anhydrous ammonia at the Gavilon facility is bounded by the transportation analysis of anhydrous ammonia. Anhydrous ammonia is transported along the Victoria Barge Canal located approximately 4.9 miles from the VCS power block area (a typical vessel quantity for waterway transport is 10 million pounds). Further, as substantiated in RG 1.78, given the distance from the plant, if a release were to occur, atmospheric dispersion would dilute and disperse the incoming plume to such a degree that the concentration would be below the toxic/flammable limits prior to reaching a control room/safety related structure or there would be sufficient time for appropriate action to be taken. In addition, the probability of a plume remaining within a given sector for a long period of time is quite small.

Inergy Propane, LLC

A subsidiary of Inergy Propane, Independent Propane is located 7.5 miles northwest of the VCS site. Inergy Propane is a propane distribution company that serves residential, agricultural, and industrial propane customers (Reference 2.2-23). There are no permanent employees at this facility and a review of the 2008 SARA Title III, Tier II report indicates that the only reported material onsite is a 30,000 gallon bulk propane storage tank (Reference 2.2-1).

The analysis of the storage of propane at the Inergy Propane site is bounded by the transportation analysis of propane. Two transportation scenarios involved the release of propane within 5 miles of the VCS site, (1) 132,000 pounds of propane released at the nearest approach of the Union Pacific Railway located approximately 3.8 miles from the VCS power block area, and (2) 50,000 pounds of propane released at the nearest approach of U.S. Highway 77 located approximately 0.56 miles from the VCS power block area.

Tennessee Gas Pipeline – Station 9

The Tennessee Gas Pipeline – Station 9 is located approximately 7.0 miles northeast of the VCS site. A natural gas compressor station, this facility has seven employees. All chemicals stored at this facility are transported by road via FM 1432 to State Highway 185. The truck transport route does not approach within 5 miles of the VCS site. The natural gas (methane) is transported via pipeline.

A review of the 2008 SARA Title III, Tier II report indicates that there are no highly volatile or toxic chemicals stored at the site with large RMP endpoint distances. As provided in RG 1.206, evaluations of facilities at a distance greater than 5 miles of the VCS site are included as appropriate based on their significance. Therefore, no further analysis is required.

2.2.2.3 Description of Natural Gas/Chemical Pipelines and Gas/Oil Fields

Fourteen active natural gas pipelines and seven major natural gas and/or oil fields are identified within a 5-mile radius of the VCS site. There are ten active natural gas transmission pipelines and four active natural gas gathering pipeline systems (Figures 2.2-2 and 2.2-3). In order to increase standoff/safe distances for potential pipeline ruptures, three natural gas pipelines that are currently routed in two corridors will be relocated within the VCS site as illustrated in Figure 2.2-2. This includes two pipelines, operated by Natural Gas Pipeline Company of America, LLC, that share an easement that crosses through the middle of the proposed cooling basin, and another pipeline, operated by Transcontinental Gas Pipeline Corporation, that is located in an easement that passes between the proposed locations of the VCS power block area and the AEP Why Substation. All three pipelines will be relocated to the northwestern side of the site where they will parallel the nearest Tennessee Gas Pipeline (Figure 2.2-2).

A more detailed description and disposition of each of these pipelines—along with the identified gas/oil fields—is presented in the following subsections and in Table 2.2-6. This description of the pipelines includes pipe diameter, operating pressure, depth of burial, location, and distance between isolation valves, where available.

2.2.2.3.1 Natural Gas Transmission Pipelines

Transcontinental Gas Pipeline Company, LLC

The closest pipeline currently to the VCS power block area is a 26-inch natural gas transmission line operated by Transcontinental Gas Pipeline Corporation (Reference 2.2-5). The pipeline is part of the Mainline 26-0100 system and runs through the VCS site between the proposed locations for the AEP Why Substation and the power block area (Figure 2.2-2). The pipeline is buried at a depth of 3 feet and has an operating pressure of 700 pounds per square inch (psig). In order to increase the standoff/safe distances, this pipeline will be rerouted as illustrated in Figure 2.2-2. Following the proposed relocation of the pipeline, the power block area will be approximately 0.42 miles (2237 feet) away from the closest approach of the natural gas transmission pipeline.

Gulf South Pipeline Company, L.P.

The Gulf South Pipeline Company, L.P. operates a natural gas transmission pipeline that passes approximately 3.5 miles south of the VCS power block area as shown in Figure 2.2-2. The pipeline is part of the Koch Gateway Pipeline System and is 30 inches in diameter. (Reference 2.2-5)

Kinder Morgan Texas Pipeline, L.P.

Kinder Morgan Texas Pipeline, L.P. operates one natural gas transmission pipeline within a 5-mile radius of the VCS site (Reference 2.2-5). The Tom O'Connor FL - Missouri City Junction pipeline passes approximately 3.5 miles southeast of the VCS power block area (Figure 2.2-2). The pipeline is 30 inches in diameter, operates at a pressure of 795 psig, and is buried at a depth of 30 inches.

Natural Gas Pipeline Company of America, LLC

The Natural Gas Pipeline Company of America, LLC operates three natural gas transmission pipelines within a 5-mile radius of the VCS site (Reference 2.2-5).

The Gulf Coast Mainline #1 pipeline passes approximately 1.2 miles southeast of the VCS power block area and runs beneath the area designated for the VCS cooling basin. The pipeline is 26 inches in diameter, operates at a pressure of 900 psig, and is buried at a depth of 45 inches. The Gulf Coast Mainline #1 pipeline will be relocated as illustrated in Figure 2.2-2. Following the proposed relocation of the pipeline, the power block area will be approximately 0.42 miles (2237 feet) away from the closest approach of the natural gas transmission pipeline.

The Gulf Coast Mainline #2 pipeline is located adjacent to the Gulf Coast Mainline #1 pipeline and passes approximately 1.2 miles southeast of the VCS power block area. This pipeline also runs beneath the area designated for the VCS cooling basin (Figure 2.2-2). The pipeline is 30 inches in diameter, operates at a pressure of 900 psig, and is buried at a depth of 45 inches. The Gulf Coast Mainline #2 pipeline will also be relocated as illustrated in Figure 2.2-2. Following the proposed relocation of the pipeline, the power block area will be approximately 0.42 miles (2237 feet) away from the closest approach of the natural gas transmission pipeline.

The South Texas Lats. – Petrotex Lateral subsystem is a 4.5-inch diameter natural gas transmission line that passes within approximately 3.8 miles of VCS (Figure 2.2-2). This line serves the Anaqua Field. (Reference 2.2-5)

Tennessee Gas Pipeline Company

Tennessee Gas Pipeline Company operates four natural gas transmission pipelines within a 5-mile radius of the VCS site. All four of the pipelines are part of the Tennessee Gas Pipeline 100 system including pipelines 100-1, 100-2, 100-3, and the Coleto Creek Line. (Reference 2.2-5)

The 100-1 pipeline passes approximately 0.58 miles northwest of the VCS power block area Figure 2.2-2). The 100-1 pipeline is 24 inches in diameter, has a maximum operating pressure of 750 psig, and is buried at a depth of 36 inches.

The 100-2 pipeline runs parallel with 100-1 and also passes approximately 0.56 miles northwest of the VCS power block area. The 100-2 pipeline is 24 inches in diameter, has a maximum operating pressure of 750 psig, and is buried at a depth of 36 inches.

The 100-3 pipeline passes approximately 0.45 miles northwest of the VCS power block area (Figure 2.2-2). The 100-3 pipeline is 30 inches in diameter, has a maximum operating pressure of 750 psig, and is buried at a depth of 36 inches.

The Coleto Creek Line branches from the 100-2 pipeline and runs north of the 100-2 pipeline. The 12.75-inch diameter pipeline is located approximately 0.68 miles west of the VCS power block area. (Reference 2.2-5)

Disposition of the Identified Natural Gas Transmission Pipelines

Due to their proximity to the VCS power block area, the re-routed pipelines, inclusive of the Transcontinental Gas Pipeline Company's Mainline 26-0100 system and the Natural Gas Pipeline Company of America, LLC's Gulf Coast Mainline #1 and #2, represent a greater potential hazard than the remaining gas transmission pipelines within the vicinity of the VCS site, inclusive of:

- The Gulf South Pipeline Company's Koch Gateway pipeline
- The Kinder Morgan Texas Pipeline, L.P.—Tom O'Connor FL—Missouri City Junction pipeline
- Natural Gas Pipeline Company of America, LLC's South Texas Lats. Petrotex Lateral subsystem pipeline
- The four Tennessee Gas Pipeline Company's pipelines

Therefore, no further deterministic analysis is warranted for the pipelines bounded by the analysis of the rerouted pipelines. Where a deterministic analysis for the relocated pipelines indicates a possible hazard, a comprehensive probabilistic analysis for the VCS site is performed to address those possible hazards to ensure the scenario is not a design-basis event. As detailed in Subsection 2.2.3, where a probabilistic evaluation was warranted, the analysis comprised the total length of the natural gas transmission pipelines within 5 miles of the power block area, with the smallest analyzed pipeline having an inner diameter of 12.39 inches and a pressure of 750 psig.

2.2.2.3.2 **Chemical Pipelines**

Citgo Products Pipeline Company

Citgo Products Pipeline Company operates a pipeline that transports refined products (gasoline and diesel fuel) (Reference 2.2-5). The Casa Pipeline System—Nueces Station to Victoria Station pipeline at its closest approach is approximately 3.1 miles northeast of the VCS power block area (Figure 2.2-2). The pipeline is a steel line that ranges from 8 to 10 inches in diameter, operates at a maximum pressure of 625 psig, and is buried at an average depth of 2.5 feet.

Due to the low vapor pressure of diesel fuel, the transport of diesel fuel in this pipeline is screened from further analysis. The analysis of the gasoline transported in the Citgo Products Pipeline is bounded by the road transportation analysis of gasoline. Three identified transportation scenarios involve the above ground release of gasoline within 5 miles of the VCS site (a postulated above ground release allows for the formation of a vapor cloud), (1) the transport of gasoline along the Victoria Barge Canal located approximately 4.9 miles from the VCS power block area, (2) the transport of gasoline along the Union Pacific Railway located approximately 3.8 miles from the VCS power block area, and (3) the transport of gasoline along U.S. Highway 77 located approximately 0.56 miles from the VCS power block area (typical vessel quantities for waterway, railway and highway transport are 10 million, 132,000 and 50,000 pounds, respectively).

Likewise, when considering if an explosion analysis is warranted for this pipeline, because of the proximity of this pipeline to the power block area (3.1 miles at its closest approach) and the heat of combustion for gasoline (18,720 Btu/lb) compared with methane (21,517 Btu/lb) (Reference 2.2-39), the analyzed natural gas transmission pipeline scenarios present a bounding analysis for the explosion accident category.

United Brine Pipeline Co., LLC

The United Brine Pipeline Co., LLC operates a pipeline that transports ethylene/cyclohexane. The Ingleside to Bloomington System at its closest approach is approximately 4.5 miles from the VCS power block area. (Figure 2.2-4) (Reference 2.2-5) The pipeline is 4.5 inches in diameter.

Potential explosive hazards from the ethylene/cyclohexane pipeline operated by the United Brine Pipeline Co., LLC are bounded by the analysis of the natural gas transmission pipelines due to the proximity to the power block area, size of this pipeline (4.5 inches), and heats of combustions of ethylene (20,290 Btu/lb) and cyclohexane (18,684 Btu/lb) (Reference 2.2-39).

2.2.2.3.3 Natural Gas Gathering Pipeline Systems

Apache Corporation

The Apache Corporation operates two active natural gas transmission pipelines within a 5-mile radius of the VCS site. The pipelines are part of the McFaddin Gathering System. The pipelines are 4.5 and 6.63 inches in diameter and are located approximately 3.3 miles south of the VCS power block area. (Reference 2.2-5) (Figure 2.2-3)

Southcross Gulf Coast Transmission, LTD

Southcross Gulf Coast Transmission, LTD operates a 14-inch diameter natural gas gathering line that passes approximately 3.9 miles southeast of the VCS power block area (Figure 2.2-3) (Reference 2.2-5).

Enerfin Field Services, LLC

Enerfin Field Services, LLC operates a 4.5-inch diameter natural gas gathering line that passes approximately 4.7 miles southeast of the VCS power block area (Figure 2.2-3). This gas gathering line is part of the McFaddin and Refugio Gathering System. (Reference 2.2-5)

Gulf South Pipeline Company, L.P.

Gulf South Pipeline Company, L.P. operates a 4.5-inch diameter natural gas gathering line that passes approximately 1.4 miles east of the VCS power block area (Figure 2.2-3). This gas gathering line is part of the Victoria Gathering System and serves the McFaddin Field. (Reference 2.2-5)

Disposition of the Identified Natural Gas Gathering Pipelines

Potential hazards from the natural gas gathering pipelines identified above are bounded by the natural gas transmission pipelines due to the larger volume of natural gas in the transmission pipelines and their closer proximity to VCS.

2.2.2.3.4 Gas/Oil Fields

There are six major natural gas/oil extraction fields located within the 5-mile vicinity of VCS. Many of the wells in these fields have been plugged and are no longer in operation. Active gas wells, oil wells and gas/oil wells as well as the approximate extent of the fields are shown in Figure 2.2-5. Additionally, the locations of permitted wells are identified. (Reference 2.2-6) The closest active well is located approximately 0.76 miles east of the VCS power block area and the closest permitted location is approximately 0.52 miles south of the VCS power block area. Potential hazards from these wells are bounded by the analysis of the natural gas transmission lines due to their closer proximity to the VCS site, the larger volume (larger diameter and operating pressure) of natural gas in the transmission lines, the safety controls (such as blowout preventors) on the wells, and the expected damage radius.

2.2.2.4 Description of Waterways

The VCS power block area is located approximately 4.9 miles west of the Victoria Barge Canal. The canal traverses 35 miles from the Port of Victoria Turning Basin to the Gulf Intracoastal Waterway. The canal is maintained to a depth of 12 feet and a width of 125 feet (Reference 2.2-24). The Port of Victoria Turning Basin is located at the northernmost end of the Victoria Barge Canal, approximately 6.2 miles northeast of VCS, and is also served by the Union Pacific Railway with access to State Highway 185 (Figure 2.2-1).

During the 12-month period from January 2007 through December 2007, there were a total of 2630 inbound and 2677 outbound trips recorded along the canal. These vessels transported a total of 3.155 million tons of commodities along the 35 mile stretch of the canal (Reference 2.2-10). Table 2.2-5 identifies the hazardous materials transported near the VCS site.

Additionally, the VCS proposed site configuration is designed for inclusion of a closed-cycle cooling system using an approximate 4900-acre cooling basin as the normal power heat sink. The makeup water to the cooling basin would be withdrawn from the Guadalupe River, a waterway located about 4 miles to the east of the VCS site, via a newly constructed canal and raw water makeup system intake structure, located upstream of the Guadalupe-Blanco River Authority (GBRA) Lower Guadalupe Diversion Dam and saltwater barrier. Because the newly constructed intake canal is a non-navigable waterway, damage to the makeup water intake structure from a collision is not a credible event.

2.2.2.5 Description of Highways

Victoria County is traversed by several highways. There is a single highway within 5 miles of the VCS site—U.S. Highway 77, located west of the VCS site, which transverses in a north-to-south direction. At its nearest approach, U.S. Highway 77 will be approximately 0.56 miles from the power block area. The western most property line of the VCS site is immediately adjacent to U.S. Highway 77, which serves to connect Victoria, Texas with Corpus Christi, Texas to the south (Reference 2.2-7).

To the east of the VCS site, State Highway 185 (also known as FM 404) runs in a north-to-south direction, and at its closest approach is approximately 7.9 miles from the VCS power block area. State Route 185 serves to link facilities along Old Bloomington Road to Victoria, Texas and the interstate highway system (Reference 2.2-7).

State Highway 239, located south of the VCS site, runs in an east-to-west direction and is located approximately 6.3 miles from the VCS power block area. To the north of the VCS site, U.S. Route 59 runs in an east-to-west direction. At its closest point, U.S. Route 59 is located approximately 7.5 miles from the VCS power block area. State Route 91, located approximately 7.0 miles north of the VCS power block, serves to connect U.S. Highway 77 north of the site to U.S. Route 59 (Reference 2.2-7).

A traffic corridor analysis was performed to identify the hazardous materials potentially transported along the roadways in the vicinity of the VCS site. The identification process included a review of the following:

- Three commodity flow studies. In 1996, the Victoria City/County Local Emergency Planning Commission (LEPC) conducted a 4-week survey of hazardous materials transported on local streets and highways (Reference 2.2-25). In 1998, the Corpus Christi/Nueces County LEPC conducted an assessment of truck and rail transport of hazardous materials which identified seven serious chemicals transported in the area (Reference 2.2-26). A freight and hazardous materials movement study prepared in 2004 for the Corpus Christi Metropolitan Planning Organization modeled commodity movements by truckload between Corpus Christi, Houston and Dallas (Reference 2.2-27).
- SARA Title III, Tier II reports. Hazardous products and materials stored at EPA Tier II facilities located along U.S. Highway 77 within the vicinity of VCS were evaluated and included for analysis of possible roadway hazards (References 2.2-1 through 2.2-4).

Based on an analysis of the compilation of hazardous materials identified from the commodity flow studies and the distribution of EPA Tier II facilities within a 20-mile radius of the VCS site, the potential chemicals to be transported along U.S. Highway 77 in the vicinity of VCS were identified. Table 2.2-3 identifies the chemicals likely to be transported along U.S. Highway 77.

2.2.2.6 Description of Railroads

The Union Pacific Railway passes through the towns of Bloomington and Vidaurri (Figure 2.2-1). At its closest approach, the railway is located approximately 3.8 miles south of the VCS power block area. In addition to Union Pacific, this line is also utilized by Burlington Northern Santa Fe and Kansas City Southern railroads. The railway does not support passenger service.

This railway may provide rail access to the VCS site. The track could be connected to the southwestern corner of the site area, and a rail spur run north alongside the western boundary of the cooling basin. The spur to the site may traverse approximately 4.5 miles.

Approximately 48,500 shipments of hazardous materials are transported yearly along the section of the railway within the 5-mile vicinity of the VCS site. Table 2.2-4 identifies the most frequently transported hazardous materials near the VCS site.

2.2.2.7 Description of Airports, Airways and Military Operations Areas

Airports

The privately owned Green Lake Ranch Airport is located approximately 10.5 miles east of the VCS power block area (Figure 2.2-6). The runway is 4390 feet long by 60 feet wide and is asphalt. The airport is an unattended private facility with no control tower and permission is required prior to landing. The traffic pattern is to the left. (References 2.2-12 and 2.2-20) NUREG-0800 states that the probability of an aircraft accident can be considered less than 10^{-7} per year by inspection if distances from the plant and airport operations meet specific criteria. For airports greater than 10 miles from the plant, airport operations must be less than $1000D^2$, where D is the distance in statute miles from the site. Based on the distance from the VCS site — Green Lake Ranch Airport is 10.5 miles from the site — projected operations must be less than 110,250 operations per year. Flights from this private airport are characterized as sporadic, and as such, no further analysis is warranted. (Table 2.2-2)

The Victoria Regional Airport is located approximately 18 miles northeast of the VCS site. This public airport has four runways and a helipad. Runway 12L/30R is 9101 feet long and 150 feet wide and is listed as asphalt/grooved. The traffic pattern for runway 12L is left and the traffic pattern for runway 30R is right. Runway 17/35 is 4899 feet long and 75 feet wide and is listed as asphalt/grooved. The traffic pattern for both runway 17 and runway 35 is left. Runway 12R/30L is 4643 feet long and 150 feet wide and is listed as concrete. The traffic pattern for runway 12R is right and the traffic pattern for runway 30L is left. Runway 6/24 is 4200 feet long and 75 feet wide and is listed as asphalt. (Reference 2.2-14) Applying the NUREG-0800 screening criteria, the projected operations must be less than 324,000 operation per year — the Victoria Regional Airport is 18 miles from the site. The number of aircraft operations reported for the Victoria Regional Airport is 47,911 operations per year. (Table 2.2-2)

Airways

The VCS site is not located closer than 2 statute miles to the nearest edge of a federal airway. The closest federal airway is V13-407. The centerline of airway V13-407 is located approximately 12.6 statute miles from the VCS power block area (Figure 2.2-6). The width of a federal airway is typically 8 nautical miles, 4 nautical miles (4.6 statute miles) on each side of the centerline, placing the nearest edge of the federal airway approximately 8 statute miles from the VCS power block area (Reference 2.2-11).

Military Operations Areas

The VCS site is located within the Kingsville Military Operations Area (MOA) (Figure 2.2-6). There are approximately 421 operations per year in the Kingsville MOA within the site vicinity. The Kingsville MOA is restricted to military operations; therefore, there are no commercial or general aviation flights in the vicinity of the VCS site. Naval Air Station Kingsville is responsible for the Kingsville MOA and maintains records pertaining to its use by all military facilities. No operations carrying bombs or live ordinance occur near VCS.

2.2.2.8 Description of Mining Activities

There are no mining activities within 5 miles of the VCS site. The nearest mining activity is the Briggs Plant, a sand and gravel dredging operation owned by Fordyce, Ltd. located 7.0 miles northeast of the VCS site (Reference 2.2-13). There are no blasting explosives or hazardous chemicals used or stored on the Briggs Plant property.

2.2.2.9 Military Facilities

There are no military facilities within a 20-mile radius of the VCS site. The nearest military facility is Ingleside Naval Station, which is approximately 55 miles south of the VCS site (Reference 2.2-15). Because of its distance from the VCS site, no further evaluation is warranted.

2.2.2.10 Projections of Industrial Growth

DuPont Victoria is planning a 15 million dollar expansion of the ethylene copolymers facility to implement distributed control systems and increase output through process improvement and additional equipment. The expansion will provide for an additional 10 employees and will result in an increased production capacity of 200 million pounds (Reference 2.2-28).

Lone Star Ethanol was expected to begin construction of an ethanol plant at the Port of Victoria during 2008. The new facility was scheduled to be located approximately 6.5 miles northeast of the VCS site and have approximately 60 full-time employees. (References 2.2-29 and 2.2-30) However, the project has been put on hold pending an improvement in the economy. (Reference 2.2-17)

Additionally, the Port of Victoria is also one of the sites being considered for a 350-acre biodiesel plant. The plant would produce biodiesels from vegetable and plants oils. The plant is expected to have 30 to 40 full-time employees. (Reference 2.2-31) No other projections of industrial growth within a 10-mile radius of the VCS site were identified.

2.2.3 **Evaluation of Potential Accidents**

An evaluation of the information provided in Subsections 2.2.1 and 2.2.2 for potential accidents that should be considered as design basis events, and the potential effects of these accidents on the nuclear plant in terms of design parameters (e.g., overpressure, missile energies) and physical phenomena (e.g., concentration of flammable or toxic clouds outside building structures), was performed in accordance with the requirements in 10 CFR 20, 52.17, 50.34, 100.20, and 100.21, using the guidance contained in RGs 1.78, 1.91, 4.7, and 1.206.

2.2.3.1 **Determination of Design Basis Events**

RG 1.206 states that design basis events, internal and external to the VCS site, are defined as those accidents that have a probability of occurrence on the order of magnitude of 10^{-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. The following accident categories are considered in selecting design basis events: explosions, flammable vapor clouds (delayed ignition), toxic chemicals, aircraft crashes, fires, collisions with the intake structure, and liquid spills. For each of these categories, postulated accidents were analyzed at the following locations:

- Natural Gas/Chemical Transmission Pipelines
- Victoria Barge Canal
- U.S. Highway 77
- Union Pacific Railway
- Kingsville MOA

2.2.3.1.1 **Explosions**

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

The postulated accidents, involving those hazardous materials determined to have the potential to explode, include the rupture of a vessel whereby the entire contents of the vessel are released and an immediate deflagration/detonation ensues. That is, immediately upon release, the contents of the vessel are assumed to be capable of supporting an explosion upon detonation (e.g., flammable liquids are present in the gas/vapor phase between the upper flammability limits (UFL) and lower flammability limits (LFL)). The trinitrotoluene (TNT) mass equivalency methodology employed for determining the safe distances, the minimum separation distance required for an explosive force to not exceed 1 psi peak incident pressure, involve a compilation of principles and criterion, including RG 1.91, NUREG-1805, and the National Fire Protection Association (NFPA) Code.

The allowable and actual distances of hazardous chemicals transported or stored are evaluated in accordance with RG 1.91 which cites 1 psi as a conservative value of peak positive incident overpressure, below which no significant damage would be expected. Conservative assumptions are used in determining the “safe distance” (i.e., the minimum separation distance required for an explosive force to not exceed 1 psi peak incident pressure). RG 1.91 defines this safe distance by the Hopkinson Scaling Law relationship (Reference 2.2-32) as:

$$R = kW^{1/3} \qquad \text{Equation 2.2-1}$$

Where R is the distance in feet from an explosive charge of W pounds of TNT and k is the scaled ground distance constant at a given overpressure. For 1 psi, k is equal to 45 feet per pound$^{1/3}$.

The methodology for calculating W, and hence the safe distance, R, is selected depending upon the phase of the hazardous material during storage or transportation-solid, atmospheric liquid, or pressurized or liquefied gas.

Solids

For a solid substance not intended for use as an explosive but subject to accidental detonation, RG 1.91 states that it is conservative to use a TNT mass equivalent (W) in Equation 2.2-1 equal to the cargo mass.

Atmospheric Liquids

RG 1.91 states that it is *limited to solid explosives and hydrocarbons liquefied under pressure*, and the guidance provided in determining W, the mass of the substance that will produce the same blast effect as a unit mass of TNT, is specific to solids. Therefore, the guidance for determining the TNT mass equivalent, W, in RG 1.91, where the entire mass of the solid substance is potentially immediately available for detonation, is not applicable to atmospheric liquids, where only that portion in the vapor phase between the UFL and LFL is available to sustain an explosion.

The methodology employed conservatively considers the maximum gas or vapor volume within the storage vessel as explosive. Thus, for atmospheric liquid storage, this maximum gas or vapor would involve the container to be completely empty of liquid and filled only with air and fuel vapor at UFL conditions in accordance with NUREG-1805. Therefore, for atmospheric liquids, the TNT mass equivalent, W, is determined following guidance in NUREG-1805, such that:

$$W = (M_{vapor} \times \Delta H_c \times Y_f) / \Delta H_{c,TNT}$$ Equation 2.2-2

Where, M_{vapor} is the flammable vapor mass (pounds), ΔH_c is the heat of combustion of the chemical (Btu per pound), Y_f is the explosion yield factor, and $\Delta H_{c,TNT}$ is the heat of combustion of TNT (Btu per pound) (Reference 2.2-33). The yield factor is an estimation of the explosion efficiency, or a measure of the portion of the flammable material participating in the explosion. An explosion yield factor of 100 percent was applied to account for a confined explosion (Reference 2.2-33). In reality, only a small portion of the vapor within the flammability limits would be available for combustion and potential explosion, and a 100 percent yield factor is not achievable (Reference 2.2-34). Therefore, this is a conservative assumption.

Pressurized or Liquefied Gases

For pressurized and liquefied gases (which are not hydrocarbons), the entire mass of the pressurized or liquefied gas is considered flammable because a sudden tank rupture would involve the release of a majority of the contents in the vapor phase. Therefore, in the case of pressurized or liquefied gases, the entire mass was conservatively considered as available for detonation, and the equivalent mass of TNT, W, was calculated in accordance with NUREG-1805 (Equation 2.2-2) where the M_{vapor} is the flammable mass (pounds) and the entire mass of the pressurized or liquefied gas is considered flammable. Again, an explosion yield factor of 100 percent was conservatively assumed to account for a confined explosion (NUREG-1805).

Hydrocarbons Liquefied Under Pressure

RG 1.91 presents a special case for hydrocarbons liquefied under pressure. RG 1.91 states that it is conservative to use a TNT mass equivalent (W) in Equation 2.2-1 equal to 2.4 times the cargo mass.

The hazardous materials potentially transported by pipeline, the Victoria Barge Canal (Table 2.2-7), U.S. Highway 77 (Table 2.2-8), and the Union Pacific Railway (Table 2.2-9), are evaluated to ascertain whether they have the potential to explode. The effects of these explosion events from both internal and external sources are summarized in Table 2.2-10, and are described in the following subsections relative to the release source.

2.2.3.1.1.1 Pipelines

There are several natural gas transmission pipelines within the vicinity of the VCS site. As described in Subsection 2.2.2.3.1, three of these natural gas transmission pipelines will be relocated. Following the proposed rerouting of these natural gas transmission pipelines, the closest approach from the nearest natural gas transmission pipeline to the edge of the power block area will be approximately 2237 feet.

A natural gas pipeline explosion occurring in the vicinity of the release point would be unconfined. A damaging detonation from an unconfined natural gas release is not credible according to the NRC Safety Evaluation Report for Hartsfield Nuclear Power Plant (NUREG-0014). However, ignition of a natural gas release near the release point could result in a less damaging deflagration explosion and jet fire.

The computer program Areal Locations of the Hazardous Atmospheres (ALOHA) (Reference 2.2-39) is used to demonstrate that unconfined natural gas deflagrations would not produce an overpressure on VCS safety-related structures greater than 1 psi. RG 1.91 indicates that 1 psi is an acceptable explosion overpressure for safety-related structures. The explosion modeled uses the maximum mass of natural gas (modeled as methane) released in the flammable vapor cloud analysis described in Subsection 2.2.3.1.2.1. The ALOHA results conclude that the overpressure near the release point from a deflagration of natural gas would not exceed 1 psi. Therefore, unconfined natural gas explosions would not adversely affect the safe operation or shutdown of units at the VCS site.

2.2.3.1.1.2 Waterway Traffic

The nearest approach from the Victoria Barge Canal to the VCS power block area is approximately 26,020 feet. The canal spans 35 miles and connects the Port of Victoria Turning Basin with the Gulf Intracoastal Waterway (Reference 2.2-24). Table 2.2-5 details the hazardous materials potentially transported along the Victoria Barge Canal. The hazardous materials transported along the canal that are identified for further analysis with regard to explosion potential are: acetone, acetone cyanohydrin, acrylonitrile, butadiene, cyclohexane, cyclohexanone (ketone alcohol), gasoline, hexamethylenediamine, and propylene (Table 2.2-7). The maximum quantity of all identified chemicals assumed to be carried on a vessel is 10,000,000 pounds as provided in RG 1.91.

An analysis for the identified chemicals is conducted using the TNT mass equivalency methodologies as described in Subsection 2.2.3.1.1. The results indicate that the safe distances are less than the minimum separation distances from the VCS power block area to the Victoria Barge Canal for all of the identified chemicals (Table 2.2-10). Butadiene and propylene explosions result in the largest safe distance of 12,980 feet, which is less than the distance of 26,020 feet to the VCS power block area. Therefore, an explosion from hazardous materials transported along the Victoria Barge Canal would not adversely affect the safe operation or shutdown of units at the VCS site.

2.2.3.1.1.3 Highways

Table 2.2-3 details the hazardous materials potentially transported on U.S. Highway 77. The hazardous materials that are identified for further analysis with regard to explosion potential are: acetylene, gasoline, hydrogen sulfide, methanol, methyl cyanide, natural gas (methane), and propane (Table 2.2-8). With the exception of acetylene and propane, the maximum quantity of the identified chemicals potentially transported on the roadway is 50,000 pounds as provided in RG 1.91. Acetylene is transported in cylinders (References 2.2-37 and 2.2-38). It was conservatively assumed that eight cubic meters of acetylene at 250 psig is equivalent to 144 cubic meters at atmospheric pressure. Due to the low density of propane, the mass of propane assumed is 36,800 pounds based on a determined bounding volume for the transportation of propane.

An analysis for the identified chemicals is conducted using the TNT mass equivalency methodologies as described in Subsection 2.2.3.1.1. The nearest approach from U.S. Highway 77 to the VCS power block area is approximately 2950 feet at its closest point of approach. Hydrogen sulfide explosions result in the largest safe distance of 2462 feet, which is less than the minimum separation distance, 2950 feet, from the VCS power block area to U.S. Highway 77 for the identified chemicals (Table 2.2-10). Therefore, an explosion from hazardous materials transported along nearby highways would not adversely affect the safe operation of units at the VCS site.

2.2.3.1.1.4 Railroads

The VCS power block area is located approximately 20,174 feet from the Union Pacific Railway. Table 2.2-4 details the hazardous materials frequently transported on the Union Pacific Railway. The hazardous materials transported along the railway that are identified for further analysis with regard to explosion potential are: 1,1-difluoroethane, acetaldehyde, acetone, benzene, butyraldehyde, carbon bisulphide, gasoline, hexane, isopropanol, maleic anhydride, methyl methacrylate monomer, n-butyl acetate, n-propanol, n-propyl acetate, paraformaldehyde, propane, propylene oxide, p-xylene, toluene, vinyl acetate, and vinyl chloride (Table 2.2-9). The maximum quantity of all identified chemicals carried in a single rail car is 132,000 pounds as provided in RG 1.91.

An analysis for the identified chemicals is conducted using the TNT mass equivalency methodologies as described in Subsection 2.2.3.1.1. The results indicate that the safe distances are less than the minimum separation distances from the VCS power block area to the Union Pacific Railway for all of the identified chemicals (Table 2.2-10). Propane, 1,1-difluoroethane, and vinyl chloride result in the largest safe distance, 3068 feet, which is less than the distance of 20,174 feet to the VCS power block area. Therefore, an explosion from hazardous materials transported along the Union Pacific Railway will not adversely affect the safe operation or shutdown of units at the VCS site.

2.2.3.1.2 Flammable Vapor Clouds (Delayed Ignition)

Flammable materials in the liquid or gaseous state can form unconfined vapor clouds that can drift towards the plant, dispersing before an ignition event as they travel downwind. The portion of the cloud with a chemical concentration within the flammable range (i.e., between the LFL and UFL) may burn if the cloud encounters an ignition source. The speed at which the flame front moves through the cloud determines whether it is considered a deflagration or a detonation. If the cloud burns quickly enough to create a detonation, an explosive force is generated. (References 2.2-32 and 2.2-34) The hazardous materials potentially transported by pipeline, via the Victoria Barge Canal (Table 2.2-7), via U.S. Highway 77 (Table 2.2-8), and by the Union Pacific Railway (Table 2.2-9), are evaluated to ascertain those that have the potential to form flammable and/or explosive vapor clouds. For those chemicals with identified flammability limits, ALOHA, Version 5.4.1, air dispersion model is used to determine the distances at which portions of the vapor cloud could exist within the flammability range, thus presenting the possibility of ignition (Reference 2.2-39).

ALOHA is used to determine the possible effects of the worst-case accidental vapor cloud explosion for the identified chemicals, including the safe distances. To model the worst-case scenario in ALOHA, detonation is chosen as the ignition source. The safe distance is measured as the distance from the spill site to the location where the pressure wave is at 1 psi overpressure. Conservative assumptions are used in the ALOHA analyses for both meteorological inputs and identified scenarios.

The following meteorological assumptions are used as inputs to the computer model: ambient temperature of 25 degrees Centigrade; relative humidity of 50 percent; cloud cover of 50 percent; and atmospheric pressure of 1 atmosphere (Reference 2.2-40).

For each of the identified chemicals in the liquid state, it is conservatively assumed that the entire contents of the vessel are released, instantaneously forming a 1 centimeter-thick puddle. This provides a significant surface area from which to maximize evaporation and formation of a vapor cloud. The exception to this approach is the treatment of puddles formed from barge leakage, which could theoretically involve 10,000,000 pounds of material. ALOHA is limited to 484,000 pound releases over areas of approximately 338,000 square feet. This is an acceptable representative maximum spill for barges considering that the canal is only 250 feet wide, and any spill of greater than 338,000 square feet would form a thin rectangle extending far away from the site.

For each of the identified chemicals in the gaseous state, it is assumed that the entire contents of the vessel are released in a sudden tank burst (Reference 2.2-41). (For compressed gases in the liquid state, the results of a sensitivity analysis indicated that a saturated puddle model [which results in rapid boiling] is more conservative than depressurizing and flashing due to a release from a large hole. Therefore, the puddle model was also used for compressed gases like propane and liquefied natural gas.)

The effects of flammable vapor clouds and vapor cloud explosions from internal and external sources are summarized in Table 2.2-11 and are described in the following subsections relative to the release source.

2.2.3.1.2.1 Pipelines

There are several natural gas transmission lines within 5 miles, both onsite and offsite, that could pose a hazard to the VCS site with respect to flammable vapor clouds (see Table 2.2-6). These pipelines could, under a very unlikely set of worst-case conditions, lead to an unacceptable condition at the VCS site. Three of these natural gas transmission pipelines will be relocated. Following the proposed rerouting of these natural gas transmission pipelines, the closest approach from the nearest natural gas transmission pipeline to the edge of the power block area will be approximately 2237 feet. Deterministic analyses were performed and concluded that a large rupture of any of these pipelines combined with unfavorable meteorological conditions could lead to unacceptable flammable vapor concentrations.

To demonstrate the acceptability of the natural gas pipelines, a probabilistic approach is used to show that the frequency of an unacceptable result is sufficiently low. Each of the gas lines is analyzed using a probabilistic approach consistent with RG 1.91 and RG 1.78. Gas transmission lines further than 5 miles from the site are not investigated. For the analysis, the hazard frequency is defined as the frequency (events per year) of pipeline failures which result in various specified conditions-e.g., an explosive gas concentration greater than the Lower Explosive Limit (LEL) below an elevation of 160 feet and within the power block area, or an explosive overpressure greater than 1 psi at the power block area boundary. The 160 foot elevation is based on the limiting (highest) main control room intake height from the plant parameter envelope of 65 feet above grade, which is at an elevation of approximately 95 feet NAVD 88.

The hazard frequency for each pipeline is computed utilizing a Monte Carlo simulation in which many deterministic calculations are performed for each pipeline with randomly sampled sets of input data. Input data distributions for the set of deterministic plant hazard calculations are developed for the ambient air temperature, the Pasquill stability class, the wind speed, the wind direction, the break size, and the break location. The distributions for the ambient conditions (air and wind parameters) are based on the plant-specific data.

The distribution for the break size is based on data from January 2002 to July 2009 from the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration Office of Pipeline Safety (Reference 2.2-43). The data indicates that the size of approximately 60 percent of the pipeline breaks is less than 20 percent of the pipe diameter, while approximately 25 percent of pipeline breaks are complete ruptures (100 percent of the pipe diameter). A uniform distribution is used for the location of each break; i.e., the pipeline break location is equally probable in all locations within 5 miles of the VCS site.

The gas release due to a break is modeled as both a puff and plume, consistent with RG 1.78 and NUREG-0570. The mass of gas released is determined based on the pipe size, the break size, the gas pressure, and the gas temperature. For the initial puff release, the flow rate out of the break is modeled as choked flow through a truncated nozzle with a conservative discharge coefficient of 1.0. After the initial release, the steady state plume release is computed based on Fanno flow and the upstream pipeline pressure (taken as the maximum allowable pipeline pressure), assuming a complete double ended pipe break. However, for small pipeline breaks in which the pipeline is not completely ruptured, the Fanno flow computation could result in a larger flow rate than for choked flow; in this case, the choked flow value is used for both the puff and plume release.

Jet entrainment of ambient air is credited for the plume release near the break when the break area is large, using the methodology in Reference 2.2-44. Entrainment mixing is based on an equivalent nozzle area, the gas velocity, and the gas density following expansion to ambient conditions. Entrainment is not credited for small breaks since there may not be sufficient momentum to create a crater, and therefore air entrainment would be impeded. Similarly, air entrainment is not credited for the puff release due to the presence of ground over the pipeline initially.

The Gaussian diffusion model is used for both the puff and plume portions of the release in accordance with NUREG-0570 and NUREG/CR-6624. The gas concentration at the point of interest is based on the puff and plume centerline concentrations, the mass of gas released (for a puff), the continuous source strength (for a plume), the wind speed, the Pasquill dispersion coefficients, the distance from the target, the distance from the puff or plume centerline, and the elevation of the target. The concentration of gas as it disperses is limited to the minimum concentration predicted by the dispersion model or the density of gas at ambient conditions. As the puff and plume move away from the break location due to wind, dispersion occurs, thus reducing the gas concentration along the puff and plume centerlines. However, per NUREG/CR-2260, the gas concentrations at low wind speeds are often much less than those predicted with the Pasquill dispersion coefficients due to the horizontal spreading of the plume as it meanders over a large area. To account for this, a meander factor is utilized in accordance with RG 1.145. In addition, buoyancy driven puff and plume rise is accounted for in the dispersion analysis using the guidance in Reference 2.2-44. Temperature gradients as a function of elevation are accounted for using RG 1.23 and Reference 2.2-45.

For pipeline breaks in which the wind direction is towards the VCS site, the gas concentration at the power block area boundary taken at the intake elevation is determined. The maximum intake elevation is used since it yields the highest concentration for a buoyant natural gas cloud. If the concentration at the intake is below the LEL, the hazard due to both explosion and asphyxiation is acceptable. If the concentration is above the LEL, both ignition and detonation are assumed, and the hazard for this case is unacceptable. If the wind direction is away from the VCS site, the gas concentration at the intake is zero.

For all pipeline breaks, the distance that the gas plume travels prior to reaching the LEL is determined using the dispersion analysis. Ignition of a natural gas plume can occur anywhere between the pipeline break and the point at which the LEL is reached. The probability of ignition is a function of the total mass of gas released (Reference 2.2-46). The mass of the gas in the plume is the total integrated mass release over the period from the break to the ignition. The ignition time is typically between one and five minutes per Reference 2.2-42.

In the explosion analysis, longer ignition delay times are modeled for many releases since this approach leads to larger quantities of gas released and therefore more significant explosions. A longer ignition delay time also allows the gas cloud to travel to a location nearer to the VCS site. If an ignition occurs when the explosion point is in the vicinity of plant buildings and structures which could provide confinement or semi-confinement, a detonation is assumed to occur. The region where this is assumed to occur is defined by a cylindrical zone centered at the center of the power block area with a height equal to the determined bounding elevation of an assumed plant structure. For ignitions which occur when the plume is in an unconfined space, e.g., above the tallest plant structure, the probability of a damaging detonation is not credible according to the NRC Safety Evaluation Report for Hartsfield Nuclear Power Plant (NUREG-0014). Explosions are modeled as occurring at the nearest approach of the gas cloud centerline to the plant at the time of ignition.

RG 1.91 indicates that 1 psi is an acceptable explosion overpressure for safety-related structures. To determine if the overpressure is acceptable for a given explosion, the standoff/safe distance for a 1 psi overpressure is calculated in accordance with the RG 1.91 method. The standoff distance is the distance from the explosion beyond which "adverse effects on plant operations" are not likely to occur. If the distance between the explosion point and the power block area is greater than the standoff distance, then the hazard due to an explosion is acceptable for safety-related plant structures within the power block area.

For each deterministic analysis, the result is either acceptable or a failure based on the gas concentration at the power block area boundary at an elevation of 160 feet, or the overpressure experienced by safety-related plant structures due to an explosion. The total number of unacceptable results (failures) relative to the total number of scenarios investigated yields the probability of a hazardous condition at the plant, given that a pipeline failure has occurred. This probability, combined with the gas pipeline failure rate (failures per pipeline-mile-year) and length of a given pipeline, results in the hazard frequency due to a given pipeline in events per year, as shown below.

$$F_N = \lambda_{on} \circ L_{on_N} \circ P_{failon_N} + \lambda_{off} \circ L_{off_N} \circ P_{failoff_N}$$ Equation 2.2-3

Where:

F_N Hazard frequency due to pipeline N (events per year)

λ_{on} Onsite gas pipeline failure rate (failures/pipeline-mile-year)

λ_{off} Offsite gas pipeline failure rate (failures/pipeline-mile-year)

L_{on_N} Length of onsite portion of pipeline N (miles)

L_{off_N} Length of offsite portion of pipeline N (miles)

P_{failon_N} Probability of plant hazard given an onsite pipeline failure of pipe N (–)

$P_{failoff_N}$ Probability of plant hazard given an offsite pipeline failure of pipe N (–)

$$P_{failon_N} = \frac{N_{failon_N}}{N_{calcon_N}} \qquad P_{failoff_N} = \frac{N_{failoff_N}}{N_{calcoff_N}}$$ Equations 2.2-4 and 2.2-5

Where:

N_{failon_N} Number of deterministic calculations that result in an unacceptable result for the onsite portion of pipeline N (–)

N_{calcon_N} Number of deterministic calculations performed in the Monte Carlo simulation for the onsite portion of pipeline N

$N_{failoff_N}$ Number of deterministic calculations that result in an unacceptable result for the offsite portion of pipeline N (–)

$N_{calcoff_N}$ Number of deterministic calculations performed in the Monte Carlo simulation for the offsite portion of pipeline N

The total hazard frequency for all pipelines within 5 miles of the VCS site is then the sum of the individual pipeline hazard frequencies.

$$F_{total} = \sum_{N=1}^{N_{pipes}} F_N$$ Equation 2.2-6

Where:

F_{total} Total hazard frequency due to all natural gas pipelines (events per year)

N_{pipes} Number of natural gas pipelines analyzed (–)

The gas pipeline failure rate is based on data from the Office of Pipeline Safety (Reference 2.2-43). Two failure rates are determined, one for onsite pipeline and another for offsite pipeline. Both failure rates are based on the total onshore gas transmission pipeline mile-years of 2,234,920 from January 2002 through July 2009.

To determine the failure rates, the accident reports are first screened to remove non-relevant failures. The total number of accidents reported from 2002 to 2009 is 978. The following failures are screened from the analysis:

- Failures of offshore pipeline are removed for onsite and offsite pipeline.
- Failures due to excavation (excavation assumed to be prohibited), vandalism (owner-controlled area), vehicles not related to excavation (onsite pipe is buried), and high winds (onsite pipe is buried) are also screened out for onsite pipeline.
- Failures that occurred at a compressor station are removed for the onsite failure rate calculation since there are no natural gas compressor stations onsite.

The screening resulted in 429 relevant failures for onsite pipeline and 695 relevant failures for offsite pipeline. Combining the number of failures with the total onshore gas transmission pipeline mile-years results in an onsite pipeline failure rate of 1.92×10^{-4} and an offsite pipeline failure rate of 3.11×10^{-4} failures per pipeline-mile-year.

The results of the analysis described above indicate that the total hazard frequency due to the natural gas pipelines in the vicinity of the VCS site is 3.67×10^{-7} events/year. This is less than the 10^{-6} acceptance criterion presented in RG 1.206 which cites that a 10^{-6} rate of occurrence is acceptable if reasonable qualitative arguments can be made which show the realistic probability is lower. However, the analysis will be revised at the COL stage to address the actual site layout in any cases where the assumptions for this probabilistic evaluation are not bounded.

Based on the potential effects of a vapor cloud explosion and heat flux on structures positioned above the pipeline, the natural gas transmission pipelines that may produce such effects will be rerouted such that a safe distance from the VCS site is achieved as demonstrated by the pipeline hazard probabilistic analysis. The final pipeline routing is acceptable provided the total hazard frequency due to natural gas pipelines in the vicinity of the VCS site remains below 10^{-6} events/year.

2.2.3.1.2.2 Waterway Traffic

The VCS power block area is located approximately 26,020 feet from the Victoria Barge Canal. Table 2.2-5 details the hazardous materials potentially transported along the Victoria Barge Canal. The materials identified for further analysis with regard to flammable vapor clouds were: acetone,

acetone cyanohydrin, acrylonitrile, butadiene, cyclohexane, cyclohexanone (ketone alcohol), gasoline, and propylene (Table 2.2-7). The maximum quantity of all identified chemicals assumed to be carried on a vessel is 10,000,000 pounds as provided in RG 1.91, but as noted, due to ALOHA limitations, all spills were limited to 242 tons (484,000 pounds) releases over areas of 337,986 square feet. This is considered acceptable because of the narrow constraints of the 250-foot-wide canal.

An analysis for the identified chemicals is conducted using ALOHA as described in Subsection 2.2.3.1.2. The results indicate that the safe distances are less than the minimum separation distances from the VCS power block area to the Victoria Barge Canal for all of the identified chemicals (Table 2.2-11). Butadiene results in the longest flammable plume of 3444 feet, which is much less that the distance of 26,020 feet to the power block area for the VCS site. Propylene and butadiene both result in the longest distance to 1-psi should the plume detonate, 7392 feet, which is also much less than the distance to the power block area. Therefore, flammable and explosive vapor clouds from hazardous materials transported along the Victoria Barge Canal will not adversely affect the safe operation or shutdown of units located at the VCS site.

2.2.3.1.2.3 Highways

The VCS power block area is located approximately 2960 feet from U.S. Highway 77. Table 2.2-3 details the hazardous materials potentially transported on U.S. Highway 77. The materials identified for further analysis with regard to flammable vapor clouds are: acetylene, gasoline, hydrogen sulfide, methanol, methyl cyanide, natural gas (methane), and propane (Table 2.2-8). With the exception of acetylene and propane, the maximum quantity of the identified chemicals potentially transported on the roadway is 50,000 pounds as provided in RG 1.91. Acetylene is transported in cylinders (References 2.2-37 and 2.2-38). It was conservatively assumed that 8 cubic meters of acetylene at 250 psig is equivalent to 144 cubic meters at atmospheric pressure. Due to the low density of propane, the mass of propane assumed is 36,800 pounds based on a determined bounding volume for the transportation of propane.

An analysis for the identified chemicals is conducted using ALOHA as described in Subsection 2.2.3.1.2. The results indicate that any plausible vapor cloud that could form and mix sufficiently would be below the LFL boundary before reaching the VCS power block area. The safe distances are less than the minimum separation distances from the VCS power block area to U.S. Highway 77 for all of the identified chemicals (Table 2.2-11). Propane results in the longest flammable plume of 1293 feet, which is less than the distance of 2950 feet to the nearest approach of the power block area.

A vapor cloud explosion analysis was also completed as detailed in Subsection 2.2.3.1.2 to obtain safe distances. With the exception of propane, the results indicate that the safe distances, the minimum distance required for an explosion to have less than a 1 psi peak incident pressure, are less than the shortest distance to the power block area to U.S. Highway 77. The calculated safe distance for propane will be compared to the actual distances to the nearest safety-related structure for the selected technology at the VCS site to ensure the safe distances are adhered to at the COL stage.

2.2.3.1.2.4 Railroad

The VCS power block area is located approximately 20,174 feet from the Union Pacific Railway. Table 2.2-4 details the hazardous materials frequently transported on the Union Pacific Railway. The materials identified for further analysis with regard to flammable vapor clouds are: 1,1-difluoroethane, acetaldehyde, acetone, benzene, butyraldehyde, carbon bisulphide, gasoline, hexane, isopropanol, methyl methacrylate monomer, n-butyl acetate, n-propanol, n-propyl acetate, propane, propylene oxide, p-xylene, toluene, vinyl acetate, and vinyl chloride (Table 2.2-9). The maximum quantity of all identified chemicals carried in a single rail car is 132,000 pounds as provided in RG 1.91.

An analysis for the identified chemicals is conducted using ALOHA as described in Subsection 2.2.3.1.2. The results indicate that the safe distances are less than the minimum separation distances from the VCS power block area to the Union Pacific Railway for all of the identified chemicals (Table 2.2-11). Acetaldehyde results in the longest flammable plume of 1959 feet, which is much less than the distance of 20,174 feet to the power block area for the VCS site. Propane results in the longest distance to 1-psi should the plume detonate, 4860 feet, which is also much less than the distance to the power block area. Therefore, flammable and explosive vapor clouds from hazardous materials transported along the Union Pacific Railway would not adversely affect the safe operation or shutdown of units at the VCS site.

2.2.3.1.3 **Toxic Chemicals**

As described in Subsection 2.2.2.2.1, the locations and quantities of chemicals that would be stored at the VCS site have not yet been determined. And, although hazardous materials—stored or transported within the vicinity of the VCS site—which have the potential for forming a toxic or asphyxiating vapor cloud were identified, these chemicals would be analyzed at the COL stage in order to account for the control room ventilation design for the selected technology. Accordingly, the impact on the units from toxic chemicals stored onsite or nearby will be evaluated in the COL application in order to provide a detailed control room habitability assessment.

2.2.3.1.4 **Aircraft Crashes**

RG 1.206 and NUREG-0800 state that the risks as the result of 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 an order of magnitude of 10^{-7} per year should be considered in the design of the plant. Section 3.5.1.6 of

NUREG-0800 provides three acceptance criteria for the probability of aircraft accidents to be less than 10^{-7} per year by inspection: (1) meeting plant-to-airport distance and projected annual operations criteria; (2) plant is a least five statute miles from military training routes; and (3) plant is at least two statute miles beyond the nearest edge of a federal airway.

As presented in Subsection 2.2.2.7, the VCS site meets acceptance criteria 1 and 3—there are no airways whose edge is within two statute miles of the power block area or airports with plant-to-airport distance and annual operations projections which exceed the criteria outlined in Section 3.5.1.6 of NUREG-0800.

However, the VCS site is located within the Kingsville Military Operations Area (MOA) as depicted on Figure 2.2-6. Therefore, a calculation to determine the maximum area of a bounding building—that is, the maximum area of the safety-related structures mapped into a rectangular building—in which the probability of an aircraft accident possibly resulting in radiological consequences would remain less than an order of magnitude of 10^{-7} for the VCS site was performed following DOE-STD-3014-96 (Reference 2.2-36) methodology.

To determine the effective area, the four factor formula was utilized:

$$F = \sum_{ijk} N_{ijk} \circ P_{ijk} \circ f_{ijk}(x,y) \circ A_{ij} \qquad \text{Equation 2.2-7}$$

Where:

F Estimated annual aircraft crash impact frequency for the facility of interest (number per year)

N_{ijk} Estimated annual number of site-specific aircraft operations for each applicable summation parameter (number per year)

P_{ijk} Aircraft crash rate (per takeoff or landing for near-airport phases and per flight for the in-flight (non-airport) phase of operation for each applicable summation parameter)

$f_{ijk}(x,y)$ Aircraft crash location conditional probability (per square mile) given a crash evaluated at the facility location for each applicable summation parameter

A_{ij} The site-specific effective area for the facility of interest that includes skid and fly-in effective areas (square miles) for each applicable summation parameter, aircraft category or subcategory, and flight phase for military aviation

i (index for flight phases): i =1, 2, and 3 (takeoff, in-flight, and landing)

j (index for aircraft category or subcategory): j = 1, 2, …,11

k (index for flight source): k =1, 2, …, k

$\sum$ = $\sum_k \sum_j \sum_i$

ijk site-specific summation over flight phase, i; aircraft category or subcategory, j; and flight source, k

A hypothetical bounding building was first derived. The height of the bounding building was based on the maximum height dimension of the various reactor technologies–230 feet. In order to determine the maximum length and width of the bounding building, the various technologies were considered and a maximum allowable footprint area was determined that would yield an estimated crash impact of approximately 10^{-7} per year. This analysis shows that a footprint area 925 feet long and 700 feet wide would yield a site specific effective area of 0.1231 square miles and a resulting estimated crash impact frequency (F) of 4.92×10^{-7}.

NUREG-0800 specifies calculated frequencies should not be greater than an order of magnitude of 10^{-7} per year. The calculated results are not an order of magnitude greater than 10^{-7} so the bounding evaluation is acceptable for all technologies with an effective area less than 0.1231 square miles.

2.2.3.1.5 **Fires**

Accidents are considered in the vicinity of the VCS site that could lead to high heat fluxes or smoke, and nonflammable gas or chemical-bearing clouds from the release of materials as a consequence of fires. Fires from pipelines; brush and forest fires; and fires from transportation accidents are evaluated as events that could lead to high heat fluxes or to the formation of such clouds.

Those chemicals transported by roadway on U.S. Highway 77, by rail on the Union Pacific Railway, and by waterway on the Victoria Barge Canal, are evaluated in Subsection 2.2.3.1.2 for potential effects of accidental releases leading to a delayed ignition of any formed vapor cloud. For each of the stored or transported hazardous materials evaluated, the results indicate that any formed vapor cloud will dissipate below the LFL before reaching the power block area. Therefore, it is not expected that there would be any hazardous effects to units at the VCS site from fires or heat fluxes associated with above mentioned transportation routes.

Furthermore, a heat flux analysis for a pipeline break indicates that there would be no effect on the safe operation and or shutdown of units at the VCS site. ALOHA was used to determine the limiting heat flux from a jet fire due to a natural gas pipeline break. This analysis utilized the largest inner diameter (29.376 inches) and highest pressure (900 psig) pipeline within 5 miles of the VCS power block area. The analyzed fire scenario was located closer than the closest point of approach of the relocated pipelines to the VCS site. The jet fire results in a heat flux of 1.44 kW/m^2 at a 2200 foot separation distance. This is well below the heat flux necessary to spontaneously ignite wood after prolonged exposure (29 kW/m^2) and is nearly the same as the nominal solar heat flux on a clear summer day (1 kW/m^2) (Reference 2.2-35). Therefore, a jet fire from the analyzed pipeline would have no adverse effect on the VCS power block area. However, predicted flame lengths are in excess of 250 feet (76 meters) thus, equipment (e.g., power cables) directly above the pipeline may be affected. As addressed in Subsection 2.2.3.1.2.1, pipelines will be rerouted such that a safe distance from the VCS site is achieved.

Likewise, the potential for brush, forest, or woodland fires was evaluated. The Texas Parks and Wildlife Department has categorized the vegetation in the VCS site vicinity from a compilation of satellite imagery, land surveys and site inspections. There are no forested areas in the site vicinity. Grasslands, marshes and croplands are the predominant vegetation types in the area. (Reference 2.2-52) The area to the north of the VCS power block area comprises the substation and the area to the south of the VCS power block area comprises the cooling basin. There are no appreciable brush or trees surrounding the power block area. Therefore, the zone surrounding the VCS power block area is of sufficient size to afford protection in the event of a fire. For perspective, the Texas Department of Public Safety recommends a safety zone of only 30 to 50 feet be maintained around structures for protection against wildfires, whereas California has adopted regulations requiring a fire break of at least 30 feet and a fuel break to 100 feet (References 2.2-47 and 2.2-48). The safety zone around the VCS power block area exceeds these recommended distances. Therefore, it is not expected that there will be any hazardous effects to units at the VCS site from fires or heat fluxes associated with wild fires or fires along nearby transportation routes.

2.2.3.1.6 **Collisions with Intake Structure**

Because the raw water makeup system intake structure for the VCS site is not safety-related and is not expected to be located on a navigable waterway, an evaluation that considers the probability and potential effects of impact on the plant cooling water intake structure and enclosed pumps is not warranted.

2.2.3.1.7 **Liquid Spills**

The accidental release of oil or liquids that may be corrosive, cryogenic, or coagulant are considered to determine if the potential exists for such liquids to be drawn into the plant's raw water makeup system's intake structure and circulating water system or otherwise affect the plant's safe operation. In the unlikely event that these liquids would spill into the Guadalupe River or the intake canal, they would not only be diluted by the large quantity of river water, but the raw water makeup intake from the intake canal is not necessary for the safe shutdown of the plant, that is, the intake structure is a non-safety related structure. Therefore, any spill in the Guadalupe River or the intake canal will not affect the safe operation or shutdown of units at the VCS site.

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Table 2.2-1
Description of Facilities – Products and Materials

Facility	Concise Description	Primary Function	Major Products	Number of Persons Employed
Air Liquide America Corporation	Gas Separation Unit	Producers of pure gas products	Oxygen, nitrogen, argon	10
INVISTA	Manufacturer of textile intermediates	Producer of Nylon intermediates	Hexamethylenediamine, adipic acid, dodecanedioic acid	555
DuPont	Ethylene copolymers facility	Producer of low-density polyethylene (LDPE) resins	LDPE resins	90
Equistar Chemicals	Manufacturer of high density polyethylene (HDPE) resins	Producer of HDPE resins	HDPE resins	92
Gavilon Fertilizer, LLC	Produces fertilizers for agricultural use	Producer of liquid fertilizers	Liquid ammonium fertilizers	4
Inergy Propane, LLC	Propane distributor	Distributes propane to residential, agriculture and industry	Propane	0
Tennessee Gas Pipeline – Station 9	Natural gas compressor station	Natural gas transmission	Natural gas	7

Source: References 2.2-1, 2.2-16, 2.2-18, 2.2-19 and 2.2-21 through 2.2-23.

Table 2.2-2
Aircraft Operations—Significant Factors

Airport	Number of Operations	Distance from the Site	Significance Factor[(a)]
Green Lake Ranch Airport[(b)]	Sporadic	10.5 miles	110,250
Victoria Regional Airport[(b)]	47,911	18 miles	324,000

(a) $500D^2$ movements per year for sites within 5 to 10 miles and $1000D^2$ movements per year for sites outside 10 miles.

(b) Because the projected number of operations is less than the calculated significance factor, an evaluation for this airport is not conducted.

Table 2.2-3 (Sheet 1 of 2)
Hazardous Materials Transported Along U.S. Highway 77

Chemical	Quantity (lbs)	Toxicity Limit (IDLH)[a]
Acetylene[b]	144 m^3	Asphyxiant
Alkyl Phenols: Octylphenol, Nonylphenol	50,000	None established
Aluminum Sulfate	50,000	None established
Anhydrous Ammonia	50,000	300 ppm
Argon	50,000	Asphyxiant
Calcium Chloride	50,000	None established
Carbon Dioxide	50,000	40,000 ppm
Chlorine	50,000	10 ppm
Crude Oil	50,000	None established
Diesel Fuel	50,000	None established
Diethanolamine	50,000	0.46 ppm[c]
Engine Lubricants	50,000	None established
Ferrous Chloride	50,000	1 mg/m^3 as iron[c]
Ferrous Sulfate Solution	50,000	None established
Gasoline	50,000	300 ppm[c]
Hexanols: 1-Hexanol, n-Hexanol	50,000	None established
Hydrofluorosilicic Acid	50,000	25 ppm as fluorine
Hydrogen Chloride	50,000	50 ppm
Hydrogen Fluoride	50,000	30 ppm as fluorine
Hydrogen Sulfide	50,000	100 ppm
Kerosene	50,000	200 mg/m^3[c]
Liquid Ammonium Sulfate	50,000	None established
Liquid Nitrogen	50,000	Asphyxiant
Liquid Oxygen	50,000	None established
Metallic Acetates (Cadmium Acetate)	50,000	9 mg/m^3 as Cd
Methanol	50,000	6000 ppm
Methyl Cyanide (Acetonitrile)	50,000	500 ppm
Methyl Diethanolamine	50,000	None established
Molten Sulfur	50,000	None established
Motor Oil/Used Oil	50,000	None established
Natural Gas	50,000	Asphyxiant
Sodium Phosphate	50,000	None established
Propane	50,000	2100 ppm
Sodium Chlorite Solution	50,000	None established
Sodium Hydrosulfite	50,000	None established
Solvit MPA-7747 (THPS)	50,000	None established
Solvit SF8101 (Acetic Acid)	50,000	50 ppm

Table 2.2-3 (Sheet 2 of 2)
Hazardous Materials Transported Along U.S. Highway 77

Chemical	Quantity (lbs)	Toxicity Limit (IDLH)[a]
Sulfur Dioxide	50,000	100 ppm
Sulfuric Acid	50,000	15 mg/m^3
Tars/Asphalt	50,000	5 mg/m^3[c]
Triethylene Glycol	50,000	None established

(a) Immediately Dangerous to Life or Health (IDLH).
(b) Acetylene is transported in cylinders that range in size between 4 and 8 cubic meters. Eight cubic meters of acetylene at 250 psig is equivalent to 144 cubic meters at atmospheric pressure.
(c) Threshold Limit Value/Time Weighted Average (TLV-TWA).

Sources: References 2.2-1 through 2.2-4, 2.2-8, 2.2-9; 2.2-25 through 2.2-27; 2.2-37, 2.2-38, 2.2-39, 2.2-49, 2.2-50, 2.2-53, and 2.2-54.

Table 2.2-4 (Sheet 1 of 2)
Hazardous Materials Transported Along Railroad

Material	Maximum Quantity (lbs)	Toxicity Limit (IDLH)[(a)]
Acetaldehyde	132,000	2000 ppm
Acetic Anhydride	132,000	200 ppm
Acetone	132,000	2500 ppm
Amyl Acetate	132,000	1000 ppm
Anhydrous Ammonia	132,000	300 ppm
Benzene	132,000	500 ppm
Butyraldehyde	132,000	None established
Carbon Bisulphide	132,000	500 ppm
Carbon Dioxide	132,000	40,000 ppm
Chlorine	132,000	10 ppm
Chlorodifluoromethane	132,000	1250 ppm[(b)]
Dichloromethane	132,000	2300 ppm
Dicyclopentadiene	132,000	5 ppm[(c)]
1,1-Difluoroethane	132,000	Asphyxiant
Formaldehyde Solution	132,000	20 ppm
Fuel Oil (Diesel Fuel)	132,000	None established
Gasoline	132,000	300 ppm[(c)]
Glacial Acetic Acid	132,000	50 ppm
Hexane	132,000	1100 ppm
Hydrochloric Acid	132,000	50 ppm
Hydrogen Chloride	132,000	50 ppm
Hydrogen Fluoride, anhydrous	132,000	30 ppm
Hydrogen Peroxide	132,000	75 ppm
Isopropanol	132,000	2000 ppm
Liquified Petroleum Gas (Propane)	132,000	2100 ppm
Maleic Anhydride	132,000	10 mg/m^3
Methyl Methacrylate Monomer	132,000	1000 ppm
Molten Phenol	132,000	250 ppm
Molten Sulfur	132,000	None established
Naptha - Petrol	132,000	None established
n-Butyl Acetate	132,000	1700 ppm
n-Butyl Acrylate	132,000	10 ppm[(c)]
n-Butyl Alcohol	132,000	1400 ppm
n-Butylbenzene	132,000	None established
n-Propanol	132,000	800 ppm
n-Propyl Acetate	132,000	1700 ppm
p-Xylene	132,000	900 ppm

Table 2.2-4 (Sheet 2 of 2)
Hazardous Materials Transported Along Railroad

Material	Maximum Quantity (lbs)	Toxicity Limit (IDLH)[a]
Paraformaldehyde	132,000	None established
Phosphoric Acid Solution	132,000	1000 mg/m^3
Potassium Hydroxide, Solution	132,000	None established
Propionic Acid	132,000	15 ppm[b]
Propylene Oxide	132,000	400 ppm
Sodium Aluminate, Solution	132,000	2 mg/m^3 as Al salts[c]
Sodium Chlorate	132,000	None established
Sodium Hydroxide, Solution	132,000	10 mg/m^3
Sulfuric Acid	132,000	15 mg/m^3
Tetrachloroethylene	132,000	150 ppm
1,1,1,2-Tetrafluoroethane	132,000	Asphyxiant
Toluene	132,000	500 ppm
Toluene Diisocyanate	132,000	2.5 ppm
Vinyl Acetate	132,000	4 ppm[b]
Vinyl Chloride	132,000	1000 ppm

(a) Immediately Dangerous to Life or Health (IDLH).
(b) Short Term Exposure Limit (STEL).
(c) Threshold Limit Value/Time Weighted Average (TLV-TWA).

Sources: References 2.2-8, 2.2-9, 2.2-39, 2.2-49 and 2.2-50.

Table 2.2-5
Hazardous Materials Transported Along Victoria Barge Canal

Material	Maximum Quantity (pounds)	Toxicity Limit (IDLH)[(a)]
Acetone	10,000,000	2500 ppm
Acetone Cyanohydrin	10,000,000	1 ppm[(b)]
Acrylonitrile	10,000,000	85 ppm
Adiponitrile	10,000,000	2 ppm[(c)]
Ammonium Nitrate	10,000,000	None established
Anhydrous Ammonia	10,000,000	300 ppm
Butadiene	10,000,000	2000 ppm
Cyclohexane	10,000,000	1300 ppm
Cyclohexanone (Ketone Alcohol)	10,000,000	700 ppm
Gasoline	10,000,000	300 ppm[(c)]
Hexamethylenediamine	10,000,000	0.5 ppm[(c)]
Naptha	10,000,000	None established
No. 2 Fuel Oil	10,000,000	None established
No. 6 Fuel Oil	10,000,000	None established
Poly-N (Ammonium Polyphosphate Solution)	10,000,000	None established
Propylene	10,000,000	Asphyxiant
Sodium Hydroxide Solution	10,000,000	10 mg/m^3
Urea	10,000,000	None established
URAN	10,000,000	None established

(a) Immediately Dangerous to Life or Health (IDLH).
(b) NIOSH-Ceiling (15-minute).
(c) Threshold Limit Value/Time Weighted Average (TLV-TWA).

Sources: References 2.2-8, 2.2-9, 2.2-10, 2.2-39, 2.2-49, 2.2-50, and 2.2-51.

Table 2.2-6
Pipeline Information Summary

Operator	Pipeline System/Name	Product	Pipeline Diameter (inches)	Operating Pressure	Depth of Burial	Distance Between Isolation Valves
Gulf South Pipeline Co., L.P	Koch Gateway	Natural Gas Transmission	30	Not Available[(a)]	Not Available[(a)]	Not Available[(a)]
Gulf South Pipeline Co., L.P.	Victoria Gathering	Natural Gas Gathering	4.5	Not Available[(a)]	Not Available[(a)]	Not Available[(a)]
Natural Gas Pipeline Company of America, LLC[(b)]	Gulf Coast Mainline #1	Natural Gas Transmission	26	900 psig	45 inches	18.0 miles
Natural Gas Pipeline Company of America, LLC[(b)]	Gulf Coast Mainline #2	Natural Gas Transmission	30	900 psig	45 inches	18.0 miles
Natural Gas Pipeline Company of America, LLC[(b)]	Petrotex Lateral	Natural Gas Transmission	4.5	Not Available[(a)]	Not Available[(a)]	Not Available[(a)]
Kinder Morgan Texas Pipeline, L.P.[(b)]	Tom O'Connor–Missouri City Jct.	Natural Gas Transmission	30	795 psig	30 inches	17.0 miles
Transcontinental Gas Pipeline Company	Mainline 26-0100	Natural Gas Transmission	26	700 psig	36 inches	17.6 miles
Tennessee Gas Pipeline Company	100-1	Natural Gas Transmission	24	750 psig	36 inches	10.0 miles
Tennessee Gas Pipeline Company	100-2	Natural Gas Transmission	24	750 psig	36 inches	10.0 miles
Tennessee Gas Pipeline Company	100-3	Natural Gas Transmission	30	750 psig	36 inches	10.0 miles
Tennessee Gas Pipeline Company	Coleto Creek	Natural Gas Transmission	12.75	Not Available[(a)]	Not Available[(a)]	Not Available[(a)]
Citgo Products Pipeline Company	Casa Pipeline—Nueces St. to Victoria St.	Gasoline and Diesel Fuel	8–10	625 psig	30 inches	5.9 miles
United Brine Co., LLC	Ingleside to Bloomington System	ethylene/cyclohexane[(c)]	4.5	Not Available[(a)]	Not Available[(a)]	Not Available[(a)]
Apache Corporation	McFaddin	Natural Gas Gathering	4.5	Not Available[(a)]	Not Available[(a)]	Not Available[(a)]
Apache Corporation	McFaddin	Natural Gas Gathering	6.63	Not Available[(a)]	Not Available[(a)]	Not Available[(a)]
Southcross Gulf Coast Transmission, LTD	Gulf Coast Transmission	Natural Gas Gathering	14	Not Available[(a)]	Not Available[(a)]	Not Available[(a)]
Enerfin Field Services, LLC	McFaddin & Refugio	Natural Gas Gathering	4.5	Not Available[(a)]	Not Available[(a)]	Not Available[(a)]

(a) This information was not provided by the pipeline operators.
(b) Natural Gas Pipeline Company of America is a subsidiary of Kinder Morgan.
(c) The toxicity analysis for cyclohexane will be done at the time of the COL.

Sources: Reference 2.2-6.

Table 2.2-7 (Sheet 1 of 2)
Disposition of Hazardous Materials Transported on Waterway

Material	Toxicity Limit (IDLH)	Flammability	Explosion Hazard?	Vapor Pressure	Disposition
Acetone	2500 ppm	2.6–12.8%	Vapor may explode	4.791 psi @ 80°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Acetone Cyanohydrin	1 ppm[a]	2.2–12.0%	Vapor may explode	3 kPa @ 20°C	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Acrylonitrile	85 ppm	3.05–17.0%	Vapor may explode	2.205 psi @ 80°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Adiponitrile	2 ppm[b]	1.7–4.9%	Vapor may explode	0.3 Pa @ 20°C	No further analysis required—low vapor pressure[c]
Ammonium Nitrate	None established	Not Flammable	None listed	Not available—solid	No further analysis required
Anhydrous Ammonia	300 ppm	15.5–27.0%[d]	Vapor may explode[d]	157.000 psi @ 80°F	Toxicity Analysis at Time of COL
Butadiene	2000 ppm	2.0–11.5%	Vapor may explode	36.050 psi @ 70°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Cyclohexane	1300 ppm	1.33–8.35%	Vapor may explode	1.978 psi @ 80°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Cyclohexanone (Ketone Alcohol)	700 ppm	1.1–9.4%	Vapor may explode	0.503 psi @ 80°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Gasoline	300 ppm [b]	1.4–7.4%	Vapor may explode	9.18 psia	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Hexamethylenediamine	0.5 ppm [b]	Flammable solid	Flammable solid	Not available—solid	Explosive Analysis
Naptha	None established	0.7–6.0%	Vapor may explode	0.3 kPa @ 20°C	No further analysis required—low vapor pressure[c]
No. 2 Fuel Oil	None established	1.3–6.0%	None listed	0.057 psi @ 80°F	No further analysis required—low vapor pressure[c]

Table 2.2-7 (Sheet 2 of 2)
Disposition of Hazardous Materials Transported on Waterway

Material	Toxicity Limit (IDLH)	Flammability	Explosion Hazard?	Vapor Pressure	Disposition
No. 6 Fuel Oil	None established	1.0–5.0%	None listed	0.057 psi @ 80°F	No further analysis required—low vapor pressure[(c)]
Poly-N (Ammonium Polyphospate Solution)	None established	Not Flammable	None listed	Not available—no inhalation hazard	No further analysis required
Propylene	Asphyxiant	2.0–11.0%	Vapor may explode	20.600 psi @ –40°F	Asphyxiation Analysis at Time of COL Flammability Analysis Explosive Analysis
Sodium Hydroxide (Solution)	10 mg/m^3	Not flammable	None listed	1 mmHg @ 20°C	No further analysis required—low vapor pressure[(c)]
URAN	None established	Not Flammable	None listed	Not available—vaporization unlikely	No further analysis required
Urea	None established	Not Flammable	None listed	Not available—solid	No further analysis required

(a) NIOSH Ceiling (15-minute).
(b) Threshold Limit Value/Time Weighted Average (TLV-TWA).
(c) If a chemical had a vapor pressure below 10 torr (0.193 psi) then no further analysis was required.
(d) Studies have shown that an ammonia-air mixture does not ignite at less than 1562°F. Conditions favorable for ignition are seldom encountered during normal operations due to this high ignition temperature required.

Sources: References 2.2-8, 2.2-9, 2.2-10, 2.2-39, 2.2-49, 2.2-50, 2.2-51, 2.2-55, 2.2-63, and 2.2-65.

Table 2.2-8 (Sheet 1 of 3)
Disposition of Hazardous Materials Transported on U.S. Highway 77

Material	Toxicity Limit (IDLH)	Flammability	Explosion Hazard?	Vapor Pressure	Disposition
Acetylene	Asphyxiant	2.5–100%	Vapor may explode	51.37 psi @ –76°F	Asphyxiation Analysis at Time of COL Flammability Analysis Explosive Analysis
Alkyl Phenols: Octylphenol, Nonylphenol	None established	~1.0% LEL	Vapor may explode	Negligible @ 20°C	No further analysis required—low vapor pressure[a]
Aluminum Sulfate	None established	Not flammable	Not explosive	Not available—solid	No further analysis required
Ammonia	300 ppm	15.5–27.0%[b]	Vapor may explode[b]	157 psi @ 80°F	Toxicity Analysis at Time of COL
Argon	Asphyxiant	Not flammable	Not explosive	Not available—gas	Asphyxiation Analysis at Time of COL
Calcium Chloride	None established	Not flammable	Not explosive	Not available—soild	No further analysis required
Carbon Dioxide	40,000 ppm	Not flammable	Not explosive	907.299 psi @ 75°F	Toxicity Analysis at Time of COL
Chlorine	10 ppm	Not flammable	Not explosive	70.04 psi @ 50°F	Toxicity Analysis at Time of COL
Crude Oil	None established	Not available	Not available	0.057 psi @ 80°F	No further analysis required—low vapor pressure[a]
Diesel Fuel	None established	1.3–6.0%	Vapor may explode	0.057 psi @ 80°F	No further analysis required—low vapor pressure[a]
Diethanolamine	0.46 ppm[c]	1.6–9.8%	Vapor may explode	<1 Pa @ 20°C	No further analysis required—low vapor pressure[a]
Engine Lubricants	None established	Not available	Not available	0.057 psi @ 80°F	No further analysis required—low vapor pressure[a]
Ferrous Chloride	1 mg/m^3 as iron[c]	Not flammable	None listed	Not available—solid	No further analysis required
Ferrous Sulfate Solution	None established	Not flammable	None listed	Vapor is water	No further analysis required
Gasoline	300 ppm [c]	1.4–7.4%	Vapor may explode	9.18 psia	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Hexanols: 1-Hexanol, n-Hexanol	None established	1.2–7.7%	Vapor may explode	0.124 kPa @ 25°C	No further analysis required—low vapor pressure[a]
Hydrofluorosilicic Acid	25 ppm as fluorine	Not flammable	None listed	24 mmHg @ 77°F	Decomposes into hydrogen fluoride—HF toxicity analysis is bounding.

Table 2.2-8 (Sheet 2 of 3)
Disposition of Hazardous Materials Transported on U.S. Highway 77

Material	Toxicity Limit (IDLH)	Flammability	Explosion Hazard?	Vapor Pressure	Disposition
Hydrogen Chloride	50 ppm	Not flammable	None listed	148.299 psi @ –25°F	Toxicity Analysis at Time of COL
Hydrogen Fluoride	30 ppm as fluorine	Not flammable	None listed	6.923 psi @ 30°F	Toxicity Analysis at Time of COL
Hydrogen Sulfide	100 ppm	4.3–45.5%	Vapor may explode	182.4 psi @ 45°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Kerosene	200 mg/m^3[(c)]	0.7–5.0%	Vapor may explode	0.056 psi @ 80°F	No further analysis required—low vapor pressure[(a)]
Liquid Ammonium Sulfate	None established	Not flammable	None listed	Not available	No further analysis required
Liquid Nitrogen	Asphyxiant	Not flammable	None listed	14.41 psi @ –320°F	Asphyxiation Analysis at Time of COL
Liquid Oxygen	None established	Not flammable	None listed	36.26 psi @ –280°F	No further analysis required
Metallic Acetates	9 mg/m^3 as Cd	Not flammable	None listed	Not available—solid	No further analysis required
Methanol	6000 ppm	6.0–36.5%	Vapor may explode	2.579 psi @ 80°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Methyl Cyanide (Acetonitrile)	500 ppm	4.4–16.0%	Vapor may explode	1.805 psi @ 80°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Methyl Diethanolamine	None established	0.9 – 8.4%	None listed	0.03 Pa @ 25°C	No further analysis required—low vapor pressure[(a)]
Molten Sulfur	None established	Not flammable	None listed	0.003 psi @ 280°F	No further analysis required—low vapor pressure[(a)]
Motor Oil/Used Oil	None established	Not available	Not available	0.057 psi @ 80°F	No further analysis required—low vapor pressure[(a)]
Natural Gas	Asphyxiant	4.4–16.5%	Vapor may explode	13.82 psi @ –260°F	Asphyxiation Analysis at Time of COL Flammability Analysis Explosive Analysis
Sodium Phosphate	None established	Not flammable	None listed	Not available—solid	No further analysis required
Propane	2100 ppm	2.0–9.5%	Vapor may explode	25.4 psi @ –20°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis

Table 2.2-8 (Sheet 3 of 3)
Disposition of Hazardous Materials Transported on U.S. Highway 77

Material	Toxicity Limit (IDLH)	Flammability	Explosion Hazard?	Vapor Pressure	Disposition
Sodium Chlorite Solution	None established	Not flammable	None listed	Not available	No further analysis required
Sodium Hydrosulfite	None established	Flammable solid	Combustible solid	Not available—solid	Explosive Analysis[d]
Solvit MPA-7747 (THPS)	None established	Not flammable	None listed	0.7 kPa @ 25°C	No further analysis required—low vapor pressure[a]
Solvit SF8101 (Acetic Acid)	50 ppm	4.0—19.9%[e]	Vapor may explode[e]	0.324 psi @ 80°F	Toxicity Analysis at Time of COL
Sulfur Dioxide	100 ppm	Not flammable	None listed	40.97 psi @ 60°F	Toxicity Analysis at Time of COL
Sulfuric Acid	15 mg/m^3	Not flammable	None listed	1 mmHg @ 295°F	No further analysis required—low vapor pressure[a]
Tars/Asphalt	5 mg/m^3[c]	Combustible	None listed	Negligible @ 20°C	No further analysis required—low vapor pressure[a]
Triethylene Glycol	None established	0.9—9.2%	Vapor may explode	0.02 Pa @ 20°C	No further analysis required—low vapor pressure[a]

(a) Chemicals with vapor pressures less than 10 torr, 0.193 psi, or solids were not considered for toxicity or flammable vapor cloud analysis. Chemicals at this low vapor pressure are not very volatile. That is, under normal conditions, chemicals cannot enter the atmosphere fast enough to reach concentrations hazardous to people and, thus, are not considered to be an air dispersion hazard.
(b) Chemicals with vapor pressures less than 10 torr, 0.193 psi, or solids were not considered for toxicity or flammable vapor cloud analysis. Chemicals at this low vapor pressure are not very volatile. That is, under normal conditions, chemicals cannot enter the atmosphere fast enough to reach concentrations hazardous to people and, thus, are not considered to be an air dispersion hazard.
(c) Threshold Limit Value/Time Weighted Average (TLV-TWA).
(d) Assuming a 100% TNT (mass) equivalence for solid energetic materials, a 132,000-pound boxcar load of this solid meets the safe distance requirements established in Regulatory Guide 1.91 (c)(1), and no further consideration need be given to the effects of blast in plant design.
(e) The concentration of the vapor above the liquid was less than the LFL for the chemical, thus no further analysis was required.

Sources: References 2.2-1 through 2.2-4, 2.2-8, 2.2-9, 2.2-24 through 2.2-28, 2.2-39, 2.2-49, 2.2-50, 2.2-53 through 2.2-60.

Table 2.2-9 (Sheet 1 of 4)
Disposition of Hazardous Materials Transported on Railroad

Material	Toxicity Limit (IDLH)	Flammability	Explosion Hazard?	Vapor Pressure	Disposition
Acetaldehyde	2000 ppm	4.0–60.0%	Vapor may explode	18.610 psi @ 80°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Acetic Anhydride	200 ppm	2.7–10.3%	Vapor may explode	0.119 psi @ 80°F	No further analysis required—low vapor pressure[a]
Acetone	2500 ppm	2.6–12.8%	Vapor may explode	4.791 psi @ 80°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Amyl Acetate	1000 ppm	1.1–7.5%	Vapor may explode	0.116 psi @ 80°F	No further analysis required—low vapor pressure[a]
Anhydrous Ammonia	300 ppm	15.5–27.0%[b]	Vapor may explode[b]	157.000 psi @ 80°F	Toxicity Analysis at Time of COL
Benzene	500 ppm	1.3–7.9%	Vapor may explode	1.989 psi @ 80°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Butyraldehyde	None established	2.5–0.6%	Vapor may explode	3.620 psi @ 80°F	Flammability Analysis Explosive Analysis
Carbon Bisulphide	500 ppm	1.3–50.0%	Vapor may explode	7.402 psi @ 80°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Carbon Dioxide	40,000 ppm	Not flammable	None listed	907.299 psi @ 75°F	Toxicity Analysis at Time of COL
Chlorine	10 ppm	Not flammable	None listed	74.040 psi @ 50°F	Toxicity Analysis at Time of COL
Chlorofidluoromethane	1250 ppm[c]	Not flammable	None listed	47.96 psi @ 10°F	Toxicity Analysis at Time of COL
Dichloromethane	2300 ppm	Not flammable	None listed	9.237 psi @ 80°F	Toxicity Analysis at Time of COL
Dicyclopentadiene	5 ppm[d]	0.8–6.3%	Vapor may explode	0.092 psi @ 80°F	No further analysis required—low vapor pressure[a]
1,1–Difluoroethane	Asphyxiant	3.7–18.0%	Vapor may explode	90.709 psi @ 80°F	Asphyxiation Analysis at Time of COL Flammability Analysis Explosive Analysis

Table 2.2-9 (Sheet 2 of 4)
Disposition of Hazardous Materials Transported on Railroad

Material	Toxicity Limit (IDLH)	Flammability	Explosion Hazard?	Vapor Pressure	Disposition
Formaldehyde Solution	20 ppm	7.0–73.0%	Vapor may explode	0.042 psi @ 80°F	No further analysis required—low vapor pressure[a]
Fuel Oil (Diesel Fuel)	None established	1.3–6.0%	None listed	0.057 psi @ 80°F	No further analysis required—low vapor pressure[a]
Gasoline	300 ppm[d]	1.4–7.4%	Vapor may explode	9.18 psia	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Glacial Acetic Acid	50 ppm	4.0–19.9%[e]	Vapor may explode[4]	0.324 psi @ 80°F	Toxicity Analysis at Time of COL
Hexane	1100 ppm	1.2–7.7%	Vapor may explode	3.147 psi @ 80°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Hydrochloric Acid	50 ppm	Not flammable	None listed	148.299 psi @ –25°F as hydrogen chloride	Toxicity Analysis at Time of COL
Hydrogen Chloride	50 ppm	Not flammable	None listed	148.299 psi @ –25°F	Toxicity Analysis at Time of COL
Hydrogen Fluoride, anhydrous	30 ppm	Not flammable	None listed	6.923 psi @ 30°F	Toxicity Analysis at Time of COL
Hydrogen Peroxide	75 ppm	Not flammable	None listed	0.143 psi @ 80°F	No further analysis required—low vapor pressure[a]
Isopropanol	2000 ppm	2.3–12.7%	Vapor may explode	0.953 psi @ 80°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Liquefied Petroleum Gas (Propane)	2100 ppm	2.1–9.5%	Vapor may explode	25.4 psi @ –20°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Maleic Anhydride	10 mg/m^3	Flammable solid	Flammable solid	Not available—solid	Explosive Analysis
Methyl Methacrylate Monomer	1000 ppm	2.1–12.5%	Vapor may explode	0.843 psi @ 80°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Molten Phenol	250 ppm	1.7–8.6%	Vapor may explode	47 Pa @ 20°C	No further analysis required—low vapor pressure[a]

**Table 2.2-9 (Sheet 3 of 4)
Disposition of Hazardous Materials Transported on Railroad**

Material	Toxicity Limit (IDLH)	Flammability	Explosion Hazard?	Vapor Pressure	Disposition
Molten Sulfur	None established	Not flammable	None listed	0.003 psi @ 280°F	No further analysis required—low vapor pressure[a]
Naptha – Petrol	None established	0.7–6.0%	Vapor may explode	0.3 kPa @ 20°C	No further analysis required—low vapor pressure[a]
n-Butyl Acetate	1700 ppm	1.7–7.6%	Vapor may explode	0.277 psi @ 80°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
n-Butyl Acrylate	10 ppm[d]	1.4–9.4%	Vapor may explode	0.114 psi @ 80°F	No further analysis required—low vapor pressure[a]
n-Butyl Alcohol	1400 ppm	1.4–11.2%	Vapor may explode	0.137 psi @ 80°F	No further analysis required—low vapor pressure[a]
n-Butylbenzene	None established	0.8–5.8%	Vapor may explode	0.133 kPa @ 23°C	No further analysis required—low vapor pressure[a]
n-Propyl Acetate	1700 ppm	2.0–8.0%	Vapor may explode	0.697 psi @ 80°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
p-Xylene	900 ppm	1.1–7.0%	Vapor may explode	0.187 psi @ 80°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Paraformaldehyde	None established	Flammable solid	Flammable solid	Not available—solid	Explosive Analysis
Phosphoric Acid Solution	1000 mg/m^3	Not flammable	None listed	5.5 mmHg @ 20°C	No further analysis required—low vapor pressure[a]
Potassium Hydroxide, solution	None established	Not flammable	None listed	2 mmHg @ 20°C	No further analysis required—low vapor pressure[a]
Propionic Acid	15 ppm[c]	2.9–12.1%	Vapor may explode	0.092 psi @ 80°F	No further analysis required—low vapor pressure[a]
Propylene Oxide	400 ppm	2.1–38.5%	Vapor may explode	11.110 psi @80°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis

Table 2.2-9 (Sheet 4 of 4)
Disposition of Hazardous Materials Transported on Railroad

Material	Toxicity Limit (IDLH)	Flammability	Explosion Hazard?	Vapor Pressure	Disposition
Sodium Aluminate, solution	2 mg/m^3 as Al salts[(d)]	Not flammable	None listed	Negligible @ 20°C	No further analysis required—low vapor pressure[(a)]
Sodium Chlorate	None established	Not flammable	None listed	Not available—solid	No further analysis required
Sodium Hydroxide, solution	10 mg/m^3	Not flammable	None listed	1 mmHg @ 20°C	No further analysis required—low vapor pressure[(a)]
Sulfuric Acid	15 mg/m^3	Not flammable	None listed	1 mmHg @ 295°F	No further analysis required—low vapor pressure[(a)]
Tetrachloroethylene	150 ppm	Not flammable	None listed	0.425 psi @ 80°F	Toxicity Analysis at Time of COL
1,1,1,2–Tetrafluoroethane	Asphyxiant	Not flammable	None listed	630 kPa @ 25°C	Asphyxiation Analysis at Time of COL
Toluene	500 ppm	1.27–7.0%	Vapor may explode	0.600 psi @ 80°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis
Toluene Diisocyanate	2.5 ppm	0.9–9.5%	Vapor may explode	1.3 Pa @ 20°C	No further analysis required—low vapor pressure[(a)]
Vinyl Acetate	4 ppm[(c)]	2.6–13.4%	Vapor may explode	2.433 psi @ 80°F	Toxicity Analysis at Time of COL Flammability Analysis Explosive Analysis

(a) Chemicals with vapor pressures less than 10 torr, 0.193 psi, or solids were not considered for toxicity or flammable vapor cloud analysis. Chemicals at this low vapor pressure are not very volatile. That is, under normal conditions, chemicals cannot enter the atmosphere fast enough to reach concentrations hazardous to people and, thus, are not considered to be an air dispersion hazard.
(b) Studies have shown that an ammonia-air mixture does not ignite at less than 1562°F. Conditions favorable for ignition are seldom encountered during normal operations due to this high ignition temperature required.
(c) Short Term Exposure Limit (STEL).
(d) Threshold Limit Value/Time Weighted Average (TLV-TWA).
(e) The concentration of the vapor above the liquid was less than the LFL for the chemical, thus no further analysis was required.

Sources: References 2.2-8, 2.2-9, 2.2-39, 2.2-49, 2.2-50, 2.2-55, and 2.2-61 through 2.2-65.

Table 2.2-10 (Sheet 1 of 2)
Design-Basis Events — Explosions

Source	Material Evaluated	Quantity (lbm)	Heat of Combustion (Btu/lb)	Equivalent TNT Mass (lbm)	Distance to Power Block Area Boundary (feet)	Distance for Explosion to have less than 1 psi of Peak Incident Pressure (feet)
U.S. Highway 77	Acetylene	339	20,747	814	2,957	420
	Gasoline	50,000	18,720	241		280
	Hydrogen Sulfide	50,000	6,552	20,000		2462
	Methanol	50,000	8,419	139		233
	Methyl Cyanide	50,000	13,360	125		225
	Natural Gas	50,000	21,517	20,000		2220
	Propane	36,880	19,782	88,512		2005
Railway	1,1-Difluoroethane	132,000	7,950	316,800	20,174	3068
	Acetaldehyde	132,000	10,600	218		459
	Acetone	132,000	12,250	70		314
	Benzene	132,000	17,460	74		321
	Butyraldehyde	132,000	15,210	88		339
	Carbon Bisulphide	132,000	5,814	107		362
	Gasoline	132,000	18,720	131		387
	Hexane	132,000	19,246	119		375
	Isopropanol	132,000	12,960	77		324
	Maleic Anhydride	132,000	5,936	132,000		2291
	Methyl Methacrylate Monomer	132,000	11,400	92		344
	n-Butyl Acetate	132,000	13,130	80		329
	n-Propanol	132,000	13,130	81		329
	n-Propyl Acetate	132,000	11,255	63		303
	Paraformaldehyde	132,000	6,682	132,000		2291

Table 2.2-10 (Sheet 2 of 2)
Design-Basis Events — Explosions

Source	Material Evaluated	Quantity (lbm)	Heat of Combustion (Btu/lb)	Equivalent TNT Mass (lbm)	Distance to Power Block Area Boundary (feet)	Distance for Explosion to have less than 1 psi of Peak Incident Pressure (feet)
Railway (continued)	Propane	132,000	19,782	316,800	20,174	3068
	Propylene Oxide	132,000	13,000	213		455
	p-xylene	132,000	17,559	92		344
	Toulene	132,000	17,430	79		327
	Vinyl Acetate	132,000	9,754	73		319
	Vinyl Chloride	132,000	8,136	316,800		3068
Victoria Barge Canal	Acetone	10,000,000	12,250	6027	26,020	1329
	Acetone Cyanohydrin	10,000,000	11,312	5706		1366
	Acrylonitrile (Vinyl cyanide)	10,000,000	14,300	7467		1482
	Butadiene	10,000,000	18,234	24,000,000		12,980
	Cyclohexane	10,000,000	27,081	10,757		1509
	Cyclohexanone (Ketone Alcohol)	10,000,000	24,436	10,908		1454
	Gasoline	10,000,000	18,720	9,985		1638
	Hexamethylenediamine	10,000,000	12,200	10,000,000		9695
	Propylene	10,000,000	14,264	24,000,000		12,980
Natural Gas Transmission Pipelines	Natural Gas (methane)[a]	[a]	[a]	[a]	At least 2,237	[a]

(a) Unconfined deflagration of methane gives less than 1 psi overpressure at the release point.

Table 2.2-11 (Sheet 1 of 2)
Design-Basis Events — Flammable Vapor Clouds (Delayed Ignition) and Vapor Cloud Explosions

Source	Material Evaluated	Release Model	Quantity (lbm)	Puddle Area (m^2)	Distance to Power Block Area Boundary (feet)	Distance to LFL (ft)	Distance to 1-psi (ft)
U.S. Highway 77	Acetylene	gas; instant	339	NA	2,950	834	1,092
	Gasoline	puddle	50,000	3123		429	969
	Hydrogen Sulfide	puddle	50,000	3730		1,266	2,547
	Methanol	puddle	50,000	2882		105	333
	Methyl Cyanide	puddle	50,000	2921		174	531
	Natural Gas	puddle	50,000	5531		414	2,850
	Propane	puddle [(e)]	36,800	3407		1,293	3,237
Railway	1,1-Difluoroethane	puddle	132,000	7,155	20,174	1,560	3,231
	Acetaldehyde	puddle	132,000	13,141		1,959	3,984
	Acetone	puddle	132,000	8,626		1,029	2,109
	Benzene	puddle	132,000	7,030		879	1,797
	Butyraldehyde	puddle	132,000	7,513		729	1,596
	Carbon Bisulphide	puddle	132,000	4,772		1,812	2,853
	Gasoline	puddle	132,000	8,245		747	1,590
	Hexane	puddle	132,000	10,629		1,482	2,982
	Isopropanol	puddle	132,000	7,663		501	1,056
	Methyl Methacrylate Monomer	puddle	132,000	6,384		495	1,074
	n-Butyl Acetate	puddle	132,000	7,502		120	336
	n-Propanol	puddle	132,000	7,476		177	495
	n-Propyl Acetate	puddle	132,000	7,754		486	1,032
	Propane	puddle	132,000	17,115		1,701	4,860
	Propylene Oxide	puddle	132,000	7,274		1,725	3,339
	p-xylene	puddle	132,000	7,079		117	333
	Toulene	puddle	132,000	7,757		519	1,125
	Vinyl Acetate	puddle	132,000	7,475		744	1,557
	Vinyl Chloride	puddle	132,000	8,622		1,647	3,690

Table 2.2-11 (Sheet 2 of 2)
Design-Basis Events — Flammable Vapor Clouds (Delayed Ignition) and Vapor Cloud Explosions

Source	Material Evaluated	Release Model	Quantity (lbm)	Puddle Area (m^2)	Distance to Power Block Area Boundary (feet)	Distance to LFL (ft)	Distance to 1-psi (ft)
Victoria Barge Canal	Acetone	puddle	(a)	31,400	26,020	2,100	4,071
	Acetone Cyanohydrin	puddle	(a)	31,400		(b)	(b)
	Acrylonitrile (Vinyl cyanide)	puddle	(a)	31,400		1,893	3,723
	Butadiene	puddle	(a)	31,400		3,444	7,392
	Cyclohexane	puddle	(a)	31,400		2,679	5,277
	Cyclohexanone (Ketone Alcohol)	puddle	(a)	31,400		1,326	2,586[c]
	Gasoline	puddle	(a)	31,400		2,598	5,082
	Propylene	puddle	(a)	31,400		2,868	7,392
Natural Gas Transmission Pipelines	Natural Gas (methane)[d]	(d)	(d)	Not Applicable	At least 2,237	(d)	(d)

(a) ALOHA release is limited by evaporation from a maximum 31,400 m^2 surface area with a puddle mass of 242 tons.
(b) Evaporation rate insufficient to create LFL, therefore the plume is not a flammability risk.
(c) ALOHA identifies that this chemical's ambient saturation concentration is below the lower explosive limit, so explosions are unlikely.
(d) A probabilistic analysis approach is used to demonstrate that the frequency of releases that could lead to hazardous conditions at the power block boundary is less than 10^{-6} events/year.
(e) A sensitivity analysis was done with a 10.7 ft^2 hole for comparison with the puddle release and it was found that the puddle release was the limiting case.

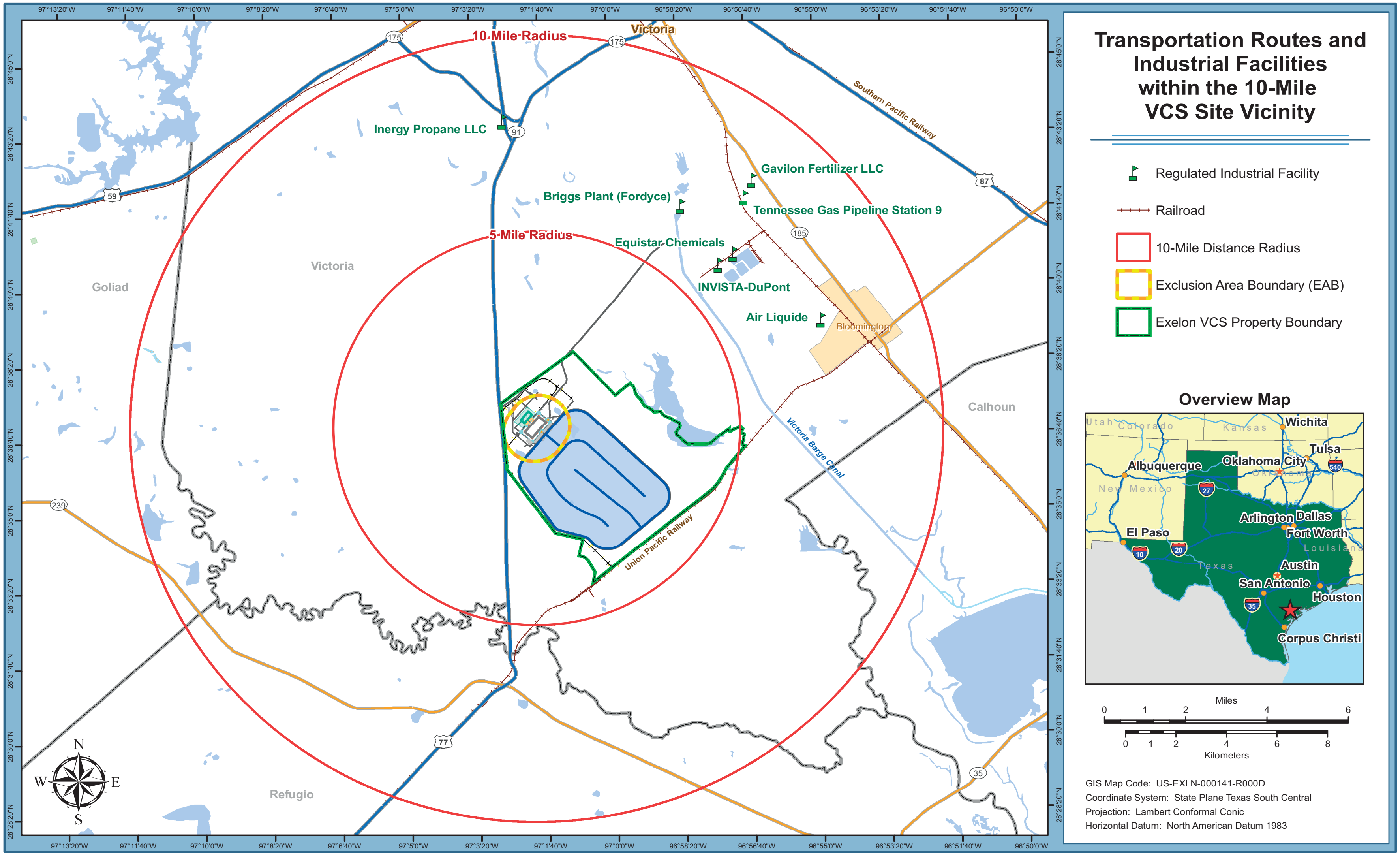

Figure 2.2-1 Transportation Routes and Industrial Facilities in the 10-mile VCS Site Vicinity

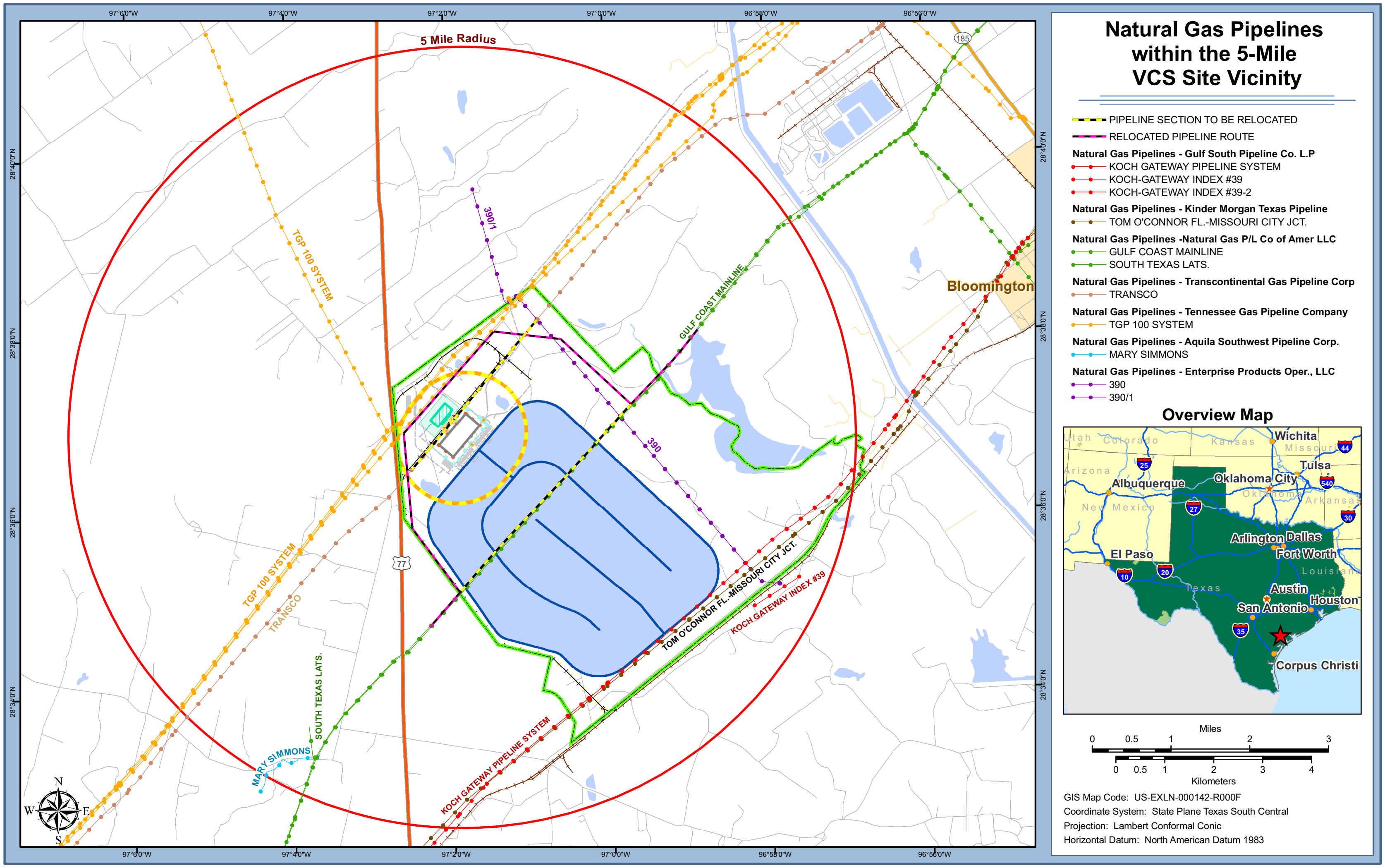

Figure 2.2-2 Natural Gas Transmission Pipelines within the 5-mile VCS Site Vicinity

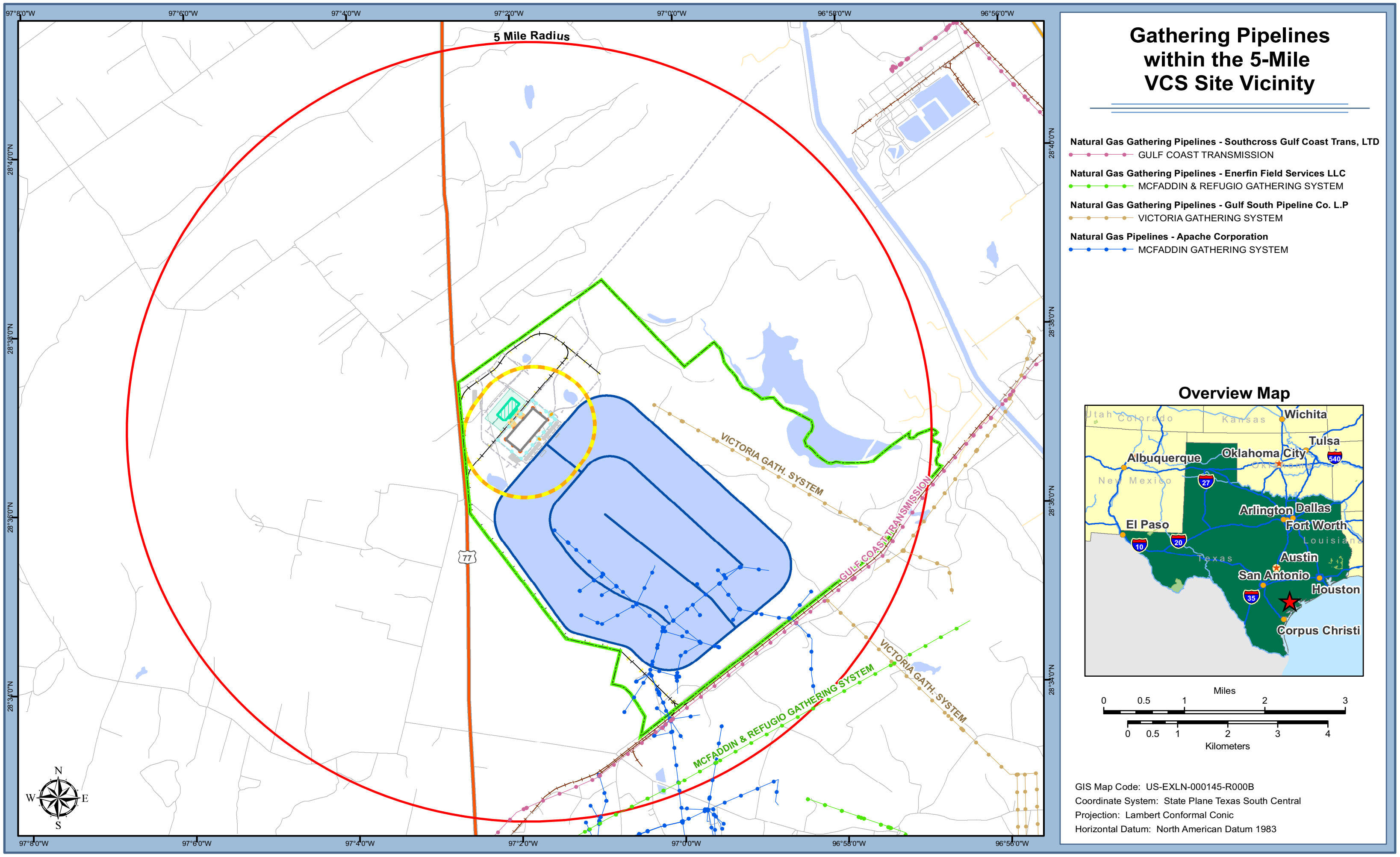

Figure 2.2-3 Natural Gas Gathering Pipelines within the 5-mile VCS Site Vicinity

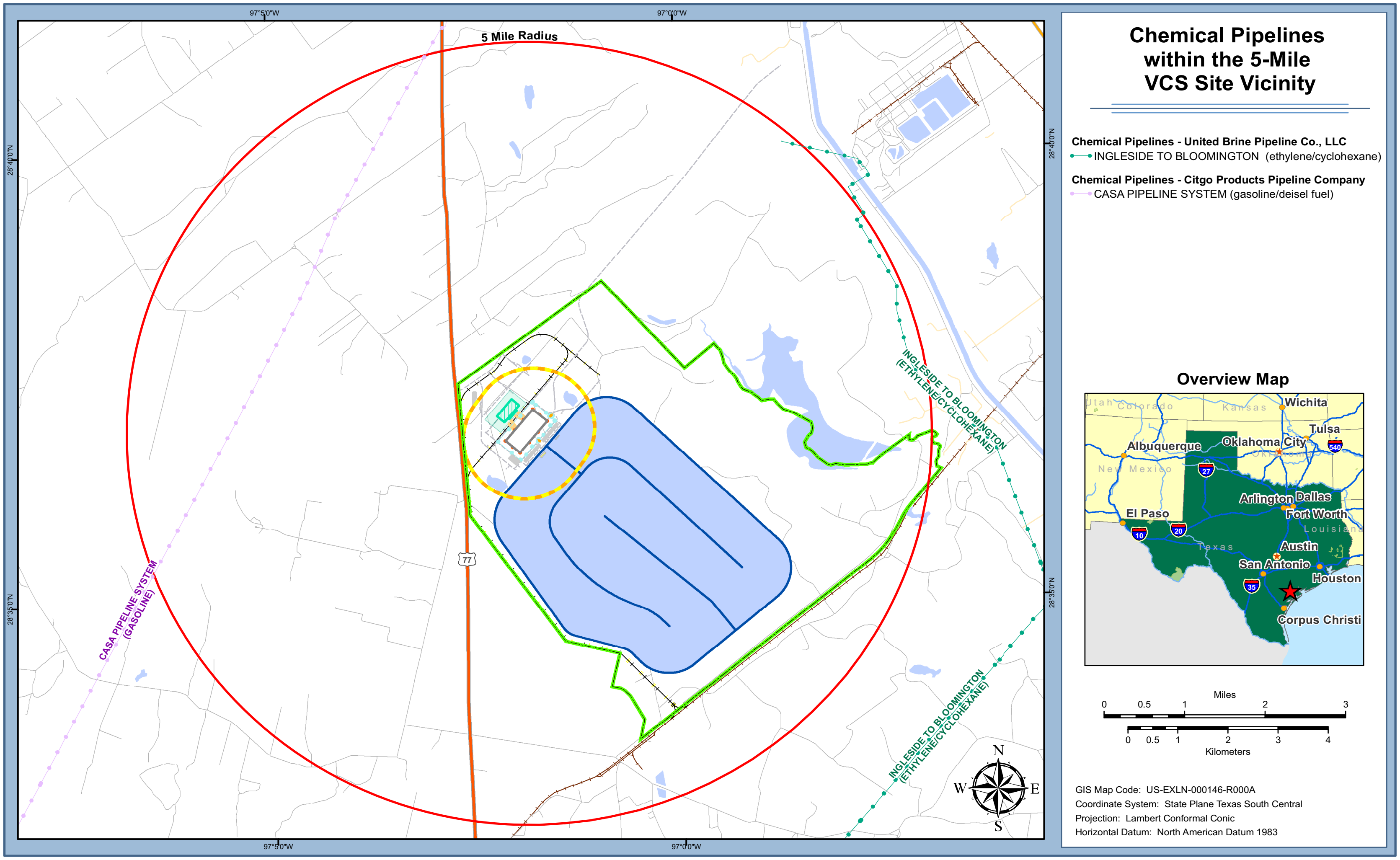

Figure 2.2-4 Chemical Pipelines within the 5-mile VCS Site Vicinity

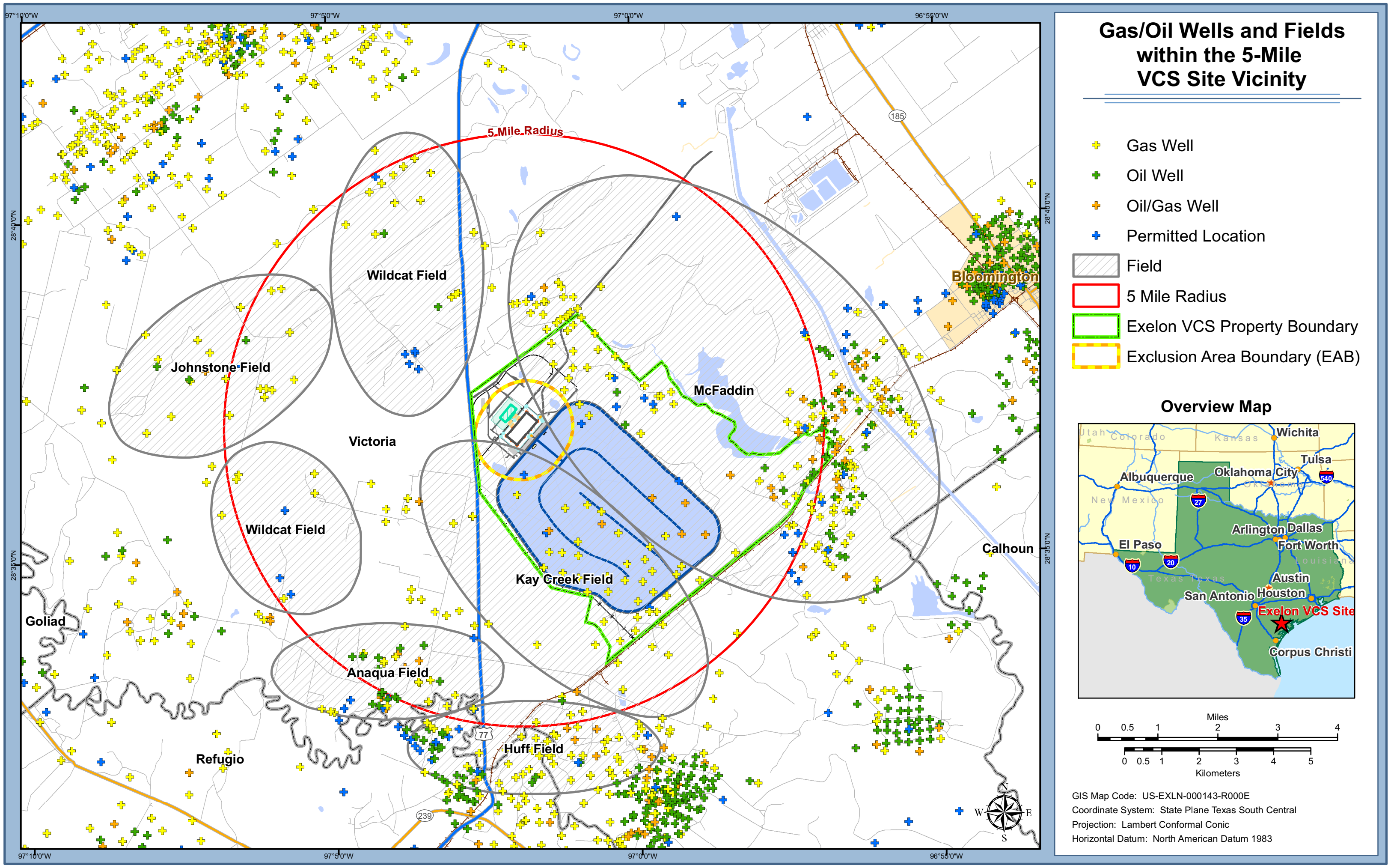

Figure 2.2-5 Gas/Oil Wells and Fields within the 5-mile VCS Site Vicinity

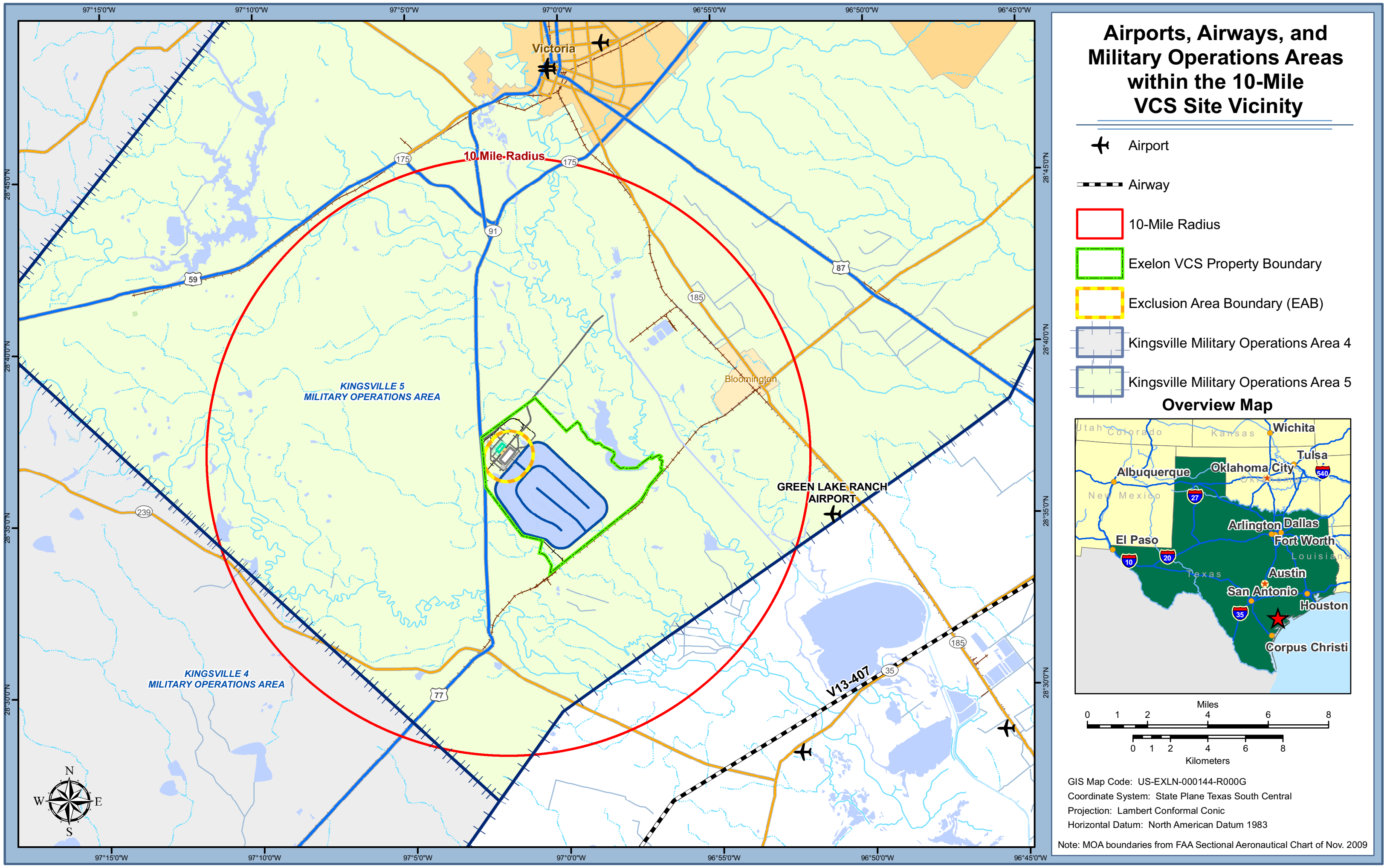

Figure 2.2-6 Airports and Airways within the 10-mile VCS Site Vicinity