

February 4, 2010

**UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION  
BEFORE THE ATOMIC SAFETY AND LICENSING BOARD**

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In the Matter of )

Tennessee Valley Authority )

(Watts Bar Unit 2) )  
\_\_\_\_\_

Docket No. 50-391

**PETITION FOR WAIVER OF 10 C.F.R. §§ 51.53(b) AND 51.95(b) WITH  
RESPECT TO ADMISSION OF CONTENTIONS REGARDING NEED FOR  
POWER AND CONSIDERATION OF ALTERNATIVE ENERGY SOURCES**

**I. INTRODUCTION**

Pursuant to 10 C.F.R. § 2.335(b), Southern Alliance for Clean Energy (“SACE”) hereby requests a waiver of 10 C.F.R. §§ 51.53(b) and 51.95(b) (“the No-New-Analysis Regulations”) to the extent that those regulations bar consideration of the need for power and alternative energy sources (including energy efficiency/no action) in this proceeding.<sup>1</sup> In the unique circumstances of this particular case, the purpose of the regulations would not be served by applying them to the supplemental environmental impact statement (“SEIS”) submitted by the Tennessee Valley Authority (“TVA”) in

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<sup>1</sup> Section 2.335(b) provides that waiver petitions may only be submitted by parties to an adjudicatory proceeding. Therefore SACE, which was granted party status by the Atomic Safety and Licensing Board (“ASLB”) in LBP-09-26, Memorandum and Order (Granting Petition to Intervene) (November 19, 2009), is the sole sponsor of this petition. Four other organizations that were denied party status in LBP-09-26 -- Blue Ridge Environmental Defense League, Tennessee Environmental Council, the Sierra Club, and We the People – have appealed the Board’s ruling in LBP-09-26. They seek to join SACE as co-sponsors of this petition if their appeal is successful.

support of its operating license application for the Watts Bar 2 nuclear power plant,<sup>2</sup> or to the corresponding SEIS that the U.S. Nuclear Regulatory Commission (“NRC”) Staff will prepare on the basis of TVA’s SEIS. Therefore, pursuant to 10 C.F.R. § 2.335(d), SACE requests the ASLB to certify this petition to the Commission for a determination as to whether the regulations should be waived.

This waiver petition is supported by the attached Declaration of Dr. Arjun Makhijani, which presents *prima facie* evidence regarding the specific aspects of this proceeding as to which the application of the No-New-Analysis Regulations would not serve the purpose for which those regulations were adopted.<sup>3</sup>

## **II. STANDARD FOR ISSUANCE OF A WAIVER**

NRC regulation 10 C.F.R. § 2.335(b) provides that a party to an adjudication may petition for a waiver on the “sole ground” that “special circumstances with respect to the subject matter of the particular proceeding are such that the application of the rule or regulation (or a provision of it) would not serve the purposes for which the rule or regulation was adopted.” The waiver petition must be supported by an affidavit. *Id.*

The Commission has interpreted § 2.335(b) to require a four-fold showing:

That (i) the rule’s strict application ‘would not serve the purposes for which [it] as adopted’; (ii) the movant has alleged “special circumstances” that were “not considered, either explicitly or by necessary implication, in the rulemaking proceeding leading to the rule sought to be waived”; (iii) those circumstances are

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<sup>2</sup> Final Supplemental Environmental Impact Statement, Completion and Operation of Watts Bar Nuclear Plant Unit 2 (June 2007) (“TVA FSEIS”).

<sup>3</sup> Declaration of Dr. Arjun Makhijani in Support of Southern Alliance for Clean Energy’s Petition for Waiver of or Exception to 10 C.F.R. §§ 51.53(b) and 51.95(b) With Respect to Need for Power and Consideration of Alternative Energy Sources (February 3, 2010) (“Makhijani Declaration”) (Exhibit 1).

“unique” to the facility rather than “common to a large class of facilities”; and (iv) a waiver of the regulation is necessary to reach a “significant safety problem.”<sup>4</sup>

With respect to an environmental issue raised under the National Environmental Policy Act (“NEPA”), the fourth factor cited above – demonstration of a “significant safety problem” – would not be strictly applicable. SACE respectfully submits that in circumstances where the petitioner seeks a waiver of a regulation that would allow an applicant or the NRC to rely on an existing environmental analysis without the need for supplementation, it would be consistent with NEPA to require the petitioner to demonstrate the existence of new and significant information or changed circumstances that would affect the outcome of the previous environmental analysis.<sup>5</sup>

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<sup>4</sup> *Dominion Nuclear Connecticut, Inc.* (Millstone Nuclear Power Station, Units 2 and 3), CLI-05-24, 62 NRC 551, 560, quoting 10 C.F.R. § 2.335(b); *Public Service Company of New Hampshire* (Seabrook Station, Units 1 and 2), CLI-89-20, 30 NRC 231, 235 (1989); *Public Service Company of New Hampshire* (Seabrook Station, Units 1 and 2), CLI-88-10, 28 NRC 573, 597 (1988), *reconsideration denied*, CLI-89-3, 29 NRC 234 & CLI-89-7, 29 NRC 395 (1989); *Private Fuel Storage, L.L.C.* (Independent Spent Fuel Storage Installation), LBP-98-7, 47 NRC 142, 239, *reconsideration granted in part on other grounds*, LBP-98-10, 47 NRC 288, *aff’d*, CLI-98-13, 48 NRC 26 (1988).

<sup>5</sup> See 10 C.F.R. § 51.92, *Marsh v. Oregon Natural Resources Council*, 490 U.S. 360, 374 (1989). In fact, SACE respectfully submits that in a NEPA case, the Commission *must* waive the regulation and require a new environmental analysis if the *Marsh* standard is met, regardless of whether the new information or changed circumstances are unique to the particular licensing case.

### III. WAIVER REQUEST

#### A. The Circumstances of this Case are Unique.

There can be no disagreement that the circumstances of this case are unique. In no other case of which SACE is aware has so much time passed between the issuance of a construction permit and the conduct of an operating license proceeding – over 30 years. It is also unique in the sense that although the operating license proceeding has commenced, construction is far from complete: 40% of the facility remains unfinished, with an estimated cost of completion of \$2.5 billion.<sup>6</sup> As this Board has observed, “the fact pattern presented here, where construction of the facility is suspended for more than a quarter century, is unusual and not anticipated or discussed by the regulations.”<sup>7</sup>

The Watts Bar Unit 2 licensing case is also unique with respect to the events that have occurred since 1972, when TVA predicted in its construction permit EIS that the power generated by Watts Bar Unit 2 was needed.<sup>8</sup> First and foremost, TVA obviously found it more economical to rely on other sources of energy, including demand side management and efficiency, to the extent of purposely excluding Watts Bar 2 from the energy portfolio that it developed in the mid-1990’s.<sup>9</sup>

In addition, the past several decades have witnessed a number of fundamental changes in the regional economy, energy technology, and the administrative and political

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<sup>6</sup> Makhijani Declaration, par. 13.

<sup>7</sup> LBP-09-26, slip op. at 44. The NRC Staff has also recognized that Watts Bar Units 1 and 2 have “a unique licensing history and regulatory framework.” NRC Office Instruction LIC-110, Watts Bar Unit 2 License Application Review at 1 (September 2, 2008) (ADAMS Accession No. ML082460988).

<sup>8</sup> TVA, Final Environmental Statement, Watts Bar Nuclear Plant Units 1 and 2 (1972).

<sup>9</sup> Makhijani Declaration, pars. 14-15 and 17.c.

landscape, including the steep decline of the regional economy, including the automobile industry, in the TVA service area; TVA's own post-1972 pattern of chronic delays and escalating costs in nuclear plant construction; TVA's institution of a resource planning program that aggressively pursues efficiency and conservation, and that purposely excluded Watts Bar 2 from its energy plans through 1995; and the decreasing cost of purchased power for TVA.<sup>10</sup> All of these changes significantly undermined the validity of TVA's 1972 prediction of need for Watts Bar Unit 2.

Finally, the case is unique in the sense that this agency's actions with respect to consideration of the issues of need for power and energy alternatives are internally contradictory. On the one hand, in this adjudication the ASLB has interpreted 10 C.F.R. 10 C.F.R. §§ 51.53(b) and 51.95(b) to bar consideration of SACE's Contention 4 (Inadequate Discussion of Need for Power and Energy Alternatives).<sup>11</sup> On the other hand, the NRC Staff (with TVA's cooperation) has taken up the issue of need for power in its review of TVA's operating license application. In a December 3, 2009, Request for Additional Information ("RAI"), the NRC Staff posed a set of questions to TVA regarding the need for power.<sup>12</sup> TVA has agreed to answer the NRC Staff's questions, responding to some in an RAI Response on December 23, 2009, and postponing other answers until later.<sup>13</sup>

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<sup>10</sup> Makhijani Declaration, par. 17.

<sup>11</sup> LBP-09-26, slip op. at 44.

<sup>12</sup> Letter from Joel S. Wiebe, NRC, to Ashok S. Bhatnagar, TVA, re: Watts Bar Nuclear Plant, Unit 2 – Request for Additional Information Regarding Environmental Review (TAC No. MD8203) (December 3, 2009) (ADAMS Accession No. ML093030148).

<sup>13</sup> Letter from Masoud Bajestani to NRC at E1-7 (December 23, 2009) ("12/23/09 RAI Response") (ADAMS Accession No. ML100210350). In the 12/23/09 RAI Response,

**B. The Purpose of the No-New Analysis Regulations Would Not be Served by Applying Them in this Case Because the Regulations Were Not Designed for the Unique Circumstances of this Case.**

**1. The Regulations' purpose is to avoid needless repetition of an analysis whose outcome will remain the same.**

As the NRC explained in proposing 10 C.F.R. §§ 51.53(b) and 51.95(c), the general purpose of those regulations is to avoid, at the operating license stage, the unnecessary duplication of need for power and energy alternatives analyses that were completed at the construction permit stage.<sup>14</sup> For several reasons, the Commission believed that once construction of a nuclear power plant is completed, any changes in the need for power or availability of energy alternatives would not be great enough to have a meaningful effect on an NRC operating licensing decision.

With respect to need for power, the Commission reasoned that at the construction permit stage, because there has been little site disruption or capital investment, “real alternatives to the construction and operation of the propose facility exist, including no additional generating capacity at all if no ‘need’ exists or generation of the needed electricity by some non-nuclear energy source.”<sup>15</sup> In contrast, once construction of a nuclear reactor is completed, it would almost always be cost-beneficial to operate the plant.<sup>16</sup> As the Commission explained:

Operation of a nuclear power plant entails some environmental cost which should be justified, under NEPA, by some benefit from plant operation. In all cases to

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TVA promised to provide additional information by January 29, 2009, although the submission of that additional RAI Response appears to have been delayed.

<sup>14</sup> Proposed Rule, Need for Power and Alternative Energy Issues in Operating License Proceedings, 46 Fed. Reg. 39,440 (August 3, 1981).

<sup>15</sup> *Id.*

<sup>16</sup> *Id.*

date, and in all foreseeable future cases, there will be some benefit in terms of either meeting increased energy needs or replacing older less economical generating capacity. Experience shows that completed plants are in fact used to their maximum availability for either purpose. Such facilities are not abandoned in favor of some other means of generating electricity. For purposes of this proposed rule the Commission has assumed, conservatively, that the plant is not needed to satisfy increased energy needs, but rather is justified, if at all, as a substitute for other generating capacity.<sup>17</sup>

With respect to the analysis energy alternatives, the Commission stated that it was not necessary to repeat the analyses absent “new information or new developments” showing that an alternative means of generating baseload power existed that was both environmentally and economically superior, and that this combination was extremely unlikely to occur.<sup>18</sup>

In promulgating the final rule, the Commission repeated its previous conclusion that once construction of a nuclear reactor is completed, it would almost always be cost-beneficial to operate the plant.<sup>19</sup> The Commission also rejected a comment that the combination of energy conservation and alternative energy sources usually result in lower costs than operating a nuclear plant.<sup>20</sup> According to the Commission, “[i]f conservation lowers demand, then utility companies take the most expensive operating plants off-line first. Thus, a completed nuclear plant would be used as a substitute for less economical generating capacity,” *i.e.*, coal fired plants.<sup>21</sup>

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<sup>17</sup> 46 Fed. Reg. at 39,441.

<sup>18</sup> *Id.*

<sup>19</sup> Proposed Rule, Need for Power and Alternative Energy Issues in the Operating License Proceedings, 46 Fed. Reg. 39,440 (August 3, 1981). *See also* Makhijani Declaration, par. 8.

<sup>20</sup> Final Rule, Need for Power and Alternative Energy Issues in Operating License Proceedings, 47 Fed. Reg. 12,940, 12,941 (March 26, 1982).

<sup>21</sup> *Id.*

**2. The Regulations' purpose is not satisfied here because construction of Watts Bar Unit 2 is not complete and TVA has demonstrated that it does not need Watts Bar Unit 2.**

The No-New-Analysis Regulations are premised on a fundamental and indispensable assumption: that at the time of the operating license proceeding, construction of the proposed reactor has been finished. Only by assuming that the investment of large amounts of construction capital has been completed could the Commission reasonably conclude that operation of a new nuclear reactor would always be cost-effective.

In the unique circumstances of this case, however, the Commission's essential assumption is unfulfilled: Watts Bar Unit 2 is only 60% complete, and TVA has \$2.5 billion in capital expenditures ahead of it.<sup>22</sup> And the very fact that TVA has been able to satisfy its energy needs through means other than Watts Bar 2 for over three decades shows that it is far from a foregone conclusion that TVA should spend \$2.5 billion to finish Watts Bar Unit 2.<sup>23</sup> TVA implicitly concedes as much in its own FSEIS, which admits that construction is not complete and proposes to "update" the need for power analysis.<sup>24</sup>

Moreover, as discussed in par. 17 of Dr. Makhijani's declaration, significant changes in the regional economy, energy technology, and the administrative and political landscape have significantly depressed the demand for energy in TVA's service area and altered the types of energy alternatives available to and pursued by TVA. Under the

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<sup>22</sup> See discussion above at page 4.

<sup>23</sup> *Id.*, pars. 14-16.

<sup>24</sup> FSEIS at 1.



circumstances, it is not a foregone conclusion that operation of Watts Bar Unit 2 would be preferable to other energy alternatives.

**C. Waiver of the No-New-Analysis Regulations is Necessary to Allow the Consideration of Significant New Information That Would Change the Outcome of the Environmental analysis for Watts Bar Unit 2.**

As demonstrated in Dr. Makhijani's declaration in pars. 19-25, SACE's Contention 4 (attached to this petition as Exhibit 2), and Dr. Makhijani's report in support of Contention 4 ("Watts Bar Unit 2: Analysis of Need and Alternatives (July 10, 2009), See Attachment 2 to Dr. Makhijani's declaration), TVA has not provided sufficient information to show that the energy that would be produced by Watts Bar Unit 2 is needed; nor has TVA provided an adequate discussion of the relative costs and benefits of energy alternatives. As Dr. Makhijani explains, given that TVA's cost of purchased power is less than the *operating cost* of some of its existing units, it is necessary to consider whether (i) purchased power, (ii) operating the units that are now idle as a result of lower demand, or (iii) some combination of purchased power contracts and operating idle units would be preferable to completion of Watts Bar Unit 2.<sup>25</sup>

SACE respectfully submits that TVA's circumstances have changed so dramatically since it predicted the need for Watts Bar Unit 2 in 1972, and are so different from the circumstances assumed by the Commission in the No-New-Analysis Regulations, that the NRC has no lawful basis under NEPA for refusing to re-examine the need for the power generated by Watts Bar Unit 2 or the relative costs and benefits of relying on other energy alternatives. In order to fulfill its obligation under NEPA to

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<sup>25</sup> Makhijani Declaration, par. 26.

make a well-informed environmental decision regarding the licensing of Watts Bar 2, based on all current information that could affect the outcome of that decision, the NRC must waive 10 C.F.R. §§ 51.53(b) and 51.59(b) and examine the need for Watts Bar Unit 2 and the relative costs and benefits of energy alternatives. *Marsh*, 490 U.S. at 374.

**D. The NRC Must Grant SACE a Hearing on Issues Any Need for Power and/or Energy Alternatives Issues That Are Considered by the NRC Staff in Reviewing TVA’s Operating License Application.**

As discussed above at page 5, the NRC Staff has demonstrated, through the issuance of an RAI, that it considers the issue of need for power to be relevant to the agency’s licensing decision for Watts Bar Unit 2. Given the conceded relevance of the issue to the NRC’s licensing decision, it would be unlawful for the ASLB or the Commission to refuse SACE a hearing on the issue. *Union of Concerned Scientists v. NRC*, 735 F.2d 1437, 1439 (D.C. Cir. 1984), cert. denied, 469 U.S. 1132 (1985). While the NRC Staff has not explicitly questioned TVA on the issue of energy alternatives, the issues of need for power and energy alternatives are so closely related that both should be subject to a hearing.<sup>26</sup>

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<sup>26</sup> See Makhijani Declaration, par. 18.

#### **IV. CONCLUSION**

For the foregoing reasons, the ASLB should conclude that SACE has made a *prima facie* case that a waiver should be granted and certify this waiver petition to the Commission for its determination on the matter.

Respectfully submitted,

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UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION  
ATOMIC SAFETY AND LICENSING BOARD

_____	)	
In the Matter of	)	
	)	Docket No. 50-391
Tennessee Valley Authority	)	
	)	
(Watts Bar Unit 2)	)	
_____	)	

**DECLARATION OF DR. ARJUN MAKHIJANI IN SUPPORT OF SOUTHERN ALLIANCE FOR CLEAN ENERGY’S PETITION FOR WAIVER OF OR EXCEPTION TO 10 C.F.R. §§ 51.53(b) AND 51.95(b) WITH RESPECT TO NEED FOR POWER AND CONSIDERATION OF ALTERNATIVE ENERGY SOURCES**

Under penalty of perjury, I, Arjun Makhijani, declare as follows:

**Introduction and Qualifications**

1. I am President of the Institute for Energy and Environmental Research (“IEER”) in Takoma Park, Maryland. Under my direction, IEER produces technical studies on a wide range of energy and environmental issues to provide advocacy groups and policy makers with sound scientific information and analyses as applied to environmental and health protection and for the purpose of promoting the understanding and democratization of science.
2. I am qualified by training and experience as an expert in the fields of plasma physics, electrical engineering, nuclear engineering, and energy-related technology and policy issues. I have conducted numerous studies and written extensively regarding investment planning in the electricity sector and the comparative costs of nuclear power plants and other energy sources. A copy of my curriculum vitae, including a list of my publications, is attached (Attachment 1).
3. I am familiar with the environmental documents prepared by the Tennessee Valley Authority (“TVA”) and the U.S. Nuclear Regulatory Commission (“NRC”) with respect to the need for power and energy alternatives issues raised by the proposed licensing of Watts Bar Units 1 and 2, including TVA’s 2008 Final Supplemental Environmental Impact Statement for Watts Bar Unit 2 (“FSEIS”), TVA’s 1972 Final Environmental Statement for construction of Watts Bar Units 1 and 2, the NRC’s 1995 Final Environmental Statement for operation of Watts Bar Units 1 and 2. I am also

familiar with TVA's Integrated Resource Plan ("IRP") of 1995 and TVA's recent filings before the United States Securities and Exchange Commission ("SEC").

4. In the summer of 2009, I prepared an expert report and declaration which addressed the fundamental inadequacy of TVA's FSEIS for Watts Bar Unit 2 to address the issues of need for power and energy alternatives: *Watts Bar Unit 2: Analysis of Need and Alternatives* (July 11, 2009) and Declaration by Dr. Arjun Makhijani in Support of Petitioners' Contentions (July 11, 2009). Copies are attached to this declaration (Attachments 2 and 3, respectively).

5. My expert report and declaration were submitted to the NRC in support of a hearing request on the Watts Bar operating license application by Southern Alliance for Clean Energy, Blue Ridge Environmental Defense League, the Sierra Club, Tennessee Environmental Council, and We the People. I continue to believe, as stated in my declaration of July 11, 2009, that the facts in my expert report are true and correct. In addition, I continue to adhere to the expressions of opinion in my expert report, which are based on my best professional judgment.

6. The purpose of this declaration is to explain the factual basis for my opinion that in the particular circumstances of the NRC's licensing proceeding for the proposed Watts Bar Unit 2 nuclear reactor, the purpose of NRC regulations barring consideration of the need for power and alternative energy sources (including energy efficiency/no action) would not be served by applying those regulations.

#### **Purposes of the Regulations Excusing Analyses of Need for Power and Energy Alternatives at the Operating License Stage**

7. As the NRC explained in proposing 10 C.F.R. §§ 51.53(b) and 51.95(c), the general purpose of those regulations is to avoid, at the operating license stage, the unnecessary duplication of need for power and energy alternatives analyses that were completed at the construction permit stage. Proposed Rule, Need for Power and Alternative Energy Issues in Operating License Proceedings, 46 Fed. Reg. 39,440 (August 3, 1981). For several reasons, the Commission believed that once construction of a nuclear power plant is completed, any changes in the need for power or availability of energy alternatives would not be great enough to have a meaningful effect on an NRC operating licensing decision.

8. For instance, with respect to need for power, the Commission reasoned that at the construction permit stage, because there has been little site disruption or capital investment, "real alternatives to the construction and operation of the propose facility exist, including no additional generating capacity at all if no 'need' exists or generation of the needed electricity by some non-nuclear energy source." *Id.* In contrast, once construction of a nuclear reactor is completed, it would almost always be cost-beneficial to operate the plant. *Id.* As the Commission explained:

Operation of a nuclear power plant entails some environmental cost which should be justified, under NEPA, by some benefit from plant operation. In all cases to date, and in all foreseeable future cases, there will be some benefit in terms of either meeting increased energy needs or replacing older less economical generating capacity. Experience shows that completed plants are in fact used to their maximum availability for either purpose. Such facilities are not abandoned in favor of some other means of generating electricity. For purposes of this proposed rule the Commission has assumed, conservatively, that the plant is not needed to satisfy increased energy needs, but rather is justified, if at all, as a substitute for other generating capacity.

46 Fed. Reg. at 39,441.

9. With respect to the analysis of energy alternatives, the Commission stated that it was not necessary to repeat the analyses absent “new information or new developments” showing that an alternative means of generating baseload power existed that was both environmentally and economically superior, and that this combination was extremely unlikely to occur. *Id.*

10. In promulgating the final rule, the Commission rejected a comment that the combination of energy conservation and alternative energy sources usually result in lower costs than operating a nuclear plant. Final Rule, Need for Power and Alternative Energy Issues in Operating License Proceedings, 47 Fed. Reg. 12,940, 12,941 (March 26, 1982). According to the Commission, “[i]f conservation lowers demand, then utility companies take the most expensive operating plants off-line first. Thus, a *completed* nuclear plant would be used as a substitute for less economical generating capacity,” *i.e.*, coal fired plants. *Id.* (italics added).

### **Statement of Professional Opinion and Supporting Facts**

11. In my professional opinion, the purpose of 10 C.F.R. §§ 51.53(b) and 51.95(c) – to avoid having to re-do analyses that would have no meaningful effect on the ultimate decision at the operating license stage – would not be served in the unique circumstances of the Watts Bar Unit 2 licensing proceeding.

12. As discussed below in pars. 13 through 25, the circumstances of this case are unique in three key respects which justify a renewed examination of the need for the power that would be generated by Watts Bar Unit 2 and cost-effectiveness of energy alternatives. First, Watts Bar Unit 2 is not yet complete, and thus it is not a foregone conclusion that it would be cost-effective for TVA to finish construction and operate the plant. Second, this case is unique with respect to the number of fundamental changes in the regional economy, the low cost of purchased power, the changes in energy technology, and the alteration of the administrative and political landscape that have occurred since 1972, when TVA prepared the need for power and energy alternatives

analyses in support of its construction permit application. Finally, both TVA and the NRC technical staff are now engaged in a review of the need for power from Watts Bar Unit 2, and the NRC Staff appears to intend to use that analysis in its environmental licensing decision. The data presented by TVA in the course of that review do not support TVA's assertion that Watts Bar 2 is needed. It would be very poor decision-making indeed for the NRC to rely on a need for power analysis at the same time it prevented interested members of the public from criticizing the analysis.

13. **Watts Bar Unit 2 is not yet complete, and thus it is not a foregone conclusion that it would be cost-effective for TVA to finish construction and operate the plant.** TVA applied for an operating license for Watts Bar Unit 2 in 1976, but abandoned construction of Unit 2 in the mid-1980s. At the time that TVA stopped work on Unit 2, construction was 80% complete.<sup>1</sup> Over the ensuing years, however, TVA removed a "substantial amount of equipment" from Unit 2 in order to support Unit 1 and the Sequoyah reactors; and thus, at the time the FSEIS was written, the degree to which construction was complete was only 60%.<sup>2</sup> TVA's cost estimate for completing Unit 2 of \$2.5 billion<sup>3</sup> also shows that a great deal of work remains to be done.

14. During the thirty two years that elapsed between TVA's initial operating license application for Unit 2 and its renewed application in 2008, TVA obviously found it more economical to rely on other sources of energy, including demand side management and efficiency. The very fact that TVA found other ways to satisfy regional energy demands -- besides finishing Watts Bar 2 -- fatally undermines any foregone conclusion that operation of Watts Bar Unit 2 is a necessary and environmentally preferable course of action.

15. TVA continues to have more than enough idle capacity to generate electricity in the absence of Watts Bar 2. TVA's generation fell by about 13,500 million kWh between 2008 and 2009, or about 8.5 percent. This is about one-and-a-half times the electricity that Watts Bar 2 would generate at 90 percent capacity factor.<sup>4</sup> Nationally, the peak of generation was reached in 2007. National electricity generation fell substantially in 2009 (by 4.6 percent through October 2009). As a result the prices of purchased power fell even more. Prices to TVA "for purchased power were 36 percent lower in 2009 than in 2008, and at times during 2009 it was cheaper for TVA to purchase power than to operate some of its less efficient generation plants. As a result, TVA purchased 5.7 percent more

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<sup>1</sup> *Final Supplemental Environmental Impact Statement, Completion and Operation of Watts Bar Nuclear Unit 2, Rhea County, Tennessee*, Tennessee Valley Authority, June 2007. page 5. Hereafter FSEIS.

<sup>2</sup> FSEIS page 19.

<sup>3</sup> See TVA Watts Bar website at <http://www.tva.gov/power/nuclear/wattsbar.htm>, viewed on February 3, 2010.

<sup>4</sup> Watts Bar Capacity of 1,150 MW from *2009-2010 Information Digest*, Nuclear Regulatory Commission, Washington, D.C., August 2009, page 114. Hereafter NRC 2009.

power in 2009 than in 2008.”<sup>5</sup> It is important to note that TVA increased its purchased power even as its sales of electricity fell by about 7 percent.

16. The present value of the operating cost for Watts Bar 2, plus the capital cost for completion of the plant, is about \$5 billion (assuming operating costs of 2 cents per kWh,<sup>6</sup> in constant dollars, for 40 years and a 6 percent constant-dollar discount rate). This is very far from the case where a plant is complete and the only cost criterion is comparing operating costs with existing plants. Moreover, in this case, some existing plants are uneconomical relative to purchased power, a situation not considered by the NRC at all. In this circumstance, a comparison with other alternatives – purchased power, other TVA generation, renewable such as efficiency and baseload wind, and combinations of the forgoing, is necessary. The NRC’s assumption that need should not be considered because nuclear operating costs would be lower than the operating costs of some other existing plants does not apply.

17. **This case is also unique simply for the number of fundamental changes in the regional economy, the changes in energy technology, and the alteration of the administrative and political landscape that have occurred since 1972, when TVA prepared the need for power and energy alternatives analyses that must govern the NRC’s licensing decision for Watts Bar Unit 2 under the NRC’s rules.** For instance:

a. As discussed in my expert report at page 2-3, the country is suffering a severe economic decline, which has had a particularly devastating effect on the auto industry – which is a primary customer of TVA.

b. TVA’s post-1972 experience in nuclear power plant construction shows that TVA has a history of chronic delays that drive up nuclear plant costs. *Id.* at 4.

c. TVA now has in place a process for “Integrated Resource Planning,” in which TVA periodically reviews and revises its energy portfolio, with participation by the general public. In the most recent version of TVA’s IRP, issued in 1995, Watts Bar Unit 2 was not even included in TVA’s preferred energy portfolio. *Id.* at 8, 9-10.

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<sup>5</sup> Tennessee Valley Authority. *Form 10-K: Annual Report*, Securities and Exchange Commission filing for the Fiscal Year ended September 30, 2009, on the web at [http://www.sec.gov/Archives/edgar/data/1376986/000137698609000113/tva\\_10-k2009.htm](http://www.sec.gov/Archives/edgar/data/1376986/000137698609000113/tva_10-k2009.htm). page 16. Hereafter TVA 10-K.

<sup>6</sup> The O&M cost (including fuel) of 2 cents/kWh is from NRC 2009, Table 2. Some independent projections of future O&M costs are much higher than this. For instance, the Nuclear Power Joint Fact-Finding report of the Keystone Center estimated future O&M costs (including fuel) to be between 3.7 and 4.9 cents per kWh. Individuals from the nuclear industry were included in the panel that prepared the report. See *Nuclear Power Joint Fact-Finding*, The Keystone Center, June 2007, page 11. The high end of this range plus the costs of completion of Watts Bar 2 would give a present value of costs of about \$9 billion.



d. TVA is aggressively pursuing conservation measures that may significantly reduce energy demand in its service area. For instance, in its Form 10-K for fiscal year 2009, TVA announced to the SEC that it “is proposing to have all distributors on a time-of-use wholesale rate structure by no later than April 2012.”<sup>7</sup> As discussed in my expert report at page 5, TVA is also investigating other energy conservation measures, all of which may have a significant effect on energy demand in the region.

e. As discussed above in par. 14, since demand for power has gone down generally, the prices of purchased power have fallen. TVA has increased its purchased power substantially, even as demand for its electricity fell by about 7 percent.

Even the NRC has acknowledged, in its “History of Watts Bar Unit 2 Reactivation” that licensing history of these two reactors is unique.<sup>8</sup>

18. **This case is also unique in the respect that both TVA and the NRC have undertaken an analysis of the need for Watts Bar Unit 2, and the data presented shows that need for power and energy alternatives should be examined.** TVA appears to agree that the 1972 EIS is obsolete, and therefore has addressed both the need for power and energy alternatives in its Environmental Report for Watts Bar Unit 2.<sup>9</sup> And the NRC technical staff, in a recent set of requests for additional information (“RAIs”) to TVA, asked TVA questions about the need for power at the facility.<sup>10</sup> While the Staff has not asked TVA questions about energy alternatives, the topics of need for power and energy alternatives are closely related. As stated by the NRC and discussed in paragraph 8 above, the NRC conservatively assumes that a new nuclear reactor “is not needed to satisfy increased energy needs, but rather is justified, if at all, as a substitute for other generating capacity.”

19. TVA’s responses to the NRC RAIs on the costs and benefits of the plant provide additional evidence that a comparative analysis of the need for Watts Bar 2 is essential. The NRC asked TVA its electricity growth rate 1990 and 2008 and the expected “power supply and demand” requirements to 2011 and 2012 and 2014 (RAI #BC-3). TVA stated that its growth rate from 1990 to 2008 was 2.3 percent.<sup>11</sup> It stated its expected (medium)

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<sup>7</sup> TVA 10-K page 12.

<sup>8</sup> See History of Watts Bar 2 Reactivation, Nuclear Regulatory Commission on the web at <http://www.nrc.gov/reactors/plant-specific-items/watts-bar/history.html>, viewed on February 3, 2010.

<sup>9</sup> FSEIS. See Section 1.6.

<sup>10</sup> Letter from Joel S. Wiebe, NRC, to Ashok S. Bhatnagar, TVA, re: Watts Bar Nuclear Plant, Unit 2 – Request for Additional Information Regarding Environmental Review (TAC No. MD8203) (December 3, 2009) (ADAMS Accession No. ML093030148).

<sup>11</sup> While TVA did not specify whether it was considering summer or winter peaks; we presume that it was considering summer peaks, which have generally been the highest peak loads, except for FY 2008 and 2009, when the winter load exceeded the summer peak. We have used summer peak loads in this analysis. Load data are from TVA annual financial report summaries. In any case applying a 3 percent growth rate to the 2008 winter peak yields approximately the same results since the winter peak was only slightly greater than the summer peak.

peak load growth of “3 percent during the 2011 and 2012 timeframe.”<sup>12</sup> TVA did not provide a base year from which this three percent was calculated and did not respond to the power supply question at all.

20. TVA appears to have used 2006 as the base year to project peak demand in 2012 and 2014 peak load at 3 percent growth. In doing so it has ignored its entire recent history. From 2006 to 2008, the summer peak did not grow at all (it went up in 2007 and then came down again in 2008). In 2009, its summer peak declined drastically from the 2008 level. If 2008 is used as the base year with 3 percent growth, the TVA summer peak projection, TVA’s projected load would be over 3,000 MW less than the TVA projection for 2012 and about 2,700 MW less for 2014 than the TVA’s responses to the NRC. Another way of seeing it is that the TVA has implicitly “projected” its 2008 peak to be 34,000 MW (two years of 3 percent growth applied to the 2006 peak), instead of the actual 31,600 MW (all figures are rounded).

21. Moreover, TVA has provided no reason why its growth rate should jump from its 1990-2008 rate of 2.3 percent to 3 percent. Actually, TVA’s peak load growth rate from 2000 to 2008 was only about 0.9 percent. Hence, the TVA projects that its load growth would be more than triple the actual growth from 2000 to 2008, even leaving out the severe recession year of 2009.

22. If one uses actual data from 2009 as the basis for TVA’s forecasts, TVA anticipates five years of growth at more than 7 percent per year compounded. There is no basis for such a projection. TVA has not experienced long-term growth rates of 7 percent since before the first energy crisis in the 1970s. Indeed, comparing the recession years of 2001 and 2009, TVA’s peak load hardly grew at all. It was 27,368 MW in 2001 and 28,711 MW in 2009. Even comparing the recession year of 2001 and the peak of the economy in 2007, the growth rate was only about 3.4 percent. The peak load in 2009 was about 14 percent below the peak of 2007. In sum, based on a careful view of presently available data, TVA has overestimated its 2012 and 2014 peak loads by thousands of megawatts – amounts that are far greater than the capacity that Watts Bar 2 would add – in its response to the NRC RAIs.

23. The present period is economically similar to the period that followed October 1973, when TVA’s electricity sales barely grew for nearly two decades. The TVA has simply not given serious attention to the plain facts of its load growth history, to its own surplus capacity, to low purchased power prices, and to the overall state of the economy that provides opportunities for longer-term purchased power contracts.

24. The TVA’s responses to NRC’s RAIs reinforce the need for a fresh analysis of comparative costs in the unique context of Watts Bar 2.

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<sup>12</sup> Letter from Masoud Bajestani to NRC (December 23, 2009) (ADAMS Accession No. ML100210350). Page E1-7.

25. Finally, given the importance of public participation with respect to the adequacy of an EIS, and given the tremendous public interest in conserving energy and using renewable energy sources, I believe the NRC would be engaging in a very poor decision-making process if it were to update its analysis of need for power and energy alternatives at Watts Bar Unit 2, yet at the same time prevent the public from criticizing that analysis in the hearing process.

### **Conclusion**

26. Under any of the circumstances described above, it is illogical to assume that operation of Watts Bar 2 would be needed or cost-beneficial. It is especially important to note that the Commission's own revision of the rule waiving consideration of power requirements at the time of issuing an operating license was based on the assumption that the operating costs of nuclear would be less than the operating costs of other power plants. The Commission's framework was that it was reasonable to assume that that if a completed nuclear plant displaced existing power plants, it would reduce overall operating costs. However, Watts Bar 2 is not complete. Therefore, in the present case, the Commission's framework does not apply. Given that TVA's cost of purchased power is less than the *operating* cost of some of its existing units, it is necessary for the TVA to consider whether (i) purchased power, (ii) operating the units that are now idle as a result of lower demand, or (iii) some combination of purchased power contracts and operating idle units would be preferable to completion of Watt Bar 2. The capital cost of completing Watts Bar 2 plus the cost of operating it should be the metric used for these comparisons.

27. It is clear that the situation represented by the Watts Bar 2 case, including its the economic and energy context, was not foreseen when the Commission promulgated the rule and stated that "in all foreseeable future cases, there will be some benefit in terms of either meeting increased energy needs or replacing older less economical generating capacity."

28. Therefore, I believe that the NRC's licensing process for Watts Bar Unit 2 poses unique circumstances, such that application of 10 C.F.R. §§ 51.53(b) and 51.95(c) would not serve the purposes for which those rules were promulgated.

I declare that the foregoing facts are true and correct to the best of my knowledge and that the foregoing expressions of opinion are based on my best professional judgment.



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A recognized authority on energy issues, Dr. Makhijani is the author and co-author of numerous reports and books on energy and environment related issues, including two published by MIT Press. He was the principal author of the first study of the energy efficiency potential of the US economy published in 1971. He is the author of *Carbon-Free and Nuclear-Free: A Roadmap for U.S. Energy Policy* (2007).

In 2007, he was elected Fellow of the American Physical Society. He was named a Ploughshares Hero, by the Ploughshares Fund (2006); was awarded the Jane Bagley Lehman Award of the Tides Foundation in 2008 and the Josephine Butler Nuclear Free Future Award in 2001; and in 1989 he received The John Bartlow Martin Award for Public Interest Magazine Journalism of the Medill School of Journalism, Northwestern University, with Robert Alvarez. He has many published articles in journals and magazines as varied as *The Bulletin of the Atomic Scientists*, *Environment*, *The Physics of Fluids*, *The Journal of the American Medical Association*, and *The Progressive*, as well as in newspapers, including the *Washington Post*.

Dr. Makhijani has testified before Congress, and has appeared on ABC World News Tonight, the CBS Evening News, CBS 60 Minutes, NPR, CNN, and BBC, among others. He has served as a consultant on energy issues to utilities, including the Tennessee Valley Authority, the Edison Electric Institute, the Lawrence Berkeley Laboratory, and several agencies of the United Nations.

### ***Education:***

- Ph.D. University of California, Berkeley, 1972, from the Department of Electrical Engineering. Area of specialization: plasma physics as applied to controlled nuclear fusion. Dissertation topic: multiple mirror confinement of plasmas. Minor fields of doctoral study: statistics and physics.
- M.S. (Electrical Engineering) Washington State University, Pullman, Washington, 1967. Thesis topic: electromagnetic wave propagation in the ionosphere.
- Bachelor of Engineering (Electrical), University of Bombay, Bombay, India, 1965.

### ***Current Employment:***

- 1987-present: President and Senior Engineer, Institute for Energy and Environmental Research, Takoma Park, Maryland. (part-time in 1987).
- February 3, 2004-present, Associate, SC&A, Inc., one of the principal investigators in the audit of the reconstruction of worker radiation doses under the Energy Employees Occupational Illness Compensation Program Act under contract to the Centers for Disease Control and Prevention, U.S. Department of Health and Human Services.

### ***Other Long-term Employment***

- 1984-88: Associate Professor, Capitol College, Laurel, Maryland (part-time in 1988).
- 1983-84: Assistant Professor, Capitol College, Laurel, Maryland.
- 1977-79: Visiting Professor, National Institute of Bank Management, Bombay, India. Principal responsibility: evaluation of the Institute's extensive pilot rural development program.
- 1975-87: Independent consultant (see page 2 for details)
- 1972-74: Project Specialist, Ford Foundation Energy Policy Project. Responsibilities included research and writing on the technical and economic aspects of energy conservation and supply in the U.S.; analysis of Third World rural energy problems; preparation of requests for proposals; evaluation of proposals; and the management of grants made by the Project to other institutions.
- 1969-70: Assistant Electrical Engineer, Kaiser Engineers, Oakland California. Responsibilities included the design and checking of the electrical aspects of mineral industries such as cement plants, and plants for processing mineral ores such as lead and uranium ores. Pioneered the use of the desk-top computer at Kaiser Engineers for performing electrical design calculations.

### ***Professional Societies:***

- Institute of Electrical and Electronics Engineers and its Power Engineering Society
- American Physical Society (Fellow)
- Health Physics Society
- American Association for the Advancement of Science

### ***Awards and Honors:***

- The John Bartlow Martin Award for Public Interest Magazine Journalism of the Medill School of Journalism, Northwestern University, 1989, with Robert Alvarez
- The Josephine Butler Nuclear Free Future Award, 2001
- Ploughshares Hero, Ploughshares Fund, 2006
- Elected a Fellow of the American Physical Society, 2007, "*For his tireless efforts to provide the public with accurate and understandable information on energy and environmental issues*"
- Jane Bagley Lehman Award of the Tides Foundation, 2007/2008

***Invited Faculty Member, Center for Health and the Global Environment, Harvard Medical School:*** Annual Congressional Course, *Environmental Change: The Science and Human Health Impacts*, April 18-19, 2006, Lecture Topic: An Update on Nuclear Power - Is it Safe?

***Consulting Experience, 1975-1987***

Consultant on a wide variety of issues relating to technical and economic analyses of alternative energy sources; electric utility rates and investment planning; energy conservation; analysis of energy use in agriculture; US energy policy; energy policy for the Third World; evaluations of portions of the nuclear fuel cycle.

Partial list of institutions to which I was a consultant in the 1975-87 period:

- Tennessee Valley Authority
- Lower Colorado River Authority
- Federation of Rocky Mountain States
- Environmental Policy Institute
- Lawrence Berkeley Laboratory
- Food and Agriculture Organization of the United Nations
- International Labour Office of the United Nations
- United Nations Environment Programme
- United Nations Center on Transnational Corporations
- The Ford Foundation
- Economic and Social Commission for Asia and the Pacific
- United Nations Development Programme

***Languages:*** English, French, Hindi, Sindhi, and Marathi.

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## **Watts Bar Unit 2: Analysis of Need and Alternatives**

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### **Introduction**

In the Tennessee Valley Authority's (TVA's) 2007 Watts Bar Unit 2 Final Supplemental Environmental Impact Statement (hereafter Watts Bar FSEIS), consideration of the need for the plant and alternatives to the plant is fundamentally incomplete and largely obsolete with respect to the consideration of costs, environmental impacts, relative merit of alternatives, and the state of the technological alternatives. TVA's analysis is based on outdated documents, including its 1972 Environmental Statement (ES) for construction of the plant and a 1995 Integrated Resource Plan and Environmental Impact Statement (IRP/EIS, hereafter referred to as the 1995 IRP).<sup>1</sup> In addition, the 1995 IRP does not support the proposed operation of Watts Bar Unit 2. In fact, the IRP considered and rejected that option, omitting it from the portfolio of options that TVA intended to pursue in the 25 years following issuance of the IRP.<sup>2</sup>

The analysis of the need for power and alternatives in the FSEIS is also incomplete and sketchy at best. It does not contain essential elements of a reasonable analysis of energy demand and alternative energy supplies, such as the potential for efficiency and renewables to meet the forecasted requirements, or the effects of climate legislation. The FSEIS contains no analysis of the effect of the economic crisis in the TVA region and the country as a whole. Further, the Watts Bar FSEIS does not take into account TVA's own statement that a new IRP is needed.

The TVA initiated a new IRP/EIS process for its electricity options in June 2009. The TVA should re-do the Watts Bar FSEIS after it has completed its proposed new IRP because no valid evaluation of the need for the project or a valid comparison with reasonable alternatives can be done until the new IRP/EIS process is complete.

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<sup>1</sup> TVA 1972 and Energy Vision 2020 1995

<sup>2</sup> Federal Register 1996 p. 7572. The Record of Decision for the 1995 IRP was published in the Federal Register in 1996. The 1995 Final Environmental Statement deferred discussion of need to the 1995 IRP. (NRC 1995, p. 9-3)

## A. Analysis in the Watts Bar FSEIS

The FSEIS provides a very cursory, business-as-usual approach to forecasting electricity. It takes a very short term view – projecting only to about 2015,<sup>3</sup> for a project that would have a licensed lifetime of 40 years, takes no account of cost escalations that have plagued TVA nuclear projects in the past, and takes no account of the severe economic crisis in its projections or its analysis. Its core premise for electricity demand is stated as follows:

The primary factor affecting the demand for power in the TVA power service area (Region) is economic growth. Historically, regional economic growth has been more dependent on manufacturing than the U.S. average. This trend is forecast to continue as the Region benefits from its favorable location at the center of the auto industry in the southern U.S., even though job growth in the manufacturing sector is declining in the Region. Population growth is expected to be strong. Most migration to the Region is still due to job opportunities.<sup>4</sup>

In projecting continued population growth and increasing job opportunities, which would both tend to contribute to economic growth and the need for electricity services (whether through supply or efficiency), the FSEIS takes no account of changes in the economic picture since 2007, including the devastating changes in the auto industry. Unemployment in Tennessee, for instance, increased from a low of 4.5 percent in April 2007 to 10.7 percent in May 2009.<sup>5</sup> Nor does TVA note that unemployment in Alabama increased from a rate of 3.3 percent in January 2007 to 9.8 percent in May 2009.<sup>6</sup> These realities are reflected in declining TVA power sales, as noted in a TVA press release describing its filing by the TVA with the Securities and Exchange Commission:

Power sales during the second quarter of 2009 decreased by 9.4 percent from sales for the second quarter last year, and power sales for the first six months of fiscal year 2009 were 5.6 percent below sales for the first six months of fiscal year 2008 according to TVA's quarterly financial report filed with the Securities and Exchange Commission today.<sup>7</sup>

These are huge declines. Moreover, Fiscal Year 2008 sales were 180,000 GWh, only about half a percent more than FY 2007.<sup>8</sup> This would make FY 2007 sales about 179,000 GWh. Current trends (5.6 percent below 2008 levels for the first half of the fiscal year) would put TVA sales at about 170,000 GWh for FY 2009, even if one ignores the deteriorating trend within the first half of the fiscal year that is evident from the data in the quote above. Hence, at present, TVA electricity sales are set to be well below the lowest forecast in the FSEIS, which is for a flat sales projection. The current outlook is for FY 2009 sales to be back to the 2004 or 2005 level and perhaps lower.<sup>9</sup> It is unclear how long recovery of demand to above the recent 2008 peak might

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<sup>3</sup> Watts Bar FSEIS 2007 Figure 1-3 (p. 13)

<sup>4</sup> Watts Bar FSEIS 2007 p. 12

<sup>5</sup> BLS 2009 TN (preliminary number for May 2009)

<sup>6</sup> BLS 2009 AL (preliminary number for May 2009)

<sup>7</sup> TVA 2009

<sup>8</sup> TVA 2008

<sup>9</sup> Some data in this paragraph are taken from TVA's FY 2008 SEC filing (TVA SEC 2008)



take, given economic uncertainties, potential changes in efficiency regulations, and climate-related regulation and legislation. TVA has acknowledged as much since its own prognosis for 2009, and possibly 2010 or longer, is grim. According to its most recent quarterly report with the SEC:

*Financial Outlook*

**For the remainder of 2009 and perhaps beyond**, TVA is facing several financial pressures, including the following:

Rates and Electricity Sales. On April 1, 2009, TVA reduced its FCA [Fuel Cost Adjustment] for the second time this year. Combined with a previous six percent drop on January 1, 2009, this latest seven percent decrease rolls back much of the 17 percent increase in the FCA from October 2008. The FCA is applied to the bills of the majority of TVA's customers to compensate for TVA's costs associated with fuel, purchased power, and emissions allowances. The two decreases are due to lower than forecasted fuel and purchased power costs.

The effects of the economic downturn are resulting in less demand for electric power. Sales of electricity are about six percent below 2008 levels and could decline further if commercial and industrial employers continue to reduce production in response to the downturn. Through March 2009, directly served industrial sales are down approximately 14.9 percent, while municipal and cooperative sales have experienced a 3.1 percent decline compared to the prior year.<sup>10</sup>

In sum, the business-as-usual forecast (low, medium, high) in the Watts Bar FSEIS is completely inappropriate in the present economic circumstances and their effect on demand. While the failure to include these circumstances is understandable, in that the FSEIS was completed in June 2007, it does not negate the fact that its economic basis is obsolete and cannot be used to establish the need for the project. Basing the need for the project by 2013 on the FSEIS analysis would risk the same type of problem that the TVA encountered in the mid-to-late 1970s when its power projections turned out to be too high (see below) and it cancelled or postponed several nuclear power plants. The FSEIS analysis is so obsolete that it stands in stark contrast to TVA sales in the past year, current trends, and TVA's own analysis of its outlook as reported to the Securities and Exchange Commission.

A related problem is that the Watts Bar FSEIS takes no account of the history of delays and cost escalations that have plagued nuclear projects. This is not just a general problem, but rather specific to TVA. In fact, Watts Bar Unit 1 took 23 years to complete.<sup>11</sup> The implications of delay of even a few years on the plant's economics and on the attractiveness of shorter lead time alternatives are not discussed. Indeed, there is no analysis of efficiency at all, even though TVA has stated that this is a priority and that TVA wants to be a leader in efficiency and demand response.<sup>12</sup> The FSEIS contains only a single conclusory statement about needing more

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<sup>10</sup> TVA SEC 2009 p. 45, emphasis added.

<sup>11</sup> Construction started in 1973 and start up was in 1996. See the TVA Watts Bar Web site at <http://www.tva.gov/sites/wattsbar.nuc.htm>

<sup>12</sup> See, for instance, TVA Staff Report 2009 p. 59.

generating capacity without any analysis of the capacity potential of efficiency and demand response:

The amount of generating capacity, the source for which is yet to be determined (TBD), increases between 2008 and 2013. During this period, the need for capacity of any type (baseload, intermediate or peaking) increases by 3800 MWs in that five year period; Completing WBN Unit 2 with its 1150 MWs would only meet part of this projected need. The TVA Board recently announced in the form of a strategic plan that TVA would place greater emphasis on increasing energy efficiency and energy conservation and more use of renewable energy resources to help meet and reduce future demand. These actions would help address the projected shortfall that remains even if WBN Unit 2 is completed.<sup>13</sup>

## **B. Failure to Consider Energy Efficiency and Alternative Energy Sources**

Chapter 2 of the FSEIS is supposed to be about “Alternatives and the Proposed Action.” However, in essence it is only about the proposed action, since Chapter 1 does not consider alternatives (see the quote above) and neither does Chapter 2:

The need for power analysis presented in Chapter 1 shows how completion of WBN Unit 2 would help TVA meet expected demands for increased baseload power and the need for greater operating reserves. WBN Unit 2 completion would also provide more flexibility to reduce fossil plant emissions and lower the cost of power. To meet the need for additional baseload power and the objective of maximizing the use of exiting [sic] assets, TVA is proposing to follow through with its original plans to complete WBN Unit 2.<sup>14</sup>

By any standard of reasonableness this discussion is surely inadequate to address the broad range of energy alternatives available to TVA. It is especially inadequate by the standard of TVA’s 2007 strategic plan, which stressed efficiency as one of its top objectives:

In partnership with others, TVA will strive to be a leader in energy-efficiency improvements and peak demand reduction over the next five years. Improving energy efficiency and reducing peak demand are significant actions that help slow demand growth in a cost-effective manner while addressing air pollution and global climate change... Efficiency, conservation, and peak-shaving, along with on-site generation (such as photovoltaics), are key components of TVA’s energy resource mix.<sup>15</sup>

Besides its own strategic plan, the TVA, like other utilities, is also required by the Energy Independence and Security Act of 2007 (EISA 2007) to consider incorporating a “smart grid” and increase energy efficiency. The TVA has begun the process of implementing the smart grid provisions of EISA 2007 in 2009.<sup>16</sup> A smart grid is one in which there is communication between the consuming device (such as a clothes washing machine or a home air-conditioner)

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<sup>13</sup> Watts Bar FSEIS 2007 pp. 14-15

<sup>14</sup> Watts Bar FSEIS 2007 p. 19

<sup>15</sup> TVA Strategic Plan 2007 p. 13

<sup>16</sup> Federal Register 2009b

and the utility. Time of use electricity rates, the state of the system in terms of CO<sub>2</sub> emissions, and various other parameters can also be communicated, so that emissions can be minimized, customers can save money, and utilities can avoid the heavy expense of generating electricity during peak loads. Smart grids are also expected to play a significant role in the integration of renewable energy sources on a large scale into electricity supply systems

On June 25, 2009, the TVA solicited public comment<sup>17</sup> on its approach to the smart grid pursuant to EISA 2007, which is developed in a staff report.<sup>18</sup> Overall, the staff report has accepted the recommendations set forth in the law for pursuing energy efficiency and smart grids (with the departures having largely to do with the fact that the TVA is a federally-owned and not an investor-owned utility). For instance, the staff report recommends adopting all the policies regarding efficiency promoting rate structures set forth in EISA 2007 as being “fully consistent” with TVA policy.

Besides making time of use rates and other information available to consumers that will allow efficiency improvements and changes in consumer behavior in unprecedented ways, a smart grid will also allow for much greater integration of distributed renewable energy resources into the grid.<sup>19</sup> Further, as described below, large changes in efficiency are on the horizon and are likely to be mandated by federal energy and climate legislations.

This energy and economic environment would make an up-to-date analysis of future electricity demand, and hence the need for the project, essential for any major investment, even outside of the economic downturn. For instance, the TVA needs to establish that the expected increase in demand of 3,800 MW cannot be met by conventional efficiency and demand response approaches alone. It has not done so. Combinations of demand response and efficiency can meet demand growth as shown in, for instance, in an analysis of the Texas grid by the American Council for an Energy Efficient Economy (See Figure 1 at end of text).

.Note that over 90 percent of projected demand growth could be met by demand response and efficiency. In a parallel circumstance for TVA, Watts Bar would not be needed. Moreover, as noted above, the TVA Board has decided to emphasize efficiency, so that it should be incumbent upon TVA to make a thorough analysis showing that it could not do the job. The Watts Bar FSEIS has provided none.

In fact, the Watts Bar FSEIS does not provide a detailed analysis of any alternatives. Rather, the chapter on alternatives simply refers to other documents, including the 1972 Environmental Statement, which was written before the first energy crisis, and the 1995 IRP. The need for an analyses is not only essential for efficiency and demand response, but also for supply alternatives.

For instance, TVA’s statement in the FSEIS that WBN Unit 2 is needed for baseload capacity also reflects the outdated view that only fossil fuel or nuclear plants can supply baseload. However, this is no longer the case. For instance, the National Renewable Energy Laboratory

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<sup>17</sup> Federal Register 2009b

<sup>18</sup> TVA Staff Report 2009

<sup>19</sup> See for instance, Xcel Energy’s plans for a smart grid in the city of Boulder, Colorado. (Xcel Energy 2008)

(NREL) has developed and published the system concept for dispatchable wind energy.<sup>20</sup> The concept involves using wind power to supply electricity to the grid when the demand is there and to compress air for storage when there is excess wind energy supply. The stored air is heated using a small amount of natural gas and used to generate electricity in the same manner as normal large-scale compressed air storage facilities. The arrangement can be designed to supply dispatchable electricity at any desired load factor, with the appropriate matching of wind and storage capacity.

NREL's baseload wind energy concept, energy flows, wind generation, and grid supply are shown in Figures 2 through 5 (see at end of text), which are reproduced from the NREL publication already cited. The data presented in the figures show that it is possible at present to deploy a small amount of natural gas (about 400 to 1,200 Btu per kWh, depending on the capacity factor, as opposed to 7,000 Btu per kWh for a combined cycle power plant) to provide dispatchable wind. Emissions of CO<sub>2</sub> corresponding to these heat rates would be about 20 grams and 65 grams of CO<sub>2</sub> per kWh. Hence, such a power plant would reduce emissions relative to coal by 93 to 98 percent (which have emissions of almost 1,000 grams per kWh) and relative to natural gas by 85 to almost 95 percent depending on the mode in which it is deployed (baseload or intermediate load).<sup>21</sup> All technologies employed in this baseload wind scheme have been deployed on a large scale. In fact, TVA considered large scale compressed air energy storage on almost the same scale as Watts Bar Unit 2 as part of its 1995 IRP.<sup>22</sup>

Further, the wind energy industry has matured and become a major industry in the United States and elsewhere since the 1995 IRP and the 1996 ROD. For instance, the TVA considered 350 to 450 kW turbines at hub heights of 33 to 39 meters.<sup>23</sup> In 1996, the year that TVA published its ROD, only 1 MW of wind capacity was added and the total installed capacity was 1,703 MW.<sup>24</sup>

By contrast, in 2008, the additions to wind capacity were 8,545 MW and the total installed capacity was over 25,000 MW.<sup>25</sup> The total investment in the economy was about \$17 billion in 2009, which yields an average cost of about \$2,000 per kW. Typical turbine size installed was 1,500 kW to 2,500 kW.<sup>26</sup> Offshore wind is becoming a major industry in several countries. Hub height has increased from the 33 to 39 meters assumed by TVA in 1995 to well over 100 meters. The E-126 wind turbine is rated at 6,000 KW (about 15 times the average size that TVA was considering) and has a hub height of 126 meters.<sup>27</sup> This has immense significance, because the economical resources at 100 meters are generally considerably greater than the resources at heights of 50 meters or less, or even at 70 meters in some cases. Figures 6 and 7 (see at end of text) show maps of wind resources in Indiana at 50 meters and at 100 meters. Note that at 50 meters, there is no large discernible area in Indiana with a capacity factor of more than 30

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<sup>20</sup> NREL 2006

<sup>21</sup> Emission factors are from the EIA 2001 p. 140.

<sup>22</sup> Energy Vision 2020 1995 TD6, Options 1.2.2.1 and 1.2.2.2 (p. T6.2). The total capacity considered was 1,011 MW (3x337MW).

<sup>23</sup> Energy Vision 2020 1995 TD6 p. T6.8

<sup>24</sup> Typical additions to capacity in early 1990s were tens of MW per year. (AWEA 2009 p. 4)

<sup>25</sup> AWEA 2009 p. 4

<sup>26</sup> AWEA 2009 p. 2 and Appendix

<sup>27</sup> The specifications can be found on the Wind Power *Wind Turbines and Wind Farms Database* at <http://www.thewindpower.net/wind-turbine-datasheet-223-enercon-e126-6000.php>

percent, whereas at 100 meters over half the state appears have capacity factors of 30 percent or more. Of course, capacity factor is directly related to wind power economics: The higher the capacity factor, the cheaper the power.

The Watts Bar FSEIS takes none of these changed realities into account.

Finally, the 1972 ES is completely obsolete in regard to need. It was prepared prior to the first energy crisis in the context of 7 percent annual electricity growth experienced until 1970. TVA projected that it needed the plant for the 1977-2012 period and that any delays beyond 1977 would have a heavy economic cost. Further, the TVA claimed that such delays would risk increasing loss of load probability to an “unacceptable” level.<sup>28</sup> TVA’s dire forecasts in its EIS were wrong – fortunately, given the serious delays that did occur. Watts Bar Unit 1 did not come on line till 1996 and Unit 2 obviously has not yet been completed. Indeed, the 1995 IRP itself acknowledged that the TVA’s projections in the 1970 to 1975 period were huge overestimates – see Figure 8 (at end of text), which is reproduced from the 1995 IRP.

The 1972 EIS is of no value in determining need. Moreover, even the 1995 IRP is obsolete in regard to alternatives.

### **C. Internal Contradictions Regarding Reliance on 1995 IRP**

In the Summary of the FSEIS, TVA generally states that it relies for consideration of alternatives on the 1995 IRP, which is the most recent report that TVA has produced with regard to overall power planning and environmental impact:

In the 1972 FES for Watts Bar Units 1 and 2, TVA considered a number of alternatives to constructing and operating WBN, including the No Action Alternative. TVA is proposing to complete WBN Unit 2 as originally designed except for modifications consistent with those made to Unit 1. Consistent with the Council on Environmental Quality's National Environmental Policy Act (NEPA) regulations [§1502.4(D)], this document also tiers off of *Energy Vision 2020 - An Integrated Resource Management Plan and Final Programmatic Environmental Impact Statement* (TVA 1995a), the *Final Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor* (DOE 1999), and the *Reservoir Operations Study Final Programmatic Environmental Impact Statement* (TVA 2004a) and incorporates by reference the balance of the environmental record pertinent to WBN. As such, this FSEIS identifies no new alternatives to those already addressed in those documents.<sup>29</sup>

TVA’s statement that it relies on the 1995 IRP is also consistent with a recent Federal Register notice regarding the proposed update of the IRP, in which TVA stated that it intends to use the 1995 IRP for its decisions until the process for developing a new IRP is complete:

In the mid-1990s, TVA developed an integrated resource plan with extensive public involvement. This process was completed with publication of the Energy

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<sup>28</sup> TVA 1972, Section 1.2. The word in quotation marks is from page 1.2.9.

<sup>29</sup> Watts Bar FSEIS 2007 pp. S-1 and S-2

Vision 2020 IRP/Final EIS in 1995 and the associated Record of Decision in 1996. Based on the extensive evaluation, TVA decided to adopt a flexible portfolio of supply- and demand-side energy resource options to meet the growing demand for electricity in the region and achieve the goals of the TVA Act and other congressional directives. This portfolio of energy resource options, as amended through subsequent EISs, will be a baseline for evaluations conducted as part of this EIS process. As appropriate, TVA expects to continue to implement the existing portfolio of resource options during this EIS process.<sup>30</sup>

But TVA glosses over the fact that, although the 1995 IRP considered the completion and operation of Watts Bar Unit 2,<sup>31</sup> it was *not part of the preferred portfolio* selected by the TVA for implementation, which was described in the 1996 Record of Decision (ROD) as follows:

Portfolio options include: combustion turbines, the purchase of options for both base load and peaking power, improvements to the existing hydro system, purchases from independent power producers, combined cycle repowering of coal-fired plants, use of landfill and coalbed methane and refuse derived fuel, converting TVA's Bellefonte Nuclear Plant to an integrated combined cycle gasification plant with a chemical coproduct, one additional coal unit at TVA's Shawnee fossil plant, demand-side management programs, beneficial electrification programs, compressed air energy storage, wind turbines, a coal refinery, a biomass energy facility, and cascaded humidified advanced turbines. As events unfold, TVA can decide which of the portfolio options to deploy. Prior to deploying a specific resource option, TVA would conduct an appropriate site or project-specific environmental review that tiers off of Energy Vision 2020.<sup>32</sup>

In the FSEIS, TVA attempts to justify its departure from the 1995 IRP on the basis that:

TVA considered a number of alternatives to constructing and operating WBN, including the No Action Alternative, in its 1972 FES. In December 1995, TVA issued the IRP FEIS (TVA 1995a). As described in Section 1.3 of this document, the IRP FEIS analyzed a portfolio of options for meeting TVA's future power needs that were derived from the best strategies identified during a two-year process with extensive public input. The environmental impacts of energy resource options were evaluated as part of the IRP FEIS. Because of uncertainties about performance and cost, however, completion of WBN Unit 2 was not included in the portfolio of resource options selected by TVA for implementation. Keeping open alternatives that would meet the goals and objectives of the IRP FEIS, TVA did, however, reserve [sic] for future consideration completing WBN Unit 2. TVA is now, in the context of this SEIS process, reconsidering completion of WBN Unit 2. This is in large part due to the actual operating experience with TVA's nuclear plants which have achieved a capacity factor of 90 percent, a substantial improvement compared to what was projected in the IRP FEIS (67 percent) (see Section 1.3). In tiering off the original 1972 FEIS, the IRP FEIS, and the balance of the environmental record pertinent to WBN, this FSEIS identifies no new alternatives or resource options beyond those already addressed in those documents.<sup>33</sup>

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<sup>30</sup> Federal Register 2009 pp. 28323.

<sup>31</sup> Energy Vision 2020 1995 TD6. See Option 9.1.4.1, p. T6.42.

<sup>32</sup> Federal Register 1996 p. 7574

<sup>33</sup> Watts Bar FSEIS 2007 p. 19

But TVA can't have it both ways: it cannot rationally rely on the IRP and related studies for the consideration of alternatives, and at the same time ignore those studies because they reject WBN Unit 2 as a viable option for TVA's energy portfolio during the years 1995-2020. If TVA intends to reject the IRP analysis and substitute another, then it must provide that analysis in the FSEIS or wait and re-do the FSEIS after the IRP process it has started in 2009 is complete (see below). Further, as discussed above, the current economic crisis has made even the small amount of information about and projections of electricity sales in the FSEIS entirely obsolete.

The TVA is obligated to follow the elements of the preferred portfolio in the 1996 ROD unless there is a documented and major reason to diverge, for which economic and environmental reasons must be established. But that rationale would require either detailed analysis in the FSEIS or the updating of the IRP decision to include WBN Unit 2 as an element of the portfolio.

#### **D. Outdated Nature of FSEIS Demonstrated by TVA Plan to Update IRP**

TVA's own documents show that it has already established a decision-making process for updating the economic and alternatives analyses of the 1995 IRP. As TVA recognizes, in light of the significant changes that have occurred since publication of the 1995 IRP and its associated 1996 Record of Decision, a revised IRP is needed to revisit cost and impact questions and also address the mix of resources required by TVA going forward. On June 15, 2009, the TVA published a notice in the Federal Register soliciting public input on the scope of such an IRP and the associated environmental impact statement.<sup>34</sup> According to this Federal Register notice, the "preliminary" questions that the new IRP should address, and on which TVA has sought public comment, are:

- \* How should TVA measure its success in the future?
- \* *Should the current power generation mix (e.g., coal, nuclear power, natural gas, hydro, renewables) change? If so, how?*
- \* *Should renewable power be available and added in the Valley at a significant scale? If so, how?*
- \* How should energy efficiency and demand response be considered in planning for future energy needs and how can TVA directly affect electricity usage by consumers?
- \* What stewardship activities should TVA focus on over the next 10–20 years?
- \* *And how will all of this affect reliability and the price we pay for electricity?*<sup>35</sup>

The above quote makes it very clear and explicit that TVA is not at present in a position to provide answers to the above questions, including whether new nuclear power reactors should be included in its generation portfolio or whether existing partially complete reactors like WBN Unit 2, should be completed. TVA will not be in a position to do so until it completes the IRP process and provides answers to these questions in the present context.

The present context is, in many ways, like the period between the mid-1970s and the early 1980s when TVA's demand projections were so far off course. It was a time of rapidly changing and volatile fuel prices, a time of new national energy policies, a time when all aspects of the energy

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<sup>34</sup> Federal Register 2009 pp. 28322-28325

<sup>35</sup> Federal Register 2009 p. 28324, italics added.

situation from energy security to nuclear proliferation and environmental impacts are being re-evaluated. Moreover, the importance of the climate issue is now far greater than it was, as demonstrated by the recent passage by the House of Representatives of sweeping legislation that, if enacted into law in anything like its present form, will affect everything from fuel prices to the efficiencies of residential and commercial buildings.<sup>36</sup> A 30 percent improvement in new building efficiency after 3 years and a 50 percent improvement in less than ten years will make an enormous impact on electricity demand, the more so in the TVA region, where space and water heating are more oriented to electricity than is typical for the whole country. This one factor alone would necessitate a complete revision of TVA's demand projections. The Federal Register notice for the new IRP process recognizes the importance of the new situation, including climate change, which is mentioned three times in a four-page notice.

Further, it is clear that conditions have changed dramatically since 1995. We have already cited climate legislation, which, if passed and enacted into law, will profoundly affect the energy scene. Specifically, electricity demand growth will likely be considerably dampened. Further, the present economic crisis is deep, unlike the economically prosperous times of the mid-1990s.

Since the new IRP will also consider the mix of generation resources and the balance of generation with efficiency (in the context of the smart grid that the TVA is developing), a full reassessment of renewable energy technology is also needed.

## **E. Overall Conclusions Regarding the Need for the Project and Consideration of Alternatives**

The analysis in this report shows that the 1995 IRP is obsolete and cannot be used as the basis for deciding on electricity system planning or spending large sums of money on any single project, such as Watts Bar Unit 2 completion. The TVA has acknowledged as much by launching a new IRP process in June 2009 which seeks to establish, among other things, what the mix of TVA generation should be. The 1972 EIS, prepared before the first energy crisis (which was in 1973-1974) is hopelessly outdated and TVA's own analysis in the 1995 IRP had already established that.

Besides the various energy crises that have afflicted the United States since 1973, the climate crisis and impending legislation on energy and climate have also fundamentally changed the situation. For instance, drastic increases in energy efficiency starting in 2012 and continuing on to 2030, by which time new building efficiency is supposed to increase 70 percent according to House passed legislation, mean that forecasts of demand have to be reconsidered with new parameters. In addition there have been vast technological changes in renewable technology and there are currently ongoing basic changes in the management of the grid, through adoption of smart grid approaches. The TVA has just embarked on this process in June 2009, pursuant to the 2007 Energy Independence and Security Act.

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<sup>36</sup> For instance, the efficiency of new residential buildings is mandated to improve by 50 percent relative to the baseline code by 2014, 50 percent by 2017, and 70 percent by 2029. Commercial building efficiency is mandated to improve by the same amounts with a one year delay relative to the residential dates. (HR 2454 2009, Section 304 (a)(1))



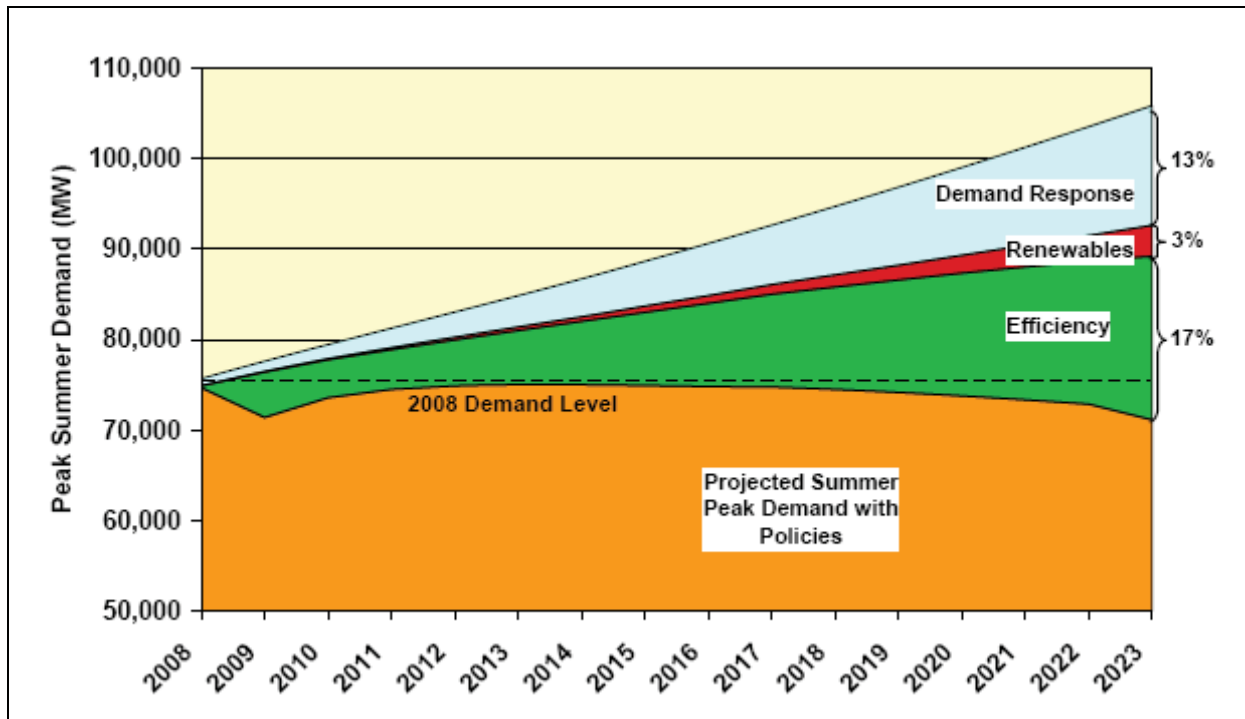
This FSEIS does not give any systematic consideration to these basic factors. Even the modest discussion in the FSEIS of electricity projections to the year 2015 have been rendered moot by the economic crisis. TVA electricity sales in 2009 are declining and are on a course to revert to 2004 or 2005 levels, which would make it lower than the lowest level projected in the FSEIS.

The TVA itself has acknowledged the severity of the problem in its latest quarterly filing with the Securities and Exchange Commission. Indeed, the present circumstances point to a repeat of the problems of the 1970s when the TVA kept forecasting business and usual load growth or something close to it, while demand suddenly became static or even dropped for some time, and did not go significantly beyond the peak in the mid-1970s for over a decade-and-a-half. (see Figure 8, at end of text, from TVA's 1995 IRP).

Major changes in technology, in the global and U.S. energy economies as a result of climate change considerations, and in the U.S. and regional TVA economies as a result of a severe and steep recession all indicate that the need for the plant has not been established. On the contrary, they point in the direction that the plant is not needed.

The process that the TVA has launched on June 15, 2009 to create a new IRP is the right one and it asks the kinds of questions that need to be answered before a decision is made to pursue large conventional fossil fuel or nuclear generation.

## Figures



**Figure 1: Fraction of summer peak demand that can be met with demand response, efficiency, and renewable resources**

Source: Reproduced from ACEEE 2007 page ix, with permission

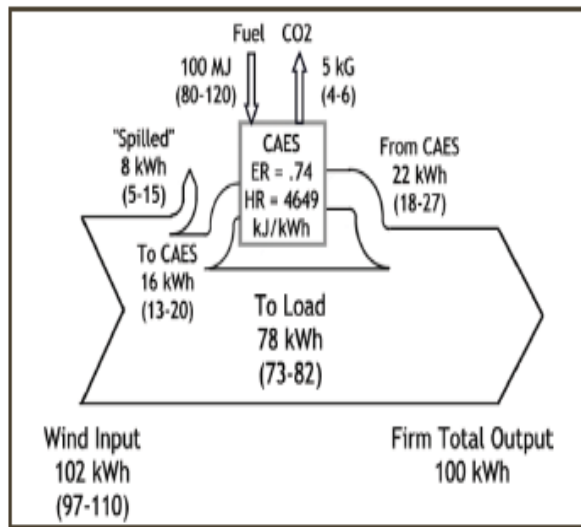


Figure 4: Energy Flow through a Baseload Wind Power Plant

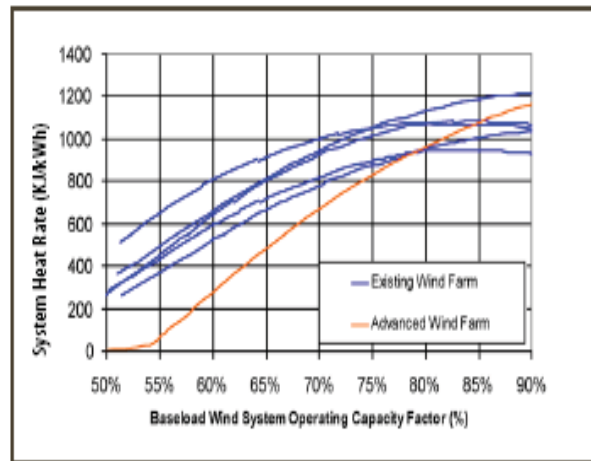


Figure 5: Baseload Wind Plant Fuel Requirements

Figures 2 and 3: Baseload wind with CAES

Source: National Renewable Energy Laboratory (NREL 2006)

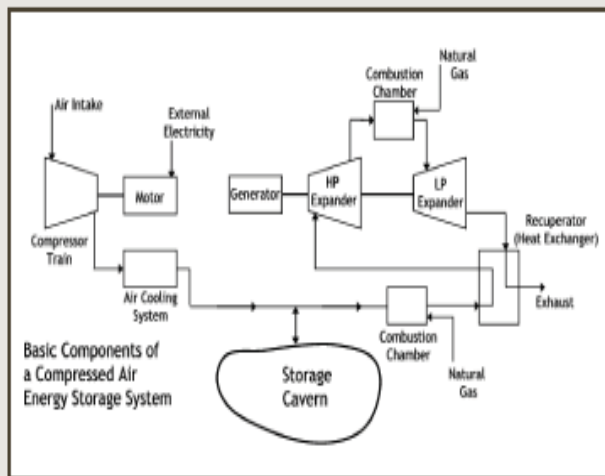


Figure 2. Basic Components of a Compressed Air Energy Storage System

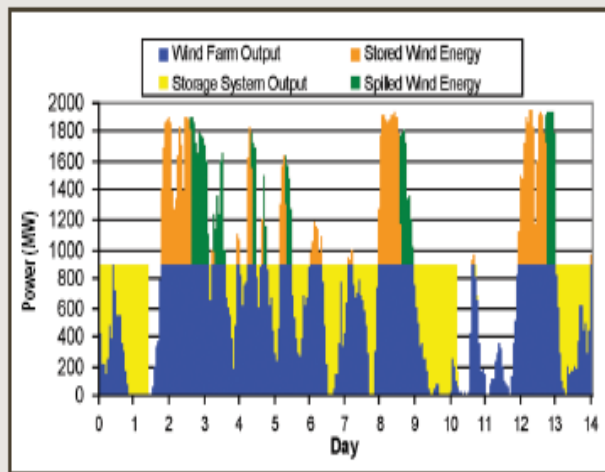
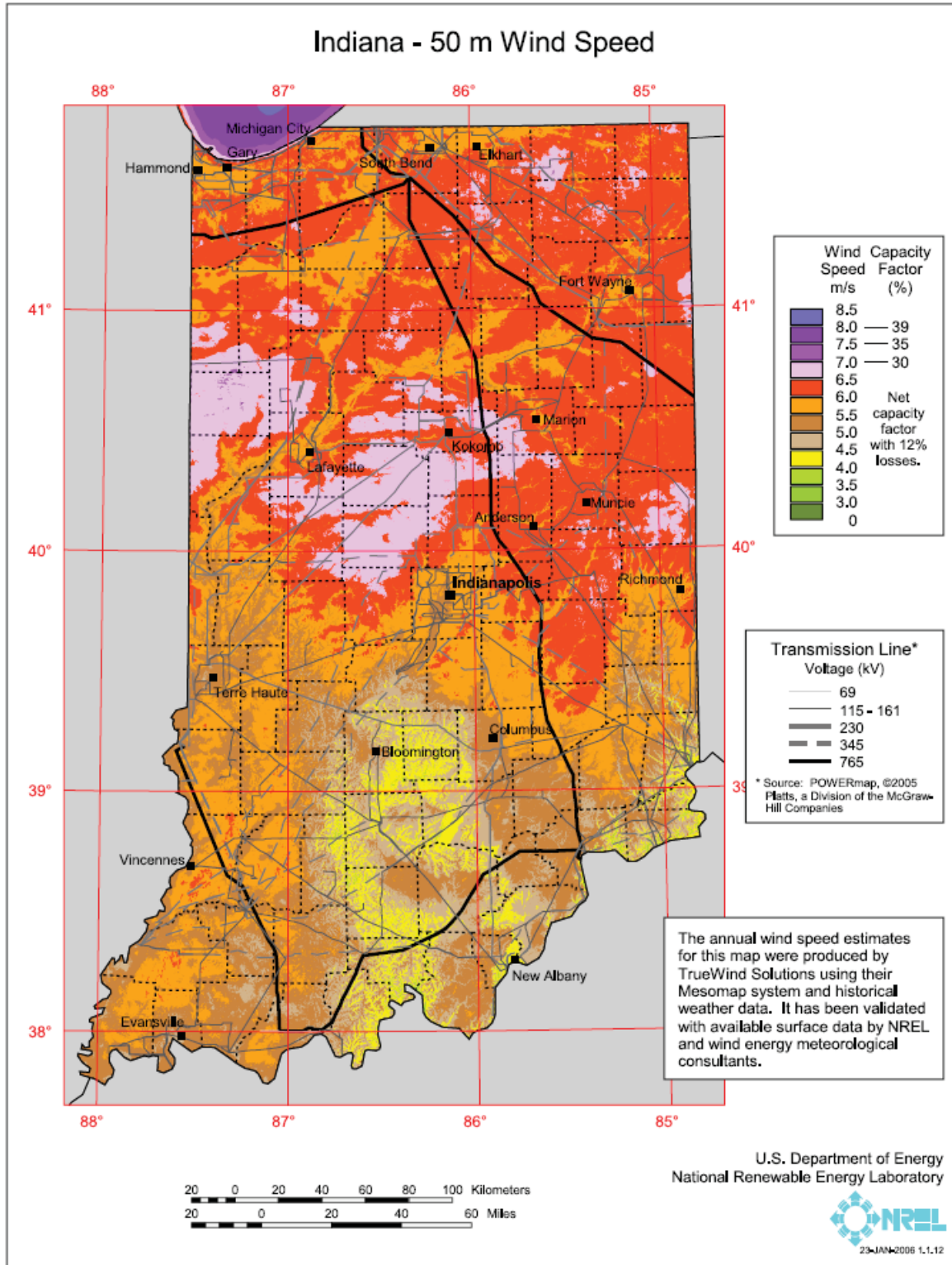


Figure 3. Sample Baseload Wind Generator Output (Target Output = 900 MW)

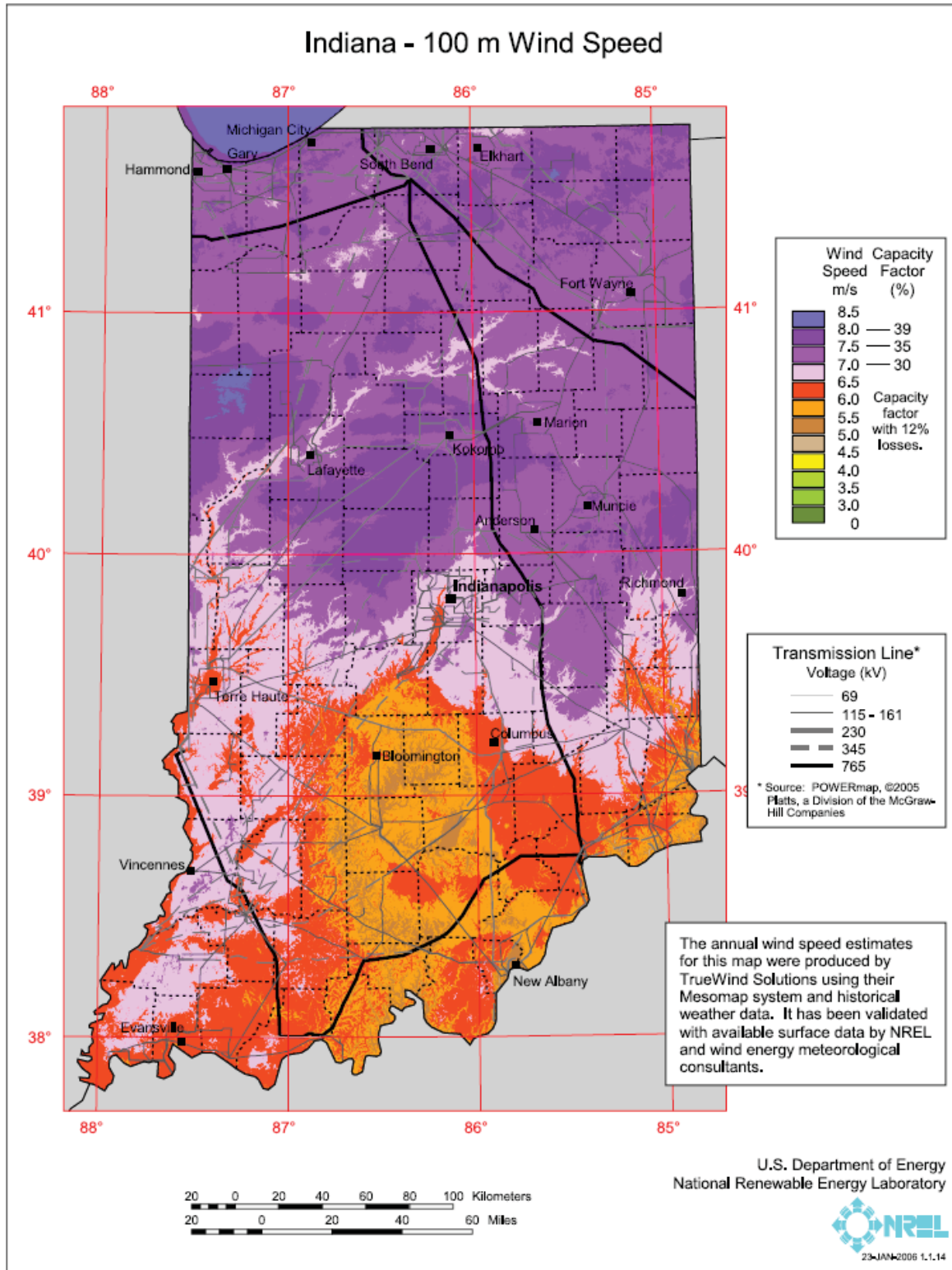
**Figures 4 and 5: Schematic for wind plus CAES and power supply to the grid**

Source: National Renewable Energy Laboratory (NREL 2006)



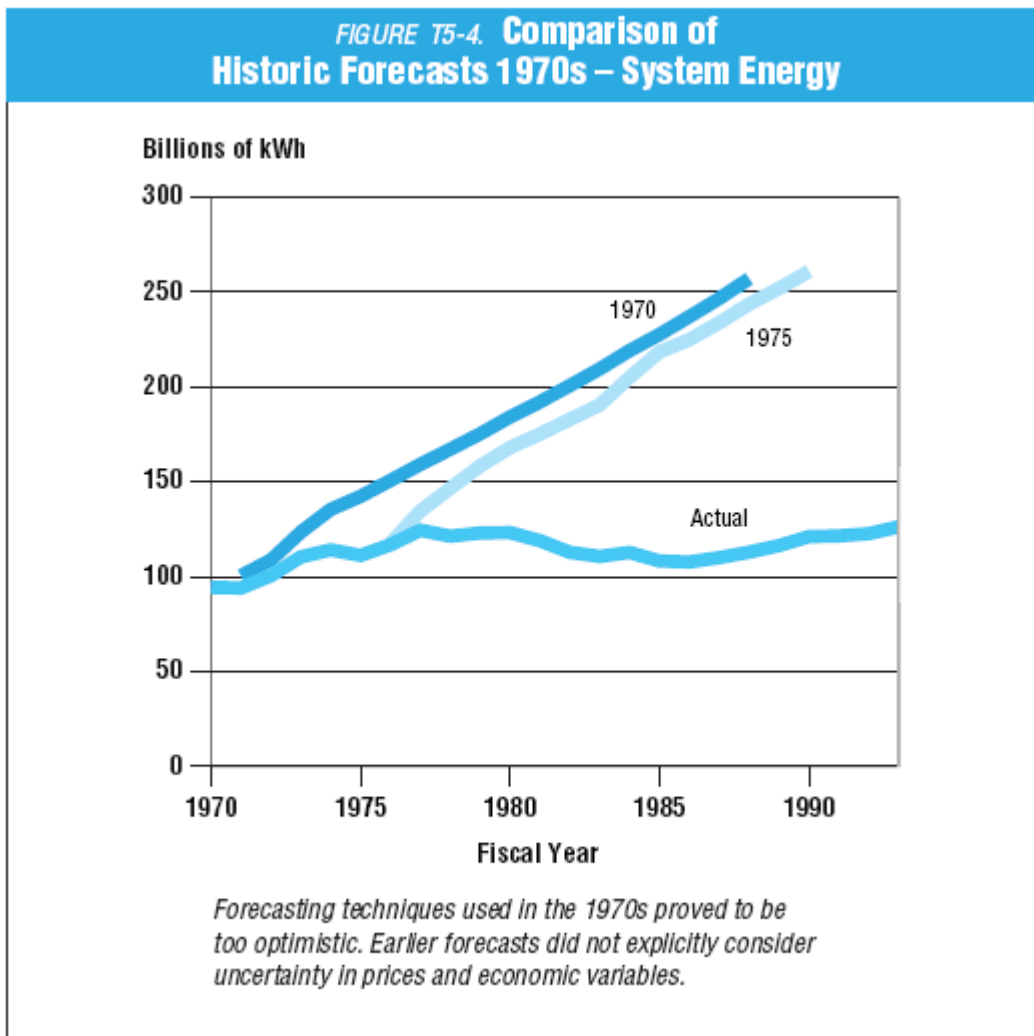
**Figure 6: Indiana Wind Map, 50 meters**

Source: National Renewable Energy Laboratory (NREL 2008 page 25, and <http://www.in.gov/oed/files/windpower1-1-12speed50mcap.pdf>)



**Figure 7: Indiana wind map, 100 meters**

Source: National Renewable Energy Laboratory (NREL 2008 page 25, and <http://www.in.gov/oed/files/windpower1-1-14speed100mcap.pdf>)



**Figure 8: TVA 1970 and 1975 forecasts compared to actual electricity use**  
 Source: Energy Vision 2020 1995 TD5 p. T5.3

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July 11, 2009

**UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION  
BEFORE THE SECRETARY**

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 In the Matter of
 

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Tennessee Valley Authority

(Watts Bar Unit 2)

Docket No. 50-391

**DECLARATION BY DR. ARJUN MAKHIJANI IN SUPPORT OF  
PETITIONERS' CONTENTIONS**

Under penalty of perjury, I, Dr. Arjun Makhijani, declare as follows:

1. I am President of the Institute for Energy and Environmental Research (IEER). IEER has been doing nuclear-related studies for more than twenty years and is an independent non-profit organization located in Takoma Park, Maryland. Under my direction, IEER produces technical studies on a wide range of environmental issues to provide advocacy groups and policymakers with sound scientific information and analyses as applied to environmental and health protection and for the purpose of promoting the understanding and the democratization of science.

2. I have a Ph.D. (Engineering), granted by the Department of Electrical Engineering of the University of California, Berkeley, where I specialized in the application of plasma physics to controlled nuclear fusion. I also have a master's degree in electrical engineering from Washington State University, and a bachelor's degree in electrical engineering from the University of Bombay. I am qualified by training and experience as an expert in the fields of plasma physics, electrical engineering, nuclear engineering, and energy-related technology and policy issues. I have extensive professional experience and am qualified as an expert in radioactive waste disposal standards for protection of human health from radiation, and the relative costs and benefits of nuclear energy and other energy sources. I have served as a nuclear engineering expert witness in lawsuits and testified on a variety of issues including the release of radioactivity from nuclear facilities. A copy of my curriculum vita is attached.

3. Over the past 25 years, I have developed extensive experience with nuclear fuel cycle-related issues, including standards and strategies for radioactive waste storage and disposal, accountability with respect to measurement of radioactive effluent from nuclear facilities, health and environmental effects of nuclear testing, strategies for disposition of fissile materials, energy efficiency, and other energy-related issues. As reflected in my

curriculum vita, which is attached, I have authored or co-authored many publications on these subjects. I have testified before Congress on several occasions regarding issues related to nuclear waste, reprocessing, environmental releases of radioactivity, and regulation of nuclear weapons plants.

4. Between 1997 and 2002, I was on the expert team monitoring independent audits of the compliance of Los Alamos National Laboratory with the radiation release portion of the Clean Air Act (40 CFR 61 Subpart H), conducted under a Consent Decree, which was the result of a federal court finding that Los Alamos was out of compliance with Subpart H. In that capacity I have reviewed extensive records, models, facilities, procedures, measurements, and other aspects of the Los Alamos National Laboratory air emissions control and measurement program in order to determine whether the audits were being properly conducted and whether they were thoroughly done. I am the principal author of an assessment of the radioactive waste management and disposal costs of depleted uranium from the National Enrichment Facility (2004 and 2005) and of an analysis of U.S. waste classification regulations. I was the director of a team that analyzed ANDRA's plans for a geological repository for high level radioactive waste in France on behalf of a French government-sponsored stakeholder committee (2004). I have also served as a member of the Radiation Advisory Committee of the U.S. Environmental Protection Agency's (EPA's) Science Advisory Board from 1992 to 1994 and on the EPA's Advisory Subcommittee on Radiation Standards, which is part of the National Advisory Committee on Environmental Policy and Technology. In addition, I have served as a consultant to numerous organizations, as mentioned in my CV.

5. I have written a number of books and other publications analyzing the safety, economics, and efficiency of various energy sources, including nuclear power and sustainable energy sources such as wind and solar energy. I was the principal author of the first evaluation of energy end-uses and energy efficiency potential in the U.S. economy (published by the Electronics Research Laboratory, University of California at Berkeley in 1971). I was also the principal author of the first overview study on *Energy and Agriculture in the Third World* (Ballinger 1975). This study included consideration of both traditional and modern energy sources. I was one of the principal technical staff persons of the Ford Foundation Energy Policy Project, and a co-author of its final report, *A Time to Choose*, which helped shape U.S. energy policy during the mid-to-late 1970s. I am co-author of *Investment Planning in the Energy Sector*, which is an economic model published by the Lawrence Berkeley Laboratory in 1975. I am also the author of *Nuclear Power Deception* (Apex Books 1999), an analysis of the costs for nuclear power in the United States. On behalf of the SEED Coalition, I have assessed the capital costs of proposed nuclear power reactors in South Texas (2008). In addition, I am the author of *Carbon-Free and Nuclear Free* (RDR Books and IEER Press 2007, reprinted in 2008), the first analysis of a transition to a U.S. economy based completely on renewable energy, without any use of fossil fuels or nuclear power. I have been a consultant on energy issues to several U.N. agencies, the Tennessee Valley Authority (TVA), the Lower Colorado River Authority, the Lawrence Berkeley Laboratory, Edison Electric

Institute, and the Congressional Office on Technology Assessment. I was elected a Fellow of the American Physical Society in 2007, an honor granted to at most one-half of one percent of APS members.

6. I have also done extensive work with respect to the health and environmental effects of nuclear weapons production. I am the principal author of the first independent assessment of radioactivity emissions from a nuclear weapons plant (1989) and a co-author of the first audit of the cost of the U.S. nuclear weapons program (*Atomic Audit*, 1998). I am also a co-author of the first global assessment of the health and environmental effects of nuclear weapons production (*Nuclear Wastelands*, 1995 and 2000), which was nominated for a Pulitzer Prize by MIT Press and the principal editor of this book.

7. I have reviewed TVA's 2008 Final Supplemental Environmental Impact Statement for Watts Bar Unit 2 ("FSEIS") and the documents that it cites with respect to the need for power and alternative sources of energy, including TVA's 1972 Final Environmental Statement for construction of Watts Bar 1 and 2, the NRC's 1995 Final Environmental Statement for operation of Watts Bar 1 and 2, and TVA's Integrated Resource Plan (1995).

8. I am responsible for the factual content and expert opinions expressed in the attached report entitled "Watts Bar Unit 2: Analysis of Need and Alternatives." The facts presented in my report are true and correct to the best of my knowledge, and the opinions expressed therein are based on my best professional judgment.



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Dr. Arjun Makhijani

July 11, 2009

July 13, 2009

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

BEFORE THE SECRETARY

In the Matter of	)	
Tennessee Valley Authority	)	Docket No. 50-391
(Watts Bar Unit 2)	)	

PETITION TO INTERVENE AND REQUEST FOR HEARING

I. INTRODUCTION

Pursuant to 10 C.F.R. § 2.309 and the notice published by the Nuclear Regulatory Commission (“NRC” or “Commission”) at 74 Fed. Reg. 20,350 (May 1, 2009), Petitioners Southern Alliance for Clean Energy (“SACE”), Tennessee Environmental Council (“TEC”), We the People (“WTP”), the Sierra Club, and Blue Ridge Environmental Defense League (“BREDL”) hereby request a hearing and petition to intervene in this proceeding regarding the Tennessee Valley Authority’s (“TVA’s”) updated application for a facility operating license (“OL”) for the Watts Bar Nuclear Plant (“WBN”) Unit 2. Petitioners’ standing to intervene is described in Section II of this pleading, and Petitioners’ contentions are set forth in Section III.

This proceeding is highly unusual in that TVA’s updated OL application follows a lengthy hiatus in the WBN Unit 2 OL proceeding: TVA submitted its Final Environmental Statement for construction of WBN Units 1 and 2 in 1972 (TVA, Final Environmental Statement, Watts Bar Nuclear Plant Units 1 and 2 (1972) (“FES”)), and was issued construction permits for both units in January 1973. Final Supplemental Environmental Impact Statement for the Completion and Operation of Watts Bar Nuclear Plant Unit 2, at 5 (2007) (“FSEIS”). TVA

doubts about the effectiveness of the voluntary measures that TVA has implemented at these reactors to address GSI-189.

The information provided in the SAMA Analysis is thus insufficient to determine whether the alternate power supply for the hydrogen igniters will be effective and reliable, and whether the benefits of a more robust backup power supply would potentially be cost-beneficial and worthy of more detailed analysis. TVA should provide adequate information to evaluate the reliability of the power supply. It should also examine a reasonable range of measures for ensuring the reliability of the alternate power supply to the hydrogen igniters. Issues that should be considered include: mandatory dedication of the power supply; independence of the backup power supply to the igniters from backup power to other systems; and seismic qualification.

**Contention 4: Inadequate Discussion of Need for Power and Energy Alternatives**

The discussion of the need for power and alternatives in Sections 1.6, 2.0 and 2.6 of the FSEIS for WBN Unit 2 is inadequate to satisfy NEPA because TVA fails to demonstrate that the power which will be generated by the proposed plant is actually needed. TVA also fails to justify its rejection of less financially and environmentally costly alternatives for generating additional power or for reducing demand through energy efficiency measures.<sup>4</sup>

**Basis and Discussion**

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<sup>4</sup> As discussed above in Section I, Petitioners are aware that ordinarily, at the operating license stage, the NRC does not require consideration of the need for power. 10 C.F.R. §§ 51.53(b), 51.95(b). In this case, however, TVA has stated that the purpose of the FSEIS – as described in both the title and the body of the document -- is not just to support TVA's operating license, but to update TVA's 1972 EIS for construction of the plant. Therefore, neither § 51.53(b) nor 51.95(b) bars the admission of this contention. If the Atomic Safety and Licensing Board ("ASLB") should rule otherwise, Petitioners intend to submit a waiver petition pursuant to 10 C.F.R. § 2.335(b).

This contention is supported by the expert Declaration of Dr. Arjun Makhijani (July 10, 2009) (Attachment 4), and by his expert report, *Watts Bar Unit 2: Analysis of Need and Alternatives* (July 10, 2009) (“Makhijani Report”) (Attachment 5).

The NRC interprets its NEPA-implementing regulations to require construction permit applicants to evaluate the need for power and energy alternatives. As the Commission has explained:

Prior to the start of construction there has been little environmental disruption at the proposed site and only a relatively small capital investment has been made by the license applicant. Hence, real alternatives to the construction and operation of the proposed facility exist, including no additional generating capacity at all if no “need” exists or generation of the needed electricity by some non-nuclear source. In issuing this proposed rule, the Commission in no way diminishes the importance that attaches to having the most accurate possible assessment of need for power and alternative sources during the construction permit review.

Proposed Rule, Need for Power and Alternative Energy Issues in Operating License Proceedings, 46 Fed. Reg. 39,440 (August 3, 1981). TVA estimates that Watts Bar Unit 2 is sixty percent complete, with significant expenditures and modifications still to be made. FSEIS at 19.

Therefore, it is appropriate to revisit the question of need and alternatives.

As discussed in Dr. Makhijani’s report, TVA’s analysis of the need for power and alternatives is deficient in the following respects:

1. TVA’s energy demand projections are based on outdated studies, including TVA’s 1972 FES and TVA’s 1995 Integrated Resource Plan and Environmental Impact Statement (“1995 IRP”). As discussed in Dr. Makhijani’s Report at 7, the predictions of energy demand in the 1972 FES were so wildly optimistic that the delay of almost two decades in completion of WBN Unit 1 and the suspension of WBN Unit 2 did not affect TVA operations, even though construction of several other reactors was also suspended during the same period. Makhijani Report at 3, 7 and Figure 8. WBN Unit 1 did not even come on-line until 1996. *Id.*



The 1995 IRP is also outdated in a number of respects, including costs of alternatives; the state of various technologies that can be used as a baseload; and the effects of impending climate legislation on increasing efficiency. This is reflected in the fact that TVA recently instituted a process for revising the IRP by noticing its intent to publish a new EIS. TVA, Notice of Intent, Environmental Impact Statement; Integrated Resource Plan, 74 Fed. Reg. 28,322 (June 15, 2009) (“TVA Notice Regarding IRP Update”).

2. TVA also relies on the 1995 IRP in a manner that is arbitrary and inconsistent with TVA’s own policies and procedures. TVA acknowledges that the 1995 IRP specifically excludes completion of construction and operation of WBN Unit 2 from the “preferred portfolio” of energy options that it intended to pursue between 1995 and 2020. TVA tries to rationalize a departure from the 1995 IRP, however, arguing that the 1995 IRP underestimates the capacity factor for TVA’s nuclear plants. FSEIS at 19.

But this argument is not relevant because the demand forecast used in the FSEIS is already obsolete, as is the 1995 IRP. In fact, a higher capacity factor would only result in a higher potential for new generation at a time when demand is running well below 2008 levels. TVA cannot definitively state when the region will emerge from the current crisis and demand will grow beyond its peak in 2008. Makhijani Report at 2 and 3. Demand in the first half of 2009 was six percent below 2008 and at that rate is set to revert back to 2004 or 2005 levels by the end of the fiscal year. And TVA would be trying to sell more power in a context where demand is declining more generally due to the severe economic crisis and the increase in unemployment in the region. TVA’s claim that completing Watts Bar would lower electricity costs and emissions (FSEIS at 19) is not supported by any analysis as to whether costs would be lowered in the context of declining demand and lacks any comparative analysis as to whether

costs and emissions might be lowered even more if the same investments were made in efficiency and demand response. Makhijani Report at 3-4.

3. TVA also fails to justify its disregard of the energy planning process developed in the 1995 IRP. This process resulted in a “portfolio” of energy options that TVA determined was environmentally-optimal after preparing an EIS and subjecting it to public comment. Makhijani Report at 7-8. *See also* Issuance of Record of Decision, Tennessee Valley Authority, 61 Fed. Reg. 7,572 (February 28, 1996) (“TVA’s preferred alternative, the Energy Vision 2020 portfolio, contains all of the resource options that perform best under the environmental criteria and from this perspective, the portfolio can be viewed as environmentally preferable.”) If TVA wants to alter the decision reflected in the 1995 IRP, it should follow its own established procedures for revising the IRP. In fact, that process has already begun, and TVA offers no reason for disregarding it. TVA Notice Regarding IRP Updated, 74 Fed. Reg. at 28,322.

4. The FSEIS contains no analysis of the effects of the nationwide economic crisis or its effects on the TVA region, including huge increases in unemployment in the TVA region since 2007 and serious declines in power sales. Makhijani Report at 2-4. TVA’s most recent report to the Security and Exchange Commission (“SEC”), for example, states that “[s]ales of electricity are about six percent below 2008 levels and could decline further if commercial and industrial employers continue to reduce production in response to the economic downturn.” Quoted in Makhijani Report at 3.

5. The FSEIS does not contain any discussion of alternative sources of energy or alternatives to reduce demand. Makhijani Report at 4. TVA’s disregard of energy efficiency measures as an alternative is not only unreasonable from a practical standpoint, but is also

inconsistent with TVA's own 2007 strategic plan, which stresses efficiency as one of TVA's top objectives. Makhijani Report at 5.

TVA also ignores the fact that it is required by the Independence and Security Act of 2007 to consider incorporating a "smart grid" and increasing energy efficiency. *Id.* Smart grids are expected to enable better demand response and help to integrate renewable energy sources into electricity systems on a large scale. TVA has issued a report adopting policies to increase energy efficiency and promote smart grids and started the process of taking public comment on its staff report, but this is not reflected in the FSEIS. *Id.* at 5. *See also* TVA, Notice of Consideration of Energy Efficiency and Smart Grid Standards, 74 Fed. Reg. 30,360 (June 25, 2009).

6. The FSEIS does not provide a detailed analysis of any alternatives. Makhijani Report at 4-6. Moreover, TVA cannot rationally rely on the 1995 IRP's discussion of alternatives because it effectively rejected the 1995 IRP's analysis of alternatives when it decided to pursue operation of WBN Unit 2. Makhijani Report at 9.

7. The FSEIS also contains the mistaken implication that only a nuclear or fossil fuel plant can satisfy the need for baseload capacity. FEIS Section 2.0 and Makhijani Report at 6. Based on this false premise, TVA also states that the operation of Watts Bar 2 will allow it to reduce its dependence on fossil fuel. FSEIS, Section 2.6. This is no longer the case as the production of cleaner and more sustainable renewable energy sources, such as wind energy, has matured and become a major industry both in the United States and abroad. Makhijani Report at 6-7. For example, the National Renewable Energy Laboratory has developed and published a system for dispatching wind energy that has minimal CO<sub>2</sub> emissions. Makhijani Report at 5-6.

8. For numerous reasons set forth throughout Dr. Makhijani's Report, completion of the process for revising the IRP is necessary before TVA can claim that it has made an adequate and reasonable assessment of the need for power and alternative energy alternatives. These reasons include: TVA demand in 2009 is running at a rate well below the lowest projection in the FSEIS, the fact the present downturn resembles in some essential ways the situation the earlier energy crisis of the 1970s and early 1980s, which was so severe that demand in the TVA region did not recover and go steadily beyond its mid-1970s levels until well into the 1990s, TVA's own commitment to use the 1995 IRP process to make decisions about energy options until a new IRP process is complete, the fact the TVA itself has in effect acknowledged that its 1995 IRP is obsolete by launching a new IRP process in June 2009, the requirements of the 2007 Energy Independence and Security Act of 2007, the likely changes that will be wrought as part of impending climate legislation, and the vast technological changes that are currently ongoing in the electricity production and management sectors.

**Contention 5: Inadequate Basis for Confidence in Availability of Spent Fuel Repository and Safe Means of Interim Spent Fuel Storage**

The NRC published both its Proposed Waste Confidence Decision and its Proposed Spent Fuel Storage Rule on October 9, 2008. 73 Fed. Reg. 59,547 and 59,551. Neither the Proposed Waste Confidence Decision nor the Proposed Spent Fuel Storage Rule satisfies the requirements of NEPA or the Atomic Energy Act, and thus do not provide adequate support for any NEPA determination in this proceeding regarding the environmental impacts of spent fuel storage or disposal. The deficiencies in the Proposed Waste Confidence Decision also fatally undermine the adequacy of the NRC's findings in Table S-3 of 10 C.F.R. § 51.51 to satisfy NEPA.

