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3.1 External Appearance and Plant Layout

3.1.1 Site Description

The Victoria County Station (VCS) will be located on a greenfield site, currently used primarily for cattle ranching. The site is located in Victoria County, approximately 127 miles southwest of Houston, 13.3 miles south of Victoria, Texas, and west of the Guadalupe River. The approximately 11,500 acre site is bounded by Linn Lake to the east, U.S. Highway 77 and Kuy Creek to the west, the Union Pacific railroad (formerly called the Missouri Pacific railroad) to the south, and open fields to the north. The site boundary is shown in Figure 3.1-1.

3.1.2 Power Plant Design

No specific plant design has been chosen for the new units. Instead, a set of bounding plant parameters is presented to envelope VCS site development. The set of plant parameters used in the ER is based on two to twelve power generation units using various reactor technologies. Subsection 3.1.3 provides a description of the set of design parameters and describes its development.

Each unit will represent a portion of the total generation capacity to be provided and may consist of one or more reactor(s) or reactor modules. Each unit will be a stand-alone plant, with its own auxiliary systems and power block structures. These units may share common functions and support structures such as maintenance facilities, office centers, waste processing, water treatment plant, and fire protection system.

Depending on the reactor technology selected, units will be developed in a conventional style as individual large capacity plants or as smaller units with each unit being a modular reactor and power conversion unit.

The reactor thermal power rating varies between 425 MWt for each modular unit up to 4500 MWt for each conventional unit. Up to two conventional advanced LWR units or 12 advanced LWR modular units are envisioned to be placed in the power block area designated for the VCS (see Figure 3.1-2). The VCS site can accommodate construction and operation of 2 conventional units to 12 modular units, configured to a total that can vary from 5100 MWt up to 9000 MWt, with a corresponding gross electrical capacity ranging from 1500 MWe to 3400 MWe.

The power block and common support buildings will be designed to integrate into the overall station design. Each conventional unit will have a single control room and operating staff. The modular units, which are designed to be stand-alone units, are arranged in groups of two units in adjacent buildings. Because of the limited level of information available at this time about mPower technology, it is assumed that each unit will have its own control room; sharing a common control room between two units may be considered later.

Structure height will vary depending upon the reactor technology chosen. As stated in Table 3.1-1, the tallest expected structure for the power plant (excluding plant stacks) will be approximately 230 feet above grade level.

Figure 3.1-2 provides the proposed VCS site layout. Each unit will be provided with a closed-cycle cooling system, sharing a cooling basin with a nominal area of 4900 acres and a normal operating level of 90.5 feet NAVD 88, which would serve as the normal power heat sink for the entire station. The makeup water to the cooling basin will be withdrawn from the Guadalupe River via a new intake canal and raw water makeup (RWMU) intake pumphouse located upstream of the Guadalupe Blanco River Authority (GBRA) saltwater barrier. A 90-inch-diameter pipeline approximately 8.5–11 miles long would be used to deliver the makeup water from the RWMU intake structure to the cooling basin.

The pumphouse will be located on top of an escarpment above the Guadalupe river flood plain that is 0.6 miles south of the Lower Guadalupe River. Water from the river will be diverted to the pumphouse and intake structure by an approximately 3150-foot-long canal and 200-foot-long intake basin. The cooling basin will be contained within an earthen embankment. An access/maintenance road will be constructed along the perimeter of the embankment.

Some technologies require additional cooling equipment for an ultimate heat sink (UHS) or service water systems. The area required for mechanical draft cooling towers, up to 4.8 acres per unit, is small compared to the area required for natural draft cooling towers that are used as the normal power heat sink, instead of a cooling basin, at other sites. Ample area is reserved for these mechanical draft cooling towers, if needed, in the power block area. The height of these mechanical draft cooling towers would be less than 70 feet.

Groundwater from onsite wells will be treated and supplied to the potable water system, water treatment system for makeup water to the power cycle, fire protection system, and other systems, as described in Section 3.3.

Wastewater from nonradiological systems will be treated as needed before being discharged into the cooling basin. The cooling basin blowdown, which is used to maintain the cooling basin water chemistry, will be pumped from the cooling basin through a buried pipe to the Guadalupe River where it will be discharged via a multi-port diffuser.

Figures 3.1-3 through 3.1-7 provide an artist's conception of the VCS, either with two conventional units superimposed on the site or with the power block area identified.

3.1.3 ER Design Parameters

A set of design parameters was developed to characterize the installation of nuclear generating units at the site without defining a reactor technology. The set of design parameters was selected to provide a technical description of plant infrastructure and operational characteristics of sufficient breadth and depth to support the analysis of potential construction and operations impacts in Chapter 4 and Chapter 5, respectively. The values included in Table 3.1-1 for the selected design parameters represent values selected from a survey of various reactor technologies, as described below.

The set of design parameters was developed from reviews of technical data from six designs, based on five technologies of advanced light-water reactors (ALWR):

- Advanced Boiling Water Reactor (ABWR) (GE and Toshiba designs), two units
- Economic Simplified Boiling Water Reactor (ESBWR), two units
- Advanced Pressurized Water Reactor (APWR), two units
- Advanced Passive Pressurized Water Reactor (AP1000), two units
- mPower (Babcock & Wilcox design), twelve units.

This set of design parameters is not intended to limit the ESP to these designs, but rather to provide a broad overall outline of a design concept and to allow other potential designs to be included if they can be demonstrated to fall within these parameter values.

The ER design parameters and site characteristics are presented in Table 3.1-1. The values presented in Table 3.1-1 are for one unit, but apply to two or more units, unless otherwise noted. Bracketed numbers represent the value for all units. This table contains the site characteristic and design parameter values used for assessing the environmental impacts of constructing and operating nuclear power plants at the proposed VCS site. They have been established by analyses presented throughout the ER.

3.1.4 Plant Appearance

The reactor technology that will be constructed at the site has not been selected; therefore, a general arrangement of the site is not presented in Figure 3.1-2. The "Power Block Area" identified in Figure 3.1-2 designates the area that would be needed for future reactor construction at the VCS site.

The units at the VCS site will be designed to emphasize the power-unit concept. The units, along with their support structures, will be kept separate from each other. Each unit will have its own control room and structures but could share radwaste and other waste handling facilities. Paved site roadways will connect the units to provide routine and nonroutine access to entire plant areas with minimal disturbance of the area.

Where possible, building lines will be blended to minimize the visual effect and reduce the multiple unit visual images. This visual effect will be accomplished by connecting turbine and support buildings and blending multiple structures together where possible. A separate control area for each unit will be used to further enhance the single unit concept. The use of common and shared nonsafety-related support systems will reduce the number of ancillary buildings and connecting structures.

The power block area will be located on the northwest side of the site where the existing grade is at approximate elevation 80 feet NAVD 88. To the southeast of the power block area will be the cooling basin, which has a nominal surface area of 4900 acres at the normal operating water level of 90.5 feet NAVD 88. The majority of the embankment around the cooling basin will be approximately at elevation 102 feet NAVD 88.The minimum finished site grade elevation of the power block area will be at 95 feet NAVD 88 as shown in Figure 3.1-1.

Construction of units could occur in a single time frame (back to back) or could be separated by a significant amount of time. In the event of a time separation, efforts will be made to landscape and plant the unused portion of the site to control erosion and restore those disturbed areas to green space.

The VCS buildings will be constructed of concrete, structural steel with metal siding, or other acceptable material. The colors of the plant will be selected to be aesthetically compatible with the surrounding environment. The landscaping design for the site areas adjacent to the structures, including parking areas, will be compatible with the natural surroundings at the plant location.

3.1.5 **Site Development and Improvements**

Site access is provided from U.S. Highway 77 on the west side of the site. U.S. Highway 77 is an existing four-lane divided highway. Turn and merge lanes from U.S. Highway 77 will be constructed at the main entrance for the plant. The plant heavy haul road depicted in Figures 3.1-1 and 3.1-2 will be connected to the Victoria County Navigation District (VCND) transportation corridor, as described in Section 4.7, "Cumulative Impacts."

A 4900 acre (nominal) cooling basin will be constructed, including intake and outfall structures, to provide the normal power heat sink for the circulating water system for all units.The makeup water to the VCS cooling basin would be provided by an RWMU pumphouse and intake structure located approximately 8 miles southeast of the VCS cooling basin and approximately 1.5 miles northwest of State Highway 35 in Refugio County.

As mentioned above, some technologies may require mechanical draft cooling towers to remove the heat from safety-related systems (Ultimate Heat Sink – UHS) by spraying the water into a forced air or induced air stream. Other technologies may require nonsafety-related mechanical draft cooling towers to cool the service water used for other components located mainly in the reactor, control, and turbine buildings. The cooling requirements for such water systems will be small when compared to the normal heat rejection requirements of the circulating water system. These cooling towers will be located close to the power blocks. Operation of the cooling fans in the towers will create an audible noise. By using standard design techniques, the noise contribution from the mechanical draft cooling tower systems will not exceed 65 dBA at 400 feet away.

Temporary facilities provided during construction of the units are shown in Figure 3.1-8. The total land area to be developed, excluding the makeup water pump house area, can be seen in Figure 3.1-9.

After construction is complete, areas used for construction support will be landscaped as appropriate to match the overall site aesthetic appearance. Previously forested areas beyond applicable setbacks and rights-of-way will be revegetated, as necessary. Additionally, certain topographical features created during construction, including equipment laydown and fabrication areas, areas around completed structures, and construction parking that is not required following the completion of construction, will be contoured to match the surrounding areas. The interim plantings will consist of not less than grass seeding with a mix appropriate for the area.

Table 3.1-1 (Sheet 1 of 6)
Site Characteristics and Site-Related Design Parameters

Part 1 — Site Characteristics			
Item	**Site-Specific Value[a]**	**Description**	**References**
Maximum Groundwater Level	85.0 feet NAVD 88	The maximum groundwater level under the power block area.	Refer to Subsection 2.3.1.
Atmospheric Dispersion (X/Q) (Accident)		Atmospheric dispersion coefficients used in the environmental report to estimate dose consequences of accident airborne releases.	Refer to Subsection 2.7.5 and Section 7.1.
• 0–2 hr @ EAB	8.85×10^{-5} sec/ m^3		
• 0–8 hr @ LPZ	5.30×10^{-6} sec/ m^3		
• 8–24 hr @ LPZ	3.92×10^{-6} sec/ m^3		
• 1–4 day @ LPZ	2.05×10^{-6} sec/ m^3		
• 4–30 day @ LPZ	8.05×10^{-7} sec/ m^3		
Atmospheric Dispersion (X/Q) (Annual Average)	1.8×10^{-5} sec/m^3	Maximum annual average atmospheric dispersion coefficient at the EAB.	Refer to Subsection 2.7.6.2.
Dose Consequences (Gaseous Releases)			
• Normal	10 CFR 20, 10 CFR 50 Appendix I Meets requirement	The estimated design radiological dose consequences due to gaseous releases from normal operation of the plant.	Refer to Sections 4.5 and 5.4.
• Post-Accident	10 CFR 50.34(a)(1), 10 CFR 100 Meets requirement	The estimated design radiological dose consequences due to gaseous releases from postulated accidents.	Refer to Section 7.1.
• Severe Accidents	25 rem whole body in 24 hours at 0.5 miles; $<1 \times 10^{-6}$/reactor-year Meets requirement	The estimated design radiological dose consequences due to gaseous releases from postulated accidents.	Refer to Section 7.2.
Release Point (Gaseous Releases)			
• Minimum Distance to the Site Boundary	3274 feet	Minimum lateral distance from the release point to the site boundary.	Refer to Section 2.7.
Dose Consequences (Liquid Releases)			
• Normal	10 CFR 20 Appendix B, 10 CFR 50 Appendix I Meets requirement	The estimated design radiological dose consequences due to liquid effluent releases from normal operation of the plant.	Refer to Sections 4.5 and 5.4.
• Post-Accident	10 CFR 20, 10 CFR 100 Meets requirement	The estimated design radiological dose consequences due to liquid effluent releases from postulated accidents.	Refer to Section 7.2.
Exclusion Area Boundary (EAB)	10 CFR 100.21(a) Meets requirement	The perimeter of an oval, 9000 feet in the plant east-west direction, and 8000 feet in the plant north-south direction.	Refer to Section 2.1.
Low Population Zone (LPZ)	10 CFR 100.21(a) Meets requirement	A 5-mile radius circle centered at the power block area reference point.	Refer to Section 2.1
Population Center Distance	10 CFR 100.21(b) Meets requirement	The distance from the power block area to the nearest boundary of a population center containing more than 25,000 residents. This distance should not be less than 1.33 times the distance from the power block area to the outer boundary of the LPZ (i.e., 6.7 miles for VCS).	Refer to 2.5.1.2

Table 3.1-1 (Sheet 2 of 6)
Site Characteristics and Site-Related Design Parameters

Part 2 — Site-Related Design Parameters			
Item	**Bounding Value[(a)]**	**Description**	**References**
Structure Height	230 feet	The height from finished grade to the top of the tallest power block structure, excluding stacks and cooling towers.	Refer to Subsections 3.1.2, 3.1.3, and 3.1.4.
Structure Foundation Embedment	110 feet	The depth from finished grade to the bottom of the basemat for the most deeply embedded power block structure.	Refer to Subsections 4.2.1.2, 4.2.1.3, 4.6.3.7, and 6.3.2.3.
Normal Plant Heat Sink			
• Maximum Inlet Temperature Condenser/ Heat Exchanger	100˚F	Design assumption for the maximum acceptable circulating water temperature at the inlet to the condenser or cooling water system heat exchangers.	Refer to Section 3.4
• Condenser/Heat Exchanger Duty	10.03×10^9 Btu/hour [20.06×10^9 Btu/hour]	Design value for the waste heat rejected to the circulating water and service water systems.	Refer to Section 3.4.
• Maximum Cooling Water Flow Rate Across Condenser	1,280,000 gpm [2,560,000 gpm]	Design value for the maximum flow rate of the circulating water system through the condenser tubes.	Refer to Section 3.4.
• Cooling Basin			
Acreage	[4900 acres]	Nominal cooling basin water surface area at normal operating level of 90.5 feet NAVD 88.	Refer to Subsections 3.1.2 and 3.1.5 and Section 3.4.
Blowdown Constituents and Concentration	Table 3.6-1	The maximum expected concentrations of constituents in the blowdown stream from the cooling basin.	
Blowdown Flow Rate	[≤6500 gpm normal] [≤40,000 gpm maximum]	The normal and maximum flow rate of the blowdown stream from the cooling basin to the Guadalupe River.	Refer to Sections 3.3 and 3.4.
Blowdown Temperature	≤100˚F	The maximum expected blowdown temperature at the point of discharge to the Guadalupe River.	
Cycles of Concentration	Approximately 4.0 Cycles of Concentration	The ratio of total dissolved solids in the cooling basin blowdown stream to the total dissolved solids in the Guadalupe River.	Refer to Section 3.6 and Subsection 5.3.2
Evaporation Rate	[39,030 gpm expected] [60,440 gpm maximum]	The expected and maximum monthly rate at which water is lost by evaporation from the cooling basin. The expected value is the long-term average value based on a station capacity factor of 96%. The maximum value is based on 100% full station load.	Refer to Section 3.3.
Makeup Flow Rate	[217 cubic feet/second (97,396 gpm)]	The maximum rate of removal of water from the Guadalupe River to replace water losses from the cooling basin.	Refer to Sections 3.3 and 3.4.
Stored Water Volume	[108,500 acre-feet at normal maximum operating water level of 91.5 feet NAVD 88] [103,600 acre-feet at design basin level of 90.5 feet NAVD 88]	The quantity of water stored in the cooling basin.	Refer to Section 3.4.

Table 3.1-1 (Sheet 3 of 6)
Site Characteristics and Site-Related Design Parameters

Part 2 — Site-Related Design Parameters			
Item	**Bounding Value[(a)]**	**Description**	**References**
• Cooling Basin (Con't)			
Temperature Range	18˚F for 1,100,000 gpm/unit circulating water flow rate	The CWS temperature difference between the cooling water entering and leaving the cooling basin (main condenser temperature rise).	Refer to Section 3.4
Consumption of Raw Water	[46,000 gpm normal] [68,300 gpm maximum]	The normal and maximum short-term consumptive use of water by the cooling water systems.	Refer to Sections 3.3 and 3.4.
UHS and/or Plant Service Water Mechanical Draft Cooling Towers			
• Cycles of Concentration	1.19	The ratio of total dissolved solids in the UHS/service water system blowdown streams to the total dissolved solids in the make-up water streams.	Refer to Section 5.3
• Evaporation Rate			
Normal	620 gpm [1240 gpm]	The maximum rate at which water is lost by evaporation from the mechanical draft cooling towers during normal operations.	Refer to Sections 3.3 and 3.4.
Accident	1061 gpm	The maximum rate at which water is lost by evaporation from the mechanical draft cooling towers during accident conditions.	Refer to Sections 3.3 and 3.4.
• Cooling Tower Deck Height	37 feet	The height of the mechanical draft cooling tower deck above grade.	Refer to Subsection 3.1.2.
• Exhaust Stack Height	29 feet	The height of the exhaust stack above the mechanical draft cooling tower deck.	Refer to Subsection 3.1.2.
• Makeup Flow Rate			
Normal	Included in cooling basin makeup	The maximum rate of removal of water from a natural source to replace water losses from the safety-related and nonsafety-related service water systems during normal operations.	Refer to Sections 3.3 and 3.4.
Accident	0 gpm	The maximum rate of removal of water from a natural source to replace water losses from the safety-related and nonsafety-related service water systems during accident conditions.	Refer to Sections 3.3 and 3.4.
• Noise	≤65 dBA at 400 feet	The maximum expected sound level produced by operation of mechanical draft cooling towers.	Refer to Subsection 3.1.5.
• Cooling Tower Temperature Range	33 ˚F	The temperature difference between the cooling water entering and leaving the safety-related and nonsafety-related service water systems.	Refer to Section 3.4.
• Cooling Water Flow Rate			
Normal	40,000 gpm [80,000 gpm]	The total cooling water flow rate through the safety-related and nonsafety-related service water systems during normal operations.	Refer to Section 3.4.

Table 3.1-1 (Sheet 4 of 6)
Site Characteristics and Site-Related Design Parameters

Part 2 — Site-Related Design Parameters			
Item	**Bounding Value**[(a)]	**Description**	**References**
• Cooling Water Flow Rate (Con't)			
Accident	60,000 gpm	The total cooling water flow rate through the safety-related and nonsafety-related service water systems during abnormal conditions.	Refer to Section 3.4.
• Heat Rejection Rate			
Normal	1.22×10^8 Btu/hour [2.44×10^8 Btu/hour]	The maximum expected heat rejection rate to the atmosphere during normal operations.	Refer to Section 3.4.
Accident	4.72×10^8 Btu/hour	The maximum expected heat rejection rate to the atmosphere during accident conditions.	Refer to Section 3.4.
• Maximum Consumption of Raw Water	1061 gpm [2122 gpm]	The expected maximum short-term consumptive use of water by the safety-related and nonsafety-related service water systems (evaporation).	Refer to Sections 3.3 and 3.4.
• Normal Consumption of Raw Water		The expected normal operating consumption of water by the safety-related and nonsafety-related service water systems (evaporation and drift losses).	Refer to Sections 3.3 and 3.4.
Evaporation	620 gpm [1240 gpm]		
Drift	Negligible (less than 0.005%)		Refer to Subsection 5.3.3.
• Stored Water Volume	30.6×10^6 gallons [61.2×10^6 gallons]	The quantity of water stored in mechanical draft cooling tower impoundments, basins, tanks, and/or ponds.	Refer to Section 3.4.
Potable Water/Sanitary Waste System			
• Flow Rate – Potable Water			
Normal	N/A	The expected effluent flow rate from the potable water system to the cooling basin.	Refer to Section 3.3.
Maximum	N/A	The maximum effluent flow rate from the potable water system to the cooling basin.	Refer to Section 3.3.
• Flow Rate – Sanitary Waste			
Normal	[100 gpm]	The expected effluent flow rate from the sanitary wastewater system to the cooling basin.	Refer to Section 3.3.
Maximum	[200 gpm]	The maximum effluent flow rate from the sanitary wastewater system to the cooling basin.	Refer to Section 3.3.

Table 3.1-1 (Sheet 5 of 6)
Site Characteristics and Site-Related Design Parameters

Part 2 — Site-Related Design Parameters			
Item	**Bounding Value[(a)]**	**Description**	**References**
Potable Water/Sanitary Waste System (cont.)			
• Raw Water Usage			
Maximum	[211 gpm]	The maximum short-term rate of withdrawal from groundwater for the potable water system.	Refer to Section 3.3.
Monthly Average	[105 gpm]	The average rate of withdrawal from groundwater for the potable water system.	Refer to Section 3.3.
Demineralized Water System			
• Raw Water Usage			
Maximum	[789 gpm]	The maximum short-term rate of withdrawal from groundwater for the demineralized water system.	Refer to Section 3.3.
Monthly Average	[316 gpm]	The average rate of withdrawal from groundwater for the demineralized water system.	Refer to Section 3.3.
Fire Protection System			
• Raw Water Usage			
Maximum	[1200 gpm]	The maximum short-term rate of withdrawal from well water for the fire protection system.	Refer to Section 3.3.
Monthly Average	Negligible	The average rate of withdrawal from filtered well water for the fire protection system.	Refer to Section 3.3.
Miscellaneous Drains			
• Flow Rate			
Normal	[40 gpm]	The normal effluent flow from the miscellaneous equipment drains/floor washdown into the cooling basin.	Refer to Section 3.3.
Maximum	[50 gpm]	The maximum effluent flow from the miscellaneous drains into the cooling basin.	Refer to Section 3.3.
Solid Radwaste Volume	16,722 cubic feet/year wet/dry generation (one unit)	The expected volume of solid radioactive wastes generated during routing plant operations.	Refer to Subsection 3.5.4
Auxiliary Boiler System Flue Gas Effluents	Table 3.6-4	The expected combustion products and anticipated quantities released to the environment due to the operation of the auxiliary boilers.	Refer to Table 3.6-4.
Standby Diesel Generator Flue Gas Effluents	Table 3.6-2	The expected combustion products and anticipated quantities released to the environment due to the operation of the emergency standby diesel generators.	Refer to Table 3.6-2.
Combustion Turbine Flue Gas Effluents	Table 3.6-3	The expected combustion products and anticipated quantities released to the environment due to the operation of the emergency standby combustion turbine generators.	Refer to Table 3.6-3.

Table 3.1-1 (Sheet 6 of 6)
Site Characteristics and Site-Related Design Parameters

Part 2 — Site-Related Design Parameters			
Item	**Bounding Value[(a)]**	**Description**	**References**
Release Point (Liquid Releases)			
• Flow Rate	17 gpm to 260 gpm	The discharge of liquid potentially radioactive effluent streams from plant systems to the Guadalupe River.	Refer to Section 3.3.
Source Term (Liquid Releases)			
• Normal	Table 3.5-1	The annual activity, by isotope, contained in routine plant liquid effluent streams.	Refer to Table 3.5-1.
Source Term (Gaseous Releases)			
• Normal	Table 3.5-2	The annual activity, by isotope, contained in routine plant airborne effluent streams.	Refer to Table 3.5-2.
Release Point Elevation	Ground Level	The elevation above finished grade of the release point for routine operational and accident sequence releases.	
Plant Megawatts Thermal	425 MWt to 4500 MWt [5100 MWt to 9000 MWt]	The thermal power generated by one unit.	Refer to Subsection 3.1.2 and Section 3.2.
Plant Megawatts Electrical	125 MWe to 1700 MWe [1500 MWe to 3400 MWe]	The expected gross electrical output of one unit.	Refer to Subsection 3.1.2 and Sections 3.2 and 3.8.
Plant Population			
• Operation	[800]	The number of people required to operate and maintain the plant.	Refer to Section 5.8.
• Refueling/Major Maintenance	[1750]	The additional number of temporary staff required to conduct refueling and major maintenance activities.	Refer to Section 5.8.
• Construction	6300	Peak employment during construction.	Refer to Section 4.4.
Station Capacity Factor	96.0%	The ratio of the actual output of the plant over a period of time and its output if it had operated at full nameplate capacity over the same period.	Refer to Section 3.4
Plant Operating Cycle	18 to 24 months	The normal plant operating cycle length.	Refer to Section 3.8.
Permanently Disturbed Acreage	Approximately 6354 acres	Approximate area within the VCS site that would be permanently dedicated to the reactors and their supporting facilities.	Refer to Subsection 4.1.1.1 and Table 4.1-1
Fuel			
• Maximum Average Assembly Burnup	62,000 MWD/MTU	Maximum average assembly burnup at end of assembly life.	Refer to Section 5.7.
• Maximum Average Discharge Batch Burnup	62,000 MWD/MTU	Maximum average discharge batch burnup.	Refer to Subsection 3.2.1 and Section 5.7.
• Maximum Fuel Enrichment	5%	Concentration of U-235 in fuel.	Refer to Subsection 3.2.1

(a) Values shown are for a single unit, but would be the same value for each additional unit, unless a second bracketed number is provided. If a second bracketed number is provided, the first number represents the value for one unit and the bracketed number represents the value for two units.

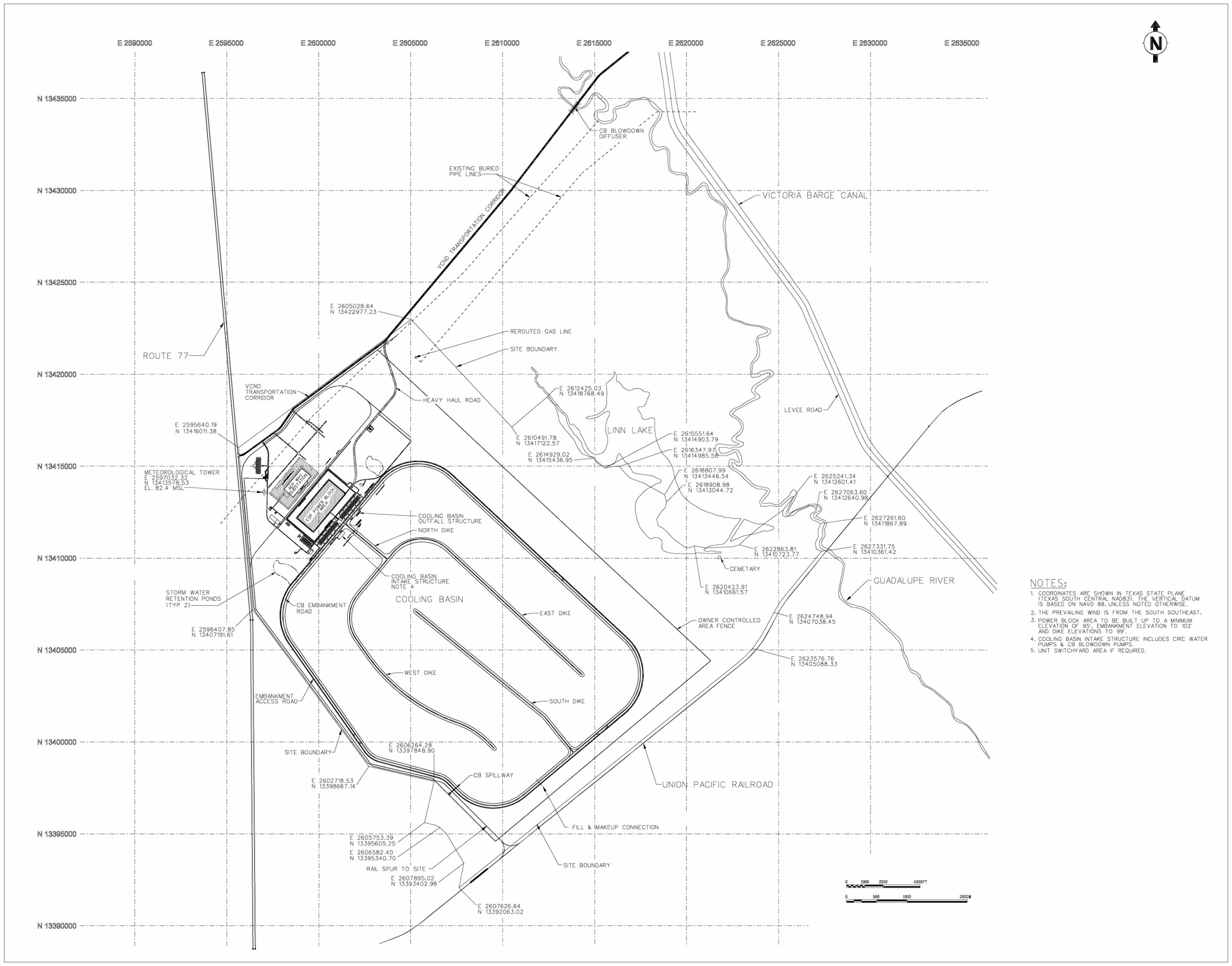


Figure 3.1-1 VCS Site Layout

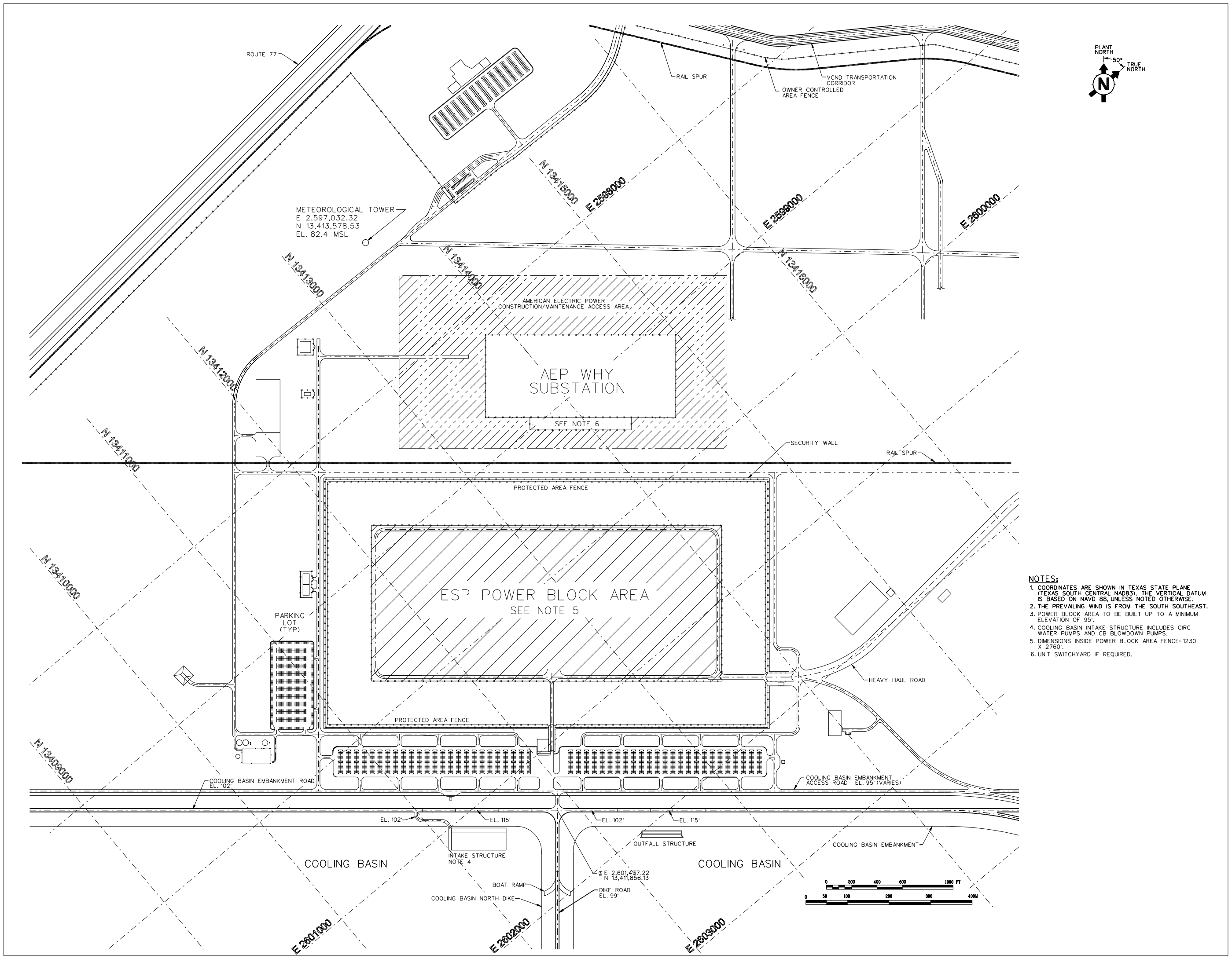


Figure 3.1-2 VCS Power Block Area

Figure 3.1-3 VCS (2 Units) Superimposed on Site Picture (Typical)

Figure 3.1-4 Architectural Rendering with Landscaping (Typical) for VCS (2 Units)

Figure 3.1-5 VCS (2 Units) Superimposed on Site Picture Looking Southwest (Typical)

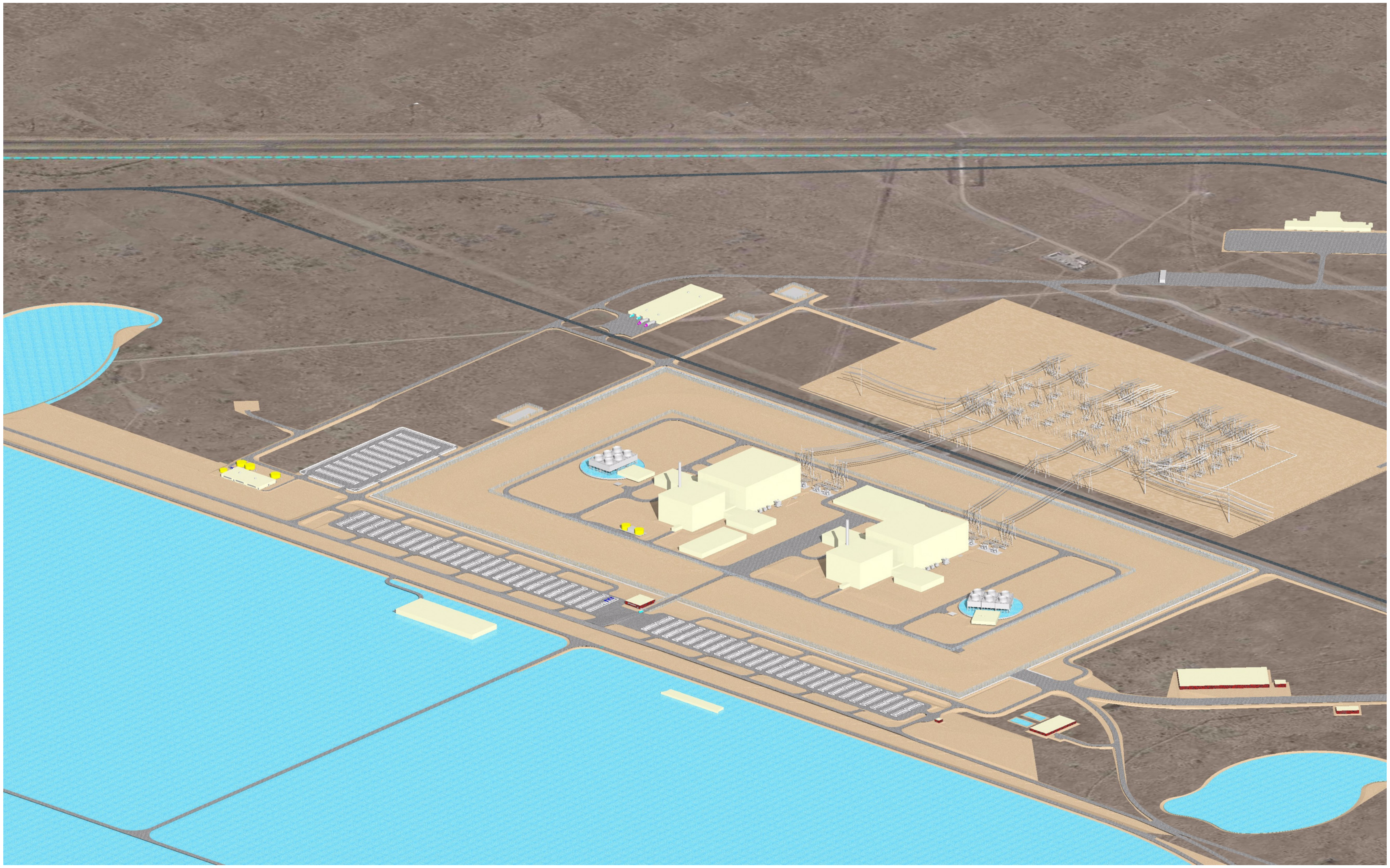


Figure 3.1-6 VCS (2 Units) Superimposed on Site Picture Looking West (Typical)

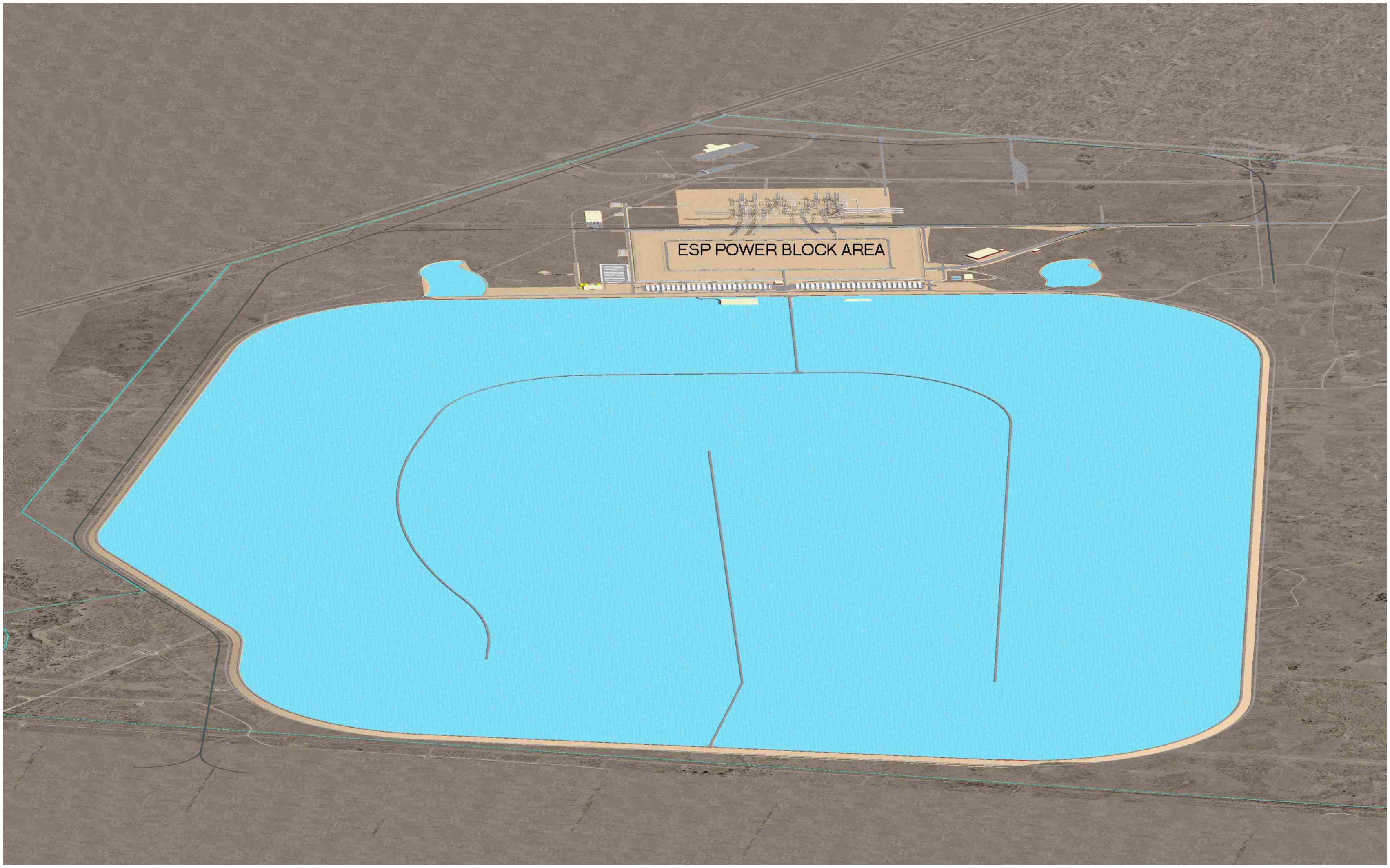


Figure 3.1-7 Station Superimposed on Site Picture Looking Northwest (Typical)

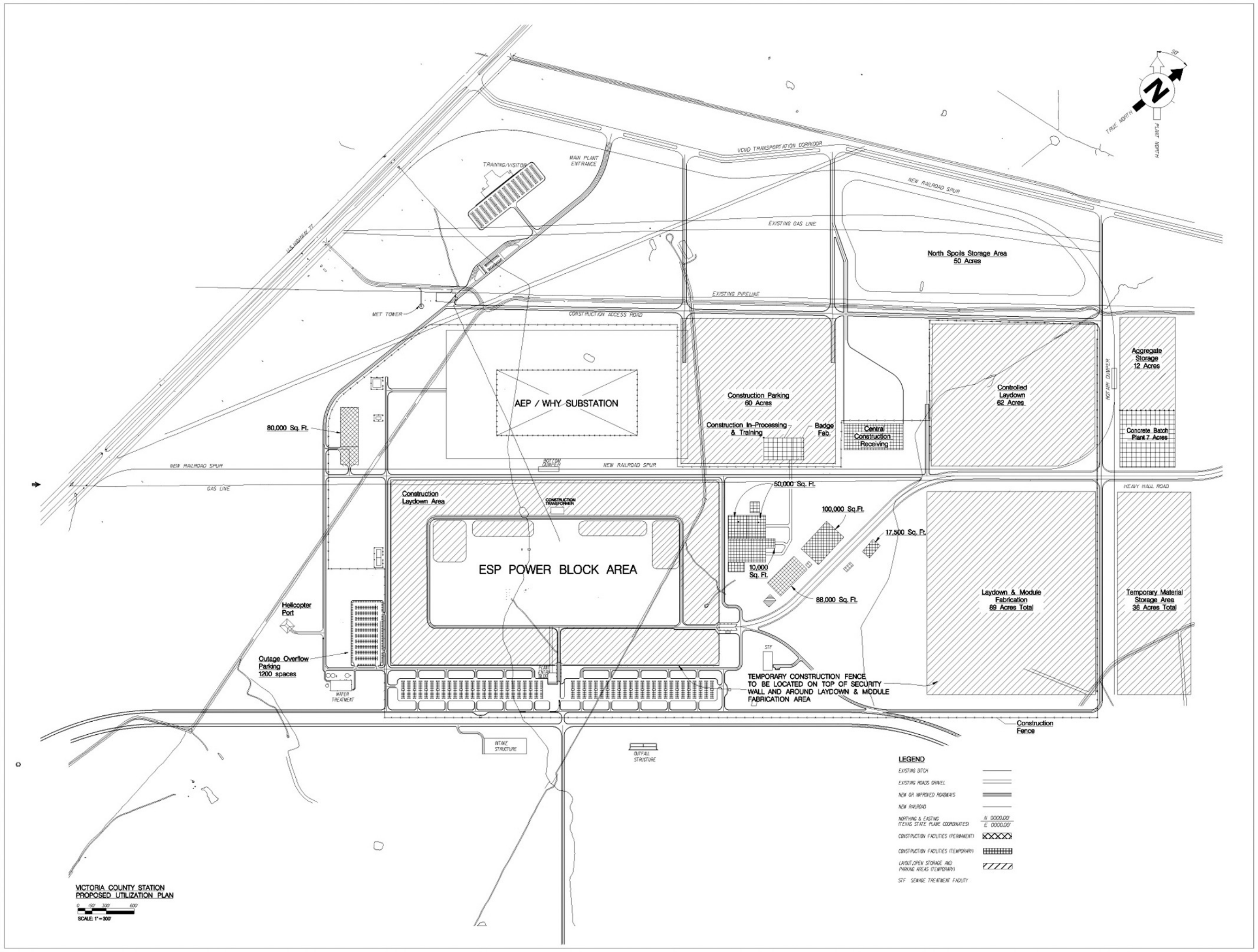


Figure 3.1-8 Temporary Facilities During Construction (Typical)

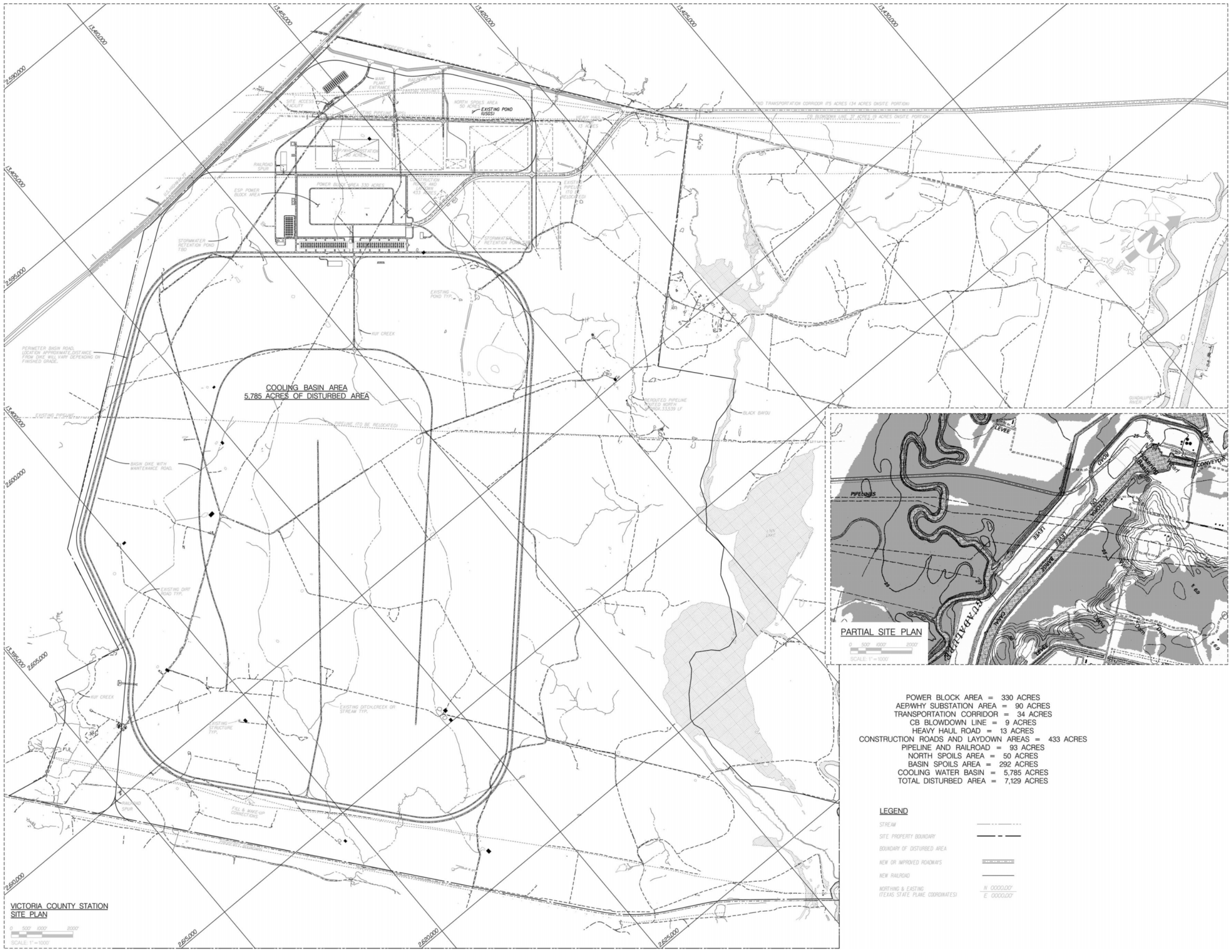


Figure 3.1-9 Total Land to be Developed

3.2 Reactor Power Conversion System

Steam generated by the nuclear steam supply system (NSSS) of each unit flows through the steam turbine creating rotational mechanical work, which in turn rotates the electric generator to produce electricity. Figure 3.2-1 is a simplified (typical) flow diagram for the reactor power conversion system.

For the VCS site, the selection of the reactor and power conversion system has not been made. In its place, a detailed set of site characteristics and design parameters was developed to describe the maximum potential impacts. This set of site characteristics and design parameters is described in Section 3.1. The technologies considered for the ESP application are based on the following advanced light-water reactors (ALWR):

- Advanced Boiling Water Reactor (ABWR)
- Economic Simplified Boiling Water Reactor (ESBWR)
- Advanced Pressurized Water Reactor (APWR)
- Advanced Passive Pressurized Water Reactor (AP1000)
- mPower (Babcock & Wilcox design)

The site has a potential for development of up to 1500 MWe gross, with twelve units of the modular mPower design, or up to approximately 3400 MWe (gross), with two units (power blocks) of the other technologies, dependent on the selected technology. Each unit is powered by one reactor.

3.2.1 Reactor Description

The VCS site has been designed to allow incremental addition of new units. Since the number of units could vary from 1 to 12, the unit arrangement will be developed as part of the COL application for the selected technology. Figure 3.1-2 shows the location for the new units. The space allocated for construction is sized to allow construction of up to 2 conventional advanced LWR units or 12 modular units, depending on the selected technology.

The size of the reactor, based on the technologies considered, varies from 425 MWt up to 4500 MWt for each unit. The reactor and associated turbines and power conversion equipment would allow generation of a gross electrical output per unit of 125 MWe up to 1700 MWe, depending on the condenser design (series or parallel configuration). Since the auxiliary loads vary for each technology and even for the same technology based on the design features, the net output would be determined at the COL stage. All of the proposed reactors use uranium as their fissile material. Enrichment of the uranium would vary based on the reactor type deployed, ranging from 2 percent to 5 percent enriched U-235.The peak fuel rod exposure at end of life varies from 55,000 to 68,000 megawatt-days per metric ton of uranium (MWD/MTU). Maximum average discharged batch burn-up is based on the specific plant design but would be in the range of 46,000 to 60,000 MWD/MTU.

Fuel design and total quantity of uranium is specific to the reactor design selected. The largest core assembly of a single unit contains 1132 fuel assemblies with a total uranium dioxide fuel weight of 184,867 kg.

3.2.2 **Engineered Safety Features**

Depending on the reactor technology selected, a wide range of engineered safety systems could be used. Potential plant designs for the VCS site currently employ both active and passive types of engineered safety features (ESF) systems.

The passive system designs are based on using gravity to move water, and valves are typically actuated by safety-related dc power sources. The active system designs rely on powered components, such as pumps, to move coolant to the needed locations. At the loss of preferred normal and preferred alternate ac power, the active systems are powered by redundant power sources, such as emergency diesel generators or combustion turbine generators.

Some designs rely on a UHS to remove heat from safety-related systems and discharge it to the atmosphere. If required for the design selected, the UHS cooling would be by small mechanical draft cooling towers.

3.2.3 **Power Conversion Systems**

The various designs of light water-cooled reactors use a steam turbine to convert the heat energy to mechanical energy. Waste heat from the turbine condensers would be rejected to a cooling basin which represents the normal power heat sink. The tube material for the condensers has not been selected.

Specific design details about the power conversion system will be provided as part of the COL application, based on the selected technology.

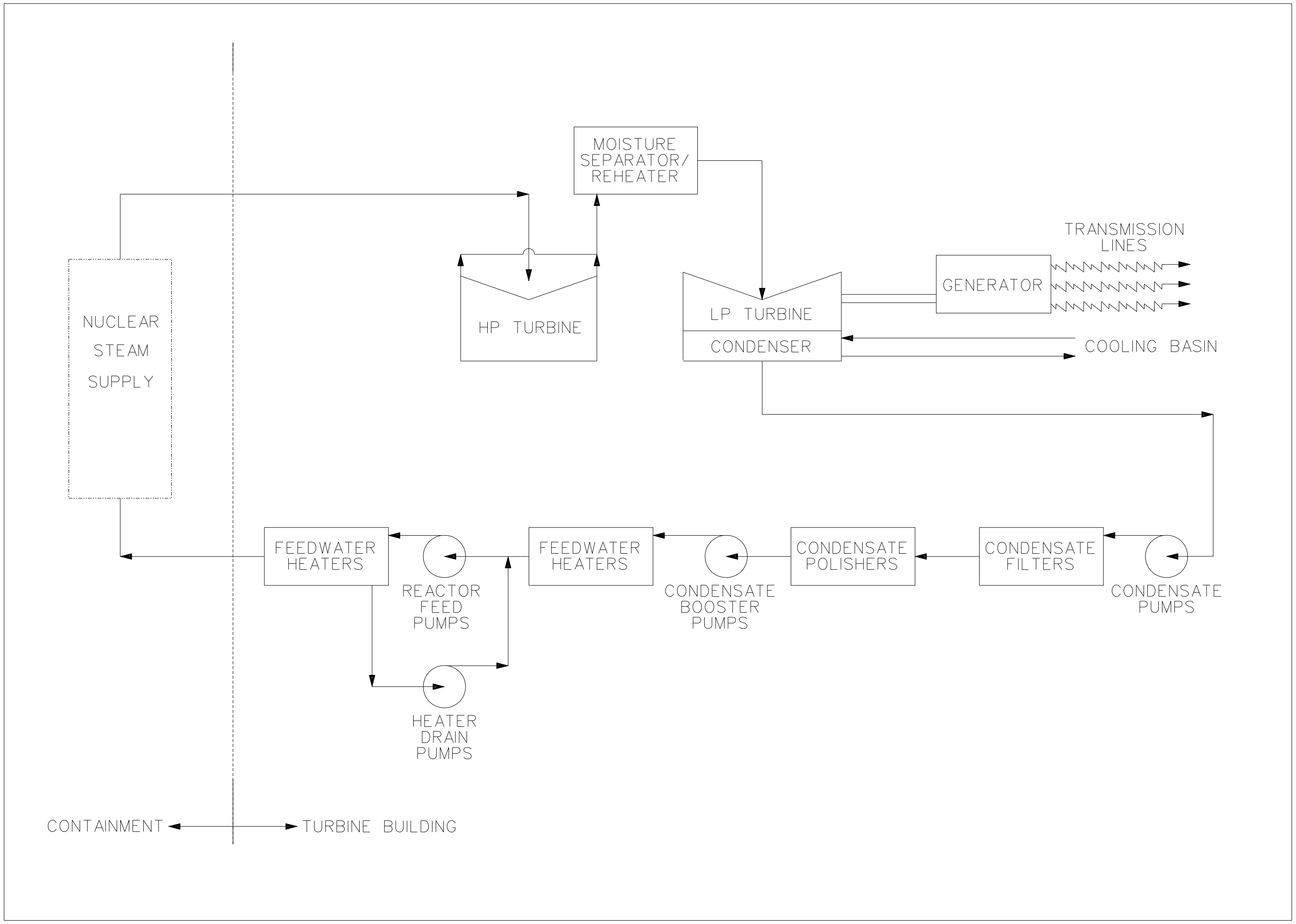


Figure 3.2-1 Simplified Flow Diagram of Power Reactor Conversion

3.3 Plant Water Use

Since no specific design has been selected for the VCS site, plant water use is defined in broad terms, using as a basis the site characteristics and design parameters described in Subsection 3.1.3. This set of site characteristics and design parameters describes a plant design that is intended to accommodate current and future plants by defining the bounding water consumption requirements and is based on representative plant designs.

3.3.1 Water Consumption

Plant water would come from two sources—the Guadalupe River and local wells—depending on the quality of water required and the intended use.

Plant cooling for units at the VCS site would be provided by a closed cycle system with a cooling basin. Some technologies may use mechanical draft cooling towers for additional plant cooling. Makeup water necessary to replace the water lost due to evaporation and seepage would be obtained from the Guadalupe River.

Local wells supply water to systems such as potable water, fire protection, and demineralized water that may require higher water quality than river water.

Figures 3.3-1 and 3.3-2 outline the water use for the units. As stated earlier, the water balance for the units is based on data from the representative plant designs and on site-specific parameters. The evaporation estimate for the cooling basin is based on site-specific data (see Subsections 5.2.1 and 5.2.2).

Hydrological impacts of the arrangement in Figure 3.3-1 and Figure 3.3-2 are provided in Subsection 5.2.1, and water use impacts are provided in Subsection 5.2.2.

3.3.1.1 Plant Water Use

The normal and maximum well water use for the units is shown in Table 3.3-1. This includes water supply for systems such as the potable water system, the demineralized water system, the fire protection system, and to miscellaneous onsite uses. Well water capacity is selected as 1200 gpm. The normal values listed are expected limiting values for normal plant operation. The total normal groundwater usage for the services listed in Table 3.3-1 is 464 gpm. The maximum values are those expected for upset or abnormal conditions. The total maximum groundwater usage for the services listed in Table 3.3-1 is 1053 gpm, not including fire water refill requirements. The demand for well water to meet the NFPA 22 requirement to refill the fire water storage tank within 8 hours after a fire event exceeds 1200 gpm. Because the total demand of well water for normal plant operation, while simultaneously refilling the fire water storage tank, exceeds the well water availability currently being considered, administrative actions to limit well water usage, an increase in the well water capacity, or other alternatives will be considered to meet the refill requirement at the COL stage. Figure 3.3-1 illustrates water requirements for all units. It should be noted that fire protection water consumption maximums are based on system actuation, which is an event-based activity.

The normal and maximum surface water use for the units is shown in Table 3.3-1 including makeup water from the Guadalupe River to the cooling basin. Normal water use is that required to maintain plant normal operation. The maximum values are those expected for abnormal conditions. Figure 3.3-2 illustrates water requirements for all units. Figures 2.2-5 and 3.3-3 show the location of the intake on the Guadalupe River, which is described in more detail in Subsection 3.4.2.1. Makeup from the Guadalupe River to the cooling basin is selected to be a maximum instantaneous rate of 217 cfs (97,396 gpm) but not more than 75,000 acre-feet per year.

3.3.1.2 **Plant Water Releases**

The water release estimates for the units are provided in Table 3.3-1 as well as in Figures 3.3-1 and 3.3-2. These estimates include evaporation and seepage (from both the cooling basin and the mechanical draft cooling towers) and blowdown from the cooling basin. The radiological waste, sanitary waste, miscellaneous drains, and demineralizer discharges are also included. The normal values listed are the expected limiting values for normal plant operation. The maximum values are those expected for upset or abnormal conditions.

Plant discharges, which typically include cooling tower blowdown, sanitary waste discharge, process discharges, and miscellaneous drains are routed to the cooling basin. Water is discharged from the cooling basin via the blowdown line. The cooling basin blowdown line discharges to the Guadalupe River with a maximum design rate of 40,000 gpm. The cooling basin blowdown line is shown in Figure 2.2-5 and described in more detail in Subsection 3.4.2.2. Specific release points to the cooling basin and quantities would be determined once the plant design has been finalized. These release points would be described in the COL application.

3.3.2 **Water Treatment**

Water systems would use typical treatment technologies. The expected water treatment systems are described in the following subsections.

3.3.2.1 **Surface Water**

Surface water from the Guadalupe River is used for cooling basin makeup. The cooling basin serves as the nonsafety-related heat sink for systems such as circulating water and auxiliary cooling systems and provides makeup water to the mechanical draft cooling towers.

Surface water treatment for biofouling, scaling, and suspended matter would typically be addressed with acceptable biocides, antiscalants, and dispersants, respectively. Water treatment for surface water systems would typically be provided at the respective intake locations on an as needed basis which include:

- Guadalupe River intake structure which supplies makeup/initial fill water to the cooling basin and
- Cooling basin intake structure which supplies water to:
  - the circulating water system and to the associated service water cooling systems, where applicable,
  - the service water systems that use mechanical draft cooling towers as a heat sink.

3.3.2.2 **Groundwater**

Groundwater is distributed to systems such as the fire protection system, potable water system, and demineralized water system. Before distribution to the individual system, the groundwater is filtered.

The fire protection system would be treated for biofouling and scaling, as well as to disinfect the system.

The potable water system produces a safe water supply for human use and consumption, which may require treatment for disinfection.

Water supplied to the demineralized water system, in order to meet demineralized water quality requirements, would be treated with a process that may include reverse osmosis (RO) and electro-deionization, which results in highly purified water for various plant systems. In the final stages of the purification process, the treated water passes through ion exchange beds. Once purified, the demineralized water would be directed to the following water supplies:

- Condensate water supply
- Demineralized water supply to primary and secondary systems
- Closed cooling water supply (for various subsystems)

Condensate water would further serve as a water source for the feedwater system. Condensate water would require additional water treatment from the supplied demineralized water to meet feedwater water quality requirements. Additional water treatment may consist of filtration and deep bed demineralization.

Table 3.3-1
VCS Water Use – Enveloping Data

Service	Flow Rates[(a)] Normal (gpm)	Flow Rates[(a)] Maximum[(b)] (gpm)
Water Supplies		
Well Water[(c)]	464[(d)]	1053[(d)]
Potable Water System	100	200
Demineralized Water System	300	750
Fire Protection Water System	negligible[(d)]	negligible[(d)]
Miscellaneous Users	40	50
Filter Backwash Water[(e)]	24	53
Cooling Basin Makeup from Guadalupe River[(h)]	42,250	97,396[(f)]
Precipitation		
Cooling Basin	9,773	59,980[(b)]
Mechanical Draft Cooling Towers	negligible	negligible
Water Releases		
From Well Water		
Wastewater to Cooling Basin	447	877
Radwaste to River (before being diluted in the CB blowdown)	17	260
From Cooling Basin		
Evaporation		
Cooling Basin	39,030	60,440[(b)]
Mechanical Draft Cooling Towers	1,240	2,122
Drift		
Mechanical Draft Cooling Towers[(j)]	negligible	negligible
Cooling Basin	negligible	negligible
Seepage		
Cooling Basin	5700[(g)]	5700[(g)]
Mechanical Draft Cooling Towers	negligible	negligible
Cooling Basin Blowdown	6500	40,000[(i)]

(a) Flow rates are for a 2 unit site using ABWR, ESBWR, AP1000, or APWR technologies or 12 mPower units.

(b) The data provided for maximum conditions represent the highest expected/design flow rates and may not occur simultaneously.

(c) Selected well water capacity is 1200 gpm.

(d) The maximum process does not include fire water. At normal power operation and the highest demand for fire water (when the fire water storage tank has to be refilled in 8 hours to comply with the NFPA requirement), there is a well water deficit of 464 gpm. Administrative and/or design actions are required to be considered during the detailed design phase to address the well water deficit.

(e) The filter backwash flow rates are assumed 5 percent of the filtered well water flow rate.

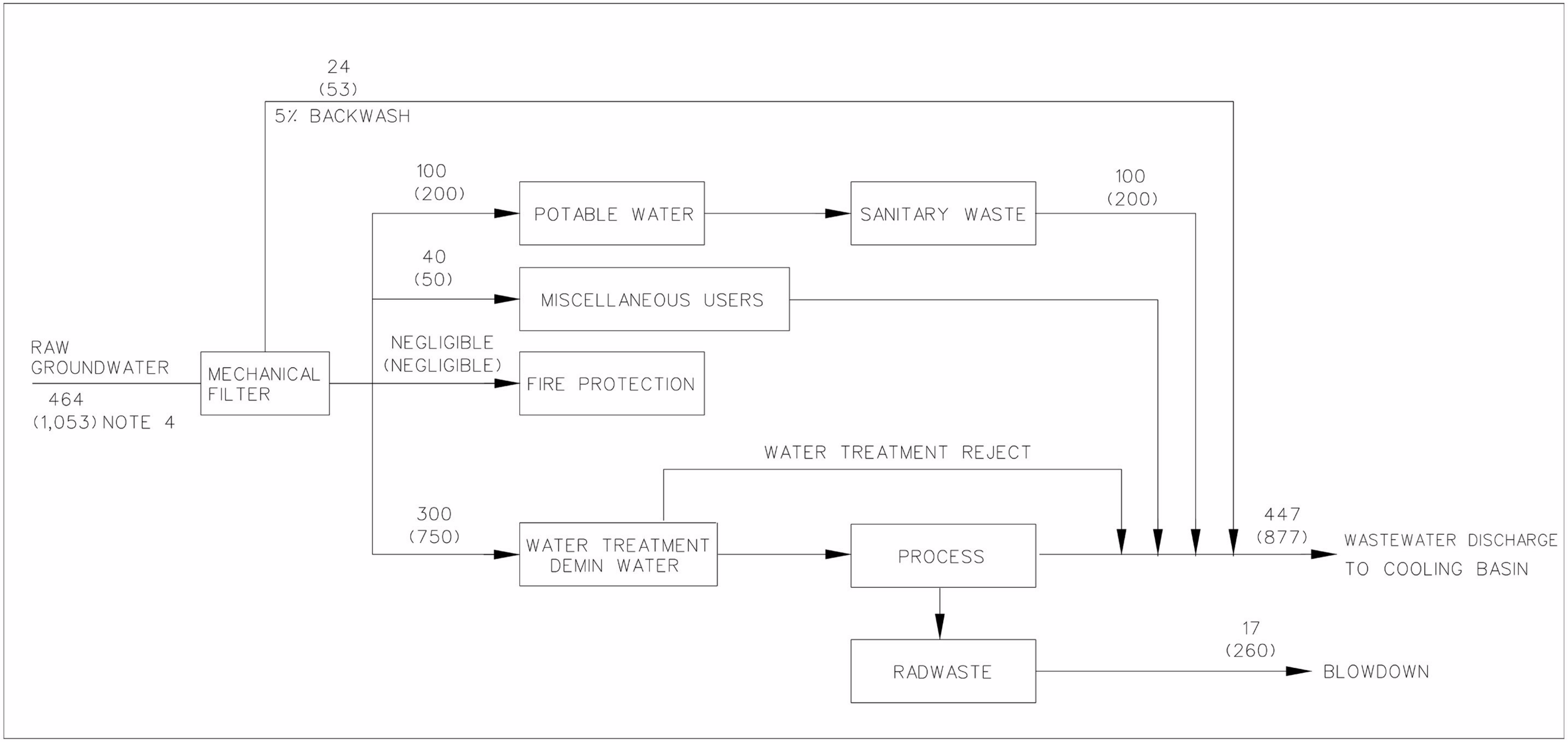
(f) The cooling basin makeup is not to exceed 75,000 acre-feet/year and the maximum withdrawal rate is not to exceed 217 cfs.

(g) A conservative seepage rate of 5700 gpm is considered; this seepage rate is higher than the 3930 gpm of cooling basin seepage estimated by the groundwater model described in Subsection 2.3.1.2 and therefore, represents a more conservative scenario for plant water use evaluation.

(h) The makeup water to the mechanical draft cooling towers is provided from the cooling basin (7766 gpm during normal power operation and 13,290 gpm during maximum operation). The blowdown from the mechanical draft cooling towers is returned to the cooling basin. The mechanical draft cooling tower blowdown flow rate is 6526 gpm during normal power operation and 11,168 gpm at maximum operation).

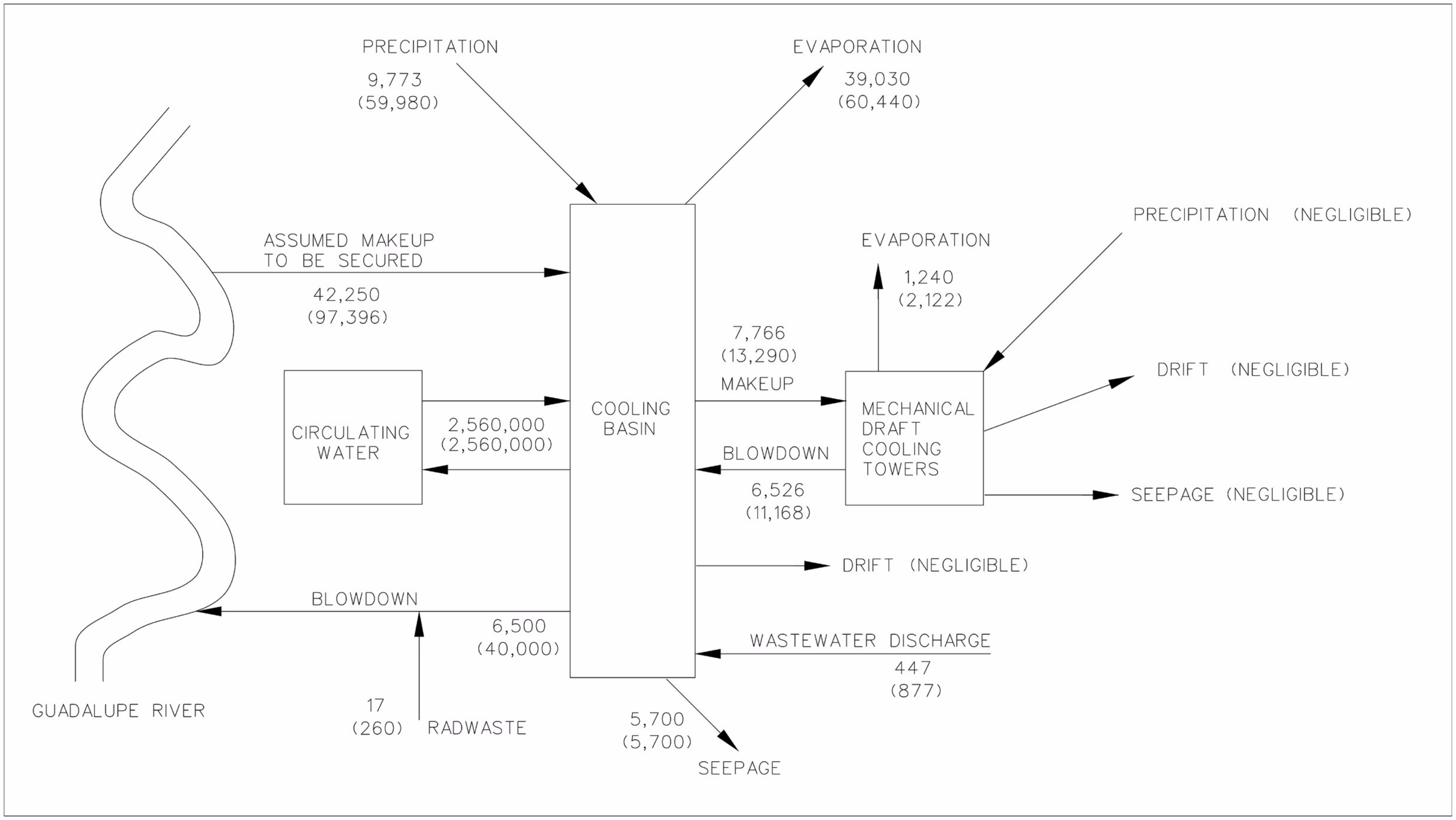
(i) The 40,000 gpm is the selected capacity for the CB blowdown pumps and discharge line.

(j) The mechanical draft cooling tower drift loss is negligible (based on drift loss of 0.005 percent of the cooling tower flow rate of 40,000 gpm/unit is 4 gpm/station during normal power operation.



Notes:
1. All flow rates are in GPM and are for the station.
2. Values shown are expected or monthly averages. The maximum value is shown in ( ).
3. Values shown are based on Table 3.3-1.
4. Maximum well water demand is the maximum process use and excludes fire water use.
5. This figure is not intended to present the water balance.
6. Maximum flow rate required when filling the fire water tank is assumed to be 1200 gpm.

Figure 3.3-1 Groundwater Source Use Diagram



Notes:

1. All flow rates are in GPM and are for the station.
2. Values shown are expected or monthly averages. The maximum value is shown in ( ).
3. Service water cooling tower may not be needed depending on plant design selected.
4. Values shown are based on Table 3.3-1.
5. This figure is not intended to present the water balance.

Figure 3.3-2 Surface Water Source Use Diagram

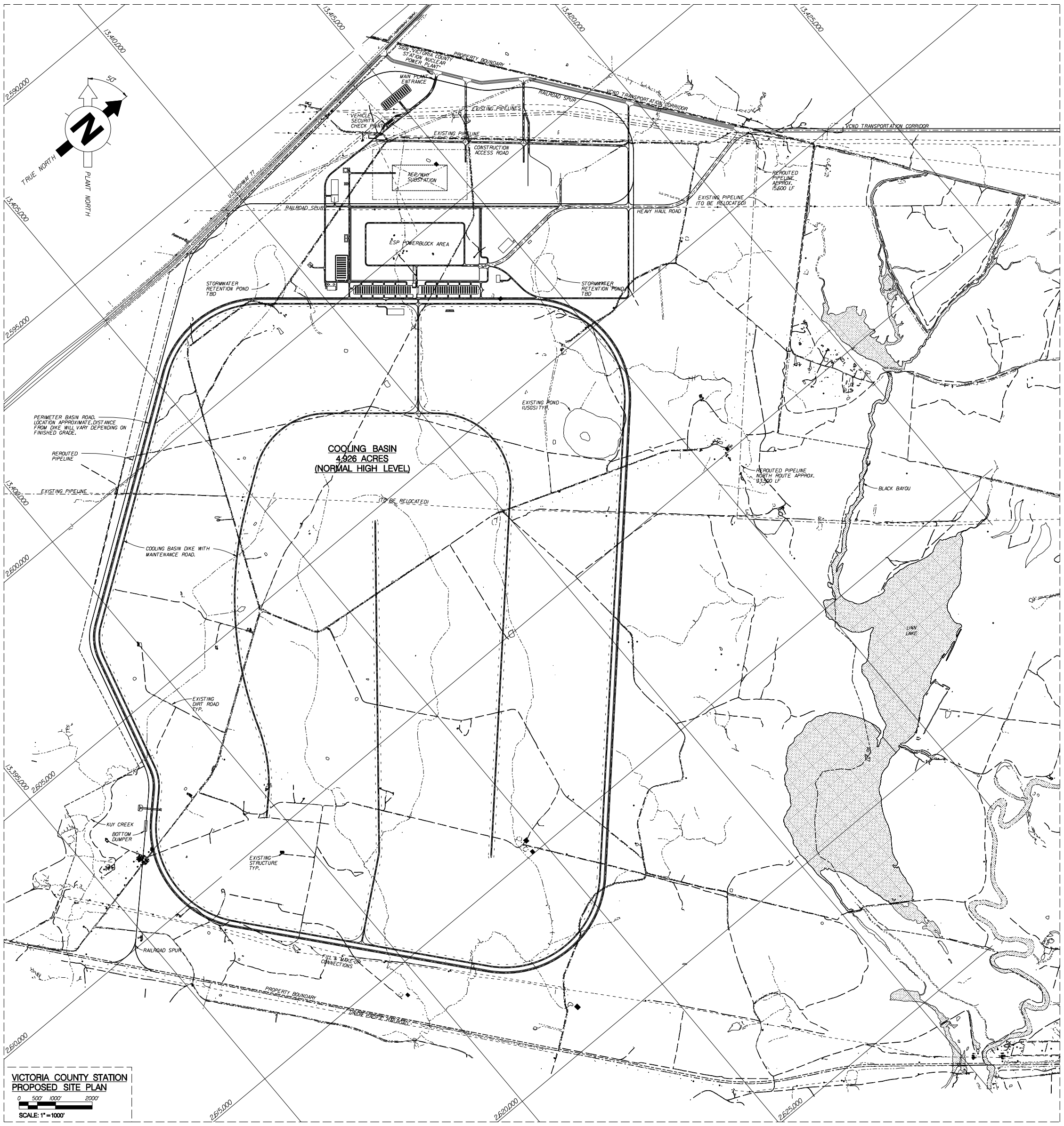


Figure 3.3-3 Power Block and Cooling Basin

3.4 Cooling System

The description of the plant cooling system for the VCS and the anticipated modes of operation of the cooling system are described in Subsection 3.4.1. The conceptual design for the cooling system components (i.e., the intake, the discharge, and the heat dissipation system) and their performance characteristics for the anticipated operational modes are presented in Subsection 3.4.2. The parameters provided are used to evaluate the physical, chemical, and biological impacts to the environment that would result from the expected operation of the cooling system. The environmental interfaces occur at the river intake and discharge structures, the cooling basin, and the mechanical draft cooling towers, as needed by some technologies. Figure 3.3-2 is a general flow diagram of the cooling water systems for VCS.

As discussed in Subsection 3.1.2, no specific plant design has been chosen for the VCS site. However, the following cooling system description assumes that two large, conventional units will be selected.

3.4.1 Description and Operational Modes

The selection of the type of cooling system for VCS requires consideration of the total amount of waste heat that would be generated as a byproduct of the proposed electricity generation, as well as the impacts of the waste heat to the environment. The amount of waste heat rejected from the power cycle system varies, depending on the reactor type, because the core thermal output and the gross electrical output are different among the reactor types being evaluated. Site-related design parameters described in Section 3.1, along with site characteristics, were used to provide the basis for evaluation and selection of the type of cooling system best suited for the site. However, certain site parameters discussed herein, such as the use of a cooling basin, were pre-established as an evaluation basis, based on prior design work. Exelon would apply for the required permits to support the construction of the new cooling system(s), including permits for the discharge and intake structures, after a decision is made to proceed with development of the VCS.

3.4.1.1 Normal Plant Condenser Cooling

VCS would use closed-cycle cooling systems to dissipate up to 10.03×10^9 Btu/hour (2940 MWt) per unit, and up to 20.06×10^9 Btu/hour (5880 MWt) for the station, of waste heat rejected from the main condensers and the auxiliary heat exchangers during normal plant operation at full station load. The normal plant cooling system, also referred to as the circulating water system (CWS), would have a nominal flow rate up to 1,280,000 gpm per unit, and up to 2,560,000 gpm for the station.

The VCS CWS would use a cooling basin of approximately 4900-acres as the normal power heat sink. The exhaust from the plant's steam turbines would be directed to the main condensers, where waste heat is transferred to the circulating water. The heated circulating water from the main condensers would be discharged to the cooling basin, where the heat content of the circulating water is transferred to the ambient air via evaporative cooling, back radiation, and convection. After traversing the cooling basin, the cooled water would be withdrawn from the cooling basin CWS intake and recirculated back to the main condensers to complete the closed cycle circulating water loop. Makeup water to replace the cooling basin water loss due to evaporation, seepage, and blowdown would be supplied from the Guadalupe River. Figure 3.4-1 shows the location of the VCS circulating water intake and outfall structures.

In addition to the CWS, the normal power heat sink may also be used by a service water system for dissipation of waste heat from nonsafety-related heat exchangers. Therefore, the cooling basin may receive a small heat load in addition to that of the CWS.

Makeup water to the cooling basin would be withdrawn from the Guadalupe River. The raw water makeup (RWMU) system consists of an intake pumphouse and intake canal, which would divert river water at a maximum flow rate of 217 cfs (97,396 gpm). The RWMU intake canal would be located on the Guadalupe River approximately 500 feet upstream of the GBRA Lower Guadalupe Diversion Dam and Saltwater Barrier. The maximum withdrawal rate of 217 cfs is approximately 5 percent of the average river flow estimated for the period of 1997 to 2006 at the diversion location.

The cooling basin and associated components are described further in Subsection 3.4.2.

3.4.1.2 **Safety-Related and NonSafety-Related Service Water Systems**

For the non-passive reactor technologies, an external UHS using mechanical draft cooling towers would provide cooling water to the safety-related service water systems that are necessary for the safe shutdown and cooldown of the plant under normal power operations, shutdown, anticipated operational events, and design basis accidents (DBAs). Mechanical draft cooling towers may also be required by some passive reactor technologies to provide cooling to nonsafety-related service water systems that perform functions important to safety but are not essential for safe shutdown.

The UHS is a dedicated closed-cycle system with mechanical draft cooling towers that dissipate the heat generated by reactor components and supporting systems. The UHS for each unit would dissipate heat of up to 1.22 x 10^8 Btu/hr at a flow rate of 42,795 gpm during normal conditions and up to 4.72 x 10^8 Btu/hr at a flow rate of approximately 64,200 gpm during shutdown or accident conditions. The evaporation water loss during normal power operation is expected to be up to 283 gpm/unit and 1061 gpm/unit during shutdown conditions, respectively.

The heat load and flowrate for the nonsafety-related service water system during normal power operation would be up to 2.98 x 10^8 BTU/hr at 40,000 gpm and the evaporation water loss of each unit is expected to be up to 620 gpm. During abnormal conditions, the heat load and flowrate for the nonsafety-related service water system would be 4.09 x 10^8 BTU/hr and 60,000 gpm for each unit, and the evaporation water loss for each unit is expected to be up to 868 gpm.

The UHS system, as well as the nonsafety-related service water system, would consist of a pumphouse that circulates cooling water to the respective heat exchangers and components during normal power operation, shutdown or accident conditions. The cooling water would return to the mechanical draft cooling towers where the heat would be dissipated mainly by evaporation and convection to the atmosphere and conduction to the ground through the cooling tower basin. The mechanical draft cooling towers differential temperature range would be up to 33°F during accident conditions.

The blowdown flow from the mechanical draft cooling towers, which is required for maintaining the cooling water chemistry within acceptable limits during all normal power operations and anticipated operational events, would be discharged to the cooling basin. During normal conditions, the blowdown would have a flow rate up to 6526 gpm. No blowdown is assumed from the UHS system during accident conditions. The UHS cooling tower basin of each unit contains enough water storage capacity – up to 3.06 x 10^7 gallons – to provide the required post-accident cooling for 30 days when no makeup water or blowdown is assumed.

During reactor normal power operation and shutdown, the makeup water to the mechanical draft cooling tower basins is provided from the cooling basin by pumps installed in the cooling basin intake structure. During normal power operation the makeup flow rate could be up to 7766 gpm.

3.4.1.3 **Other Operational Modes**

3.4.1.3.1 **Consideration of Station Capacity Factor**

The units are expected to operate with a station capacity factor of 96 percent (annualized), taking into consideration scheduled outages and other plant maintenance. On a long-term basis, VCS would discharge to the cooling basin an average heat load of up to 9.63 × 10^9 Btu/hour per unit (i.e., 96 percent of the maximum rated heat load of 10.03 × 10^9 Btu/hour per unit) or up to 19.26 x 10^9 Btu/hour for the station.

3.4.1.3.2 **River Water Low Temperature**

Based on historical data available from the representative USGS stations during the 40 year period from December 1966 to December 2006, water temperature in the Guadalupe River and San Antonio River in the proximity of the site remained constantly above the freezing point, with the minimum recorded water temperature of 36.5°F. There are no records of ice jams in the Guadalupe and San Antonio Rivers. Thus, it is concluded that there would be no anticipated flow blockage at the river intake system (the RWMU intake facility) due to ice formation in the river.

3.4.1.3.3 Minimum Operating Water Level

The RWMU system and the cooling basin are nonsafety-related facilities and do not perform any safety-related functions. Plant safe shutdown would not depend on minimum water level in the cooling basin or the ability of the RWMU system to deliver river water to the cooling basin.

The design low water level at the cooling basin for CWS pump operation is established at 71.5 feet NAVD 88 for the ESP, as shown in Figure 3.4-6. At the COL application stage when the reactor technology is selected, the minimum operating water level in the cooling basin would be evaluated against the specific CWS system requirements and thermal performance criteria including the permissible range of cooling water temperatures.

3.4.1.3.4 Chemical Treatment

Water in the mechanical draft cooling tower basins would be chemically treated to prevent organic and inorganic fouling of the cooling tower fill material. Prevention would consist of controlling pH and adding anti-fouling, scale inhibitor and dispersant chemicals.

Plant cooling water would be treated with chemicals for bio-fouling and scale control, injected into the CWS pump intake structure forebay to control fouling in the condenser tubes. The bio-fouling treatment, if required, would be applied intermittently as a shock treatment at the pump intake forebay when the system is in operation. In addition to chemical treatment, an online condenser tube cleaning system would be provided.

3.4.2 Component Descriptions

The design data of the cooling system components and their performance characteristics during the anticipated system operation modes are described in this section.

3.4.2.1 RWMU System Intake Structure

The RWMU system would provide makeup water for the cooling basin. The RWMU pumphouse/forebay structure would be located approximately 8 miles southeast of the VCS cooling basin, on an escarpment above the flood plain that is 0.6 miles from the Guadalupe River. The RWMU system would withdraw water from the Guadalupe River via a new intake canal with the inlet located upstream of the Lower Guadalupe Diversion Dam and Saltwater Barrier across from the diversion to the GBRA Calhoun Canal System. River water would be diverted into the approximately 3150 foot long intake canal and an approximately 200 foot long intake basin located on the southwest side of the Guadalupe River.

Makeup water from the RWMU system intake would compensate for the cooling basin water consumed during station operation, including evaporation, blowdown, and seepage. The reinforced concrete intake structure of the RWMU system would consist of a three-bay pumphouse protected by trash racks and through-flow traveling water screens. The intake structure would be equipped with a fish return system. Fish collected on the traveling water screens would be returned to the Guadalupe River by a 3400 foot long sluiceway routed along the east side of the intake canal.

Typical design features of the trash racks, traveling screens, trash baskets, and fish return devices, including the maximum and limiting flow velocities at the trash racks and traveling screens, are described in Section 5.3.

The pumping station would be provided with three 1/3-capacity pumps, each with the capacity of 89 cfs (40,000 gpm) with a total design capacity of 267 cfs (120,000 gpm). The RWMU pumphouse would provide makeup water at a rate of up to 217 cfs to the cooling basin and an additional 50 cfs capacity would be reserved for use by another entity or entities in the future. Figures 3.4-2 and 3.4-3 show the plan and section views of the RWMU system intake structure, respectively.

The RWMU System would deliver the makeup water to the cooling basin via a 90-inch buried pipeline that would travel approximately 8.5 to 11 miles from the RWMU system intake pumphouse, depending on the route selected. The size of the pipeline under the San Antonio River would be changed from 90-inch diameter to a section of two 60-inch pipelines to allow for installation via horizontal directional drilling.

3.4.2.2 **Plant Discharge**

The cooling basin would include a blowdown system that discharges to the Guadalupe River. The cooling basin would blow down as needed to maintain the cooling basin water chemistry by limiting the dissolved solids concentration buildup and also to dilute the radiological concentration within acceptable limits during radioactive liquid waste discharges. The blowdown discharge system would consist of blowdown pumps (two are assumed) and a 48-inch blowdown pipeline that discharges via a multi-port diffuser outfall at the Guadalupe River. The discharge would comply with the Texas Pollutant Discharge Elimination System (TPDES) permit that would be applied to the outfall at the river. The function of the multi-port diffuser would be to enhance dilution in the nearfield mixing zone of the discharge outfall. For the purpose of environmental impact evaluation, an approximately 11 foot long diffuser with four 1.5-foot diameter ports is considered. Each of the diffuser ports would be discharging from the west bank of the river. Riprap protection around the diffuser would be provided to protect the river bed against erosion from the discharge flow. Figure 3.4-4 shows a typical concept of the diffuser outfall. Subsections 5.3.2.1 and 5.3.2.2.1 provide details of the diffuser performance evaluation.

The blowdown system would be designed to operate using discharge rates up to a design maximum of 40,000 gpm. As described in Section 3.3, a normal blowdown discharge flow of 6500 gpm and a maximum flow up to 40,000 gpm were considered in the plant surface water demand analysis. The water demand takes into consideration the allowable makeup rates from the RWMU system along with annual rainfall and the reduction in the cooling basin inventory because of evaporation and seepage. The difference in flow rates between the cooling basin inflow (primarily makeup plus precipitation) and the inventory loss would be available for the cooling basin blowdown to the Guadalupe River.

A cooling basin water budget evaluation, addressed in Subsection 3.4.2.4, was performed to demonstrate the adequacy of the cooling basin water inventory to support operation of VCS during historical dry conditions, including the historical drought of record. Exelon would implement water conservation programs during applicable dry periods, including limiting cooling basin blowdown during periods of limited water availability.

Restricting blowdown rates during droughts is the best option for managing the cooling basin water inventory when the cooling basin cannot be maintained at normal water levels. VCS would implement water conservation management programs during periods of abnormally low cooling basin water level. These programs would also include actions to maximize recycling of liquid radioactive waste in order to eliminate or minimize the need for discharging radioactive waste. These controls are used at Exelon's existing nuclear power plants and have proven to be effective at conserving water and minimizing or eliminating the need for liquid radwaste discharges. The elements of these programs envisioned during drought periods would be:

- Administrative controls (procedural guidance) to terminate blowdown for the cooling basin chemistry control when the basin water level is less than normal operating range.
- Management controls for the radwaste system:
  - To maximize the storage of radioactive water inside the plant during unit operation.
  - To prevent the introduction of organic compounds in the radwaste systems.
  - To maintain optimal performance of the radioactive waste treatment systems through chemical and operating controls.
  - To minimize the inputs by prioritizing maintenance through identification and control of water inputs to the liquid radwaste systems.

In addition to water conservation programs, the following mitigation features are available to reduce the amount of water required to be blown down from the cooling basin:

- Condenser tube cleaning

- Plant cooling water chemical treatment
- Safety-related and nonsafety-related service water system water chemical treatment

3.4.2.3 **Cooling Basin CWS Intake Structure and Discharge Outfall**

The CWS intake structure for VCS would be located south of the power block on the northwest side of the cooling basin. The intake structure would be designed to accommodate CWS pumps with a nominal flow capacity up to 1,280,000 gpm per unit and 2,560,000 gpm for the station. The CWS pumps would be protected by trash racks with an automatic raking system and traveling water screens with spray water jets supplied by the screen wash pumps to dislodge debris collected on the screens. The cooling basin pump intake would also accommodate two 20,000 gpm cooling basin blowdown pumps, which are located in a stand-alone bay, and multiple UHS/service water makeup water pumps, if required by the selected technology, which share the pump bays with the circulating water pumps. The intake structure would be designed to allow continuous CWS pump operation until the cooling basin water level drops below a low water level of 71.5 feet NAVD 88. Figures 3.4-5 and 3.4-6 show the plan and section views of a representative layout of a CWS pump intake structure that is based on a flow capacity of 2,580,000 gpm for the station's main CWS pumps.

The CWS discharge structure for VCS would be designed to accommodate a total discharge flow of approximately 2,664,000 gpm. There would be six 138-inch diameter circulating water pipes entering the discharge outfall structure. Downstream of the discharge outfall, riprap would be placed to prevent erosion. Figures 3.4-7 and 3.4-8 show the layout of a representative design of the cooling basin discharge structure. This representative design is based on a flow capacity of 2,664,000 gpm for the station, which reserves approximately 84,400 gpm (for the station) for the return flow from some of the auxiliary heat exchangers, such as those cooled by the turbine service water system(s) present in some of the reactor technologies.

3.4.2.4 **Heat Dissipation System**

The sizing of the cooling basin is based on a maximum annual diversion of makeup water from the Guadalupe River of 75,000 acre-feet, which would require contracting with an existing water rights holder and/or securing new water rights at the COL application stage (see Section 5.2).

The long-term operating margin of the cooling basin is evaluated from the considerations of thermal performance and sufficient storage capacity for the CWS to sustain continuous operation during extreme low water conditions. The evaluations, assisted by a hydrothermal model and a water budget analysis, use representative plant cooling system characteristics and water supply at the site to demonstrate that the cooling basin would be capable to cool the station in full load operation under extreme low flow conditions including those that would be encountered during a hypothetical recurrence of the historical drought of record in the Guadalupe River basin. The water supply to the cooling basin is represented by a maximum annual diversion of 75,000 acre-feet of makeup water with a maximum withdrawal rate of 217 cfs. The thermal performance of the cooling basin and water availability are described in further detail in Subsection 5.2.2.1.

As stated in Subsection 3.4.1, VCS would use a cooling basin as the normal power heat sink for the CWS. The heated circulating water from the main condenser of each unit would be discharged to the cooling basin, where the heat content of the circulating water would be transferred to the ambient air via evaporative cooling, convection and back radiation. After passing through the cooling basin, the cooled water would be pumped back to the main condenser at the cooling basin intake structure, to complete the closed-cycle circulating water loop.

As shown in Figure 3.4-1, the cooling basin would be completely enclosed by embankment dams consisting of clay or clayey sand fill that would be constructed above ground. Interior earth dikes inside the cooling basin would be used to guide the cooling water circulation from the cooling basin outfall structure to the cooling basin intake structure. The interior dikes would promote surface heat transfer by reducing ineffective surface cooling areas and potential short circuiting in the flow path. The bottom of the cooling basin would be graded to a nominal elevation of 69 feet NAVD 88 for the most part, with a portion toward the south where the bottom of the cooling basin would follow the existing natural grade that varies between elevations 66 feet to 69 feet NAVD 88. The elevation of the top of the exterior embankment dams would be 102 feet NAVD 88, except at a few locations that need to be elevated to accommodate pipe crossings. The top elevation of the interior dikes would be at 99 feet NAVD 88. The exterior embankment dams would be approximately 25 feet wide at the top and be constructed with an exterior slope of 3 horizontal to 1 vertical (3H to 1V) and an interior slope of 4H to 1V. The internal dikes would have a slope of 3H to 1V on both sides. The interior slope of the embankment dams and both sides of the interior dikes would be armored with a layer of soil-cement in a stair-stepped design, to protect against wave-induced erosion. The exterior slopes of all embankment dams would be covered by vegetation for protection against storm runoff scouring and wind erosion. Other acceptable erosion and slope protection technologies that achieve the same design objectives may be evaluated during detailed design.

At the design pool level of 90.5 feet NAVD 88, the cooling basin would have a minimum water depth of 21.5 feet at the northern, shallower end that would get deeper towards the southern end. The storage volume of the cooling basin at the design pool level is approximately 103,600 acre-feet. The normal maximum operating level of the cooling basin would be 91.5 feet NAVD 88 that includes an operating range of 1 foot. The storage volume of the cooling basin is about 108,500 acre-feet when the basin water level reaches the normal maximum operating level. The design low water level at the cooling basin for CWS pump operation is established at 71.5 feet NAVD 88, as shown in

Figure 3.4-6. The operating units would be shut down if the cooling basin water level drops below elevation 71.5 feet NAVD 88.

The average residence time in the basin is defined as the storage volume divided by the CWS flow rate, which would be 9 days or more based on a nominal CWS flow rate for the station of up to 2,560,000 gpm and with the cooling basin filled to the design pool level. The cooling basin surface area varies slightly with water depth, increasing at a rate of approximately 11 acres for each foot rise in the basin water depth.

There would be a service road on the top of the embankment dams and interior dikes, and another embankment access road that would run along the outside perimeter of the cooling basin. A drainage ditch between the toe of the embankment dam and the embankment access road would collect surface runoff generated on the exterior slope of the embankment dams and the small amount of seepage through the embankment dams. The ditch would discharge to natural drainage paths through culverts underneath the embankment access road.

The cooling basin would have an emergency spillway to release water during extreme storm events. There would be no normal discharge through this spillway except during storm events that have a return period higher than 100 years. The emergency spillway is designed to pass outflow during a probable maximum precipitation (PMP) event. The emergency spillway would be located near the southwestern end of the cooling basin embankment dam and would have slide gates on top of an ogee weir with a crest elevation at 87 feet NAVD 88. The spillway gates are designed to open whenever the basin water level exceeds the normal maximum operating level of 91.5 feet NAVD 88. However, the spillway design was conservatively developed by assuming that the spillway gates would be opened only when the basin water level approaches the top elevation of the gates at 94 feet NAVD 88. The maximum water level in the cooling basin during a 72-hour duration PMP event in this case is predicted to be about 95.7 feet NAVD 88 with all spillway gates opened. The general layout of the cooling basin emergency spillway is shown in Figures 3.4-9 and 3.4-10.

A stilling basin would be installed at the end of the spillway channel to dissipate energy in the outflow and to reduce the potential of downstream erosion. The cooling basin spillway flow would discharge to Kuy Creek.

A freeboard analysis to estimate the maximum basin level including the wind wave action, i.e., setup and run-up, was conducted to establish the final top elevation of the embankment dams for the cooling basin. The Texas Commission for Environment and Quality (TCEQ) publication "*Hydrologic and Hydraulic Guidelines for Dams in Texas*" (TCEQ Jan 2007) does not provide specific guidelines on the wind condition to use to estimate the maximum wave run-up in the determination of the required freeboard of new dams. To evaluate the safety of the cooling basin embankment dams, the following conservative scenarios were considered: (1) a 2-year wind speed in conjunction with the maximum still water level in the basin resulting from the PMP, (2) a probable maximum hurricane (PMH) wind condition with the normal maximum operating water level as the starting basin level, and (3) 10-year wind speed with the maximum still water level resulting from the PMP. The first two scenarios were conservatively selected based on the combined events criteria in Section 10 of ANSI/ANS-2.8-1992 (ANSI Jul1992) for safety-related facilities, even though the cooling basin is not a safety-related structure. The last scenario is adopted from the guidelines of the U.S. Department of the Interior, Bureau of Reclamation (USBR 1992) for the design of storage dams. It is further assumed conservatively that the gates of the emergency spillway would not be operable during the PMP resulting in a higher PMP water level of 96.2 feet NAVD 88 in the cooling basin. Based on the longest fetch distance of about 17,850 feet estimated from the physical dimensions of the cooling basin, the worst case maximum water level would be produced by the PMH condition and was postulated to happen on the north and south embankment dams. Including wind setup and the 2 percent wave run-up, the water level is calculated to be on the order of 0.5 feet or more below the top elevation of the embankment dams at 102 feet NAVD 88. The wave run-up prediction was based on the methodology described in the USACE Coastal Engineering Manual (USACE Oct 2005).

The thermal performance of the cooling basin is evaluated using a one-dimensional, multilayer finite difference hydrothermal model that simulates the transient response of a cooling basin or lake to the meteorological conditions and heat load discharge from the plant. The numerical model mathematically simulates the heat transfer and mass balance process that is a result of natural and waste heat inputs, as well as surface cooling and forced circulation induced by the cooling basin intake and discharge systems. Direct precipitation and makeup water inflows to the cooling basin are not simulated, because the inflows are insignificant when compared to the CWS flow rate. The physical characteristics in terms of surface area and storage volume of the cooling basin, as described above, are represented in the model by a simplified unidirectional flow path in two layers with the CWS discharge at the upstream end of the model and the CWS intake at the downstream end of the model.

The cooling basin thermal model predicts the spatial and time variation of water temperature in the cooling basin in response to the CWS system parameters and up to 60 years of historical meteorological conditions. For the ESP, the thermal performance of the cooling basin and associated water consumption of the CWS system are evaluated with the use of a representative set of CWS parameters (instead of bounding values) including a station heat load of 19.76 x 10^9 Btu/hour and a total circulating water flow rate of approximately 2,200,000 gpm. When the reactor technology is selected during the COL application stage, technology-specific plant design parameters and plant performance criteria would be used to re-evaluate the thermal performance of the cooling basin and to optimize the CWS design. Because the representative heat load of 19.76 x 10^9 Btu/hour used in the ESP evaluation is lower than the bounding heat load of 20.06 x 10^9 Btu/hour by a small amount, about 1.5 percent, no significant impact on the predicted cooling basin thermal performance and associated water consumption is expected when the system would be re-evaluated at the COL application stage.

Water losses from the basin as a result of natural and forced evaporation are predicted as part of the modeling process. The 60 years (from 1947 to 2006) of meteorological data, including dry bulb temperature, wind speed, relative humidity, cloud cover and solar radiation, primarily come from the Victoria Regional Airport meteorological station and are supplemented by the data from the Corpus Christi and Galveston stations where there are data gaps. The meteorological data from eight years out of the 60 years have poor quality and are not used in the cooling basin thermal analysis. The cooling basin thermal model is calibrated using recent water temperature data measured at a cooling pond in the region.

Thermal performance of the cooling basin is simulated at the design pool level of 90.5 feet NAVD 88 and at lower basin water levels down to 73.5 feet NAVD 88. The model results demonstrate that, with the station CWS rejecting heat at a rate of 19.76 x 10^9 Btu/hour, the intake temperature would be less than 100°F for all water depths examined including the reduced basin level of 73.5 feet NAVD 88. Specifically, the maximum daily average temperature at the intake (i.e., the cold side), with the basin at the design pool level, is predicted to be about 95.9°F. The cooling basin intake water maximum, minimum, and average predicted temperatures with both units in full load operation for each month are presented in Table 3.4-1. This maximum temperature condition typically occurs in the months of June, July, August, and September. The maximum daily average cold side temperature for the entire modeling period, with the basin water level at 73.5 feet NAVD 88, is 98.4°F occurring in August 1998. The annual combined natural and forced evaporation losses from the cooling basin are estimated to vary from a maximum of about 172.5 inches to a long-term average of about 154.0 inches at the design pool level. The long-term average evaporation loss estimate is based on a station capacity factor of 96 percent. The evaporation loss varies very slightly with different basin water levels. For instance, the thermal model predicts that at a basin water level of 77.5 feet NAVD 88, the annual maximum evaporation loss is about 176.8 inches and the long-term average is about 162.4 inches. Taking into account the reduced surface area at the lower water depth, the total evaporation losses actually decrease by about 1 percent at the reduced cooling basin water level of 77.5 feet NAVD 88, comparing to the design pool condition. The predicted cooling basin maximum, minimum, and average evaporation losses for each month, with the station rejecting a heat load of 19.76 x 10^9 Btu/hour at the design pool level of 90.5 feet NAVD 88, are presented in Table 3.4-2.

Blowdown capability would be provided to maintain adequate water chemistry in the cooling basin as described in Subsection 3.4.2.2. During drought conditions, water level in the cooling basin is likely to drop below the design pool level, because of natural evaporative losses, basin seepage, and plant induced water losses such as forced evaporation (when applicable) and basin blowdown, until the RWMU system intake structure can resume pumping.

A water budget analysis for the cooling basin has been performed to evaluate the impacts of potential drought conditions on plant operation, assuming a repeat of the historical hydrometeorological conditions from 1947 to 2006, including the drought of record for the region. Inflow to the cooling basin includes primarily direct precipitation and the makeup water flow rate that is based on a maximum annual diversion of 75,000 acre-feet and a maximum instantaneous RWMU system pumping rate of 217 cfs, both subject to the run-of-river availability. The outflow from the cooling basin includes the natural and forced (as applicable) evaporative water losses, seepage through the bottom of the cooling basin and through the embankment dams, and blowdown discharges.

For direct precipitation, the historical rainfall record from the Victoria Regional Airport meteorological station is used. The run-of-river availability at the RWMU system intake location, for the model period of 1947 to 2006, is projected based on an extension to 2006 of the conservative "Full Authorization" scenario of the Guadalupe-San Antonio River Basin Water Availability Model (GSA-WAM) for the region. The “Full Authorization” scenario reflects the condition that all water rights in the river basin would use their maximum authorized amounts.

The water budget model further assumes that 70,000 acre-feet per year of treated effluent would be discharged by the City of San Antonio and would increase the run-of-river flow available for withdrawal at the RWMU intake location. The period of record for the existing GSA-WAM is 1934 through 1989. The extension of the GSA-WAM to 2006 is based on a simplified hydrologic data extension that relies on gaged stream flow for the 1990 to 2006 period, with limited adjustments for flow naturalization.

The extended GSA-WAM stream flow values, in a monthly interval, are disaggregated and redistributed to daily values based on historical daily stream flow patterns and used as input to the water budget model. For the basin outflow, the combined natural and forced (as applicable) evaporative losses are estimated using the cooling basin thermal model described above.

A conservative seepage rate of 5700 gpm, which includes seepage through the embankment dams of the cooling basin and seepage through the cooling basin bottom, is used to represent the total seepage losses from the cooling basin. This seepage rate is higher than the 3930 gpm of cooling basin seepage estimated by the groundwater model described in Subsection 2.3.1.2 and therefore, represents a more conservative scenario for plant water use evaluation.

The blowdown outflow is represented in the model as a continuous discharge of 6500 gpm during normal years, which would be reduced to 1000 gpm for drought periods to reflect the effect of administrative controls for low flow conditions similar to those described in Subsection 3.4.2.2. The low flow conditions that initiate blowdown reduction are defined in the model as whenever the basin water level is 4 feet or more below the design pool level. Also included in the inflow is a small effluent flow from the plant's wastewater treatment system described in Section 3.3. The results of the water budget model indicate that there is sufficient inventory in the cooling basin to support plant cooling water needs during the repeat of the historical regional drought of record, when there would be reduced and infrequent withdrawals of makeup water. It is predicted that with the operation of the station at a long-term average station capacity factor of 96 percent, the water level is not expected to drop below 73.5 feet NAVD 88, even at the return of the drought of record. The thermal performance analysis of the cooling basin also indicates that the cooling basin would perform adequately for cooling basin water levels as low as 73.5 feet NAVD 88 with the station in full load condition, using a 100°F intake temperature criterion as the plant's circulating water system performance requirement. However, the cooling basin intake structure would be designed to allow pump operation until the water level drops to the design low water level of 71.5 feet NAVD 88.

3.4.3 **References**

ANSI Jul1992. American Nuclear Society, ANSI 2.8-1992, *Determining Design Basis Flooding at Nuclear Power Reactor Sites*, July 1992.

Ryan 1973. Ryan, P. J. and D. R. F. Harleman. *An Analytical and Experimental Study of Transient Cooling Pond Behavior*, Report 161, Ralph M. Parsons Laboratory, Massachusetts Institute of Technology, 1973.

TECQ Jan 2007. Texas Commission on Environmental Quality, *Dam Safety Program Hydrologic and Hydraulic Guidelines for Dams in Texas*, January 2007.

USACE Oct 2005. U.S. Army Corps of Engineers, Coastal Hydraulics Laboratory, EM1110-2-1100, *Coastal Engineering Manual*, October 2005.

USBR 1992. U.S. Department of the Interior, Bureau of Reclamation *Freeboard Criteria and Guidelines for Computing Freeboard Allowance for Storage Dams*, Acer Technical Memorandum No.2, Revised 1992.

Table 3.4-1
Predicted Cooling Basin Intake Temperatures (Based on 100 Percent Load Condition)

Month	Temperature (°F)		
	Maximum	Minimum	Average
January	75.4	47.3	63.3
February	77.1	49.9	65.7
March	80.9	56.8	70.3
April	85.9	65.7	76.1
May	90.2	72.7	82.3
June	93.9	81.4	87.9
July	95.4	83.4	90.1
August	95.9	83.8	90.4
September	94.7	77.7	87.6
October	94.6	66.9	81.2
November	84.5	58.8	72.8
December	79.5	47.7	65.9

Note: Based on Daily Average Temperature at Design Pool Level of 90.5 feet NAVD 88.

Table 3.4-2
Predicted Cooling Basin Evaporation Losses (Based on 100 Percent Load Condition)

Month	Evaporation (inches)		
	Maximum	Minimum	Average
January	10.9	6.2	8.7
February	11.2	5.2	8.9
March	13.0	8.1	11.0
April	14.3	9.8	12.0
May	17.4	11.6	14.2
June	18.3	12.8	16.0
July	20.2	14.3	17.6
August	19.2	14.7	17.4
September	18.9	14.2	16.0
October	18.6	11.6	14.6
November	14.2	9.4	11.9
December	11.6	7.6	9.7

Notes: Based on Design Pool Level of 90.5 feet NAVD 88, includes both natural and forced evaporation.
The summation of the 12 monthly maximum values exceeds the annual maximum of 172.5 inches because the 12 monthly maximum values do not typically occur in a single year.
The monthly average values shown in this table are based on a 100% station capacity factor, resulting in a higher annual average value than the long-term annual average evaporation rate of 154 inches, which is based on a 96% capacity factor.

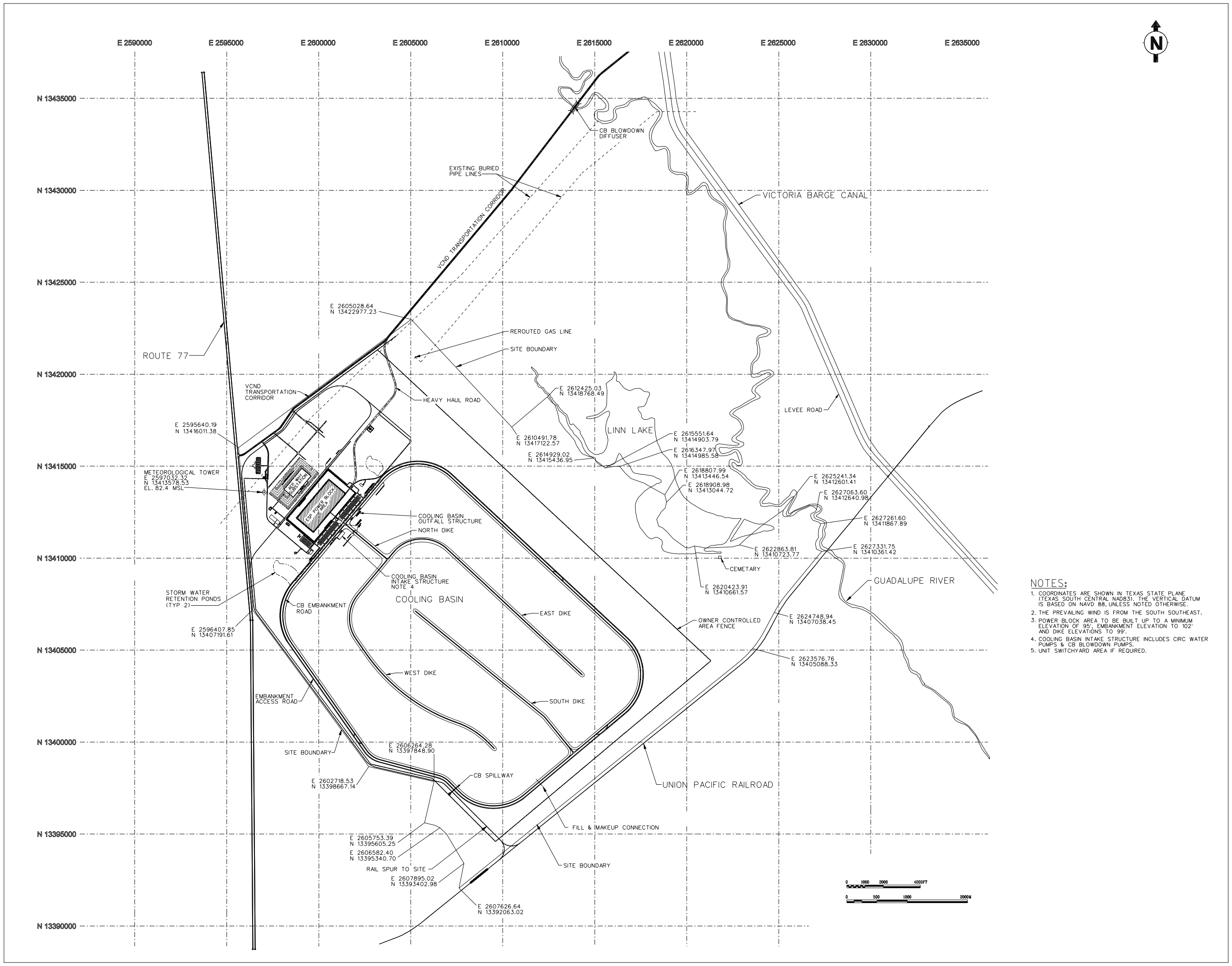


Figure 3.4-1 VCS Cooling Basin

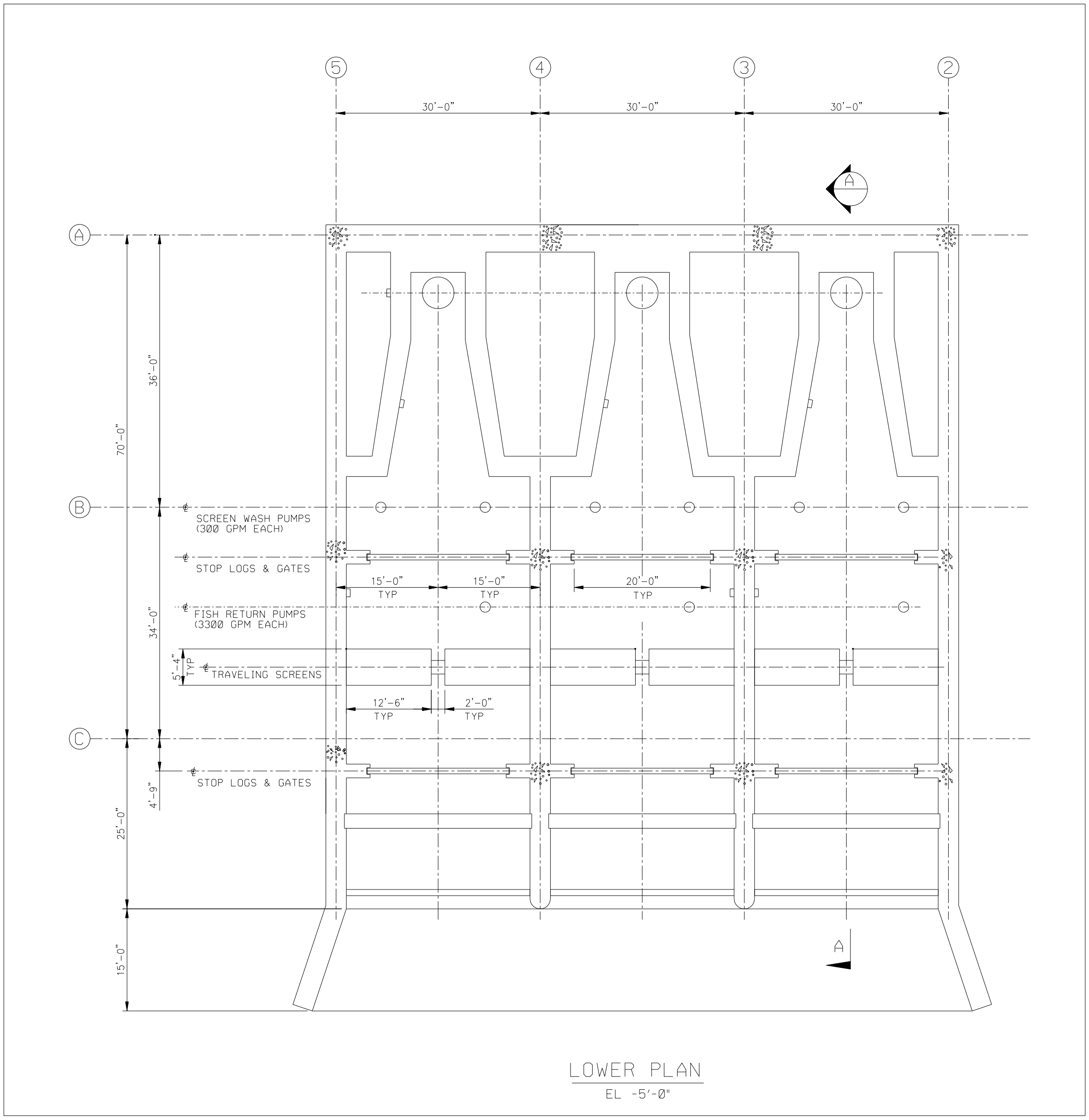


Figure 3.4-2 VCS RWMU Intake Structure (Plan View) — Typical

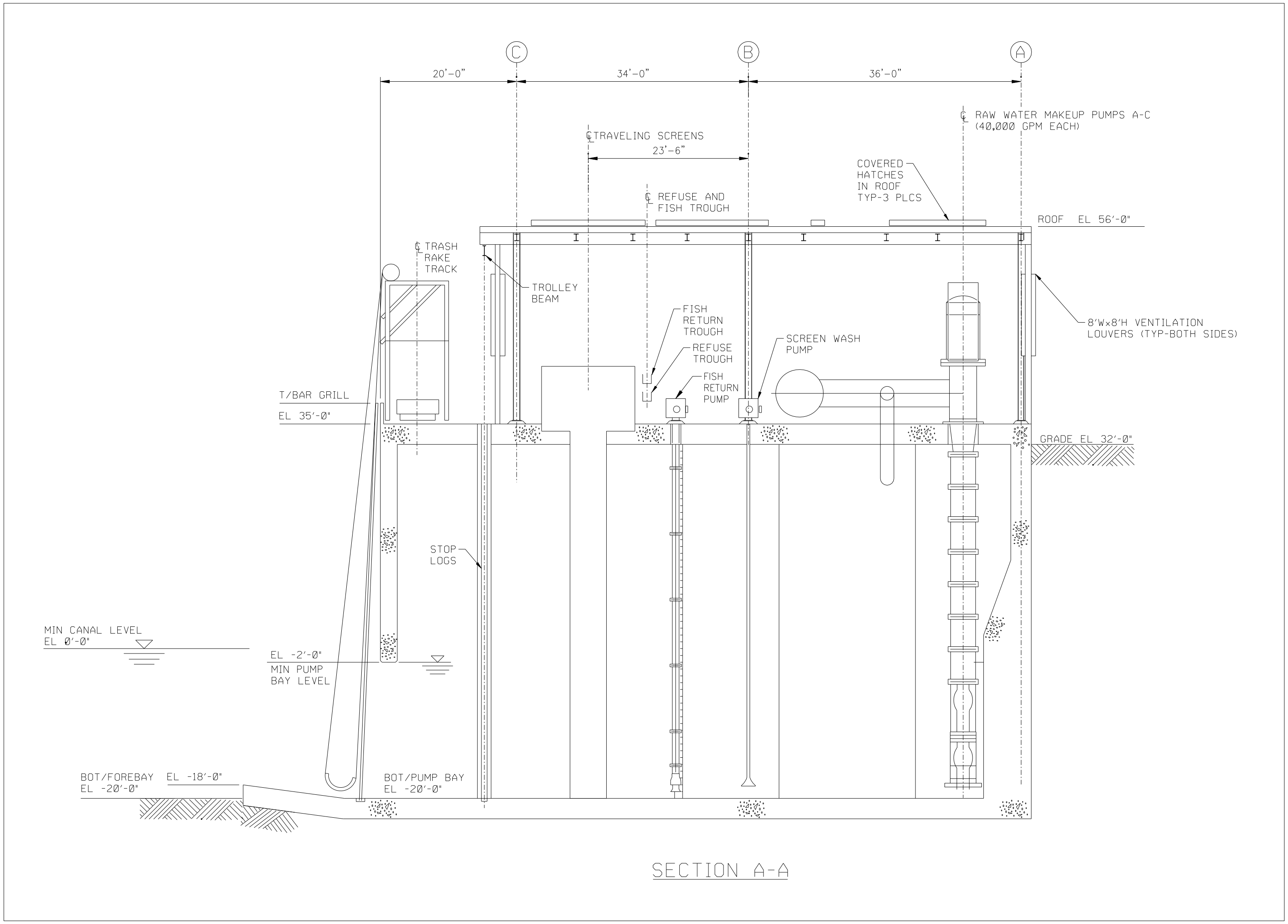


Figure 3.4-3 RWMU Intake Structure (Section View) — Typical

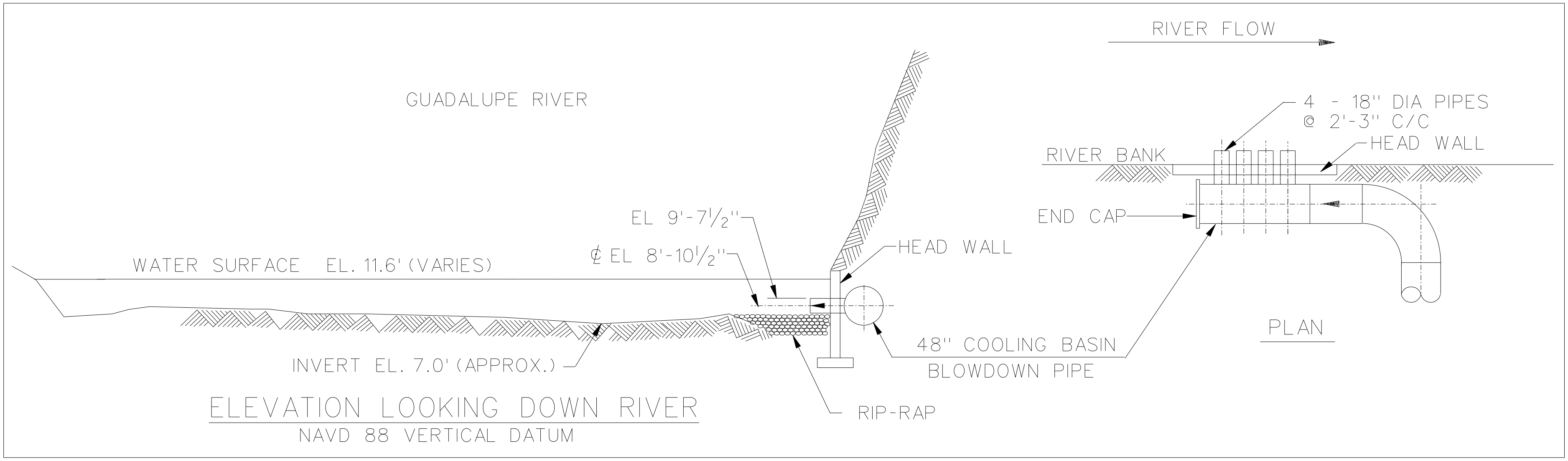


Figure 3.4-4 Blowdown Discharge Outfall — Typical

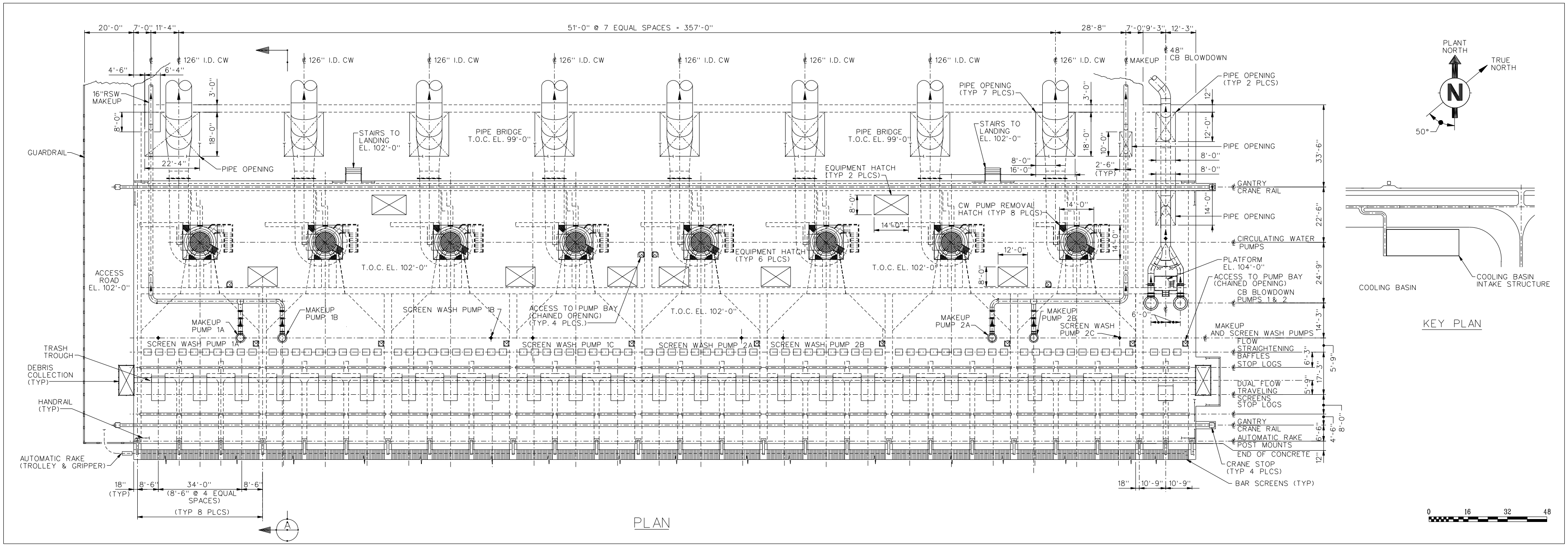


Figure 3.4-5 VCS Cooling Basin Intake Structure (Plan View) — Typical

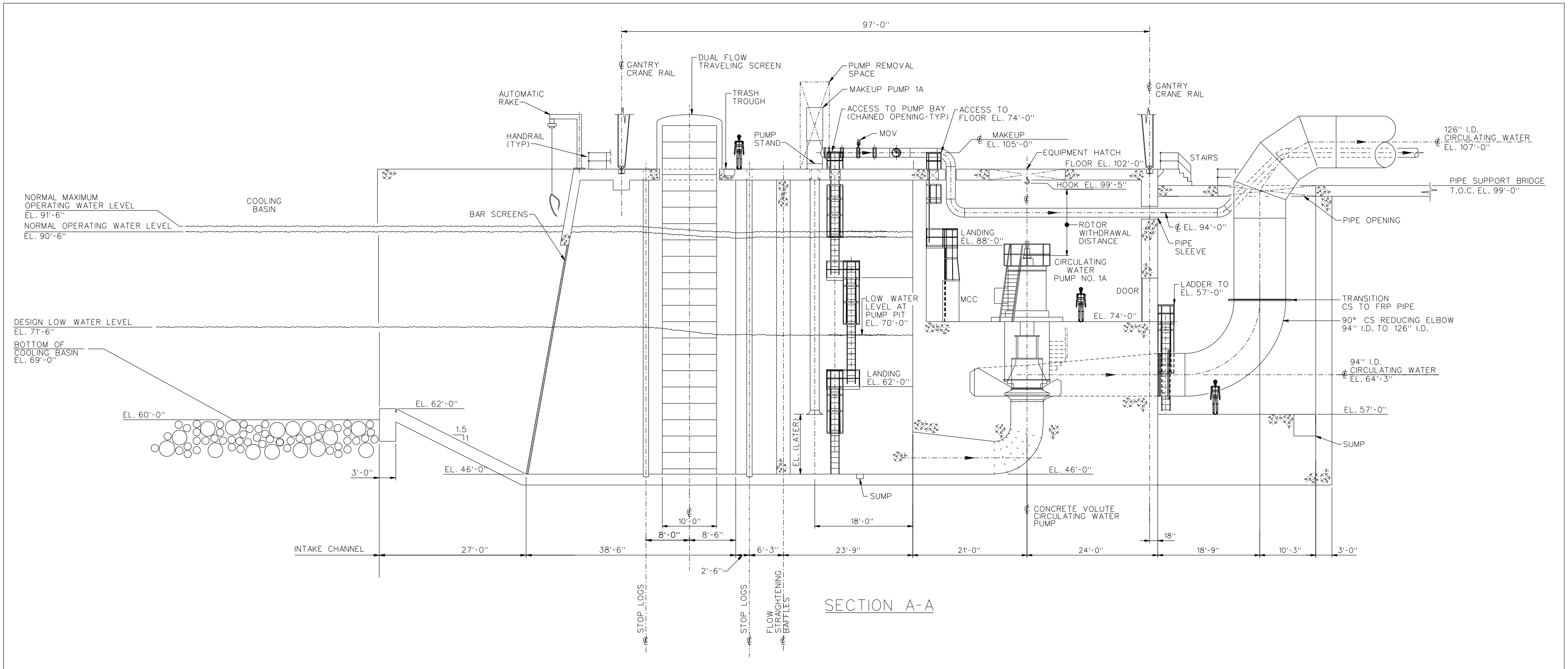


Figure 3.4-6 Cooling Basin Intake Structure (Section View) — Typical

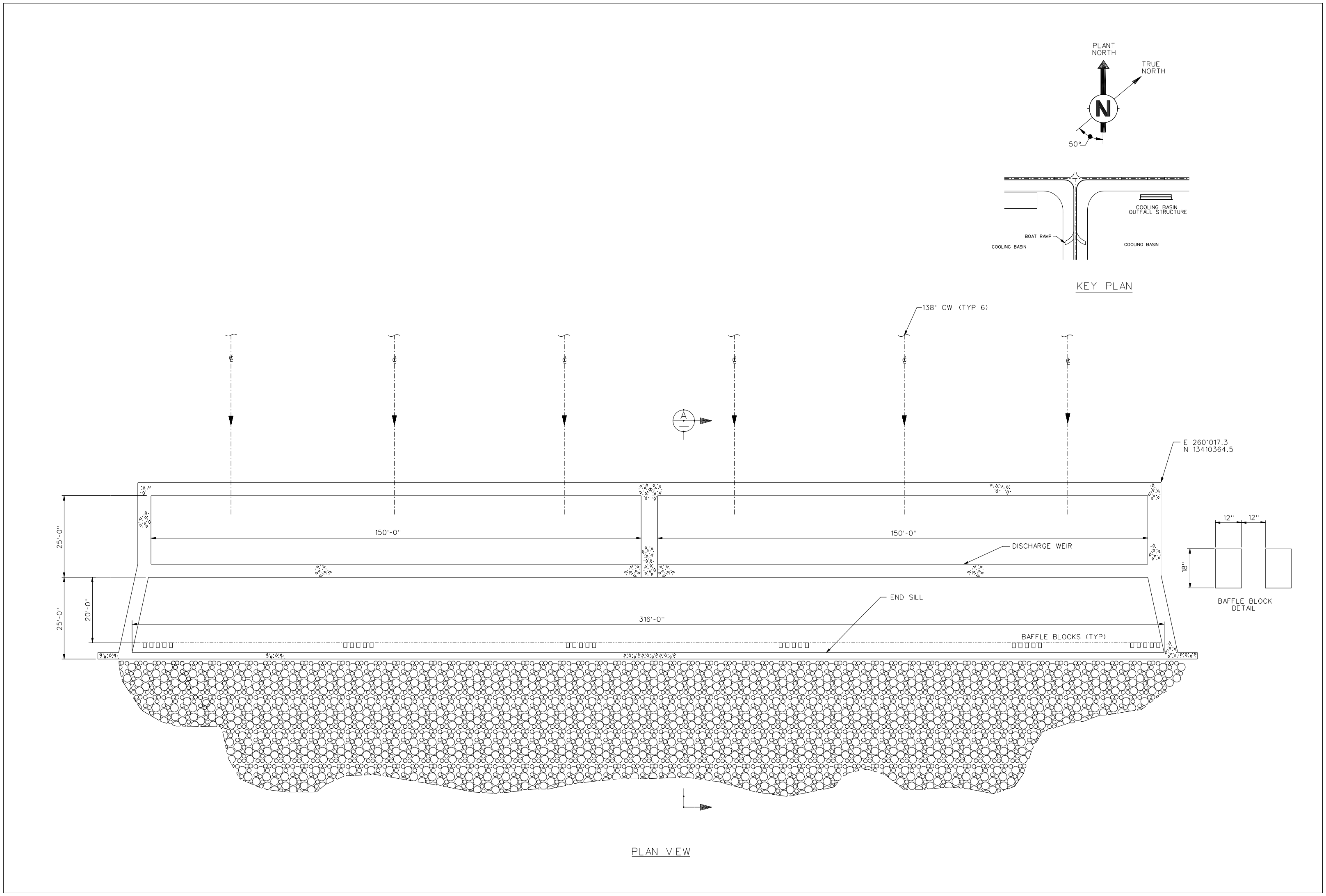


Figure 3.4-7 VCS Cooling Basin Discharge Structure (Plan View) — Typical

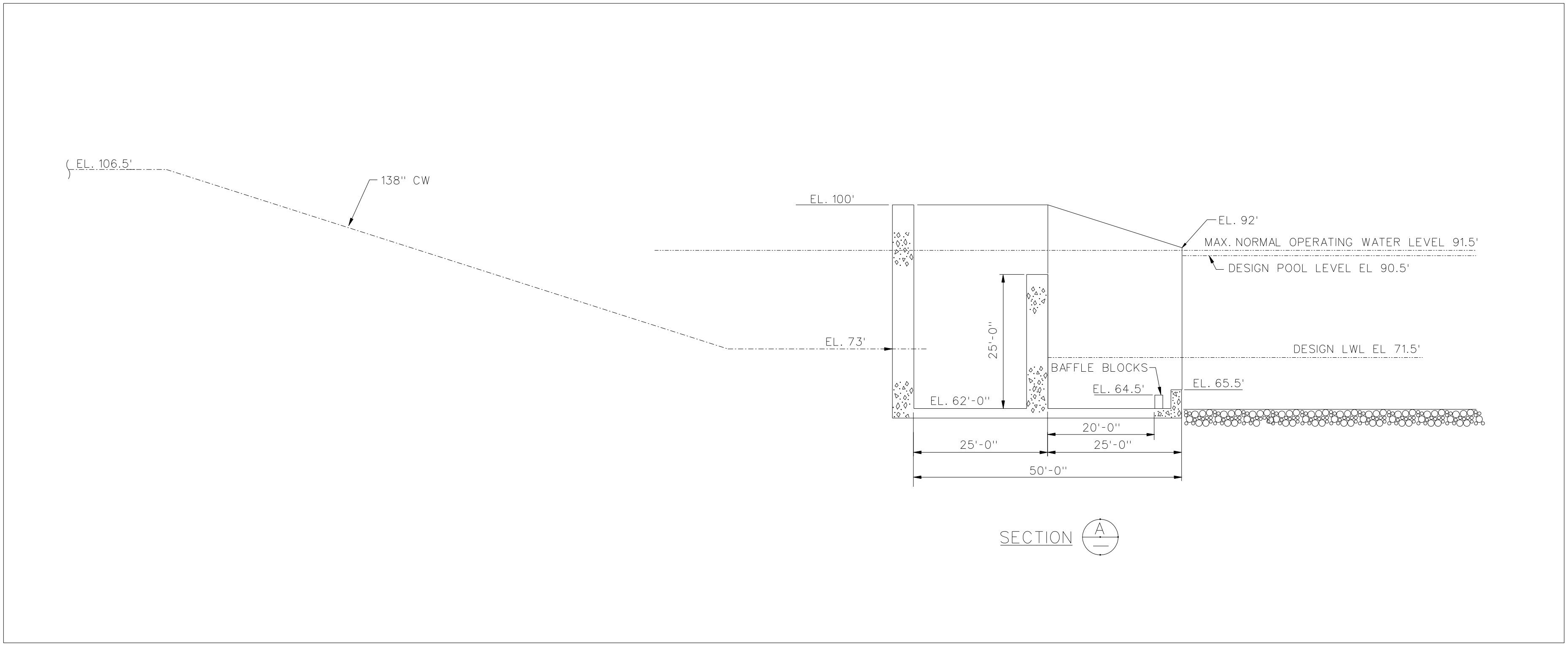


Figure 3.4-8 Cooling Basin Discharge Structure (Section View) — Typical

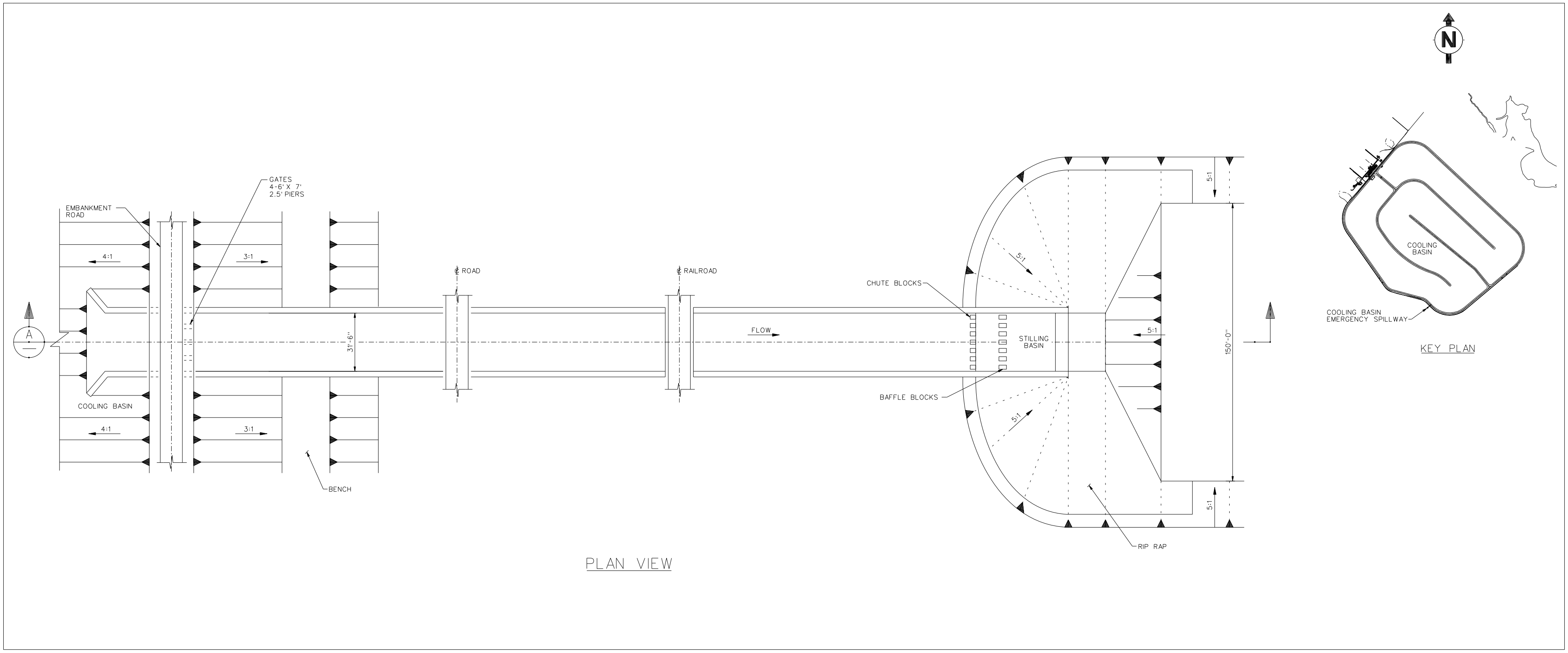


Figure 3.4-9 VCS Cooling Basin Emergency Spillway General Layout (Plan View) — Typical

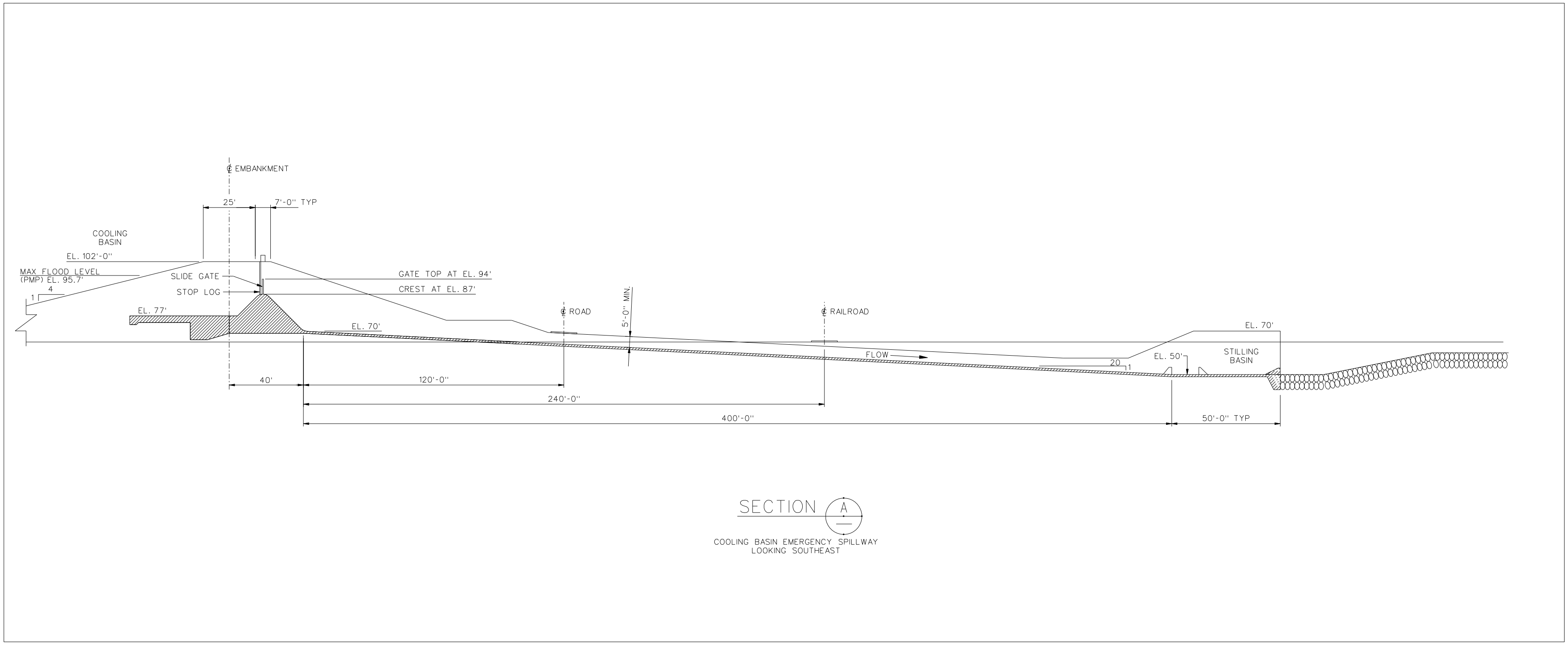


Figure 3.4-10 VCS Cooling Basin Emergency Spillway General Layout (Section View) — Typical

3.5 Radioactive Waste Management System

This section describes the liquid, gaseous, and solid radioactive waste management systems proposed to be used at VCS. Because a reactor design has not been chosen for the VCS site, bounding values have been developed for the quantities of radioactive wastes that are projected to be generated and processed and then stored or released as liquid or gaseous effluents or as solid waste. The radioactive waste management systems will be designed to maintain the radiation exposure of plant personnel as low as reasonably achievable and to ensure offsite radiation exposures are within the limits of 10 CFR 20 and 10 CFR 50, Appendix I.

3.5.1 **Source Terms**

Radionuclides are produced during the normal operation of nuclear reactors through the processes of fission and activation. Fission products may enter the reactor coolant by diffusion or through defects in the fuel cladding or encasement. The reactor coolant may also contain dissolved or suspended corrosion products or leached materials that can be activated by neutrons in the reactor core. These radionuclides can enter the environment either from plant systems designed to remove impurities, small leaks in the reactor coolant system and auxiliary systems, or by breaching of systems for maintenance. Radioactive wastes can be liquid, gaseous, or solid.

The radioactive waste management systems (radwaste systems) will be designed to minimize releases from reactor operations to values as low as reasonably achievable (ALARA). These systems will be designed and maintained to meet the requirements of 10 CFR 20 and 10 CFR 50, Appendix I. Table 3.5-1 lists the conservatively estimated annual liquid radioactive effluent releases, and Table 3.5-2 lists the conservatively estimated annual gaseous radioactive effluent releases for the VCS.

3.5.2 **Liquid Radioactive Waste Management System**

The liquid radwaste system will be designed to control, collect, process, handle, store, and dispose of liquid radioactive waste generated as the result of normal operation, including anticipated operational occurrences. Sources of liquid radioactive waste include leakage from systems, wastes generated by processing systems, and maintenance activities. During the design phase of VCS, these sources and potential sources will be identified and collection and processing systems will be designed to remove the radioactivity to the extent that the processed liquid can be recycled or discharged in accordance with the requirements of 10 CFR 20 and the ALARA principles of 10 CFR 50, Appendix I. Discharges will be to the Guadalupe River and will be controlled and monitored to measure the activity released. Liquid waste processing systems will be designed to maintain the radiation exposures of plant personnel as low as reasonably achievable. Radioactivity releases in liquid effluents are given in Table 3.5-1.

3.5.3 Gaseous Radioactive Waste Management System

Typical gaseous radioactive wastes include vents from collection tanks and processing equipment and non-condensables in steam systems. The radioactive isotopes contained in these waste streams include fission product iodines and the noble gas fission products xenon and krypton as well as activation products such as Ar-41 and Co-60. These wastes will be collected and processed to decrease the radioactivity content to the point that they can be released to the environment through a controlled and monitored release point (plant vent or plant stack). The typical processing technique is one of holdup or delay to allow the short-lived activity to decay. Adsorption on activated charcoal or compression and storage are two methods used to create the necessary holdup time. Processing systems will be designed to process gaseous wastes generated by normal plant operation and anticipated operational occurrences.

Minor leakage of radioactive gases from plant systems to building atmosphere will be detected by area radiation monitors. Ventilation systems will process these gases by filtration, if needed, and direct them to a controlled and monitored release point.

Gaseous radwaste discharges will be controlled to the requirements of 10 CFR 20 and the ALARA principles of 10 CFR 50, Appendix I. Gaseous radwaste system equipment will be designed to ensure occupational exposures to plant personnel are as low as reasonable achievable. Bounding release quantities are provided in Table 3.5-2.

3.5.4 Solid Radioactive Waste Management System

Solid radioactive wastes are produced by multiple activities in a nuclear power station. The solid waste can be either wet or dry, depending on whether the source is a processing activity, maintenance, or other function such as housekeeping. The solid radioactive waste management system is designed to collect, monitor, segregate, process, and prepare solid radioactive wastes prior to and for their shipment or onsite storage. The system design will ensure that the wastes are handled, processed, and stored in a manner that minimizes exposure to plant personnel and the public in accordance with 10 CFR 20 and 10 CFR 50, Appendix I. The bounding total annual activity and generated volume of solid radwaste are 9600 Ci/yr and 16,722 ft^3/yr per unit, respectively.

Table 3.5-1
Composite Release Activities in Liquid Effluents (Ci/yr) per VCS Unit

Radionuclide	Release Activity	Radionuclide	Release Activity
H-3	1.60×10^{3}	Rh-106	7.35×10^{-2}
C-14	1.60×10^{-4}	Ag-110m	1.80×10^{-3}
Na-24	5.05×10^{-3}	Ag-110	1.40×10^{-4}
P-32	5.68×10^{-4}	Sb-124	4.30×10^{-4}
Cr-51	1.70×10^{-2}	Te-129m	1.20×10^{-4}
Mn-54	4.50×10^{-3}	Te-129	3.10×10^{-4}
Mn-56	3.81×10^{-3}	Te-131m	2.50×10^{-4}
Fe-55	9.46×10^{-3}	Te-131	7.60×10^{-5}
Fe-59	2.30×10^{-3}	Te-132	4.70×10^{-4}
Co-56	5.19×10^{-3}	I-131	1.41×10^{-2}
Co-57	7.19×10^{-5}	I-132	2.60×10^{-3}
Co-58	9.80×10^{-3}	I-133	3.73×10^{-2}
Co-60	1.54×10^{-2}	I-134	1.70×10^{-3}
Ni-63	1.70×10^{-3}	I-135	1.09×10^{-2}
Cu-64	1.26×10^{-2}	Cs-134	1.20×10^{-2}
Zn-65	4.41×10^{-4}	Cs-136	2.20×10^{-2}
Zn-69m	7.51×10^{-4}	Cs-137	1.80×10^{-2}
Br-83	1.00×10^{-4}	Cs-138	1.90×10^{-4}
Br-84	2.00×10^{-5}	Ba-137m	1.25×10^{-2}
Rb-88	2.80×10^{-2}	Ba-139	3.00×10^{-5}
Rb-89	4.41×10^{-5}	Ba-140	5.80×10^{-3}
Sr-89	3.14×10^{-4}	La-140	8.00×10^{-3}
Sr-90	3.51×10^{-5}	La-142	2.00×10^{-5}
Sr-91	1.25×10^{-3}	Ce-141	2.97×10^{-4}
Sr-92	8.00×10^{-4}	Ce-143	5.00×10^{-4}
Y-90	3.11×10^{-6}	Ce-144	5.60×10^{-3}
Y-91m	4.40×10^{-5}	Pr-143	1.30×10^{-4}
Y-91	2.35×10^{-4}	Pr-144	3.16×10^{-3}
Y-92	1.69×10^{-3}	Nd-147	2.00×10^{-6}
Y-93	1.36×10^{-3}	W-187	3.50×10^{-4}
Zr-95	1.30×10^{-3}	Np-239	9.49×10^{-3}
Nb-95	2.00×10^{-3}	Mo-99	2.61×10^{-3}
Tc-99m	5.68×10^{-3}	Ru-106	7.35×10^{-2}
Ru-103	4.93×10^{-3}	Rh-103m	4.93×10^{-3}
Ru-105	1.30×10^{-4}	Total	1.60×10^{3}

Note: The release activity of a given radionuclide is the highest of the activities for that radionuclide from a composite of all the reactor technologies considered for the ESP. These values are per reactor, except for mPower. For mPower, the activities from six reactors are considered when arriving at the composite values.

Table 3.5-2 (Sheet 1 of 2)
Composite Release Activities in Gaseous Effluents (Ci/yr) per VCS Unit

Radionuclide	Release Activity	Radionuclide	Release Activity
H-3	3.50×10^{2}	Rh-103m	1.11×10^{-4}
C-14	1.43×10^{1}	Rh-106	1.89×10^{-5}
Na-24	4.05×10^{-3}	Ag-110m	2.70×10^{-6}
P-32	9.19×10^{-4}	Sb-124	1.81×10^{-4}
Ar-41	2.04×10^{2}	Sb-125	6.10×10^{-5}
Cr-51	3.51×10^{-2}	Te-129m	2.19×10^{-4}
Mn-54	5.41×10^{-3}	Te-131m	7.57×10^{-5}
Mn-56	3.51×10^{-3}	Te-132	1.89×10^{-5}
Fe-55	6.49×10^{-3}	I-131	2.59×10^{-1}
Fe-59	8.11×10^{-4}	I-132	2.19
Co-57	8.20×10^{-6}	I-133	1.70
Co-58	2.30×10^{-2}	I-134	3.78
Co-60	1.30×10^{-2}	I-135	2.41
Ni-63	6.49×10^{-6}	Xe-131m	1.80×10^{3}
Cu-64	1.00×10^{-2}	Xe-133m	8.70×10^{1}
Zn-65	1.11×10^{-2}	Xe-133	4.60×10^{3}
Kr-83m	2.30×10^{-3}	Xe-135m	5.95×10^{2}
Kr-85m	3.60×10^{1}	Xe-135	7.57×10^{2}
Kr-85	4.10×10^{3}	Xe-137	7.57×10^{2}
Kr-87	3.78×10^{1}	Xe-138	6.22×10^{2}
Kr-88	5.68×10^{1}	Xe-139	4.05×10^{-4}
Kr-89	3.78×10^{2}	Cs-134	6.22×10^{-3}
Kr-90	3.24×10^{-4}	Cs-136	5.95×10^{-4}
Rb-89	4.32×10^{-5}	Cs-137	9.46×10^{-3}
Sr-89	5.68×10^{-3}	Cs-138	1.70×10^{-4}
Sr-90	1.20×10^{-3}	Ba-137m	3.60×10^{-3}
Sr-91	1.00×10^{-3}	Ba-140	2.70×10^{-2}
Sr-92	7.84×10^{-4}	La-140	1.81×10^{-3}
Y-90	4.59×10^{-5}	Ce-141	9.19×10^{-3}
Y-91	2.41×10^{-4}	Ce-144	1.89×10^{-5}
Y-92	6.22×10^{-4}	Pr-144	1.89×10^{-5}
Y-93	1.11×10^{-3}	W-187	1.89×10^{-4}
Zr-95	1.59×10^{-3}	Np-239	1.19×10^{-2}
Nb-95	8.38×10^{-3}	Total	1.44×10^{4}

Table 3.5-2 (Sheet 2 of 2)
Composite Release Activities in Gaseous Effluents (Ci/yr) per VCS Unit

Radionuclide	Release Activity	Radionuclide	Release Activity
Mo-99	5.95×10^{-2}		
Tc-99m	2.97×10^{-4}		
Ru-103	3.51×10^{-3}		
Ru-106	7.80×10^{-5}		

Note: The release activity of a given radionuclide is the highest of the activities for that radionuclide from a composite of all the reactor technologies considered for the ESP. These values are per reactor, except for mPower. For mPower, with the exception of C-14, the activities from six reactors are considered when arriving at the composite values. As the source for mPower is still being developed, the design currently uses the C-14 activity provided in NUREG-0017 for a 3400 MWt PWR, using no scaling to adjust for the much lower thermal power of the mPower. However, multiplying this value times six to account for six mPower reactors (a total of 2550 MWt) would be overly conservative. As such, the next highest C-14 release (ESBWR), which is greater than that in NUREG-0017, is used to represent the six mPower reactors in the composite gaseous source term.

3.6 Nonradioactive Waste Systems

The section provides descriptions of nonradioactive waste systems for VCS. Typical nonradioactive waste systems addressed are: (1) waste streams with effluents containing chemicals or biocides, (2) sanitary system effluents, and (3) miscellaneous or other effluents. Because a reactor design has not been selected for VCS, descriptions in this section are based on the best information currently available from industry operating experience and regulatory guidance.

3.6.1 Effluents Containing Chemicals or Biocides

The maintenance of proper water chemistry 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. Biocides and chemical additives used in plant systems will be those approved by the EPA or the state of Texas. A discussion of chemical treatments for potential use at VCS is located in Subsection 3.3.2. Waste effluents from equipment such as water filters, demineralized water system reverse osmosis and electro-deionization rejects, sanitary waste treatment plant, and nonradioactive drains throughout the station will be collected in the blowdown sump and subsequently pumped to the cooling basin. Blowdown from any UHS/service water system mechanical draft cooling towers will be discharged directly to the cooling basin. Cooling basin blowdown, required to maintain acceptable water quality in the basin, will be discharged to the Guadalupe River.

The effluents associated with these nonradioactive systems may contain low concentrations of some chemicals and/or biocides in addition to those chemicals contained originally in the Guadalupe River. The concentrations of chemicals in the river and groundwater makeup sources, including the 126 Priority Pollutants from 40 CFR 423, Appendix A, are described in Subsection 2.3.3. The concentration of chemicals in the cooling basin will be monitored by laboratory testing and the water will be treated, if necessary, to ensure that the limits established in the Texas Pollution Discharge Elimination System (TPDES) permit to be issued by the Texas Commission on Environmental Quality (TCEQ) are met before the cooling basin blowdown is released to the Guadalupe River.

The systems that require a means of control and treatment are described in Subsection 3.3.2. The average and maximum concentrations of natural material in the makeup and well water are addressed in Subsection 2.3.3. The constituents and concentrations for the groundwater makeup are shown in Table 2.3.3-3. The constituents and concentrations in the makeup to the cooling basin and the blowdown effluent to the Guadalupe River are shown in Table 3.6-1.

3.6.2 Sanitary System Effluents

A sanitary waste system will be maintained on site during the construction and operation of VCS with effluents in compliance with acceptable industry design standards, the Clean Water Act, and the TPDES permit.

A permanent sanitary treatment facility will be constructed onsite and designed to provide capacity for the site. Treated water will be routed to the blowdown sump which, in turn, will be pumped to the cooling basin. Waste sludge generated at the water treatment plant and sanitary wastewater treatment plant will be disposed of offsite via contract with a licensed waste transportation and disposal company. Offsite sludge disposal methods could include landfilling, incineration, land application, and/or further treatment at licensed facilities. This sludge will be regularly monitored for radioactivity before discharge. In the event that sewage sludge becomes radioactively contaminated above the anticipated background level and regulations prohibit discharge, the sludge will be processed by the solid waste management system. For information on the solid waste management system, see Subsection 3.5.4.

The permanent sanitary waste discharge system for VCS will be designed to collect and transfer sanitary water/waste from the potable water and sanitary waste system to the sewage treatment facility. The sewage treatment facility will be a standard industry design for processing the sanitary water/waste to meet local and state regulations for the effluent quality. Operation of the permanent sewage treatment system will be independent of plant operational mode (full power operation, shutdown/refueling, and startup).

Portable sanitary facilities will be used until a permanent sanitary waste treatment facility is functional and as needed during peak construction or outage activities to augment the permanent system. These temporary facilities will include centralized restroom and hand-wash trailer(s) in addition to single restroom units located throughout the site, as necessary. Waste collected in temporary facilities will be disposed of by a licensed sanitary waste disposal contractor.

Technology for processing wastes will include laboratory testing of effluents to ensure proper treatment. Monitoring will be conducted to ensure compliance with regulatory limits.

3.6.3 Other Effluents

This section describes miscellaneous gaseous, liquid, and solid effluents not addressed in Subsections 3.6.1 and 3.6.2.

3.6.3.1 **Gaseous Effluents**

VCS plant operation will result in small amounts of nonradioactive gaseous emissions (including airborne particulate) from equipment associated with plant auxiliary systems (e.g., diesel engines, combustion turbines, and auxiliary boilers if fired by gas or oil). Operation of this equipment and the associated emissions will be intermittent. Emissions will be regulated by permits that will specify the allowable limits and frequency. Tables 3.6-2, 3.6-3, and 3.6-4 provide representative values of these releases.

3.6.3.2 **Liquid Effluents**

Nonradioactive liquid effluents (excluding laboratory wastes) will be discharged to the cooling basin. Process diagrams of the liquid effluents (use and discharge) are provided in Figures 3.3-1 and 3.3-2. Concentrations of applicable constituents in nonradioactive liquid effluents that will be discharged (via cooling basin blowdown) to the Guadalupe River will be limited under the TPDES permit. This permit could also limit mass loading to the river by specifying allowable discharge quantities. Laboratory testing of liquid effluents will be performed to ensure proper treatment. The pollutants listed in 40 CFR 423, Appendix A, *EPA Steam Electric Power Generating Point Source Category, 126 Priority Pollutants*, if present on site, will be tracked and monitored.

The liquid lab wastes generated by sampling systems will be tested and disposed of in the radioactive liquid waste management system.

The stormwater that collects in the protected area will be directed to two retention ponds, one on the east side of the plant and the other on the west. Overflow to these ponds will be directed to Linn Lake and Kuy Creek, for the east and west ponds, respectively.

3.6.3.3 **Solid Effluents**

Nonradioactive solid wastes typically include industrial wastes such as metal, wood, and paper, and process wastes like resins and sludges. To the extent practicable, scrap metal, lead-acid batteries, and paper will be recycled offsite at an approved recycling facility. Laboratory testing may be completed to ensure proper treatment of the solid waste effluent.

Debris (e.g., vegetation) collected on trash screens at the water intake structure(s) will be disposed of either on site or offsite as solid waste in accordance with TCEQ regulations.

Nonradioactive hazardous wastes will be collected and stored temporarily on site until disposed of at licensed offsite commercial waste disposal facilities or recovered at an offsite permitted recycling or recovery facility. Solid effluents will meet the requirements of the Solid Waste Disposal Act of 1965.

3.6.3.4 **Hazardous Wastes**

Hazardous wastes are wastes with properties that make them dangerous or potentially harmful to human health or the environment, or that exhibit at least one of the following characteristics: ignitability, corrosivity, reactivity, or toxicity. Federal Resource Conservation and Recovery Act regulations govern the generation, treatment, storage, and disposal of hazardous wastes.

Based on Exelon's fleet operating experience, VCS would be expected to be registered as a Small Quantity Generator for hazardous waste and would typically generate no more than 2200 pounds (between 220 and 2200 pounds) of hazardous waste per month. VCS would implement a waste minimization plan, as described in Subsection 5.5.2.3.

Wastes will be stored temporarily on site, packaged in an approved U.S. Department of Transportation container, and periodically disposed of at a permitted disposal facility. All hazardous waste activities will be performed in compliance with federal regulations. Treatment, storage, and disposal of wastes generated by construction and operations of VCS will be governed by local and federal regulations.

Table 3.6-1 (Sheet 1 of 2)
River Water and Cooling Basin Blowdown Constituents and Concentrations

Symbol	Constituent Name	River Water ppm (mg/L)	Cooling Basin Blowdown ppm (mg/L)
NH_3	Ammonia as N	0.28	1.35
—	BOD	8.67	30.1
B	Boron	0.127	0.453
Cr	Chromium +6	0	0
—	COD	20.1	69.8
F	Fluoride	0.306	1.07
—	Alkalinity, total as $CaC0_3$	201	698
$N0_3$	Nitrate as N	1.86	7.24
—	Oil and Grease	0	0.082
$S0_4$	Sulfate	50.4	181
S	Sulfide	2	6.97
TKN	Total Kjeldahl Nitrogen	0.974	3.45
—	TOC	5.2	19.7
—	TDS	425	1948
—	TSS	94.3	327
P	Phosphorous	0.3	1.07
$P0_4$	Phosphate	0.437	1.55
Al	Aluminium	4.94	17.1
Sb	Antimony	0	0
As	Arsenic	0	0
Ba	Barium	0.109	0.393
Be	Beryllium	0	0
Cd	Cadmium	0	0
Cr	Chromium	0	0
Co	Cobalt	0	0
Cu	Copper	0	0
Fe	Iron	2	6.93
Pb	Lead	0.00335	0.0116
Mo	Molybdenum	0	0
Ni	Nickel	0	0
Se	Selenium	0	0
Sr	Strontium	0.576	2.03
Ag	Silver	0	0
Sn	Tin	0	0
Ti	Titanium	0.0454	0.157

Table 3.6-1 (Sheet 2 of 2)
River Water and Cooling Basin Blowdown Constituents and Concentrations

Symbol	Constituent Name	River Water ppm (mg/L)	Cooling Basin Blowdown ppm (mg/L)
Zn	Zinc	0.0202	0.070
Ca	Calcium	87.7	304
Fe	Dissolved Iron	0	0.012
Mg	Magnesium	14.8	51.4
Mn	Manganese	0.0605	0.209
Mn	Dissolved Manganese	0	0.000611
K	Potassium	5.64	19.6
Na	Sodium	59.3	219
V	Vanadium	0	0
$Si0_2$	Silica as $Si0_2$	15.3	53.5
$Si0_2$	Dissolved Silica as $Si0_2$	9.8	34.0
Cl	Chloride	56.5	235
$N0_2$	Nitrite as N	0.051	0.176
—	Conductivity (μmhos/cm)	698	2486
—	pH (standard units)	7.52 to 8.37	4.91
Tl	Thallium	0	0
Hg	Mercury	0	0

Table 3.6-2
Yearly Emissions from Standby Diesel Generators for VCS

Constituent	Emissions (Pounds per Year)
Particulates	4,660
Sulfur Oxides	94,787
Carbon Monoxide	9,200
Hydrocarbons	9,479
Nitrogen Oxides	126,382

Notes:
Emissions are based on 4 hours per month of operation of the generators.
Emissions are based on use of diesel fuel oil with a maximum sulfur content of 3% by weight.

Table 3.6-3
Yearly Emissions from Combustion Turbine Generators for VCS

Constituent	Pounds per Year
Particulates	44
Sulfur Oxides	3824
Carbon Monoxide	1824
Hydrocarbons	116
Nitrogen Oxides	4032

Note: Emissions are based on 4 hours per month of operation of the generators.

Table 3.6-4
Yearly Emissions from Auxiliary Boilers for VCS

Constituent	Pounds per Year
Particulates	2,876
Sulfur Oxides	1,030
Carbon Monoxide	6,534
Hydrocarbons	360
Nitrogen Oxides	28,748

Note: Emissions are based on 30 days operation per year.

3.7 Power Transmission System

This section identifies the interconnection components and activities necessary to complete the interface between the VCS units and their associated switchyards (if required), VCS American Electric Power (AEP) WHY Substation and the interconnections to the regional power grid, for offsite power supply to VCS and for VCS-generated power export. These components include:

- A new onsite AEP 345 kV WHY Substation for VCS.
- Onsite 345 kV tie-lines from VCS unit switchyards to the new AEP 345 kV WHY Substation. The 345 kV switchyards interconnect the VCS generator main unit auxiliary, and reserve auxiliary transformer terminals with AEP WHY Substation.
- Six new or rerouted AEP 345 kV transmission lines (eight total circuits) that interconnect VCS with various existing 345 kV substations and a new Cholla substation of the regional AEP transmission system.

Switchyard and substation activities will involve construction on the VCS site. Transmission facilities are constructed within designated overhead transmission line corridors to remote transmission provider interconnection substation locations.

In addition, six new or rerouted 345 kV transmission lines (eight total circuits) and one 138 kV transmission line, remote from the VCS site and beyond the VCS-direct interconnections, have been identified to fully integrate the VCS generation into the regional transmission grid and to enhance economic dispatch. Impacts of construction and operation of these lines are not addressed further.

3.7.1 **Switchyard and Substation Interfaces**

The VCS generator main, unit auxiliary, and reserve auxiliary transformers will be connected to the unit switchyards. Onsite tie-lines will connect the unit switchyards to the AEP WHY Substation.

The AEP 345 kV WHY Substation will be provided to accommodate the output of the VCS units. The location of this new substation will be on the VCS site, approximately 1000 feet north of the VCS power block area. The design of the substation will be a standard air-insulated breaker-and-a-half scheme and will be comprised of eight high-voltage equipment bays in the configuration, two of which are reserved for future transmission lines.

The dimensions, material, color, and finish of the substation structures will be in accordance with AEP design practices.

3.7.2 Transmission System

The following describes the power transmission system line components, the corridor locations for the lines, and prospective ownerships.

Six new regional 345 kV overhead transmission lines (two double-circuit and four single-circuit) would connect to the new AEP WHY Substation on the VCS site. Figure 3.7-1 provides the overall transmission system interconnection configuration and transmission corridors' general locations for the VCS site and outlying region.

The transmission line corridors are as follows:

WHY Substation to Existing Coleto Creek Substation

- Construction: double-circuit, overhead, lattice, or tubular steel structures
- Length: Approximately 20 miles
- Conductors/Rating: 1590 kcmil ACSR, 1852/2740 MVA (normal/emergency)
- Route: The lines between WHY and Coleto Creek will require a new corridor that takes a generally northwest-southeast path between the substations. An alternate corridor based on colocation with existing 138 kV lines is possible. Final route selection will be based on considerations of least impact to the community and lowest cost.
- Counties traversed: Victoria, Goliad
- Owner: AEP[1]

WHY Substation to Existing Hillje Substation

- Construction: double-circuit, overhead, lattice, or tubular steel structures
- Length: Approximately 60 miles
- Conductors/Rating: 1590 kcmil ACSR, 1852/2740 MVA (normal/emergency)

1. Indicates ownerships are tentative. ERCOT planning process will establish final ownership.

- Route: A candidate "northern" route corridor follows an existing 138 kV line northeast to the existing STP-Whitepoint 345 kV line. The candidate "southern" route corridor follows a rail line to the existing STP-Whitepoint 345 kV line. The corridor then heads northeast where the existing 345 KV line turns southeast to STP. From that point to Hillje, the new lines would generally parallel existing 138 kV lines into Hillje substation.
- Counties traversed: Victoria, Calhoun, Jackson, Wharton
- Owner: AEP[1]

WHY Substation to Existing Blessing Substation

- Construction: single-circuit, overhead, lattice, or tubular steel structures
- Length: Approximately 60 miles
- Conductors/Rating: 1590 kcmil ACSR, 1852/2740 MVA (normal/emergency)
- Route: This line will parallel the new line to Hillje described above, up to a point near the existing Lolita Substation. At this point, the new line will head east to Blessing Substation, generally paralleling existing 138 kV lines.
- Counties traversed: Victoria, Calhoun, Jackson, Matagorda
- Owner: AEP[1]

The following lines consist primarily of reuse of existing operating 345 kV line infrastructure from STP to Whitepoint Substation:

WHY Substation to Existing STP Substation

There is an existing 345 kV line between STP and Whitepoint Substation that passes nearby the WHY Substation. This line will be "looped in" to the WHY Substation from the intersection point.

- Construction: single-circuit, overhead, lattice, or tubular steel structures
- Length: 6–20 miles to existing line intersection point.
- Line Rating: 1011/1011MVA (normal/emergency)

1. Indicates ownerships are tentative. ERCOT planning process will establish final ownership.

- Route: The line will leave WHY Substation and head east to the existing right-of-way and connect into the existing line to STP. This is an existing line, so no new right-of-way is required beyond the intersection point.
- Counties traversed: Victoria, Calhoun, Jackson, Wharton, Matagorda
- Owner: AEP[1]

WHY Substation to Existing Whitepoint Substation

- There is an existing 345 kV line between STP and Whitepoint Substation that passes nearby the WHY Substation. This line will be “looped in” to the WHY Substation from the intersection point.
- Construction: single-circuit, overhead, lattice, or tubular steel structures
- Length: 6–20 miles to existing line intersection point.
- Line Rating: 1011/1011MVA (normal/emergency)
- Route: The line will leave WHY Substation and head east to the existing right-of-way and there connect into the existing line to Whitepoint. This is an existing line, so no new right-of-way is required beyond the intersection point.
- Counties traversed: Victoria, Calhoun, Jackson, Refugio
- Owner: AEP[1]

WHY Substation to New Cholla Substation

The Cholla Substation is expected to be built before VCS site completion, to accommodate other generation interconnections. This new substation is expected to be located in the vicinity of the existing 138 kV and 345 kV transmission lines between STP and Elm Creek Substation (San Antonio region). This would place the new substation approximately 40 miles northwest of WHY Substation, in DeWitt County.

- Construction: single-circuit, overhead, lattice, or tubular steel structures
- Length: Approximately 46 miles
- Conductors/Rating: 1590 kcmil ACSR, 1852/2740 MVA (normal/emergency)

1. Indicates ownerships are tentative. ERCOT planning process will establish final ownership.

- Route: The new 345 kV line would follow a direct path northwest and would colocate with existing transmission lines where practical. Additional right-of-way width would be required.
- Counties traversed: Victoria, Goliad, DeWitt.
- Owner: AEP[1]

The following transmission lines beyond the VCS-direct interconnections are necessary to fully deliver VCS-generated power to the regional transmission grid under the range of system operating and line outage scenarios:

Cholla Substation to Zorn Substation

A new double-circuit 345 kV line will be connected from Cholla Substation to the existing Zorn Substation. The Zorn Substation is part of the existing 345 kV transmission system that includes the STP-Elm Creek line. It would be expected that the new line could use (or widen) the existing right-of-way used by the STP-Elm Creek lines. Zorn is in Guadalupe County, east of San Antonio.

- Length: Approximately 75 miles
- Counties traversed: DeWitt, Gonzales, Wilson, Guadalupe
- Owner: AEP[1]

Cholla Substation to Coleto Creek Substation

A new single-circuit 345 kV line would be connected between Cholla and the existing Coleto Creek substation in Goliad County. There is an existing 138 kV system that exists between Victoria Substation and Coleto Creek Substation. This new line may be able to colocate with the existing transmission lines where practical. Additional right-of-way width would be required.

- Length: Approximately 40 miles
- Counties traversed: Goliad, DeWitt
- Owner: AEP[1]

1. Indicates ownerships are tentative. ERCOT planning process will establish final ownership.

Cholla Substation to Elm Creek Substation to STP Substation

The existing Elm Creek to STP 345 kV circuit, in the vicinity of the new Cholla Substation would be "looped in" to the Cholla Substation to facilitate these two new line terminations. Therefore, no new transmission line construction is necessary.

- Counties traversed (by existing line): DeWitt, Gonzales, Wilson, Guadalupe, Victoria, Lavaca, Jackson, Wharton, Matagorda

Hillje Substation to O'Brien Substation

A new double-circuit 345 kV line will be required between the existing Hillje Substation and the existing O'Brien substation in Fort Bend County, southwest of Houston. This line will support the output of the STP and VCS to the Houston area. There are existing 345 kV lines between Hillje and W. A. Parrish Station, and between W. A. Parrish Station and O'Brien. These existing transmission lines rights-of-way may be used or widened for this new line.

- Length: Approximately 70 miles
- Counties traversed: Wharton, Fort Bend
- Owner: CenterPoint Energy[1]

Marion Substation to Elm Creek Substation

A new single-circuit 345 kV line, nominally 14 miles in length, will be connected between Marion and Elm Creek. There is an existing 345 kV line between these substations, thus the new line could be able to use or widen this existing corridor

- Length: Approximately 14 miles
- Counties traversed: Guadalupe
- Owners: CenterPoint Energy and Lower Colorado River Authority[1]

East Bernard Substation to Flewellen Substation

A new single-circuit 138 kV transmission line will be constructed from the existing East Bernard Substation to the existing Flewellen Substation.

- Length: 29 miles

1. Indicates ownerships are tentative. ERCOT planning process will establish final ownership.

- Counties traversed: Fort Bend, Austin, Wharton
- Owner: CenterPoint Energy[1]

In addition, certain upgrades of existing transmission facilities will be required. This will consist principally of reconductoring of existing transmission circuits and installation of new transformers at existing substations.

3.7.3 **Transmission Line Rights-of-Way (Corridors)**

The following describes the power transmission system features and the applicable regulations governing transmission system and facilities design, construction, operation, and maintenance.

Transmission service providers in the Electric Reliability Council of Texas (ERCOT) region are subject to regulations of the Public Utility Commission of Texas (PUCT), which requires that new transmission facilities and interconnections consider alternative means for providing necessary transmission capacity that are least costly, operationally sound, and use existing capacity when available. (PUCT 2008)

In accordance with PUCT requirements, an interconnection study was prepared by the transmission service provider in 2008 to address power transmission options for VCS. The power transmission system interconnections described herein are, in large part, based on this study. The study was based on a total grid injection value of 3200 MWe. This value bounds the maximum grid injection value based on the net electrical output of the reactor technologies discussed in Section 3.1.

The end result of the selection process is the identification of a preferred corridor for each transmission line. Selection of transmission line rights-of-way is described in Section 9.4 and Subsection 2.2.2. The lengths, widths, and area of rights-of-way, including modification and use of existing rights-of-way, are also described in that section.

Ruling spans for transmission lines will be defined during detailed design of the lines by the transmission service provider. The transmission line corridors of the transmission system are described in detail in Subsection 3.7.2. Single-tower lines occupy nominal 150-foot-wide final rights-of-way in the respective corridor. Parallel and adjacent lines require nominal final right-of-way widths of 300 feet and 450 feet for colocated cases of two or three lines, respectively, to accommodate the side-by-side towers.

Topographic maps for transmission corridors that have been studied to date are provided in the Electrical Transmission Corridor Study, referenced in Subsections 2.2.2 and 2.2.4.

1. Indicates ownerships are tentative. ERCOT planning process will establish final ownership.

3.7.3.1 Transmission Line Rights-of-Way Ecological and Cultural Surveys

The Texas PUCT will select the transmission corridor routes during the Certificate of Convenience and Necessity (CCN) process. As part of final transmission corridor selection, the transmission service provider will provide the PUCT with information on the ecological and cultural resources along the alternative corridors. Given that the final results of the PUCT CCN process are not available, the VCS ER relied upon a macro-corridor analysis that included the review of publicly available information on ecological and cultural resources, as detailed in Subsection 2.2.2.1. The results of the macro-corridor analysis are described in Section 2.4 and Subsection 2.5.3. Section 2.2 describes the Texas PUCT process for final selection of the preferred transmission line right-of-way.

3.7.3.2 Transmission Corridor Maintenance

The safe and reliable operation of transmission lines and corridors will be maintained through regular inspection of the structures, insulators, access areas, and vegetation in the rights-of-way. These inspections will consist of ground patrols (truck) and/or aerial (airplane/helicopter) patrols. Transmission lines normally require minimal maintenance. However, the line owners will regularly inspect the transmission lines to identify problems caused by weather, vandalism, vegetation growth, etc.

In areas that are not in active agricultural cultivation, the line owners will manage vegetation within the rights-of-way using a variety of methods, including trimming, mowing, and the use of growth regulators and herbicides, targeting species that are incompatible with the safe access, operation, and maintenance of the transmission system.

The line owners' right-of-way maintenance program is site-specific. The exact manner in which maintenance will be performed will depend on location, type of terrain, and the surrounding environment. Vegetation removal will be minimized consistent with safe and reliable operation of the transmission lines. Each area of the right-of-way will be addressed based on site-specific vegetation. Endangered or threatened species, if present, are considered and accommodated in the maintenance program. Growth regulators and herbicides, when selectively used, will meet federal, state, and local regulations.

3.7.3.3 Transmission System Operation

The transmission lines owners will continue to operate and maintain their respective transmission lines after they are constructed. Protocol agreements between Exelon and the line owners will establish the communications protocols with the transmission service operators. These protocols will facilitate prompt and effective communications between the transmission service operators and the VCS plant operators. The transmission service operators regularly inspect their substations and perform regular maintenance and necessary repair or replacement of equipment.

The safe and reliable operation of transmission lines and corridors will be maintained through regular inspection of the structures, insulators, access areas, and vegetation in the right-of-ways as noted in Subsection 3.7.3.2.

3.7.3.4 **Noise**

Transmission lines and high-voltage substations can produce noise from corona discharge (the electrical breakdown of air into charged particles at the conductor surfaces). The noise, referred to as corona noise, occurs when air ionizes near irregularities such as nicks, scrapes, dirt, or insects on the conductors. Corona noise is composed of both broadband noise, characterized as a crackling noise, and pure tones, characterized as a humming noise. Corona noise, which is greater with increased voltage, is also affected by weather. During dry weather, the noise level is low and often indistinguishable from background noise. In wet conditions, water drops collecting on conductors can cause louder corona discharges.

During rain showers, the corona noise would likely not be readily distinguishable from background noise. During very moist, non-rainy conditions, such as heavy fog, the resulting small increase in the background noise levels is not expected to result in annoyance to adjacent residents.

The noise levels resulting from transmission system operations of the transmission system will be in accordance with the state and local code requirements. Actual decibel noise levels will be held to a minimum by proper sizing of conductors and the use of corona-free hardware. Corona-induced noise along existing 345 kV transmission lines is very low or inaudible.

Additional information regarding noise levels resulting from transmission system operation is provided in Subsection 5.6.3.4.

3.7.3.5 **Transmission Line Design and Methods of Construction**

The 345 kV overhead transmission lines will be constructed with steel towers to provide robust, proven, and long-lived infrastructure that provides electrical clearances and design factors consistent with the National Electrical Safety Code (NESC). (IEEE 2007)

The transmission service provider will construct the new 345 kV towers for the transmission lines using the utility's standard-type steel towers with designs providing clearances consistent with the NESC. Figure 3.7-2 represents a typical lattice construction tower. Tubular steel monopole construction could also be used. Tower foundations are of concrete construction and use foundation configurations and depths appropriate for local soil conditions. Conductor spans are maximized to reduce the number of towers required. This is beneficial to reduce overall line cost and to minimize tower access road and local site disturbance requirements. The dimensions, material, color, and finish of the transmission structures will be in accordance with AEP design practices.

The 345 kV transmission lines use bundle-type conductors in groups of two for each of the three current-carrying phases. This conductor configuration will be implemented for the new transmission lines to mitigate corona and audible noise formation. Transmission lines crossing roads and railroads will comply with NESC requirements for clearances. The design of all towers includes grounding methods with either ground rods or a counterpoise ground system. Lightning protection is provided by shield wires positioned above the current-carrying conductors.

The PUCT regulations impose standards of construction and operation of transmission facilities. When determining standard practices, the PUCT shall be guided by the provisions of the American National Standards Institute, NESC, and such other applicable codes and standards that are generally accepted by the industry, except as modified by the PUCT. Line owners are required to construct, install, operate, and maintain their respective transmission lines in accordance with the NESC, as a minimum, and in such a manner to best accommodate public safety needs.

Conductor minimum electrical clearances to ground will be in accordance with the requirements of the NESC. Conductor clearances, spacings, and geometry will limit electrostatic field effects sufficiently to ensure that maximum induced shock current to ground for a vehicle parked under the line will be consistent with the NESC 5-milliamp standard.

The indicated owners will construct these new transmission lines. The line owners and constructors are expected to implement mitigation measures adapted to the specifics of each project in accordance with Title 16, Part 2, Section 25.101(d) of the Texas Administrative Code (PUCT 2008) and may include such requirements as:

- Selective clearing of the right-of-way to minimize the amount of flora and fauna disturbed.
- Implementation of erosion control measures.
- Reclamation of construction sites with native species of grasses, forbs, and shrubs.
- Returning the site to its original contours and grades.

The transmission line owners must obtain Certificates of Convenience and Necessity from the PUCT for new transmission lines. The development of related environmental impact studies of alternative transmission corridors and the selection of final transmission line rights-of-way is a detailed and lengthy process. Detailed design and construction of the transmission lines will be done close to the time of the need to be in service.

3.7.4 **References**

IEEE 2007. Institute of Electrical and Electronics Engineers (IEEE), *National Electrical Safety Code (NESC)*, C2-2007, 2007 Edition.

PUCT 2008. Public Utility Commission of Texas, *Texas Administrative Code, Title 16, Part 2, Sections 25.101(d) and 25.195(c)*.

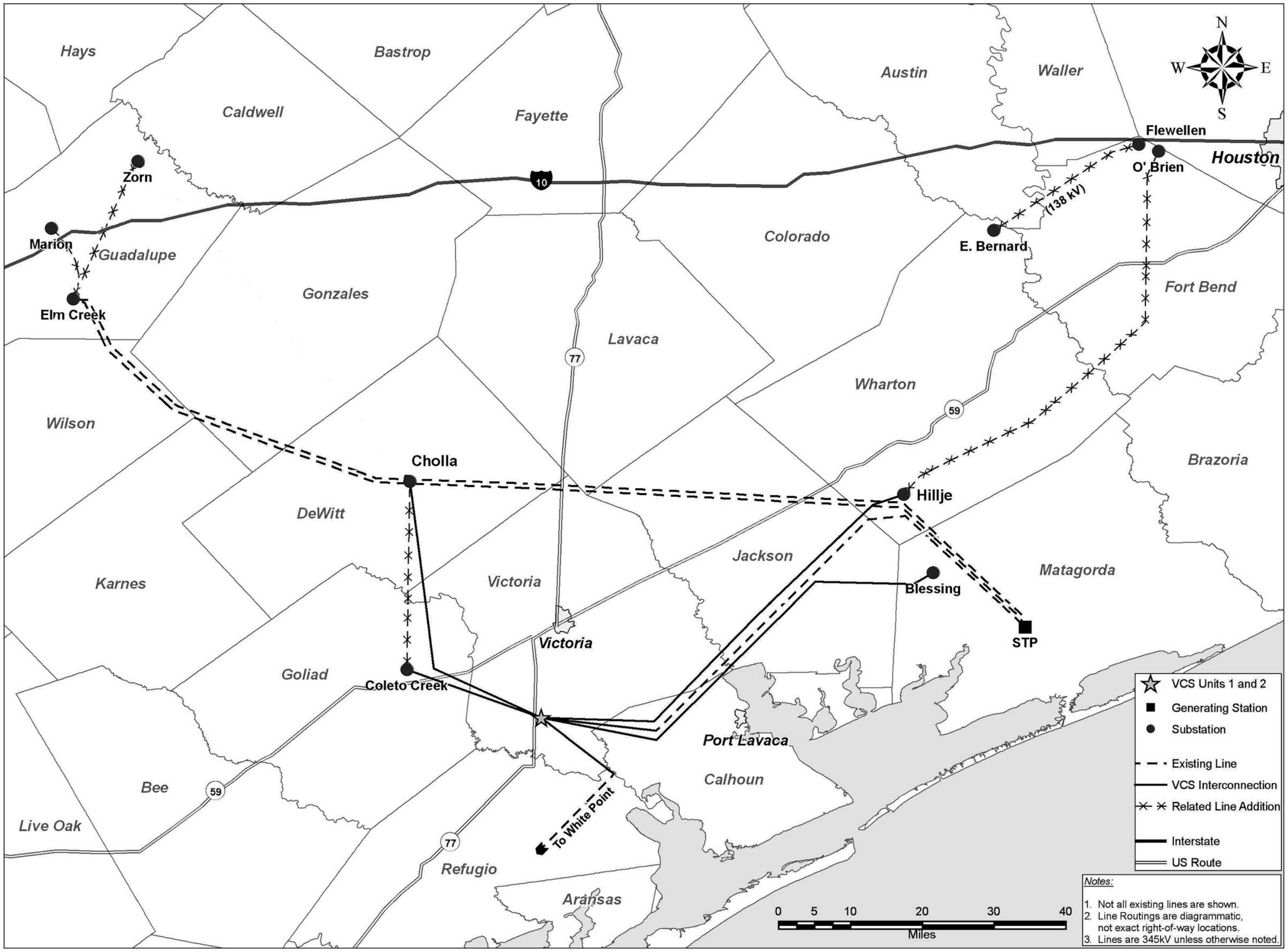


Figure 3.7-1 Transmission Corridors Conceptual Location Plan

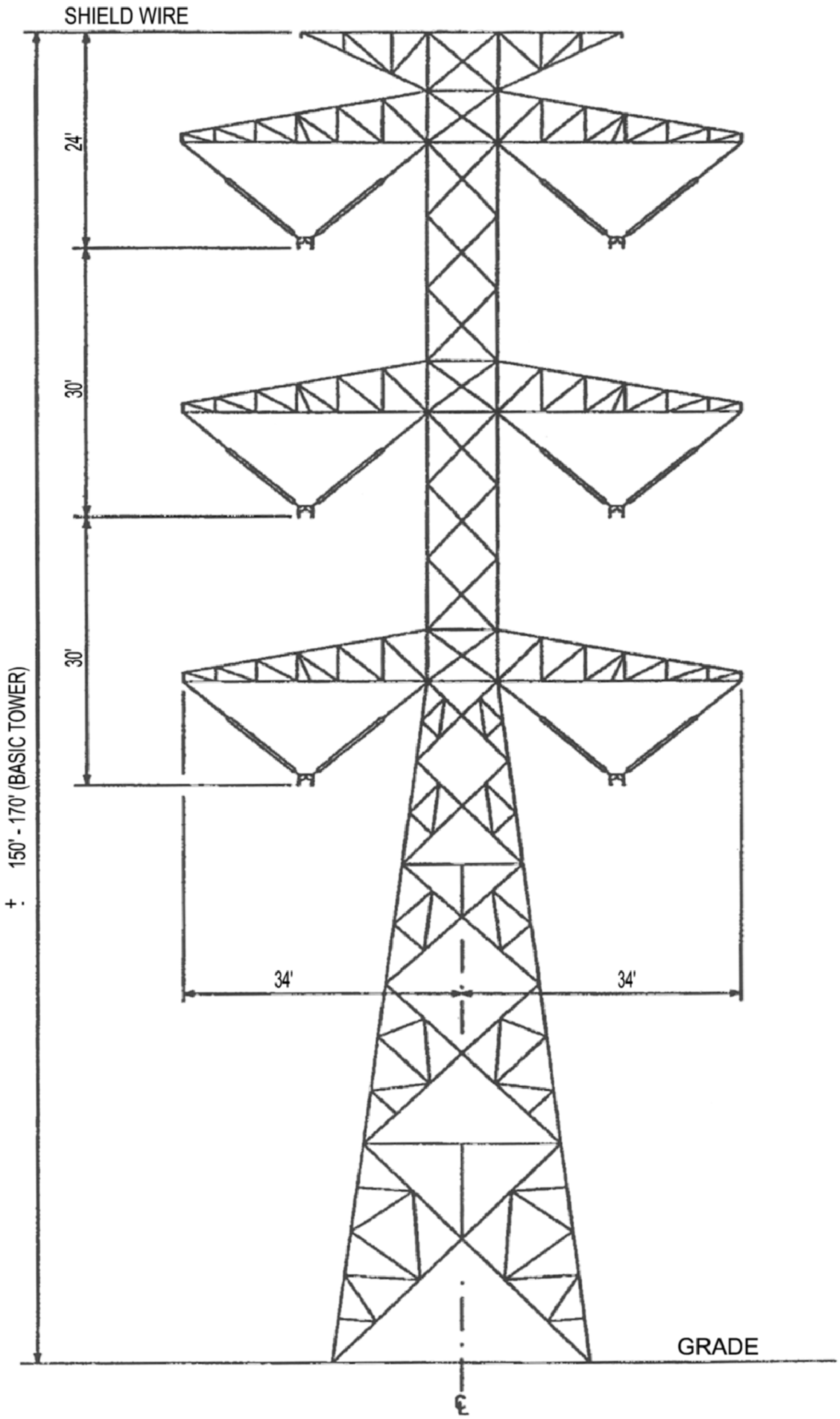


Figure 3.7-2 345 kV Transmission Tower

3.8 Transportation of Radioactive Materials

Operation of nuclear power units at the VCS site will require transportation of unirradiated fuel, irradiated fuel (spent nuclear fuel), and radioactive waste. The subsections that follow describe transportation of these three types of radioactive materials. Subsection 5.7.2 addresses the conditions in subparagraphs 10 CFR 51.52(a)(1) through (5) regarding use of Table S-4 to characterize the impacts of radioactive materials transportation and provides an analysis of the radiological impacts from incident-free transportation of these materials. Section 7.4 addresses radiological transportation accidents. The data currently available for the mPower reactor will not support an evaluation of radioactive materials transportation. Should Exelon select the mPower technology for VCS, an evaluation of radioactive materials transportation will be provided as part of the COL application.

3.8.1 Transportation of Unirradiated Fuel

Transportation of new fuel assemblies to the site from a fuel fabrication facility will be in accordance with U.S. Department of Transportation (U.S. DOT) and NRC regulations. The initial fuel loading will consist of 872 fuel assemblies for one ABWR unit (GE Mar 1997), 1132 fuel assemblies for one ESBWR unit (GEH Aug 2009), 157 fuel assemblies for one AP1000 unit (Westinghouse Sep 2008), and 257 fuel assemblies for one APWR unit (MHI Aug 2008).On an annualized basis, refueling will require approximately 173 fuel assemblies for one ABWR unit, 236 fuel assemblies for one ESBWR unit, 43 fuel assemblies for one AP1000 unit, and 65 fuel assemblies for one APWR unit.

The fuel assemblies will be fabricated at a fuel fabrication plant and shipped by truck to the site before fuel load. The details of the container designs, shipping procedures, and transportation routes will be in accordance with U.S. DOT (49 CFR 173 and 178) and NRC (10 CFR 71) regulations and depend on the requirements of the suppliers providing the fuel fabrication services. The truck shipments will not exceed 73,000 pounds net as governed by federal and state gross vehicle weight restrictions.

3.8.2 Transportation of Irradiated Fuel

Spent fuel assemblies will be discharged from each unit on an 18- to 24-month refueling cycle and will remain in the spent fuel pool at each unit for at least 5 years while short half-life isotopes decay, as required in 10 CFR 961, Appendix E. Each unit will have a spent fuel pool with capacity for at least 8 calendar years of fuel discharges plus one full core offload. The spent fuel pool storage capacity ranges from 8 years to 17 years of fuel discharges depending on the technology selected. After a minimum 5-year decay period, the fuel will be removed from the pool and packaged in casks for storage on site and eventual transport offsite. The spent fuel will be transferred to the independent spent fuel storage installation facility or a disposal facility. Packaging of the fuel for offsite shipment will comply with applicable U.S. DOT (49 CFR 173 and 178) and NRC (10 CFR 71) regulations for transportation of radioactive material. As required by the Nuclear Waste Policy Act of 1982, Section 302, DOE is responsible for spent fuel transportation from reactor sites to a repository and will make the decision on transport mode.

3.8.3 Transportation of Radioactive Waste

Solid low-level waste will be the only type of radwaste transported offsite in accordance with 10 CFR 51.52(a)(4). As described in Subsection 3.5.4, low-level radioactive waste will be packaged to meet transportation and burial site acceptance requirements. Packaging of waste for offsite shipment will comply with applicable U.S. DOT (49 CFR 173 and 178) and NRC (10 CFR 71) regulations for transportation of radioactive material. The packaged waste will be stored on site on an interim basis before being shipped offsite to a licensed processing or disposal facility. Onsite storage capacity will be provided for 30 days to more than 2 years volume of packaged waste, depending upon the technology selected (GE Mar 1997, GEH Aug 2009, Westinghouse Sep 2008, MHI Aug 2009). Radioactive waste will be shipped off site by truck.

3.8.4 References

GE Mar 1997. General Electric Nuclear Energy, *ABWR Design Control Document*, Revision 4, March 1997.

GEH Aug 2009. General Electric–Hitachi Nuclear Energy, *ESBWR Design Control Document*, Revision 6, August 2009.

MHI Aug 2008. Mitsubishi Heavy Industries, Ltd., *Design Control Document for the US-APWR*, Revision 1, August 2008.

Westinghouse Sep 2008. Westinghouse Electric Company, LLC, *AP1000 Design Control Document*, Revision 17, September 2008.

3.9 Construction Activities

Subsection 3.9, while not specifically a requirement of NUREG-1555, provides a summary of construction activities anticipated for VCS. The description of construction activities is pertinent to addressing potential impacts of plant construction as discussed primarily in Chapter 4.

The construction activities addressed in this section include preconstruction and site preparation activities that are nonsafety-related, and construction activities that are safety-related. The preconstruction and site preparation activities are less unit-specific and more project- and site-wide in nature, and could start anytime between ESP issuance and 20 years after ESP issuance. Construction activities, on the other hand, are mostly unit-specific, and could only start after COL issuance.

In addition to preconstruction and construction activities, this section provides a description of the construction and environmental processes and procedures associated with construction.

3.9.1 Preconstruction and Site Preparation Activities

Activities defined as not constituting "construction" by 10 CFR 50.10(a)(2) are permissible before issuance of a COL. These activities include installation of temporary facilities, construction support facilities, service facilities, utilities, barge unloading facilities, excavations and backfill of facility structures and foundations, and the construction of structures, systems and components (SSCs) that are not specifically described as construction activities in 10 CFR 50.10(a)(1). These activities may be performed as part of VCS preconstruction and site preparation.

Preconstruction planning and exploration activities, including a new meteorology tower at the northwest corner of the plant property, soil sampling and testing, geophysical borings, and monitoring wells have already been undertaken. Such activities are also not defined as "construction" as defined by 10 CFR 50.10(a)(2) and are permissible before the COL is issued.

Site preparation activities at VCS will also include:

- Installing temporary facilities (e.g., warehouses, concrete batch plant, craft change houses and sanitary facilities)
- Relocating obstructions and infrastructure within the VCS footprint
- Staging the equipment
- Preparing for the plant module assemblies
- Preparing activities to support power plant construction

Specific preconstruction and site preparation activities are addressed in the following subsections. Typical durations for these activities are provided in Table 3.9-1. Note that the durations are not sequential, and multiple activities can occur concurrently.

3.9.1.1 Installation and Establishment of Environmental Controls

The preconstruction and construction activities anticipated for VCS will comply with the federal, state, and local environmental regulations and permit requirements. Permits required for construction are generally described in Section 1.2. Best management practices will be implemented to minimize impacts during preconstruction and construction activities. Construction procedures and processes are addressed in Subsection 3.9.4.

Establishment of environmental controls will include evaluation of major land disturbance on and near the site because of the following activities:

- Constructing the power block area and related structures
- Constructing the substation/switchyard area
- Installing the cooling basin blowdown water pipeline to the Guadalupe River adjacent to the Victoria County Navigation District (VCND) transportation corridor
- Constructing the onsite construction roads and laydown areas
- Constructing the cooling basin
- Constructing the spoils areas
- Relocating the existing gas lines and constructing the rail spur
- Plugging and sealing of the existing gas/oil wells
- Installing the water makeup line from the intake structure on the Guadalupe River to the cooling basin

3.9.1.2 Clearing, Grubbing, and Grading

Clearing the site will begin with the removal of trees to the minimum extent necessary. Scrub vegetation and brush removal will be accomplished through the use of appropriate and approved techniques that may include controlled burning.

Three existing east/west pipelines that cross the plant property (two gas lines that traverse the cooling basin area, and one gas line that is located between the switchyard and power block) will be rerouted to the north around the planned substation. The new pipelines will be reconnected at the eastern and western property boundaries.

Existing gas/oil wells that are deemed necessary for in-place abandonment will be filled with concrete or grout, sealed and/or capped, and abandoned in accordance with the applicable guidelines of those regulatory agencies having jurisdiction. Other facilities within the cooling basin footprint will be removed.

Topsoil storage areas will be established at the site as needed. Existing topsoil from areas identified to require stripping will be removed and moved to the storage areas for later use during final site grading. The material below the topsoil may be used to build other structures as appropriate. Excess topsoil will be transported offsite, deposited on the outer perimeter of the cooling basin, and/or placed in established onsite spoils areas. Soil transported offsite will be reused or disposed of in accordance with applicable laws and regulations.

3.9.1.3 **Road, Rail, and Barge Facility Construction**

Construction vehicular traffic access to the site will be via U.S. Highway 77, which borders the plant property to the west. A construction access road will be constructed from U.S. Highway 77 onto the site property. A site road system will be installed around the site construction areas and the cooling basin. It is anticipated that the roads will be paved (subcourse) to accommodate the traffic, alleviate dust, and minimize stone projectiles from travel on a gravel road system. Upon project completion, the top course will be installed on the paved roads. The roads around the cooling basin will not be paved.

A new rail spur will connect the site to the Union Pacific railway line, which passes southeast of VCS property. The rail spur construction will include installation of new bed, ballast, ties and rail from the southeast perimeter of the site property to the northern plant boundary. The rail spur will be installed adjacent to the construction lay down areas to facilitate receipt of bulk commodities (e.g., pipe, reinforcing steel, structural steel) and will service the batch plant area to support concrete materials and backfill offloading. Railcar unloading facilities (car shakers, pneumatic railcar unloaders, rotary dumpers, or other effective methods of high volume railcar unloading) will be located at areas deemed appropriate. It is anticipated that the installation of offloading or material handling crane foundations will be required, and heavy lift cranes will be erected for the larger components that are delivered to the site.

The Victoria Barge Canal connects the Gulf Intracoastal Waterway (GIWW) to the Port of Victoria, and will be used for large module delivery. Three bridges span the canal between the Gulf and the

Port of Victoria (turning basin) with a limiting height clearance of approximately 50 feet and width clearance of approximately 75 feet. The turning basin barge facility is the preferred option for module receipt and will require minor upgrades to accommodate roll on/roll off transporters. These upgrades would be completed by VCND as part of the VCND transportation corridor construction.

The VCND is proposing to construct a transportation corridor to link the Port of Victoria to U.S. Highway 77. This project would enhance the region's multi-modal transportation capabilities, and would include improvements to the barge offload facility at the Port of Victoria and the construction of a road from the port to U.S. Highway 77. The road construction would require erection of a bridge over the Guadalupe River.

Upon exiting the Port of Victoria barge facility and crossing the Victoria Barge Canal levee, the transportation corridor would traverse the Guadalupe River floodplain in a southwesterly direction toward the VCS site. This portion of the corridor road would include drainage elements to reduce floodplain effects. The transportation corridor would run adjacent to the VCS site and shortly thereafter become a divided highway to its connection point with U.S. Highway 77. A separate heavy haul road would be constructed entirely on the VCS site to link the power block and fabrication areas with the transportation corridor.

The VCND would own the transportation corridor and would obtain the permits and authorizations necessary for its construction. VCS may aid the VCND in constructing the transportation corridor and would use the corridor during VCS construction. Use of the corridor in lieu of building a dedicated heavy haul road from the port to the site would minimize impacts to the environment. See Sections 4.7 and 5.11 for evaluations of the cumulative impacts associated with the VCND's construction and operation, respectively, of the proposed transportation corridor.

3.9.1.4 **Construction Security Program Implementation**

Construction security programs and features will be implemented as part of the early site preparation activities. Security structures will include access control points, fencing, lighting, physical barriers, and guardhouses.

Temporary security provisions will be installed in locations where access is to be limited to those having a need to be in that locale. Details of the site security plan will be provided as part of the COL application.

3.9.1.5 **Temporary Utilities Construction**

Temporary utilities will include aboveground and underground infrastructure for power, lighting, communications, potable water, wastewater and waste treatment facilities, fire protection, and construction gasses and air systems. The temporary utilities will support the entire construction site and associated activities, including construction offices, warehouses, storage and laydown areas, fabrication and maintenance shops, the power block, the batch plant facility, test and calibration labs, and the circulating water intake and discharge areas.

3.9.1.6 Temporary Construction Facilities Construction

The temporary construction parking lot and construction laydown and fabrication areas will be cleared, grubbed, graded, and graveled with a road system to accommodate the site construction traffic. Temporary construction facilities, including offices, warehouses, temporary workshops, sanitary facilities, locker rooms, training facilities, and access facilities will be constructed.

The site of the concrete batch plant will be prepared for cement and aggregate unloading and storage. Cement storage silos and the concrete batch plant will be erected. Dry material storage facilities will be equipment with fugitive dust control systems to meet the requirements of the applicable permits and guidelines.

3.9.1.7 Laydown, Fabrication, and Shop Area Preparation

Activities to support preparation of the laydown, fabrication, and shop areas will include:

- Conducting property surveys to establish local coordinates and placing benchmarks for horizontal and vertical control
- Developing laydown areas by grading, stabilizing, and surfacing these areas
- Installing construction fencing
- Installing shop and fabrication areas
- Installing concrete work slabs for formwork laydown, module assembly
- Installing equipment maintenance and parking areas
- Installing fuel and lubricant storage areas
- Installing concrete pads for cranes and crane assembly

3.9.1.8 Cooling Basin Construction

The cooling basin will have a footprint of approximately 5785 acres, and a water surface area, depending on the level, of approximately 4900 acres. The top of the perimeter embankment will be at an approximate elevation of 102 feet NAVD 88. The interior water flow diversion dikes will have a top elevation of approximately 99 feet NAVD 88. The bottom elevation of the basins will be approximately

69 feet NAVD 88 (with a 6-inch silt allowance [69.5 feet NAVD 88]), with the flow channel formed sloping down to the intake structure forebay at approximate elevation 60 feet NAVD 88. The high water elevation in the basins, when filled to the design depth, will be approximately 95 feet NAVD 88. The basin design will include a high water overflow spillway structure which will divert overflow to Kuy Creek to the southwest. The interior embankment slope design will include features to preclude erosion of the embankments.

After topsoil removal operations and topsoil storage, excavation of the northeast portion of the basin's area will begin. The excavated material from the northeast portion of the basin area will be used to construct the exterior dam embankment and interior dikes, thus leveling the basin's bottom while balancing the excavation cut and fill operation necessary to construct the basin structure.

Temporarily stockpiled topsoil within the basins will be relocated and deposited on the exterior perimeter of the basin's embankments, and will also be used for the finish grading around the power block area. The topsoil deposited around the basin's exterior will be vegetated for erosion control. A gravel perimeter road around the basin will be constructed with ramps located at appropriate locations to allow access to the top of the exterior and interior embankments. These roads will be used for periodic inspection and maintenance purposes.

3.9.1.9 **Cooling Basin Intake and Discharge Structure Installation**

The installation of the intake and forebay structure and the circulating water discharge structure are prerequisites to starting the cooling basin filling operations.

Once the excavation in the northeast interior perimeter of the cooling basin reaches the bottom of foundation elevation, work on foundations can begin, and civil work will continue into the major construction phases.

The intake and discharge structures will be reinforced concrete structures. The intake structure will rise from the bottom of the basin and forebay to the top of the basin embankment, but below the embankment road. The circulating water discharge piping will be routed from the discharge structure (at the bottom of the basin) over the top of the embankment above the design high water level but below the embankment access road. The circulating water and cooling basin blowdown piping will be routed over the embankment and go underground at the exterior perimeter of the basin. The circulating water pipelines will be routed to the turbine building. The completion of circulating water piping installation will coincide with turbine building pedestal basemat placement.

3.9.1.10 **Blowdown Discharge Line Installation**

The cooling basin blowdown discharge line will be installed adjacent to the VCND transportation corridor. The blowdown line will exit the intake structure and terminate at the Guadalupe River outfall diffuser approximately 3 miles upriver of the intake of the Invista-DuPont Plant. A cofferdam system will be installed around the footprint of the new blowdown discharge pipeline and diffuser. Excavation of the discharge pipe outfall diffuser cofferdam will be protected from silting the river by the use of silt screens or other approved techniques. The dewatering pumps required to maintain a dry excavation will also use approved silt prevention techniques before discharge to the Guadalupe River. Excavated and dredged material will be transported to a spoils area in the northern portion of the plant property or elsewhere to designated spoils areas as coordinated with the U.S. Army Corps of Engineers.

3.9.1.11 Raw Water Makeup System Pump Station and Pipeline Installation

To supply water to the cooling basin, a new pump station will be installed at a location approximately 8 miles southeast of the cooling basin. An intake canal will be built to carry water from the lower Guadalupe River to an intake basin at the new intake pumphouse location. The pumphouse will be a reinforced concrete two-level structure with the lower level submerged in the water basin. The pumphouse will occupy an area of 110 feet by 135 feet (at grade elevation), and will have a hypochlorite system and screen wash pumps for keeping the flow area clear through the trash screens. The pumphouse will house pumps to supply a 90-inch-diameter buried pipeline.

The buried pipeline will be constructed from the pump station, across the San Antonio River, to the south end of the cooling basin on the site. Two smaller pipes will be used where the pipeline crosses the San Antonio River, allowing for installation via horizontal directional drilling (HDD). Using HDD in lieu of conventional trenching techniques will minimize the impact to the river channel, reducing the potential for habitat and water quality impacts.

Three possible routes (designated as A, B, and C) for the makeup water pipeline are under consideration and have been surveyed. Route A would extend southwest from the pumping station for approximately 1.4 miles before turning northwest for 8.7 miles. This route would cross the San Antonio River, Elm Bayou, Cushman Bayou, Kuy Creek, and a tributary of Dry Kuy Creek. As reported in Table 2.2-3, land uses along this route would include cropland and pasture (approximately 65 percent), shrub and brush rangeland (17 percent), mixed forestland (13 percent), and deciduous forest (5 percent).

Route B would follow Route A from the pumping station for 1.4 miles then extend another 1.2 miles to the southwest. It then would extend to the northwest for 3.5 miles and converge with Route A for the remaining 5.2 miles. This route would cross the San Antonio River and one of its tributaries, cross Bayou, Cushman Bayou, Kuy Creek, and a tributary of Dry Kuy Creek. Land uses along this route would include shrub and brush rangeland (37 percent), cropland and pasture (44 percent), mixed forestland (14 percent), and evergreen forest (5 percent).

Route C would extend northwest from the pumping station for 8.5 miles to the VCS. It would cross the San Antonio River, Elm Bayou, Kuy Creek, a tributary of Kuy Creek, and Dry Kuy Creek.This route would also cross a Natural Resources Conservation Service Wetlands Reserve Program area between Elm Bayou and Kuy Creek. Land uses along this route would include cropland and pasture (41 percent), forested wetlands (35 percent), shrub and brush rangeland (10 percent), and mixed forestland (14 percent).

3.9.1.12 **Power Block Area Excavation**

Mass excavation of the VCS power block area will occur in conjunction with the site preparation activities. The power block area footprint encompasses the major buildings for each unit, such as the reactor building. The power block area will be excavated to varying depths as required by the design features of each structure.

It is anticipated that an extensive dewatering system will be installed around VCS units excavation boundary before the mass excavation begins. During the excavation, slope protection and temporary ground support systems will be installed. Swales and/or dikes will be constructed around the excavation areas to prevent surface water/runoff from entering the excavation work area. Drainage sumps and/or temporary well points will be installed at the bottom of the excavations from which surface drainage and/or accumulated groundwater will be pumped to a stormwater discharge point that will pipe the water to detention ponds to filter out turbidity and solids. Stormwater detention ponds will be located adjacent to the VCS units. Water from the power block area will be piped to the detention ponds which ultimately flow to Linn Lake and Kuy Creek.

Excavated material will be transferred to designated spoils and backfill borrow storage areas. Material removed from the excavation and evaluated as acceptable for reuse will be stored for common or structural backfill.

In accordance with RG 1.165 (U.S. NRC Mar 1997), Subsection (C.1.3), the open excavations will be geologically mapped and the NRC will be notified when the excavations are open for inspection. In the event any unsuitable sub-foundation material is discovered during the mapping operations, the affected area within the power block will be over-excavated to remove unsuitable material. The over-excavated material would be replaced with structural backfill material after COL or LWA issuance.

3.9.1.13 **Module Assembly**

The reactor designs under consideration use high degrees of modularization. The module components in the nuclear island will be fabricated offsite, shipped to the site via rail, truck, or barge, and assembled into complete modules before being set in the power block. Modules weighing up to 1000 tons will arrive by barge and be transported to the power block area or offloaded in fabrication assembly areas. The assembly of the module components into complete modules onsite will begin during the site preparation phase. The reactor building basemat reinforcing module will be the first module assembled during site preparation activities. The containment building liner module assembly will also occur during the site preparation phase. The completion of the containment basemat reinforcing steel module assembly will be planned to coincide with the completion of reactor building foundation excavation of the first unit. Setting the completed modules will begin upon receipt of the COL.

3.9.2 Construction Activities

Once the COL has been issued, the activities constituting construction as defined in 10 CFR 50.10(a)(1), including subsurface preparation, placement of backfill and concrete within the excavation, and installation of foundations, will begin. The other remaining construction activities, including in-place erection of reactor building, turbine building, placement of equipment, etc., will also begin.

A summary of the activities that will be performed following issuance of the COL is provided below. Typical durations for these activities are provided in Table 3.9-1.

3.9.2.1 Power Block Area Backfill

The general plant area inside the protected area boundary will be brought to plant grade.

In preparation for foundation installation, any over-excavated areas (areas where material of unacceptable structural integrity is encountered will be removed until an acceptable structural bearing surface is reached) within the power block will be backfilled to the bottom elevation of foundation. Backfill material will come from the evaluated and qualified onsite material storage areas, qualified onsite borrow pits, or qualified offsite sources. Potential backfill material may be “lean mix concrete” which is an engineered backfill material produced from the concrete batch plant.

3.9.2.2 Reactor Building Basemat Foundation

The deepest foundation in the power block is expected to be the reactor basemat, which will be installed first. The installation steps will include:

- Installing the electrical grounding grid or mat
- Installing a mud mat, a concrete work surface
- Installing reinforcing steel
- Installing civil, electrical, mechanical/piping embedded items

- Installing concrete formwork
- Placing the structural concrete and the concrete curing process

The activities associated with the nuclear island foundations are safety-related and will occur after the issuance of the COL.

3.9.2.3 Power Block Area Construction

Each VCS unit will consist of a series of buildings and structures with systems installed within the structures. The power block area will encompass several safety-related buildings, such as the reactor building. These structures will be constructed of steel and concrete. The buildings are typically constructed with the major mechanical and electrical equipment and piping systems installed in each respective elevation as the civil construction advances upward.

Much of the commodity installation will consist of prefabricated civil/structural, electrical, mechanical, and piping modules with field-installed interconnections. The balance of the field installation will consist of bulk commodity installation.

3.9.2.4 Construction of Other Facilities

Other facilities to be constructed will include the following:

- Substations, transformers, and transmission lines
- Operator simulator and training facility buildings and warehouse
- Circulating water intake and discharge structures
- Tunnels and pipe chases
- Hot and cold machine shop
- Sewage treatment facility
- Fire protection pumphouse
- Water treatment building
- Guard houses, sally ports, protected area, and delay fence
- Administration building

- Various yard tanks
- Hydrogen, nitrogen, oxygen, and CO_2 storage facilities

3.9.3 Other Activities Associated with Construction

Construction activities will involve the movement of workers and construction equipment. Construction personnel will commute to and from the site on local roads. Deliveries to the construction site will be by truck, rail, or barge.

The installation contractors will have procedures in place for spill prevention, control, and countermeasures that include the control of potential petroleum leaks from construction equipment, and remedial actions in the event of such a leak. Response to major spills from construction equipment will also be addressed. Measures will be put in place to control stormwater discharges associated with construction activity. An erosion, sediment, and pollution prevention plan specific to the construction activities will be prepared.

During site preparation and plant construction, air quality protection procedures as described in Subsection 3.9.5 will be used to minimize and control fugitive dust from construction activities and vehicular traffic. Fugitive dust control measures such as watering of roads, covering truck loads and material stockpiles, reducing material handling activities, and limiting vehicle speed are anticipated to effectively control fugitive dust during construction.

Some level of noise is expected to be generated from operation of construction equipment, including earthmoving equipment, trucks, cranes, portable generators, pile drivers, pneumatic equipment, and hand tools. Table 3.9-2 summarizes the expected noise levels (in dBA) from various types of anticipated equipment to be used during construction.

3.9.4 Construction Procedures and Processes

As part of the overall construction program for VCS, procedures and processes are necessary to ensure protection of the local environmental conditions during construction. These procedures and processes will include developing a Construction Environmental Controls Plan (CECP) or a comparable document. The CECP will be developed and in place before the construction activity begins.

The CECP contains descriptions of the environmental management controls that will be used at VCS to assist in meeting the overall environmental management objectives for the project.

The processes for achieving these objectives will include:

- A summary matrix of environmental and permit requirements for construction
- Environmental awareness training of site personnel as part of generic site training and orientation
- Periodic site environmental compliance reviews/coordination meetings
- Periodic environmental compliance field inspections of construction activities and documentation

3.9.5 Environmental Procedures

Environmental procedures will be prepared and implemented to address the federal, state, and local regulatory requirements. Site-specific permit requirements that address measures for mitigation of environmental impacts will be incorporated. The types of environmental procedures for the construction of VCS are described in Subsections 3.9.5.1 through 3.9.5.11.

3.9.5.1 Noise and Vibration

Procedures related to mitigating noise and vibration impacts from construction activities will be employed. Such measures may include:

- Limiting, as much as practicable, noise and vibration generating activities to certain hours.
- Minimizing construction noise-producing and vibratory activities in sensitive areas.
- Using less vibration-producing equipment and/or methods such as staggering of activities.
- Using appropriate noise control equipment on vehicles and equipment such as mufflers and/or dampeners.
- Notifying regulatory agencies and nearby residents regarding atypical noise and vibration events (e.g., pile driving).

3.9.5.2 Air Quality (Fugitive and Vehicular Emissions)

Air quality protection procedures will be developed that employ methodologies to minimize, as much as practicable, the generation of fugitive dust from construction activities and reduce the emissions from construction equipment and vehicles. Fugitive dust control measures such as watering of roads, covering truck loads and material stockpiles, reducing materials-handling activities, and limiting vehicle speed may be employed, when appropriate. Visual inspection of emission control equipment will be undertaken.

Concrete batch plant operation will be conducted in accordance with applicable permits, including the best available technology and control measures required therein, to minimize particulate emissions. Typical controls could include: maintaining the condition of fabric filters to ensure acceptable pressure drops; prewashing aggregate; using suction shrouds or water fog rings at truck drop points; spraying stockpiles, as necessary; and meeting specified opacity and fuel quality guidelines.

3.9.5.3 **Erosion and Sediment Control**

Erosion and sediment control procedures will be developed that describe the measures to be taken during the course of construction. These procedures will describe temporary and permanent measures undertaken and include relevant engineering drawings illustrating the erosion and sediment control design features. Depending on site conditions and permit requirements, this information typically includes:

- Defined clearing limits and maintenance of existing vegetative cover
- Details of site grading
- The extent of topsoil stripping and stockpiling
- Design of temporary erosion controls (e.g., silt fencing, mulching, erosion control blankets, temporary seeding)
- Design of permanent erosion controls (e.g., reestablishing natural drainage patterns, vegetated swales, permanent seeding/plantings)
- Design and location of check dams, riprap, retention basins, and sediment barriers
- Details of slope restoration and protection
- Design of roads and equipment crossings
- Site-specific designs that maintain drainage patterns

3.9.5.4 **Construction Water Management**

Construction water management procedures will be developed and employed to manage water runoff and miscellaneous discharges from the construction areas and to prevent and/or minimize contamination of surface waters due to project activities. The discharge flows that will be addressed include, but are not limited to:

- Stormwater discharges

- Construction dewatering flows
- Sanitary wastes
- Vehicle wash water discharges, if necessary

Upon completion of the detailed design, the temporary and permanent water management measures will be addressed in the VCS Stormwater Pollution Prevention Plan and Water Management Plan. These plans and the relevant design drawings referenced therein will address the nature and volume of the discharges, the points of discharge, and the erosion and sediment control measures used to control construction water discharge and runoff. They will also address methods and techniques employed to prevent and/or minimize contamination of stormwater from construction activities.

3.9.5.5 **Protection of Sensitive Resources**

Procedures and programs will be established to avoid, minimize, or mitigate, as necessary, impacts to sensitive resources either within the site or in the immediate surrounding areas that may be impacted during construction. The primary control measure for each of the areas described below is avoidance. Where avoidance is not feasible, the measures to be used are addressed in this subsection.

Sensitive areas will be identified during preconstruction surveys as part of the overall site investigation and permitting effort. Mitigation measures will be addressed under the VCS permits described in Section 1.2.

Environmentally sensitive resources that may be encountered during construction activities at the site, along with the typical mitigation measures required to eliminate and/or minimize impacts on these resources, follow.

Wetlands

Wetlands will be identified during preconstruction surveys. Exclusion and/or silt fencing or other barriers will be installed at such a time during the construction period as is appropriate to adequately protect those areas identified. Certain unavoidable activities may require temporary incursions into identified wetlands. Impacts to wetlands will be mitigated and/or remediated by following measures that may include:

- Reduction of clearing limits and preservation of existing vegetative cover
- Maintenance of existing drainage patterns
- Prohibitions/restrictions on equipment and vehicular travel

- Prohibition of maintenance/refueling near wetland boundaries

Rivers and Streams

Exclusion fencing and/or silt fencing or other barriers will be installed at such a time during the construction period, as appropriate, to adequately protect those areas identified. Mitigation measures for direct impacts to waterways (e.g., pipeline crossings, access road construction, and discharge pipe installation) will be spelled out in the relevant permits. Mitigation/remediation measures may include:

- Limitations on the length of time of a disturbance
- Limitations or restrictions on seasonal in-water work
- Reduction in clearing limits and preservation of existing vegetative cover in or near stream banks
- Limitations on the installation design of specified crossings (e.g., mat bridges)
- Use of silt curtains, coffer dams, or other sediment transport barriers
- Restrictions on fill activities and materials
- Restoration of stream beds, banks, and natural vegetation
- Horizontal directional drilling for applicable pipeline crossings of water features (e.g., RWMU system makeup water pipeline crossing of the San Antonio River)

Areas of Special Status (Protected or Unique Wildlife or Vegetation Habitats)

Based on preconstruction surveys, exclusion fencing and/or silt fencing or other barriers will be installed at such a time during the construction period, as appropriate, to adequately protect those areas identified. In the event construction activities encounter special status wildlife species or their habitat, work in the immediate area would be halted and the appropriate agency officials and/or environmental consultants would be contacted to determine proper mitigation measures before resuming work.

Archaeological/Cultural Resource Areas

Based on preconstruction surveys, buffer zones will be established and exclusion fencing or other barriers will be installed at such a time during the construction period, as appropriate, to adequately protect those areas identified. In the event that construction activities encounter buried archaeological/cultural resources, work in the immediate area would be halted and an archaeological expert (such as a professional archaeologist or representative from the Texas Historical Commission) would be contacted to determine proper mitigation measures before resuming work.

3.9.5.6 **Unanticipated Discoveries**

Procedures will be developed to address unanticipated discoveries made during construction. These procedures will address the onsite and offsite notification of parties having relevant interest or jurisdiction over the discovery. Those contacted would include local or state authorities having jurisdiction, depending on the nature of the discovery. Others to be notified would be onsite management or those with the authority to stop work if that is deemed the appropriate action.

Unanticipated discoveries may include:

- Suspected contaminated soils or groundwater
- Unidentified or suspicious drums, tanks, or piping
- Unidentified building foundations
- Suspected cultural artifacts
- Bones

In the event a discovery is made and it is deemed appropriate to stop work in the area, the sequence of events will be to cease activities in the vicinity of the unanticipated discovery and to immediately report the situation to the appropriate authorities.

For unanticipated discoveries that would be hazardous to human life, health, or safety, the site safety representative would also be immediately notified. Additional investigations, sampling, analysis, and notifications to appropriate agencies will be performed as appropriate.

3.9.5.7 **Hazardous Materials and Petroleum Management**

The hazardous materials and petroleum management procedures will describe the management program that will be implemented and how petroleum products and applicable chemical substances (termed “hazardous materials”) will be managed to minimize the potential for threats to human health, safety, and the environment. The management program will address the need for Material Safety Data Sheets for applicable materials brought on site, and county/state-specific requirements regarding handling, storage, use, and disposal. Certain activities that involve the use of petroleum products and solvents would be restricted to designated areas, such as laydown, fabrication, and shop areas.

3.9.5.8 Solid Waste Management (Hazardous/Nonhazardous Wastes)

Solid waste management procedures will be used to describe the management program for handling construction wastes generated at the site. The management program will address nonhazardous wastes and hazardous wastes through separate procedures. In all cases, the management program will be compliant with the relevant environmental requirements including county and state-specific waste handling and transportation practices and approvals, waste minimization activities, and offsite recycling of certain common construction wastes (e.g., used oil, antifreeze, scrap metal, wood).

3.9.5.9 Asbestos and Lead-Based Paint

In the event that hazardous materials such as asbestos, asbestos-containing material, or lead-based paint are encountered, a process will be established to address the county/state-specific regulatory requirements for containment and/or removal of such materials by trained, authorized personnel. Site-specific procedures will also address regulations governing the overall management of the removal and abatement work including:

- Prework notifications
- Removal by certified contractors
- Handling before disposal
- Transport to and disposal at licensed facilities
- Post-work closure reports

3.9.5.10 Spill Prevention and Response

The spill prevention and response procedures will address how to manage hazardous materials, petroleum products, and related wastes in such a manner as to prevent releases and to minimize the potential for threats to human health and the environment in the event of a release. The management program will address the need for secondary containment, spill response materials, spill magnitude thresholds for reporting the release (e.g., reportable quantities), emergency response actions, and notification requirements for project personnel and county/state agencies.

3.9.5.11 Cleanup and Restoration

Procedures and programs will be developed to describe the activities to be undertaken for cleanup and restoration of the site and other areas used during construction (e.g., offsite laydown yards). The developed procedures and programs will address the cleanup and removal of unused construction materials and debris, restoration of topographical surfaces (e.g., swales, roads, fences, gates, walls) and subsurface features (e.g., drainage tiles, utilities) in accordance with permit requirements and best management practices for permanent site stabilization.

3.9.6 References

Golden et al. 1980. Golden, J., Ouellette, R. P., Saari S., and Cheremisinoff, P. N., *Environmental Impact Data Book*, Chapter 8: Noise, 2nd Printing, Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1980.

U.S. NRC Mar 1997. Regulatory Guide 1.165, *Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion*, March 1997.

Table 3.9-1
Construction Activity Individual Durations

Construction Activity	Approximate Duration[a]
Preconstruction Activities	
Installation and establishment of environmental controls	4 months (after the acquisition of required permits and authorizations)
Clearing, grubbing, and grading	9 months
Road and rail construction	5 months
Construction security program implementation	3 months
Temporary utilities construction	6 months
Temporary construction facilities construction	9 months
Laydown, fabrication, shop area preparation	5 months
Cooling basin, intake pumphouse, and discharge structure	36 months
Blowdown discharge cofferdams and piling installation	5 months
Power block area excavation	10 months
Module assembly	15 months
Underground installations	8 months
Unloading facilities installation	9 months
Construction Activities	
Power block area backfill	5 months
Reactor building basemat foundation	5 months
Power block area construction	69 months
Switchyard and installation of main transformers	9 months
Administration, simulator and training facility buildings	12 months
Cooling towers	18 months
Yard tanks	12 months

(a) The durations tabulated here include parallel activities and are not additive to the project schedule values.

Table 3.9-2
Peak and Attenuated Noise (in dBA) Levels
Expected from Operation of Construction Equipment

Source	Noise Level (peak)	Distance from Source			
		50 feet	100 feet	200 feet	400 feet
Heavy trucks	95	84–89	78–83	72–77	66–71
Dump trucks	108	88	82	76	70
Concrete mixer	105	85	79	73	67
Jackhammer	108	88	82	76	70
Scraper	93	80–89	74–82	68–77	60–71
Dozer	107	87–102	81–96	75–90	69–84
Generator	96	76	70	64	58
Crane	104	75–88	69–82	63–76	55–70
Loader	104	73–86	67–80	61–74	55–68
Grader	108	88–91	82–85	76–79	70–73
Dragline	105	85	79	73	67
Pile driver	105	95	89	83	77
Forklift	100	95	89	83	77

Source: Golden et al. 1980

3.10 Workforce Characterization

In order to ascertain the environmental impact of building and operating VCS, a description of the workforce required to construct and operate the new units is characterized and analyzed.

3.10.1 Construction Workforce

The construction workforce will consist of two components, (1) field craft labor and (2) field nonmanual labor. Field craft labor is the largest component of the construction workforce, approximately 70 percent of the field workforce in conventional nuclear plant construction. The field craft labor force is comprised of civil, electrical, mechanical, piping, and instrumentation personnel used during the installation and start up of the units. The field nonmanual labor makes up the balance of the construction workforce; approximately 30 percent when the design engineering is performed offsite. The field nonmanual labor force comprises field management, field supervision, field engineers, quality assurance/quality control, environmental, safety and health, and administrative/clerical staff.

Table 3.10-1 illustrates the approximate percentage makeup of each skill set for the field craft and field nonmanual labor. This skill set makeup is representative of a conventional nuclear power plant construction site force.

In order to bound the workforce makeup, it is assumed that 5 percent to 10 percent of the skilled craft workforce would be drawn from within 50 miles of the VCS site. The remainder of the craft labor workforce is assumed to come from outside the 50-mile area. Nonmanual labor is assumed to come from contractor personnel from outside the 50-mile area.

Most plant design concepts use a number of prefabricated large modules. This modularization shifts some of the work (and workforce) to other locations that are outside the 50-mile radius of the site, and decreases the onsite construction staff and duration. The construction duration and estimated onsite workforce presented here is used as the basis for the Chapter 4 analyses and assumes a high degree of offsite fabrication. Because a specific reactor design has not been selected, the peak workforce estimate does not include consideration of additional reactor-specific approaches (including modular reactors and/or modular design elements) that could reduce the types and lengths of activities onsite.

Sequential construction of two large advanced LWR units at the VCS site is assumed to be the representative construction scenario. The total onsite construction workforce for sequential construction of two units is estimated to be approximately 25 jobhours per net kilowatt of generating capacity. The schedule assumes 18 months for site preparation and early site work activities, 44 months from the start of first nuclear concrete placement to fuel load for the first unit, and

8 months for startup. Fuel load for the second unit is scheduled 12 months after the first unit for a total schedule duration of 82 months. Based on this schedule, the maximum onsite, peak construction workforce for two units with a large cooling basin is estimated to be 6300 people, working 5 days per week, 10 hours per day (Table 3.10-2 and Figure 3.10-1).

3.10.2 **Workers Relocation and Commuting**

It is assumed that construction workers typically commute up to 50 miles to the jobsite. Assuming 5 percent of the construction craft workforce will be available to the VCS project from within 50 miles, approximately 315 local crafts people could be used to staff the construction of two units. The balance of the construction workforce is assumed to come from outside the 50-mile radius. For the analysis of construction impacts in Chapter 4, it is assumed the field nonmanual labor workforce will relocate to the area from outside the 50-mile radius. This analysis assumes that 70 to 80 percent of the construction workforce will be employed for more than 3 years. For the purposes of this analysis, it is assumed that 95 percent of the construction workforce will try to locate within the 50-mile area to minimize their commute distance.

3.10.3 **Operations Workforce**

Based on Exelon's operating fleet experience, it is estimated that the onsite operations workforce for a dual unit plant would be approximately 800 (650 for the operating staff and an additional 150 security personnel). It is also estimated that there will be an additional 30 support people offsite.

It is estimated that 450 of the 650 plant operations staff would be on site before startup of the first unit, and an additional 200 would be added for the second unit.

Operations staffing for each unit would begin approximately 2 years before fuel load of each unit to allow time for simulator training and startup testing support, and increase to the full complement of personnel at the time of fuel load (see Figure 3.10-2). It is assumed that 100 percent of the operations staff would be recruited and trained from outside the 50-mile site radius and will relocate to within the 50-mile area.

3.10.4 **Total Construction and Operations Workforce**

The combined construction and operations workforce on site would peak at approximately 6497 (Figure 4.4-1).

3.10.5 **Outage Workforce**

Based on fleet operating experience, Exelon assumes that the number of temporary workers for a typical outage would be 1750, and the duration of the outage would be 20 to 25 days. For the socioeconomic analysis presented in Chapter 5, Exelon assumes that all of the temporary outage workers would come from outside the 50-mile radius.

Table 3.10-1
Estimated Percent of Onsite Construction Labor Force by Skill Set

Labor	Installation Items - Responsibility	Percent of Total Workforce for Construction[(a)]
Mechanical equipment	NSSS, Turbine Generator, Condenser, Process Equipment, HVAC	2.5
Electrical	Equipment, Cable, Cable Tray, Conduit, Wire, Connections	10
Concrete	Concrete and Reinforcing Steel	10
Structural steel	Structural and Miscellaneous Steel	2.5
Other civil	Piling, Architectural Items, Painting, Yard Pipe, Earthwork	15
Piping/instrumentation	Pipe, Tubing, Valves, Hangers/Supports	12
Site support	Scaffolding, Equipment Operation, Transport, Cleaning, Maintenance, etc	16
Specialty labor	Fireproofing, Insulation, Rigging, etc	12
Non-manual labor	Management, Supervision, Field Engineering, Quality Control/Quality Assurance, Safety and Health, Administration	20

(a) Percentages are based on two conventional BWR units.

Table 3.10-2
Estimated Construction Workforce and Construction Duration

Month	Workforce Strength	Month	Workforce Strength	Month	Workforce Strength	Month	Workforce Strength
Site preparation begins month -18		8	5200	34	5800	60	2100
–18	200	9	5400	35	5700	61	2000
–17	400	10	5600	36	5600	62	1800
–16	600	11	5800	37	5500	63	1500
–15	800	12	5950	38	5400	64	1200
–14	1000	13	6040	39	5300		
–13	1200	14	6080	40	5200		
–12	1400	15	6120	41	5100		
–11	1600	16	6160	42	5000		
–10	1800	17	6200	43	4800		
–9	2000	18	6240	44	4600		
–8	2200	19	6280	45	4400		
–7	2400	20	6300	46	4200		
–6	2600	21	6300	47	4000		
–5	2800	22	6300	48	3800		
–4	3000	23	6300	49	3600		
–3	3200	24	6300	50	3400		
–2	3400	25	6300	51	3200		
–1	3600	26	6300	52	3000		
1	3800	27	6300	53	2800		
2	4000	28	6300	54	2700		
3	4200	29	6300	55	2600		
4	4400	30	6200	56	2500		
5	4600	31	6100	57	2400		
6	4800	32	6000	58	2300		
7	5000	33	5900	59	2200		

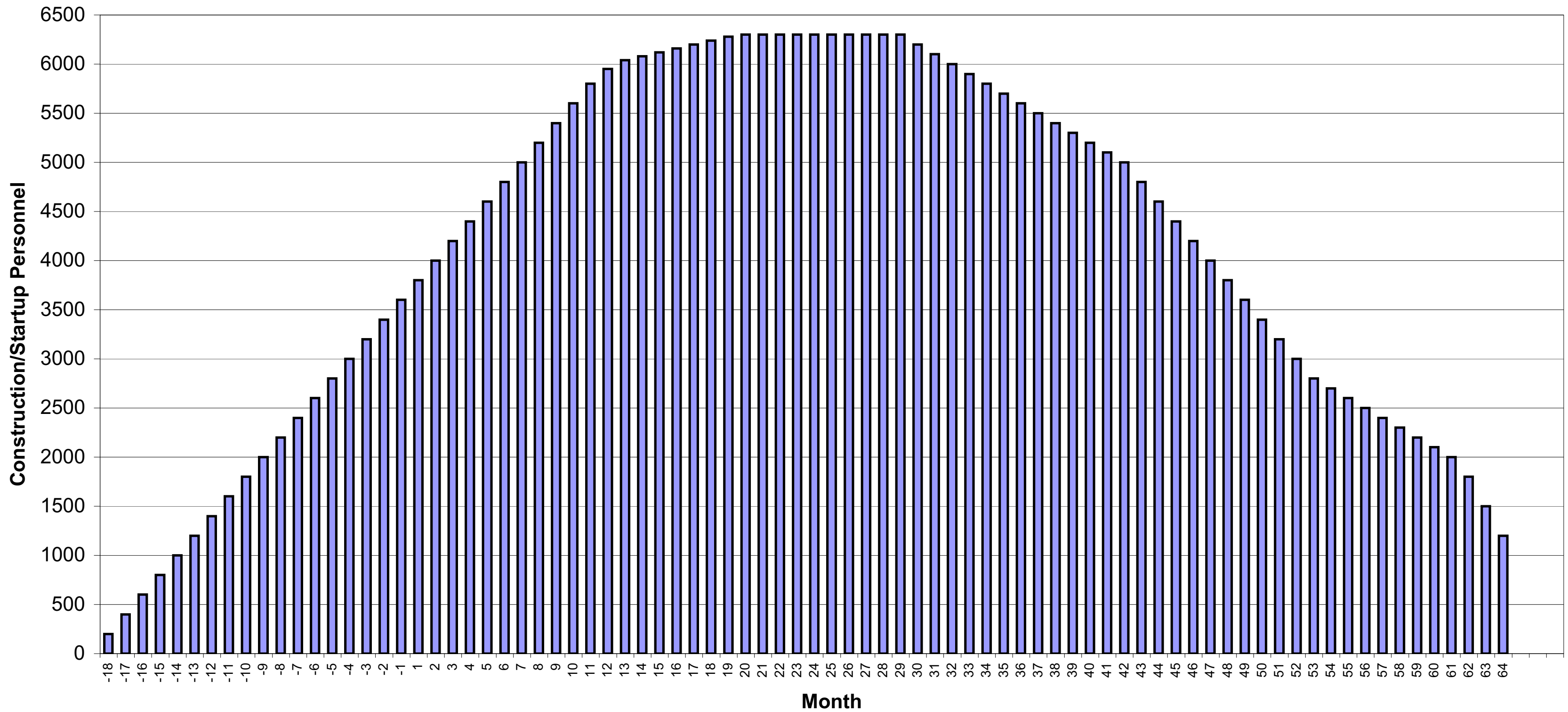


Figure 3.10-1 Projected Construction Workforce by Month

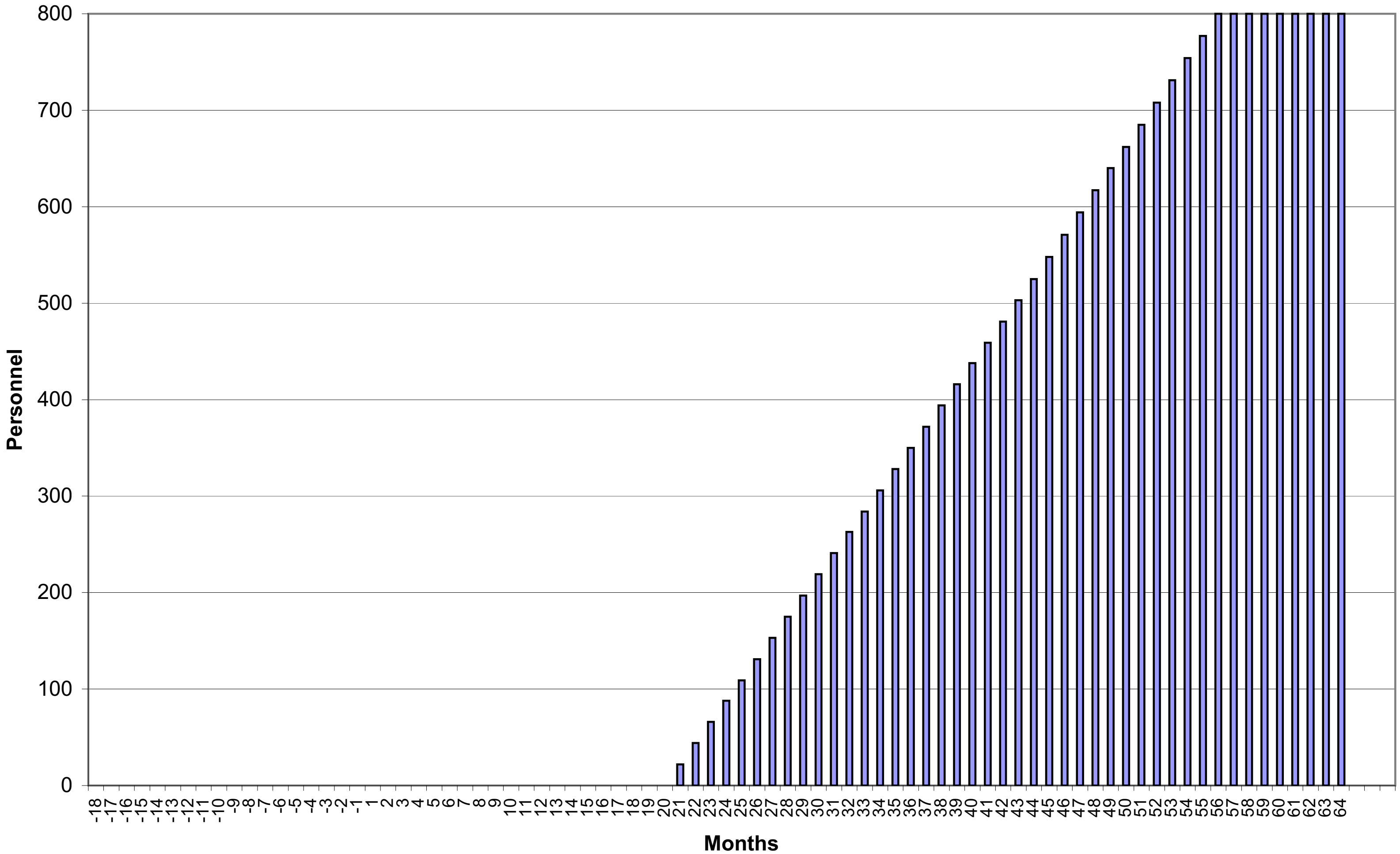


Figure 3.10-2 Projected Operations Workforce by Month