2.5.3 Surface Faulting

The following surface and subsurface geological, seismological, and geophysical information related to the potential for surface or near-surface faulting affecting the site is addressed below:

- Geological, seismological, and geophysical investigations
- Geological evidence, or absence of evidence, for surface deformation
- Correlation of earthquakes with capable tectonic sources
- Ages of most recent deformation
- Relationship of tectonic structures in the site area to regional tectonic structures
- Characterization of capable tectonic sources
- Designation of zones of quaternary deformation in the site region
- Potential for surface tectonic deformation at the site

The AP1000 design has not been evaluated for a site where there is a fault displacement potential. The requirement for no surface or near surface tectonic structure capable of displacements beneath the nuclear island and adjacent seismic Category II structures is satisfied by the completion of geological, seismological, and geophysical investigations that are consistent with the guidance of Regulatory Guide 1.206.

As defined in NRC Regulatory Guide 1.208, *A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion*, a capable tectonic source is a tectonic structure that can generate both vibratory ground motion and tectonic surface deformation, such as faulting or folding at or near the earth's surface, in the present seismotectonic regime. This section documents an evaluation of the potential for tectonic and non-tectonic surface deformation at the VCSNS site. Information contained in this section was developed in accordance with Regulatory Guide 1.208 and is intended to demonstrate compliance with 10 CFR 100.23, *Geologic and Seismic Siting Criteria*.

There are no capable tectonic sources within the 25-mile VCSNS site vicinity radius. There is negligible potential for tectonic fault rupture within 25 miles of the site. There is also negligible potential for non-tectonic surface deformation within 5 miles of the site. The following sections provide the data, observations, and references to support these conclusions.

2.5.3.1 Geological, Seismological, and Geophysical Investigations

The following investigations were performed to assess the potential for tectonic and non-tectonic deformation at and within 25 miles of the VCSNS site:

- Compilation and review of existing data and literature
- Interpretation of aerial photography and satellite imagery
- Field and aerial reconnaissance
- Review of historical and recorded seismicity
- Discussions with current researchers in the area.

An extensive body of information is available for the VCSNS site vicinity. This information is contained in five primary sources:

- Previous VCSNS site investigations performed for Unit 1, presented in the Unit 1 FSAR and supplementary basis documents

- Geologic mapping published by the USGS, the South Carolina Department of Natural Resources, and other researchers
- Articles published in peer-reviewed journals by various researchers and field trip guidebooks published primarily by the Carolina Geological Survey
- Seismicity data compiled and analyzed in published journal articles, EPRI (Reference 210), and the update to the EPRI catalog, performed for Units 2 and 3.

This existing information was supplemented by aerial and field reconnaissance performed within and beyond the 25-mile site vicinity radius, and by interpretation of aerial photography and satellite imagery within and beyond the 5-mile site area radius.

2.5.3.1.1 Previous VCSNS Site Investigations

The results of previous site investigations are presented in the Unit 1 FSAR and in supplementary basis documents. This previous work did not identify the existence of active or geologically recent tectonic faulting within the VCSNS site area. These studies did, however, identify several features with postulated Mesozoic slip, as well as older tectonic features within the VCSNS site area.

In addition, detailed geologic mapping and inspection of excavations during construction of Unit 1 revealed minor bedrock shears (Subsection 2.5.1.2.4, Figures 2.5.1-230 and 2.5.1-231). These minor shears are common to rocks in the Piedmont and are not capable faults as defined by 10 CFR 100, Appendix A. These shears terminate upward within the bedrock and do not penetrate the overlying soil profile. The presence of undeformed, euhedral laumontite (zeolite) crystals on many of the shear surfaces precludes post-45 Ma slip (References 209 and 232). The Cenozoic or Mesozoic timing of last movement on the bedrock shears demonstrates that these features are not capable tectonic sources and represent neither a surface rupture hazard nor a ground motion hazard to the site. These types of minor shears and fractures, which are common to rocks in the Piedmont, might be encountered within the foundation excavations for Units 2 and 3. During excavation for these units, detailed mapping of the foundation exposures will provide the ability to document the presence or absence of these minor, near-vertical bedrock shears, which typically cannot be recognized nor adequately characterized by surficial mapping (of saprolite-covered areas) or analysis of drill core.

2.5.3.1.2 Published Geologic Mapping

The USGS, the South Carolina Geological Survey, and other researchers have mapped the geology of the site vicinity (25-mile radius) and site area (5-mile radius) at a variety of scales. Sources of geologic mapping reviewed and used for Units 2 and 3 are discussed below. This mapping suggests no evidence of geologically recent or active faulting within the site area.

Secor et al.'s (Reference 219) 1:24,000-scale mapping of the Jenkinsville, Pomaria, Little Mountain, and Chapin 7.5-minute quadrangles present the most detailed published geologic mapping in the site area (Figure 2.5.1-225). Subsequent unpublished mapping of these quadrangles by Secor (Reference 221) has been included in Figures 2.5.1-220 and 2.5.1-224.

Detailed geologic mapping of the Ridgeway-Camden, South Carolina area, about 18 miles east of the VCSNS site, has also been published. Secor et al. (Reference 220) mapped at 1:24,000-scale the Ridgeway, Longtown, and Rabon Crossroads 7.5-minute quadrangles (Figure 2.5.1-213). The South Carolina Geological Survey published 1:24,000-scale geologic maps of the Longtown and Ridgeway 7.5-minute quadrangles (Reference 202).

Smaller scale, regional geologic mapping compilations assembled by experts in the geology of the Carolinas that cover the VCSNS site are incorporated into Figures 2.5.1-203, 2.5.1-204, 2.5.1-211, and 2.5.1-212. Horton and Dicken (Reference 214) compiled geologic mapping of the Piedmont and Blue Ridge of South Carolina at 1:500,000-scale. This map was produced by integrating data and interpretations from a variety of preexisting sources (see Reference 214). Horton and Dicken's (Reference 214) geologic mapping is used to supplement those areas not covered by the more detailed, 1:24,000-scale mapping described above. Hibbard et al.'s (Reference 213) 1:500,000-scale lithotectonic map of the Appalachian Orogen is a compilation of geologic and structural mapping that spans eastern North America from Alabama to Lake Ontario. This map was produced by integrating data and interpretations from a variety of preexisting sources (see Reference 213).

In addition to the geologic mapping discussed above, the USGS has published several compilations of known and suggested Cenozoic tectonic features. Prowell's (Reference 217) 1:2,500,000-scale map is an early compilation of faults of Cretaceous and Cenozoic age in the CEUS. Prowell (Reference 217) maps one small fault exposed in a construction excavation (his fault #67) within 25 miles of the site (Figure 2.5.1-212). Crone and Wheeler (Reference 206; updated in Reference 231) compiled all known or suggested Quaternary faults, liquefaction features, and possible tectonic features in the CEUS (Figure 2.5.1-215). No suspected Quaternary features identified by Crone and Wheeler (Reference 206) or Wheeler (Reference 231) are located within 25 miles of the VCSNS site. In addition, reviews of literature, field reconnaissance, and consultations with experts concerning Units 2 and 3 found no additional tectonic features.

2.5.3.1.3 Current Geologic Mapping

The existing geologic maps discussed in Subsection 2.5.3.1.2 form the basis for the geologic maps presented for Units 2 and 3. Field reconnaissance conducted for Units 2 and 3 includes field checks of existing mapping and, where necessary, refinement of extant geologic maps. Geologic mapping is discussed in detail in Subsection 2.5.1.2.

Surficial geology of the site area is predominantly saprolite and residual soil, with only sparse outcroppings of weathered bedrock (granodiorite and amphibolite gneiss), as shown on Figure 2.5.1-226.

2.5.3.1.4 Previous Seismicity Data

The EPRI seismicity catalog (Reference 210; see discussion in Subsection 2.5.2.2) does not include any earthquakes of body wave magnitude (m_b) ≥3.0 within 5 miles of the site area. Only two earthquakes of m_b ≥3.0 within 25 miles of the site vicinity are included in the EPRI seismicity catalog (Reference 210). These are the 1853 m_b 4.3 and the 1968 m_b 3.68 earthquakes.

The highest recorded ground shaking intensities at the VCSNS site are the result of earthquakes located beyond the 25-mile site radius. The 1886 Charleston earthquake was likely located greater than 125 miles from the VCSNS site, and produced shaking intensity of about MMI VII or VIII at the site (Figure 2.5.1-217) (Reference 204). The January 1, 1913 m_b 4.8 Union County, South Carolina, earthquake is poorly located and the fault on which this earthquake occurred has not been identified, but was likely located about 30 to 50 mi from the VCSNS site (Reference 210). MMI shaking intensity at the site from the Union County earthquake is estimated at IV, Rossi-Forel shaking intensity at the site from the Union County earthquake is estimated at III (Reference 223, as reported in Reference 229).

2.5.3.1.5 Current Seismicity Data

For Units 2 and 3, the EPRI earthquake catalog was updated to incorporate seismicity in the site region that occurred between 1985 and 2005. The updated catalog of m_b ≥3 earthquakes for the period 1985 to 2005 includes only one event (m_b 3.17 occurring in 2005) within 25 miles of the VCSNS site and no events within 5 miles of the site.

In 2006 (after the completion of the update to the EPRI seismicity catalog performed for Units 2 and 3), four noteworthy earthquakes occurred in northeast South Carolina. An unpublished online report (Reference 224) describes two earthquakes located near Jonesville, South Carolina, approximately 40 miles northwest of the VCSNS site. Talwani (Reference 224) suggests that the January 24, 2006 magnitude 2.5 and January 25, 2006 magnitude 1.5 (magnitude scale unspecified) earthquakes are associated with the western margin of the Baldrock granitic pluton. Talwani (Reference 224) does not provide estimates of location uncertainty for these two microearthquakes, but the epicentral locations are likely highly inaccurate due to the small magnitudes of these events and sparse station coverage.

Two additional, minor earthquakes occurred in northeast South Carolina near the town of Bennettsville in September 2006. In unpublished online reports, the USGS National Earthquake Information Center describes the September 22, 2006 m_b 3.5 and the September 25, 2006 m_b 3.7 earthquakes (References 226 and 227). The epicenters of these two earthquakes are not precisely located, but are more than 90 miles east-northeast of the VCSNS site. Estimates of location uncertainty for the September 22, 2006 event are: ±7.3 kilometers (4.5 miles) horizontal, ±12.8 kilometers (8 miles) depth (Reference 226). Estimates of location uncertainty for the September 25, 2006 event are: ±10.9 kilometers (6.8 miles) horizontal, with depth fixed at 5 kilometers (3.1 miles) by the location program (Reference 227). Because of the lack of nearby seismograph stations, focal mechanisms have not been obtained for these events. The September 2006 earthquakes are spatially associated with a small Mesozoic extensional basin mapped beneath the Coastal Plain by Benson et al. (Reference 203). In an unpublished online report, Talwani (Reference 225) suggests that these two earthquakes may be spatially related to the Eastern Piedmont fault system, a broad zone of faults interpreted by Hatcher et al. (Reference 212) as a regional fault zone (Figure 2.5.1-211). At the latitude of the two September 2006 earthquakes, the eastern Piedmont fault system is up to 40 miles wide. Given the poor location of the two September 2006 earthquakes and the broad regional extent of the eastern Piedmont fault system, it does not appear that these two minor events can be positively correlated to this fault system. The lack of focal mechanisms and significant location uncertainty for even recent earthquakes makes it difficult to positively associate seismicity with any geologic structures.

2.5.3.1.6 Current Aerial and Field Reconnaissance

Aerial photography, satellite imagery, and topographic maps of varying scales and vintages reveal no evidence of geomorphic features indicative of the potential for tectonic surface deformation (*e.g.,* faulting, warping, and lineaments) within the site area. Imagery reviewed for Units 2 and 3 includes:

- 1955, 1:20,000-scale, black and white, stereo aerial photographs from the U.S. Department of Agriculture covering the most of the 5-mile site area
- 1994, 1:40,000-scale, color-infrared, stereo aerial photographs from the USGS covering most of the 5-mile site area
- Landsat satellite imagery of varying color bands covering the 25-mile site vicinity and beyond
- Shaded relief topographic imagery (30-meter grid spacing) covering the 25-mile site vicinity and beyond.

Field and aerial reconnaissance inspections reveal no evidence for surface rupture, surface warping, or the offset of geomorphic features indicative of active faulting within the site area.

2.5.3.2 Geological Evidence, or Absence of Evidence, for Surface Deformation

Twelve bedrock faults are mapped within the 25 miles of the site vicinity as listed below. These 12 faults range in age from Paleozoic to Cenozoic and are discussed in detail in Subsection 2.5.1.1.2.4.

- Wateree Creek fault zone
- Summers Branch fault zone
- Chappells shear zone
- Cross Anchor fault
- Beaver Creek shear zone
- Modoc shear zone
- Gold Hill fault extension
- Ridgeway fault
- Longtown fault
- Fault #67 of Prowell (Reference 217) near Irmo, South Carolina
- Unnamed fault of Secor et al. (Reference 220) and Barker and Secor (Reference 202) near Ridgeway, South Carolina
- Unnamed fault of Dames & Moore (Reference 207) near Parr, South Carolina.

No deformation or geomorphic features suggestive of potential Quaternary activity have been reported in the literature for these twelve faults. Aerial and field reconnaissance and interpretation of aerial photographs and satellite imagery show that no geomorphic features indicative of Quaternary activity exist along any of the mapped fault traces. These twelve features are summarized in Table 2.5.3-201 and described below.

- <u>Wateree Creek fault</u>. The more than 8-mile-long Wateree Creek fault is mapped by Secor et al. (Reference 219) as an approximate northerly trending, unsilicified fault zone. At its nearest point, the Wateree Creek fault is located approximately 2 miles south of the VCSNS site (Figures 2.5.1-212, 2.5.1-220, 2.5.1-224, and 2.5.1-225). Based on crosscutting relationships with Triassic or Jurassic diabase dikes, Secor et al. (Reference 220) estimate a minimum age of Triassic for the Wateree Creek fault. More recent maps of the site area by Maher et al. (Reference 216) and Secor (Reference 221) have reinterpreted the northernmost portion of the fault as striking northeast. The central and southern portions of the fault are well located due to roadcut and trench exposures (Reference 222). Detailed studies of the central and southern portions of the Wateree Creek fault were performed by magnetometer surveys and trench exposures to demonstrate the continuity of an unfaulted Mesozoic diabase dike across the fault (Reference 222). Based on testimony given by Professor Donald Secor before issuance of the Unit 1 operating license, the Atomic Safety and Licensing Board concluded, “the Wateree Creek fault is not of concern to the seismic safety of [the VCSNS site]” (Reference 228).

- <u>Summers Branch fault</u>. The approximate 8-mile-long Summers Branch fault is mapped by Secor et al. (Reference 220) as an approximate northerly trending, unsilicified fault zone. At its nearest point, the Summers Branch fault is located approximately 5 miles southwest of the VCSNS site (Figures 2.5.1-212, 2.5.1-220, 2.5.1-224, and 2.5.1-225). By association with the Wateree Creek fault, Secor et al. (Reference 220) estimate a minimum age of Triassic for the Summers Branch fault. More recent maps of the site area by Maher et al. (Reference 216) and Secor (Reference 221) have omitted the speculative Summers Branch fault. Despite questions regarding its existence, the Summers Branch fault is shown on figures throughout Subsection 2.5.1.

- Chappells shear zone. The 60-mile-long Chappells shear zone is mapped by Horton and Dicken (Reference 214) and Hibbard et al. (Reference 213) as an approximate northeasterly trending, 2-mile-wide zone of ductile deformation. At its nearest point, the Chappells shear zone is located approximately 2 miles south of the VCSNS site (Figure 2.5.1-212). Post-Paleozoic slip on the Chappells shear zone is precluded by crosscutting relationships with the late Paleozoic (309 Ma; Reference 211) Winnsboro pluton.

- Cross Anchor Fault. The more than 60-mile-long Cross Anchor fault is mapped by Hibbard et al. (Reference 213) as a thrust fault of variable strike. At its nearest point, the Cross Anchor fault is located approximately 10 miles north of the VCSNS site, and is associated with the Whitmire reentrant (Figure 2.5.1-212). West (Reference 230) interprets the Cross Anchor fault as the Carolina-Inner Piedmont terrane boundary. Crosscutting and structural relationships indicate that the Cross Anchor fault is Paleozoic (325 Ma) and may be part of the Central Piedmont shear zone (Reference 230).

- Beaver Creek Shear Zone. The more than 50-mile-long Beaver Creek shear zone is located approximately 10 miles north of the VCSNS site (Reference 213) (Figures 2.5.1-212 and 2.5.1-220). This shear zone is mapped as an approximately 2-mile-wide zone of ductile deformation. Evidence suggesting dextral strike-slip motion for this shear zone includes feldspar porphyroclasts with tails and shear bands from orthogneiss sheets, as well as from rotated, s-shaped quartz veins (Reference 230). Crosscutting relationships with the mesoscopically undeformed Newberry granite zone indicate that ductile motion on the Beaver Creek shear zone predates 415 Ma (Reference 230).

- Modoc Shear Zone. At its nearest point, the Modoc shear zone is about 20 miles south of the VCSNS site (Figures 2.5.1-211, 2.5.1-212, and 2.5.1-220). The Modoc shear zone is a region of high ductile strain separating the suprastructural Charlotte Terrane and infrastructural Carolina Terrane from the amphibolite facies migmatitic and gneissic infrastructural rocks of the Uchee and Savannah River Terranes and the suprastructural rocks of the Milledgeville Terrane. (References 205, 213, and 218) (Figure 2.5.1-202). The northeast-striking Modoc zone dips steeply to the northwest and can be traced through the Piedmont from central Georgia to central South Carolina based on geological and geophysical data. The shear zone appears to continue northeastward to North Carolina beneath the Coastal Plain, as demonstrated by magnetic data (Figure 2.5.1-206). The Modoc shear zone contains fabrics characterized by brittle and ductile deformation produced during an early phase of the Alleghanian orogeny approximately 315 to 290 Ma (Reference 208). There is no evidence in the published literature for significant post-290 Ma slip on the Modoc shear zone.

- Gold Hill Fault Extension. Horton and Dicken (Reference 214) and Hibbard et al. (Reference 213) map an unnamed fault north of the Beaver Creek shear zone that is considered the southwest extension of the Gold Hill fault (Figure 2.5.1-212). The southwest extension of the Gold Hill fault is a dextral strike-slip shear zone located approximately 20 miles north of the VCSNS site (Figure 2.5.1-212). Based on structural correlations with the Deal Creek shear zone (Figure 2.5.1-211) and crosscutting relationships with intrusive igneous bodies, West (Reference 230) constrains motion on the Gold Hill fault to between approximately 400 and 325 Ma.

- Ridgeway Fault. The more than 9-mile-long Ridgeway fault is mapped by Secor et al. (Reference 220) and Barker and Secor (Reference 202) as a northerly trending, unsilicified fault zone located approximately 20 miles east of the VCSNS site (Figures 2.5.1-212 and 2.5.1-213). By association with the Wateree Creek fault, Secor et al. (Reference 220) estimate a minimum age of Triassic for the Ridgeway fault.

- Longtown Fault. The Longtown fault strikes west-northwest in the Ridgeway-Camden area (Figure 2.5.1-213), about 25 miles from the VCSNS site (Figures 2.5.1-212 and 2.5.1-213). As mapped by Secor et al. (References 220 and 202), the Longtown fault terminates eastward against the Camden fault. The Longtown fault is associated with fracturing and brecciation of the crystalline rocks, and fragments of silicified breccia are found along its trace (Reference 220). Total slip on the Longtown fault is unresolved, although Secor et al. (Reference 220) suggest total displacement on the order of hundreds to thousands of meters is likely in order to explain the apparent disruption of crystalline rocks across the fault. Map relationships suggest that the Longtown fault vertically separates the Late Cretaceous basal unconformity (Reference 220). However, it is possible that the irregularity in the basal unconformity represents buried topography and not tectonic deformation (Reference 202). Mapping by Barker and Secor (Reference 202) shows diabase dikes of Jurassic age that cross, but are not offset by, the Longtown fault. Available data suggest that the most recent slip on the Longtown fault may have occurred during the Mesozoic. There is no evidence for post-Mesozoic slip on the Longtown fault, but this cannot be precluded by available data.

- Fault #67 of Prowell (1983). Prowell (Reference 217) describes a number of small, N80°E-striking, near-vertical (dipping 87° to the north) reverse faults exposed in a construction excavation near Irmo, South Carolina (Figure 2.5.1-212). One fault strand is described as offsetting postulated Eocene to Pliocene fluvial sands and gravels by about 5 feet. Prowell's (Reference 217) fault #67 was not mapped beyond the single construction site exposure, which is now covered, and this feature does not appear on more recent geologic maps of the area. This feature, which was exposed in an excavation over 25 years ago, has not been mapped beyond the initial exposure nor correlated to any other fault of known tectonic origin.

- Unnamed Fault near Ridgeway, South Carolina. Secor et al. (Reference 220) and Barker and Secor (Reference 202) map an unnamed fault south of the Longtown fault that terminates westward against the Ridgeway fault near Ridgeway, South Carolina (Figure 2.5.1-213). Secor et al. (Reference 220) and Barker and Secor (Reference 202) map six diabase dikes of Triassic or Jurassic age that cross, but are not offset by, this unnamed fault. Based on these crosscutting relationships, a minimum age of Triassic is established for the unnamed fault of Secor et al. (Reference 220) and Barker and Secor (Reference 202).

- Unnamed Fault near Parr, South Carolina. As part of an investigation performed for the Parr Hydroelectric Project, Dames & Moore (Reference 207) describes a postulated fault 3 miles south-southwest of the VCSNS site (Figures 2.5.1-224 and 2.5.1-225). Evidence for this fault includes slickensides observed in a boring at Parr Dam and four bedrock exposures described as "faulted rock", "dip reversal across narrow disrupted zone", "discordance in foliation and beds", and "shear features." The postulated unnamed fault near Parr is based on a limited number of exposures and the assumption that these exposures all represent the same structure. With the exception of the outcrop in Parr and the boring on Parr Dam, the exposures are separated by distances greater than 1 mile. In addition, none of these exposures provide kinematic indicators and only one of the exposures yields information on orientation. Alternatively, the exposures observed by Dames & Moore (Subsection 2.5.1.3, Reference 239) could represent individual local features of limited extent, similar to the minor faults and shears studied in the V.C. Summer Unit 1 exposure. More recent mapping of the area at 1:24,000 scale (Subsection 2.5.1.3, References 363 and 364) does not include this postulated fault. For completeness, the inferred fault was conservatively included on

Figures 2.5.1-224 and 2.5.1-225, even though the existence of a single fault connecting each of the Dames & Moore (Subsection 2.5.1.3, Reference 239) exposures is highly speculative. This postulated fault, if it exists, is assigned a Paleozoic age; however, there are no data to constrain timing at any of the exposures. It is permissible that some could be as young as Mesozoic in age if they are similar to the bedrock shears mapped in the V.C. Summer Unit 1 excavation. The brief descriptions of the exposures by Dames & Moore (Subsection 2.5.1.3, Reference 239) do not provide sufficient information to even classify the minor deformational features as having formed under ductile or brittle conditions. Field reconnaissance performed for Units 2 and 3 did not recognize evidence for faulting in the vicinity of Dames & Moore's (Reference 207) postulated fault near Parr, South Carolina (Reference 221).

In addition to the faults specified above, the site is underlain by low angle Paleozoic thrust faults that do not daylight in the site area and therefore do not appear on maps of surface geology. Based on regional cross sections (Figures 2.5.1-207 and 2.5.1-208), the base of the Appalachian crust is at about 7 to 15 miles deep. Imbricate, low angle, southeast dipping Paleozoic thrust faults exist within the Appalachian crust above the basal decollement.

2.5.3.3 Correlation of Earthquakes with Capable Tectonic Sources

Seismicity within 50 miles of the VCSNS site is shown in Figure 2.5.1-212. As shown on this figure, there is no spatial correlation of earthquake epicenters with known or postulated faults or other tectonic features. No faults or geomorphic features within 50 miles of the site can be correlated with earthquakes. Based on review of existing literature, no reported historical earthquake epicenters have been associated with bedrock faults within 50 miles of the VCSNS site (Figure 2.5.1-212). None of these faults within 25 miles of the VCSNS site are classified as capable tectonic sources.

Figure 2.5.1-212 shows only three historical earthquakes of $m_b \geq 3$ within 25 miles of the site. The largest earthquake within 50 miles of the site is the January 1, 1913, m_b 4.8 Union County, South Carolina earthquake. The fault on which this earthquake occurred has not been identified. Given the distribution of damage and the location of strongest shaking reflected in isoseismals (Reference 223, as reported in Reference 229), this event likely occurred beyond 25 miles from the VCSNS site.

2.5.3.4 Ages of Most Recent Deformations

Of the 12 faults identified in the VCSNS site vicinity, six are Paleozoic in age (*i.e.,* Beaver Creek shear zone, Chappells shear zone, Cross Anchor fault, Modoc shear zone, the Gold Hill fault extension, and the postulated fault of Dames & Moore 1972 near Parr); five are Mesozoic or pre-Mesozoic in age (Wateree Creek fault, Summers Branch fault [if it exists], Ridgeway fault, Longtown fault, and the unnamed fault of Secor et al. (Reference 220) and Barker and Secor (Reference 202) south of the Longtown fault); and one is Cenozoic in age (fault #67 of Prowell (1983) (Reference 217).

The Cenozoic fault #67 of Prowell (1983) (Reference 217) was temporarily exposed in a construction grade at the junction of Interstate 26 and US Route 76-176, located over 20 miles southeast of the site (Figure 2.5.1-212). As described by Prowell (1983) (Reference 217), "a number of reverse faults were exposed in excavation (now covered) but only one had substantial offset." The largest of these faults was oriented N80ºE, 87ºNW and exhibited 5 feet of vertical separation in Cenozoic Coastal Plain fluvial sand and gravel deposits.

The next nearest fault to the VCSNS site with demonstrable Cenozoic activity is the northeast striking Camden fault, about 40 miles east of the VCSNS site (see discussion in Subsection 2.5.1.1.2.4.3). Total slip on the Camden fault is unresolved, although Secor et al. (Reference 220) suggest total displacement on the order of kilometers is likely in order to explain the apparent disruption of crystalline rocks across the fault. Up-to-the-north vertical separation of the basal Late Cretaceous unconformity of about 50 to 80 feet suggests Late Mesozoic and possibly Cenozoic (pre-Oligocene) reactivation of the Camden fault (References 201 and 220). Knapp et al. (Reference 215) describe seismic reflection and gravity data that they interpret as suggesting an 80 to 100 feet offset of the base of the Coastal Plain section. Knapp et al. (Reference 215) suggest that the Tertiary Upland formation (Oligocene age) covers and is likely undeformed by the Camden fault, providing a potential upper age limit on the Cenozoic movement of the fault.

2.5.3.5 Relationship of Tectonic Structures in the Site Area to Regional Tectonic Structures

Some of the 12 faults identified within the site area have been attributed to larger, regional tectonic structures. West (Reference 230) includes the Beaver Creek shear zone as part of the larger Lowdensville shear zone, and suggests that the Cross Anchor fault is part of the Central Piedmont shear zone. Hatcher et al. (Reference 212) include the Modoc shear zone as part of the larger eastern Piedmont fault system.

2.5.3.6 Characterization of Capable Tectonic Sources

Based on review of updated geologic, seismic, and geophysical data from published literature, interviews with expert earth scientists, and field investigations, there are no capable tectonic sources identified within 25 miles of the VCSNS site.

2.5.3.7 Designation of Zones of Quaternary Deformation Requiring Detailed Fault Investigation

Based on review of updated geologic, seismic, and geophysical data from published literature, interviews with expert earth scientists, and field investigations, no evidence of Quaternary deformation is identified within the site area. Based on this finding, no further investigation is required.

2.5.3.8 Potential for Surface Tectonic Deformation at the Site

The potential for tectonic deformation at the site is negligible. Detailed geologic mapping and inspection of excavations during construction of Unit 1 revealed no evidence of geologically recent or active faulting. There are no Quaternary faults or capable tectonic sources within 25 miles of the site.

There is negligible potential for non-tectonic surface deformation within the site area. There is no information suggesting the potential for non-tectonic surface deformation within the site area. Rocks within the site area are igneous and metamorphic crystalline rocks (References 219 and 221) that are neither susceptible to karst-type dissolution collapse nor to subsidence due to fluid withdrawal.

2.5.3.9 References

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Table 2.5.3-201
Summary of Bedrock Faults Mapped Within the 25-Mile VCSNS Site Vicinity

Feature Name	Distance from Site (mi)	Mapped Length (mi)	Orientation	Assigned Age	Basis for Assigned Age
Beaver Creek shear zone	10	>50	ENE-NE	Paleozoic	Paleozoic Newberry granite crosses but not deformed by shear zone (Reference 230).
Chappells shear zone	2	60	NE-ENE	Paleozoic	Paleozoic (Reference 211) Winnsboro pluton crosses but not deformed by shear zone (Reference 230).
Cross Anchor fault	10	>60	Variable	Paleozoic	Pre- to syn-kinematic Paleozoic granite crosses fault (Reference 230).
Fault #67 of Prowell (1983)	20	18	E	Cenozoic	5 ft vertical separation of Cenozoic Coastal Plain sand and gravel deposits (Reference 217).
Gold Hill fault extension	20	75	NE	Paleozoic	Paleozoic Concorde intrusive suite cut by fault (Reference 230); fault is truncated by the Paleozoic Cross Anchor fault (Reference 230).
Longtown fault	25	20	WNW	Mesozoic (minimum age)	Undeformed Jurassic diabase dikes cross fault (Reference 202).
Modoc shear zone	>12	20	NE	Paleozoic (possible localized Mesozoic reactivation)	$^{40}Ar/^{39}Ar$ ages indicate ductile fabrics formed in Paleozoic (Reference 216); localized silicified breccias suggest possible Mesozoic brittle reactivation (Reference 220).
Ridgeway fault	20	>9	N	Mesozoic (minimum age)	Association with Wateree Creek fault (Reference 220).
Summers Branch fault	6 [?]	8 [?]	N [?]	Mesozoic [?] (minimum age) (likely non-existent)	Association with Wateree Creek fault (Reference 220); parameters are queried indicating fault likely non-existent (References 216 and 221).
Unnamed fault near Parr	3 [?]	5 [?]	NE [?]	Paleozoic [?] (likely non-existent)	No data constraining age; parameters are queried indicating fault likely non-existent.
Unnamed fault near Ridgeway	20	9	E	Mesozoic (minimum age)	Six undeformed Triassic to Jurassic diabase dikes cross fault (References 202 and 220).
Wateree Creek fault	2	>8	N	Mesozoic (minimum age)	Undeformed Triassic to Jurassic diabase dike crosses fault (Reference 219).