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Sequoyah License Renewal
Comment
NRC-2013-0037

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From:
Gretel Johnson
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Mothers Against Tennessee River Radiation

Articles to be considered in the environmental review

1) Sequoyah License Extension, Docket ID NRC-2013-0037
2) Executive Summary Energy Efficiency in the South
3) GAO Report GAO-12-107 – Tennessee Valley Authority, Full Consideration of Energy Efficiency and Better Capital Expenditures Planning Are Needed.
4) Improving Spent-Fuel Storage at Nuclear Reactors
5) Leaked Report Suggests Long-Known Flood Threat To Nuclear Plants, Safety Advocates Say
6) Nuclear Tornadoes

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Add= E. Gaypool (ECS4)

Ann Harris
Gretel Johnston

Bellefonte Efficiency & Sustainability Team

B.E.S.T.

A local chapter of Blue Ridge Environmental Defense League

April 3, 2011

Cindy Bladey, Chief, Rules, Announcements, and Directives
Branch (RADB), Office of Administration,
Mail Stop: TWB-05-B01M,
U.S. Nuclear Regulatory Commission,
Washington, D.C. 20555-0001

re: Sequoyah License Extension, Docket ID NRC-2013-0037

Dear NRC Environmental Impact Analysts:

As a representative of Mothers Against Tennessee River Radiation (MATRR), I come to this scoping session to express our concerns about Tennessee Valley Authority's (TVA) requested 50% beyond-design-life-span license extension for their Sequoyah Nuclear Power Plant (SQN) and about the Environmental Impact Statement they have submitted for Nuclear Regulatory Commission (NRC) and National Environmental Protection Act (NEPA) review.

First, we think it is important to challenge the stated assumption that, "Possible alternatives to the proposed action (license renewal) include no action and reasonable alternative energy sources," given that only nuclear and gas power plants are considered as "reasonable alternative energy sources."[1] We assert that Energy Efficiency and Renewable Energy are "reasonable alternative energy sources" that need to be identified and evaluated in the Supplemental Environmental Impact Statement (SEIS). To support our claim, we enter into the record multiple studies showing that Energy Efficiency Programs are definitively more economically viable and environmentally "reasonable alternative energy sources" than nuclear or gas power plants.

All of the power generated by Sequoyah can be replaced by energy efficiency alone and new power can be generated with renewable sources, such as wind or solar. In fact, Energy Efficiency Programs can readily replace the existing power and provide for future power needs – offering significantly more jobs, coming 'on-line' more quickly, and enhancing the quality of life of TVA rate-payers by improving the efficiency of our homes, reducing monthly electric bills, and improving our environment by not emitting toxic waste. According to a Georgia Tech and Duke University study, assertive energy efficiency programs in one decade in the south alone can create 380,000 new jobs and lower utility bills by $41 billion, while eliminating the need for new power plants for two decades, and saving 8.6 billion gallons of fresh water.[2]

And if more energy does need to be generated, solar is now less expensive than nuclear, and a 2012 federal report on renewable energy states that Tennessee alone has the technical potential of generating well over 2 million GWh of utility scale solar power.[3]

Rather than "reasonable alternative energy sources", we believe this false assumption of limited options is biased toward environmentally unsound choices requiring the use of dirty nuclear and fossil fuels rather than the best replacement of existing power – which is first and foremost that of demand reduction through energy efficiency and heat recycling, and secondly through environmentally sustainable renewable energy such as wind and solar. That the SEIS has not included these options with its nuclear and gas generation alternatives indicates how behind-the-times TVA seems determined to remain, no matter what the cost to rate-payers or the environment.[4] The NRC should not accept this assessment of environmental impact without studying and reasonably adjusting these basic assumptions about viable alternatives.

Our next area of concern is the compromised integrity of reactor containment at Sequoyah. This is a basic line of defense for the environment against nuclear contamination, and the very fact that the reactor designers did not allow for replacement of the generators is cause for concern – along with the design fault issue of the ice-condensers being placed too near the reactors causing them to jam up in the baskets and not perform their designed cooling functions. TVA cut through the concrete and metal containment and lifted the top off the reactors secondary containment vessel in order to replace a generator that was not designed to be replaced. We consider this a "beyond-design-basis event" that was created, rather than mitigated, by the utility company. The fact that TVA was willing to cut into and compromise the nuclear containment, in order to cut costs for their nuclear program, shows an unacceptable lack of quality control and little concern for the safety and health of the environment for well over a million people in the area.

Another deliberately fabricated "beyond-design-basis" ongoing event is the extended use of spent fuel cooling pools as storage tanks, rather than the temporary circulating cooling pools they were designed to be. As originally designed, and as recommended by a National Academy of Sciences study commissioned for Congress and Homeland Security in 2005, radioactive trash (or spent fuel) should be moved from the cooling pools into dry cask storage after 5 years, not continually packed into the vulnerable cooling pools. As Robert Alvarez states in the 2012 submitted article, "Improving Spent-Fuel Storage at Nuclear Reactors," nuclear safety studies for decades have said severe accidents can occur at spent fuel pools and the consequences could be catastrophic. "A severe pool fire could render about 188 square miles around the nuclear reactor uninhabitable, cause as many as 28,000 cancer fatalities, and cause $59 billion in damage, according to a 1997 report for the NRC by Brookhaven National Laboratory."[5]

Sequoyah has well over a thousand metric tons (about 2.5 million pounds) of highly radioactive waste with a history of improper storage.[6] In 2010, for example, about 75% of 30 years of spent fuel was being stored in cooling pools. While this is better than the 100% pool storage record at Watts Bar and the 88% record at Browns Ferry, this clearly indicates the lack of attention by the corporate culture of TVA to the maintenance and security warranted by a nuclear power utility, which indicates a potential threat to our environment. The concentration of fuel, transfer and storage plans, and scheduled implementation of those plans needs to be identified and evaluated in the Safety Evaluation Report.

Other concerns are potential non-deliberate "beyond-design-basis events," such as floods and tornadoes. TVAs dams are aging and maintenance has been spotty at best. Many valley residents are concerned over the possibility of a catastrophic flood being caused by one or more dam failures. Dams were not built to the same earthquake safety standards as the power plants and one dam failure could trigger a domino effect upstream of nuclear power plants, possibly overwhelming the planned backup systems should 'all hell break loose'.

Responsible maintenance is another issue of concern. When tornadoes took out power to Browns Ferry for several days in 2011, two of the eight backup power generators were inoperable when the tornado hit and a third generator was shut down the next day. That is a 40% failure rate. If TVA maintenance is not keen for nuclear power plants, where NRC oversight is physically in effect daily, one wonders about the quality of maintenance at the many aging TVA dams upstream from Sequoyah. Multiple dam failure scenarios need to be identified and evaluated for the Safety Evaluation Report.[7]

We all know, from watching the Fukushima helicopters desperately dropping water on the reactors and cooling pools stranded without power backup generators, that nuclear power plants ironically must have a constant supply of power and of pumped water in order to prevent the environmental horror of reactor and/or cooling pool meltdowns.

Another lesson of Fukushima is the necessity of preparedness for multiple events or even compound disasters. In the Tennessee Valley, we have what many here call a tornado corridor. Please note the submission, for the record, of the map of TVA nuclear power plants 50 mile radii superimposed on the NOAA Tornado Track of the April 2011 outbreak in this area.[8] The Safety Evaluation Report for Sequoyah needs to identify and evaluate not only the dual dangers of floods and tornadoes, but also the potential consequences of combined and compound disasters on the environment of our valley.

National Severe Storms Forecast Center reported 29-31 tornadoes within a 30 nautical mile radius of Sequoyah in the 37 year period between 1950 and 1986. Within the next fifteen year period ending in 2002, they reported 23 tornadoes in that same area [9] nearly doubling the incidence of tornadoes in the 30 nautical (34.5 U.S. mile) radius. This record was up to the year 2002, and does not appear to address the increased incidence, size, and ferocity of tornadoes associated with the ongoing problem of climate change.

According to the NOAA tornado track of the April 2011 outbreaks, here entered into the record, there appear to be about 15 tornadoes within that same radius,[10] and according to the SEIS, three tornadoes touched down within 10 miles of Sequoyah (according to Kenneth Wastrack, TVA, personal communication).[11] The increasing frequency, size, and severity of tornadoes due to climate change is a potential environmental hazard that needs to be identified and evaluated in the SEIS and Safety Evaluation Report.

Although your statisticians predict unlikely odds of a direct tornado hit on Sequoyah, we are not confident with TVA gambling on the odds of a nuclear tornado disaster any more than we are comfortable with predicted cancer mortality rates around each nuclear power plant. It appears that the TVA SEIS staff as well as the concerned citizen activists who have focused on this request for a renewal license can only address a percentage of the issues that need to be identified and evaluated for our safety. The very volume of issues necessary to mitigate the hazards and

Environmental Impact of extending the Sequoyah Nuclear Power Plant operating license another 50% beyond its design-basis life span, indicates the number of potential and known problems with this inherently dangerous radioactive technology – and its potential and already known deleterious impacts on the human environment.

We know that energy efficiency programs can 'supply' the energy we need at less cost for TVA and at greater benefit to the people of this valley. We also know that renewable electricity can be generated for less money and with significantly less risk to human habitat. What we do not know is why the NRC continually enables an industry that is willing to gamble with human lives and habitats, despite the "reasonable alternative energy sources" of energy efficiency and renewables. Thank you for your consideration of our concerns and for your service at the Nuclear Regulatory Commission.

BEST wishes,

Gretel Johnston, co-founder
Mothers Against Tennessee River Radiation

for BEST/MATRR
Bellefonte Efficiency & Sustainability Team (BEST)
Mothers Against Tennessee River Radiation (MATRR)

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1. <Executive Summary Energy Efficiency in the South.pdf>,
2. ~~<NREL-RenewablesByState_7'12.png>~~, <Energy Savvy Nuclear vs. EE>
3. <GAO_TVAneedsEE&$Plan_'11.pdf>,
4. <Alvarez_spentfuel_'12.pdf>,
<Huffington_DamDanger_'12.pdf>,
<_TornadoMapFinal.pdf>

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1 Nuclear Regulatory Commission, "License Renewal Application for Sequoyah Nuclear Plant, Units 1 and 2, Tennessee Valley Authority," *Federal Register*, March 8, 2012, [Docket Nos.: 50–327, 50–328; NRC–2013– 0037], http://www.gpo.gov/fdsys/pkg/FR-2013-03-08/pdf/2013-05491.pdf

2 Marilyn Brown, Etan Gumerman, Oiaojing Sun, Youngsun Baek, Joy Wang, Rodrigo Cortes, and Diran Soumonni, "Energy Efficiency in the South," Southeast Energy Efficiency Alliance, Atlanta, GA, April 12, 2010, http://www.aaec.arkansas.gov/Solutions/Documents/ReportEfficiencyInTheSouth.pdf

3 Anthony Lopez, Billy Roberts, Donna Heimiller, Nate B;air, Gian Porro, "U.S. Renewable Energy Technical Potentials", National Renewable Energy Laboratory, NREL/TP-6A20-51946, July 2012, Tables No. 2 and No. 3, www.nrel.gov/docs/fy12osti/51946.pdf

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8 Roy Simmons for BEST/MATRR, "Nuclear Tornados?" map, compiled from NOAA map and NRC & TVA data, May, 2011, http://candel.net/_TornadoMapFinal.pdf

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10 NOAA, "Tornado Tracks: April 27 through 29th, 2011," http://www.srh.noaa.gov/srh/ssd/mapping/

11 TVA, "Final Supplemental Environmental Impact Statement: Sequoyah Nuclear Power Plant Units 1 & 2 License Renewal," June 2011, Chapter 3, page 134, http://www.tva.com/environment/reports/sqn-renewal/seis/chapter_3.pdf

ENERGY EFFICIENCY IN THE SOUTH

Marilyn A. Brown,[1] Etan Gumerman,[2]
Xiaojing Sun,[2] Youngsun Baek,[1] Joy Wang,[1] Rodrigo Cortes,[1]
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April 12, 2010

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EXECUTIVE SUMMARY

The economic recession, climate change concerns and rising electricity costs have motivated many states to embrace energy efficiency as a way to create new local jobs, lower energy bills, and promote environmental sustainability. With this surge of interest in energy efficiency, policymakers are asking how much wasted energy can be eliminated by expanding investments in cost-effective technologies and practices.

This report describes the results of primary in-depth research focused on the size of the South's energy-efficiency resources and the types of policies that could convert this potential resource into reality over the next 20 years. We limit the scope of our analysis to energy-efficiency improvements in three sectors: residential and commercial buildings and industry (RCI). Our rigorous modeling approach – applied uniformly across the multi-state region and accompanied by a detailed documentation of assumptions and methods – separates this study from many previous assessments of energy-efficiency potential.

The major findings are listed below.

1. **Aggressive energy-efficiency initiatives in the South could prevent energy consumption in the RCI sectors from growing over the next twenty years.**

   The initiatives would involve actions at multiple levels (state and local, national, utility, business, and personal). In the absence of such initiatives, energy consumption in these three sectors is forecast to grow by approximately 16% between 2010 and 2030.

2. **Fewer new power plants would be needed with a commitment to energy efficiency.**

   Our analysis of nine illustrative policies shows the ability to retire almost 25 GW of older power plants – approximately 10 GW more than in the reference case. The nine policies would also avoid over the next twenty years the need to construct 49 GW of new plants to meet a growing electricity demand from the RCI sectors.

3. **Increased investments in cost-effective energy efficiency would generate jobs and cut utility bills.**

   The public and private investments stimulated by the nine energy-efficiency policies would deliver rapid and substantial benefits to the region. In 2020, energy bills in the South would be reduced by $41 billion, electricity rate increases would be moderated, 380,000 new jobs would be created, and the region's economy would grow by $1.23 billion.

The cost/benefit ratios for the modeled policies range from 4.6 to 0.3, with only two showing costs greater than benefits. When the value of saved CO_2 is included, only one policy is not cost effective, and it could be tailored to reduce the amount of subsidy.

4. **Energy efficiency would result in significant water savings.**

   The electricity generation that could be avoided by the nine energy-efficiency policies in the South could in turn conserve significant quantities of freshwater consumed for cooling. In the North American Electric Reliability Council (NERC) regions in the South, **8.6 billion gallons of freshwater could be conserved in 2020 (56% of projected growth in cooling water needs) and in 2030 this could grow to 20.1 billion gallons of conserved water (or 45% of projected growth).**

Methodology and Background

The research team used a modified version of the National Energy Modeling System (NEMS) for its analysis, which is referred to as "SNUG-NEMS" (SNUG is short for the Southeast NEMS Users Group). By employing a hybrid approach using both the "bottom-up" and "top-down" modeling features of SNUG-NEMS and Global Insight's macroeconomic model, we are able to characterize a host of complicated interactive effects that are important, but often overlooked consequences of energy and climate policies. These include:

- the interaction of multiple energy efficiency policies on one another and their effect on the final demand for energy;

- the interaction of demand-side policies on supply-side trends;

- the feedback of energy efficiency policies on energy prices, and the subsequent (i.e., second-order) effect of prices on energy demand; and

- the interaction of energy-efficiency policies with the implementation of a carbon constrained future that puts a price on carbon.

We do not examine the impact of energy-efficiency investments on peak demand reductions. While clipping system peaks is critical to improving electric system performance, we treat this as an ancillary benefit of energy efficiency. Nor do we examine the role of demand-response or load-management programs aimed strictly at shifting on-peak consumption to off-peak hours.

The geographic scope covered by this report is defined by the U.S. Census Bureau's definition of the South, composed of the District of Columbia and 16 States stretching from Delaware down the Appalachian Mountains, including the Southern Atlantic seaboard and spanning the Gulf Coast to Texas. The South is the largest and fastest growing region in the United States, with 36% of the nation's population and a considerably larger share of the nation's total energy consumption (44%) and supply (48%). It produces a large portion of the nation's fossil fuels, and the vast majority of the energy it consumes is derived from fossil resources.

Relative to the rest of the country, the South consumes a particularly large share of industrial energy, accounting for 51% of the nation's total industrial energy use. In addition, the region has a higher-than-average per capita energy consumption for each of the end-use sectors covered in this report: the South consumes 43% of the nation's electric power, 40% of the energy consumed in residences, and 38% of the energy used in commercial buildings. This energy-intensive lifestyle may be influenced by a range of factors including:

- the South's historically low electricity rates,
- the significant heating and cooling loads that characterize many southern states,
- its relatively weak energy conservation ethic (based on public opinion polls),
- its low market penetration of energy-efficient products (based on purchase behavior) and
- its lower than average expenditures on energy-efficiency programs.

If the South could achieve the substantial energy-efficiency improvements that have already been proven effective in other regions and other nations, carbon emissions across the South would decline, air quality would improve, and plans for building new power plants to meet growing electricity demand could be downsized and postponed, while saving ratepayers money.

Magnitude of the Energy-Efficiency Resource in the South

The U.S. Energy Information Administration projects energy consumption in the RCI sectors of the South to increase over the next 20 years, expanding from approximately 30,000 TBtu in 2010 to more than 35,000 TBtu in 2030 (Figure ES.1).

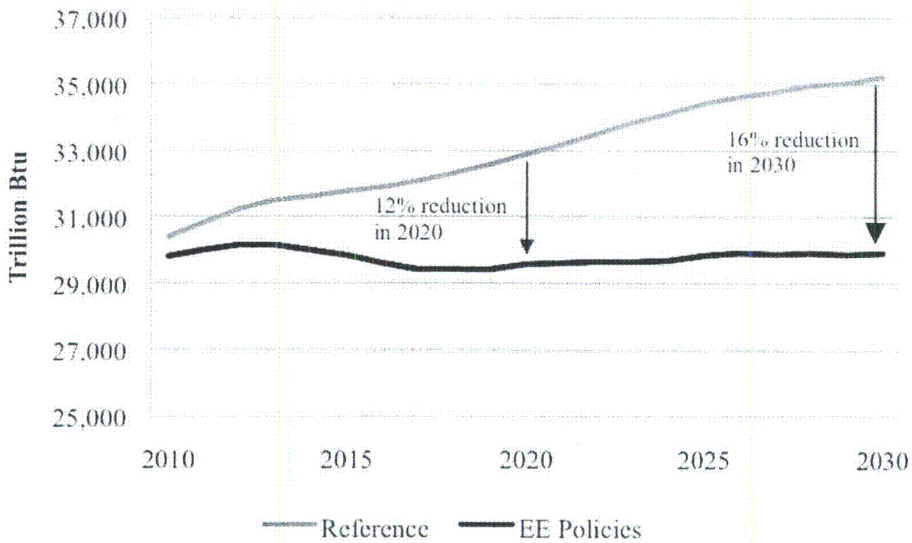

Figure ES.1 Primary Energy Consumption Projections (RCI Sectors) in the South

With the nine energy-efficiency policies, energy consumption does not grow over the next 20 years. This flat consumption trajectory represents a 16% reduction in energy consumption in 2030 relative to the reference forecast, or a savings of 5,600 trillion Btu (that is, 5.6 quads) in that year.

Energy-Efficiency Potential, by End-Use Sector. Among the three energy demand sectors in the South, the potential for improved energy efficiency is greatest in the commercial building sector in terms of percent energy reductions (Figure ES.2), while industrial sector has the largest absolute energy saving.

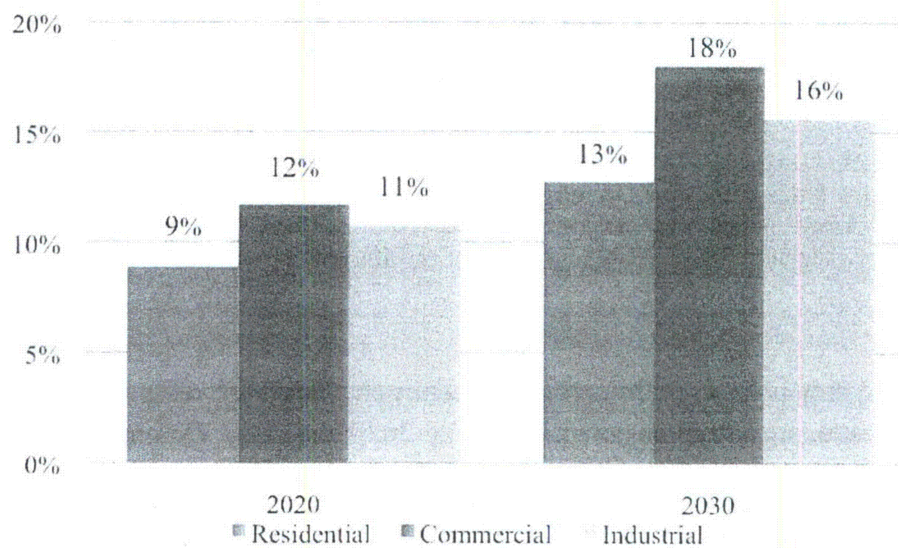

Figure ES.2 Energy-Efficiency Potential by Sector, in 2020 and 2030

Energy-Efficiency Potential, by Policy. Figure ES.3 portrays the energy-efficiency potential of each of the nine policies evaluated in this study.

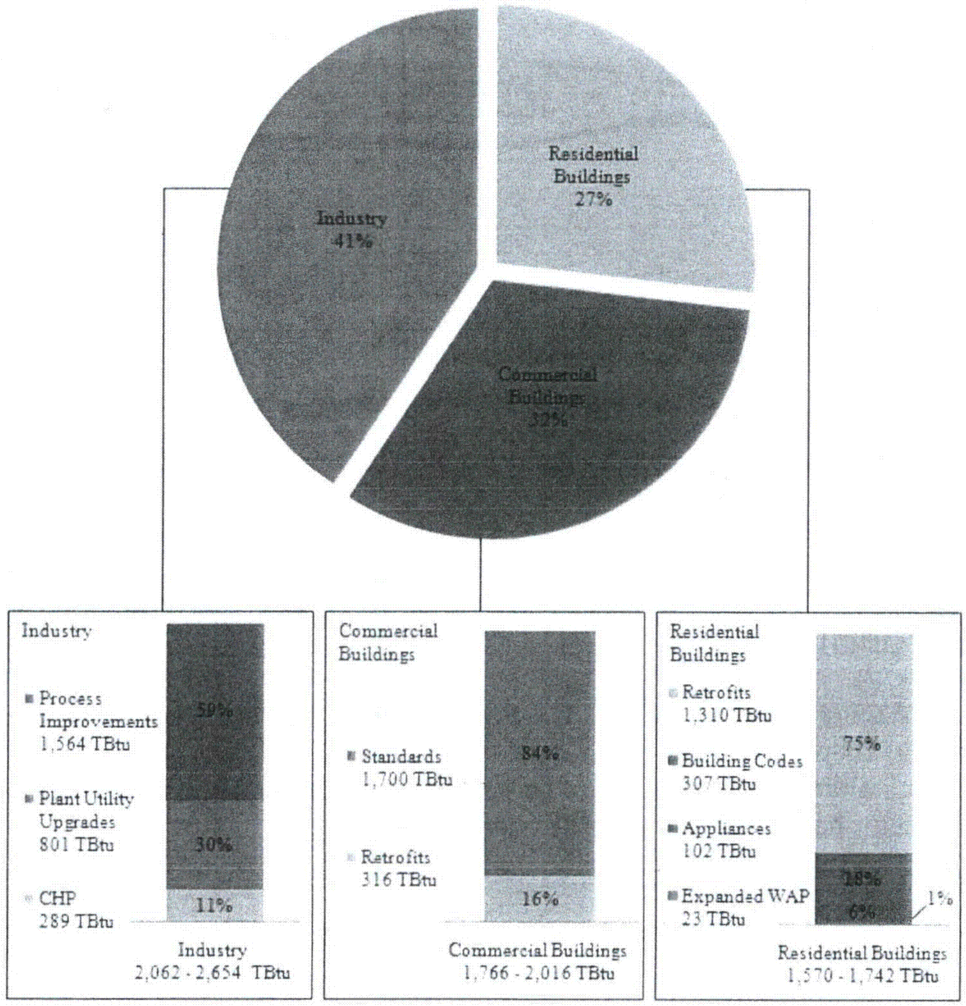

Figure ES.3 Energy-Efficiency Potential by Sector and Policy, in 2030*
(*The range of energy-efficiency potential shown for each sector reflects differences from summing individual policy estimates, SNUG-NEMS modeling of specific sectors, and economy-wide modeling estimates.)

- Of the nine policies, commercial appliance standards are estimated to have the greatest energy-savings potential in both 2020 and 2030. Commercial retrofit incentives account for additional cost-effective energy savings potential.
- In the industrial sector, process improvements could save significant quantities of natural gas and other fossil fuels. Significant industrial savings are also possible through policies that promote plant utility upgrades and incentives for combined heat and power systems.

- In the residential sector, retrofit incentives combined with equipment standards for heating, cooling, and water heating, is the dominant policy in terms of estimated energy-savings potential. It accounts for more than the other three residential policies combined (building codes, appliance standards, and expanded weatherization).

Impact on Power Plant Construction

By 2030, the Reference Scenario forecasts the need for an increase of 49 GW of electricity capacity in the southern National Electricity Reliability Council (NERC) regions above the capacity in operation in 2010 (Figure ES.4). This growing demand is expected to be met primarily by the addition of new combined cycle natural gas plants and new combined natural gas/diesel plants, along with some additional nuclear power, coal plants, and renewable power generation. Some oil and natural gas steam plants are retired during this period, as well. This is represented by the part of the bar in Figure ES.4 that is below the zero axis.

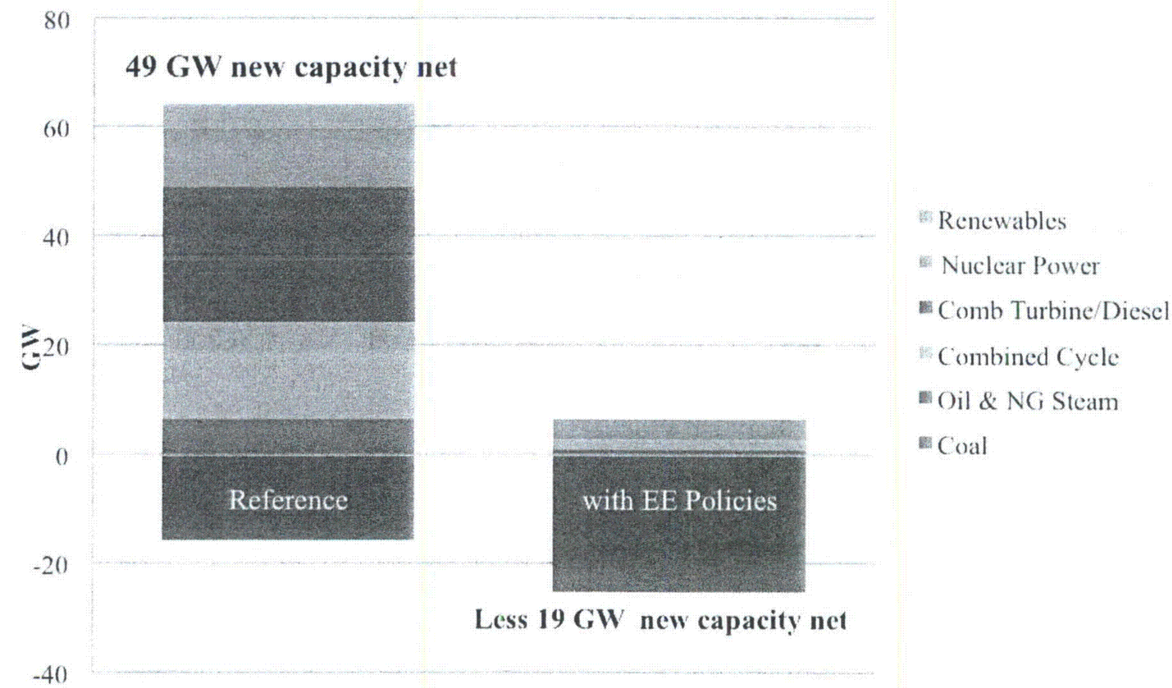

Figure ES.4 Incremental Generating Capacity in 2030 Beyond 2010 -- Southern NERC Regions

In contrast, implementation of vigorous energy-efficiency policies could eliminate the need to expand overall capacity between 2010 and 2030; in fact, the electricity capacity in the Southern NERC regions could decrease over the 20-year period by 19 GW. While new plants are needed, their capacity is more than offset by plant retirements. In addition to retiring more than 20 GW of oil and natural gas steam plants and some natural gas capacity, the energy-efficiency policies eliminate the need for all but 7 GW of new capacity, most of which is expected to be nuclear and natural gas powered, based on the SNUG-NEMS model. Very little new renewable capacity is added in this Energy-Efficiency scenario because the addition of new capacity of any type is minimized, and most renewable power options exceed the cost of power production by new combined cycle natural gas plants.

Economic Impacts

The public and private investments stimulated by the energy-efficiency policies outlined in this study could reduce energy bills in the South, moderate electricity rate increases, create new employment opportunities, and expand the region's level of economic activity (i.e., Gross Regional Product) (Table ES.1).

Table ES.1 Economic and Employment Impacts of Energy-Efficiency Policies in the South

	2020	2030
Annual Energy Savings (billion $2007)	$40.9	$71.0
Annual Public and Private Investment (billion $2007)	$15.8	$22.4
Annual Increased Employment (From Productive Investment and Energy Savings) (in full-time-equivalents)	380,000	520,000
Impact on Gross Regional Product (GRP) (billion $2007)	$1.23	$2.12

Energy Bill Savings. Consumers in the South could save $41 billion in reduced energy bills in the year 2020 as a result of the portfolio of nine energy-efficiency policies. These energy bill savings increase to $71 billion in 2030. For example, a typical household in the South would save $26 on its monthly electricity bill in 2020, and would save $50 each month in 2030. In addition to directly benefiting the consumers who make energy-efficiency investments, these policies benefit all consumers because the reduction in overall energy consumption causes energy prices to rise more moderately than would otherwise occur.

Electricity Rate Impacts. The portfolio of nine energy-efficiency policies modeled together would lead to a moderation of the energy price escalation that is otherwise forecast to occur over the next two decades (Table ES.2). For example, **residential electricity rates in 2030 would be 17% lower in the Energy-Efficiency scenario than in the Reference Scenario.** The reduced prices resulting from improved energy efficiency occur for both electricity and natural gas and across all sectors. The moderating impact on electricity rates grows over time as electricity consumption declines relative to the Reference case.

Table ES.2 The Effect of Energy-Efficiency Policies on Expected Southern Electricity Rates

	2015	2020	2025	2030
Residential	-3%	-8%	-11%	-17%
Commercial	-1%	-6%	-8%	-13%
Industrial	-3%	-8%	-11%	-16%

Employment Impacts. The public and private investments stimulated by the energy-efficiency policies outlined in this study will have a positive impact on employment in the South. The electric utility and the natural gas sectors directly and indirectly employ about 5.6 and 8.4 jobs, respectively, for every $1 million of spending in the South. But, sectors vital to energy-efficiency improvements, like construction and manufacturing, generate 16.5 jobs per $1 million of spending.[1] (All of the remaining sectors in the South have an average employment coefficient of 13.9 jobs per million dollars of spending.) By diverting expenditures away from non-labor intensive sectors, energy-efficiency policies can positively impact employment growth.

The results shown in Table ES.1 are based on (1) this study's estimated energy savings and investment costs from implementing nine energy-efficiency policies, (2) national, regional, and state input-output coefficients provided by the Minnesota IMPLAN Group for 2008, and (3) calculators developed by the American Council for an Energy Efficient Economy, the Center for American Progress, and the President's Council of Economic Advisors.

Policies that drive a higher level of efficiency investments can create new jobs quickly, and can sustain a favorable employment balance because of the utility bill savings that foster long-term growth in other productive sectors of the economy. The combination of direct and indirect job growth attributed to the energy-efficiency policy scenario is estimated to be 380,000 in 2020 and 520,000 in 2030. In comparison, there were 5.4 million unemployed residents in the South at the end of 2009.[2]

[1] These estimates are based on 2008 IMPLAN data.
[2] Bureau of Labor Statistics. (2010) Civilian labor force and unemployment by state and selected area, seasonally adjusted (Last modified: January 22, 2010, Accessed: March 9, 2010). http://www.bls.gov/news.release/laus.t03.htm

Impact on Gross Regional Product (GRP). A vigorous commitment to energy efficiency would have a small, positive impact on the level of economic activity of the South. Specifically, the GRP of the South would increase by $1.23 billion in 2020 and by $2.12 billion in 2030. These changes are small relative to the South's $4.7 trillion economy in 2007.[3]

Cost-Effectiveness of the Portfolio of Energy-Efficiency Policies

As Table ES.3 shows, the portfolio of nine energy-efficiency policies is cost-effective. The two policies addressing commercial buildings have the highest combined ratio of benefits to costs using the "total resource cost test." Over the 20-year period, an investment of $31.5 billion[4] would generate energy bill savings of $126 billion. Energy bill savings would begin immediately in 2010, would grow through 2030, and would then taper off until 2050 when the useful life of the improved technologies is expected to end. The result is a benefit/cost (B/C) ratio of 4.0 for the commercial sector. That is, for every dollar invested by the government and the private sector, four dollars of benefit is received. The industrial and residential sector policies are similarly cost effective with B/C ratios of 3.4 and 1.3.

The savings from the greater efficiency stimulated by these nine policies would total approximately $448 billion in present value to the U.S. economy. It would require an investment over the 20-year planning horizon of approximately $200 billion in present value terms. These costs include both public program implementation costs as well as private-sector investments in improved technologies and practices.

Among the nine individual policies, only two have benefit/cost ratios of less than one – indicating that they are not cost-effective. These include appliance incentives and standards (with a B/C ratio of 0.3) and combined heat and power incentives (with a B/C ratio of 0.7). When clothes washers and refrigerators are removed from the suite of appliance standards with incentives, the B/C ratio rises to 0.7. When carbon dioxide emission reductions are valued at a range of $15 per metric ton in 2010 rising to $51 in 2030), both of these policies approach or exceed the breakeven B/C ratio of 1.

According to the total resource cost test, the most cost-effective policy is tighter commercial appliance standards (with a B/C ratio of 4.6) followed by B/C ratios of 4.5 for industrial plant utility upgrades and 4.1 for residential building codes with third-party verification. These high B/C ratios combined with the fact that we examined an incomplete set of policies and technologies suggests that greater levels of investment could generate additional, cost-effective energy savings.

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[3] Bureau of Economic Analysis. (2008). GDP by State. http://www.bea.gov/newsreleases/regional/gdp_state/gsp_newsrelease.htm.
[4] In 2007 dollars, using a 7% discount rate.

Table ES.3 Total Resource Cost Tests by Sector (Million $2007)			
Residential Sector Policies			
	NPV Cost	NPV Benefit	B/C Ratio
Building Codes with Third-Party Verification	$10,000	$41,400	4.1
Appliance Incentives and Standards	$25,500	$7,060	0.3
Expanded Weatherization Assistance Program	$5,840	$6,420	1.1
Residential Retrofit and Equipment Standards	$86,600	$119,000	1.4
Combined Policies	**$115,000**	**$143,000**	**1.3**
Commercial Sector Policies			
	NPV Cost	NPV Benefit	B/C Ratio
Tighter Commercial Appliance Standards	$26,300	$109,000	4.6
Commercial Retrofit Incentives	$8,540	$20,900	2.4
Combined Policies	**$31,500**	**$126,000**	**4.0**
Industrial Sector Policies			
	NPV Cost	NPV Benefit	B/C Ratio
Industrial Plant Utility Upgrades	$10,800	$48,400	4.5
Industrial Process Improvement Policy	$36,000	$128,811	3.6
Combined Heat and Power Incentives	$16,900	$11,400 $17,600*	0.67 1.04*
Combined Policies	**$53,200**	**$179,000**	**3.4**

* Includes the environmental benefits from CO_2 emissions avoided by CHP systems.

Water Conservation from Energy Efficiency

Water conservation is an important co-benefit of policies that promote the efficient use of electricity. Based on a water calculator developed for this project, the freshwater consumed in the process of cooling conventional and nuclear thermoelectric power plants in the Southern NERC regions is forecast to grow to 334 billion gallons in 2020 and 381 billion gallons in 2030.

Implementation of the nine Energy-efficiency policies examined here could avoid generation that in turn would save southern NERC regions 8.6 billion gallons of freshwater in 2020 and 20.1 billion gallons in 2030. On a percentage basis, this represents 56% of the projected growth in water consumption over the next decade, and 43% of the projected growth for the following decade. These savings in 2030 represent about one-quarter of the current total water needs of the City of Atlanta.

Policy Supply Curves for Energy Efficiency in the South

Energy-efficiency supply curves have typically focused on individual technologies. Since the emphasis of this report is on energy-efficiency potential that is achievable with policy initiatives, we have developed policy supply curves. The magnitude of energy demand resources that can be achieved by launching aggressive energy-efficiency policies is shown along the horizontal axis, and the vertical axis presents the levelized cost of delivering these energy demand resources. The policies are ordered from the lowest to the highest levelized cost. Only the electricity supply curve is presented here, in Figure ES.5. Chapter 6 also presents energy-efficiency supply curves for total energy savings and natural gas. In all cases, we focus on the year 2020.

The electricity efficiency supply curve for the South (Figure ES.5) illustrates how more than 2,000 TBtu of electricity savings could be realized from implementing eight energy-efficiency policies. (The combined heat and power policy could not be assigned a levelized cost value.)

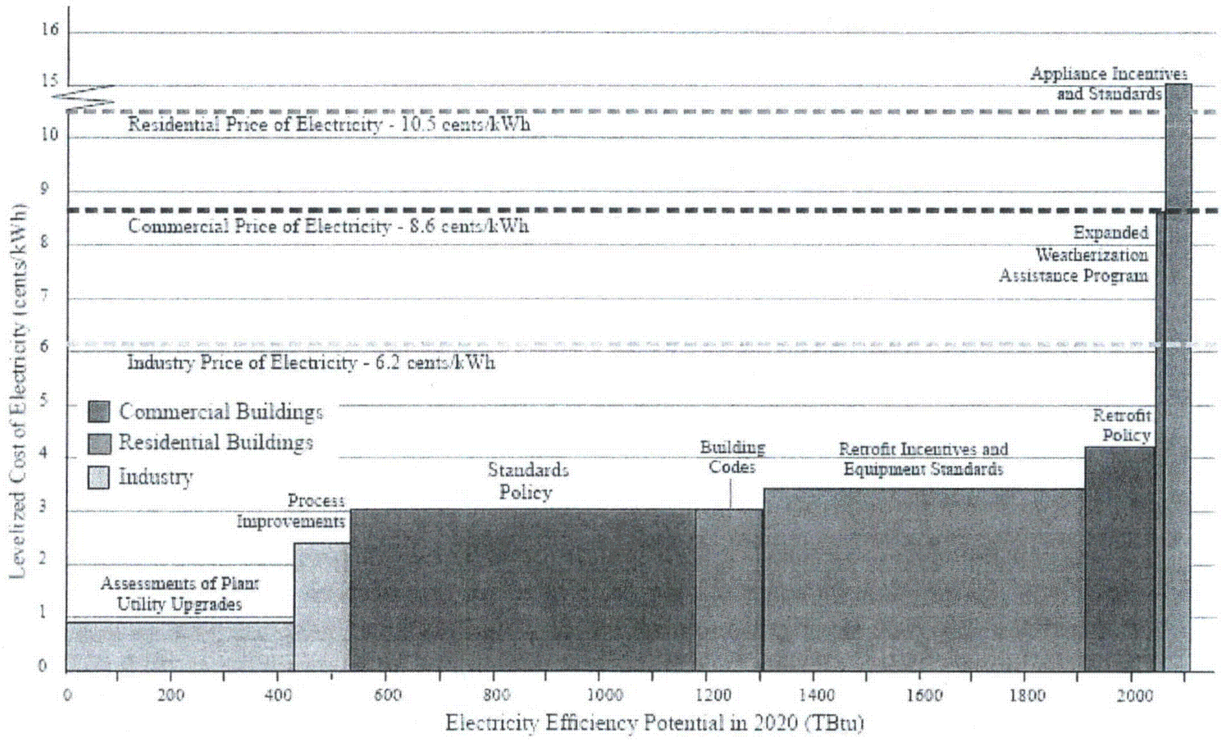


Figure ES.5 Supply Curve for Electricity Efficiency Resources in the South in 2020 (RCI Sectors)

The supply curve also highlights the large, low-cost potential of industrial efficiency opportunities, which together could save more than 500 TBtu of electricity for a levelized cost that is significantly lower than the price of electricity for industrial consumers (6.2 cents/kWh). The next most cost-effective efficiency option is the commercial standards policy, followed by building codes, bringing the cumulative savings for these four policies to nearly 900 TBtu. When the retrofit incentives and equipment standards are added, a large additional savings can be achieved. The three remaining policies do not save as much electricity and are more costly.

The natural gas supply curve distributes approximately 1,450 TBtu of savings across the eight efficiency policies. Commercial standards and residential building codes offer particularly low-cost, but somewhat limited natural gas savings. Industrial plant utility upgrades and process improvements, on the other hand, offer low-cost and large-scale opportunities for natural gas savings in the South.

Carbon Constrained Sensitivity Analysis

An analysis of the sensitivity of our study's findings to a particular key parameter was undertaken to ensure the analysis helps capture some of the uncertainties associated with SNUG-NEMS forecasting. This sensitivity is called the Carbon-Constrained Future (CCF). It was chosen because the national regulation of greenhouse gases appears possible and will affect how energy-efficiency policies are perceived and implemented. The scenario is modeled by assuming a \$15/tCO_2 price on carbon in 2010, increasing linearly to \$51/tCO_2 in 2030.

Given our interest in how energy-efficiency policies interact with other supply- and demand-side initiatives, we evaluated the CCF constraint both on its own and in the presence of energy-efficiency polices. In this combined set up of CCF + energy-efficiency policies, the effect of efficiency policies on consumption under the assumption of a Carbon Constrained Future appears to be additive. That is, the efficiency policies reduce consumption by approximately the same increment when added to either the Reference scenario or the CCF.

However, this is not to say that there is no interactive effect at all. Rather, the interaction is apparent when examining the reduction in CO_2 emissions. **Emission reductions from energy-efficiency policies result from the consumption of less energy, while the reductions from the Carbon-Constrained Future result primarily from switching to cleaner fuels. When these two policy scenarios are imposed simultaneously, the interactions between them grow over time, as the cleaner fuels predicted in a CCF scenario become the fuels not consumed as the result of energy-efficiency investments. This effect is noticeable in Figure ES.6 starting around 2025.**

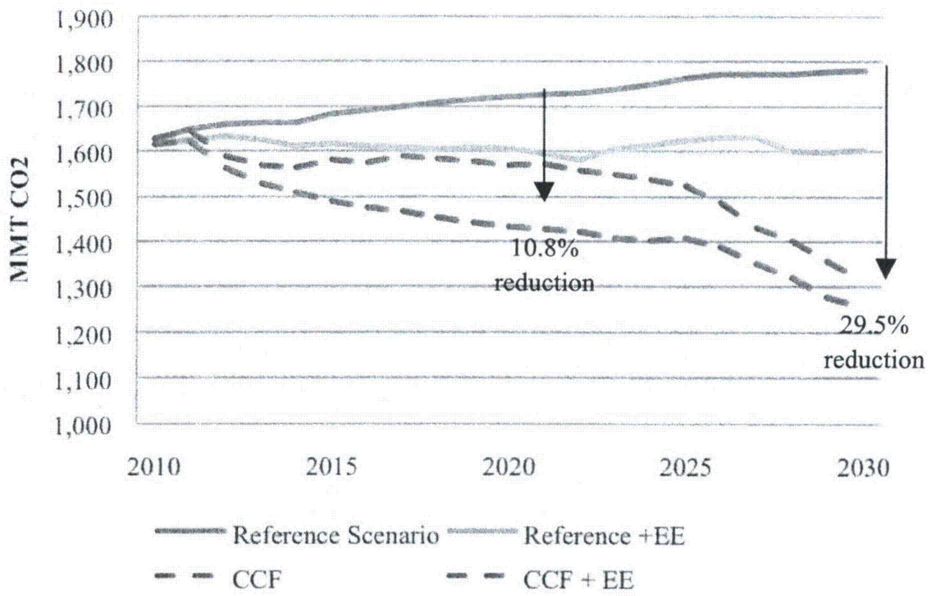


Figure ES.6 Carbon Dioxide Emissions with Energy-Efficiency Policies

Conclusions

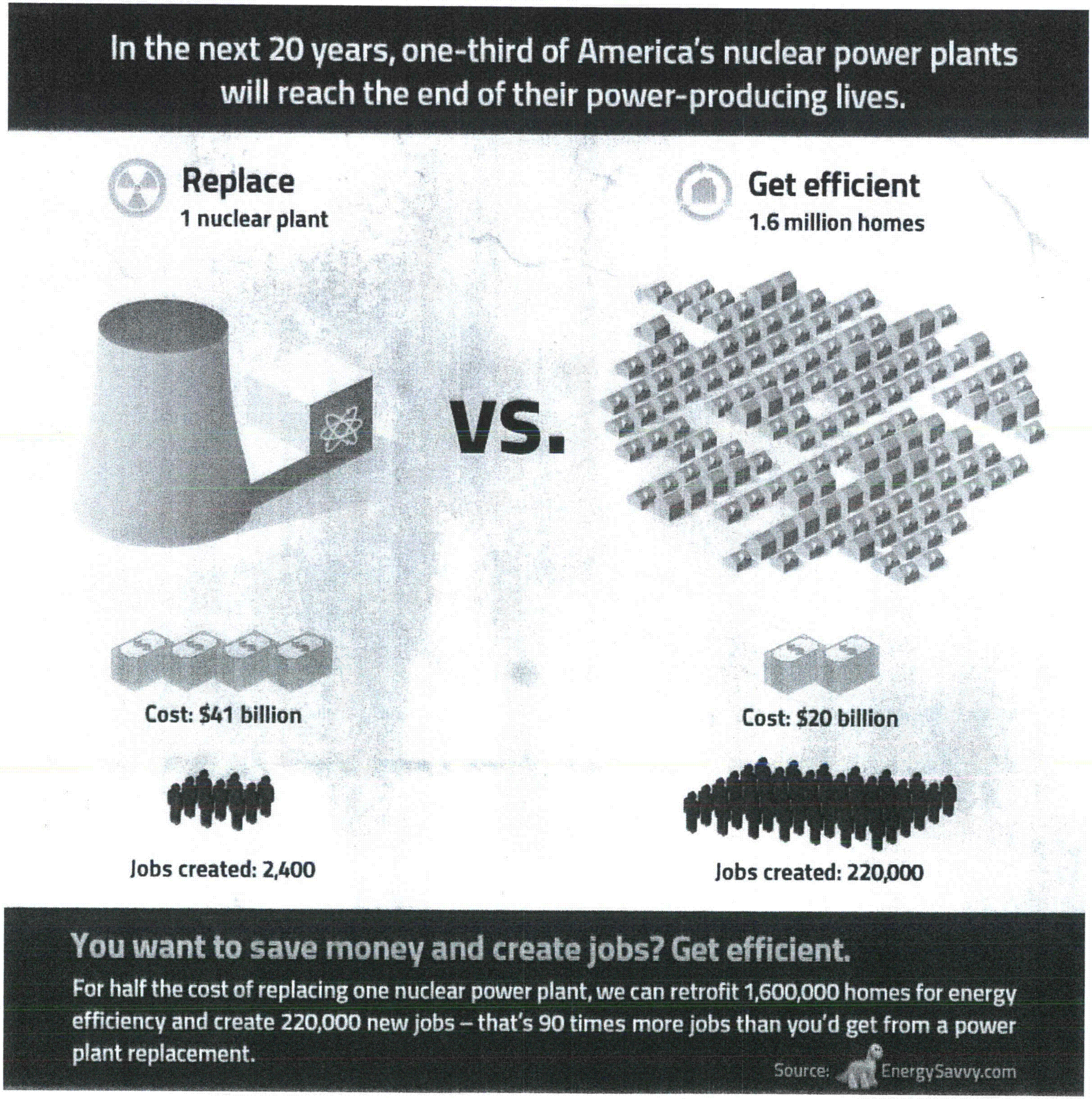
If the South could achieve the substantial energy-efficiency improvements that have already been shown effective in other regions and nations, carbon emissions across the South would decline, air quality would improve, and plans for building new power plants could be downsized or postponed, all while saving ratepayers money.

While we examined nine policies, others exist that would lead to additional efficiency. However, these nine were chosen because they were all deemed likely to be cost-effective, significant, large, realistic, and quantifiable. We do not examine the impact of energy-efficiency investments on peak demand reductions. While clipping system peaks is critical to electric power planners, we treat this as an ancillary benefit of improved energy efficiency. Nor do we examine the role of demand-response or load-management programs aimed strictly at shifting on-peak consumption to off-peak hours. These are also valuable "demand-side" resources that merit further assessment.

The energy-efficiency policies described in this report could set the South on a course toward a more sustainable and prosperous energy future. If utilized effectively, the region's substantial energy-efficiency resources could reverse the long-term trend of expanding energy consumption. With a concerted effort to use energy more wisely, the South could grow its economy, create new jobs, and improve the health of its citizens and ecosystems.

Without new supporting policies, this potential for energy-efficiency improvement will not be realized. Energy-efficiency upgrades require consumer and business investment and they compete with other priorities. With so many demands on financial and human capital, cost-effective energy-efficiency improvements are easily ignored. Through a combination of information dissemination and education, financial assistance, regulations, and capacity building, consumers can be encouraged to invest in energy efficiency. In addition, expanded research and development and public-private partnerships are needed to innovate and deploy transformational technologies that enlarge the efficiency potential over the long run.

The ability to convert this vision into reality will depend on the willingness of consumer, business and government leaders to champion the kinds of policies modeled here.


In the next 20 years, one-third of America's nuclear power plants will reach the end of their power-producing lives.
Replace
1 nuclear plant
Get efficient
1.6 million homes
VS.
Cost: $41 billion
Cost: $20 billion
Jobs created: 2,400
Jobs created: 220,000
You want to save money and create jobs? Get efficient.
For half the cost of replacing one nuclear power plant, we can retrofit 1,600,000 homes for energy efficiency and create 220,000 new jobs – that's 90 times more jobs than you'd get from a power plant replacement.
Source: EnergySavvy.com

For half the cost of a new nuclear power plant, we can retrofit 1,600,000 homes for energy efficiency and save the same amount of energy. Retrofitting the houses would create 220,000 new jobs – that's 90 times more jobs than you'd get from the replacement nuclear power plant.

Crunching the Numbers

To be clear, we at EnergySavvy are not anti-nuclear. We're not pro-nuclear either. We're just presenting the numbers in a way that we hope can inform the national discussion.

In this comparison, a new nuclear power plant is expected to last 40 years and produce at the U.S. average of 12.3 billion kilowatt-hours (kWh) per year. The levelized cost of electricity for a new nuclear plant that we're using is 8.4 cents per kWh, which includes the cost of financing, building and operating the plant for 40 years. The total cost for this plant and its power for 40 years is $41 billion.

Instead, if you want to retrofit enough houses to eliminate the need for 12.3 billion kWh per year, the calculation works like this: A typical electrically heated U.S. home uses 20,000 kWh per year, which can be reduced by 30% with a $12,000 energy retrofit, based on various industry estimates. You'd need to retrofit just over 1.6 million homes to equal the entire annual energy production of a nuclear power plant, for a total cost of just under $20 billion. Home energy efficiency improvements in electrically heated homes include upgrading the efficiency of the electric heating system, insulating and making air sealing improvements to the home's building envelope, using solar hot water heating systems and replacing inefficient A/C units and appliances.

Job creation, in each case, looks like this: At peak construction, building a nuclear power plant would employ as many as 2,400 workers, eventually leveling out at around 400 to 700 long-term employees. For home retrofits: According to Matt Golden, Policy Chair for Efficiency First, retrofitting 1,600,000 homes would create roughly 220,000 jobs.

Caveats and Criticism

This kind of rough analysis uses many assumptions and can be subject to many criticisms. Let the discussion ensue:

What about the cost of storing nuclear waste forever? While the operating cost of a nuclear power plant includes the storage of spent nuclear fuel during its 40-year operational life, the cost of safely storing that fuel for thousands of years afterwards is not included in this analysis. If it were even possible to estimate, the relative cost effectiveness of home retrofits would look much, much better.

How do you really know what a new power plant will cost? We're pretty solid on the home retrofit cost statistics, but the nuclear power plant cost calculations have a lot more uncertainty. Nuclear power plants typically take around ten years to build, so estimating the true cost is nearly impossible given fluctuating material prices, cost of capital and other unforeseen costs. Cost overruns for a nuclear reactor have averaged nearly 300 percent. The last nuclear power plant to go online broke ground in 1973 and wasn't finished until 1996.

Why are we picking on electrically-heated homes? Thirty percent of U.S. homes (according to EIA's 2005 statistics) use electricity for heating. Many more use natural gas or heating oil, and most energy efficiency efforts focus on achieving efficiencies with those fuels. The impending nuclear power plant "retirement boom" provides a great opportunity to think about getting more efficient with electrically heated homes.

Don't nuclear power plants last longer than new furnaces? Nuclear plants have 40 year operational leases and can be extended for an additional 20 years. Different energy efficiency measures have different measure lives – LED light bulbs last less than 10 years, insulation and new furnaces can last for 30 years or more. For simplicity's sake, we're treating the measure lives of each option equally at 40 years.

This is a lot of houses we're talking about. Yes. If we want to avoid replacing some or all of the nuclear power plants that are going to reach the end of their operational lives within the next 20 years, we have to start retrofitting houses at volume now so we're ready when plants need to start shutting down.

Who pays for either of these two options? That's a pretty complicated question and it certainly involves issues of rates and cost recovery within the utility regulatory field. We're making the argument that investing in efficiency might be a better use of a utility's resources than fully paying to build new nuclear power plants. Some innovative utilities are developing energy efficiency models that are increasingly cost effective, and work well for their shareholders and regulatory frameworks.

In the end, we don't believe that any of these assumptions invalidate our conclusion that our country would be far better off increasing the efficiency of our housing stock through home retrofits over the next 20 years than replacing all our aging nuclear power plants. We can meet this impending energy challenge with half of the cost, create far more jobs and enjoy all the side benefits that come with going the retrofit route: healthier and more comfortable homes, lower utility bills for homeowners than what they would have paid, no increased burden of storing spent nuclear fuel for thousands of years.

http://www.energysavvy.com/blog/2011/07/13/ticking-atomic-clock-nuclear-power-vs-efficient-homes/

United States Government Accountability Office

GAO

Report to the Chairman, Committee on Environment and Public Works, U.S. Senate

October 2011

TENNESSEE VALLEY AUTHORITY

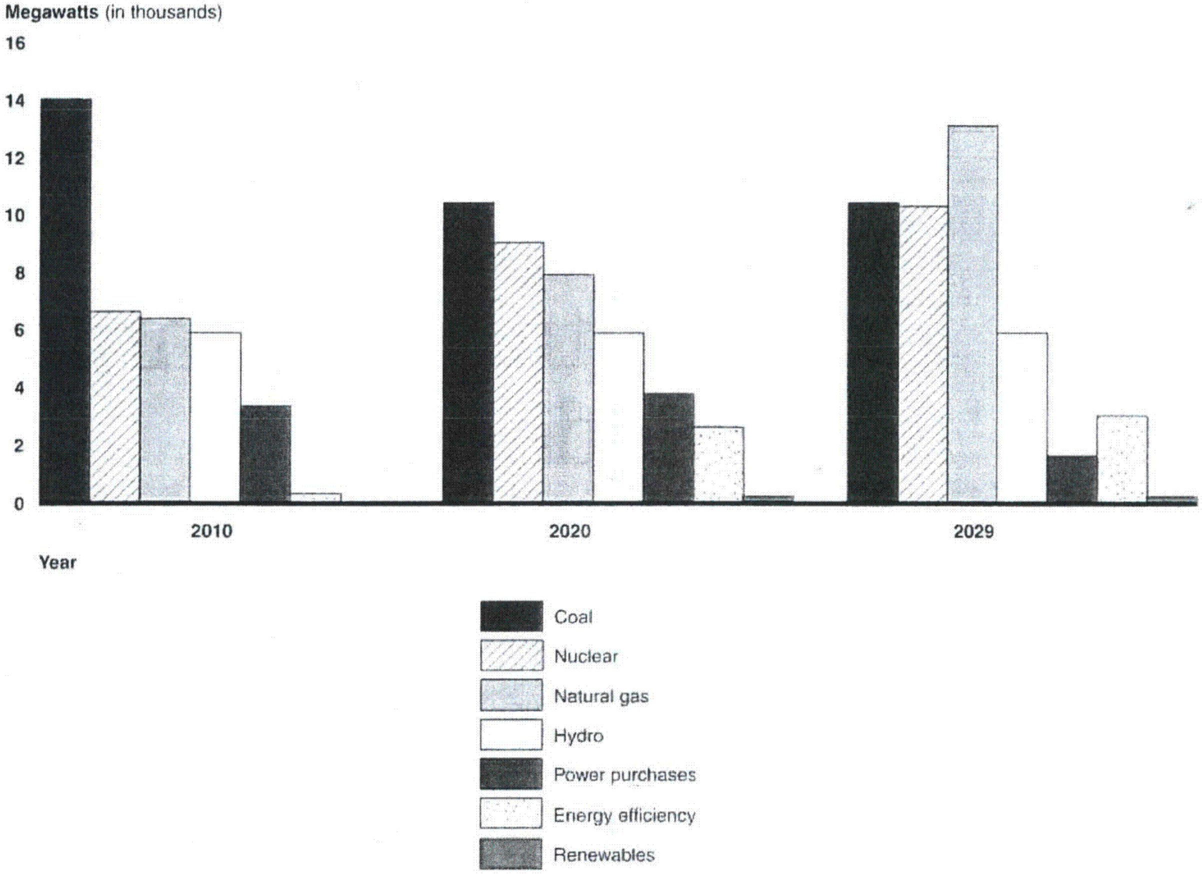
Full Consideration of Energy Efficiency and Better Capital Expenditures Planning Are Needed

GAO-12-107

Plans for Meeting Electricity Demand Focus on Building Natural Gas and Nuclear Plants

Our analysis of TVA's 2010 power supply plan indicates that TVA plans to change the mix of resources it will use to meet demand from 2010 through 2029, primarily by expanding natural gas-fired and nuclear-powered generating capacity (see fig. 3). TVA also plans expansions of energy efficiency programs.

Figure 3: TVA's Planned Capacity and Other Resources, 2010 through 2029



Source: GAO analysis of TVA data.

TVA's power supply plan describes three types of resources that TVA can use to meet its electricity demand from 2010 through 2029: its own generating capacity, power purchases, and energy efficiency. TVA's own generating capacity comprises power plants that use various sources of energy, including nuclear power, coal, hydropower, natural gas, and renewable energy sources. TVA's power purchases may include

Economic conditions could increase the need for TVA to make substantial contributions to its pension fund due to lower than anticipated returns on investments within the fund. As of September 30, 2010, TVA's pension fund liability was more than $10.3 billion; however, at that time, the fund's assets were valued at less than $6.8 billion, which amounts to an estimated $3.6 billion shortfall. The plan currently has nearly 23,000 retirees receiving benefits, totaling about $600 million per year. TVA is looking at various options for modifying the management of the pension fund, which could include revising existing pension plans or developing new ones. According to TVA officials, a contribution of $270 million to the pension fund has been budgeted in fiscal year 2011,[72] and TVA's Board approved plans to contribute up to $300 million to the pension plan in fiscal year 2012.

Finally, in addition to the specific planned financial investments discussed previously in this report, TVA must find the resources to achieve the agency's broad objectives, including the TVA Board's commitment to be a "national leader in technological innovation, low cost power and environmental stewardship." Achieving these broad objectives could require additional investments.

Conclusions

TVA has set energy and environmental goals in its 2007 strategic plan and its August 2010 renewed vision and has taken steps to increase its use of energy efficiency programs. Utilities typically try to meet future demand for electricity by identifying the most cost-effective ways of doing so. However, while TVA's strategic plan states that TVA will strive to be a leader in energy efficiency improvements, it is not clear whether TVA is making the most cost-effective resource decisions possible to meet future electricity demand, especially with regard to energy efficiency. That is because TVA's planning process may be ignoring opportunities to pursue a more cost-effective path that could make greater use of energy efficiency. More specifically, TVA's resource planning framework and decisions have not yet incorporated an analysis of the full potential for energy efficiency that exists in its service area, although TVA has commissioned a study on this. In addition, TVA did not use its planning model to identify the most cost-effective levels of energy efficiency, and, as a result, it does not know whether the model would have identified

[72]TVA made a cash contribution of $1 billion to the pension plan in fiscal year 2009.

other potentially more cost-effective levels of this resource. Energy efficiency has been shown to be a generally cost-effective option compared to new generating capacity, and energy efficiency efforts at other electric utilities show that it is possible to use energy efficiency at much higher levels. By not fully exploring and identifying energy efficiency resources, TVA cannot be certain that its plans to meet future demand, largely by building new generating capacity, are the most cost effective.

TVA is planning to spend billions of dollars on several large capital investments over the next 3 years and faces increasing operating expenditures in order to meet demand for electricity in its service area. TVA faces difficult decisions as it plans for these investments and other significant expenses related to environmental cleanup or protection. As of September 30, 2010, TVA's statutory debt was $23.6 billion, and it plans to spend about $10 billion through fiscal year 2013 for capital expenditures related to new and upgraded nuclear, fossil fuel, and hydropower plants. Moreover, pursuant to a settlement with EPA, TVA agreed to invest an additional $3 billion to $5 billion in the next 10 years on pollution control devices on existing power plants. Collectively, these expenditures could cause TVA to exceed its statutory debt limit. TVA's options for addressing its financial challenges include (1) raising rates to increase gross revenue, (2) reducing operating expenditures, (3) delaying some capital investments, and (4) modifying its debt structure. TVA's debt structure can be modified by refinancing its debt, developing additional alternative financing arrangements, or requesting an increase in its debt ceiling. Each of these options involves trade-offs that complicate the agency's financial decision making. For example, TVA could raise its rates, and with the additional revenue generated, reduce its borrowing or pay down some of its existing debt. However, the TVA Act also mandates that TVA keep rates as low as feasible, and raising rates could affect the Tennessee Valley economy.

Despite the many financial decisions it faces, TVA does not have a formal capital expenditure management plan that lays out how it will fund the significant capital investments it expects to make during the next 3 years. Such a plan is important to help identify the assets in which TVA plans to invest, the full costs of the assets, and the sources of funding for acquiring those assets to ensure that adequate funding exists to maintain and operate the assets. Without such a plan, TVA faces increased risk that its planned capital investments are not sufficiently justified or that the acquisition costs of these capital investments will rise, potentially leading to the cancellation or delays of major investments and the loss of sunk costs. Further, in the absence of a capital expenditure management plan, TVA may also face challenges in achieving the full range of the Board's stated objectives, including its commitment to be a “national leader in technological innovation, low cost power and environmental stewardship.”

Recommendations for Executive Action

Consistent with TVA’s goals, objectives and policies, including TVA being a national leader in technological innovation, low-cost power, and environmental stewardship, and to better ensure that TVA has the financial resources to accomplish the Board’s broader objectives, we recommend that TVA’s Board:

- use information on the energy efficiency potential of TVA’s service area from its commissioned study to better ensure that TVA’s future resource planning process reflects the most cost-effective mix of resources to meet the demand for electricity, and
- develop a written capital expenditure plan that includes the full costs of the assets in which TVA plans to invest and the sources of funding for acquiring those assets.

Agency Comments and Our Evaluation

TVA provided oral technical comments to our draft, and we incorporated them as appropriate. In its written comments, TVA agreed with our first recommendation, and while TVA did not expressly agree with our second recommendation, it noted the importance of utility companies having a written capital expenditure plan. TVA further stated that it is working to refine and improve its long-term planning processes and intends to more formally integrate them. We encourage TVA’s efforts in this regard. However, TVA’s current planning processes do not address how its planned capital investments will be funded. For example, TVA’s vision establishes broad agency priorities and goals and provides a structure for TVA’s budget cycle and capital expenditures, but the vision does not address how these items will be funded. As we stated in the draft report, several potential problems can occur when an agency does not describe how capital expenditures will be funded, including poor planning, acquisition of assets that have not been fully justified, higher acquisition costs, cancellation of major investments, and inadequate funding to maintain and operate the assets. TVA also remained silent on a critical component of our second recommendation, which is to describe the manner in which TVA will fund future investments, notably its planned \$9.9 billion in capital investments by the end of fiscal year 2013. As we stated in our draft report, TVA’s planned capital investments and financial flexibility may be constrained by increased operating costs, existing debt levels, and unexpected cost overruns.

In its comments, TVA also noted its need for financial flexibility in the funding of long-term assets. We acknowledge this need but believe that a more detailed blueprint for the funding of planned capital expenditures, including information on how TVA expects to manage its expenditures, would better assist TVA in prudently making its capital investments and in achieving greater financial flexibility and responsibility in the long-term. Accordingly, we reiterate the importance of a formal capital expenditure plan that not only identifies the assets that TVA intends to acquire or develop, but includes the full costs of the assets in which TVA plans to invest and the sources of funding for acquiring those assets.

As agreed with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution of this report until 30 days from the report date. At that time, we will send copies to TVA's board of directors, appropriate congressional committees, and other interested parties. In addition, this report will also be available at no charge on the GAO website at http://www.gao.gov.

If you or your staff have any questions about this report, please contact me at (202) 512-3841 or ruscof@gao.gov, or Susan Ragland at (202) 512-9095 or raglands@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix V.

Sincerely yours,

Frank Rusco

Frank Rusco
Director, Natural Resources
and Environment

Susan Ragland

Susan Ragland
Director, Financial Management
and Assurance

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A Publication of
National Academy of Sciences
National Academy of Engineering
Institute of Medicine
University of Texas at Dallas

ENERGY ACTION

ROBERT ALVAREZ

Improving Spent-Fuel Storage at Nuclear Reactors

Storing spent radioactive fuel in dry form rather than in increasingly jammed cooling pools is much safer, and can be done with already available funds.

The nuclear disaster in Fukushima, Japan, which began with an earthquake in March 2011 and continues today, is casting a spotlight on nuclear reactors in the United States. At the Dai-Ichi nuclear power plant, at least one of the pools used for storing spent nuclear fuel—indeed, the pool holding the largest amount of spent fuel—has leaked and remains vulnerable. Because U.S. nuclear plants also use cooling pools for storing spent fuel, the U.S. Nuclear Regulatory Commission (NRC) formed a task force to assess what happened at the stricken facility and identify lessons for the U.S. nuclear industry. In a July 2011 report, the NRC placed upgrading the safety of storage pools at reactor stations high on its list of recommendations.

But history and scientific evidence suggest that although useful, improving pool safety will not be enough. Efforts are needed to store more spent fuel in dry form, in structures called casks that are less susceptible to damage from industrial accidents, natural disasters, or even terrorist attacks. Fortunately, money is already available to pay for this step, a situation almost unheard of in today's harsh economic climate. Now it is up to the federal government to develop policies to make this happen, for the safety of the nuclear electric industry and the nation. There is no time to wait. It is estimated that spent-fuel storage pools at U.S. reactors, which are already jammed, will hit maximum capacity by 2015.

History of delay

Since the early days of the nuclear electric industry, the NRC's regulations regarding storage of spent fuel have assumed that the federal government would open in a timely fashion a permanent repository for nuclear wastes. This goal was codified in the Nuclear Waste Policy Act of 1982. Until such a facility became available, the NRC would allow plant operators to store spent fuel on a temporary basis in on-site cooling pools. However, the quest for permanent nuclear waste disposal remains illusory. As a result, nuclear plant operators are storing spent fuel in cooling pools for longer periods and at higher densities (four to five times higher, on average) than originally intended.

As the owner of the Millstone nuclear reactor in Waterford, Connecticut, observed in a 2001 report, neither the federal government nor utilities anticipated the need to store large amounts of spent fuel at operating sites. "Large-scale commercial reprocessing never materialized in the United States," the utility, Dominion Power, said. "As a result, operating nuclear sites were required to cope with ever-increasing amounts of irradiated fuel . . . This has become a fact of life for nuclear power stations."

> Safely securing the spent fuel that is currently in crowded pools at reactors should be a public safety priority of the highest degree.

U.S. reactor stations have collectively produced approximately 65,000 metric tons of spent fuel. Roughly three-quarters of the total is currently stored in pools, and the remainder is stored in dry form in casks, an inherently safer form of storage. The spent fuel stored in pools holds between 5 and 10 times more long-lived radioactivity than the reactor cores themselves hold. Because they were intended to be temporary, the pools do not have the same "defense in depth" features that the NRC requires of reactors. Even after it completed its assessment of the Fukushima disaster, the NRC has continued to allow nuclear operators to rely on cooling pools for storing spent fuel. As a result, spent-fuel pools may be destined to remain a fact of life for the indefinite future. But this possible future can and should be avoided, especially given the recent events in Japan.

Lessons from disaster

In the late afternoon of March 11, 2011, a 9.0 magnitude earthquake, followed by a 46-foot-high tsunami, struck the Dai-Ichi nuclear power site in the Fukushima Prefecture of Japan. The destruction was enormous. In a little more than an hour, offsite power was severed, backup diesel generators were rendered inoperable, and the infrastructure of wiring, pipes, and pumps necessary to maintain cooling for the four reactors and the fuel-storage pools was severely damaged.

Almost immediately, the site's personnel became alarmed over the storage pools and shifted the remaining cooling capacity to prevent the overheating of spent fuel at reactor No. 2. However, the emergency batteries that were providing power to cool the reactor cores soon ran out. Fuel rods became exposed and began to melt, while generating large amounts of hydrogen from the rapid oxidation of zirconium contained in the cladding surrounding the nuclear fuel. In a matter of days, venting of hydrogen from overpressurized reactor vessels led to large explosions at reactors 1, 2, and 3, which experienced full meltdown. Reactor 4, which had been shut down for maintenance and its irradiated core transferred to a nearby cooling pool, also experienced an explosion that caused structural damage to the pool and leakage.

On June 18, the Japanese government reported that between March 11 and April 5, approximately 4.3 million curies of radioiodine and 410,000 curies of radiocesium had been released to the atmosphere. A more recent study estimated that almost twice as much radiocesium had been released.

In terms of land contamination, aerial radiological surveillance done by the U.S. Department of Energy between April 6 and April 29 indicated that roughly 175 square kilometers had contamination at levels comparable to those in the exclusionary zone around the reactor ruins at Chernobyl, in the Ukraine region of the former Soviet Union. Other researchers have reported that about 600 square kilometers have been contaminated to levels that at Chernobyl required strict radiation controls. Cesium-137 hot spots were found in soil by a citizens' group in the Tokyo metropolitan area at levels comparable to those in the Chernobyl exclusionary and radiation control zones.

Tokyo Electric Power Company has yet to achieve cold shutdown at the Dai-Ichi site. The Japanese government currently estimates that it may take 30 years to remove and store nuclear and other contaminated material, at an estimated cost of $14 billion. Despite this destruction, spent fuel stored in dry casks at the reactor site was relatively unscathed.

U.S. nuclear portrait

In the United States, 104 commercial nuclear reactors are operating at 65 sites in 31 states. Sixty-nine of them are pressurized-water reactors (PWRs), and 35 are boiling-water reactors (BWRs). Thirty-one of the BWRs are Mark I and Mark II models that are built on the same basic design as those at the Dai-Ichi site. In addition, there are 14 older lightwater–cooled reactors in various stages of decommissioning.

These facilities collectively hold in their onsite spent-fuel pools some of the largest concentrations of radioactivity on the planet. The pools, typically rectangular or L-shaped basins about 40 to 50 feet deep, are made of reinforced concrete walls four to five feet thick. Most of them have stainless steel liners. (Basins without steel liners are more susceptible to cracks and corrosion.) At PWRs, pools are partially or fully embedded in the ground, sometimes above tunnels or underground rooms. At BWRs, most pools are housed in reactor buildings several stories above the ground.

Typical 1,000-megawatt PWRs and BWRs have cores that contain about 80 and 155 metric tons of fuel, respectively, and their storage pools contain 400 to 500 metric tons of spent fuel. Nearly 40% of the radioactivity in the spent fuel for both types of reactors is cesium-137, and the pools hold about four to five times more cesium-137 than is contained in the reactor cores. The total amount of cesium-137 stored in all storage pools is roughly 20 times greater than the amount released from all atmospheric nuclear weapons tests combined. With a half-life of 30 years, cesium-137 gives off highly penetrating radiation and is absorbed in the food chain as if it were potassium.

Many U.S. reactors have larger spent-fuel storage pools than found elsewhere. For example, the storage pool at Vermont's Yankee Mark I reactor holds nearly three times the amount of spent fuel that was stored in the pool at the crippled Dai-Ichi reactor No. 4.

Permanent storage déjà vu

In January 2010, the Obama administration canceled long-contested plans to develop a permanent spent-fuel disposal site deep within Yucca Mountain in Nevada. Instead, the administration appointed the Blue Ribbon Commission on America's Nuclear Future to address, once again, the country's efforts to store and dispose of high-level radioactive wastes. The 15-member commission, which will report to the secretary of Energy, includes representatives from industry, government, and academia; it is co-chaired by Brent Scowcroft, a former national security adviser to two presidents, and former congressman Lee Hamilton. The commission's charter made it clear that the Yucca Mountain site was not to be considered and that specific site locations were not to be selected. The commission provided interim recommendations in July 2011 and is expected to issue a final report in early 2012.

The challenge facing the commission is well known. In 1957, the National Academy of Sciences (NAS) warned that the "hazard related to radioactive waste is so great that no element of doubt should be allowed to exist regarding safety." In the same year, the NAS recommended that the federal government establish deep geologic disposal as the best solution to the problem.

For more than two decades, the Atomic Energy Commission (AEC) and its eventual successor, the Department of Energy (DOE), tried and failed to identify one or more sites for geologic disposal that would be acceptable to everyone, including the states where potential sites were located. Congress eventually stepped into the fray in 1982 with the Nuclear Waste Policy Act, which set forth a process for selecting multiple sites at various geographic locations nationwide. Five years later, however, Congress terminated the site selection process, in large part because of opposition by eastern states. Congress amended the law so that Yucca Mountain in Nevada was the only site to be considered. Although Congress set an opening date for January 31, 1998, the project's schedule kept slipping in the face of technical hurdles and fierce state opposition.

This was the situation when the Obama administration halted the controversial process and appointed the Blue Ribbon Commission. In its interim report, the commission recommended a number of amendments to the Nuclear Waste Policy Act. Among them were the following: The law should authorize a new consent-based process for selecting and evaluating sites and licensing consolidated storage and disposal facilities; allow for multiple storage facilities with disposal facilities; allow for multiple storage facilities with adequate capacity to be sited, licensed, and constructed, when needed; and establish a new waste management organization to replace the role of the DOE with an independent, government-chartered corporation focused solely on managing spent fuel and high-level radioactive wastes. The act also should have provisions to promote international engagement to support safe and secure waste management. In this regard, Congress may need to provide policy direction and new legislation for implementing some measures aimed at helping other countries manage radioactive wastes in a safe, secure, and proliferation-resistant manner.

Even assuming that Congress promptly adopts the recommendations, however, it will probably take decades before consolidated storage and disposal sites are established. The commission pointed to the record of the Waste Isolation Pilot Project (WIPP), a waste repository developed by the DOE near Carlsbad, New Mexico, for storing transuranic wastes from defense applications. The repository began operation in 1998, 28 years after being proposed by the AEC. Moreover, WIPP faced less difficult (though still substantial) technical challenges. For example, spent fuel from commercial nuclear reactors will be much hotter than transuranic wastes, and this extra heat potentially can corrode waste containers, enhance waste migration, and affect the geological stability of the disposal site.

There is another hurdle as well. Given the inability of the current Congress to agree on routine government funding because of policy disputes, the prospects in a national election year for enacting legislation to reopen the site selection process for the storage and disposal of high-level radioactive waste are dim. These factors underscore the likelihood of the continued onsite storage of spent power reactor fuel for an indefinite period.

Given this situation, the commission concluded: “Clearly, current at-reactor storage practices and safeguards—particularly with regard to the amount of spent fuel allowed to be stored in spent fuel pools—will have to be scrutinized in light of the lessons that emerge from Fukushima. To that end, the Commission is recommending that the National Academy of Sciences conduct a thorough assessment of lessons learned from Fukushima and their implications for conclusions reached in earlier NAS studies on the safety and security of current storage arrangements for spent nuclear fuel and high-level waste in the United States.”

Emphasis on pool safety

Until the NAS completes its study, if it agrees to do so, the bulk of current attention is focused on the NRC's analysis of the Fukushima disaster. As in Japan, U.S. spent-fuel pools are not required to have defense-in-depth nuclear safety features. They are not covered by the types of heavy containment structures that cover reactor vessels. Reactor operators are not required have backup power supplies to circulate water in the pools and keep them cool in the event of onsite power failures. Reactor control rooms rarely have instrumentation keeping track of the pools' water levels and chemistry. (In one incident at a U.S. reactor, water levels dropped to a potentially dangerous level after operators simply failed to look into the pool area.) Some reactors may not have the necessary capabilities to restore water to pools when needed. Quite simply, spent-fuel pools at nuclear reactors are not required to have the same level of nuclear safety protection as required for reactors, because the assumption was that they would be used only for short-term storage before the rods were removed for reprocessing or permanent storage.

In its interim report, the NRC task force recognized these shortcomings and recommended that the NRC order reactor operators to:

- ". . . provide sufficient safety-related instrumentation, able to withstand design-basis natural phenomena, to monitor key spent fuel pool parameters (i.e., water level, temperature, and area radiation levels) from the control room."
- ". . . revise their technical specifications to address requirements to have one train of onsite emergency electrical power operable for spent fuel pool makeup and spent fuel pool instrumentation when there is irradiated fuel in the spent fuel pool, regardless of the operational mode of the reactor."
- ". . . have an installed seismically qualified means to spray water into the spent fuel pools, including an easily accessible connection to supply the water (e.g., using a portable pump or pumper truck) at grade outside the building."

Improving pool safety is certainly important. For decades, nuclear safety research has consistently pointed out that severe accidents could occur at spent-fuel pools that would result in catastrophic consequences. A severe pool fire could result in catastrophic consequences. A severe pool fire could render about 188 square miles around the nuclear reactor uninhabitable, cause as many as 28,000 cancer fatalities, and cause $59 billion in damage, according to a 1997 report for the NRC by Brookhaven National Laboratory.

If the fuel were exposed to air and steam, the zirconium cladding around the fuel would react exothermically, catching fire at about 800 degrees Celsius. Particularly worrisome are the large amounts of cesium-137 in spent-fuel pools, because nearly all of this dangerous isotope would be released into the environment in a fire, according to the NRC. Although it is too early to know the full extent of long-term land contamination from the accident at the Dai-Ichi station, fragmentary evidence has been reported of high cesium-137 levels as far away as metropolitan Tokyo. The NRC also has reported that spent-fuel fragments were found a mile away from the reactor site.

The damage from a large release of fission products, particularly cesium-137, was demonstrated at Chernobyl. More than 100,000 residents from 187 settlements were permanently evacuated because of contamination by cesium-137. The total area of this radiation-control zone is huge: more than 6,000 square miles, equal to roughly two-thirds the area of New Jersey. During the following decade, the population of this area declined by almost half because of migration to areas of lower contamination.

Without a shift in NRC policy, reactor pools will still hold enormous amounts of radioactivity, far more than provided for in the original designs, for decades to come.

In addition to risks from accidents or other untoward events caused by either natural events or human error, another threat looms as well. In 2002, the Institute for Policy Studies helped organize a working group to perform an in-depth study of the vulnerabilities of spent-fuel reactor pools to terrorist attacks. The group included experts from academia, the nuclear industry, and nonprofit research groups, as well as former federal government officials. The group's report, *Reducing the Hazards from Stored Spent Power-Reactor Fuel in the United States*, which I coauthored, was published in 2003 in the peer-reviewed journal *Science and Global Security*. We warned that U.S. spent-fuel pools were vulnerable to acts of terror, and we pointed out that the resulting drainage of a pool might cause a catastrophic radiation fire that could render uninhabitable an area much larger than that affected by the Chernobyl disaster.

Going dry for safety

Our study group recommended that to reduce such safety hazards, all U.S. reactor operators should take steps to store all spent fuel that is more than five years old in dry, hardened storage containers. The casks used in dry storage systems are designed to resist floods, tornadoes, projectiles, fires and other temperature extremes, and other unusual scenarios. A cask typically consists of a sealed metal cylinder that provides leak-tight containment of the spent fuel. Each cylinder is surrounded by additional steel, concrete, or other material to provide radiation shielding to workers and everyone else. Casks can be placed horizontally or set vertically on a concrete pad, with each assembly being exposed to an open channel on at least one side to allow for greater air convection to carry away heat. In hardened dry-cask storage—the safest available design for such systems—the casks are enclosed in a concrete bunker underground.

We also made other recommendations, such as installing emergency spray cooling systems and making advance preparations for repairing holes in spent-fuel pool walls on an emergency basis. The German nuclear industry took these same steps 25 years ago, after several jet crashes and terrorist acts at nonnuclear locations.

The NRC and nuclear industry consultants disputed the paper, and as a result, Congress asked the NAS to sort out the controversy. In 2004, the NAS reported that spent-fuel pools at U.S. reactors were vulnerable to terrorist attack and to catastrophic fires. According to its report: “A loss-of-poolcoolant event resulting from damage or collapse of the pool could have severe consequences . . . It is not prudent to dismiss nuclear plants, including spent fuel storage facilities, as undesirable targets for terrorists . . . Under some conditions, a terrorist attack that partially or completely drained a spent fuel pool could lead to a propagating zirconium cladding fire and release large quantities of radioactive materials to the environment . . . Such fires would create thermal plumes that could potentially transport radioactive aerosols hundreds of miles downwind under appropriate atmospheric conditions.”

The NAS panel also concluded that dry-cask storage offered several advantages over pool storage. Dry-cask storage is a passive system that relies on natural air circulation for cooling, rather than requiring water to be continually pumped into cooling pools to replace water lost to evaporation caused by the hot spent fuel. Also, dry-cask storage divides the inventory of spent fuel among a large number of discrete, robust containers, rather than concentrating it in a relatively small number of pools.

The NRC has at least heard the message. In March 2010, the commission's chair, Gregory Jaczko, told industry officials at an NRC-sponsored conference that spent fuel should be primarily stored in dry, hardened, and air-cooled casks that will meet safety and security standards for several centuries. Yet today, only 25% of the spent fuel at U.S. reactors is stored in such systems, and the NRC has not taken strong steps to encourage their use. Nuclear reactor owners use dry casks only when there is no longer enough room to put the waste in spent-fuel pools. Without a shift in NRC policy, reactor pools will still hold enormous amounts of radioactivity, far more than provided for in the original designs, for decades to come.

Money at hand

In our original study, we estimated that the removal of spent fuel older than five years could be accomplished with existing cask technology in 10 years and at a cost of $3 billion to $7 billion. The expense would add a marginal increase of approximately 0.4 to 0.8% to the retail price of nuclear-generated electricity.

In November 2010, the Electric Power Research Institute (EPRI) released its own analysis of the costs associated with our recommendations. The group concluded that "a requirement to move spent fuel older than five years (post reactor operations) from spent fuel pools into dry storage would cause significant economic . . . impacts while providing no safety benefit to the public." EPRI concluded that the cost for the early transfer of spent fuel storage into dry storage would be $3.6 billion—a level near the lower end of our estimates. This increase, EPRI said, would be "primarily related to the additional capital costs for new casks and construction costs for the dry storage facilities. The increase in net present value cost is $92-95 million for a representative two-unit pressurized water reactor; $18-20 million for a representative single-unit boiling water reactor; and $22-37 million for a representative single unit new plant."

EPRI further expressed doubt that the industry would be able to meet demand needs for sufficient numbers of new casks, which the group estimated would require a "threeto four-fold increase in dry storage system fabrication capability." Our study found, however, that two major U.S. manufacturers could increase their combined production capacity within a few years to about 500 casks per year, a level sufficient to meet projected needs.

The EPRI study also argued against our proposal by maintaining that the recommended actions would increase nuclear plant workers' exposures to radiation. Upon further examination, EPRI's estimate would result in a 4% increase in the collective radiation exposure to workers over the next 88 years. This increase in worker doses is not an insurmountable obstacle if there is greater use of remotely operated technologies in the handling of spent fuel assemblies and casks.

Of course, even though our estimates suggest that the added costs of moving to dry-cask storage will not be overly burdensome, individual reactor owners will need to pay them. Here is where the NRC can play a vital role by adopting policies that will allow for the costs of dry, hardened spent-fuel storage to be taken from the electricity rates paid by consumers of nuclear-generated electricity. The Nuclear Waste Policy Act established a user fee to pay 0.1 cent per kilowatt-hour to cover the search for and establishment of a high-level radioactive waste repository, but the law did not allow these funds to be used to enhance the safety of onsite spent fuel storage.

As of fiscal year 2010, only $7.3 billion had been spent of the $25.4 billion collected through user fees, leaving $18.1 billion unspent. This sum could more than pay for the dry, hardened storage of spent reactor fuel older than five years at all reactors. Safely securing the spent fuel that is currently in crowded pools at reactors should be a public safety priority of the highest degree. The cost of fixing the nation's nuclear vulnerabilities may be high, but the price of doing too little is far higher.

Robert Alvarez (bob@ips-dc.org), a senior scholar at the Institute for Policy Studies in Washington, DC, is a former senior policy advisor at the Department of Energy.

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October 22, 2012

HUFF POST GREEN

Leaked Report Suggests Long-Known Flood Threat To Nuclear Plants, Safety Advocates Say

Posted: 10/19/2012 4:00 pm EDT Updated: 10/20/2012 8:07 am EDT

An un-redacted version of a recently released Nuclear Regulatory Commission report highlights the threat that flooding poses to nuclear power plants located near large dams -- and suggests that the NRC has misled the public for years about the severity of the threat, according to engineers and nuclear safety advocates.

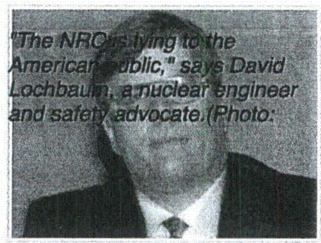
"The redacted information shows that the NRC is lying to the American public about the safety of U.S. reactors," said David Lochbaum, a nuclear engineer and safety advocate with the Union of Concerned Scientists.

A redacted version of the report was posted to the NRC website on March 6. An un-redacted version was recently obtained by the environmental group Greenpeace and shared with The Huffington Post.

Among other things, evidence in the report indicates that the NRC has known for a decade or longer that failure of a dam upriver from the Oconee Nuclear Station in South Carolina would cause floodwaters to overwhelm the plant's three reactors and their cooling equipment -- not unlike what befell Japan's Fukushima Dai-chi facility after an earthquake and tsunami struck last year. Three reactors at Fukushima experienced a full meltdown, which contaminated surrounding farmland and exiled hundreds of thousands of residents.

According to the NRC's own calculations, which were also withheld in the version of the report released in March, the odds of the dam near the Oconee plant failing at some point over the next 22 years are far higher than were the odds of an earthquake-induced tsunami causing a meltdown at the Fukushima plant.

The NRC report identifies flood threats from upstream dams at nearly three dozen other nuclear facilities in the United States, including the Fort Calhoun Station in Nebraska, the Prairie Island facility in Minnesota and the Watts Bar plant in Tennessee, among others.



"The NRC is lying to the American public," says David Lochbaum, a nuclear engineer and safety advocate.(Photo: UCSUSA)

Advocates and engineers also contend that the NRC, by originally releasing only a heavily redacted version of the report, inappropriately invoked security concerns to mask embarrassing information. This includes the full extent of the flood risk at Oconee, which is covered at greatest length in the report, and the continued failure of regulators to require the facility's owner, Duke Energy, to swiftly improve the plant's defenses.

"Rather than hiding the triple meltdown threat from the public and taking more than a decade to address it," said Jim Riccio, a nuclear analyst with Greenpeace, "the NRC should force Duke Energy to reduce the risk or retire the reactors."

In response to questions from The Huffington Post, representatives of NRC and Duke Energy said they believe the Oconee plant is adequately protected from flooding, although they also said ongoing analyses will determine whether and what more might need to be done there and at other U.S. plants. The NRC also stated that its decision to withhold certain details in the report was justified, and implemented in consultation with other federal agencies, including the Department of Homeland Security.

"NRC continues to conclude that appropriate actions have been taken at Oconee to address potential flooding issues and that the plant is currently able to safely mitigate flooding events," said Scott Burnell, an NRC spokesman. "Ongoing re-analysis of flooding hazards from all sources, required by the NRC as part of the post-Fukushima lessons learned effort, will determine whether any additional mitigation measures or plant modifications are required for every U.S. nuclear power plant."

Sandra J. Magee, a Duke Energy spokeswoman, said the Oconee facility had a "diversity of cooling water options" that allow the company to respond to virtually any event, including external flooding. "Duke Energy is continuing to look at flood protection enhancements with the NRC through the industry-wide response to the lessons learned from Fukushima," Magee added. "We are safe today, and when the new industry standards are applied, we will increase the level of safety so that Oconee and other U.S. nuclear plants maintain our position as world leaders in nuclear safety."

"THEY'RE BEING DISHONEST"

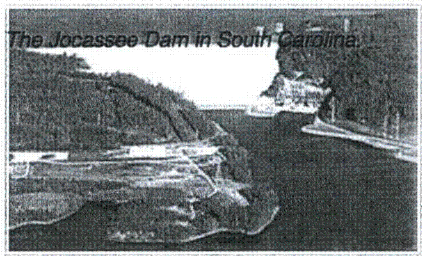
Larry Criscione, a risk engineer at the Nuclear Regulatory Commission who is one of two NRC employees who have now publicly raised questions about both the flood risk at Oconee and the agency's withholding of related information, said assertions that the plant is "currently able to mitigate flooding events," amounted to double-speak.

Criscione said this is because current regulations don't include the failure of the Jocassee Dam -- 11 miles upriver from Oconee -- in the universe of potential flooding events that might threaten the plant. "I think they're being dishonest," Criscione said in a telephone interview. "I think that we currently intend to have Duke Energy improve their flooding protection and to say that the current standard is adequate is incorrect."

According to the leaked report, NRC stated unequivocally in a 2009 letter to Duke that it believed that "a Jocassee Dam failure is a credible event" and that Duke had "not demonstrated that the Oconee Nuclear Station units will be adequately protected." These statements -- along with Duke's own flood timeline associated with a Jocassee Dam failure and NRC's calculated odds of such a failure -- were among many details that were blacked out of the earlier, publicly released report.

The NRC said it is confident that the operators of the Oconee plant, as it is currently configured, would have adequate time to restore cooling equipment following a catastrophic failure of the Jocassee dam.

"The NRC, with all the information available today, continues to conclude Duke has taken appropriate actions to ensure Oconee can safely mitigate flooding events. That statement in no way precludes additional flood mitigation actions on Duke's part," said Burnell, the spokesman. "The NRC will ensure any further work, whether based on existing information or the upcoming flooding re-analysis, meets applicable standards to further enhance Oconee's ability to operate safely."



(Photo: NOAA)

Criscione highlighted his concerns over the situation in an email message sent to several congressional staffers last month. "There are many people within Duke Energy and the U.S. Nuclear Regulatory Commission who believe that, were Jocassee Dam to fail, all three reactors at [Oconee Nuclear Station] would melt down in less than 10 hours," he wrote. Should such an event happen, the containment structures that surround the nuclear reactors would be vulnerable to failing, resulting in a release of radiation similar to what happened in Japan, Criscione noted.

"What is not known is the likelihood that, after the flood waters recede, Duke Energy will be able to re-establish cooling to the containment buildings," Criscione wrote. "If they cannot, then a dam break at Jocassee Lake will cause a Fukushima-style accident in Oconee County, South Carolina. Except instead of blowing out to sea as happened in Japan, depending on the winds, the radioactivity will be blown over Columbia or Charleston or Atlanta or Huntsville or Knoxville or Charlotte. Whatever the winds, the radioactive fallout will occur over farmlands and not merely over the ocean."

The Fukushima meltdown resulted in no immediate deaths, although the longer-term impacts of radiation exposures, as well as the precise levels of air, food and water contamination in the area immediately surrounding the facility, are still being sorted out. Roughly 340,000 people remain evacuated and living in temporary homes, and farmers in the region will likely be grappling with contaminated produce for decades, according to news reports.

The ability to withstand a failure of the Jocassee Dam was not required as part of the original 1974 licensing of the Oconee plant, nor for the more recent re-licensing of the facility in 2000, which extended the plant's life through 2034. But the leaked NRC report suggests that Duke Energy had been underestimating the probability of such a dam failure since at least 1983. At that time, the company determined that flooding at the facility as a result of the Jocassee Dam failing would peak at 4.7 feet. A year later, the company built a 5-foot flood wall around its so-called Standby Shutdown Facility, or SSF, which is designed to allow operators to shut the plant down and maintain cooling if power from the public electricity grid, as well as backup power from a nearby hydroelectric facility, are lost.

WORST-CASE SCENARIO

At the request of federal regulators in 1992, Duke Energy performed a new flood analysis, according to the NRC report, which again considered the potential impacts of a Jocassee Dam failure. That analysis, as well as others subsequent reviews, suggested that flood heights would well exceed the 5-foot barrier protecting the SSF. In one scenario contemplated by Duke in 2008 and submitted to NRC, the company considered a "worst-case scenario" timeline, in which the Jocassee Dam fails completely and plant operators are given no prior warning:

Following notification from Jocassee, the reactor(s) are shutdown within approximately 1 hour. The predicted flood would reach [Oconee Nuclear Station] in approximately 5 hours, at which time the [Standby Shutdown Facility] walls are overtopped. The [Standby Shutdown Facility] is assumed to fail, with no time delay, following the flood level exceeding the height of the [Standby Shutdown Facility] wall. The failure scenario results are predicted such that core damage occurs in about 8 to 9 hours following the dam break and containment failure in about 59 to 68 hours. When containment failure occurs, significant dose [of radiation] to the public would result.

According to the NRC report, however, Duke has steadfastly argued that this is not a realistic scenario, given that a dam would almost certainly fail more slowly, providing more time for operators to respond. The company has calculated dam failure rates due to seepage, embankment slides, and structural failure of the dam foundation or abutments, according to the NRC report, but not failures due to other major events like earthquakes or overtopping as a result of extreme precipitation. The odds of a sudden and total failure of the Jocassee Dam, the company maintains, are remote.

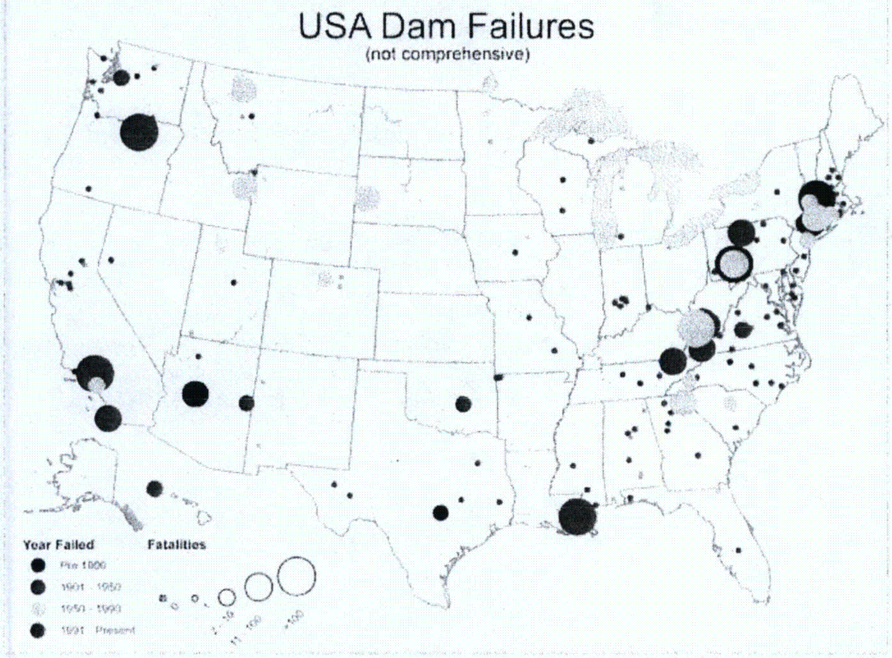
"We recently completed an independent, updated analysis that confirms that an upstream dam failure of our modern dams is a one-in-a-million-years type event," Duke spokeswoman Magee said.

The NRC report suggested that federal regulators have disagreed with that assessment for some time. In 2010, the NRC produced its own analysis estimating that the odds in any given year of a large rock-fill dam similar to the Jocaseee Dam failing were about 1 in 3,600. That works out to about a 1 in 163 chance over the remaining 22 years on Oconee's operating license, according to engineers consulted by The Huffington Post. The NRC report stated that these odds were "an order of magnitude higher" than those submitted by Duke.

Larry Criscione, the NRC engineer who contacted Congress over the Oconee issue, described the NRC's estimate as being "far better odds than drawing a straight in poker" and "significantly better odds -- roughly 8 times better -- than rolling Yahtzee."

According to the Association of Dam Safety Officials, the precise number of dam failures in the U.S. is difficult to pin down, though incidents have occurred in every state. In a recent analysis, the organization determined that in the four years beginning in January, 2005, state dam safety programs reported 132 dam failures and 434 so-called "incidents" -- described as "episodes that, without intervention, would likely have resulted in dam failure."

A non-comprehensive list of dozens of dam failures is maintained at the organization's website.



Map prepared by James S. Halgren, Office of Hydrologic Development, National Weather Service, National Oceanic and Atmospheric Administration, based on data complied by the Association of Dam Safety Officials.

Richard H. Perkins, a risk engineer with the NRC and the lead author of the leaked report, pointed to the analysis by the Association of Dam Safety Officials in an email message to The Huffington Post. "I felt it made a significant point that large, fatal, dam failures occur from time to time," he said. "They are generally unexpected and they can kill lots of people. It's not credible to say 'dam failures are not credible.'"

Dave Lochbaum, the Union of Concerned Scientists engineer who reviewed a copy of the un-redacted report, says these revelations directly contradict the NRC's assertions that Oconee is currently safe. "Fukushima operated just under 40 years before their luck ran out," Lochbaum, who worked briefly for the NRC himself between 2009 and 2010, and who now heads the Nuclear Safety Project at UCS, said in a phone call. "If it ever does occur here, the consequences would be very, very high.

"Japan is now building higher sea walls at other plants along its coasts. That's great for those plants, but it's too late for Fukushima. If in hindsight you think you should have put the wall in," Lochbaum said, "then in foresight you should do it now."

The odds of the Fukushima disaster, which was set in motion after an offshore earthquake sent a tsunami over the flood walls protecting the Dai-ichi plant, were estimated last year by George Apostolakis, one the five commissioners heading up the Nuclear Regulatory Commission, to be 1 in 1,000 in any given year. Last week, the Japanese utility that operated the Fukushima facility, Tepco, admitted for the first time that it had long known improvements were necessary to harden facilities from catastrophes like tsunamis, but that it failed to act -- in part because it wanted to avoid stirring anti-nuclear sentiment, as well as increased risks of litigation.

In an email message, Duke Energy's spokeswoman said the company is currently spending some $2 billion on upgrades to Oconee, and that part of this includes "raising the height of barriers around critical equipment and strengthening walls to protect against flooding, high winds, earthquakes, fire" and other natural phenomena.

"Oconee is in compliance with the station's licensing basis for external flood events," Magee said. "We have anticipated the maximum flooding scenario and the plant has the means to safely shutdown and cool the reactor units. Duke Energy is continuing to look at flood protection enhancements with the NRC through the industry-wide response to the lessons learned from Fukushima," she added.

A RIGHT TO KNOW?

Perkins, the report's lead author, filed a complaint with the agency's Inspector General last month, in which he suggested that NRC staff had improperly redacted information from the public version of his report "to prevent the disclosure of this safety information to the public because it will embarrass the agency."

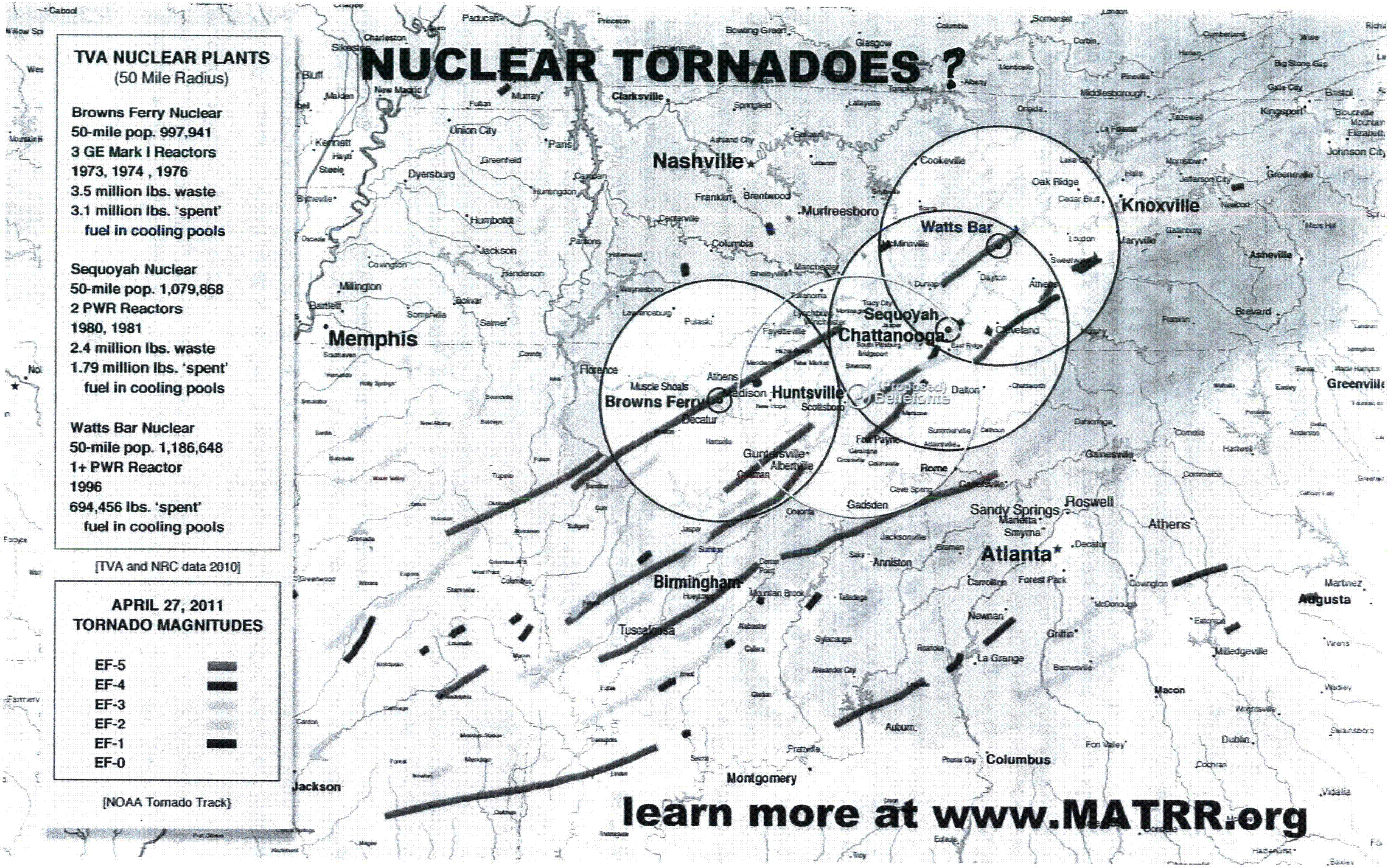
"The redacted information includes discussion of, and excerpts from, NRC official agency records that show the NRC has been in possession of relevant, notable, and derogatory safety information for an extended period but failed to properly act on it," Perkins wrote. "Concurrently, the NRC concealed the information from the public."

The NRC, which described the redacted information as a security risk, has responded by saying that the redactions were made in consultation with other federal agencies, including the Department of Homeland Security, the Federal Energy Regulation Commission and the Army Corps of Engineers. Burnell, the NRC spokesman, said the agency would only comment on information contained in the version of the document released to the public.

Critics of the redactions, however, suggested that much of the withheld information -- the location of the power plants and relevant dams, for example -- was readily available from a variety of online sources. Other information, including dates of NRC's interactions with Duke Energy, its own analysis of the threat, and its assertion that the threat was credible, had no clear security component, nuclear safety advocates said.

Perkins has also raised questions about the NRC's position, suggesting that the other consulted agencies, at least in initial interactions, had no concerns about releasing the full report, and that there appeared to be no valid reason for the NRC to withhold it.

"If that were the case, then the NRC would need to weigh the benefits of redacting this information against the detriments to safety, open discussion, prioritization, and funding that result when information is censored from the public," Perkins told The Huffington Post. "This issue of flooding following upstream dam failure has been debated for many years. Can it still be reasonable, all these years later, that the NRC needs to redact large sections of a report that deals exclusively with a safety issue? If so, how much longer should this strategy be employed? Indefinitely? Until a specific plant is retired? Does the public have a right to know?"


NUCLEAR TORNADOES ?
TVA NUCLEAR PLANTS
(50 Mile Radius)
Browns Ferry Nuclear
50-mile pop. 997,941
3 GE Mark I Reactors
1973, 1974 , 1976
3.5 million lbs. waste
3.1 million lbs. 'spent'
fuel in cooling pools
Sequoyah Nuclear
50-mile pop. 1,079,868
2 PWR Reactors
1980, 1981
2.4 million lbs. waste
1.79 million lbs. 'spent'
fuel in cooling pools
Watts Bar Nuclear
50-mile pop. 1,186,648
1+ PWR Reactor
1996
694,456 lbs. 'spent'
fuel in cooling pools
[TVA and NRC data 2010]
APRIL 27, 2011
TORNADO MAGNITUDES
EF-5
EF-4
EF-3
EF-2
EF-1
EF-0
[NOAA Tornado Track]
Nashville
Knoxville
Memphis
Watts Bar
Sequoyah
Chattanooga
Browns Ferry
Huntsville
(Proposed) Bellefonte
Birmingham
Tuscaloosa
Atlanta
Montgomery
Columbus
Jackson
Augusta
Greenville
Asheville
learn more at www.MATRR.org

Nuclear Tornadoes?

A stampede of 200 tornadoes tore through the southeastern U.S. on April 27, 2011, causing massive damage and killing 319 people. There were fifteen EF-4 and four EF-5 tornadoes – the strongest tornadoes known to man.

One EF-5 tornado roared by Browns Ferry Nuclear Power Plant, touching down very near its three Fukushima-style raised Fuel Cooling Pools – with only a sheet metal roof above them.

What if this most powerful tornado (or an airliner) had made a direct hit on the large raised Cooling Pools at Browns Ferry Nuclear Plant, not just on its power line towers?

These raised Fukushima-style Cooling Pools are holding over 3 million pounds of enriched fuel, requiring constant electricity and water, and are significantly more radioactive than the Reactor Cores – but have only sheet metal roofs for overhead containment security.

Fuel pellet pieces were found a mile away from the Fukushima pools after their explosions. What if a powerful tornado sucks radioactive water from nuclear cooling pools or flings fuel pellets into our valley neighborhoods? Will the public hear the truth about the dangers?

TVA did not tell the truth to the public after the tornadoes of April 27, 2011, saying Browns Ferry emergency procedures performed "as they were designed to do." Not according to required Nuclear Regulatory Commission reports. (See NRC Event Numbers 46793, 46801, 46805.)

Some of what went wrong after the tornadoes at Browns Ferry Nuclear Plant, 28 miles from Huntsville's city center, with nearly one million residents within its 50 mile radius:

1. Only 12 of the required 100 off-site Emergency Sirens actually worked on that day.

2. Two of eight Emergency Diesel Generators failed that day, one for the fire pump and one for the security station and sirens. A 3rd generator shutdown the next day – totaling a 37.5% failure.

3. On April 27, a Main Steam Isolation Valve indicator failed on Unit 3 – so operators could not tell if the valve had closed as it should during the reactor emergency shutdown.

4. On April 27, hours after Unit 1 automatically shut down due to loss of the electrical grid, it received a second automatic shut down signal due to a low water level inside the reactor vessel. TVA said that the operating crew was "distracted," allowing the water level to boil down too low.

5. On April 28, an electrical part failure on Unit 1 initiated an automatic closer of Shutdown Cooling emergency valves. Power was restored after 47 minutes.

6. On May 2, Unit 1 received an 'A' Emergency Generator output breaker trip, resulting in loss of Shutdown Cooling. Power was restored after 57 minutes.

Contact: best@matrr.org

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