SEQUOYAH NUCLEAR PLANT

LICENSE RENEWAL FACTS

The U.S. Nuclear Regulatory Commission has received an application from Tennessee Valley Authority to renew the operating licenses for the Sequoyah Nuclear Plant, Units 1 and 2.[1] The Sequoyah Nuclear Plants are pressurized-water reactors designed by Westinghouse, and are located in Soddy-Daisy, Tennessee, 18 miles north of Chattanooga, on the banks of Chickamauga Reservoir. Sequoyahôs two nuclear generating units have a net generating capability of 2,282 megawatts-electric. Approval of the licenses by the NRC would authorize TVA to operate each unit for an additional twenty-year period beyond the ending date of the current licenses which expire on September 17, 2020 for Unit 1 (DPRï 77) and September 15, 2021 for Unit 2 (DPRï 79). Sequoyah is one of the oldest nuclear plants operated by TVA; construction began in 1969 and was not completed until 1980.

Based on the age of the plant and critical safety factorsð flooding, earthquake and plant designð we are convinced that Sequoyahôs license should not be extended.

Flood Risk

TVAôs Sequoyah is at risk from flooding which could result from the failure of upstream dams. The consequences of such an event on the plant would be severe. Recently, NRC issued six citations to TVA and placed the plant under its ñyellowò safety flag, its second-highest level. A U.S. Nuclear Regulatory Commission Inspection Report issued March 12 states:

> The inspection examined activities conducted under your license as they relate to safety and compliance with the Commissionôs rules and regulations and with the conditions of your license. The inspectors reviewed selected procedures and records, observed activities, and interviewed personnel. The enclosed inspection report discusses one finding with two Apparent Violations (AVs) associated with the site flood mitigation strategy.[2]

In 2012 the Nuclear Regulatory Commission issued an immediately effective order indicating that, as a result of the lessons learned from the March 2011 accident at Fukushima Dai-ichi, certain actions were required by nuclear power plant licensees.[3] The order required new measures to reduce uncertainties resulting from ñbeyond-design-basis events.ò The NRC determined that all power reactor licensees and construction permit holders must ñdevelop,

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[1] The application, dated January 7, 2013, from Tennessee Valley Authority was filed pursuant to Section 103 of the Atomic Energy Act of 1954 and part 54 of Title 10 of the Code of Federal Regulations.

[2] Letter from NRC to TVA Re: Sequoyah Nuclear Plant - NRC Inspection Report 05000327/2013009, 05000328/2013009; Preliminary Yellow Finding, and Apparent Violations, March 12, 2013

[3] Order Number EA-12-049 ñOrder Modifying Licenses with Regard to Requirements for Mitigation Strategies For Beyond-Design-Basis External Eventsò to ñAll Power Reactor Licensees and Holders of Construction Permits in Active or Deferred Status,ò March 12, 2012

implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and SFP [spent fuel pool] cooling capabilities following a beyond-design-basis external event.ò TVAôs updated calculations showed flooding at Sequoyah could rise 2.4 feet higher than that plant was designed to handle. Earlier assumptions were based on decades-old data which underestimated the potential severity of flooding. But TVAôs remedy, sand and gravel baskets placed on upstream riverbanks, are stopgaps. More substantial measures for TVAôs nuclear fleet would cost tens of millions of dollars, and flood-proof modifications could top a billion dollars.

The Fukushima meltdown was caused by a flood of water, a tsunami, which disabled the emergency diesel backup generators necessary to keep the reactors from overheating when electric power failed. TVA has not implemented necessary precautions to prevent similar disaster in the Tennessee Valley. The NRCôs spokesman agreed: ñOur inspectors found that their [TVA's] strategies were not adequate.ò[4]

Earthquake Risk

The Eastern Tennessee Seismic Zone, which extends from southwest Virginia to northeast Alabama, is considered to be one of the most active seismic areas east of the Rocky Mountains. It has the potential to produce large magnitude earthquakes. Recent large earthquakes include a magnitude 4.6 that occurred in 1973 near Knoxville and the Fort Payne Earthquake, also a magnitude 4.6, that occurred in 2003 near Scottsboro, Alabama.

Nuclear Regulatory Commission Regulatory Guide 1.208, ñA Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion,ò states that:

> While the most recent characterization of any seismic source accepted by the U.S. Nuclear Regulatory Commission (NRC) staff can be used as a starting point for analysis of a new facility, any new information related to a seismic source that impacts the hazard calculations must be evaluated and incorporated into the probabilistic seismic hazard analysis (PSHA) as appropriate based on the technical information available.

Eastern Tennessee Seismic Zone models from the 1986 Electric Power Research Institute Seismicity Owners Group report may not adequately characterize the potential for large earthquakes. This concern arises from the low probabilities for larger earthquakes from the seismic sources assigned by the EPRI/SOG expert teams in the mid-1980s.[5]

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[4] ñTVA cited for flood prevention violations,ò *Chattanooga Times-Free Press*, March 19, 2013, http://www.timesfreepress.com/news/2013/mar/19/tva-cited-for-flood-prevention-violations/

[5] *Seismic Hazard Methodology for the Central and Eastern United States, Volumes 1-3, Revision 1*, Electric Power Research Institute, NP-4726-V1P1, July 1, 1986, http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?productId=NP-4726-V1P1

The Eastern Tennessee Seismic Zone is laced with ancient faults that developed as the Appalachian Mountains formed several hundred million years ago. However, faults which are mapped at the surface are poorly located at earthquake depths. This leads to uncertainty. Because few earthquakes in the Eastern Tennessee Seismic Zone can be linked to known faults, it is difficult to predict if and when a specific fault could slip and cause an earthquake. Nevertheless, if a fault lies under the Valley and Ridge region of Southern Appalachia, the possibility of an earthquake with a magnitude of 5.0 and higher is possible. An earthquake with a magnitude of 5.0 would cause serious damage to the Sequoyah nuclear plant.

Unsafe Plant Design

The containment buildings of nuclear reactors must do two things without fail: contain radioactive emissions during an accident and prevent intrusion from outside forces such as wind driven objects and man-made missiles. Sequoyahôs nuclear reactors utilize ñice condenserò containment structures. Ice condenser nuclear reactors utilize baskets of ice to reduce heat and pressure in the event of an accident, preventing damage to the containment and leaks of radioactive steam. Typical nuclear power plants have concrete containment several feet thick, but ice condenser reactors substitute a steel shell of smaller volume and less ability to withstand pressure. Ice condenser reactors economize on concrete and are less robust because of this construction method.

Sandia National Laboratories evaluated the reactor containment structures similar to those at Sequoyah Units 1 and 2 and found that if an accident involving hydrogen ignition occurs, a common characteristic of nuclear emergencies, the concrete containment will almost certainly fail. In fact, ice condenser plants are at least one hundred times more vulnerable to early containment failure than other commercial pressurized water reactors in the US.[6] And ice condenser reactors are vulnerable to other problems. Dr. Edwin Lyman, now at the Union of Concerned Scientists, wrote:

> However, even if the ice condensers do work as they are supposed to (which in itself is a questionable proposition), containment failure can still occur as a result of the combustion of hydrogen gas, which would be generated in large quantities during severe accidents when the metal cladding on fuel rods reacts with coolant water. During the Three Mile Island 2 (TMI-2) accident in 1979, a large amount of hydrogen was released to the containment and burned, although the pressure increase did not lead to rupture of TMI-2's large dry containment. The ice condensers not only cannot reduce the risk of hydrogen combustion but also can actually increase it, because they divide the containment volume into small compartments where hydrogen gas can more readily reach explosive concentrations.[7]

Dr. Lyman points out that the typical failure pressure for ice condenser containments is about 63 pounds per square inch. Pressure from hydrogen combustion in a nuclear reactor can reach 110

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[6] NUREG/CR-6427, Assessment of the Direct Containment Heating Issue for Plants With Ice Condenser Containments, April 2000

[7] ñPlutonium Fuel and Ice Condenser Reactors: A Dangerous Combination,ò Edwin S. Lyman, PhD, October 19, 2000, http://www.nci.org/e/el-ice-condensers.htm

pounds per square inch. He concludes, ñTherefore, hydrogen burns can easily over-pressurize and rupture ice condenser containments.ö[8]

Sequoyahôs nuclear reactors are under consideration for plutonium fuel. In the early days of the US Department of Energyôs Surplus Plutonium Disposition Program, DOE contracted with two electric utilities to use plutonium fuel in their power plants: Duke Energy and Virginia Power. But both withdrew their reactors from the program. Now TVA appears to have stepped into the breach. In the 2012 Surplus Plutonium Disposition Supplemental Environmental Impact Statement,[9] the DOE posits the use of Sequoyah and Browns Ferry for the experimental fuel. However, there are critical differences between plutonium fuel and conventional uranium fuel which should disqualify these TVA reactors.

The critical problem is that plutonium is fundamentally different from uranium. With plutonium fuel loaded into any commercial reactor, the power station becomes more dangerous because plutonium releases energy in a different way than uranium. Plutonium has a higher neutron flux, meaning higher energy particles at higher speeds. This and other nuclear phenomena break down metal reactor parts quicker; a process called embrittlement. This weakening of metal components would be accelerated in any reactor using plutonium fuel. Greater embrittlement means the reactor vessel may fail under circumstances which would otherwise not cause a problem. If and when failure happens and radioactive materials are released from the plant, more dangerous radionuclides are released from a reactor containing plutonium fuel, including greater quantities of radioactive elements which pose hazards to human health. Embrittlement is a safety issue which must be addressed before license renewal at the aging Sequoyah plant.

The failure of Sequoyahôs ice condenser reactor containment brought about by the use of plutonium fuel would result in devastating consequences to public health. In its review of the program, the NRCôs own reactor safety committee stated:

> Public attention has been drawn to the higher actinide inventories available for release from MOX than from conventional fuels. <u>Significant releases of actinides during reactor accidents would dominate the accident consequences.</u> Models of actinide release now available to the NRC staff indicate very small releases of actinides from conventional fuels under severe accident conditions. (emphasis added) [10]

No matter the utility or type of reactor, plutonium fuel has greater quantities of plutonium and other hazardous radioactive isotopes such as Americium 241 and Curium 242ð actinide elementsð which would cause additional harmful radiation exposure to the public.

L. Zeller 3/28/13

Photo credits: 1) Sequoyahï Dan Henry/Chattanooga Times Free Press, 2) Fukushimaï Wikimedia[11]

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[8] *ibid*

[9] Federal Register Volume 77, Number 145, Pages 44222-44224, July 27, 2012

[10] Letter from Advisory Committee on Reactor Safeguards to US Nuclear Regulatory Commission Chairman, May 17, 1999

[11] http://upload.wikimedia.org/wikipedia/commons/1/16/Fukushima_I_by_Digital_Globe_crop.jpg