Table Of Contents

List of Figures

2.6 GEOLOGY

This section contains a brief description of the geologic conditions that are present at and in the vicinity of the {Callaway site}. Groundwater and surface water are discussed in Section 2.3. The {Callaway Plant Unit 2} Final Safety Analysis Report (FSAR) presents detailed geological, seismological and geotechnical site evaluations in FSAR Section 2.5.

2.6.1 GEOLOGIC SETTING

{The Callaway Plant Unit 2 site area straddles the boundary between the Dissected Till Plains Section of the Central Lowlands Physiographic Province (AmerenUE, 2003) to the north and the Ozark Plateaus Physiographic Province to the south as shown in Figure 2.6-1 (MDNR, 2002).

The plant site is blanketed by glacial deposits, and was largely a glacial till plain during Early Pleistocene time. Erosion and downcutting of the Missouri River and its tributary streams have dissected the plain, leaving a nearly isolated plateau of 6 to 8 sq mi (16 to 21 sq km) in size. Topographic relief on the plateau varies from about El 800 ft (249 m) msl near the perimeter to a maximum of 858 ft (262 m) msl southwest of the town of Reform; the average elevation on the Callaway Plant Unit 2 site is approximately 846.5 ft (258 m).The plateau is higher than any surrounding land feature within a radius of 6 miles (10 km). The Missouri River is about 5 miles (8 km) south of the plant. Its floodplain is about 2.5 miles (4 km) wide, with an average surface elevation of about 525 ft (160 m) msl. The normal flow level of the Missouri River is 508 ft (155 m) msl.

The area between the plateau and the Missouri River floodplain is highly dissected. Mud Creek, Logan Creek and Auxvasse Creek, with their intermittent stream branches, have incised deeply into the southern, east and northeast, and western and northern flanks of the plateau, respectively. Stream gradients drop more than 200 ft (61 m) within a distance of less than 0.5 mile (0.8 km). Topographic relief is more than 150 ft to 200 ft (46 m to 61 m) between valleys and ridges, and the overall drop in elevation between the crest of the plateau and the river is about 350 ft (107 m).

Callaway Plant Unit 2 will be constructed at a grade elevation of approximately 845 ft (260 m) msl. The bearing layer over which the foundation of the plant will be placed is the Graydon Chert Conglomerate. This formation is characterized by a consolidated matrix of soils, gravels, and boulders and is 25 ft to 50 ft (8 m to 15m) thick.}

2.6.2 STRATIGRAPHY

{The sequence and character of the soil, older sediments, and lithified formations underlying the site area are shown on the composite stratigraphic column (FSAR Figure 2.5-8). This column is based on data obtained from the Callaway Plant Unit 1 FSAR (AmerenUE, 2004) and results of the foundation investigation for Callaway Plant Unit 2 FSAR, and on published literature. Sediments and rocks present on the site area range from Pre-Cambrian to Quaternary.

The top of the stratigraphic sequence are Glacial and Postglacial soil deposits of Quaternary age consisting of soils that are associated either directly or indirectly with Pleistocene glaciation. Most of the plateau area is blanketed by Modified Loess, a fairly continuous layer of mottled reddish brown and gray silty clay that varies in thickness from 4.5 ft to 22 ft (1.4 m to 7 m). The modified loess deposits are on top of a deposit of moderately plastic, gray, silty clay, known as Accretion-gley. These deposits were probably formed by streams prior to deposition of the overlying loess. The accretion-gley is slightly pre-consolidated by desiccation. At the bottom of the glacial deposits is the Glacial Till, a layer consisting of reddish brown silty clay containing some sand and gravel, which underlies the accretion-gley deposit in topographically high portions of the site area. Sand lenses in the basal portion of the till were observed and mapped during geologic mapping of the Callaway Plant Unit 1 reactor excavation. These deposits are stratified and are probably outwash stream deposits that formed in advance of Kansan glaciation of the site; these sand deposits are slightly pre-consolidated and hard. The bottom of the sediment column is the Graydon Formation, a chert conglomerate unit that applies to deposits for cherty clay, sandstone, and sandy chert conglomerate that occur unconformably in the site area between the underlying Burlington Limestone and the overlying glacial deposits. These overlying glacial deposits were observed to vary in thickness from 11.5 ft to 54.8 ft (3.5 m to 16.7 m).

The base of the sediments is marked by the top of the Burlington Limestone. This material is expected to be discontinuous across the site, with a maximum thickness of 19.7 ft (6 m), allowing the very thin Bushberg Formation or thicker Snyder Creek Formation to contact the overlying Graydon Chert Conglomerate. The Burlington Limestone is underlain by Bushberg Formation, a medium-to fine-grained poorly sorted sandstone, discontinuous across the site, with a maximum thickness of 7 ft (2 m).

Underlying both the Burlington and Bushberg Formations is the Snyder Creek Formation, typically a light green to yellow green calcareous shale. The upper part is characteristically a light gray to light cream highly calcareous block shale with the uppermost part of the formation, in some exposures, consisting of a dense dark reddish limestone. The lower part is yellowish brown calcareous shale with poorly defined bedding which locally contains thin lenses of light gray argillaceous limestone. The observed thickness varies from 22.4 ft to 32.2 ft (6.8 m to 9.8 m).

At the base of the Snyder Creek Formation is the Callaway Formation, a limestone dominated unit which varies in thickness from 31.3 ft to 41.2 ft (9.5 m to 12.6 m). Between the Callaway Formation and the Cotter-Jefferson Formation is a sequence of Joachim Formation and St. Peter Formation, above Paleokarst rubble. These deposits were encountered during the foundation investigation for Callaway Plant Unit 1, but were not found during the foundation investigation for Callaway Plant Unit 2. The Joachim Formation is a brown dolomite of thickness varying from 0 ft to 10 ft (0 m to 3 m); it is followed by a friable fine grained, massive to cross-bedded white sandstone of the St. Peter Formation with thickness varying from 0 ft to 100 ft (0 m to 30 m). The bottom of this discontinuous sequence is the Paleokarst rubble, consisting of dolomite, sandstone, siltstone and shale, disoriented and recemented, with thickness varying from 0 ft to 36 ft (0 m to 11 m).

The lowermost stratum drilled in Callaway Site during foundation investigations for either Callaway Plant Unit 1 or the Callaway Plant Unit 2 FSAR is the thin bedded dolomite of the Cotter-Jefferson Formation. The formation contains also small amounts of chert, shale and sandstone, with lateral gradation in lithologies, with total thickness varying from 360 ft to 465 ft (110 m to 142 m).

The Cotter-Jefferson Formation is underlain by the Roubidoux Formation that comprises sandstone, sandy dolomite, dolomite, chert, sandy chert, and cherty dolomite with thickness varying from 95 ft to 170 ft (30 m to 52 m). Well developed sandstone beds are present, but occur at different levels in different regions of the state (Thompson, 1991).

The bottom of the Ordovician sequence is the Gasconade Formation and its basal Gunter Member. The Gasconade Formation consists predominantly of light-brownish-gray to brown, medium to coarsely to finely crystalline dolomite, and cherty dolomite. Its basal member is marked by a prominent sandstone or sandy dolomite; separation is based primarily on the amount and type of chert (Thompson, 1991). The thickness varies from 225 ft to 310 ft (69 m to 94 m) in the Gasconade Formation, with its basal Gunter Member ranging from 15 ft to 30 ft (5 m to 9 m).

The Cambrian sequence that follows beneath the Ordovician layers has been drilled only in the site area and site vicinity by the MDNR Cambrian correlation program. Results of this drilling are presented by MDNR (MDNR, 2007) and the description of the corresponding formations is also found in Unklesbay (Unklesbay, 1992). This Cambrian sequence consists of, from top to bottom, the Eminence, Potosi, Derby-Doe Run, Davis, Bonneterre and Lamotte Formations. All of these formations are predominantly dolomite layers except for the Davis Formation that alternates with shale and some sandy layers, and the bottom Lamotte Formation that comprises sandstone conglomerate composed mostly of quartz and feldspar grains with a mixture of larger fragments of the glassy igneous bottom rocks. The total thickness of the Cambrian sequence ranges from a minimum of 850 ft (259 m) to a maximum of 1,620 ft (494 m).

Underlying the Cambrian formations is the basement rock, which is predominantly Granite and Rhyolite Porphyry. Due to variations among the different parts of the magma, the result was a mass of igneous rocks of varying colors, some light to dark gray, some pink to red.}

2.6.3 GEOLOGIC IMPACT EVALUATION

{Based on the Callaway site and vicinity geologic conditions described in the previous subsection, long-term adverse impacts on the geology are not anticipated as a result of construction or operation of Callaway Plant Unit 2. For example:

- Preliminary results from the drilling and geophysical investigation for either Callaway Plant Unit 1 or the Callaway Plant Unit 2 FSAR show no indication of capable faults (as discussed in FSAR Sections 2.5.1.2.4.2 and 2.5.3.2) at the Callaway Site, eliminating the possibility for a surface fault rupture as a result of construction or operation of the facility.
- Because of the complete coverage of the site with the glacial and post glacial deposits and a fairly continuous layer of silty clay and clay 7.0 ft to 68.5 ft (2 m to 21 m) thick, water percolation is strongly minimized; therefore, the geologic units underneath are subjected to very limited dissolution, indicating a possibility for not needing installation of a permanent dewatering system.
- Surface settlement (as a result of facility construction) could affect the drainage of surface water. However, should such settlement occur it will likely take place during construction and can be mitigated by re-grading the Callaway Plant Unit 2 area.
- There are no natural slopes in proximity to the facility that could be adversely impacted by: foundation excavation, loading resulting from construction of the structures, or infiltration of precipitation as a result of surface modifications.
- Any potentially negative impacts that could result from the placement of fill in the plant area will be mitigated by the earthwork design.
- Some short-term geologic impacts could occur during construction. These impacts could be a result of excavation, or temporary dewatering.
- Disposal of excavated material will likely be required onsite. Generally accepted methods will be used to mitigate the potential for erosion of this material at the

disposal site. Such methods may include the use of silt fences, seeding, and drainage control. Excavated soil surfaces exposed during construction will be protected to mitigate their erosion and control surface runoff.

- Temporary dewatering of foundation excavations could result in an impact on water levels in the water table aquifer. However, these impacts are not expected to be significant.}

2.6.4 REFERENCES

{**AmerenUE, 2003.** Final Safety Analysis Report Site Addendum (FSAR-SA), Callaway Plant Unit 1 Revision OL-13, 2003.

{**AmerenUE, 2004.** Final Safety Analysis Report (FSAR), Callaway Plant Unit 1 Revision 14, 2004, AmerenUE, 2004.

MDNR, 2007. Missouri Environmental Geology Atlas (MEGA 2007), A collection of Statewide Geographic Information System Data Layers, Missouri Department of Natural Resources, Division of Geology and Land Survey.

MDNR, 2002. Physiographic Regions of Missouri, Missouri Department of Natural Resources, Geological Survey and Resource Assessment Division 2002.

Thompson, 1991. Paleozoic Succession in Missouri, Part 2, Ordovician System, Missouri Department of Natural Resources, Division of Geology and Land Survey, Report of Investigation No. 70, 282 pp., Thomas L. Thompson, 1991.

Unklesbay, 1992. Missouri Geology: three billion years of volcanoes, seas, sediments, and erosion, Columbia: University of Missouri Press, 189 pp., A.G. Unklesbay and Jerry D. Vineyard, 1992.}

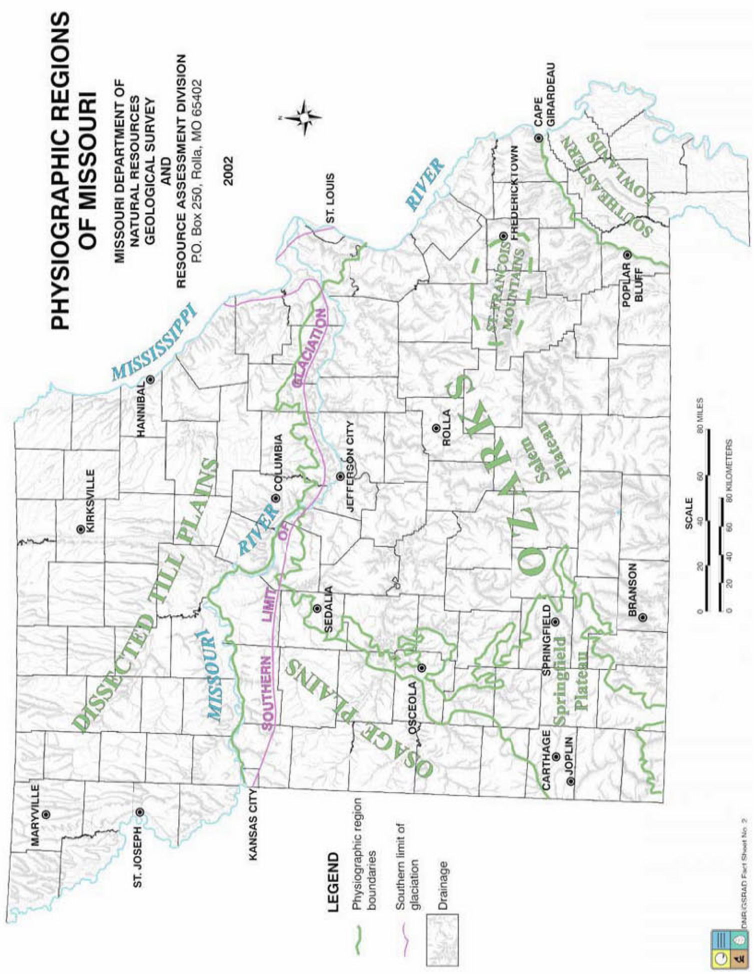

Figure 2.6-1—{Map of Regional Physiographic Provinces}