



**TRISO-X Fuel Fabrication Facility**  
**Special Nuclear Material**  
**License Application Cover Page, Chapter**  
**Index, Abbreviations, and Acronyms**

**Revision** : 5  
**Status** : Approved  
**NRC Docket No.** : 70-7027

**SPECIAL NUCLEAR MATERIAL LICENSE**

**CHAPTER INDEX**

| <b>CHAPTER</b> | <b>TITLE</b>                                                | <b>REVISION</b> | <b>REVISION DATE</b> |
|----------------|-------------------------------------------------------------|-----------------|----------------------|
| 1              | General Information                                         | 5               | February 2026        |
| 2              | Organization and Administration                             | 3               | December 2025        |
| 3              | Integrated Safety Analysis                                  | 3               | December 2025        |
| 4              | Radiation Safety                                            | 3               | December 2025        |
| 5              | Nuclear Criticality Safety                                  | 3               | December 2025        |
| 6              | Chemical Process Safety                                     | 2               | December 2024        |
| 7              | Fire Safety                                                 | 2               | December 2024        |
| 8              | Emergency Management                                        | 2               | December 2024        |
| 9              | Environmental Safety                                        | 4               | February 2026        |
| 10             | Decommissioning                                             | 2               | December 2024        |
| 11             | Management Measures                                         | 4               | February 2026        |
| 12             | Material Control and Accounting of Special Nuclear Material | 2               | December 2024        |
| 13             | Protection of Special Nuclear Material                      | 2               | December 2024        |
| Addendum       | Sensitive Information                                       | 2               | December 2024        |

**REVISION SUMMARY**

| <b>Revision</b> | <b>Date</b> | <b>Section/Page</b> | <b>Description of Change</b>                                                                                                   |
|-----------------|-------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------|
| 1               | 5-Apr-22    | ALL                 | Initial issue.                                                                                                                 |
| 2               | 4-Nov-22    | Chapter Index       | Updated License Chapter 1 to Revision 2.                                                                                       |
| 3               | Dec-24      | ALL                 | Added document number TXF-REG-NRC-0000 to header.                                                                              |
|                 |             | Chapter Index       | Updated License Chapter 1 to Revision 3, and all other Chapters to Revision 2.                                                 |
|                 |             | Revision Summary    | Deleted revision summary entries for Revision 2 on this page because all were added to the License Chapter 1 revision summary. |
| 4               | Dec-25      | Chapter Index       | Updated License Chapter 1 to Revision 4.<br>Updated License Chapters 2, 3, 4, 5, 9, and 11 to Revision 3.                      |
| 5               | Feb-26      | Chapter Index       | Updated License Chapter 1 to Revision 5.<br>Updated License Chapters 9 and 11 to Revision 4.                                   |

## ABBREVIATIONS AND ACRONYMS

This list contains the abbreviations and acronyms used in this document.

| Abbreviation or Acronym | Definition                                                   |
|-------------------------|--------------------------------------------------------------|
| ALARA                   | As Low As Reasonably Achievable                              |
| ALI                     | Annual Limit on Intake                                       |
| AHJ                     | Authority Having Jurisdiction                                |
| ANS                     | American Nuclear Society                                     |
| ANSI                    | American National Standards Institute                        |
| ASCE                    | American Society of Civil Engineers                          |
| BDC                     | Baseline Design Criteria                                     |
| BS/BA                   | Bachelor of Science / Bachelor of Arts                       |
| CAA                     | Controlled Access Area                                       |
| CAAS                    | Criticality Accident Alarm System                            |
| CEDE                    | Cumulative Effective Dose Equivalent                         |
| CFR                     | Code of Federal Regulations                                  |
| CM                      | Configuration Management                                     |
| DAC                     | Derived Air Concentration                                    |
| DFP                     | Decommissioning Funding Plan                                 |
| DOE                     | U.S. Department of Energy                                    |
| DOT                     | U.S. Department of Transportation                            |
| EPA                     | U.S. Environmental Protection Agency                         |
| ETSZ                    | East Tennessee Seismic Zone                                  |
| FFF                     | Fuel Fabrication Facility                                    |
| FHA                     | Fire Hazards Analyses                                        |
| FNMCP                   | Fundamental Nuclear Material Control Plan                    |
| HALEU                   | High Assay Low Enriched Uranium                              |
| HPGe                    | High Purity Germanium                                        |
| IAEA                    | International Atomic Energy Agency                           |
| IBC                     | International Building Code                                  |
| ICPMS                   | Inductively Coupled Plasma Mass Spectrometry                 |
| ICRP                    | International Commission on Radiation Protection Publication |
| ISA                     | Integrated Safety Analysis                                   |
| IROFS                   | Items Relied On For Safety                                   |
| KPA                     | Kinetic Phosphorescence Analyzer                             |
| LA                      | License Application                                          |
| LEU                     | Low Enriched Uranium                                         |
| MBA                     | Material Balance Area                                        |

| <b>Abbreviation or Acronym</b> | <b>Definition</b>                              |
|--------------------------------|------------------------------------------------|
| MC&A                           | Material Control and Accountability            |
| MFRS                           | Main Force Resisting System                    |
| MMI                            | Modified Mercalli Intensity                    |
| MOU                            | Memorandum of Understanding                    |
| NCRP                           | National Commission on Radiation Protection    |
| NCS                            | Nuclear Criticality Safety                     |
| NFPA                           | National Fire Protection Association           |
| NIST                           | National Institute of Standards and Technology |
| NMSS                           | Nuclear Materials Safety and Safeguards        |
| NRC                            | U.S. Nuclear Regulatory Commission             |
| OCA                            | Owner Controlled Area                          |
| OJT                            | On-the-Job Training                            |
| OSHA                           | Occupational Safety and Health Administration  |
| PHA                            | Process Hazard Analyses                        |
| PM                             | Preventive maintenance                         |
| PSP                            | Physical Security Plan                         |
| QA                             | Quality Assurance                              |
| RCA                            | Radiologically Controlled Area                 |
| REM                            | Roentgen Equivalent Man                        |
| RPP                            | Radiation Protection Program                   |
| RSO                            | Radiation Safety Officer                       |
| RWP                            | Radiation Work Permits                         |
| SEP                            | Site Emergency Plan                            |
| SME                            | Subject Matter Expert                          |
| SNM                            | Special Nuclear Material                       |
| SRC                            | Safety Review Committee                        |
| TEDE                           | Total Effective Dose Equivalent                |
| TRISO-X FFF                    | TRISO-X Fuel Fabrication Facility              |
| U                              | Uranium                                        |
| U-235                          | Uranium-235                                    |
| U-238                          | Uranium-238                                    |
| UL                             | Underwriters Laboratory                        |
| USGS                           | United States Geological Survey                |

## SNM-XXXX

CHAPTER 1

## GENERAL INFORMATION

## Table of Contents

| SECTION    | TITLE                                                  | STARTS ON PAGE |
|------------|--------------------------------------------------------|----------------|
| <b>1.1</b> | <b>Facility and Process Information</b>                | <b>1-2</b>     |
| 1.1.1      | Site Description and Location                          |                |
| 1.1.1.1    | Population, Nearby Land Uses, and Transportation       |                |
| 1.1.1.2    | Meteorology                                            |                |
| 1.1.1.3    | Hydrology                                              |                |
| 1.1.1.4    | Geology                                                |                |
| 1.1.2      | Facility Buildings and Structures                      |                |
| 1.1.3      | General Process Description                            |                |
| 1.1.4      | Raw Materials, Products, By-Products and Wastes        |                |
| <b>1.2</b> | <b>Institutional Information</b>                       | <b>1-16</b>    |
| 1.2.1      | Corporate Identity                                     |                |
| 1.2.2      | U.S. Nuclear Regulatory Commission License Information |                |
| 1.2.3      | Financial Qualifications                               |                |
| 1.2.4      | Type, Quantity, and Form of Licensed Material          |                |
| 1.2.5      | Authorized Uses and Activities                         |                |
| 1.2.6      | Site Safeguards                                        |                |
| 1.2.7      | Terminology / Definitions                              |                |
| <b>1.3</b> | <b>Special Exemptions and Special Authorizations</b>   | <b>1-21</b>    |
| 1.3.1      | Special Exemptions                                     |                |
| 1.3.1.1    | Criticality Monitoring                                 |                |
| 1.3.1.2    | Posting and Labeling                                   |                |
| 1.3.1.3    | ICRP-68 DAC and ALI Values                             |                |
| 1.3.1.4    | ICRP-60 Organ Dose Weighting Factors                   |                |
| 1.3.1.5    | Certain Unplanned Contamination Events                 |                |
| 1.3.1.6    | Process Buildings                                      |                |
| 1.3.2      | Special Authorizations                                 |                |
| 1.3.2.1    | Changes to the License Application                     |                |

## SNM-XXXX

CHAPTER 1

## GENERAL INFORMATION

**1.1 Facility and Process Information**

The primary purpose of the TRISO-X Fuel Fabrication Facility (FFF) in Oak Ridge, Tennessee, is to manufacture coated particle fuel for the next generation of commercial nuclear reactors. The modular design of the process cells / areas anticipates additional manufacturing capabilities to satisfy the needs of a variety of fuel designs and reactors (e.g., pebble bed high temperature gas-cooled, prismatic gas-cooled, molten salt-cooled, accident tolerant fuel, nuclear thermal propulsion, and others). Nuclear materials enriched to less than 20 weight percent U-235 are utilized in the product manufacturing operations authorized by this license.

**1.1.1 Site Description and Location**

The TRISO-X site is located in the Horizon Center Industrial Park on property abutting portions of Renovare Boulevard, within the western limits of the City of Oak Ridge and in the northeastern portion of Roane County, Tennessee. The site is situated in an area dedicated and zoned for industrial development, on an approximately 110-acre greenfield site. Of the total acreage, approximately 60 acres are designated for manufacturing and administrative buildings, equipment yards, access roads, parking, and stormwater management. The site is situated at approximately latitude N 35° 57' 41" and longitude W 84° 22' 13".

The site location in northeastern Roane County is in the Valley and Ridge physiographic province. The regional topography near the site is typical of the Valley and Ridge province which is characterized by northeast–southwest trending ridges and intervening valleys. The site and other developed areas along State Route 95 (TN 95 – Oak Ridge Turnpike) to the northeast and southwest are located on relatively flat or slightly undulating terrain associated with the East Fork Poplar Creek Valley, while just northwest of the site, there is a steep incline to the top of Black Oak Ridge. Several other ridges oriented northeast to southwest are present within the vicinity of the site. The Poplar Creek Valley is the next valley north and parallels Black Oak Ridge. East Fork Ridge is located to the south and east of the site and is interrupted by the valley of Bear Creek and TN 95. Pine Ridge is located south and east of East Fork Ridge.

**1.1.1.1 Population, Nearby Land Uses, and Transportation**

A site location map, including the population centers located near the site, is shown in Figure 1-1. Key features near the site are shown in Figure 1-2. The closest major population center is the City of Oak Ridge which had a population of 31,402 as of April 1, 2020, per the United States Census Bureau website. The closest residents to the site are located in a residential development off Poplar Creek Road, approximately 0.6 miles northwest of the site boundary, separated from the site by Black Oak Ridge and areas of dense vegetation. There are also residential neighborhoods located to the east off TN 95, approximately 1.3 miles or more from the site. The Environmental Report, Figures 3.10.1-1 through 3.10.1-4, provides more information about

## SNM-XXXX

CHAPTER 1

population near the site. The North Boundary Greenway, a low-density recreational trail used for hiking and biking, borders the site boundary to the northwest.

The immediate area surrounding the site consists of rural wooded area and light commercial and industrial use buildings. The immediately adjacent one-story warehouse/office building located near the southern corner of the property is the corporate office of Philotechnics Inc., a radiological service and mixed and radioactive waste brokerage provider licensed by the State of Tennessee, does not manage, utilize, or store chemicals (hazardous materials) in quantities that pose hazards to the TRISO-X site. Renovare Boulevard, which borders the site to the southeast, is a two-lane divided roadway that provides access to the site and to other parcels within the Horizon Center Industrial Park.

Lands adjacent to the industrial park are predominantly undeveloped and forested, consisting of large tracts of U.S Department of Energy Oak Ridge Reservation land which border the site to the northwest and surround the industrial park in other directions, with the exception of the TN 95 roadway corridor to the east. The existing land use within one mile of the site consists of primarily industrial development and woodlands. Within a five-mile radius of the site, approximately 83 percent of the land is undeveloped (e.g., forest, pasture, wetland) and the remainder is developed. Other land uses within 5 miles of the site include heavy industrial, light industrial/manufacturing, commercial/office space, agricultural, and residential. The Methodist Medical Center of Oak Ridge is the nearest hospital, located approximately 9 miles from the site. The closest school to the site is Dyllis Springs Elementary School, located approximately 3.2 miles northeast of the site.

Transportation infrastructure near the site includes Renovare Boulevard; TN 95; two interstate highways – Interstate 40 and Interstate 75 – several Tennessee state highways; and local roads. Regional highways and interstates near the site are shown in Figure 1-3. The McGhee Tyson Airport, which serves public and military needs, is located 26 miles from Oak Ridge by road. Oliver Springs Airport is a small private airport located 6 miles northeast of the site. The closest railroad track is approximately 1 mile southwest of the site boundary, adjacent to Blair Road. The closest major waterway, the Clinch River, is approximately 3 miles west of the site boundary. Shipping of materials and products to and from the site will be conducted by truck; no use of railroad or river barge is planned. Truck shipments would likely use Interstate 40 and State Route 58 west of the site due to the ease of access via 4-lane highways located in less populated areas with less traffic.

#### **1.1.1.2 Meteorology**

Oak Ridge is located in the broad Tennessee River valley between the Cumberland Mountains, which lie to the northwest, and the Great Smoky Mountains, to the southeast. The Cumberland Mountains moderate the local climate by retarding the flow of cold air from the north during winter. Both mountain ranges are generally oriented in a northeast-southwest direction. The

## SNM-XXXX

CHAPTER 1

valley between them is corrugated by broken ridges approximately 300 to 500 feet high and oriented parallel to the main valley in an approximate northeast-southwest direction.

The climate of Oak Ridge is classified as humid subtropical. The “subtropical” designation indicates that the region experiences a wide range of seasonal temperatures. Such areas are typified by significant temperature differences between summer and winter. The normal liquid equivalent annual precipitation in the Oak Ridge area is 50.91 inches, and the average annual snowfall is 5.9 inches. The normal daily minimum temperature in January is 28.9 degrees Fahrenheit (°F) and the normal daily maximum temperature in July is 88.4°F.

Direct deflection of the winds by terrain is a dominant mechanism that drives the winds in the Tennessee River valley. This mechanism acts approximately 50 – 60 percent of the time, resulting in winds that blow in directions generally along the approximate northeast-southwest axis of the valley. The distribution of prevailing monthly wind directions is bimodal, with winds from the northeast (50 – 60 degrees), or from the southwest (210 – 220 degrees). The mean annual wind speed is 2.8 miles per hour.

Severe storm conditions are infrequent in the Oak Ridge area, due to the area being south of most blizzard conditions, and too far inland to be affected by hurricane activity. Tornadoes generally occur more frequently in the western and middle portions of Tennessee; however, Eastern Tennessee experiences tornado outbreaks of varying magnitudes approximately every three to six years. In a four-county area around the site for the period 1950 to 2020, the highest intensity tornadoes were rated F3 as a result of storms on February 21, 1993. Due to the low frequency of tornadoes in this region, no specific design criteria relative to tornadoes are required by the International Building Code. Lightning risk at the site has been addressed through lightning protection systems as specified in the Fire Hazards Analysis as described in Chapter 7.

In accordance with 10 CFR 70.64(a)(2), the most severe documented historical events for the site are listed below for various natural phenomena.

- (a) High Wind – The most severe documented wind speed for Roane County is 74 knots (85 miles per hour) per the NOAA NCEI Storm Events Database (1950-2025) for high wind, strong wind, and thunderstorm wind. This event occurred from a thunderstorm on November 10, 2002.
- (b) Intense Precipitation – The most severe documented intense precipitation for Roane County is 7.48 inches in a 24-hour period with 3.43 inches in a 1-hour period. Per the Environmental Report Section 3.6.1.4.5, this event was recorded by the NOAA Atmospheric Turbulence and Diffusion Division (ATTD) in Oak Ridge and occurred from thunderstorms on August 10, 1960.
- (c) Temperature Extremes – The most severe documented minimum and maximum dry bulb temperatures for the area are -24 °F and 108 °F per the Environmental Report Table 3.6-21. The low temperature of -24 °F was recorded at the Knoxville airport weather station

## SNM-XXXX

CHAPTER 1

on January 21, 1985 (NOAA NCEI). The high temperature of 108 °F was recorded at the Loudon 1 E weather station on July 29, 1930 (NOAA NCEI).

- (d) Lightning and Thunderstorm – Quantifying the most severe documented historical lightning event is not straightforward, therefore an average number of cloud to ground lightning strikes per square mile per year is provided based on an EPRI estimation method available in the Environmental Report Section 3.6.1.4.1.3. The frequency of lightning strikes to ground per square mile per year is 15.1 for the TRISO-X site and surrounding area. This is based on the average number of thunderstorm days per year of 48.8 (NOAA NCEI). The most severe documented number of thunderstorm days per year occurred in 2012 with 65 thunderstorm days per the ORNL metweb website and Environmental Report Section 3.6.1.4.1.3.
- (e) Ice and Snowstorm – The most severe documented historical 24-hr snowfall is 12 inches, which occurred in March of 1960 per NOAA NCEI and the Environmental Report Section 3.6.1.4.2. Ice or freezing rain occurs relatively infrequently on an average of 1 day per year per ORNL meteorological data and the Environmental Report Section 3.6.1.4.2.

**1.1.1.3 Hydrology**

The site is categorized as upland; no water bodies or wetlands were identified within the site. The nearest water body to the site is East Fork Poplar Creek, the closest portions of which run in a southwest direction through the industrial park between TN 95 and Renovare Boulevard at an approximate elevation of less than 770 feet. East Fork Poplar Creek empties into Poplar Creek approximately 1.25 miles southwest of the site, and Poplar Creek empties into the Clinch River approximately 3 miles southwest of the site boundary.

Federal Emergency Management Agency *Flood Insurance Rate Map Number 47145C0130F, Panel 0130F, Roane County, Tennessee, and Incorporated Areas*, Effective Date September 28, 2007, shows the site outside the 500-year floodplain (unshaded Zone X). The nearest section of detailed study for East Fork Poplar Creek is approximately 1.5 miles northeast of the site, with a 100-year base flood elevation of 783 feet at the downstream end of mapping. The closest Clinch River location to the site has a 100-year base flood elevation of 747 feet at the Poplar Creek outlet.

The nearest portion of the East Fork Poplar Creek to the TRISO-X site is 2.2 miles upstream of Poplar Creek. The 500-yr flood elevation at this location is El. 762.3 (ER Figure 3.4.3-2), which is more than 48 feet below the TX-1 and TX-2 process floors at El. 811. Further review of the 1991 TVA Study referenced in the Environmental Report indicates the 100,000-yr flood elevation for the area of the East Fork Poplar Creek nearest the TRISO-X site (between 1.66 and 3.32 miles upstream of Poplar Creek) is El. 780.4. Therefore, the TX-1 and TX-2 process floors at El. 811 are more than 30 feet above the 100,000-year flood elevation for the East Fork Poplar Creek.

## SNM-XXXX

CHAPTER 1

Four groundwater observation wells were installed on the site in fall of 2021 with total depths and screened intervals based on observed first water identified in the upper most bedrock during drilling. No water was identified in the shallow unconsolidated surficial sediments above the bedrock. Total well depths range from approximately 39 feet to 75 feet below ground surface. The underlying bedrock in which the observation wells are completed is primarily comprised of dolomite and is the first type of bedrock encountered at all sites.

Depth to groundwater measurements taken at the four observation wells vary from approximately 10 to 57 feet below the top of the well casing. Groundwater elevation measurements and modeling indicate that groundwater generally flows in a southwest direction toward East Fork Poplar Creek. Based on a search of several database sources, there are no known household, public, or industrial users of groundwater downgradient of the site for the 3-mile distance that East Fork Poplar Creek travels to empty into the Clinch River. The closest well to the site is a residential well located upgradient, 1-mile north-northwest of the site, within the Poplar Creek Valley which is separated from the site by Blackoak Ridge.

Stormwater discharges from all onsite detention basins are permitted by the state of Tennessee under the NPDES Stormwater Multi Sector permitting program for discharges from industrial facilities. As part of the permit program, the state of Tennessee defines minimum general site maintenance and housekeeping practices and establishes water quality basin discharge outfall requirements for discharges leaving the site.

Stormwater collected during normal operations would contain pollutants typically associated with runoff collected from public streets and parking areas. Small amounts of oil and grease, metals, and other constituents associated with vehicular activity are expected to be carried in runoff from the roads and parking areas within the site. Water quality of stormwater runoff is maintained through the use of detention ponds. Stormwater generated is collected in peripheral ditches and the interior stormwater system before being discharged to the stormwater detention basin. The detention basin is divided into two separate sections, the forebay section and the main detention basin section. The forebay section collects the runoff from the entire permanent site areas and provides storage for a portion of the runoff for water quality treatment that allows sediment and site generated total suspended solids (TSS) to settle at the bottom of the forebay. The main detention basin section receives stormwater overflow from the forebay section and provides additional storage for the remaining stormwater volume to allow for TSS to settle at the bottom of the detention basin section. Treated water effluent is discharged via the valved NW Outlet pipe into an existing drainage swale that traverses at least 400 feet through a vegetated path to an observed sinkhole feature in the adjacent parcel. The intent of the detention basin design is not to overwhelm the sinkhole area by limiting the post-developed volume to less than the pre-developed volume within the first 24 hours of a rainfall event. As such, all constituents within stormwater runoff are expected to be at or below the allowable limits set by the state of Tennessee. Any stormwater runoff from electrical transformers, mechanical yards and above ground tank containments is collected separately and disposed of after adequate treatment.

## SNM-XXXX

CHAPTER 1

Groundwater hydraulic gradients are based on potentiometric level contours of water levels collected on September 16, 2021, and January 12, 2022, and are shown on Figures 1-9 and 1-10, respectively. These two months were selected for their seasonal influence (summer and winter) on potentiometric levels, as it is apparent that lower evapotranspiration levels during colder shorter days (i.e., decreases naturally as vegetation is dormant, and less need of infiltrating water) influences groundwater availability. The interpreted flow paths, perpendicular to contours, indicate groundwater flows from north of the site in a predominantly southeastern direction toward East Fork Poplar Creek and is consistent in summer and winter. The groundwater flow paths do not indicate flow toward any potential groundwater users.

**1.1.1.4 Geology**

The TRISO-X site is located within the Valley and Ridge Province, a long, narrow belt trending northeast to southwest that is bordered on the west by the Appalachian Plateau and on the east by the Blue Ridge Province. The province is expansive and extends from Vermont to Alabama. This physiographic province consists of a series of northeast/-southwest- trending synclines and anticlines composed of Early Paleozoic sedimentary rocks. Drainage patterns in the Valley and Ridge Province generally follow the northeast-southwest trend of topography. However, segments of major rivers cut across the regional topographic alignment following deeply entrenched, ancient stream courses. These include the Powell, Clinch, Holston, and French Broad rivers that join to form the Tennessee River after flowing many miles in northeast/southwest-trending valleys.

The Rome Formation and the Conasauga, Knox, and Chickamauga Groups and associated formations comprise the majority of the underlying bedrock of the Valley and Ridge Province. The site is underlain by limestones-dolomites of the Knox Group and limestones with interbedded shale, argillaceous limestone, mudstone, and wackestone associated with the Chickamauga Group.

**Site Topography**

The terrain within the Horizon Center Site (HCS) boundaries is typical of the Oak Ridge region and generally contains mild rolling hills with ridges and valleys. The existing site surface elevations vary from approximately Elevation 780 feet to Elevation 825 feet in most parts of the HCS, except at the north corner where the existing surface elevation rises to approximately 850 feet. More detailed topography descriptions are included in Section 3.3 of the Environmental Report.

The site development for the project will include extensive site grading with cut and fill. Engineered fill will be used for placement and compaction. The final site grade will be relatively level across the site with most boundaries matching the existing surrounding topography. The only significant slope for the site is on the north side of the facility, separated from the primary facility structures and equipment by a perimeter access road. This slope will be designed with a grade of approximately 3:1 (Horizontal:Vertical) after excavation. The design will be verified by

## SNM-XXXX

CHAPTER 1

a slope stability calculation and designed using standard geotechnical engineering practice. The toe of the north slope is expected to be approximately 75 feet from the edge of the eastern-most process building (PB).

**Site Geotechnical Investigations**

Site-specific geotechnical investigations presented in the Environmental Report, Section 3.3.3.2, indicate the overall subsurface profile consists of clay soils underlain by weathered limestone and dolomite to more competent bedrock at greater depths. The clay overburden is classified as CH or CL per USCS (unified soil classification system) and is considered to have negligible potential of liquefaction. The in-situ medium stiff to very stiff or hard clays are not susceptible to strength degradation during seismic events.

Based on the drilling logs from the construction of groundwater monitoring wells (GW-1 to GW-6), the overburden soil thickness varies from 7 feet to 50 feet. The soil thickness of 50 feet was encountered at GW-1 with the surface elevation at 841.55 feet, which was located on the hill at the north corner of the property boundary. However, the groundwater monitoring wells are located away from the main facilities near the property boundaries. Detailed information about groundwater monitoring wells can be found in Section 3.4.1.2 of the Environmental Report.

Based on the soil boring logs within the footprint of the HCS, the overburden consists of residual clay soils encountered at depths ranging from 3.6 feet to 31.5 feet below the existing ground surface at boring locations. The soil overburden becomes deeper at locations closer to the north and northwest boundaries on the hill side.

**Potential for Differential Settlement**

After site grading cut and fill to establish the final grade, the overburden soil thickness below the final grade is expected to vary generally from less than 5 feet to approximately 25 feet within the footprint of the two PBs. The majority of the PB area, a low-lying area in the middle of the site, will receive fill. Potential settlement in this area will be mitigated with the following measures.

The entire PBs are designed to rest on a large mat foundation to reduce the potential for differential settlement. Furthermore, a geotechnical ground improvement approach using an intermediate foundation system is designed to further minimize the potential for differential settlement from the underlying clay soils. This intermediate foundation type is called a rigid inclusion (RI) system, which primarily consists of cement grout columns being installed down to the top of bedrock across the entire PB area in a grid pattern. The RI elements are similar to a pile foundation, without steel reinforcement. Typically, between the foundation mat and the top of the RI elements there is a layer of compacted granular soil called the load transfer platform (LTP). The LTP, RI elements, and the in-situ soils act as a composite matrix system with overall improved engineering properties to mitigate differential settlements. The large mat foundation

## SNM-XXXX

CHAPTER 1

supported by the RI matrix system will minimize the potential long-term differential settlement of the PB and ensure the safe operation of the proposed facility.

**Subsurface Bearing Capacity**

The subsurface medium stiff to very stiff clay soils discovered by the site-specific geotechnical investigations exhibit adequate bearing capacity for the PB with standard factor of safety against general soil failure based on the preliminary analysis. The primary design concern was the potential for differential settlement produced by the underlying clay soils. As discussed above, the large mat foundation supported by the RI matrix system will minimize the potential for long-term differential settlement of the PB and ensure the safe operation of the proposed facility. With the use of the RI matrix system, the overall foundation bearing capacity will be improved as well. Detailed information about geology and soils can be found in Section 3.3 of the Environmental Report.

**Potential for Karst Features**

According to the United States Geological Survey (USGS), the region containing the site may contain carbonate rocks that can become karstified. These folded and faulted carbonate rocks are Paleozoic in age and are subject to dissolution that may produce a range of features that include solution, collapse, cover-collapse sinkholes and caves. Karst features previously reported on lands adjacent to the site have included springs and sinkholes of various sizes. While sinkholes are known to occur adjacent to the site, no sinkholes were reported to occur directly on the site. Based on the topography of the site, several shallow draws and depressions exist on the site which may reveal karst features beneath the surface. Karst features are caused by dissolution of carbonate rocks and deep weathering along prevailing fractures and strike-oriented bedding, creating conduits and voids (open and/or clay-filled). Voids within the dolomite and limestone bedrock were encountered on the site during the geotechnical drilling program to support facility design. Bedrock was encountered during drilling at a minimum depth of 3.6 feet and a maximum depth of 50.0 feet.

In early 2022, a subsurface investigation was performed to support the facility design, which involved 22 geotechnical soil borings (B-1 to B-22) and a surface geophysical investigation. There were 6 borings located within the PB footprint with total boring depths ranging from 30 feet to 100 feet below ground surface (b.g.s.) and rock core total lengths ranging from 22 feet to 100 feet. Voids were encountered during rock coring in most borings within the PB footprint with the vertical dimensions from as thin as 0.2 feet to approximately 2.6 feet. The 2.6 feet opening was at 82 feet deep b.g.s. at one corner of the PB, while the majority of voids were filled with stiff clay and encountered within the upper 25 feet b.g.s.

The surface geophysical investigation performed shear wave seismic refraction tomography (SWSRT) and electrical resistivity tomography (ERT) to map the subsurface bedrock conditions, including possible major void (empty or soil-filled) anomalies associated with karst features. The

## SNM-XXXX

CHAPTER 1

tomography survey lines were over 700 feet long each and spaced at 50 feet to cover the entire PB area. The geophysical findings indicated the same general subsurface profiles as discovered by soil borings, which contained shallow residual stiff overburden underlain by weathered bedrock with higher weathering at upper rock formation and very hard competent rock at greater depths. The geophysical report also identified some anomalies where the ERT results showed high resistivity at deep zones compared to the surrounding rock data, although the shear wave velocity at those deep zones did not show abnormal results.

Further soil boring investigations were performed in June 2022 to focus on the anomaly locations identified in the geophysical work and included 6 borings (B-23 to B28) in the PB footprint. Rock coring of 60 feet to 80 feet were performed to reach those anomaly zones as identified by geophysical investigation and 20 feet to 30 feet beyond (deeper) the anomaly locations. These additional rock coring samples did not find any significant voids at those anomalies.

An additional geotechnical boring subsurface exploration included the advancement of eight geotechnical test borings (B-29 to B-36) at predetermined locations representing the area where the TX-1 buildings (including the Process Building) would be located. Similar to the previous subsurface explorations, voids within the limestone bedrock were encountered within six of the eight borings. Voids ranged from as thin as 0.1 ft. (0.03 m) to as much as 4.7 ft. (1.4 m). Occurrence of voids were limited to the upper 45 ft. (13.8 m) below ground surface. These voids were found within limestone and limestone interbedded with shale. Detailed information about geology and soils can be found in Section 3.3, and karst is discussed in 3.3.2, of the Environmental Report.

**Subsurface Engineering Characteristics**

The soil layer over bedrock generally consists of medium stiff to very stiff CH and CL clay at depths ranging from 3.6 feet to 18 feet below the existing ground surface within the PB footprint. At a boring location to the south of the PB, the clay was encountered to a depth of 27 feet b.g.s. Based on the 12 geotechnical borings performed in the PB/AB area, the limestone and dolomite bedrock exhibit higher weathering at shallower depth (generally upper 10 feet to 20 feet) and became more competent at greater depths. The rock core recovery ranges from approximately 24% to 100% while Rock Quality Designation (RQD) ranges from 0 to 100%. The lower recovery and RQD were mostly within the upper rock layers. The unconfined compressive strength values of intact rock cores range from 4,500 psi to 19,500 psi, which indicates hard to very hard strength.

The cross sections of subsurface soil/rock profiles are provided in Figures 1-5 through 1-10.

**Seismicity**

The East Tennessee Seismic Zone (ETSZ) is the second most active zone in the eastern United States in terms of small magnitude ( $M < 5$ ) seismicity, second in frequency to the New Madrid seismic zone. Activity in the ETSZ has remained high for several decades with only a few events having magnitudes as large as M 4.6. Generally, earthquakes in the ETSZ produce minor or no

## SNM-XXXX

CHAPTER 1

damage: the largest observed earthquakes have produced only minor damage to buildings, typically chimney collapse, cracks in plaster, and broken windows, consistent with intensity VI on the Modified Mercalli Intensity (MMI) scale.

**1.1.2 Facility Buildings and Structures**

A site plan showing the location and arrangement of buildings is included as Figure 1-4. Security fencing along or near the property boundaries defines the Owner Controlled Area. Five buildings are located on the TRISO-X property: the Security/Emergency Operations Center Building, the Administration Building, two Process Buildings, and the Graphite Matrix Powder (GMP) Building. Additional structures on-site include exhaust stacks, electrical equipment yards, mechanical equipment yards, cooling towers, roads, parking areas, loading docks, storage tanks, and a detention basin.

The Security/Emergency Operations Center Building is located near the main entrance to the property at Renovare Boulevard and serves as the main entry/exit security checkpoint for vehicles and people accessing the property. The Security/Emergency Operations Center Building also serves as the emergency operations center in the event of a site emergency. No radiological material is housed in this building.

The Administration Building is connected to the southwest corner of the Process Building and contains offices, meeting rooms, locker rooms, restrooms, and a break area for employees and authorized visitors. The Administration Building also contains the entry/exit point for workers accessing the radiologically-controlled Process Building. No radiological material is housed in this building.

The two Process Buildings, located at the center of the property, receive special nuclear material (SNM) and ship out final fuel forms (pebbles, compacts, etc.). The Process Buildings house SNM, chemicals, and equipment to support manufacture of coated particle fuel for the next generation of commercial nuclear reactors. The Process Buildings also receive GMP from the GMP Building. All handling, processing, and storage of SNM occurs in the Process Buildings.

The GMP Building is located southwest of the Process Buildings and is used to prepare GMP from raw materials. GMP is transported from the GMP Building to the Process Buildings to be used in the manufacturing process. No radiological material is housed in this Building.

Additional layout descriptions for the buildings and structures on-site are available in the ISA Summary Section 2.0, and the Emergency Plan Section 1.2.

The building code of record for the buildings on the site is the 2018 Edition of the *International Building Code*. The design satisfies American Society of Civil Engineers (ASCE) 7-16, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, structural requirements for a Risk Category IV facility. The type of construction is classified as non-combustible. All

## SNM-XXXX

CHAPTER 1

handling, processing, and storage of licensed material occurs in the two process buildings. One process building is sized for one process line, and the other process building is sized for two process lines, each building including similar process steps as outlined in Section 1.1.3.

**Seismic Load:** The design of the structures and facilities complies with seismic loadings based on the 2018 Edition of the *International Building Code* and ASCE 7-16, as appropriate for the geographic location of the site.

The ASCE 7 design basis earthquake is set at 2/3 of the site-class adjusted Maximum Considered Earthquake ( $MCE_R$ ) accelerations in accordance with Section 11.4.5 of ASCE 7-16:

$$S_{DS} \text{ (Design, 5\% damped, spectral response acceleration, short periods)} = 2/3 * S_{MS} = 0.432$$

$$S_{D1} \text{ (Design, 5\% damped, spectral response acceleration, 1-s periods)} = 2/3 * S_{M1} = 0.122$$

The Seismic Design Category (SDC) is determined in accordance with Section 11.6 of ASCE 7-16 as a function of the structure's Risk Category and the magnitude of the design spectral response acceleration parameters stated above. The SDC for the TRISO-X FFF Process Building is D. The equivalent lateral force (ELF) seismic analysis procedure is used as permitted by Section 12.6 of ASCE 7-16. The ELF procedure detailed in Section 12.8 of ASCE 7-16 takes into consideration the dynamic properties of the structure along with the seismic Importance Factor (1.5 for Risk Category IV) structures to determine the seismic response coefficient ( $C_s$ ) and ultimately the seismic forces on the structure.

**Wind Load:** The basic (general) wind speed of 116 MPH is based upon a 3,000-yr return period for Risk Category IV structures per ASCE 7-16 Figure 26.5-1D and Commentary Section C26.5.1. For tornado wind loads, the process buildings are evaluated for the tornado load cases in ASCE 7-22 Chapter 32 for a tornado wind speed of 136 mph.

**Snow Load:** The ground snow load of 10 psf is dictated by ASCE 7-16 Figure 7.2-1 and used in conjunction with equations in Ch. 7 of ASCE 7-16 to determine the loads on the structure. Per ASCE 7-16 Commentary Section C7.2, the ground snow load maps were developed by the Corp of Engineers, Cold Region Research and Engineering Laboratory (CRREL) to estimate snow loads with a 2% annual probability of being exceeded (50-yr Mean Recurrence Interval or MRI). Further detail is provided in the aforementioned commentary section. Note also that the Snow Importance Factor for a Risk Category IV structure is 1.20 which increases the flat room snow load by 20% from what would be calculated for a common Risk Category II structure.

**Rain Load:** The design rain load for the TRISO-X Facility is 6.14 in/hr (15-min duration and 3.24 in/hr (60-min duration). These rainfall intensities have a corresponding annual probability of exceedance of once in 100 years. Chapter 8.3 of ASCE 7-16 requires that each portion of a roof shall be designed to sustain the load of all rainwater that will accumulate on it if the primary drainage system for that portion is blocked plus the uniform load cause by the water that rises above the inlet of the secondary drainage system at its design flow.

## SNM-XXXX

CHAPTER 1

NUREG/CR-7046 was used to estimate a design basis flood due to local intense precipitation (LIP) and local storm runoff. NUREG/CR-7046 defines LIP as a measure of the extreme precipitation at a given location. National Oceanic and Atmospheric Administration (NOAA) Hydrometeorological Report No. 56 (HMR 56) recommended probable maximum precipitation (PMP) values were used to determine LIP values. The design basis flood for the TRISO-X facility is an LIP event based on a 1-hour PMP of 17.61 inches and a 6-hour PMP value of 36.30 inches.

**Ice Load:** The Process Building does not meet the definition of an “ice-sensitive structure” as given in Section 10.2 of ASCE 7-16 which is why atmospheric icing loads and wind-on-ice loads are not explicitly evaluated as a load case.

**Hydrological and/or Geological Load:** There are no additional hydrological loads that apply to the structure design other than snow, ice, and rain. There are no flooding loads on the structure and the foundations are above the groundwater table.

### 1.1.3 General Process Description

TRISO-X FFF manufacturing operations consist of receiving uranium oxide powder and liquid uranyl nitrate enriched to less than 20 weight percent U-235; converting uranyl nitrate into oxide; converting oxide into a uranyl nitrate solution, into gel spheres, and then into fuel kernels; and processing the fuel kernels through coating, overcoating, fuel form pressing, and carbonization. Coated particles and/or final fuel forms are removed from the process at the appropriate point and loaded into licensed shipping containers for shipment to other licensed facilities. These operations are supported by shipping and receiving, laboratory, quality control, research and development, uranium and chemical recovery, and waste disposal processes. Detailed facility and process descriptions are provided in the *TRISO-X Fuel Fabrication Facility Integrated Safety Analysis Summary*.

A list of the major manufacturing steps is provided below in the order in which the material flows through the process building. The maximum quantity of material in the process is controlled by the possession limits for the site as listed in License Chapter 1, Section 1.2.4. Material Control and Accounting procedures used to track and inventory SNM are described in the *TRISO-X Fuel Fabrication Facility Fundamental Nuclear Material Control Plan*.

Receipt of Uranium Oxide Feedstock (TX-1 and TX-2) – Incoming U<sub>3</sub>O<sub>8</sub> feedstock enriched to less than 20 weight percent <sup>235</sup>U arrives by truck in approved containers licensed by the NRC. Shipping packages are unloaded from the delivery truck and moved to a secure storage location inside the process buildings. Receipt measurements for Material Control and Accounting are performed, and the feedstock is transferred into portable containers and stored until ready for use in the Dissolution process.

## SNM-XXXX

CHAPTER 1

Receipt of Liquid Uranyl Nitrate Feedstock (TX-1 only) – Incoming liquid uranyl nitrate feedstock enriched to less than 20 weight percent arrives by truck in approved containers licensed by the NRC or DOE. Shipping packages containing liquid uranyl nitrate remain on the delivery trailer while the feedstock solution is transferred through a hose to a storage tank located inside the TX-1 process building. Receipt measurements for Material Control and Accounting are performed. Liquid uranyl nitrate is transferred from a storage tank to the Dilute Uranyl Nitrate Evaporation (DUNE) process where it is converted to  $U_3O_8$  powder using an evaporator and a calciner.  $U_3O_8$  powder from the calciner output is transferred to portable containers. The  $U_3O_8$  powder is then either sent to storage or directly to the Dissolution process.

Dissolution –  $U_3O_8$  powder is manually transferred from a portable container into a hopper in a glovebox. The  $U_3O_8$  powder is then metered into a nitric acid and water solution in a column where it is mixed until the required amount of  $U_3O_8$  is dissolved resulting in a uranyl nitrate solution. The uranyl nitrate solution is then transferred to storage columns until it is ready to be used in the Gelation process.

Gelation – The uranyl nitrate solution is mixed with organic additives, and liquid droplets are formed that react with heated silicone oil to produce gel spheres. The gel spheres are aged in silicone oil, washed and rinsed to remove the silicone and additives, and dried. The resulting dried microspheres are combined by mass to form the input batches to the Kernel Conversion process.

Kernel Conversion – The dried microspheres are converted in a high temperature furnace to fuel kernels of uranium compounds based on the fuel design being fabricated. The uranium compounds are uranium dioxide ( $UO_2$ ) and sub-stoichiometric uranium dicarbide ( $UC_{2-x}$ ), which together are referred to as uranium oxycarbide (UCO). The fuel kernels undergo quality checks, and non-conforming products are rejected and sent to the Uranium Recovery process. The fuel kernels that pass the quality checks are combined by mass to form the input batches to the Coating process.

Coating – The fuel kernels are coated with several carbonous layers using a fluidized bed chemical vapor deposition system, resulting in coated particle fuel. When four carbonous layers are used, the resulting uranium-bearing microspheres are known as TRISO particles. The coated particles undergo quality checks and non-conforming products are rejected and sent to the Uranium Recovery process. The coated particles that pass the quality checks are combined by mass to form the input batches to the Overcoating process.

Overcoating – The coated particles are overcoated with a layer of graphite matrix powder, based on the fuel design being fabricated and the packing fraction required in the fuel element. The overcoated particles (OCPs) undergo quality checks and non-conforming products are rejected and sent to a recovery station to remove the overcoating layer before being reintroduced into the Overcoating process. The OCPs that pass the quality checks are batched and sent to the Fuel Form Preparation process.

## SNM-XXXX

CHAPTER 1

Fuel Form Preparation – OCPs are poured into molds or tooling and compressed or compacted into green fuel forms of the desired geometry, such as compacts or pebbles, based on the fuel design being fabricated. Some fuel designs require encapsulating OCPs in additional GMP and/or shaping. The green fuel forms undergo dimensional checks, and non-conforming products are rejected and sent to the Uranium Recovery process. The green fuel forms that pass the quality checks are batched and sent to the High Temperature Carbonization process.

High Temperature Carbonization – The green fuel forms are processed through a high temperature furnace to convert the green body into a strong carbonized fuel form capable of withstanding handling and reactor service conditions. Final fuel form pebbles are machined to the specified fuel diameter. The final fuel forms undergo quality checks and those that pass are loaded into interim storage containers until an order is ready for loading into shipping containers. Non-conforming products are rejected and sent to the Uranium Recovery process.

Uranium Recovery – Uranium is recovered from damaged, degraded, or otherwise non-conforming product materials through a variety of batch operations. The batch operations size reduce, deconsolidate, oxidize, and/or convert the non-conforming product materials to U<sub>3</sub>O<sub>8</sub> powder so that it can be used as feedstock for the Dissolution process.

Shipping and Transportation – All shipments of nuclear materials and wastes are conducted in conformance with NRC, U.S. Department of Transportation, and State of Tennessee requirements. Incoming U<sub>3</sub>O<sub>8</sub> feedstock arrives by truck in approved containers licensed by the NRC. Incoming liquid uranyl nitrate feedstock arrives by truck in approved containers licensed by the NRC or DOE. Final fuel forms are shipped out to customers by truck in approved containers licensed by the NRC. Low level waste shipments are appropriately packaged and analyzed for uranium content prior to shipment to licensed low-level waste disposal sites.

#### **1.1.4 Raw Materials, Products, By-Products and Wastes**

1. The uranium feed material for the TRISO-X FFF is liquid uranyl nitrate (TX-1 only) and uranium oxide powder (TX-1 and TX-2).
2. The manufacturing, recovery, support, and waste packaging activities are supported by a number of non-radiological chemical materials stored in bulk quantities, as listed in the NRC-required Emergency Plan and ISA Summary.
3. Finished products containing licensed material include coated particles and final fuel forms in various shapes and configurations.
4. There are no byproducts as defined by 10 Code of Federal Regulations (CFR) 30.4 extracted or converted after extraction from the TRISO-X FFF for use in a commercial, medical, or research activity.

## SNM-XXXX

CHAPTER 1

5. Uranium is recovered from non-conforming product materials, process solutions, and scrap materials by processing it into a form that is suitable for use as feedstock in the manufacturing process.
6. Process solutions contaminated with uranium that cannot be recovered/recycled are identified as liquid wastes. Liquid wastes are collected and sampled to determine appropriate handling/treatment steps. Treatment typically involves adjustment of pH, filtering, ion exchange, and/or precipitation. Precipitates are de-watered, and the solids are packaged for off-site disposal. If needed, liquid wastes that have been handled/treated can be sampled and discharged through an inline monitor to shipping packages for off-site disposal. Used oils may also be sampled and containerized for shipment to a licensed disposal facility.
7. Airborne effluents are discharged to the atmosphere via a number of process stacks. HEPA filtration and scrubber systems are used where needed to remove radioactive particulates and chemicals from airborne effluents to assure compliance with 10 CFR 20 and applicable State of Tennessee regulations prior to discharge to the atmosphere. See Chapters 4 and 9 for programmatic information for managing and monitoring radioactive airborne effluent discharges.
8. Wastewater from systems and equipment in non-radiological mechanical equipment areas of the facility and sanitary wastes from bathrooms and showers are discharged through piping which goes to the City of Oak Ridge publicly owned treatment works (POTW). The City of Oak Ridge process for permitting discharges to the POTW will define monitoring requirements to assess potential contaminants in sanitary waste streams. No uranium will be present in this wastewater stream.
9. Solid waste materials include, but are not limited to, damaged and/or obsolete equipment, used ventilation filters and personal protective equipment, processing and waste treatment residues, and miscellaneous combustible wastes. Materials could be radiologically contaminated, non-contaminated, hazardous, or mixed (hazardous and radioactive). Solid waste materials are processed, recycled, and/or containerized for shipment to a licensed disposal facility.

## 1.2 Institutional Information

### 1.2.1 Corporate Identity

This application is filed by TRISO-X, LLC, a Delaware limited liability company, headquartered at 530 Gaither Road, 7<sup>th</sup> Floor, Rockville, Maryland. TRISO-X, LLC is a wholly-owned subsidiary of X Energy, LLC, a Maryland limited liability company. TRISO-X, LLC is a privately held company and is not owned or controlled by a foreign corporation or government. The principal place of business and location of the licensed facility is as follows:

TRISO-X Fuel Fabrication Facility  
170 Renovare Boulevard  
Oak Ridge, Tennessee 37830

## SNM-XXXX

CHAPTER 1**1.2.2 U.S. Nuclear Regulatory Commission License Information**

1. Docket Number: 70-7027
2. License Number: TBD
3. Period of License: 40 years

**1.2.3 Financial Qualifications**

A summary of financial qualifications that demonstrates the financial capability of TRISO-X, LLC to construct and operate the TRISO-X FFF has been submitted separately for NRC review. The financial arrangements to assure that decommissioning funds will be available are set forth in Chapter 10.

**1.2.4 Type, Quantity, and Form of Licensed Material**

The following types, maximum quantities, and forms of special nuclear materials (SNM) are authorized under 10 CFR 70.

1. [REDACTED] SRI kilograms of U-235 contained in uranium enriched to less than 20%, in any chemical/physical form. Contaminants may include transuranic materials and fission products (Sum of Alphas  $\leq$  1,410 Bq/gU, Sum of Betas  $\leq$  243 Bq/gU, Sum of Gammas  $\leq$  2,710 Bq/gU).
2. 350 grams of U-235 in any chemical/physical form and at any enrichment for use in measurement and detection instruments, check sources, and instrument response standards.
3. 350 grams of U-235 in any chemical/physical form and at any enrichment for use in research and development studies.
4. 25 millicuries of plutonium as counting and calibration standards and/or for use in research and development studies.
5. 1 microcurie of any SNM as sealed and unsealed radioactive sources for use in measurement and detection instruments, check sources, instrument response standards, and counting and calibration standards.

**1.2.5 Authorized Uses and Activities**

This license authorizes the use of SNM for operations involving enriched uranium pursuant to 10 CFR Part 70 as listed in this section. This also includes the support activities related to the manufacture of SNM-containing products.

1. Manufacturing Operations
  - a. Fuel Manufacturing – Conversion of uranium oxides to uranyl nitrate solutions, conversion of uranyl nitrates to uranium oxides, and fabrication of coated particles and final fuel forms containing uranium.
  - b. Uranium Recovery – recycling/recovery of SNM from process scrap materials.

## SNM-XXXX

CHAPTER 1

2. Laboratory Operations
  - a. Chemical, instrumental, and physical analyses and testing on material consisting of and/or containing SNM.
  - b. Preparation of any required samples or standards.
3. Research and Development Operations – Process, product, and other research and development activities using natural, source, and SNM compounds and mixtures in benchtop, laboratory-scale, and/or full-scale prototype equipment environments related to:
  - a. Enriched uranium fuel designs.
  - b. Manufacturing and processing technology and equipment.
  - c. Recycling/recovery.
4. Waste Operations
  - a. Volume reduction, treatment, packaging, and storage of liquid and solid wastes contaminated with or containing non-recoverable uranium.
  - b. Treatment, packaging, and storage of hazardous or mixed waste.
  - c. Shipment of wastes to licensed facilities for disposal.
5. Support Operations
  - a. Receipt, handling, and storage of raw materials.
  - b. Storage of licensed material compounds and mixtures in areas with containers arranged specifically for maintenance of radiological and nuclear safety.
  - c. Storage of finished fuel products and the preparation of these products for transportation off-site.
  - d. Decontamination of equipment and materials.
  - e. Maintenance, repair, calibration, and/or testing of SNM processing equipment, instruments, auxiliary systems, contaminated equipment, and facilities.

**1.2.6 Site Safeguards**

Physical security at the TRISO-X FFF is described in the NRC-approved *TRISO-X Fuel Fabrication Facility Physical Security Plan*, and nuclear material control and accountability (MC&A) is described in the NRC-approved *TRISO-X Fuel Fabrication Facility Fundamental Nuclear Material Control Plan*. Both plans are maintained current in accordance with applicable regulations as outlined in Chapters 12 and 13. These plans detail the measures employed at the facility to detect potential loss of, and mitigate the opportunity for theft of, SNM of Moderate Strategic Significance, in accordance with the applicable requirements of 10 CFR 73 and 10 CFR 74. Safeguards Information is controlled as described in the *TRISO-X Facility Safeguards Information Plan*.

## SNM-XXXX

CHAPTER 1**1.2.7 Terminology / Definitions**

Definitions for terms specific to a particular safety function may be given in the corresponding chapter on that function. The following definitions apply to terms used in this license:

| Term                                              | Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| U-235 Enrichments                                 | “Low enriched uranium”, which is also known as “high assay low enriched uranium (HALEU),” is defined as any compound of uranium in which the enrichment in the isotope of uranium-235 is less than 20 percent by weight.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Nuclear Safety                                    | Nuclear criticality safety                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Will, Shall                                       | A requirement.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Should                                            | A recommendation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| May                                               | Permission (optional), neither a requirement nor a recommendation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Are                                               | An existing practice for which there is a requirement to continue.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Frequencies                                       | <p>When audit, measurement, surveillance, and/or other frequencies are specified in license documents and approved procedures, the following time spans apply:</p> <ul style="list-style-type: none"> <li>▪ Monthly – an interval not to exceed 40 days</li> <li>▪ Quarterly – an interval not to exceed 4 months</li> <li>▪ Semi-Annually – an interval not to exceed 7 months</li> <li>▪ Annually – an interval not to exceed 15 months</li> <li>▪ Biennially – an interval not to exceed 30 months</li> <li>▪ Triennially – an interval not to exceed 45 months</li> <li>▪ For time spans not covered above, an extension of 0.25 times the interval will apply.</li> </ul> <p>NUREG-1520 does not provide guidance on audit frequency. The basis for the extension is to allow for flexibility in resources and scheduling, as previously approved in ML22294A181 Westinghouse License SNM-1107, Section 1.1.6.19, which contains the same frequencies and extension.</p> |
| Criticality Control or Criticality Safety Control | The administrative and technical requirements established to minimize the probability of achieving inadvertent criticality in the environment analyzed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

## SNM-XXXX

CHAPTER 1

| Term                           | Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Work Area Air Samplers         | Stationary air samplers used to measure the effectiveness of containment. If stationary air samplers are demonstrated to represent the air breathed by a worker, the results may be used to estimate worker dose. Where stationary air samplers have not been proven to be representative of the air a worker breathes, lapel air samplers may be used to estimate the worker's dose.                                                                                                                                                                                                                                                                          |
| Equivalent Experience          | For the purpose of meeting educational requirements described throughout the license, two (2) years applicable experience is considered to be equivalent to one (1) year of post-secondary education. For example, eight (8) years of applicable experience will satisfy the requirement for a B.S. degree (4 years of post-secondary education).                                                                                                                                                                                                                                                                                                              |
| Owner Controlled Area          | A site area bounded by a fence designed to provide physical security, and which encompasses the Controlled Access Area. The area contains radioactive material processing, storage, and laboratory areas, as well as support functions.                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Restricted Area                | A site area in which individuals may be exposed to radiation or radioactive material at levels or concentrations in excess of that allowed for the general public (see definition in 10 CFR 20.1003). This could include any location on the site where the TRISO-X FFF is located, depending upon activities conducted and the exposure potential as evaluated by the safety function.                                                                                                                                                                                                                                                                        |
| Radiologically Controlled Area | A site area where uncontained radioactive material is present, such that contamination levels are likely to be encountered in excess of acceptable levels for unrestricted use. This type of area, designated for contamination control purposes, requires various levels of protective clothing and other personnel protective actions. It could include any location within the Restricted Area, either on a permanent or temporary basis. This term is analogous to the 10 CFR 20.1003 defined term "controlled area...an area, outside of a restricted area, but inside the site boundary, access to which can be limited by the licensee for any reason." |

## SNM-XXXX

CHAPTER 1

| Term                                    | Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Uncontrolled Area                       | A site area where radioactive materials may be handled in the form of sealed sources, in packages or closed containers, in small amounts (air samples, bioassay samples, etc.), or not at all. This type of area is designated for contamination control purposes and is not likely to have contamination at levels in excess of those acceptable for unrestricted use.                                                                                                |
| Conditions Adverse to Safety or Quality | As used in Sections 2.2, 2.5.1, 11.6, 11.6.1, and 11.8, events that could have the potential to impact the safety or quality of licensed activities, including equipment failures, malfunctions, or deficiencies; procedure problems, errors, or omissions; improper installations; non-conformances with regulatory requirements or commitments; quality-related issues; or a significant condition, such that if uncorrected, could have a serious effect on safety. |

### 1.3 Special Exemptions and Special Authorizations

#### 1.3.1 Special Exemptions

##### 1.3.1.1 Criticality Monitoring

10 CFR 70.24(a) requires a licensee authorized to possess SNM in stated amounts to maintain in each area in which such licensed SNM is handled, used or stored to employ a Criticality Accident Alarm System (CAAS) meeting the stated requirements.

Notwithstanding the requirements of 10 CFR 70.24(a), the licensee is granted an exemption from criticality monitoring requirements for SNM stored in authorized shipping containers complying with the requirements of the Code of Federal Regulations, Title 10, Part 71, and which are in isolated arrays or on a transport vehicle and which are no more reactive than that approved for transport.

The requirements in 10 CFR 71.55, *General Requirements for Fissile Material Packages*, and 10 CFR 71.59, *Standards for Arrays of Fissile Material Packages*, ensure that arrays will remain subcritical under normal conditions and under accident conditions. The exemption does not affect the level of protection for either the health and safety of workers and the public or for the environment; nor does it endanger life or property or the common defense and security.

Under the provisions of 10 CFR 70.17, "Specific Exemptions", the Commission may, upon application, grant exemptions from the requirements of 10 CFR 70 when the exemption is

## SNM-XXXX

CHAPTER 1

authorized by law, will not endanger life or property or the common defense and security and are otherwise in the interest of the public.

The exemption is authorized by law because the Atomic Energy Act of 1954, as amended, contains no provisions prohibiting a licensee from being exempted from CAAS monitoring in a given area in which there is negligible risk of criticality. Granting such an exemption will not endanger life, property, or the common defense and security.

Granting this exemption to 10 CFR 70.24(a) is in the public interest because having criticality accident alarms in an area in which there is a negligible risk of criticality may cause unnecessary evacuations and an emergency response based on a potential spurious alarm. Spurious alarms could also cause unnecessary risk to individuals during an evacuation and provide confusing information about the safety of the facility to the public.

**1.3.1.2 Posting and Labeling**

10 CFR 20.1904(a) requires a licensee to ensure that each container of licensed material bears a durable, clearly visible label bearing the radiation symbol and the words: "CAUTION, RADIOACTIVE MATERIAL" or "DANGER, RADIOACTIVE MATERIAL". The label must also provide sufficient information (such as the radionuclide(s) present, an estimate of the quantity of radioactivity, the date for which the activity is estimated, radiation levels, kinds of materials, and mass enrichment) to permit individuals handling or using the containers, or working in the vicinity of the containers, to take precautions to avoid or minimize exposure.

Notwithstanding the requirements of 10 CFR 20.1904(a), the licensee is granted an exemption from affixing a label to each container of licensed material when entrances into each building in which radioactive materials are stored, used, or handled are posted with a sign stating "EVERY CONTAINER OR VESSEL WITHIN THIS AREA MAY CONTAIN RADIOACTIVE MATERIALS".

Granting this exemption request is otherwise in the public interest because it promotes regulatory efficiency. The exemption relieves the licensee from a requirement to label containers of licensed material in controlled areas to which the public has no access; therefore, the activities do not present a risk to public health and safety. Granting the exemption allows the licensee to focus the resources required to fulfill the labeling requirement on other activities.

The exemption is authorized by law because there is no statutory prohibition on the proposed posting of a single sign indicating that every container in the posted area has the potential for internal contamination. To reduce unnecessary regulatory burden, the NRC issued a final rule in 2007 that, in part, modified 10 CFR 20.1905, *Exemptions to Labeling Requirements*, thereby exempting certain containers holding licensed material from the labeling requirements of 10 CFR 20.1904 if certain conditions are met. Although the 2007 rulemaking only applied to facilities licensed under 10 CFR 50 and 10 CFR 52, *Licenses, Certifications, and Approvals for Nuclear Power Plants*, the rationale underlying the rule supports the exemption request. Exempting TRISO-X

## SNM-XXXX

CHAPTER 1

from this requirement reduces licensee administrative and information collection burdens but serve the same health and safety functions as the current labeling requirements. Therefore, the exemption does not affect the level of protection for either the health and safety of workers and the public or for the environment; nor does it endanger life or property or the common defense and security.

**1.3.1.3 ICRP-68 DAC and ALI Values**

Derived air concentration (DAC) and the annual limit on intake (ALI) values based on the dose coefficients published in the International Commission on Radiation Protection Publication 68 (ICRP-68) may be used in lieu of the DAC and ALI values in Appendix B of 10 CFR 20 in accordance with approved procedures. See Chapter 4 for additional details.

The ICRP-68 guidance was promulgated after the 10 CFR 20, Appendix B criteria were established, and provides an updated and revised internal dosimetry model. Use of the ICRP-68 models provide more accurate dose estimates than the models used in 10 CFR 20 and allows TRISO-X to implement an appropriate level of internal exposure protection. In a Staff Requirements Memorandum dated April 21, 1999 (SECY-99-077), the Commission approved the staff granting exemptions based on the precedent set by the decision to authorize the use of models in ICRP Publication 68.

This exemption is in accordance with the As Low As is Reasonably Achievable (ALARA) principle, international standards on radiation protection, and does not conflict with established NRC dose limits. No new accident precursors are created by this exemption to allow modification to the values used to assess internal dose. There is no significant increase in the risk to workers or members of the public as a result of this exemption. The activities that are authorized by this exemption are in compliance with law and will not endanger life or property or the common defense and security.

**1.3.1.4 ICRP-60 Organ Dose Weighting Factors**

Tissue weighting factors listed in the International Commission on Radiation Protection Publication 60 (ICRP-60) may be used in lieu of the organ dose weighting factors in 10 CFR 20.1003 for effective dose assessments listed in ICRP-68 methodologies, in accordance with approved procedures.

The ICRP-60 guidance was promulgated in the same year that 10 CFR 20 organ dose weighting factors were established. Use of the ICRP-60 models provide more accurate dose estimates than the models used in 10 CFR 20 and allows TRISO-X to implement an appropriate level of internal exposure protection. In a Staff Requirements Memorandum dated April 21, 1999 (SECY-99-077), the Commission approved the staff granting exemptions based on the precedent set by the decision to authorize the use of models in ICRP Publication 68.

## SNM-XXXX

CHAPTER 1

The underlying purpose of 10 CFR Part 20 is to ensure that occupational workers and members of the public are protected from radiation; that their doses, as a result of licensed activities, are within prescribed limits; and that their doses are ALARA.

This exemption is in accordance with the ALARA principle, international standards on radiation protection, and does not conflict with established NRC dose limits. No new accident precursors are created by this exemption to allow modification to the values used to assess internal dose. There is no significant increase in the risk to workers or members of the public as a result of this exemption. The activities that are authorized by this exemption are in compliance with law and will not endanger life or property or the common defense and security.

**1.3.1.5 Certain Unplanned Contamination Events**

Notwithstanding the requirements of 10 CFR 70.50(b)(1), the licensee is granted an exemption from the requirement to report unplanned contamination events when the following conditions are met:

1. The event occurs in a restricted area in a building which is maintained inaccessible to the public by multiple access controls.
2. The area was controlled for contamination before the event occurred, the release of radioactive material is under control, and no contamination has spread outside the area.
3. Radiation safety personnel trained in contamination control are readily available.
4. Equipment and facilities that may be needed for contamination control are readily available.
5. The otherwise reportable unplanned contamination event is documented in the licensee's Corrective Action Program.

Chapter 4 describes the radiation protection program measures that keep worker exposures ALARA through: (a) approved radiation protection procedures and radiation work permits; (b) the use of ventilation systems, containment systems, and respirators to control exposure to airborne radioactive material; (c) the use of protective clothing to prevent the spread of surface contamination; (d) the use of surveys and monitoring programs to document contamination levels and exposures to workers; and (e) identification of items relied on for safety and management measures to maintain those items available and reliable.

In addition, (f) access to the site is restricted to individuals that have completed site-specific nuclear safety training requirements or individuals that are formally escorted; (g) during normal operations, trained and qualified radiation protection staffing is provided and readily available to support and respond to radiological conditions, and the staff is trained in contamination control procedures and techniques required for responding to a contamination event when needed; (h) appropriate radiation surveys are performed by qualified personnel during or after an unplanned contamination event as necessary to assess radiological conditions and provide the appropriate response, survey results are compared to specified action guides, appropriate actions are taken when contamination levels in excess of action levels are found and the affected area is

## SNM-XXXX

CHAPTER 1

decontaminated in a safe and timely manner, and survey records for contamination events are documented pursuant to 10 CFR 20.2103 and are available for review.

Based on the limited scope of the exemption, and the access and contamination controls, training, radiation surveys and other ALARA measures described in the application, granting the exemption as stated above does not endanger life or property. The exemption does not alter reporting requirements for unplanned contamination events through other NRC requirements such as 10 CFR 20.2202, *Notification of incidents*, and 10 CFR 20.2203, *Reports of exposures, radiation levels and concentrations of radioactive material exceeding the constraints or limits*. In addition, the exemption does not involve information or activities that could impact the common defense and security.

Granting this exemption request is otherwise in the public interest because it promotes regulatory efficiency. The exemption relieves the licensee from a reporting requirement for unplanned contamination events that do not present a risk to public health and safety given the site-specific conditions and programs described above. Specifically, the exemption relieves the licensee from generating reports of contamination events in controlled areas where the release of radioactive material is under control and no contamination has spread outside the controlled area. Granting the exemption allows the licensee to focus the resources required to fulfill the reporting requirement on other activities. In addition, it relieves the NRC staff from receiving and processing reports which do not present a risk to public health and safety.

Therefore, the exemption does not affect the level of protection for either the health and safety of workers and the public or for the environment; nor does it endanger life or property or the common defense and security. Granting of this exemption will not result in a violation of the Atomic Energy Act of 1954, as amended, the Commission's regulations, or other laws. Therefore, the exemption is authorized by law.

**1.3.1.6 Process Buildings**

10 CFR 70.61(e) requires each engineered or administrative control or control system necessary to comply with paragraphs (b), (c), or (d) of this section shall be designated as an item relied on for safety.

Notwithstanding the requirements of 10 CFR 70.61(e), the licensee is granted an exemption from the process buildings being formally designated as items relied on for safety because reasonable assurance of adequate protection for the structural stability safety function is provided by meeting 10 CFR 70.64 and 10 CFR 70.61. The TRISO-X process buildings do not perform a containment or confinement safety function in the context of 10 CFR 70.61; however, they do perform a structural stability safety function to withstand the effects of credible natural phenomena hazards (NPH) so that the building does not collapse. A failure of the structural stability safety function is highly unlikely based on the design criteria applied in Section 1.1.2 and evaluation in ISA Summary Section 4.2.5. Therefore, the TRISO-X process buildings are not

## SNM-XXXX

CHAPTER 1

identified as items relied on for safety (IROFS) per 10 CFR 70.61(e) in the Integrated Safety Analysis Summary. The management measures specified in Section 11.9 are applied to the TRISO-X process buildings and provide reasonable assurance that the original building design will be maintained going forward and the building will continue to be available and reliable to perform its structural stability safety function.

Granting this exemption from the process buildings being formally designated as IROFS does not violate the Atomic Energy Act of 1954, as amended, other laws, or the Commissions' regulations because reasonable assurance of adequate protection for the structural stability safety function is provided by meeting 10 CFR 70.64 and 10 CFR 70.61. Therefore, the exemption is authorized by law.

Granting this exemption from the process buildings being formally designated as IROFS does not affect the reasonable assurance of adequate protection for the structural stability safety function provided by complying with 10 CFR 70.64 and 10 CFR 70.61 through use of building codes for either the health and safety of workers and the public or for the environment and will not endanger life or property or the common defense and security. The TRISO-X ISA demonstrates the 10 CFR 70.61 performance requirements are met when the structural stability safety function of the process buildings is maintained. The process buildings are not credited for containment or confinement of a uranium or chemical release accident scenario, and are highly unlikely to cause high or intermediate consequences to the public from a radiological release, chemical release, and a criticality event. The structural stability of the process buildings is initially demonstrated by compliance with 10 CFR 70.64 and 10 CFR 70.61 by using the International Building Code and other related building codes for the design of new facilities and processes and is continually demonstrated throughout the life of the facility by management of changes under the TRISO-X configuration management program as required by 10 CFR 70.72. Therefore, the exemption will not endanger life or property or the common defense and security.

Granting this exemption from the process buildings being formally designated as IROFS promotes regulatory efficiency by reducing construction oversight and reducing operations oversight over the life of the facility, which is an added cost that does not provide a comparable benefit of enhanced safety or reliability versus the reasonable assurance of adequate protection provided by complying with 10 CFR 70.64 and 10 CFR 70.61 through use of building codes. This allows both TRISO-X and NRC to maintain and focus resources on the appropriate systems, structures, and components that are designated as IROFS to meet the 10 CFR 70.61 performance requirements. This approach supports efficient regulatory oversight and use of TRISO-X resources while maintaining reasonable assurance of adequate protection of public health and safety. Therefore, the exemption is in the public interest.

## SNM-XXXX

CHAPTER 1**1.3.2 Special Authorizations****1.3.2.1 Changes to the License Application**

Changes may be made to the License Application and/or to supporting documents referenced in the license without prior NRC approval provided that the following conditions are met:

1. The change does not decrease the level of effectiveness of the design basis as described in the License Application.
2. The change does not result in a departure from the methods of evaluation described in the License Application used in establishing the design basis for the safety functions or their validation.
3. The change does not result in a degradation of safety.
4. The change does not affect compliance with applicable regulatory requirements.
5. The change does not conflict with an existing license condition.
6. Records of such changes shall be maintained, including management approval and a technical justification that provides the bases for the determination that prior NRC approval is not required.
7. Within 30 days after the end of the calendar year in which the change is implemented, the licensee shall submit the revised chapters of the License Application to the Director, NMSS, using an appropriate method listed in 10 CFR 70.5(a), and a copy to the appropriate NRC Regional Office.

This authorization is consistent with the process for making changes under 10 CFR 70.72, *Facility Changes and Change Process*, and is further supported by Section C5, *Other Changes*, in NRC Regulatory Guide 3.74, *Guidance for Fuel Cycle Facility Change Processes*, January 2012.

NRC SPECIAL NUCLEAR MATERIAL LICENSE  
 SNM-XXXX  
 CHAPTER 1

TXF-REG-NRC-0001

Figure 1-1: Site Location

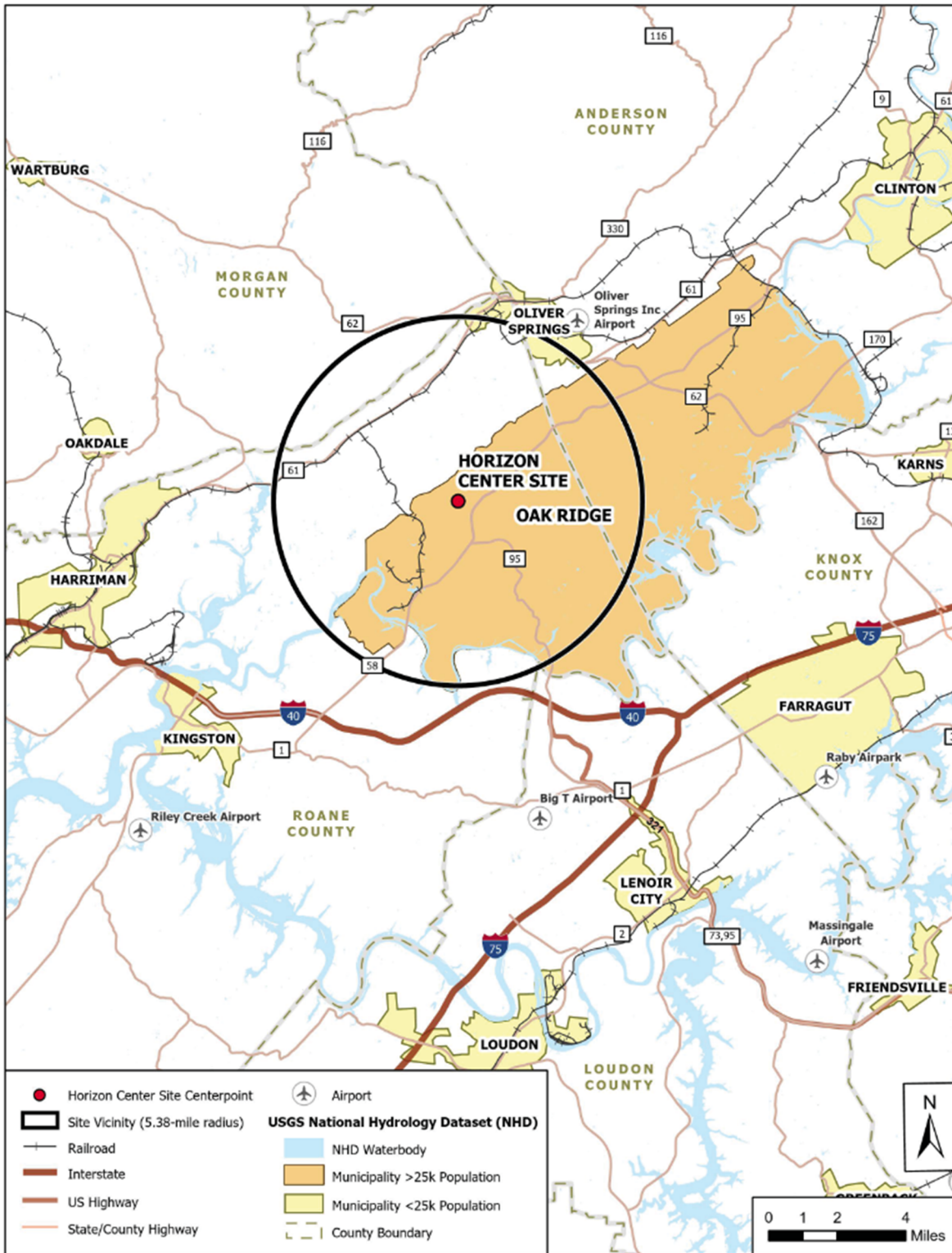


Figure 1-2: Key Features Near the Site

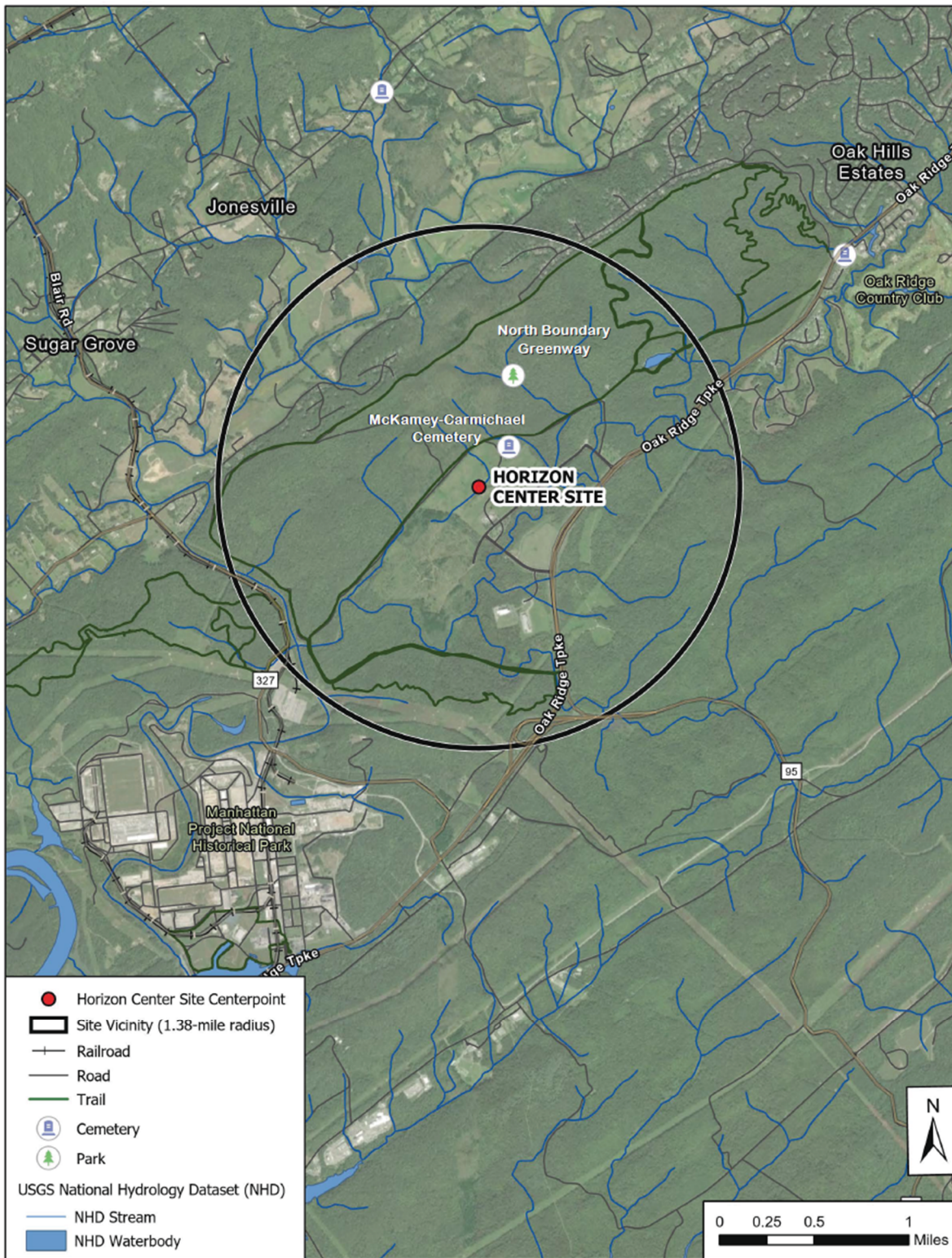


Figure 1-3: Regional Highways and Interstates Near the Site

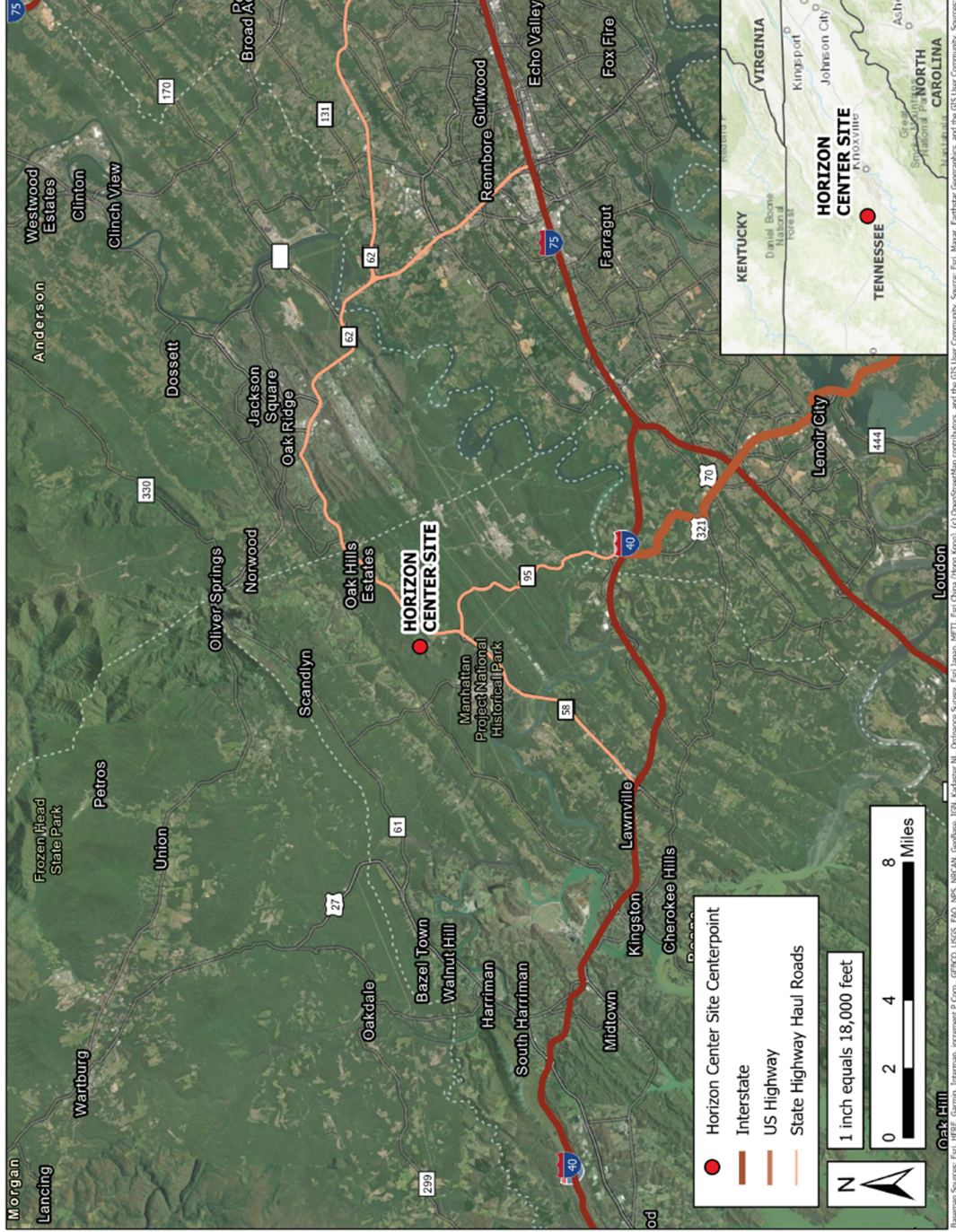
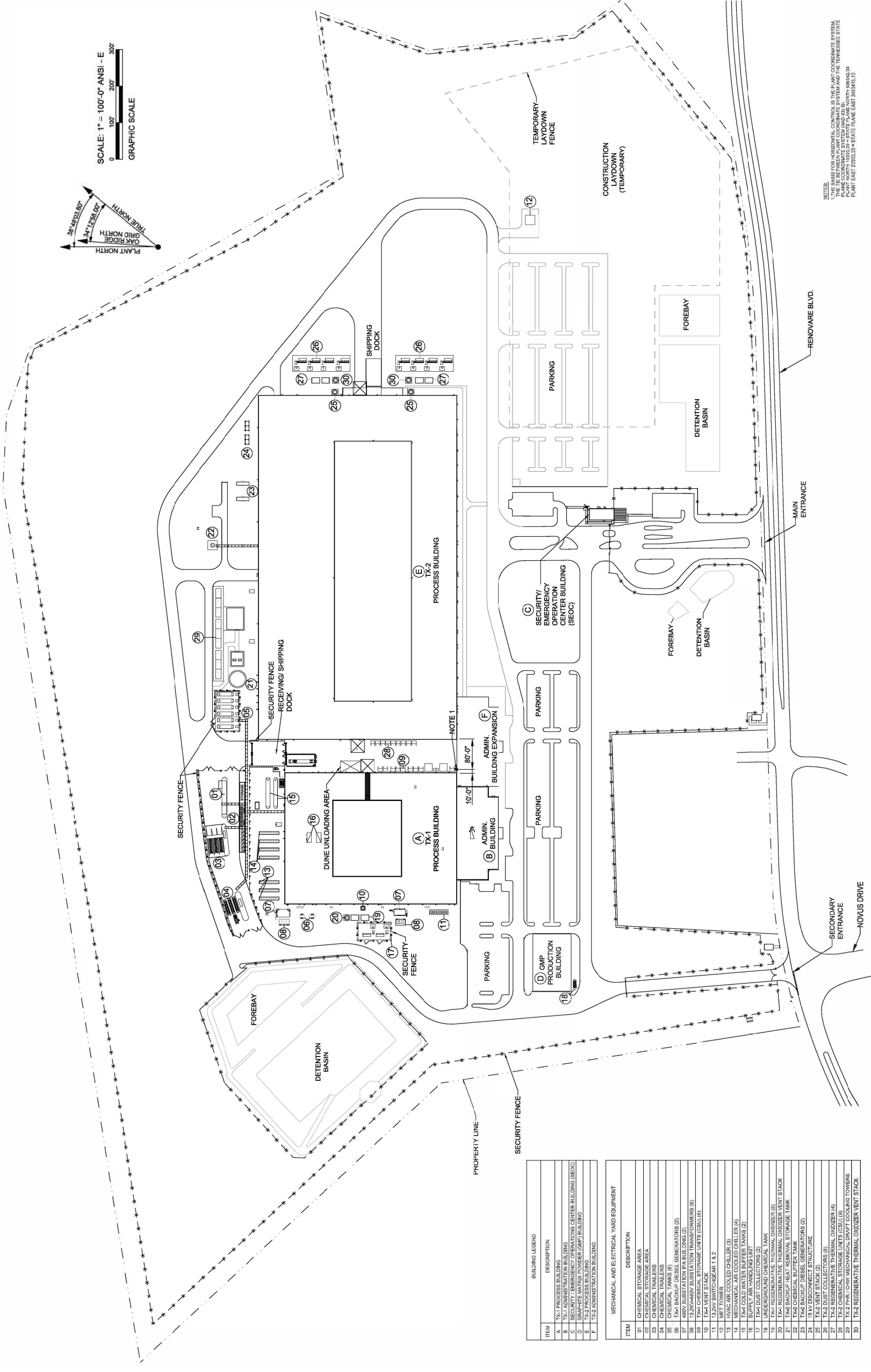


Figure 1-4: Site Plan



NOTE:  
 THESE ARE PROVISIONAL COORDINATES IN THE NAD 83 DATUM SYSTEM.  
 THE BETWEEN PLANT COORDINATE SYSTEM AND THE TENNESSEE STATE  
 PLANE COORDINATE SYSTEM IS 100.00 FEET NORTH AND 100.00 FEET  
 WEST. THE BETWEEN PLANT COORDINATE SYSTEM IS NORTH 100.00  
 PLANT EAST 22202.29 = STATE PLANE EAST 245445.10

Figure 1-5: Plan View of Geologic Cross Sections

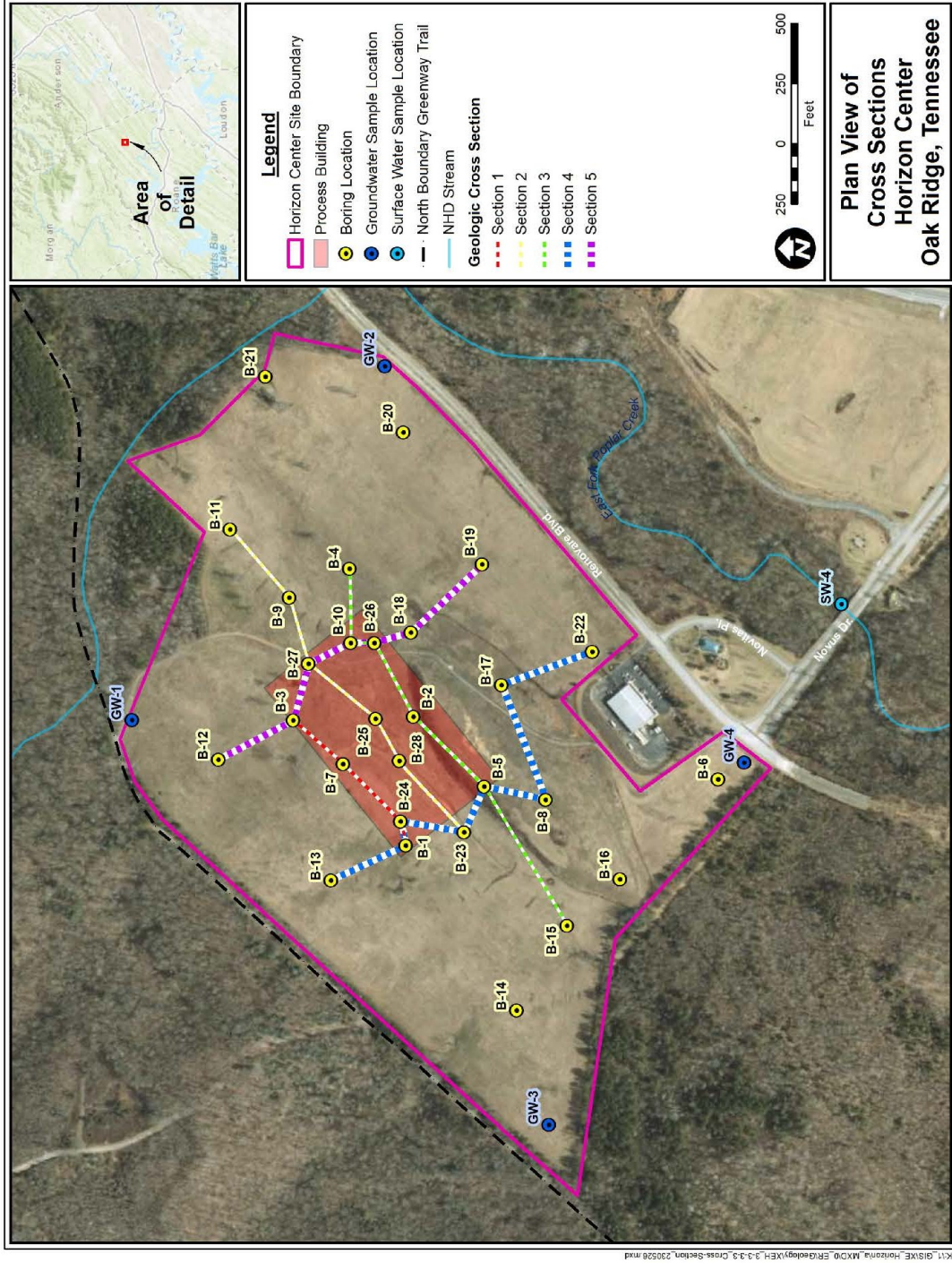
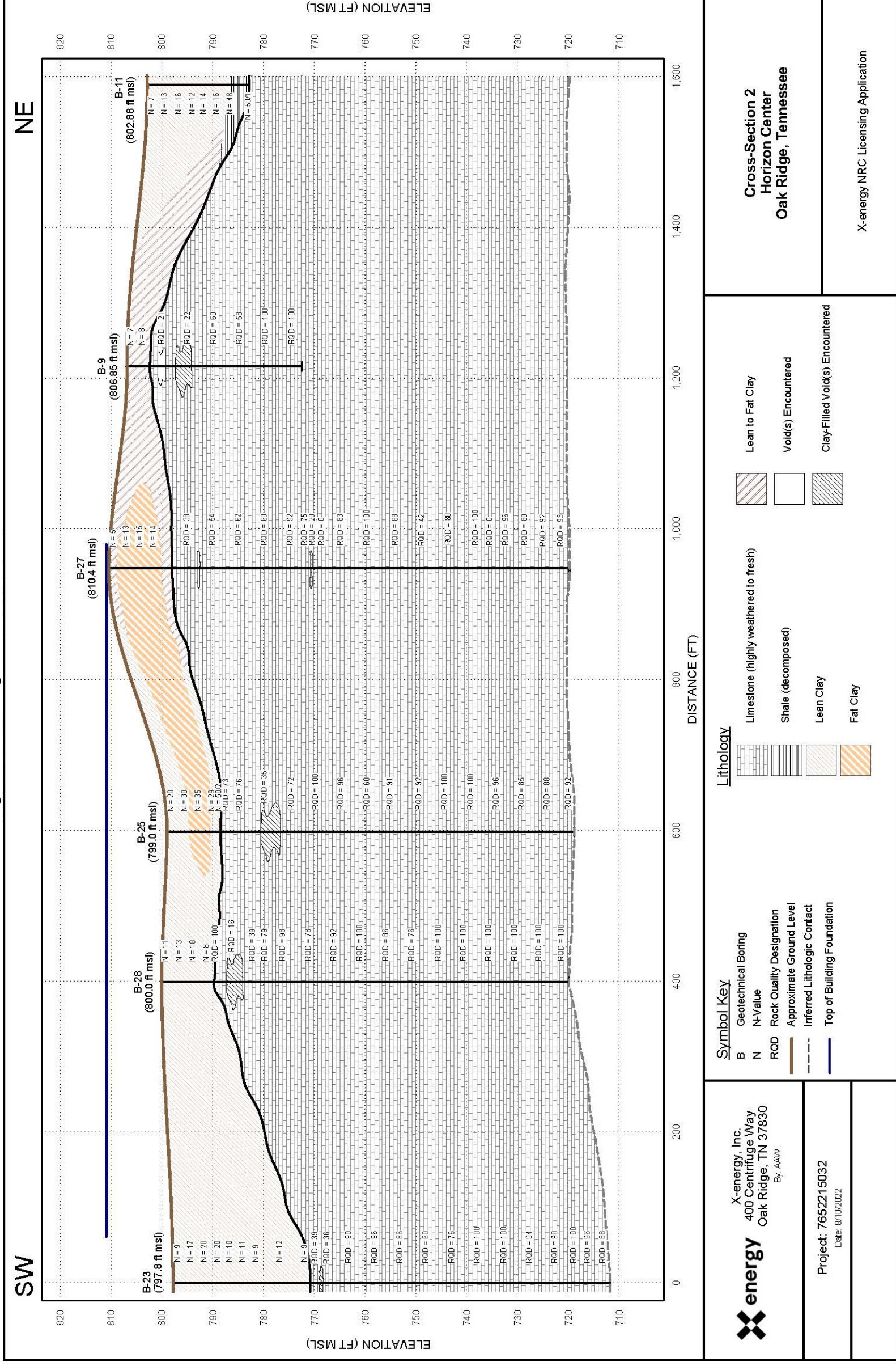




Figure 1-7: Geologic Cross-Section 2



Note: N-value and rock quality designation displayed approximately at the mid-point of the run.

**energy** X-energy, Inc.  
400 Centrifuge Way  
Oak Ridge, TN 37830  
By: AAW

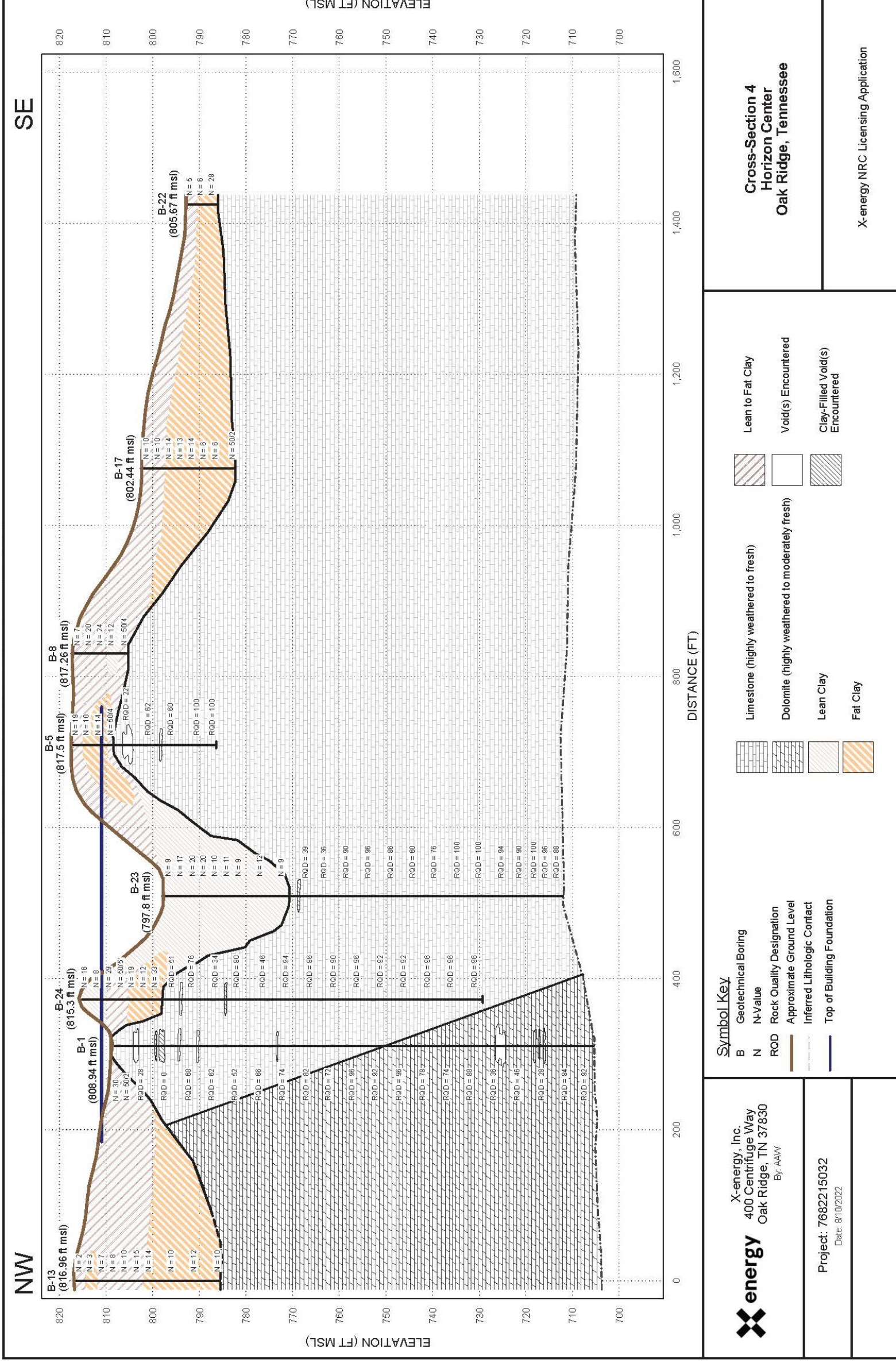
Project: 7652215032  
Date: 8/10/2022

**Cross-Section 2**  
**Horizon Center**  
**Oak Ridge, Tennessee**

X-energy NRC Licensing Application



Figure 1-9: Geologic Cross-Section 4



Note: Orientation (angle) of inferred lithologic contact(s) between bedrock (e.g., dolomite and limestone) represents approximate apparent dip (angle, 13.5 degrees SE) calculated from dip observed during drilling operations and adjusted based on actual alignment of cross-section illustrated on the 34:200 vertical-to-horizontal exaggerated-profile scale. N-value and rock quality designation displayed approximately at the mid-point of the run.

Figure 1-10: Geologic Cross-Section 5

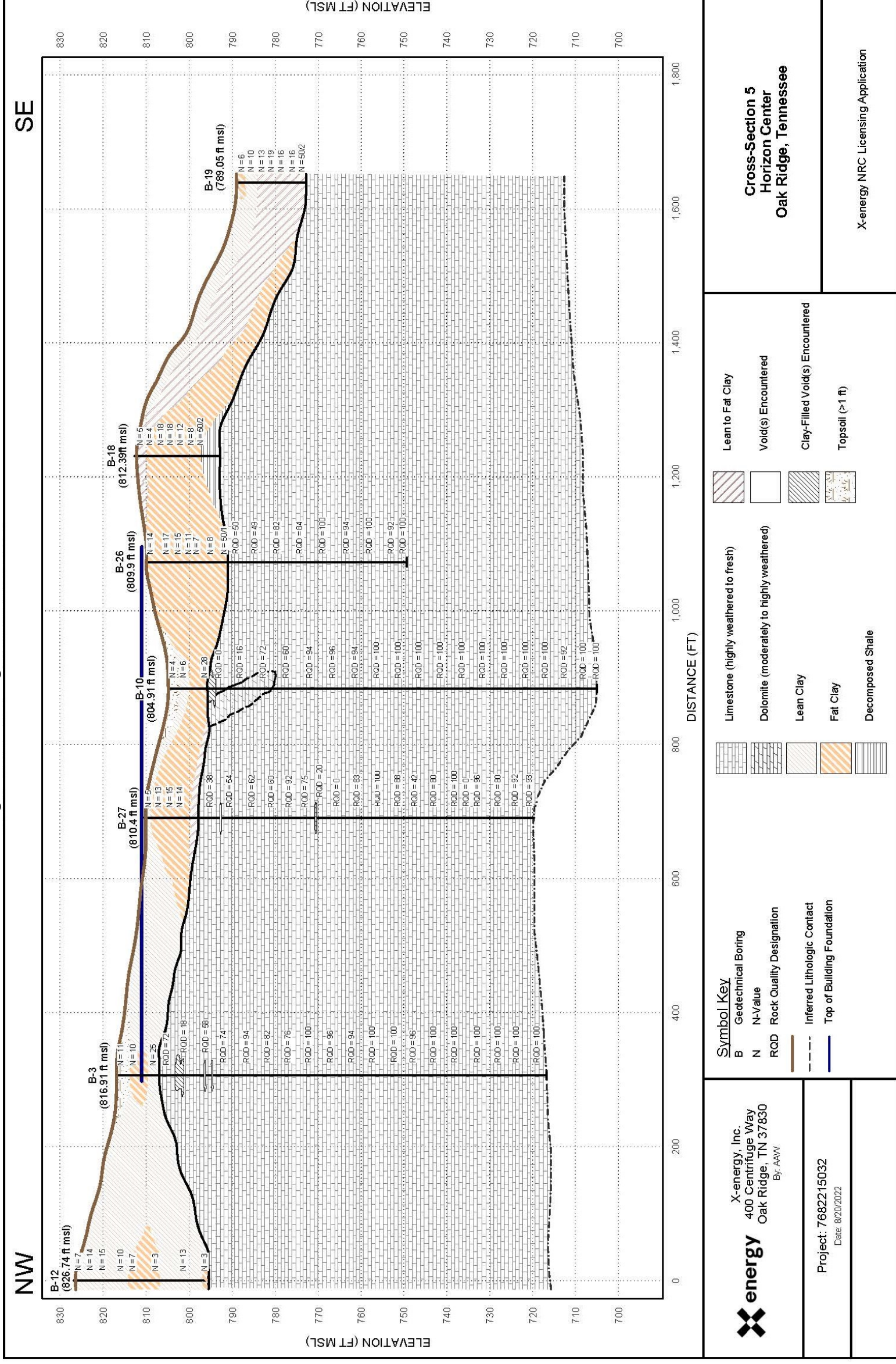


Figure 1-11: Groundwater Contours – September 2021

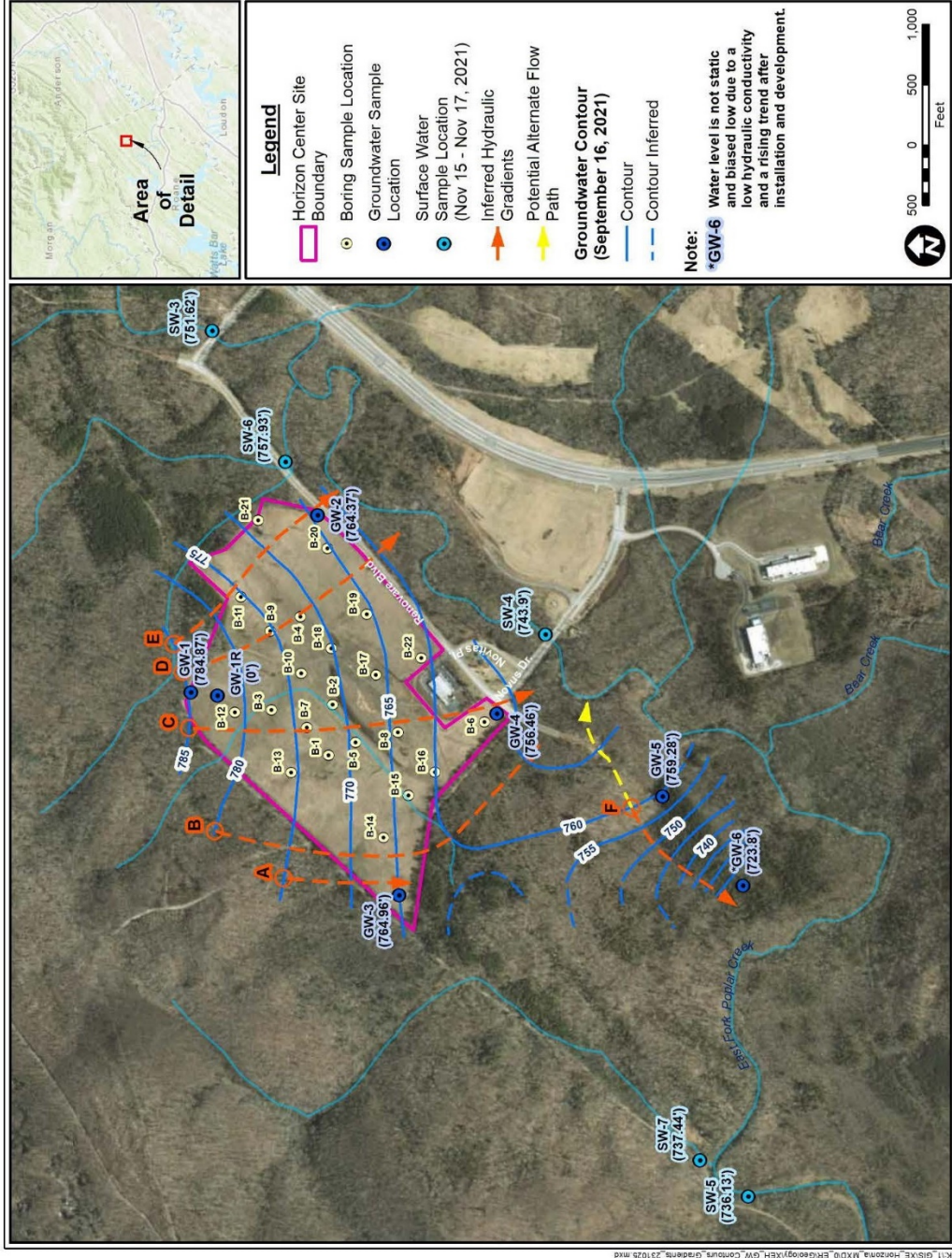
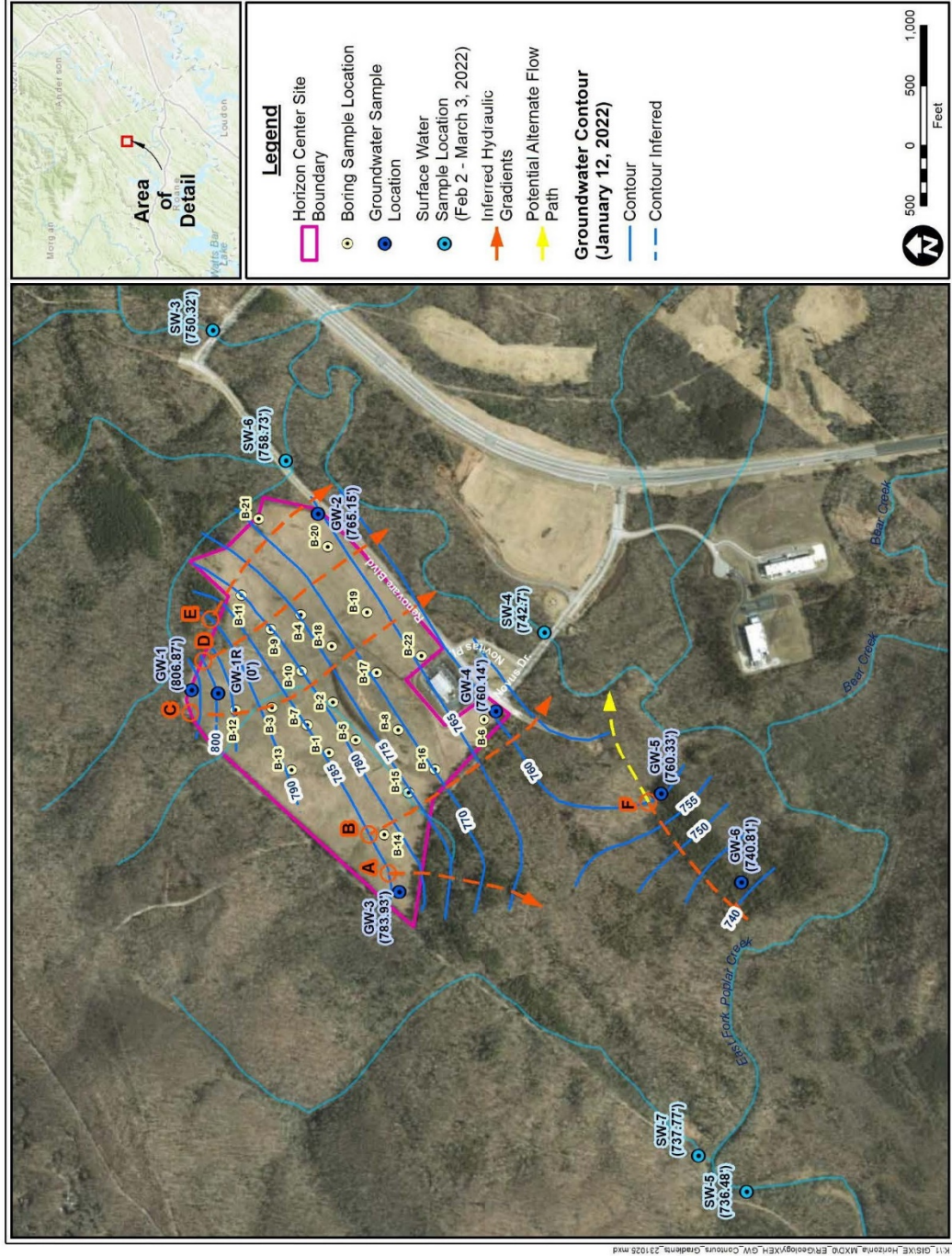


Figure 1-12: Groundwater Contours – January 2022



## SNM-XXXX

CHAPTER 1REVISION SUMMARY

| Revision | Date     | Section/Page                            | Description of Changes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------|----------|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | 5-Apr-22 | ALL                                     | Initial issue.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 2        | 4-Nov-22 | N/A                                     | All changes for this revision are based on RSI responses in TX0-LTR-0006.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|          |          | Section 1.1.1.1                         | Added geotechnical discussion of site regarding slope stability, soil liquefaction, differential settlement, bearing capacity, karst features, and site cross sections. (RSI 7.1, 7.2, 7.3, 7.4, 7.5, 7.6)                                                                                                                                                                                                                                                                                                                                                                                                      |
|          |          | Section 1.1.2                           | Added design basis values for seismic, wind, precipitation, hydrological, and geological NPH. (RSI 6.1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|          |          | Section 1.3                             | Separated special exemptions and special authorizations. Re-numbered subsections. (RSI Observation)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|          |          | Section 1.3.1.1                         | Added detail for criticality monitoring exemption. (RSI 1-A, RSI Observation)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|          |          | Figures 1-3 thru 1-8                    | Added new figures for site geological cross sections. (RSI 7.6)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 3        | Dec-24   | ALL                                     | Added document number TXF-REG-NRC-0001 to header.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|          |          | Section 1.1.1.1, Figure 1-2, Figure 1-3 | Revisions based on RAI responses, TX0-LTR-0022 <ul style="list-style-type: none"> <li>Added reference to new Figure 1-2 to show key features near the site due to License Chapter 1 RAI-1.</li> <li>Added reference to Environmental Report figures that contain more information about population near the site due to License Chapter 1 RAI-5.</li> <li>Updated nearest school name, direction, and distance due to License Chapter 1 RAI-5.</li> <li>Added description of and reference to new Figure 1-3 to show regional highways and interstates near the site due to License Chapter 1 RAI-6.</li> </ul> |
|          |          | Sections 1.1.1.3, 1.1.2                 | Updated to reflect more than one process building is planned for the site.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|          |          | Section 1.1.1.3                         | Revisions based on RAI responses <ul style="list-style-type: none"> <li>Updated description of nearest users of groundwater downgradient of the site due to TX0-LTR-0022, License Chapter 1 RAI-7.</li> <li>Added description of the stormwater system on the site due to TX0-REG-LTR-0042, Hydrology RAI-4.</li> <li>Added description of and reference to new Figures 1-9 and 1-10 that show seasonal groundwater potentiometric level contours on the site. (Hydrology RAI-6)</li> </ul>                                                                                                                     |
|          |          | Section 1.1.1.4                         | Updated "Potential for Karst Features" due to TX0-LTR-0028, Hydrology RAI-1. Added reference to additional borings performed for TX-1 location.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

SNM-XXXX

CHAPTER 1

|   |        |                          |                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---|--------|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   |        | Section 1.1.2            | <ul style="list-style-type: none"> <li>Expanded the descriptions of the five buildings planned for the site due to TX0-LTR-0022, License Chapter 1 RAI-1.</li> <li>Added commitment to ASCE 7-16 Risk Category IV due to TX0-REG-LTR-0045, Enclosure 1 Structural RAI-2, and updated design load values.</li> </ul>                                                                                                                        |
|   |        | Section 1.1.3            | Added brief descriptions for the major manufacturing steps due to TX0-LTR-0022, License Chapter 1 RAI-3. Also added new process step to receive/store/convert uranyl nitrate to uranium oxide to account for alternate HALEU feed material.                                                                                                                                                                                                |
|   |        | Section 1.1.4            | Updated Items 5, 6, and 7 due to TX0-LTR-0022, License Chapter 1 RAI-8 and RAI-9.                                                                                                                                                                                                                                                                                                                                                          |
|   |        | Section 1.2.1            | Updated legal corporate address for TRISO-X, LLC due to corporate office relocation. Updated facility address recently assigned by the City of Oak Ridge.                                                                                                                                                                                                                                                                                  |
|   |        | Section 1.2.4            | <ul style="list-style-type: none"> <li>Deleted references to 10 CFR 30 and 40 and deleted Items 5 and 6 due to TX0-LTR-0024, License Chapter 1 RAI-10 and RAI-11.</li> <li>Updated U-235 value for Item 1 based on quantity required to operate TX-1 and TX-2.</li> <li>Updated contaminant values for Item 1 based on evaluation of characterization data for the alternate HALEU feed material in the form of uranyl nitrate.</li> </ul> |
|   |        | Section 1.2.7            | Work Area Air Samplers – reworded to improve readability. Conditions Adverse to Safety – updated section references.                                                                                                                                                                                                                                                                                                                       |
|   |        | Section 1.3.1.2          | Addressed why granting the exemption request is otherwise in the public interest due to TX0-LTR-0022, License Chapter 1 RAI-14A.                                                                                                                                                                                                                                                                                                           |
|   |        | Section 1.3.1.5          | Addressed why granting of the exemption is authorized by law.                                                                                                                                                                                                                                                                                                                                                                              |
|   |        | Figure 1-4               | Renumbered Figure 1-2 due to insertion of new Figures 1-2 and 1-3. Updated to current version of site plan.                                                                                                                                                                                                                                                                                                                                |
|   |        | Figures 1-5 to 1-10      | Renumbered Figures 1-3 to 1-8 due to insertion of new Figures 1-2 and 1-3. Updated figures to show boring locations superimposed on the footprint of the process building due to TX0-LTR-0028, Geotechnical RAI-1.                                                                                                                                                                                                                         |
|   |        | Figure 1-11, Figure 1-12 | Added due to TX0-LTR-0028, Hydrology RAI-6.                                                                                                                                                                                                                                                                                                                                                                                                |
|   |        | Revision Summary         | Added revision summary to end of chapter.                                                                                                                                                                                                                                                                                                                                                                                                  |
| 4 | Dec-25 | Section 1.1.1.2          | Added most severe documented historical events in accordance with 10 CFR 70.64(a)(2) based on TX0-REG-LTR-0080 RAI-1 response.                                                                                                                                                                                                                                                                                                             |
|   |        | Section 1.1.1.3          | Revised design basis flood detail based on TX0-REG-LTR-0080 RAI-3 response.                                                                                                                                                                                                                                                                                                                                                                |
|   |        | Section 1.1.2            | Revised tornado wind load evaluation based on TX0-REG-LTR-0091 RAI-7 response.                                                                                                                                                                                                                                                                                                                                                             |

SNM-XXXX

CHAPTER 1

|   |        |                        |                                                                                                                                                                                                                                                                                                                                                                           |
|---|--------|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   |        | Section 1.1.3          | Revised general process descriptions based on TX0-REG-LTR-0071 RAI-1 response and Observation 1.<br>Removed OCP washing and replaced with OCP recovery based on TXF-DR-ECR-0036-015.                                                                                                                                                                                      |
|   |        | Section 1.1.4          | Revised feed material based on TX0-REG-LTR-0071 RAI-1 response.                                                                                                                                                                                                                                                                                                           |
|   |        | Section 1.2.5, Item 1a | Added “conversion of uranyl nitrates to uranium oxides” based on TX0-REG-LTR-0071 RAI-1 response.                                                                                                                                                                                                                                                                         |
|   |        | Section 1.2.7          | Revised definition of Frequencies based on TX0-REG-LTR-0089 Set 16 supplemental information for RAI-14 response.<br>Revised definition of Equivalent Experience based on TX0-REG-LTR-0071 Set 13 Chapter 1 Observation 2 response.<br>Added “or Quality” to “Conditions Adverse to Safety” based on TX0-REG-LTR-0089 Set 16 supplemental information for RAI-20 response. |
|   |        | Section 1.3.1.6        | New section for exemption request for the process buildings based on TX0-REG-LTR-0080 RAI-6 response.<br>Revised tornado wind load evaluation based on TX0-REG-LTR-0091 RAI-7 response.                                                                                                                                                                                   |
| 5 | Feb-26 | Section 1.3.1.6        | Revised exemption request based on meetings with NRC held January 21, 2026 (ML26013A262).                                                                                                                                                                                                                                                                                 |
|   |        | Section 1.3.2.1        | Revised exemption request to align with final License Condition wording.                                                                                                                                                                                                                                                                                                  |
|   |        | Section 1.3.2.2        | Deleted section to remove redundant information. The 1993 guidance was incorporated formally into Regulatory Guide 8.24, Appendix A, and is referenced accordingly in License Section 4.7.3.4.                                                                                                                                                                            |

## ENVIRONMENTAL SAFETY

## Table of Contents

| <b>SECTION</b> | <b>TITLE</b>                                           | <b>STARTS<br/>ON PAGE</b> |
|----------------|--------------------------------------------------------|---------------------------|
| <b>9.1</b>     | <b>Environmental ALARA</b>                             | <b>9-2</b>                |
| <b>9.2</b>     | <b>Gaseous Effluent Control</b>                        | <b>9-2</b>                |
| 9.2.1          | Gaseous Effluent Sampling                              |                           |
| 9.2.2          | High-Efficiency Particulate Absolute (HEPA) Filtration |                           |
| 9.2.3          | Final HEPA Filter Surveillance                         |                           |
| <b>9.3</b>     | <b>Liquid Effluent Control</b>                         | <b>9-4</b>                |
| 9.3.1          | Wastewater Collection/Treatment                        |                           |
| <b>9.4</b>     | <b>Waste Management</b>                                | <b>9-5</b>                |
| <b>9.5</b>     | <b>Environmental Monitoring</b>                        | <b>9-5</b>                |
| <b>9.6</b>     | <b>Program Management</b>                              | <b>9-7</b>                |

## SNM-XXXX

CHAPTER 9**ENVIRONMENTAL SAFETY****9.1 Environmental ALARA**

TRISO-X has established and maintains an environmental safety program to maintain concentrations of radioactive materials in facility effluents and the surrounding environment as low as reasonably achievable (ALARA). The TRISO-X ALARA program is described in Chapter 4. Environmental releases are limited and monitored such that compliance with the public dose limits of 10 CFR 20.1301 and the effluent limits of 10 CFR 20.1302 can be achieved and demonstrated. These objectives are supported by performing routine measurements and calculations, comparing results to action levels, and reporting results to facility management and the NRC, as appropriate. Internal action levels are implemented through approved procedures to provide early identification of potential problems and prevent exceedance of established guidelines. If action levels are exceeded, investigations are initiated to identify the cause, and appropriate corrective action(s) are taken to minimize the likelihood of recurrence as part of the corrective action program outlined in Chapter 11.

The environmental safety program implementing procedures ensure compliance with 10 CFR 20 Subparts B, *Radiation Protection Programs*, D, *Dose to the Public*, F, *Surveys and Monitoring*, K, *Waste Disposal*, L, *Records*, and M, *Reports*, that address effluent control and treatment. The program includes provisions for the monitoring of the facility environment, including ambient air, surface water, ground water, soils, and vegetation, that could be affected by facility effluents. The TRISO-X ISA Summary and Environmental Report provide additional information. Chapter 2 of this application addresses staff qualifications of individuals responsible for the environmental safety program.

**9.2 Gaseous Effluent Control**

Operating and engineered controls are used as necessary to ensure that environmental airborne concentrations of radioactive materials attributable to gaseous effluents are constrained and resultant radiological doses to members of the public comply with the concentration limits and public dose limit specified in 10 CFR 20.1101(d), consistent with guidance in Regulatory Guide 4.20. Dose calculations are performed using nationally recognized methods.

Dose calculations as well as environmental concentrations in 10 CFR 20, Appendix B, Table 2 for members of the public may be modified based on ICRP 66 and 68 as described in Chapter 1, assuming an Activity Median Aerodynamic Diameter (AMAD) of 5 micrometer.

## SNM-XXXX

CHAPTER 9**9.2.1 Gaseous Effluent Sampling**

Continuous representative sampling is performed in stacks exhausting air with potential concentrations of radioactive materials that are significant with respect to the site's compliance with 10 CFR 20. Samples are collected and analyzed for particulate radioactive material on a scheduled basis as defined in approved procedures using methods and frequencies appropriate for the effluent medium and the radionuclide(s) being sampled. Effluents are sampled unless periodic sampling or other means have established that radioactivity in the effluent is insignificant and will remain so.

Gaseous effluent sampling is performed during manufacturing operations involving licensed materials. Sampling of exhaust air stacks is not required when the underlying ventilation system has been shut down in conjunction with a cessation of the processing of licensed materials in the affected ventilated spaces. Any passive emissions of radioactive materials are abated by the continued presence of the HEPA filters in place. Approved procedures define action levels to ensure that compliance with applicable limits is maintained.

**9.2.2 High-Efficiency Particulate Absolute (HEPA) Filtration**

HEPA filtration is used on stacks exhausting air that potentially contain radioactive materials that are significant with respect to the site's compliance with 10 CFR 20. This exhaust air is passed through at least one stage of HEPA filtration prior to release from the stack. Fire-resistant HEPA filters that are certified by the manufacturer as meeting HEPA efficiency specifications are used.

The adequacy of final HEPA filter installations is verified by in-place testing prior to initiating operations with radioactive materials in the following instances:

- Startup of a new facility
- Following replacement of final filters
- After maintenance work on the final filter bank that could have foreseeable adverse impacts on their effective operation
- After exposure of the final filters to a condition or agent that may have adversely impacted their effective operation, if deemed necessary based on visual/operational inspection.

**9.2.3 Final HEPA Filter Surveillance**

Measures as described in approved procedures are taken to conservatively monitor the potential onset of, or adverse emissions impacts from HEPA filter deterioration. These measures include the following:

- Periodic inspection of HEPA filters;
- Periodic measurement of differential pressures across HEPA filter banks; and
- Stack emissions monitoring that establish action levels triggering notifications to the maintenance/engineering organization and performance of HEPA filter inspections at

## SNM-XXXX

CHAPTER 9

measured offgas radionuclide concentrations set below applicable 10 CFR 20 Appendix B effluent limits, and levels above which the process would be shut down.

Final HEPA filter installations are equipped with pressure differential measuring/indicating devices. Measured differential pressures are used to evaluate the need for filter changeout/maintenance.

### **9.3 Liquid Effluent Control**

No liquid effluents are planned for radiological process streams in the TRISO-X FFF. Design of the facility, along with operating and engineered controls, is used as necessary to ensure that radiological liquid effluent discharges to the environment do not occur. Approved procedures define action levels to ensure that compliance with applicable limits is maintained.

#### **9.3.1 Wastewater Collection/Treatment**

Process solutions generated by process systems and equipment are recycled to the maximum extent practical. Process solutions contaminated with uranium that cannot be recovered/recycled are identified as liquid wastes. Liquid wastes are collected and sampled to determine appropriate handling/treatment steps. Treatment typically involves adjustment of pH, filtering, ion exchange, and/or precipitation. Precipitates are de-watered, and the solids are packaged for off-site disposal. If needed, liquid wastes that have been handled/treated can be sampled and discharged through an inline monitor to shipping packages or conveyances for off-site disposal.

Sanitary sewer discharges to the City of Oak Ridge sewer system from facility restrooms and non-radiological process streams related to equipment blowdowns, flushes, and cleaning activities are conducted in accordance with a locally-issued permit. Used oils may also be sampled and containerized for shipment to a licensed disposal facility.

Licensed radioactive material discharges to the sanitary sewer are prevented by locating restrooms, changeroom facilities (i.e., locker rooms, showers, and bathrooms), and drains that lead to the sanitary sewer outside of the Restricted Area (the process area boundary). The Restricted Area includes the Radiologically Controlled Area (RCA). Personnel are required to doff personal protective equipment (PPE) and proceed through contamination monitors prior to exiting the Restricted Area. The sanitary sewer is not physically connected to the Restricted Area or to any process equipment within the Restricted Area.

TRISO-X prevents transport of dispersible radioactive material outside the Restricted Area by requiring personnel to doff PPE and proceed through contamination monitors prior to exiting the Restricted Area. In addition, the Restricted Area is kept at a slight negative pressure, which prevents dispersible radioactive material from migrating outside of the Restricted Area. License Chapter 4 establishes a rigorous Contamination Control Program that includes routine contamination control surveys and radiological surveys for any items removed from the

## SNM-XXXX

CHAPTER 9

Restricted Area and documents the contamination status of areas both inside and outside of the Restricted Area.

**9.4 Waste Management**

The TRISO-X Waste Management Program (WMP) is consistent with EPA and NRC guidance to meet the requirements in 10 CFR 20.1406, and is designed to minimize facility generated waste. The WMP is endorsed and supported by upper management, details waste streams and the waste characterization process, and is evaluated on a scheduled basis for improvement. The WMP procedures and facilities for waste handling, staging for shipment, and monitoring result in safe and timely disposition of materials.

Solid waste disposal preparation facilities, with sufficient capacity and capability to enable processing, packaging, and transfers of solid waste to licensed treatment and/or disposal sites in accordance with the regulations, are provided and maintained as required to support the operation of the TRISO-X Fuel Fabrication Facility.

**9.5 Environmental Monitoring**

TRISO-X conducts a routine environmental surveillance program. Compliance with 10 CFR 20.1301 is achieved using the option provided in 10 CFR 1302(b)(2)(i) to demonstrate that the annual average concentrations of radioactive material released in gaseous effluents at the boundary of the unrestricted area (the point of stack discharge) do not exceed the values specified in Table 2 of Appendix B to Part 20. Demonstration is accomplished by calculation and validated by measurement. This ensures that environmental concentrations at the site boundary and offsite are well below regulatory limits. TRISO-X evaluated potential transuranic and fission product contaminants in uranium feed material and established the contaminant limits in Section 1.2.4, Item 1 to ensure that surveys of transuranic and fission product radionuclides are not required to maintain compliance with 10 CFR 20. TRISO-X will maintain approved procedures that prevent TRISO-X from receiving uranium feed material with contaminants in excess of these limits. This approach demonstrates that specific surveys for transuranic and fission products are not needed for compliance with 10 CFR 20.

Surface environmental media and groundwater samples are collected from strategic locations in the surrounding environs and analyzed for pertinent constituents of concern. Baseline levels of radionuclides in media surrounding the facility are established through sampling and analysis prior to operations using SNM. Feed material is characterized for enrichment and other potential contaminants prior to use. Future sample results are evaluated against action levels and the facility source term to identify any confounding natural sources of radioactivity or sources from operations external to the facility. Action levels and associated responses are specified for each environmental medium and radionuclide as defined in approved procedures.

## SNM-XXXX

CHAPTER 9

The program provides early detection and response to a negative trend in environmental data, and support data in the event of a release of radioactive material. Continuous stack monitoring provides a method for early detection of a negative trend in gaseous effluent releases from normal operations. Ambient air samplers verify the absence of routine ground level gaseous effluent releases and provide a means for measuring the off-site impact in the event of a ground level gaseous effluent release from an off-normal event. Information from these monitoring activities is used to support assessments of normal operations or following off-normal events. Environmental dosimeters are co-located with the ambient air samplers to confirm the absence of ambient external dose rates above background in unrestricted areas and to assist with the assessment of potential accidents.

A summary of typical sampling activities is included in Table 9-1. Typical sampling locations are provided in Figure 9-1. The locations for sampling of soil and vegetation will be concentrated along the predominant wind directions. In addition, a soil sample will be taken at the outfall of the west detention basin. The locations for ambient air sampling are selected based on predominant wind directions and the direction of potential receptors. Four groundwater observation wells are installed on the site. Groundwater elevation measurements and modeling indicate that groundwater generally flows in a southwest direction toward East Fork Poplar Creek. There are no known household, public, or industrial users of groundwater downgradient of the site.

**Table 9-1: Environmental Monitoring Parameters**

| Type of Sample                                      | Analyses                          | Number of Locations | Typical Sampling Frequency      |
|-----------------------------------------------------|-----------------------------------|---------------------|---------------------------------|
| Air Effluent Discharge Points – Process Ventilation | Gross Alpha/Beta Isotopic Uranium | 3                   | Continuous (collection weekly)  |
| Air Effluent Discharge Points – Thermal Oxidizer    | Gross Alpha/Beta Isotopic Uranium | 3                   | Quarterly                       |
| Ambient Air                                         | Gross Alpha/Beta <sup>1</sup>     | 6                   | Continuous (collection monthly) |
| Groundwater                                         | Gross Alpha/Beta <sup>1</sup>     | 4                   | Quarterly                       |
| Soil – Predominant Wind Directions                  | Gross Alpha/Beta <sup>1</sup>     | 4                   | Semi-annually                   |
| Soil – Outfall of West Detention Basin              | Gross Alpha/Beta <sup>1</sup>     | 1                   | Semi-annually                   |
| Vegetation                                          | Gross Alpha/Beta <sup>1</sup>     | 4                   | Semi-annually                   |
| Stormwater                                          | Gross Alpha/Beta <sup>1</sup>     | 3                   | Quarterly                       |

## SNM-XXXX

CHAPTER 9

| Type of Sample          | Analyses                              | Number of Locations | Typical Sampling Frequency |
|-------------------------|---------------------------------------|---------------------|----------------------------|
| Environmental Dosimetry | Determined by NVLAP accredited vendor | 6                   | Quarterly                  |

<sup>1</sup>Isotopic Uranium analysis is performed when gross alpha/beta action levels are exceeded.

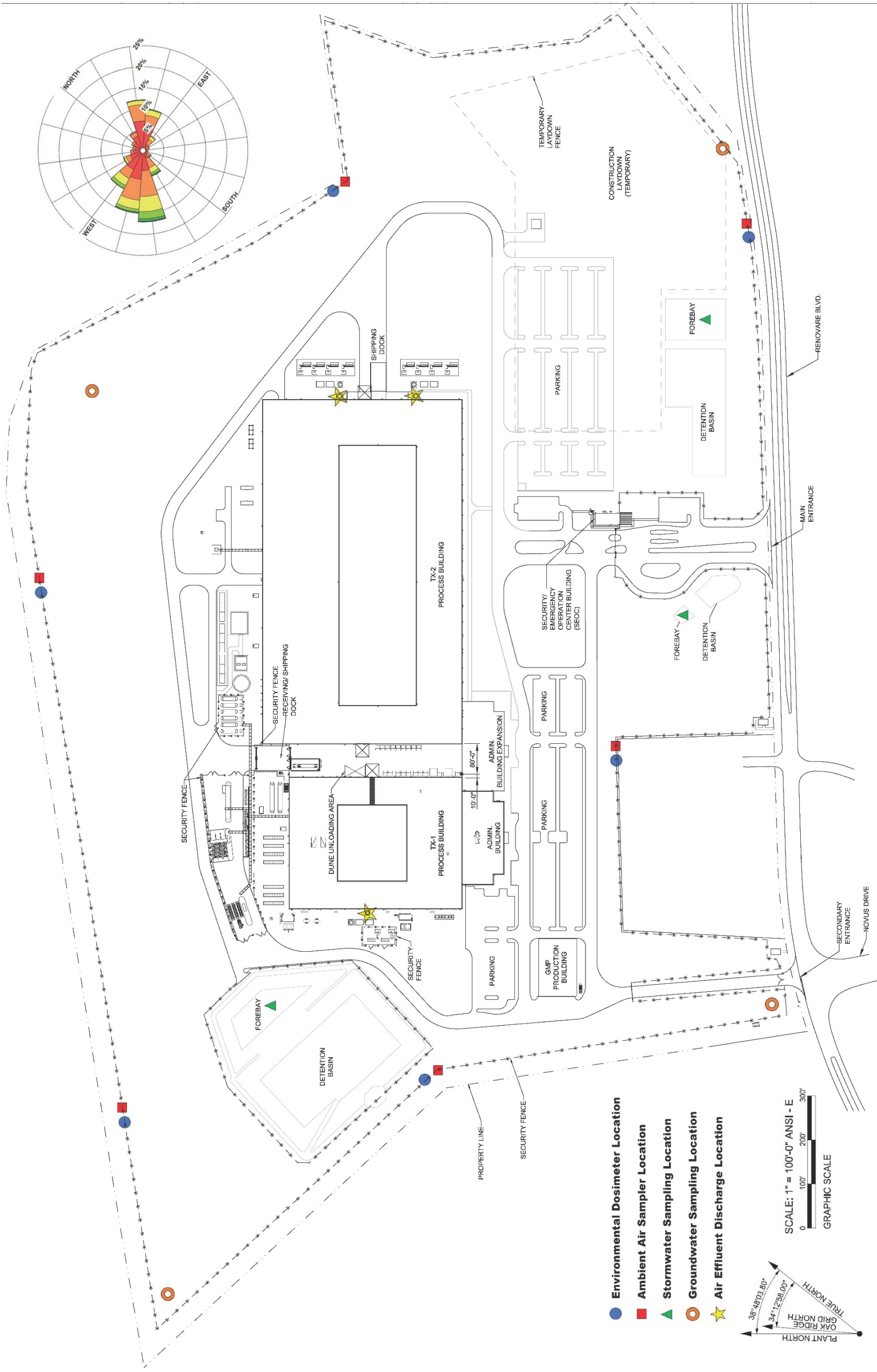
## 9.6 Program Management

Quantities of radioactive material in air and liquids released from the facility are reported to the NRC on a semi-annual basis as required by 10 CFR 70.59, *Effluent monitoring reporting requirements*.

Approved procedures outline sampling techniques, sample processing and analysis methodologies, quality assurance, and other necessary information to validate analytical results and maintain a viable program.

Sample analysis may be performed either on-site or off-site. In all cases, analytical techniques for sample analysis of each medium are appropriate for the quantities and types of radionuclides present at the facility and are sensitive enough to ensure adequate detection and quantification based on media radiological content and limits. Quality control procedures, for on-site or off-site analysis, detail the periodic checks necessary to demonstrate the operability of the instrumentation used for analysis. Analytical results are reported in a timely manner so that staff can determine the appropriate response to established action levels.

Figure 9-1: Typical Sampling Locations



## SNM-XXXX

CHAPTER 9REVISION SUMMARY

| Revision | Date     | Section/Page     | Description of Changes                                                                                                                                                                                                       |
|----------|----------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | 5-Apr-22 | ALL              | Initial issue.                                                                                                                                                                                                               |
| 2        | Dec-24   | ALL              | Added document number TXF-REG-NRC-0009 to header.                                                                                                                                                                            |
|          |          | 9.2.2            | Added "this" at beginning of sentence 2 to more directly connect the content to sentence 1 due to TX0-REG-LTR-0038, Chapter 1 RAI-9, and a meeting with NRC on 11/5/2024 to discuss open items for License Chapter 1.        |
|          |          | 9.2.3            | Deleted "modified" due to TX0-REG-LTR-0038, Chapter 1 RAI-9, and a meeting with NRC on 11/5/2024 to discuss open items for License Chapter 1.                                                                                |
|          |          | 9.3.1            | Added detail for preventing radioactive material discharge to the sanitary sewer and preventing the transport of dispersible radioactive material outside the Restricted Area. Changes made based on TX0-REG-LTR-0038 RAI-3. |
|          |          | 9.5              | Added detail for demonstrating compliance with 10 CFR 20.1301 based on TX0-REG-LTR-0038 RAI-1.                                                                                                                               |
|          |          | Figure 9-1       | Added new Figure 9-1 and updated Table 9-1 to include environmental sampling locations based on TX0-REG-LTR-0038 RAI-1. Revised Figure 9-1 based on an updated site layout showing the TX-1 and TX-2 process buildings.      |
|          |          | Revision Summary | Added revision summary to end of chapter.                                                                                                                                                                                    |
| 3        | Dec-25   | 9.5              | Clarified evaluation of contaminants in feed material based on TX0-REG-LTR-0087 RAI-1 response.<br>Corrected intent of ambient air samplers based on TX0-REG-LTR-0081 RAI-2 response.                                        |
|          |          | Table 9-1        | Updated sampling information based on TX0-REG-LTR-0081 RAI-2 response.                                                                                                                                                       |
| 4        | Feb-26   | 9.5<br>Table 9-1 | Added soil sampling location at west detention basin outfall based on TX0-REG-LTR-0105 Request 10 response.                                                                                                                  |

SNM-XXXX  
**CHAPTER 11**

**MANAGEMENT MEASURES**  
**Table of Contents**

| SECTION     | TITLE                                                                   | STARTS<br>ON PAGE |
|-------------|-------------------------------------------------------------------------|-------------------|
| <b>11.1</b> | <b>Configuration Management (CM)</b>                                    | <b>11-2</b>       |
| 11.1.1      | CM Program                                                              |                   |
| 11.1.2      | Design Requirements                                                     |                   |
| 11.1.3      | Document Control                                                        |                   |
| 11.1.4      | Change Control                                                          |                   |
| 11.1.5      | Assessments                                                             |                   |
| <b>11.2</b> | <b>Maintenance</b>                                                      | <b>11-4</b>       |
| 11.2.1      | Surveillance and Monitoring                                             |                   |
| 11.2.2      | Corrective Maintenance                                                  |                   |
| 11.2.3      | Preventive Maintenance                                                  |                   |
| 11.2.4      | Functional Testing                                                      |                   |
| 11.2.5      | Maintenance Records                                                     |                   |
| <b>11.3</b> | <b>Training and Qualification</b>                                       | <b>11-6</b>       |
| 11.3.1      | General Safety Training                                                 |                   |
| 11.3.2      | Training and Qualification for Activities Involving the Handling of SNM |                   |
| 11.3.3      | Personnel Qualification                                                 |                   |
| <b>11.4</b> | <b>Procedure Development and Implementation</b>                         | <b>11-9</b>       |
| 11.4.1      | Operating Procedures                                                    |                   |
| 11.4.2      | General Safety and Emergency Procedures                                 |                   |
| 11.4.3      | Maintenance Procedures                                                  |                   |
| 11.4.4      | Temporary Procedures                                                    |                   |
| 11.4.5      | Periodic Reviews of Procedures                                          |                   |
| <b>11.5</b> | <b>Audits and Assessments</b>                                           | <b>11-12</b>      |
| 11.5.1      | Internal Audits                                                         |                   |
| 11.5.2      | Independent Assessments                                                 |                   |
| <b>11.6</b> | <b>Incident Investigations and Corrective Action</b>                    | <b>11-13</b>      |
| 11.6.1      | Conduct of Incident Investigations                                      |                   |
| <b>11.7</b> | <b>Records Management</b>                                               | <b>11-14</b>      |
| <b>11.8</b> | <b>Other Quality Assurance (QA) Elements for IROFS</b>                  | <b>11-15</b>      |
| <b>11.9</b> | <b>Management Measures for Structural Stability Safety Function</b>     | <b>11-20</b>      |

SNM-XXXX  
CHAPTER 11

**MANAGEMENT MEASURES**

As specified in 10 CFR 70.62(d), management measures are applied to Items Relied on For Safety (IROFS) to provide reasonable assurance that the IROFS are designed, implemented, and maintained to ensure they are available and reliable to perform their functions when needed. The ISA Summary identifies IROFS applied to facility systems and activities to assure they function to satisfy the performance requirements of 10 CFR 70.61. IROFS may be engineered controls (passive or active), enhanced administrative controls (active features that prompt a person to take an action), or administrative controls (actions of people). Management measures are applied to IROFS based on the type of control (passive, active, enhanced administrative, administrative) as identified in Table 11-1. Methods used to select and assign management measures to IROFS are documented in approved procedures.

### **11.1 Configuration Management (CM)**

A formal review and approval process is used to evaluate modifications to systems and components to ensure that configuration changes do not adversely impact currently implemented IROFS and to ensure new processes meet the performance requirements of 10 CFR 70.61. The CM program captures formal documentation governing the design, safety bases, and continued modification of the site, structures, processes, systems, equipment, components, selected computer programs, personnel activities, and supporting management measures.

#### **11.1.1 CM Program**

The TRISO-X CM Program controls facilities and processes so safety bases are maintained, and changes are evaluated and documented according to approved procedures consistent with 10 CFR 70.72 process discussed in Section 11.1.4 and the license application change process discussed in Chapter 1. The CM process provides assurance that consistency is established and maintained between facility design, operational requirements, physical configuration, and facility documentation. CM provides oversight and control of design information, safety information, and records of modifications that might impact the ability of IROFS to perform their functions when needed.

The process buildings where licensed materials are stored and used are maintained under the CM Program. Changes to the process buildings are evaluated and documented according to approved procedures consistent with 10 CFR 70.72. The process buildings are maintained according to their approved design criteria presented in License Application Chapter 1, Section 1.1.2 against external initiated events over the life of the facility in accordance with accepted codes and standards and facility modifications are reviewed to ensure no adverse impact to the structural stability of the process buildings' main force resisting system.

**SNM-XXXX**  
**CHAPTER 11**

Engineering is responsible for the implementation and ongoing management of the CM Program. All TRISO-X personnel and organizations are responsible for complying with the CM Program objectives and implementing Program requirements as an integral part of their respective functional areas of operation.

### **11.1.2 Design Requirements**

Configuration control is accomplished during design using procedures for controlling design, preparation, review, and approval. Design requirements and associated design bases are established and maintained during design, construction, and operations. Design control processes include provisions to identify, document, select, review, and verify design inputs, outputs, analysis, and methods, and to manage interface control and coordination among participating design organizations. Design responsibilities are established to ensure output documents such as, but not limited to, specifications, drawings, diagrams, and test plans are verified per procedure, to meet the input requirements.

For new facilities and processes/systems, design requirements are required to be developed, reviewed, approved, and documented before input of SNM. The baseline design criteria (BDC) identified in 10 CFR 70.64(a) are addressed for IROFS. The preferred design approach is used to the extent practical to select engineered controls over administrative controls. New facility and system design is also based on defense in-depth practices in accordance with 10 CFR 70.64(b) to enhance safety by reducing challenges to IROFS. Design requirements and documents are prepared by the engineering organization. Applicable codes and standards are identified in design documents. Prior to approval, the design documents are reviewed for adequacy, accuracy and completeness as per approved procedures. Changes to design documents or the ISA are subject to the change control processes as described in Chapter 1 and Section 11.1.4

### **11.1.3 Document Control**

Procedures are established to control the preparation and issuance of documents. This includes creation, revision, storage, tracking, distribution, and retrieval of applicable information, to include but not limited to, manuals, instructions, drawings, procedures, design documents, specifications, plans, and other documents that pertain to the CM function. Measures are established to ensure documents, including revisions, are adequately reviewed, approved, and released for use by authorized personnel. An electronic document management system is used both to file facility records and to make available the latest revision (i.e., the controlled copy) of design documents. Controlled documents are maintained until cancelled or superseded.

As part of the configuration management program, refer to Section 11.7 for further discussion of the document control and records management procedures.

### **11.1.4 Change Control**

The objective of the change control process is to maintain consistency among design requirements, the physical configuration, and the related facility documentation (including the ISA). The process is used to ensure facility configuration documentation changes are properly

**SNM-XXXX**  
**CHAPTER 11**

reviewed, approved and implemented to assure that all impacts of proposed changes are identified and evaluated, design requirements (and bases) are maintained or appropriately revised, and changes are coordinated across the affected organizations and personnel responsible for activities and programs at the TRISO-X FFF.

Types of changes are defined and may range from replacement with identical design that are authorized as part of normal maintenance, to new or different designs that require specified review and approval. Major changes include substantial modifications to existing licensed facilities and/or new processes, new licensed facilities, or new processes in existing licensed facilities. Any change requiring a license amendment is also considered a major change. The change control process is implemented via approved procedures to which appropriate personnel are trained.

The change control process assures that the following items are addressed prior to implementing a change as required by 10 CFR 70.72(a):

- 1) The technical basis for the change;
- 2) The impact of the change on safety, health, and control of licensed material;
- 3) Modifications to existing drawings, procedures, and training;
- 4) Authorization requirements for the change;
- 5) For temporary changes, the approved duration (e.g., expiration date) of the change;
- 6) The impacts or modifications to the ISA, ISA Summary, nuclear criticality safety evaluation, or other safety program information, developed in accordance with 10 CFR 70.62 and/or 10 CFR 70.64; and
- 7) An evaluation as to whether or not a license amendment must be approved by the NRC prior to implementation of the change in accordance with 10 CFR 70.72(c).

Final documentation of the change approval is maintained, and the applicable documentation is made available to the affected personnel. Per 10 CFR 70.72(d)(2), a brief summary of major changes that required revision of the applicable safety or environmental bases will be submitted within 30 days after the end of the calendar year during which the changes occurred.

#### **11.1.5 Assessments**

Periodic audits and/or assessments of the configuration management program are conducted in accordance with the requirements in Section 11.5 for the purpose of evaluating the program's effectiveness and to correct deficiencies. The results of these assessments are documented and maintained in accordance with approved procedures.

#### **11.2 Maintenance**

The maintenance program is designed to ensure that IROFS are maintained in a manner to ensure they are available and reliable to perform their intended function when needed. The maintenance program consists of the following key program elements, including management systems that provide scheduling and documentation of these elements when applied to IROFS:

**SNM-XXXX**  
**CHAPTER 11**

- 1) Surveillance and Monitoring,
- 2) Corrective Maintenance,
- 3) Preventive Maintenance, and
- 4) Functional Testing.

Maintenance procedures and instructions are an integral part of the Maintenance program as described in Section 11.4.3.

### **11.2.1 Surveillance and Monitoring**

The surveillance and monitoring program is implemented to monitor the current and long-term performance of IROFS.

Surveillance activities include preventive maintenance (11.2.3) and functional testing (11.2.4) that are performed on a scheduled basis, and follow-up to corrective maintenance (11.2.2). Documentation of surveillances is prepared as per approved procedures. Frequencies of surveillances are based on the type and safety significance of the IROFS, as well as manufacturer's recommendations. The results of surveillances are trended to support the determination of performance trends for IROFS and can lead to changes to maintenance frequencies, if appropriate. Maintenance procedures also prescribe compensatory measures, if appropriate for surveillance tests of IROFS that can only be performed while the equipment is out of service.

IROFS found to be out-of-tolerance or unable to perform their intended function are reported in a timely manner through the corrective action program discussed in Section 11.6. Reports of IROFS failures are entered into the corrective action program which provides a means to evaluate the failure, identify the cause of failure, and assign appropriate corrective actions to be initiated. Records of IROFS performance issues and corrective actions are maintained within the maintenance and corrective action programs, as applicable. Records for failures of IROFS are maintained in accordance with 10 CFR 70.62(a)(3) within the corrective action program.

### **11.2.2 Corrective Maintenance**

Corrective maintenance is performed using a systematic, integrated, and controlled approach to ensure that IROFS and other systems necessary for the safe operation of the facility are properly repaired and restored to service in a manner that maintains facility safety and the function of the safety system. Maintenance activities are performed on IROFS in a manner that minimizes or eliminates the recurrence of unacceptable performance deficiencies.

Corrective maintenance is authorized, initiated, and documented through a formally established process that includes steps requiring coordination between the maintenance and operating organizations. The process also includes an evaluation to determine if IROFS performance have been, or may be, adversely affected by the equipment failure/malfunction or the ensuing maintenance and whether post-modification functional testing of IROFS is required.

**SNM-XXXX**  
**CHAPTER 11**

**11.2.3 Preventive Maintenance**

Preventive maintenance (PM) is performed in a preplanned and scheduled manner to refurbish or overhaul IROFS to ensure that they continue to perform their intended function. PM activities are appropriately balanced against the objective of minimizing unavailability of IROFS. Periodic calibrations are conducted where recommended by manufacturer or industry guidance. After conducting PM, and before returning a safety control to service, a functional test may be required to provide reasonable assurance that the safety control performs as designed and provides the safety action expected.

A schedule for performing PM on IROFS is maintained as specified in approved procedures, and frequencies are established based on operating history, manufacturer and industry guidance, feedback from surveillance and maintenance activities, and/or recommendations from the corrective action program.

**11.2.4 Functional Testing**

Functional testing of IROFS is performed using approved written instructions prior to startup of facilities or process operations involving IROFS (pre-operational testing) and at periodic intervals during operations. This is intended to provide reasonable assurance that the safety control performs as designed and provides the desired safety action. Functional test instructions and frequencies are based on operating history, manufacturer and industry guidance, risk assessment, feedback from surveillance and maintenance activities, and/or recommendations from the corrective action program. During process operations, compensatory measures are used as appropriate while functional testing is performed on IROFS.

Administrative controls that are identified as IROFS are documented in approved procedures. Administrative controls are assured to be available and reliable during operations by applying the applicable measures addressed in this chapter (e.g., procedures, training and qualifications).

**11.2.5 Maintenance Records**

The results of Surveillance and Monitoring, Corrective Maintenance, Preventive Maintenance, and Functional Testing for IROFS are documented, and the documentation is maintained as "records pertaining to safety" as specified in Section 11.7.

**11.3 Training and Qualification**

The Training and Qualification Program provides workers with the knowledge and skills to safely perform their job function, recognize the importance of IROFS, effectively deal with the hazards of the workplace, implement proper control and accounting of SNM, and properly respond to emergency situations. The qualification aspect of this program ensures that operations and maintenance are performed only by properly trained personnel.

**SNM-XXXX**  
**CHAPTER 11**

Requirements and methods for the training and qualification programs are approved by TRISO-X management, who also provide ongoing evaluation of the effectiveness of the programs.

This training typically falls into one of the following categories:

- 1) General safety training not specific to a particular workstation or activity;
- 2) Training to assure proper performance for positions and work activities that are relied on for safety, in particular those designated as IROFS; and
- 3) Proper control and accounting of SNM.

### **11.3.1 General Safety Training**

The Training and Qualification Program requires that all personnel who are granted unescorted access to the owner-controlled area receive formal safety and security orientation training. Safety orientation training covers facility security and safety rules, radiological, nuclear criticality, chemical, fire, and environmental safety topics as appropriate to the job function of the individuals being trained. In addition, this training covers proper response to emergencies.

Continuing training is conducted in these areas as necessary to maintain employee proficiency. The content of safety training is evaluated on a scheduled basis, as appropriate for the subject of the training, to ensure it remains current and relevant.

### **11.3.2 Training and Qualification for Activities Involving the Handling of SNM**

The Training and Qualification Program includes work training for operating personnel and others who directly handle greater than laboratory sample quantities of special nuclear material. Facility specific activities are correlated with applicable supporting procedures and training materials. Work training typically includes classroom, on-the-job, and guided-work-experience training necessary to provide the desired knowledge and/or skill. It covers the operating procedures, alarms, emergency response actions, special nuclear material controls and accounting, and radiological, nuclear criticality, industrial, and environmental safety controls and limits specific to the particular work assignment.

Work training includes appropriate reinstruction for previously qualified individuals prior to implementation of a process change or procedural modification. When changes are made relative to safety or emergency response requirements, provisions are made to assure that affected employees are appropriately informed and instructed on the changes. Work training is evaluated, and necessary recurrent training / retraining / requalification is identified and documented. Additional details about the work training program are provided in approved procedures.

The Training and Qualification Program provides for the instruction and training of mechanics involved in maintenance activities. The type and level of training is commensurate with the job assignments.

**SNM-XXXX**  
**CHAPTER 11**

**Organization and Management of Training**

The responsibility for the assurance of properly trained and qualified personnel resides with the discipline management team and pertinent line management. Support to line management for the development, implementation, and administration of the facility Training and Qualification Program is provided by the Training function. Implementation of the Training and Qualification Program is accomplished in accordance with approved procedures. All training is conducted by, or under the supervision of, individuals recognized by management as possessing the necessary knowledge and skills to conduct the training. Exemptions from training are only authorized as described in approved procedures.

Training records are maintained to support management information needs and provide required information on each individual's training and qualification. The records are maintained in accordance with approved procedures.

**Identification of Activities Requiring Training**

Positions impacting the availability/reliability of IROFS are assessed considering the hazards and the safety responsibilities associated with each position. Input from subject matter experts, with support from the training function, is utilized as appropriate.

**Position Training Requirements**

Objectives and requirements for training programs are jointly agreed upon by management based upon facility needs and input provided by the training function and the appropriate discipline. Each position involving personnel assigned to SNM process operations is evaluated to determine the specific requirements that apply to the defined job function. Personnel must remain current on the defined set of requirements to maintain job qualifications.

**Bases for Training**

The objective of training is to ensure safe and efficient operation of the facility and compliance with applicable established regulations and requirements. Learning objectives are established for those positions/activities impacting the safety and security of licensed material operations, and in particular the availability/reliability of designated IROFS. Objectives include, as applicable, the knowledge skills, and abilities the trainee should demonstrate; the conditions under which required actions will take place; and the standards of performance the trainee should achieve upon completion of the training activity.

**Training Materials**

Lesson plans, computer-based training, and other training guides (for self-study, classroom, and on-the-job training) developed for activities relied on for safety and security are based on learning objectives developed from specific job performance requirements. Information provided, reviewed, and approved by subject matter experts is included in the content of training elements with clearly defined objectives. The lesson plans also provide reasonable assurance that training is conducted in a reliable and consistent manner. Lesson plans, guides and other

## SNM-XXXX

**CHAPTER 11**

training materials are reviewed and approved before their issuance and use. The CM Program provides a means to assure that design changes and modifications to IROFS are accounted for in the training and that personnel are instructed using current procedures.

**Evaluation of Trainee Accomplishment**

Trainee understanding and command of learning objectives are evaluated. The evaluation may be accomplished through a combination of observation/skills demonstration, written tests, or oral examinations. The results of trainee evaluations are documented.

**On-the-Job Training (OJT)**

OJT requirements for activities relied on for safety and listed in the ISA Summary, if applicable, are specified as part of pertinent position training requirements. Completion of OJT may be demonstrated by actual task performance (preferred) or task simulation. OJT is conducted by qualified individuals using current training materials. Completion of OJT is demonstrated through actual task actions (or simulation) using conditions encountered during the performance of assigned duties including the use of references and tools, and equipment conditions reflecting the actual task to the extent practicable. Completion of OJT requirements are documented.

**Training Program Review**

The effectiveness of the Training and Qualification Program is assessed on a periodic basis. Work assignments involving the handling of SNM are evaluated for needed recurrent training and/or reevaluation of qualification activities. Improvements and changes are made to training as needed to correct any deficiencies or performance problems.

**11.3.3 Personnel Qualification**

The minimum qualifications for key management and technical professional staff positions are described in Chapter 2. Qualifications for personnel who conduct activities involving the handling of SNM are described in Section 11.3.2.

**11.4 Procedure Development and Implementation**

Activities involving the handling of SNM and/or IROFS are conducted in accordance with approved procedures as defined in this section. Procedures address the following activities: design, configuration management, procurement, construction, operations, radiation safety, maintenance, waste management, quality assurance, training and qualification, audits and assessments, incident investigations, records management, nuclear criticality safety, fire safety, chemical process safety, environmental protection, and reporting requirements. Procedures also address the requirements contained within the Site Emergency Plan, Fundamental Nuclear Material Control Plan, and Physical Security Plan. Procedures are classified into the general categories of operating, general safety and emergency, and maintenance. Administrative procedures are used for activities that support the process operations including subjects such as

## SNM-XXXX

CHAPTER 11

design, inspections and testing, and do not include activities involving the handling of SNM and/or operating IROFS.

The process for the development, management, and implementation of procedures is defined in approved procedures. These procedures address how procedures are developed, reviewed, approved, distributed, revised, and deleted. Each procedure contains an identifying number, title, revision number, date, scope of applicability, and purpose statement. The procedures include pre-requisites, cautions, controls, limitations and additional parameters, where applicable, to ensure appropriate direction is applied for procedures regardless of their type (administrative, operating, general safety and emergency, or maintenance). The system ensures that the most current revisions of procedures are readily available to workers within their work areas (operating procedures), or in a centralized location accessible to all affected personnel, that any necessary training and qualification requirements are identified, and that the timeframe for which the procedure is valid is defined.

Procedures are approved by appropriate management personnel who are responsible for the activity governed by the procedure. Changes and/or revisions to procedures covering licensed material operations and/or IROFS are reviewed by the regulatory affairs functions, as appropriate, in accordance with the requirements of the CM program, as discussed in Section 11.1, to ensure that all associated activities and documentation (safety analyses, reviews, testing, training, etc.) are completed before procedural changes are implemented.

If any aspect of a procedure is unclear or incorrect as written, personnel are authorized to safely stop the operation and/or activity and contact management. In the event of an unusual incident, accident, significant operator error, equipment malfunction, or system modification, the applicable procedures are evaluated and revised as necessary.

**11.4.1 Operating Procedures**

Operating procedures are documents written to authorize the processing of radioactive material; and within these documents, detailed instructions for operation of equipment used in the process or activity, instructions for disposition of radioactive wastes, and limits and controls established for safety and regulatory purposes, including IROFS, are identified.

Operating procedures include the required actions and limits for startup, operation, and shutdown; actions necessary to prevent or mitigate accidents identified in the ISA Summary; and responses to alarms and applicable off-normal conditions, including failure of an IROFS. Operating procedures include provisions to place process operations in a safe condition if a step of the procedure cannot be performed as written. Workplace posting of limits and controls, training, and other communication devices are used, if appropriate, to enhance comprehension and understanding of operating procedures.

**SNM-XXXX**  
**CHAPTER 11**

During operating procedure development, the technical accuracy is verified. Changes to existing operating procedures are evaluated to determine if the scope of the change warrants a walk-down and/or an independent verification/validation. New operating procedures are validated by operations staff to ensure that they can be performed as written.

#### **11.4.2 General Safety and Emergency Procedures**

General safety procedures outline health and safety practices that help maintain occupational radiation exposures at levels as low as reasonably achievable (ALARA). These procedures are generally applicable on a facility-wide basis to include safe work practices to control processes with licensed material, IROFS, and hazardous materials. Included in this category are the Emergency Plan implementing procedures and the Criticality control procedures. General safety procedures are reviewed and approved by the applicable regulatory affairs functions.

#### **11.4.3 Maintenance Procedures**

Maintenance of facility structures, systems and components is performed in accordance with approved procedures, documented instructions, checklists, or drawings appropriate to the circumstances that conform to applicable codes, standards, specifications, and other appropriate criteria. Maintenance program procedures ensure that corrective and preventive maintenance as well as functional testing are implemented for IROFS; that reviews for accuracy and completeness are conducted for work to be performed; and require the affected organizations to be notified prior to performing the maintenance work and at completion of the work. Procedures provide compensatory measures for IROFS that may be degraded or taken out-of-service during maintenance activities.

Procedures require work to be controlled through review of the planned work by the applicable regulatory affairs functions. The maintenance program identifies qualifications of personnel authorized to perform maintenance, specifications for replacement components as covered by CM, requirements for post maintenance testing, required records management of maintenance activities, and safe work practices applicable to the work to be performed.

#### **11.4.4 Temporary Procedures**

Approved temporary procedures are used when permanent procedures do not exist to:

- 1) Direct operations during testing, maintenance, and facility modifications;
- 2) Provide guidance in unusual situations not within the scope of permanent procedures; or,
- 3) Provide assurance of orderly and uniform operations for periods of short duration when the facility, a system, or a component is performing in a manner not covered by existing permanent procedures or has been modified or extended in such a manner that portions of existing procedures do not apply.

Temporary procedures are controlled, reviewed, and approved as specified by a written procedure and will not change an ISA except as authorized under 10 CFR 70.72. The review and

**SNM-XXXX**  
**CHAPTER 11**

approval process required for temporary procedures is the same as for other procedures, and a timeframe is defined for which the procedure is valid.

#### **11.4.5 Periodic Reviews of Procedures**

Procedures governing activities relied on for safety involving the handling of SNM and/or IROFS are reviewed periodically to ensure content remains current and relevant and that administrative IROFS remain available and reliable. The review frequency is defined in approved procedures and may be determined using a risk-based approach and importance to safety. Emergency procedures are reviewed per the Emergency Plan required in Chapter 8. Safeguards procedures are reviewed per the Fundamental Nuclear Material Control Plan required in Chapter 12. Security related procedures are reviewed per the Physical Security Plan required in Chapter 13. The corrective action program (Section 11.6) includes provisions to assess the role of procedures in adverse conditions or events evaluated within the program. Corrections of procedural deficiencies are tracked to completion within the system.

#### **11.5 Audits and Assessments**

A program is in place for conducting audits and assessments of activities significant to facility safety, safeguards, and environmental protection that identifies responsibility for:

- 1) Determining the appropriate utilization of internal and/or external personnel for particular audit and assessment activities.
- 2) Assuring audit and assessment personnel have the expertise and background sufficient to successfully conduct audit and assessment activities.
- 3) Assuring audit and assessment personnel are sufficiently independent of the area being reviewed.
- 4) Verifying the utilization of an effective corrective action program to address findings of audits and assessments.

Audits and assessments are conducted for the areas of radiation safety, nuclear criticality safety, chemical safety, fire safety, environmental protection, quality assurance, configuration management, maintenance, training and qualification, procedures, incident investigation, and records management. The areas of emergency management, safeguards, and security are also audited and assessed in accordance with the Emergency Plan, Fundamental Nuclear Material Control Plan, and Physical Security Plan.

Approved procedures and guidance used to plan, schedule, and perform the audits and assessments contain the following information:

- Activities to be audited and assessed.
- Qualifications for auditors/assessors.
- Frequency of audits/assessments.

## SNM-XXXX

**CHAPTER 11**

- Applicable guidance to be used in conducting the reviews.
- Responsibilities for each phase of the reviews.
- Instructions for recording the results, and recommending and approving actions to be taken.
- The levels of management to which results are reported.

Results, including findings and observations, are captured in the corrective action program. Corrective actions to prevent recurrence are assigned to owners, documented, and tracked to completion in accordance with the requirements specified in the corrective action program.

**11.5.1 Internal Audits**

Internal audits are compliance-based evaluation activities with an objective of verifying compliance of operations with established regulatory requirements, license commitments, and standard industry practice. Audits also ensure that administrative IROFS remain available and reliable to perform their intended safety function over extended periods of operation.

Members of the regulatory affairs functions, as described in Chapter 2, perform audits of activities involving the handling of SNM, including support areas, on a scheduled basis as defined in approved procedures.

Members of the Quality Assurance discipline periodically audit facility programs as directed by plant management.

**11.5.2 Independent Assessments**

Independent assessments are performance-based evaluation activities conducted to assess the effectiveness of health, safety, and environmental compliance functions in achieving their designated purpose, particularly in providing reasonable assurance of the availability and reliability of IROFS. The assessments are conducted using offsite groups or individuals not involved in the licensed activity.

**11.6. Incident Investigations and Corrective Action**

A corrective action program is implemented through approved procedures to investigate and document events for operations involving special nuclear materials, including those required to be reported under 10 CFR 70.50, 70.62, and 70.74. Events, including those with conditions adverse to safety or quality, are reported, investigated, tracked, and corrective actions are assigned through a formal corrective action program. A risk-based approach is used to establish the requirements for determining specific or generic root cause(s) and generic implication(s) of events.

Events are reviewed and classified based on the safety significance and regulatory compliance, including the impact on the health and safety of the public and the environment; impact on reliability or availability of safety controls and/or; and impacts to regulatory commitments. When

**SNM-XXXX**  
**CHAPTER 11**

recurrence would have an impact on the availability and reliability of IROFS, measures are taken to prevent recurrence and/or to control affected work in progress.

#### **11.6.1 Conduct of Incident Investigations**

A risk-based approach is applied to the assignment of the level of investigation; and, based on severity or potential severity of the event, the investigation may be conducted by one or more individual(s). Levels of investigation, as well as reviews and approvals, are assigned for events in accordance with approved procedures. Corrective actions are developed, documented, approved, and implemented. Procedural guidance for conducting an investigation defines responsibilities for investigators and approvers; general methods for conduct of investigations; and requirements for report preparation, approval, and distribution. A risk-based approach is applied to prioritize completion of corrective actions so that conditions adverse to safety or quality are corrected as soon as practicable. The process used to monitor corrective actions also includes verification of completion, and as applicable, reviews of effectiveness and management attention for those corrective actions deemed ineffective.

Corrective actions generated from investigations are used to make corrections and improvements (i.e., “lessons learned”) necessary to prevent or minimize single or common-mode failures. Details of the accident event sequence(s) are compared with accident sequence(s) already considered in the ISA, and the ISA Summary will be modified to include evaluation of the risk associated with accidents of the type experienced.

Auditable records and documentation related to events, investigations, and root cause analysis are maintained as described in approved procedures. Procedures require maintenance of all documentation relating to events for two years (or for the life of the operation), whichever is longer. This documentation will also be used as part of a “lessons learned” program that may be applied to future operations of the facility.

#### **11.7 Records Management**

A records management system, as applied to licensed regulatory and quality assurance activities, is maintained in accordance with approved procedures.

Information related to occupational exposure of personnel to radiation, releases of radioactive materials to the environment, and other pertinent activities, are maintained in such a manner as to demonstrate compliance with license conditions and the relevant regulatory requirements of 10 CFR 20.

All records pertaining to safety are retained for at least two years unless longer retention is required by other regulatory or license specifications. For example, records of major changes implemented under 10 CFR 70.72 will be maintained until termination of the license. Major changes are defined in 11.1.4.

**SNM-XXXX**  
**CHAPTER 11**

Records management procedures (a) assign responsibilities for records management, (b) specify the authority needed for records retention or disposal, (c) specify which records must have controlled access and provide the controls needed, (d) provide for the protection of records from loss, damage, tampering, theft, or during an emergency, and (e) specify procedures for ensuring that the records management system remains effective.

A functional organization is in place to ensure prompt detection and correction of deficiencies in the records management system or its implementation. The records management procedures provide the following instructions to ensure that:

- Records are prepared, verified, characterized, and maintained.
- Records are legible, identifiable, and retrievable for their designated lifetimes.
- Records are protected against tampering, theft, loss, unauthorized access, damage, or deterioration for the time they are in storage; and,
- Procedures are established and documented specifying the requirements and responsibilities for record selection, verification, protection, transmittal, distribution, retention, maintenance, and disposition.

Records are categorized by their relative importance to safety and/or regulatory compliance to identify record protection and storage needs and to designate the retention period for individual kinds of records. Records of IROFS failures are kept and updated in accordance with 10 CFR 70.62(a)(3). The decommissioning recordkeeping requirements of 10 CFR 70.25(g) are addressed in Chapter 10.

### **11.8 Other Quality Assurance (QA) Elements for IROFS**

The TRISO-X quality system consists of the organizational structure, procedures, processes, and resources needed to implement quality management. Other Quality Assurance (QA) elements are applied to IROFS to ensure that there is reasonable assurance that IROFS are available and reliable to perform their functions when needed, as further described in approved procedures. The same level of management measures, including QA elements, are uniformly and consistently applied to IROFS irrespective of whether they are needed to prevent or mitigate intermediate or high consequence events.

1. **Organization and Responsibilities**  
Chapter 2 provides the commitments associated with the organizational structure, authority, and responsibilities to ensure that activities involving the handling of SNM and/or IROFS are performed safely and in compliance with license and regulatory requirements.

**SNM-XXXX**  
**CHAPTER 11**

2. **Quality Assurance Program**  
The QA Program is based on, but is not limited to, applicable requirements and guidance in ISO 9001:2015, under the overall responsibility of the Quality Assurance discipline. Aspects of this program are applied to IROFS based on criteria including, but not limited to, type of IROFS (passive, active, enhanced administrative, administrative), complexity of design or fabrication, uniqueness of the item (commercially available or custom design), history of supply and performance, evaluation of the supplier's qualifications, and/or industry accepted practices.
3. **Design Control**  
Design control is an element of the Configuration Management Program as described in Section 11.1.2 and in approved procedures.
4. **Procurement Document Control**  
Procurement documents include those necessary requirements to ensure that IROFS will be of the desired quality. These include the following, as appropriate:
  - Scope of work – description of services or items being procured.
  - Basic technical requirements including drawings, specifications, codes, and industrial standards with applicable revision data, test and inspection requirements, special requirements such as for designing, fabricating, cleaning, identification marking, erecting, packaging, handling shipping and storage.
  - QA requirements – the extent to which will depend upon the type and use of the item or services being procured.
  - Requirements for the control of nonconformances and changes, including provisions to control and report nonconformance and changes to products being delivered.
  - Requirements on sub-tier suppliers including the pass down of relevant technical and quality requirements.
  - Procurement documents and changes thereto are reviewed to ensure they include the appropriate requirements.
5. **Instructions, Procedures, and Drawings**  
Section 11.4 includes the commitment that "activities involving the handling of SNM and/or IROFS are conducted in accordance with approved procedures". This section also describes the process for developing and implementing procedures. Drawings are controlled under the Configuration Management Program as described in Section 11.1.
6. **Document Control**  
A process is in place for developing, implementing, and revising documents to provide reasonable assurance that the appropriate documents are in use (refer to Sections 11.1 and 11.4). Document changes are reviewed for adequacy and approved for implementation by authorized personnel.

## SNM-XXXX

CHAPTER 11

## 7. Control of Purchased Items and Services

The procurement of IROFS is controlled to ensure conformance with documented requirements. The controls provide the following, as appropriate: supplier (source) evaluation and selection; evaluation of objective evidence of quality furnished by the supplier; and examination of items or services upon delivery or completion. Suppliers will provide written quality documentation for evaluation prior to selection.

Sourcing activities are planned and documented to ensure a systematic approach to the procurement process. Supplier selection is based, in part, on an evaluation of the supplier's capability to provide items or services in accordance with the requirements of sourcing documents. Procedures for Supplier selection ensure relevant parties are included as necessary, including Quality Assurance, prior to the placement of orders. Additional considerations may include complexity of design or fabrication, uniqueness of the item (commercially available or custom design), history of supply and performance, and/or industry accepted practices.

Supplier nonconformances may be identified either by TRISO-X or by the supplier. Nonconforming items are not released for use until the nonconforming condition is reviewed and accepted by TRISO-X and implementation of the disposition is verified, except where otherwise controlled and documented according to approved procedures. Records of supplier nonconformance are maintained.

Acceptance of purchased IROFS equipment will be performed to document evidence of compliance with the technical, quality and other requirements of the procurement document.

## 8. Identification and Control of Items

Controls are established to assure that only correct and accepted items are used or installed. Identification is maintained on the items or in documents traceable to the items, or in a manner that assures identification is established and maintained as described in this section.

Where specified, items having a limited operating or shelf life are identified and controlled to preclude use of items whose operating life or shelf life has expired. Procedures provide for item identification consistent with the planned duration and conditions of storage.

## 9. Control of Special Processes

Special processes identified by Engineering that control or verify quality (for example, welding or nondestructive examination) are performed by qualified personnel using approved procedures in accordance with specified requirements, codes, or standards.

## SNM-XXXX

CHAPTER 11

When the outcome of the process is highly dependent on personal skills, such individuals are certified in accordance with specified requirements. When the outcome is highly dependent on control of process parameters, the process and equipment are prequalified in accordance with specified requirements. Special process plans and/or procedures prescribe the necessary equipment, process parameters, calibration, and acceptance criteria. Records are maintained of currently qualified personnel, processes, and equipment for special processes.

10. Inspection

Acceptance testing and/or inspection is a part of the Configuration Management Program which ensures that IROFS meet specified requirements prior to initial use. The Surveillance and Monitoring, Preventive Maintenance, and Functional Testing functions, as described in Section 11.2, provide assurance that IROFS continue to meet specified requirements by assuring that these testing and inspection activities are scheduled and implemented. Qualifications of inspection personnel and characteristics of items inspected, including those identified as IROFS, will be specified in approved procedures, specifications, or plans.

11. Test Control

Acceptance testing and/or inspection is a part of the Configuration Management Program which ensures that IROFS meet specified requirements prior to initial use. The Surveillance and Monitoring, Preventive Maintenance, and Functional Testing elements, as described in Section 11.2, provide assurance that IROFS continue to meet specified requirements by assuring that these testing and inspection activities are scheduled and implemented. Qualifications of testing personnel will be specified in approved procedures. Characteristics verified through testing are stated in approved test instructions.

12. Control of Measuring and Test Equipment

Measuring and Test Equipment (M&TE) used in activities affecting the availability or reliability of IROFS are controlled, calibrated, and adjusted at specified intervals to maintain equipment performance within required limits. Policies, plans, and procedures ensure that devices and standards used for measurement, tests, and calibration activities are of the proper type, range, and accuracy. Calibration control is not necessary for commercial devices such as rulers, tape measures, levels, and stop watches. A list of devices is established to identify those items within the calibration control system. This identification listing includes, as a minimum, the due date of the next calibration and any use limitations (when calibrated for limited use).

M&TE is calibrated at specified intervals or prior to use against equipment having a known valid relationship to nationally recognized standards. If no nationally recognized standard exists, the basis for calibration is documented. M&TE is properly handled and stored to

## SNM-XXXX

CHAPTER 11

maintain accuracy. When M&TE is found to be out of calibration, as-found data are recorded, and an evaluation is made and documented as to the validity of previous inspection, test results, and of the acceptability of items previously inspected or tested. Out-of-calibration devices are tagged or segregated and are not used until recalibrated. When M&TE is consistently found to be out of calibration, it is repaired or replaced. Calibrations are also performed when personnel performing measurements and tests deem the accuracy of the equipment suspect. Records are maintained and equipment is suitably marked or otherwise identified to indicate its calibration status

13. Item Handling, Storage, and Shipping

Materials and equipment are handled, stored, and shipped in accordance with design and procurement requirements to protect against damage, deterioration, or loss. Special coverings, equipment, and protective environments are specified and provided where necessary for the protection of particular items from damage or deterioration.

14. Inspection, Test, and Operating Status

Acceptance testing and/or inspection is a part of the Configuration Management Program which ensures that IROFS meet specified requirements prior to initial use. The Surveillance and Monitoring, Preventive Maintenance, and Functional Testing elements, as described in Section 11.2, provide assurance that IROFS continue to meet specified requirements by assuring that these testing and inspection activities are scheduled and implemented. The Configuration Management and Purchasing Programs have provisions for identifying and controlling items, including IROFS, to provide reasonable assurance that incorrect or defective items are not used.

15. Control of Nonconforming Items

Items and related activities that do not conform to specified requirements are controlled to prevent inadvertent installation or use. Nonconforming items are segregated, when practical. When segregation is impractical or impossible due to physical conditions (for example, size, weight, or access limitations), other measures are employed to preclude inadvertent use of the item.

Nonconforming items are reviewed and dispositioned. Further processing, delivery, installation, or use of the nonconforming item is controlled pending an evaluation and approved disposition by personnel as authorized in approved policies, plans, and/or procedures, and documented notification to affected organizations is provided.

The responsibility and authority for the evaluation and disposition of nonconforming items is defined in approved procedures.

Nonconformance documentation identifies the nonconforming item, describes the nonconformance, contains the disposition and any re-inspection requirements, and contains the appropriate signatures approving the disposition.

SNM-XXXX  
**CHAPTER 11**

16. **Corrective Action**  
Reports of conditions adverse to safety or quality are promptly identified and entered into the Corrective Action Program (see Section. 11.6), which provides a means to evaluate the problem, identify the cause of the problem, assign appropriate corrective actions to be initiated, and track the corrective actions to closure. Prompt identification and effective corrective actions should provide reasonable assurance that repetition of the problem will be minimized.
17. **Quality Assurance Records**  
The Records Management Program, as described in Section 11.7, has provisions for the identification, retention, retrieval, and maintenance of records that furnish evidence of the control of quality of IROFS.
18. **Audits**  
Section 11.5 includes the commitments for scheduling and implementing audits and assessments.

### **11.9 Management Measures for Structural Stability Safety Function**

The following management measures are applied to ensure the structural stability of the process buildings' main force resisting system (MFRS) is maintained available and reliable:

- **Configuration Management** - Changes to the process building MFRS are reviewed prior to implementation using the 10 CFR 70.72 criteria.
- **Maintenance** - Maintenance of the process building MFRS includes inspections to support building modifications and following NPH or external events that may have challenged the structural stability of the process building MFRS.
- **Training and Qualification** - Reviews of facility modifications per 10 CFR 70.72 are performed by trained and qualified personnel. Inspections of the process building MFRS to support the Maintenance item above are performed by trained and qualified inspection personnel.
- **Procedures** - Reviews of facility modifications per 10 CFR 70.72 are performed per approved procedures.
- **Audits and Assessments** – Periodic audits and assessments of the Configuration Management Program ensure facility changes that may impact the structural stability function are appropriately reviewed.
- **Records Management** - Records of the baseline design criteria and any modifications to the process building MFRS are maintained for the life of the facility.
- **Incident Investigations** - Investigations are performed for any incidents that may have impacted the structural stability of the process building MFRS.
- **Other QA Elements** – Design control is applied by ensuring the design basis supporting the structural stability function of the process building MFRS is maintained during

**SNM-XXXX**

**CHAPTER 11**

design, construction, and operations. Inspections are performed to support building modifications and following NPH or external events that may have challenged the structural stability of the process building MFRS. Conditions adverse to safety or quality regarding the structural stability of the process building MFRS are promptly identified and entered in to the Corrective Action Program.

**SNM-XXXX**  
**CHAPTER 11**

**Table 11-1**  
**Management Measures for IROFS**

| Management Measures <sup>1</sup>        | Passive Engineered Control | Active Engineered Control | Enhanced Administrative Control | Administrative Control |
|-----------------------------------------|----------------------------|---------------------------|---------------------------------|------------------------|
| <b>Configuration Management</b>         | X                          | X                         | X                               | X                      |
| Controlled Listing Identification       | X                          | X                         | X                               | X                      |
| Drawing Identification                  | X                          | X                         | X                               |                        |
| Set point analyses                      | X                          | X                         | X                               |                        |
| Design Specifications                   | X                          | X                         | X                               |                        |
| Safety Installation Verification        | X                          | X                         | X                               |                        |
| Pre-operational Safety Review           | X                          | X                         | X                               | X                      |
| <b>Maintenance</b>                      | X                          | X                         | X                               | X                      |
| Periodic Functional Test                | X                          | X                         | X                               | X – Note 2             |
| Calibration                             |                            | X                         | X                               |                        |
| Verification after Maintenance          | X                          | X                         | X                               |                        |
| Pre-operational Tests                   | X                          | X                         | X                               |                        |
| <b>Training and Qualification</b>       | X                          | X                         | X                               | X                      |
| <b>Procedures</b>                       | X                          | X                         | X                               | X                      |
| Procedural Identification               |                            |                           | X                               | X                      |
| Posting Identification                  | X                          | X                         | X                               | X                      |
| <b>Audits and Assessments</b>           | X                          | X                         | X                               | X                      |
| <b>Records Management</b>               | X                          | X                         | X                               | X                      |
| <b>Incident Investigations</b>          | X                          | X                         | X                               | X                      |
| <b>Other Quality Assurance Elements</b> | X                          | X                         | X                               | X                      |

Note 1 – The management measures identified for each type of control are the minimum required, if applicable. For example, it is not possible to calibrate certain types of active engineered controls.

Note 2 – For frequently used equipment, functionality is readily apparent at each use (e.g., leaking valve visually noticed at use point when valve is operated). Therefore, a periodic functional test is not required.

REVISION SUMMARY

| Revision | Date     | Section/Page     | Description of Changes                                                                                                                                                                                                     |
|----------|----------|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | 5-Apr-22 | ALL              | Initial issue.                                                                                                                                                                                                             |
| 2        | Dec-24   | ALL              | Added document number TXF-REG-NRC-0011 to header.                                                                                                                                                                          |
|          |          | Introduction     | Clarified application of management measures is based on type of control due to TX0-REG-LTR-0041, QA/Mgt Measures RAI 1-2.                                                                                                 |
|          |          | Section 11.1.2   | Added new sentence to state applicable codes and standards are identified in design documents due to TX0-REG-LTR-0029, QA/Mgt Measures RAI 1-2.                                                                            |
|          |          | Section 11.8     | Changes in this section (except Item 9) due to TX0-REG-LTR-0041, QA/Mgt Measures RAI 1-2.<br>Item 9 changes due to TX0-LTR-0020, RAI 1-5.                                                                                  |
|          |          | Table 11-1       | Added due to TX0-REG-LTR-0041, QA/Mgt Measures RAI 1-2.                                                                                                                                                                    |
|          |          | Revision Summary | Added revision summary to end of chapter.                                                                                                                                                                                  |
| 3        | Dec-25   | 11.1.1           | Added clear commitment for the process buildings to be maintained under the CM Program based on TX0-REG-LTR-0080 RAI-6 response.                                                                                           |
|          |          | 11.1.2           | Revised first paragraph based on TX0-REG-LTR-0089 Set 16 supplemental information for RAI-9 response.                                                                                                                      |
|          |          | 11.3.2           | Removed "graded" based on TX0-REG-LTR-0089 RAI-5 response.                                                                                                                                                                 |
|          |          | 11.4             | Added "including subjects such as design, inspections and testing," to first paragraph based on TX0-REG-LTR-0078 RAI-10 response.<br>Added procedure detail to second paragraph based on TX0-REG-LTR-0078 RAI-10 response. |
|          |          | 11.4.5           | Removed "graded" based on TX0-REG-LTR-0089 RAI-5 response.                                                                                                                                                                 |
|          |          | 11.5             | Clarified information for audits and assessments based on TX0-REG-LTR-0089 RAI-11 response.                                                                                                                                |
|          |          | 11.6             | Added "or quality" based on TX0-REG-LTR-0078 RAI-20 response.<br>Removed "graded" based on TX0-REG-LTR-0089 RAI-5 response.                                                                                                |

**SNM-XXXX**  
**CHAPTER 11**

| Revision | Date   | Section/Page  | Description of Changes                                                                                                                                                                                                                                                                      |
|----------|--------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |        |               | Added sentence for preventing recurrence based on TX0-REG-LTR-0089 RAI-21 response.                                                                                                                                                                                                         |
|          |        | 11.6.1        | Removed "graded" based on TX0-REG-LTR-0089 RAI-5 response.<br><br>Removed sentence for measures to prevent recurrence based on TX0-REG-LTR-0089 RAI-21 response.<br><br>Added "or quality" based on TX0-REG-LTR-0078 RAI-20 response.                                                       |
|          |        | 11.8, Item 3  | Clarified reference to Section 11.1.2 based on TX0-REG-LTR-0089 RAI-9 response.                                                                                                                                                                                                             |
|          |        | 11.8, Item 4  | Removed 10 CFR 21 reference based on TX0-REG-LTR-0089 RAI-22 response.                                                                                                                                                                                                                      |
|          |        | 11.8, Item 7  | Added sentence for supplier selection based on TX0-REG-LTR-0089 RAI-15 response.                                                                                                                                                                                                            |
|          |        | 11.8, Item 10 | Clarified that qualifications of inspection personnel will be specified in approved procedures based on TX0-REG-LTR-0089 RAI-17 response.                                                                                                                                                   |
|          |        | 11.8, Item 11 | Clarified that qualifications of testing personnel will be specified in approved procedures based on TX0-REG-LTR-0089 RAI-17 response.                                                                                                                                                      |
|          |        | 11.8, Item 15 | Added "in approved procedures" to evaluation and disposition of nonconforming items based on TX0-REG-LTR-0078 RAI-19 response.                                                                                                                                                              |
|          |        | 11.8, Item 16 | Added "or quality" based on TX0-REG-LTR-0078 RAI-20 response.                                                                                                                                                                                                                               |
| 4        | Feb-26 | 11.1.1        | Clarified discussion of process building design criteria and review of facility modifications based on meeting with NRC held January 21, 2026 (ML26013A262).                                                                                                                                |
|          |        | 11.9          | Added new Section 11.9, <i>Management Measures for Structural Stability Safety Function</i> , which clarifies the management measures applied to ensure the structural stability of the process buildings. Changes were made based on meeting with NRC held January 21, 2026 (ML26013A262). |