

June 12, 2017

**UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION**

BEFORE THE SECRETARY

In the Matter of)
)
Tennessee Valley Authority) Docket No. 52-047-ESP
)
(Clinch River Nuclear Site))
_____)

PETITION TO INTERVENE AND REQUEST FOR HEARING

I. INTRODUCTION

Pursuant to 10 C.F.R. § 2.309 and the hearing notice published by the Nuclear Regulatory Commission (“NRC” or “Commission”) at 82 Fed. Reg. 16,436 (Apr. 4, 2017), Petitioners Southern Alliance for Clean Energy (“SACE”) and Tennessee Environmental Council (“TEC”) hereby request a hearing and petition to intervene in this proceeding regarding Tennessee Valley Authority’s (“TVA’s”) application for an Early Site Permit (“ESP”) that would allow TVA to bank the Clinch River Nuclear Site as a potential site for construction and operation of a small modular reactor (“SMR”).

Petitioners’ standing to intervene is described in Section II below. In Section III, Petitioners set forth their contentions. In summary, the contentions assert as follows:

- Contention 1 challenges TVA’s application for an exemption from NRC’s emergency planning requirements with respect to the establishment of a ten-mile emergency planning zone (“EPZ”). As demonstrated in the contention, TVA has failed to justify its proposal to reduce the size of the EPZ to the site boundary, or in the alternative a two-

mile radius. Contention 1 is supported by the expert declaration of Dr. Edwin S. Lyman, Senior Staff Scientist with the Union of Concerned Scientists (Attachment 1).

- Contention 2 challenges TVA’s failure to address the environmental impacts of accidents involving ignition of spent fuel in the spent fuel storage pool(s) at the proposed SMR.

There is no question that the consequences of such accidents could be catastrophic, but TVA has failed to show or even assert that the likelihood of such an accident is remote and speculative. Therefore, the Environmental Report violates NEPA by failing to address the environmental impacts of a spent fuel storage pool fire.

- Contention 3 asserts that the Environmental Report is biased and unfair, because it advocates the technical advantages of SMRs as an energy alternative, even though TVA formally elected not to address energy alternatives or the need for power in the Environmental Report for the ESP. Contention 3 is supported by the expert declaration of Dr. M.V. Ramana, Professor and the Simons Chair in Disarmament, Global and Human Security at the Liu Institute for Global Issues, University of British Columbia, Vancouver, Canada (Attachment 2).

II. DESCRIPTION OF PETITIONERS AND THEIR STANDING TO INTERVENE

A. Description of Petitioners

Petitioners are civic and environmental groups located in the area of the Clinch River Nuclear Site. SACE is a nonprofit, nonpartisan membership organization that promotes responsible energy choices that solve global warming problems and ensure clean, safe and healthy communities throughout the Southeast. SACE has staff and members throughout the Southeast, including offices in Knoxville, Tennessee; Asheville, North Carolina; and Atlanta and Savannah, Georgia.

TEC is a nonprofit organization that seeks to educate and advocate for the conservation and improvement of Tennessee's environment, public health and communities. TEC works to protect and conserve Tennessee's communities, public health, and the natural resources on which they depend. TEC currently has about 1,000 members.

B. Standing to Intervene

Pursuant to 10 C.F.R. § 2.309(f), a request for a hearing must address: (1) the nature of the petitioner's right under the Atomic Energy Act ("AEA") to be made a party to the proceeding, (2) the nature and extent of the petitioner's property, financial, or other interest in the proceeding, and (3) the possible effect of any order that may be entered in the proceeding on the petitioner's interest. The Atomic Safety and Licensing Board ("ASLB") summarized these standing requirements as follows:

In determining whether a petitioner has sufficient interest to intervene in a proceeding, the Commission has traditionally applied judicial concepts of standing. Contemporaneous judicial standards for standing require a petitioner to demonstrate that (1) it has suffered or will suffer a distinct and palpable harm that constitutes injury-in-fact within the zone of interest arguably protected by the governing statutes (*e.g.*, the Atomic Energy Act of 1954 and the National Environmental Policy Act of 1969); (2) the injury can fairly be traced to the challenged actions; and (3) the injury is likely to be redressed by a favorable decision. An organization that wishes to intervene in a proceeding may do so either in its own right by demonstrating harm to its organizational interests, or in a representational capacity by demonstrating harm to its members. To intervene in a representational capacity, an organization must show not only that at least one of its members would fulfill the standing requirements, but also that he or she has authorized the organization to represent his or her interests.

Pacific Gas & Electric Co. (Diablo Canyon Power Plant Independent Spent Fuel Storage Installation), LBP-02-23, 56 NRC 413, 426 (2002).

Petitioners' standing to participate in this proceeding is demonstrated by the declarations of the following members of the Petitioner organizations, who have authorized Petitioners to represent their interests in this proceeding.

Louis Gorenflo, SACE member (Attachment 3)
Jennifer Stachowski, SACE member (Attachment 4)
Ralph Hutchison, SACE member (Attachment 5)
Daniel Stephenson, SACE and TEC member (Attachment 6)
Ralph Hutchison, TEC member (Attachment 7)
Adam Hughes, TEC member (Attachment 8)
James Fall, Chief Financial Officer in SACE Knoxville office (Attachment 9)
Stephen A. Smith, SACE member and Executive Director (Attachment 10)

The attached declarations demonstrate that Petitioners' members live near the site of Clinch River site, *i.e.*, within 50 miles, and would be adversely affected by an accident at the proposed SMR. SACE's Knoxville office is also located within 50 miles of the site, and therefore SACE's employees would be adversely affected by an accident at the proposed SMR. As discussed in Contention 2 below, a fire in a spent fuel pool could displace as many as 4 million people out to 500 miles. In addition, Petitioners have presumptive standing by virtue of their location within 50 miles of a nuclear plant that may be operated on the site. *Diablo Canyon*, 56 NRC at 426-27 (citing *Florida Power & Light Co.* (Turkey Point Nuclear Generating Plant, Units 3 and 4), LBP-01-06, 53 NRC 138, 146, *aff'd*, CLI-01-17, 54 NRC 3 (2001)).

By intervening in this proceeding, Petitioners seek to protect their members' and SACE's employees' health, safety and lives, as well as the health and safety of the general public and the environment by opposing the issuance of an ESP to TVA for the Clinch River site. Petitioners seek to ensure that no ESP is issued by the NRC unless TVA demonstrates full compliance with federal laws for protection of public health and safety and the environment.

III. CONTENTIONS

Contention 1: Inadequate Emergency Plan

1. Statement of the Contention: The Emergency Plan in the ESP application for the Clinch River SMR is inadequate to satisfy 10 C.F.R. §52.17(b)(2) because the size of the proposed plume exposure Emergency Planning Zone (“EPZ”) is less than the minimum ten-mile radius required by 10 C.F.R. §50.47(c)(2) for most nuclear power reactors. While TVA claims to qualify for an exemption from 10 C.F.R. §50.47(c)(2) “due to the decreased potential consequences associated with such a facility” (ESP Application, Part 6 at 1), TVA has not demonstrated that it satisfies the NRC Staff’s criterion for such an exemption with respect to the potential for a spent fuel storage pool fire. As provided in an NRC guidance document that has been consistently applied to exemption applications, the Staff will not approve an exemption to offsite emergency planning requirements unless the applicant can demonstrate that the time between uncovering of spent fuel and initiation of a zirconium fire in the spent fuel storage pool is ten hours or more. Preliminary Draft, Regulatory Improvements for Power Reactors Transitioning to Decommissioning at A-1 (RIN # 3150-AJ59, NRC Docket # NRC-2015-0070, 2015) (“Draft Guidance for Decommissioning Reactors”) (NRC ADAMS Accession No. ML16309A332).¹

Therefore, for consistency with this principle, in order for TVA to qualify for an exemption from the ten-mile EPZ, TVA should have to demonstrate for the spent fuel storage pool(s) to be located at the proposed site that in the event of a loss of cooling and adiabatic

¹ In reliance on the Draft Guidance for Decommissioning Reactors, the NRC has issued exemptions from emergency planning requirements for numerous reactors, including Kewaunee, Crystal River, San Onofre, and Vermont Yankee. *See* Memorandum from Stephen S. Koenick to William M. Dean re: Transition to Decommissioning Lessons Learned Report (Oct. 28, 2016) (ADAMS Accession No. ML16176A339).

heating conditions (*i.e.*, conditions in which a range of factors may prevent heat from leaving individual fuel assemblies or spent fuel racks), at least ten hours would elapse before a zirconium fire would be initiated. Such an analysis would depend on fuel design features, as well as operational factors that are not specified in the ESP application. If this information is not available or not sufficiently well-defined to enable a technically sound analysis that could plausibly demonstrate the condition is met with adequate margin, TVA's exemption request should be rejected without prejudice and TVA should be advised to re-submit it at the COL stage.

2. Brief Summary of Basis for the Contention: While detailed emergency plans are not required for ESP applications, NRC regulation 10 C.F.R. § 52.17(b)(2) provides ESP applicants with the option to submit emergency plans for approval by the NRC. As part of its ESP, TVA has submitted two alternative emergency plans – one with an EPZ that conforms to the site boundary (Part 5A of the ESP application) and the other with a two-mile EPZ (Part B of the ESP application). Part 6 of TVA's ESP application consists of a request for an exemption from the ten-mile EPZ requirement in 10 C.F.R. §§ 50.33(g), 50.47(b), and 50.47(c)(2).

As demonstrated in Draft Guidance for Decommissioning Reactors, the NRC considers pool fires to constitute contributors to the accident risk that must be protected against through the emergency planning process. *Id.* at A-1. In Part 6, entitled "Exemptions and Departures," TVA asserts that an EPZ extending beyond the site boundary (or, alternatively, a two-mile radius) is not necessary to achieve the purpose of NRC's emergency planning regulations because "there are no offsite consequences from any credible event in excess of the [U.S. Environmental Protection Agency Protective Action Guidelines]." *Id.*, Table 1-1. But TVA completely fails to

discuss any SMR design features that would decrease the potential for spent fuel pool fires to result in significant off-site radiological releases.

The Draft Guidance for Decommissioning Reactors advocates the allowance of relaxation of the ten-mile EPZ requirement for decommissioning reactors on the ground that after a reactor has shut down and spent fuel has cooled for a period of years, the time between uncovering of spent fuel and ignition of spent fuel zirconium cladding (assumed to occur when the cladding temperature reaches 900°C) in a spent fuel storage pool increases to at least ten hours. *Id.* This guidance is based in turn on NUREG-1738, Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants (2001) (ADAMS Accession No. ML13251A342). For operating plants, the NRC has demonstrated that cladding temperatures can reach 900°C (1173 K) in less than 10 hours for certain accident scenarios. NUREG-2161, Consequence Study of a Beyond-Design-Basis Earthquake Affecting the Spent Fuel Pool for a US Mark I Boiling Water Reactor at 132-33 (2014) (ADAMS Accession No. ML13297070) (“Consequence Study”).

In the case of an operating SMR or other type of reactor, recently discharged hot spent fuel is loaded periodically into the spent fuel pool. In the case of multiple modules that share one spent fuel pool, like the NuScale SMR design, this could happen as often as every two months or even more frequently, depending on the number of modules and the fuel management strategy. As a result, the time between uncovering of spent fuel and ignition could be significantly less than ten hours.

It is well established that significant radiological consequences of a pool fire could extend beyond the site boundary, and for that matter well beyond a ten-mile EPZ. Consequence Study at 169 (reporting that 4 million people could be displaced out to 500 miles). In the NRC’s License Renewal Generic Environmental Impact Statement, the NRC also concluded that the

environmental impacts of a pool fire are “comparable to those from the reactor accidents at full power.” NUREG-1437, Generic Environmental Impact Statement for License Renewal of Nuclear Plants at 1-28 (2013). The potential for reactor accidents to have significant adverse public health effects within at least a ten-mile radius -- including early and latent fatalities -- is discussed in NRC’s emergency planning guidance documents. *See* NUREG-0396, Planning Basis for the Development of State and Local Government Radiological Emergency Response Plans in Support of Light Water Nuclear Power Plants (1978) and NUREG-0654/FEMA-REP-1, Rev. 1, Criteria for Protective Action Recommendations for Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants (1980). Thus, before an exemption from the ten-mile EPZ requirement in NRC’s emergency planning regulations may be approved, TVA should be required to demonstrate that the time between uncovering of spent fuel and ignition of spent fuel is comparable to a spent fuel pool at a decommissioning reactor, *i.e.*, greater than ten hours.

The information provided by TVA should be sufficiently detailed to allow the NRC Staff, the parties and the Atomic Safety and Licensing Board (“ASLB”) to independently verify TVA’s representations. It appears doubtful that TVA will be able to supply the NRC with that information, given that (a) TVA has not yet chosen a design for the proposed SMR, (b) only one design (NuScale) has been submitted to the NRC, and (c) even the NuScale design has not been reviewed or approved by the NRC, and is still in the early stages of review. If that is the case, the NRC should reject TVA’s exemption application without prejudice, and allow it to be re-submitted at the COL stage.

3. Demonstration that the Contention is Within the Scope of the Proceeding: This contention is within the scope of this ESP proceeding because it raises an issue of compliance with NRC safety regulations for issuance of an ESP.

4. Demonstration that the Contention is Material to the Findings NRC Must Make to issue an ESP for the proposed TVA SMR: The contention is material to the findings that NRC must make in order to issue an ESP for the proposed TVA SMR because it seeks to ensure that TVA fulfills NRC's emergency planning regulations with respect to the size of the EPZ.

5. Concise Statement of the Facts or Expert Opinion Supporting the Contention, Along With Appropriate Citations to Supporting Scientific or Factual Materials: The facts and expert opinion supporting this contention, and the citations relied on by Petitioners, are stated above. In addition, this contention is supported by the attached Declaration of Dr. Edwin S. Lyman (Attachment 1).

Contention 2: Failure to Address Consequences of Pool Fires

1. Statement of the Contention: The Environmental Report fails to satisfy NEPA because it does not address the consequences of a fire in the spent fuel storage pool, nor does it demonstrate that a pool fire is remote and speculative.

2. Brief Summary of Basis for the Contention: The consequences of spent fuel pool fires must be considered in any environmental analysis of the impacts of reactor operation, because the NRC has not ruled out their likelihood as remote and speculative. *State of New York v. NRC*, 681 F.3d 471, 483 (D.C. Cir. 2012). *See also* NUREG-1437, Generic Environmental Impact Statement for License Renewal of Nuclear Plants at 1-28 (2013) ("License Renewal GEIS") (concluding the environmental impacts of pool fires are "comparable to those from the

reactor accidents at full power.”). TVA claims that the design of the spent fuel storage pool(s) for the proposed SMR has “spent fuel pool cooling without the need for active heat removal.” Environmental Report at 9.3-2. But the Environmental Report does not state that the cooling system renders pool fires remote and speculative.

As discussed in Contention 1, it is well established that the radiological consequences of a pool fire are potentially catastrophic. For instance, radioactive fallout from a pool fire could displace as many as 4 million people out to 500 miles. Consequence Study at 169. The potential for reactor accidents to have significant adverse public health effects within at least a ten-mile radius -- including early and latent fatalities -- is also discussed in NRC’s emergency planning guidance documents. *See* NUREG-0396, NUREG-0654. In the License Renewal GEIS, the NRC also concluded that the environmental impacts of a pool fire are “comparable to those from the reactor accidents at full power.” *Id.* at 1-28 (2013).

Therefore, in the absence of a documented and supported assertion that the potential for a pool fire is remote and speculative, TVA must address the consequences of a pool fire in its Environmental Report.

3. Demonstration that the Contention is Within the Scope of the Proceeding: This contention is within the scope of this ESP proceeding because it seeks consideration of the consequences of a type of severe accident that NRC views as reasonably foreseeable and therefore must address in the EIS for the proposed ESP.

4. Demonstration that the Contention is Material to the Findings NRC Must Make to issue an ESP for the proposed TVA SMR: The contention is material to the findings that NRC must make in order to issue an ESP for the proposed TVA SMR because it relates to the

question of whether TVA has addressed all reasonably foreseeable impacts of operating an SMR in its Environmental Report, as required by NEPA. *State of New York*, 681 F.3d at 483.

5. Concise Statement of the Facts or Expert Opinion Supporting the Contention, Along With Appropriate Citations to Supporting Scientific or Factual Materials: The facts supporting this contention, and the citations relied on by Petitioners, are stated above.

Contention 3 – Impermissible Discussion of Energy Alternatives and Technical Advantages

1. Statement of Contention: The ESP application violates the National Environmental Policy Act (“NEPA”), 42 U.S.C. § 4321-4370f, and NRC implementing regulations because it contains impermissible language comparing the proposed SMR to other energy alternatives and discussing the economic and technical advantages of the facility. The language is impermissible because TVA has explicitly invoked 10 C.F.R. §51.50(b)(2), which excuses it from discussing the economic, technical, or other benefits of the proposed facility such as need for power. *See* Environmental Report, Chapter 8 (postponing need for power discussion), Environmental Report Section 9.2 (postponing energy alternatives discussion).² By formally choosing to exclude consideration of alternatives from its Environmental Report, TVA has effectively precluded Petitioners from submitting contentions on those subjects.

² *See* Environmental Report at 8-1:

Title 10 of the Code of Federal Regulations 51.50(b)(2) does not require a need for power discussion be included in an early site permit application. The need for power discussion is to be included in the combined license application.

See also Environmental Report, Section 9.2, “Energy Alternatives.” The “Energy Alternatives” section is a blank page because “[t]his section is not required for an Early Site Permit Application.” *Id.* at 9.2-1.

Under the circumstances, TVA must restrict the content of the Environmental Report to the impacts of construction and operation and a limited evaluation of alternatives related solely to the selection of the site. Any language comparing the proposed SMR to other energy alternatives, or purporting to justify the need for the SMR, should be stricken from the Environmental Report.

Furthermore, such language should not be included in the NRC's Environmental Impact Statement ("EIS") for the proposed ESP. Such an EIS would end up becoming an advertisement for SMRs rather than the rigorous, unbiased and independent scientific study required by NEPA. *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 348 (1989); *National Audubon Society v. Dep't of Navy*, 422 F.3d 174, 185 (4th Cir. 2005); 40 C.F.R. §1500.1(b).

In the alternative TVA may elect to address energy alternatives and need for power in the Environmental Report. In that case, fairness requires that Petitioners must be provided a reasonable opportunity to submit contentions on the new alternatives analysis.

2. Brief Summary of Basis for the Contention:

a. Requirements of NEPA

NEPA implements a "broad national commitment to protecting and promoting environmental quality." *Louisiana Energy Services, L.P.* (Claiborne Enrichment Center), CLI-98-3, 47 NRC 77, 87 (1998) (quoting *Robertson*, 490 U.S. at 348 and citing 42 U.S.C. § 4331). NEPA has two key purposes: to ensure that the agency "will have available, and will carefully consider, detailed information concerning significant environmental impacts" before it makes a decision; and to guarantee that "the relevant information will be made available to the larger audience that may also play a role in the decision-making process and implementation of that decision." *Robertson*, 490 U.S. at 349.

In fulfilling NEPA's first purpose of evaluating the environmental impacts of its decisions, requires a federal agency to take a "hard look" at potential environmental consequences by preparing an EIS prior to any "major Federal action[] significantly affecting the quality of the human environment." *Robertson*, 490 U.S. at 349; 42 U.S.C. § 4332(c). The "hallmarks of a 'hard look' are thorough investigation into environmental impacts and forthright acknowledgment of potential environmental harms." *National Audubon Society*, 422 F.3d at 185. In addition, the agency must "rigorously explore and objectively evaluate the projected environmental impacts of all reasonable alternatives for completing the proposed action." *Van Ee v. EPA*, 202 F.3d 296, 309 (D.C. Cir. 2000). In considering alternatives, the agency must examine the "alternative of no action." 40 C.F.R. § 1502.14.

In fulfilling NEPA's second purpose of public participation, the agency's environmental analysis must be published for public comment "to permit the public a role in the agency's decision-making process." *Robertson*, 490 U.S. at 349-50; *Hughes River Watershed Conservancy v. Glickman*, 81 F.3d 437, 443 (4th Cir. 1996). NRC's Part 51 regulations also allow interested members of the public to participate in the environmental decision-making process through the NRC's hearing process. 10 C.F.R. §51.104(a).

b. Regulatory requirements for NEPA compliance in ESP proceedings

Because an ESP approves only the banking of a site and not construction or operation of any nuclear facility, the NRC limits the scope of an EIS to issues related to the siting of the facility. As explained in the preamble to the rule, the NRC intended to focus the environmental analysis for ESP applications on issues related to site suitability, such as environmental impacts of construction and operation and alternative sites:

The environmental report and EIS for an early site permit must address the benefits associated with issuance of the early site permit (e.g., early resolution of siting issues,

early resolution of issues on the environmental impacts of construction and operation of a reactor(s) that fall within the site characteristics, and ability of potential nuclear power plant licensees to “bank” sites on which nuclear power plants could be located without obtaining a full construction permit or combined license). The benefits (and impacts) of issuing an early site permit must always be addressed in the environmental report and EIS for an early site permit, regardless of whether the early site permit applicant chooses to defer consideration of the benefits associated with the construction and operation of a nuclear power plant that may be located at the early site permit site. *This is because the “benefits * * * of the proposed action” for which the discussion may be deferred are the benefits associated with the construction and operation of a nuclear power plant that may be located at the early site permit site; the benefits which may be deferred are entirely separate from the benefits of issuing an early site permit. The proposed action of issuing an early site permit is not the same as the “proposed action” of constructing and operating a nuclear power plant for which the discussion of benefits (including need for power) may be deferred under § 51.50(b).*

Final Rule: Licenses, Certifications, and Approvals for Nuclear Power Plants, 72 Fed. Reg.

49,352, 49,430 (Aug. 28, 2007) (emphasis added). Accordingly, NRC regulation 10 C.F.R.

§51.50(b)(2) provides that an environmental report for an ESP application “need not include an assessment of the economic, technical, or other benefits (for example, need for power) and costs of the proposed action or an evaluation of alternative energy sources.” As explained in the preamble, the choice is up to the applicant:

Environmental reports must focus on the environmental effects of construction and operation of a nuclear reactor, or reactors, which have characteristics that fall within the design parameters postulated in the early site permit. Environmental reports must also include an evaluation of alternative sites to determine whether there is any obviously superior alternative to the site proposed. Environmental reports submitted in an early site permit application *are not required to but may include* an assessment of the economic, technical, and other benefits and costs of the proposed action or an analysis of other energy alternatives.

Id. at 49,434 (emphasis added). Thus, the NRC does not consider the energy alternative issue to be material to the issuance of an ESP, unless the applicant chooses to address the issue.

In a proceeding where the applicant decides not to address energy alternatives at the ESP stage, the NRC prohibits members of the public from raising contentions regarding those issues, because the NRC does not require those issues to be addressed in its ESP licensing decisions.

See, e.g., Dominion Nuclear North Anna, L.L.C. (Early Site Permit for North Anna ESP Site), LBP-04-18, 60 NRC 253, 264 (2004) (citing *Florida Power & Light Co.* (Turkey Point Nuclear Generating Plant, Units 3 and 4), LBP-01-06, 53 NRC 138, 159 (2001); *Pacific Gas & Electric Co.* (Diablo Canyon Nuclear Power Plant, Units 1 and 2), LBP-93-01, 37 NRC 5, 29-30 (2001); *Public Service Co. of New Hampshire* (Seabrook Station, Units 1 and 2), LBP-82-106, 26 NRC 1649, 1656 (1982); *Yankee Atomic Electric Co.* (Yankee Nuclear Power Station), CLI-96-7, 43 NRC 235, 251 (1996); *Arizona Public Service Co.* (Palo Verde Nuclear Generating Station, Units 1, 2, and 3), LBP-91-19, 33 NRC 397, 410, *aff'd in part and rev'd in part on other grounds*, CLI-91-12, 34 NRC 149 (1991) (holding that a contention advocating stricter requirements than agency rules impose or that otherwise seek to litigate a generic NRC determination are inadmissible)). Accordingly, with the exception of the issue of site alternatives, NRC prohibits members of the public from seeking consideration of alternatives in an Environmental Report or EIS for an ESP, including comparisons of the proposed operational technology to other technologies for production of electricity.

In hearings on NEPA issues, the NRC also requires fairness to all parties. *Hydro Resources, Inc.* (P.O. Box 15910, Rio Rancho, NM 87174), CLI-01-04, 53 NRC 31, 38 (2001). As the Commission held in *Hydro Resources, Inc.*, the NRC may not issue a license based on an EIS whose contents it has shielded from challenge in a hearing.

b. Comparison of alternatives in TVA's ESP application

In its ESP application, TVA has chosen *not* to address the issues of energy alternatives or need for the proposed SMR, and has instead postponed those issues to the Combined Operating Licensing ("COL") stage. *See* Environmental Report, Chapter 8 (postponing need for power discussion), Environmental Report Section 9.2 (postponing energy alternatives discussion).

Although the first paragraph of the “Purpose and Need” statement (Section 1.1.1) appropriately defines the purpose and need for issuance of the ESP in the limited manner prescribed by NRC regulations (*i.e.*, “to provide for resolution of site safety and environmental issues, which provides stability in the licensing process”), Chapter 1 of the Environmental Report is brimming with claims that SMR technology is preferable to other energy technology on a host of issues, including safety, security, reliability, carbon reduction, water use, and economies of scale. And in Chapter 9, TVA’s discussion of the “no action” alternative, TVA laments that all of these asserted advantages of SMRs would be lost if TVA did not receive an ESP.

For instance, TVA promotes “SMR technology” as preferable for serving federal facilities:

The SMR technology is designed with inherent enhanced safety and security features. SMR deployment will demonstrate that the technology is capable of incrementally supplying clean, secure, reliable power that is less vulnerable to disruption to facilities owned by federal agencies (e.g., U.S. Department of Energy (DOE), U.S. Department of Defense (DoD), TVA, etc.).

Environmental Report at 1-1. TVA asserts that building an SMR “near federal facilities” could provide “enhanced reliability and other benefits, by providing continued operation during a widespread and extended loss of the electrical power grid, meeting reliability needs with clean energy that supports carbon reduction directives.” *Id.* at 1-2. TVA also compares SMRs favorably to coal, to “assist federal facilities with meeting carbon reduction objectives.” *Id.* at 1-3.

To support its claims regarding the special suitability of SMRs to supply electricity to federal facilities, TVA invokes the imprimatur of DOE:

DOE expressed its support to TVA for the development and licensing of SMRs as a means to meet DOE goals of improving the environmental, economic, and energy security outlook for the United States (Reference 1-5). DOE believes that SMR deployment near federal facilities could provide enhanced reliability and other benefits,

by providing continued operation during a widespread and extended loss of the electrical power grid, meeting reliability needs with clean energy that supports carbon reduction directives. DOE specifically requested TVA to assess, as a part of the deployment project planning and licensing process, the ability of SMRs to continue to supply electricity to nearby offsite customers during a disruption to offsite power supplies. This includes electricity transmission to those customers in a manner less vulnerable to intentional destructive acts and natural phenomena that could disrupt the power supply.

Environmental Report at 1-2.

TVA also asserts that SMRs have certain benefits in relation to light water reactors (“LWRs”):

SMRs provide the benefits of nuclear-generated power in situations where large nuclear units, with an approximate electrical output exceeding 1000 MWe, are not practical, because of transmission system constraints, limited space or water availability, or constraints on the availability of capital for construction and operation.

Environmental Report at 1-1. *See also id.* at 1-4 (“SMRs may provide the benefits of nuclear-generated power in situations where large nuclear units are not practical . . .”).

Further, TVA claims that an SMR would serve national security needs: Power generated by SMRs could be used for addressing critical energy security issues. Their use on or immediately adjacent to DoD or DOE facilities, using robust transmission (e.g., armored transformers, underground transmission), could address national security needs by providing reliable electric power in the event of a major grid disruption. A more reliable electric power supply could be accomplished by the SMR operation in “power island” mode with robust transmission to critical facilities. In addition, intentional destructive acts (e.g., terrorist attacks) and natural phenomena (e.g., tornadoes, floods, etc.) could disrupt the grid and the ability to restore most generation sources.”

Id. at 1-2.

In addition, TVA favorably compares the reliability SMRs to renewable energy sources, asserting that SMRS:

can provide reliable energy for extended operation. Because nuclear reactors require fuel replenishment less frequently than other power generation sources (coal, gas, wind and solar), SMRs are less vulnerable to interruptions of fuel supply and delivery systems. TVA could demonstrate this “power islanding” and secure supply concept as part of the [Clinch River] SMR project by utilizing controls, switching, and transmission capabilities to disconnect the SMR power plant from the electrical grid while maintaining power from the SMR power plant to a specified DOE power need. Such a demonstration

would show that SMR technology is capable of supplying reliable power that is less vulnerable to disruption from intentional destructive acts and natural phenomena.

Id. at 1-2.

Finally, TVA asserts that SMRs are preferable to other reactor designs for their safety features:

SMR design features include underground containment and inherent safe-shutdown features, longer station blackout coping time without external intervention, and core and spent fuel pool cooling without the need for active heat removal. These key features advance safety by eliminating several design basis accident scenarios. Development of a security-informed design efficiently provides the same or better protection against the threats large reactors must consider. Physical security is designed into the SMR plant architecture, incorporating lessons learned from significant shifts in security posture since 2001, and the opportunity to build more inherently secure features into the initial design. In Chapter 7, TVA also compares SMRs favorably to other reactors with respect to accident risks.

In Section 9.1, TVA once again introduces impermissible energy alternative considerations by describing the disadvantages of the “no-action alternative” as the lack of the supposed benefits described above, as well as the failure to create “new jobs” or to realize the “technological and financial benefits to the local, community Tennessee Valley, and the nation that would result from the construction of the fist-of-its-kind SMRs.” *Id.* at 9.1-1 – 9.1-2. Similarly, TVA includes the same set of inappropriate energy-related alternatives in its discussion of alternative sites in Section 9.3. *Id.* at 9.3-2 – 9.3-3.

c. TVA’s comparisons of SMRs with other technologies are unlawful

TVA’s claims regarding the favorable comparison of SMRs with other energy alternatives must be stricken from the Environmental Report, and may not be included in the EIS for the ESP, because TVA has waived the right to make them by choosing not to address energy alternatives or the need for power in the Environmental Report. *Id.*, Chapter 8 and page 9-2. In addition, TVA’s claims regarding energy-related alternatives should be stricken in fairness to

Petitioners, because Petitioners are precluded from raising issues related to energy alternatives and need for power by virtue of TVA's decision not to formally address those alternatives.

TVA's claims regarding energy alternatives are not only impermissible, but they are unsupported; some are even nonsensical. Thus, to allow them to remain, unchallenged, would reduce the Environmental Report to an advertisement for SMRs, without support or verification, and without providing the context of a comprehensive environmental analysis. For instance:

- The Environmental Report lacks a thorough comparison of SMRs with other energy technologies. TVA makes selective comparisons of SMRs with other energy technologies, but does not provide a comprehensive comparison. For instance, TVA compares SMRs with coal, gas, wind and solar on the factor of reliability. Environmental Report at 1-2. But it does not make a comprehensive analysis that addresses all relevant factors, such as carbon reduction, water use, air and water impacts, generation of waste products, and costs.
- The Environmental Report fails to acknowledge that solar and wind energy sources can meet all the other objectives listed by TVA (carbon reduction, safety, and incremental deployment), and have less deleterious environmental impacts, in particular water use. In fact, the magnitude of impact on water use is listed in Table 3.1-2 of the Environmental Report, which states that: "The expected (and maximum) rate of removal of water from a natural source to replace water losses from closed cooling water system" are "17,078 gpm (expected) [and] 25,608 gpm (maximum)." Assuming that TVA used a reactor capacity of 800 MW, that expected rate translates to 1,281 gallons/MW/hour. That rate of water withdrawal is higher than almost any other form of electricity generation. A

combined cycle natural gas plant will be about a factor of four lower.³ Solar photovoltaics (PV) and wind use negligible amounts of water; PV plants, for example, use about 1 gallon/MW/hour.

- To the extent that the Environmental Report compares SMRs with other energy sources on the factor of reliability, the comparison makes only partial sense. TVA asserts that: "Because nuclear reactors require fuel replenishment less frequently than other power generation sources (coal, gas, wind and solar), SMRs are less vulnerable to interruptions of fuel supply and delivery systems." While the statement is true for coal and gas, it is irrational in the case of wind and solar because they need no fuel replenishment. Renewable sources of power like solar and wind are, therefore, not vulnerable to fuel disruption. Although these are intermittent in nature, that concern can be addressed in a number of ways, in particular by incorporating on-site energy storage technologies.
- TVA asserts that SMR technology provides "a way to supply federal mission-critical loads with reliable power from generation and transmission that is less vulnerable to supply disruption from intentional destructive acts and natural phenomenon than typical commercial power generation facilities and transmission systems." Environmental Report at 9.3-1. But TVA lumps generation and transmission together, without justification. Reliance on SMR technology has nothing to do with the security of transmission systems. In addition, TVA fails to address the United State's history of unsuccessful experimentation with small reactors, which suggests that SMRs are quite unlikely to be

³ J. Macknick et al., *Operational water consumption and withdrawal factors for electricity generating technologies: a review of existing literature*, 7 ENVIRON. RES. LETT. 45802 (2012).

reliable sources of generating power in the first place.⁴ Prior experience that is particularly important to take note of is the Army's Nuclear Power Program, which was started in the 1950s, and resulted in the construction of eight small reactors. The experiences with these reactors reveal the potential for failure implicit with SMRs. The PM-3A reactor at McMurdo Sound in Antarctica, for example, "developed several malfunctions, including leaks in its primary system [and] cracks in the containment vessel that had to be welded."⁵ The leaks from the plant resulted in significant contamination and nearly 14,000 tons of contaminated soil was physically removed and shipped to Port Hueneme, a naval base north of Los Angeles, for disposal. The Army eventually cancelled the program in 1976, due to poor economics as well as the realization that diesel generators were a superior option for supplying power to remote areas. The official history of the Army's Nuclear Power Program termed the development of small reactors "expensive and time consuming."⁶

- In both Chapter 1 and Chapter 9, the Environmental Report asserts:

SMR technology can assist federal facilities with meeting carbon reduction objectives. Energy-related carbon dioxide (CO₂) emissions account for more than 80 percent of greenhouse gas (GHG) emissions in the United States. Studies show that on average coal combustion generates approximately 894-975 grams of CO₂ per kilowatt-hour (g/kWh) of electricity generated. Natural gas generates an estimated 450-519 g/kWh. Nuclear power emission rates have been calculated to range from 6 - 26 g/kWh.

⁴ M.V. Ramana, *The Forgotten History of Small Nuclear Reactors*, IEEE SPECTRUM, 2015, <http://spectrum.ieee.org/energy/nuclear/the-forgotten-history-of-small-nuclear-reactors> (last visited May 24, 2015); M. V. Ramana, *The checkered operational history of high temperature gas cooled reactors*, 72 BULLETIN OF THE ATOMIC SCIENTISTS 171-79 (2016).

⁵ LAWRENCE H. SUID, THE ARMY'S NUCLEAR POWER PROGRAM: THE EVOLUTION OF A SUPPORT AGENCY 111 (1990).

⁶ Suid, *supra*, at 93.

Id. at 1-3, 9.3-2. TVA’s unsupported assertion that nuclear power emission rates have been calculated to range from 6 to 26 grams per kilowatt hour is erroneous in two key respects. First, independent studies suggest that there is much uncertainty about the level of emissions associated with the generation of nuclear energy. A widely cited academic study shows that estimates of lifecycle emissions from nuclear power plants vary by over two orders of magnitude, from 1.4 to 288 g/kWh of CO₂, with a mean value of 66 g/kWh.⁷ Second, and more important, SMRs require more uranium fuel for each kWh of electricity generated.⁸ Because of their smaller size and higher area to volume ratio, SMRs will necessarily leak more neutrons from the core when compared to larger reactors. As a result, SMRs need more fuel for each kWh of electricity generated in comparison to the large LWRs that are most common around the world, and that are the basis for the emission estimates made so far (either the 6-26 g/kWh or the 1.4-288 g/kWh). Emissions of CO₂ associated with uranium mining, processing, and enrichment are the dominant contributions to the lifecycle emissions associated with nuclear power. Therefore, this increased need for fuel would result in a corresponding increase in the CO₂ emissions per kWh.

- TVA claims that its SMR design improves on spent fuel pool safety by providing for “spent fuel pool cooling without the need for active heat removal.” Environmental Report at 1-3, 9.3-2. But this assertion does not mention other relevant information demonstrating that SMRs may require greater spent fuel storage capacity than LWRs,

⁷ Benjamin K. Sovacool, *Valuing the greenhouse gas emissions from nuclear power: A critical survey*, 36 ENERGY POLICY 2950–63 (2008).

⁸ Alexander Glaser, Laura Berzak Hopkins & M.V. Ramana, *Resource Requirements and Proliferation Risks Associated with Small Modular Reactors*, 184 NUCLEAR TECHNOLOGY 121–29 (2013).

because they could generate a larger quantity of spent fuel for each kWh of electricity generated – additional impacts that should be compared with the safety benefits claimed by TVA. *See, e.g.*, Glaser et al., cited in note 8 above. For instance, TVA’s calculations appear to use a burnup value of 51 gigawatt-days per metric ton of uranium (“GWD/tU”). This value is much higher than some of the reported burnups of the designs of the four potential SMRs under consideration by TVA. For example, the International Atomic Energy Agency lists the burnup of the Holtec SMR design as 32 GWD/tU.⁹ At this relatively low burnup, the Holtec SMR will generate more spent fuel than an SMR design that has a burnup of 51 GWD/tU. In turn, this would mean that the fuel pool capacity and, possibly, dry storage capacity, will have to be increased.

This is only a partial list of deficiencies in TVA’s discussion of energy alternatives, provided for purposes of illustrating the bias and lack of rigor in TVA’s discussion, as further grounds for Petitioners’ argument that the discussion should be stricken from the Environmental Report. If and when TVA decides to formally address the issue of energy alternatives in a revised Environmental Report, Petitioners will review it and may submit a contention that challenges its contents with a more comprehensive list of deficiencies.

3. Demonstration that the Contention is Within the Scope of the Proceeding: This contention is within the scope of this ESP proceeding because it seeks compliance with NEPA and NRC regulations for the implementation of NEPA in ESP applications.

4. Demonstration that the Contention is Material to the Findings NRC Must Make to issue an ESP for the proposed TVA SMR: The contention is material to the findings that NRC must make in order to issue an ESP for the proposed TVA SMR because it relates to the

⁹ IAEA, ADVANCES IN SMALL MODULAR REACTOR TECHNOLOGY DEVELOPMENTS 89 (2014).

question of whether TVA's Environmental Report improperly addresses issues that TVA has determined should be excluded from this ESP proceeding and therefore may not be addressed by TVA or NRC and also may not be challenged by Petitioners in contentions.

5. Concise Statement of the Facts or Expert Opinion Supporting the Contention, Along With Appropriate Citations to Supporting Scientific or Factual Materials: The facts and expert opinion supporting this contention, and the citations relied on by Petitioners, are stated above. This contention is supported by the attached declaration of Dr. M.V. Ramana.

IV. CONCLUSION

For the foregoing reasons, Petitioners' contentions should be admitted and Petitioners should be admitted as parties to this proceeding.

Respectfully submitted,

 /signed electronically by/

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June 12, 2017

CERTIFICATE OF SERVICE

I certify that on June 12, 2017, I posted copies of the foregoing Petition to Intervene and Request for Hearing, including Attachments 1 through 10, on the NRC's Electronic Information Exchange System.

 /signed electronically by/

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