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SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT

MURFREESBORO-EAST FRANKLIN AND PINHOOK-RADNOR 161-KV TRANSMISSION LINE

Rutherford and Williamson Counties, Tennessee

TENNESSEE VALLEY AUTHORITY

DECEMBER 2007

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The Proposed Decision

Tennessee Valley Authority's (TVA) proposed action is to relieve the potential for transmission line overloading on the TVA transmission line system by building an approximately 23-mile, 161-kilovolt (kV) transmission line connection from the existing Murfreesboro Substation to the existing East Franklin Substation by May 2008. On March 30, 2007, TVA issued an environmental assessment (EA) and finding of no significant impact (FONSI) for the Murfreesboro-East Franklin and Pinhook-Radnor 161-kV Transmission Line project in Rutherford, Williamson, and Davidson counties, Tennessee (TVA 2007). Subsequently, some members of the public have raised concerns about the Murfreesboro-East Franklin 161-kV Transmission Line, and TVA received comments on the EA and FONSI when they were made available to the public. This supplemental EA addresses these concerns by providing additional information on the selection of the route for the Murfreesboro-East Franklin line, on the potential alternative of building an underground line, and post-construction impacts including electric and magnetic fields (EMF), lightning strikes, and transmission structure stability.

Need

Reliability is a concern in providing adequate electric service to the area. TVA's transmission system studies identified several different contingencies, or unexpected event scenarios, which each predict that seven separate 161-kV transmission lines in the Middle Tennessee power service area in Rutherford and Williamson counties are likely to overload by 2008 (TVA 2007). In addition to the overload concerns, a loss of one of the lines now serving the Murfreesboro Substation during certain contingency situations would result in a voltage collapse in Murfreesboro and the Middle Tennessee area (TVA 2007).

To increase the reliability of the TVA transmission line system in the Middle Tennessee power service area, TVA proposed the construction of approximately 23 miles of new 161-kV transmission line from the existing Murfreesboro Substation to the existing East Franklin Substation. This transmission line would provide a third strong power source into the Murfreesboro area and would provide voltage support for the Murfreesboro power service area that would prevent overloading of the transmission lines based on the contingency situations identified in the TVA transmission system studies.

Background

TVA 2007 described the proposed Murfreesboro-East Franklin 161-kV Transmission Line. Most of this new transmission line would be on transmission line right-of-way owned by TVA, where the existing transmission line infrastructure would be removed and replaced. About 1.75 miles of new right-of-way would be required to avoid environmentally sensitive areas on the existing right-of-way. The new transmission line would tie to the existing transmission system near the Cason Lane Substation before continuing west to the Triune Substation and finally to the East Franklin Substation. The transmission line would be constructed as two circuits on a single set of structures located on mostly existing TVA 100-foot-wide right-of-way. The two circuits would be tied together electrically to allow a higher electric capacity.

Supplemental Evaluations

Alternative Line Routes

During the project scoping to identify potential transmission line routes that could serve the Murfreesboro area, TVA identified an existing TVA-owned transmission line right-of-way between Murfreesboro and East Franklin that could meet the project needs.

TVA purchased this 100-foot-wide right-of-way from Tennessee Electric Power Company in the 1930s. This line was operated as a 46-kV transmission line until 1985, when the line was removed from service after the Triune Substation went from 69-kV operation to 161-kV operation. In 1999, TVA obtained additional easement rights for this right-of-way to support its use for a possible future higher voltage transmission line connection to the Murfreesboro Substation. At that time, residential subdivisions had been developed immediately adjacent to part of the existing right-of-way. Avoiding these residential areas would have required the acquisition by TVA of 1 to 2 miles of new right-of-way on landowners not crossed by the existing right-of-way. Using the existing right-of-way compared to acquiring new right-of-way elsewhere minimizes the number of new landowners that would be affected by the construction of the transmission line in the project area, minimizes the number of miles of new transmission line needed, and reduces the potential for environmental impacts. Because no significant conflicts with either safety or natural and cultural resources were identified in the areas adjacent to the subdivisions that would require the removal of any buildings or the implementation of a nonstandard transmission line design, no alternate routes were developed.

Underground Transmission Line

Underground transmission lines are quite common at distribution voltage levels of 13-kV to 46-kV normally seen along streets or in subdivisions. However, building underground transmission lines at the higher voltage level of 161-kV introduces several considerations. The major considerations are described below.

The conductor of choice would be a cross-linked polyethylene (XLPE), direct bury cable, which does not use a dielectric fluid for cooling. The cost of an underground 161-kV transmission line using XLPE cable would be more than 10 times that of a typical overhead 161-kV line. The increased cost is due primarily to the additional cost associated with trenching and/or directional boring to bury the cables, the cost of electrical cables, conduit, backfilling materials, manholes, risers, and redundant cables to guard against cable failure.

The environmental impacts associated with underground transmission lines could be greater than those for a comparable overhead line. To bury a typical 161-kV transmission circuit, a trench at least 48 inches wide and 60 inches deep would have to be dug. Digging such a large trench could have much greater impacts than a similar overhead line, depending on the length of underground line and whether it crosses streams, wetlands, and forested areas. In addition, given two equal voltage transmission lines, the electric and magnetic fields (EMF) associated with an underground transmission line is higher because of the closer proximity to the buried conductors—approximately 60 inches deep. In the Middle Tennessee area, the presence of extensive limestone outcrops and thin soil layers would also result in the need for extensive drilling or blasting to excavate the trench, further increasing the cost disadvantage of underground construction and increasing community disturbance and potential for environmental impacts over that associated with overhead construction.

Right-of-way requirements for underground and overhead transmission lines of the same voltage would be very similar. The major difference would be that additional restrictions would be necessary on use of the land area by the property owner in the vicinity of the buried underground cables. Furthermore, should a cable become damaged, it would require that the area be dug up again to replace the cable. This could result in extended power outages and additional environmental impacts.

Based on these facts, TVA does not propose underground transmission lines because the technology does not represent any significant reduction in land use or environmental impacts, and the costs would be substantially greater to build and maintain these lines.

<u>Electric and Magnetic Fields</u>

For the planning of new transmission line rights-of-way, TVA's transmission line route selection team uses a constraint model that places a 300-foot-radius buffer around occupied buildings, except schools, for which a 1,200-foot buffer is used. The purpose of these buffers is to reduce potential land use conflicts with yard trees, outbuildings, and ancillary facilities, reduce potential visual impacts, and reduce exposure to the magnetic field produced by the transmission line. Application of these constraints typically require trade offs and balancing, and TVA can and does deviate from the constraints. These constraints are not applied to the use of existing transmission line rights-of-way. Property owners are free to build houses and other structures up to the edge of TVA's rights-of-way within these constraint distances. This is what has occurred along the Murfreesboro-East Franklin line.

Transmission lines, like all other types of electrical wiring, generate both electric and magnetic fields (EMF). The voltage on the conductors of the transmission line generates an electric field that occupies the space between the conductors and other conducting objects, such as the ground, transmission line structures, or vegetation. A magnetic field is generated by the current (movement of electrons) in the conductors. The strength of the field depends on the current, design of the line, and distance from the line.

The fields from a transmission line are reduced by mutual interference of the electrons that flow around and along the conductors and between the conductors; the result is dissipation of the already low energy. Most of this energy is dissipated on the right-of-way, and the residual very low amount is reduced to background levels near the right-of-way or energized equipment.

Magnetic fields can induce currents in conducting objects. Electric fields can create static charges in ungrounded, conducting materials. The strength of the induced current or charge under a transmission line varies with (1) the strength of the electric or magnetic field, (2) the size and shape of the conducting object, and (3) whether the conducting object is grounded. Induced currents and charges can cause shocks under certain conditions by making contact with objects in an electric or magnetic field.

The proposed transmission line, like other transmission lines, has been designed to minimize the potential for such shocks. This is done, in part, by maintaining sufficient clearance between the conductors and objects on the ground. Stationary conducting objects, such as metal fences, pipelines, and highway guard rails, that are near enough to the transmission line to develop a charge (for 161-kV this would typically be objects located within the right-of-way) would be grounded by TVA to prevent them from being a source of shocks.

Under certain weather conditions, high-voltage transmission lines, such as the proposed 161-kV line, may produce an audible low-volume hissing or crackling noise. This noise is generated by the corona resulting from the dissipation of energy and heat as high voltage is applied to a small area. Under normal conditions, corona-generated noise is not audible. The noise may be audible under some wet conditions, and the resulting noise level off the right-of-way would be well below the levels that can produce interference with speech. Corona is not associated with any adverse health effects in humans or livestock.

Other public interests and concerns have included potential interference with AM radio reception, television reception, satellite television, and implanted medical devices. If interference occurs with radio or television reception, it would be due to unusual failures of power line insulators or poor alignment of the radio or television antenna and the signal source. Both conditions are correctable and would be repaired if reported to TVA.

Implanted medical devices historically had a potential for power equipment strong-field interference when they came within the influence of low-frequency, high-energy workplace exposure. However, the older devices and designs (i.e., more than five to 10 years old) have been replaced with different designs and different shielding that eliminate the potential for interference from external field sources up to and including the most powerful magnetic resonance imaging medical scanners. Unlike high-energy radio frequency devices that can still interfere with implanted medical devices, low-frequency and low-energy powered electric or magnetic devices no longer potentially interfere (Journal of the American Medical Association 2007).

Research has been done on the effects of EMF on animal and plant behavior, growth, breeding, development, reproduction, and production. This research has been conducted in the laboratory and under environmental conditions, and no adverse effects on health or the above considerations have been reported for the low-energy power frequency fields (World Health Organization [WHO] 2007a). Effects associated with ungrounded, metallic objects and static charge accumulation and discharge in dairy facilities have been found when the connections from a distribution line meter have not been properly installed on the farm side of a distribution circuit.

There is some public concern as to the potential for adverse health effects that may be related to long-term exposure to EMF. A few studies of this topic have raised questions about cancer and reproductive effects on the basis of biological responses observed in cells or in animals or on associations between surrogate measures of power line fields and certain types of cancer. Research has been ongoing for several decades.

The consensus of scientific panels reviewing this research is that the evidence does not support a cause-and-effect relationship between EMF and any adverse health outcomes (e.g., American Medical Association [AMA] 1994; National Research Council 1997; National Institute of Environmental Health Sciences [NIEHS] 2002). Some research continues of the statistical association between magnetic field exposure and a rare form of childhood leukemia known as acute lymphocytic leukemia. A recent review of this topic by the WHO (International Association for Research on Cancer 2002) concluded that this association is very weak, and there is inadequate evidence to support any other type of excess cancer risk associated with exposure to EMF.

TVA follows medical and health research related to EMF, along with media coverage and reports that may not have been peer reviewed by scientists or medical personnel. No controlled laboratory research has demonstrated a cause-and-effect relationship between low-frequency electric or magnetic fields and health effects or adverse health effects even when using field strengths many times higher than those generated by power transmission lines. Statistical studies of overall populations and increased use of low-frequency electric power have found no associations (WHO 2007b).

Neither medical specialists nor physicists have been able to form a testable concept of how these low-frequency, low-energy power fields could cause health effects in the human body where natural processes produce much higher fields. To date, there is no agreement in the scientific or medical research communities as to what, if any, electric or magnetic field parameters might be associated with a potential health effect in a human or animal. There are no scientifically or medically defined safe or unsafe field strengths for low-frequency, low-energy power substation or line fields.

The current and continuing position of the scientific and medical communities regarding the research and any potential for health effects from low-frequency power equipment or line fields is that there are no reproducible or conclusive data demonstrating an effect or an adverse health effect from such fields (WHO 2007c). In the United States, national organizations of scientists and medical personnel have recommended no further research on the potential for adverse health effects from such fields (AMA 1994; U.S. Department of Energy 1996; NIEHS 1998).

Although no federal standards exist for maximum EMF strengths for transmission lines, two states (New York and Florida) do have such regulations. Florida's regulation is the more restrictive of the two with field levels being limited to 150 milligauss (mG) at the edge of the right-of-way for lines of 230-kV and less. The expected magnetic field strength at the edge of the right-of-way here falls well within these standards.

TVA has conducted additional analysis for houses that are closer than 300 feet. This additional analysis shows that magnetic fields are well within available guidelines at the edge of the transmission line right-of-way. TVA's calculations show that the magnetic field at the edge of the right-of-way, for the highest possible line loading, would be about 22.8 mG. This level assumes that other transmission lines in the area are out of service, which would result in this transmission line carrying the maximum load of current possible. The calculated field level at normal operation during peak loading that is projected for 2009 is about 17.5 mG. These calculated field levels are about 15 and 12 percent, respectively, of the Florida limit. In light of all of the above, the construction and operation of the proposed transmission line is not anticipated to cause any significant EMF-related impacts.

Lightning Strike Hazard

TVA transmission lines are built with overhead ground wires that lead a lightning strike into the ground for dissipation. Thus, a safety zone is created under the ground wires at the top of structures and along the line for at least the width of the right-of-way. The National Electrical Safety Code is strictly followed when installing, repairing, or upgrading TVA lines or equipment. Transmission line structures are well grounded, and the conductors are insulated from the structure. Therefore, touching a structure supporting a 161-kV transmission line poses no inherent shock hazard.

Transmission Structure Stability

The structures that would be used on the proposed transmission line have demonstrated a good safety record. Unlike lattice-type structures, they are difficult to climb without special equipment. They are not prone to rot or crack like wooden poles, nor are they subject to substantial storm damage due to their low cross-section in the wind. Thus, the proposed structures do not pose any significant physical danger. For this reason, TVA does not typically construct barricades or fences around structures.

Noise and Odor

During construction of the proposed transmission line, equipment would generate noise above ambient levels. Because of the short construction period, noise-related effects are expected to be temporary and insignificant. In the more densely populated areas along the right-of-way, construction techniques would be used to limit noise as much as possible. For similar reasons, noise related to periodic line maintenance is also expected to be insignificant. In residential areas, the need for periodic right-of-way vegetation maintenance, i.e., mowing, would be limited or nonexistent. Construction and operation of the line is not expected to produce any noticeable odors.

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