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Table of Contents

Executive Summary

Constellation Energy has proposed building a third reactor at the Calvert Cliffs nuclear power plant in Maryland. Building a third reactor at Calvert Cliffs would be expensive, threaten public health and safety, and damage the environment. Maryland should oppose construction of a third reactor.

Encouraged by growing demand for electricity and generous subsidies in the 2005 federal Energy Policy Act, Constellation Energy has proposed constructing a 1,600 MWe nuclear reactor next to the two reactors operating at Calvert Cliffs. The new plant—larger than any existing nuclear reactor in the U.S.—would not be completed until well into the next decade, and would be licensed to operate for 40 years. Its operation would not be a benefit to Maryland.

Nuclear power is an expensive energy source at every stage, from plant construction to waste disposal and decommissioning.

- Constellation estimates that designing and building the plant will cost $2.5 billion to $3.0 billion, if the plant is built on schedule. Cost estimates for building nuclear power plants are notoriously inaccurate, however. Areva, a French-government owned company and Constellation's partner in the proposed third reactor, has fallen 1.5 years behind on the construction of a reactor of the same size and design in Finland, adding $922 million to the cost of the plant.
- Radioactive waste generated at nuclear power plants must be guarded and kept from the environment for tens of thousands of years. Already, the federal government has spent decades and billions of dollars trying to devise a storage solution for nuclear waste without obtaining a solution to the problem.
- Cleaning up the plant after its operating license expires and it has quit generating power will cost an estimated $290 to $370 million, excluding the cost of storing spent fuel and other radioactive waste.

Constellation Energy and the French government-owned Areva may seek to shift the financial risk of the new reactor to Maryland taxpayers and electricity consumers.

- The federal government has offered up to $13 billion in subsidies to encourage the construction of new nuclear power plants across the country.
- Calvert County has already promised $300 million in tax breaks to Constellation if the company builds a new reactor at Calvert Cliffs. This is equal to $4,500 per taxpayer in Calvert County. The new plant will add 450 full-time jobs in the county, but at a cost to taxpayers of approximately $750,000 per job.
- Despite this massive tax break, Constellation may seek additional financing from the state.
- Constellation could also try to force ratepayers to pay the cost of its license application, whether or not it decides to build the reactor, as other utilities have tried elsewhere.

Building a third reactor at Calvert Cliffs will threaten public health by adding to the amount of radioactive material that could be released through an accident or terrorist attack involving the plant or its radioactive waste.

- The new reactor at Calvert Cliffs could generate an estimated 1,375 tons of radioactive waste during its 40 years of operation. This waste will be stored indefinitely at the site, where it poses an attractive target for potential terrorist attacks.
- The two existing reactors at Calvert Cliffs have been fined for safety failures. For example, the Nuclear Regulatory Commission (NRC) fined the plant $50,000 in 1996 for problems with emergency equipment that had been identified in 1992 but still had not been repaired four years later.
- If the proposed federal nuclear waste repository at Yucca Mountain is ever opened, waste from Calvert Cliffs will be transported by rail or truck to Nevada, passing within five miles of 3.1 million people in Maryland. An accident involving a transport vehicle could expose thousands to radiation.

Despite claims by the nuclear industry, nuclear power is not an environmentally benign source of electricity. The mining and processing of uranium destroys land, disproportionately harms native peoples, and creates toxic and radioactive waste. Though nuclear power has lower global warming emissions than electricity generated from coal or natural gas, it is not an emission-free power source.

Maryland should refuse to accept the construction of a new reactor at Calvert Cliffs. Policymakers at the state and local levels can take several steps to prevent construction of a third reactor:

- No additional state or local subsidies should be offered to Constellation and its partners to help offset the cost of constructing a third reactor.
- The application and construction costs of a new reactor should not be added to the rate base paid by electricity consumers.
- The state should adopt a ban on construction of additional nuclear capacity unless the country has implemented a long-term solution for all radioactive waste that will be produced at a new plant. Illinois, California and Wisconsin have already adopted such laws.
- Maryland should invest in energy efficiency programs and encourage the development of clean, renewable energy sources.

Introduction

Maryland is seeking to ensure the reliability of its energy supply, reducing dependence on costly energy sources that are subject to unexpected price spikes. In particular, reliance on limited natural gas—preferred over coal for its lower global warming pollution and toxic emissions—has led to rising costs for electricity.

Constellation Energy has proposed constructing a new nuclear power plant that would add to electricity generation without increasing the state's reliance on natural gas or contributing to global warming. The plant, to be constructed in Calvert County, would increase Maryland's generating capacity by 13 percent.[1] But it would also be expensive to build, and it will generate radioactive waste that will be dangerous to life for thousands of years.

Maryland does not need this new plant. Energy efficiency and renewable energy can meet the state's electricity needs at a lower cost, without producing radioactive waste or contributing to global warming.

Energy efficiency can reduce electricity consumption. Data presented in a study by the American Council for an Energy-Efficient Economy (ACEEE) suggests that potential energy efficiency savings are great enough to reduce energy use, not simply reduce the rate of growth in energy use. ACEEE compared the results of energy efficiency potential studies in states and regions across the country. On average, those studies found that electricity use could be reduced cost-effectively by 24 percent through energy efficiency over a period of 10 to 20 years.[2]

Wind and solar energy resources are abundant in the region. Maryland currently generates only 8 percent of its electricity from renewable sources.[3] Those sources include hydropower dams and biomass. The state does not generate any appreciable electricity from wind or solar power. By tapping its wind and solar resources, Maryland could increase generation from nonpolluting sources at a modest cost.

As discussed throughout this report, nuclear power creates radioactive waste that will remain dangerous for thousands of years. Energy efficiency and renewable energy create none of that risk. Maryland should reject the proposed new nuclear power plant, and turn to the cleaner, safer alternatives that are readily available.

Constellation Wants to Build a New Reactor At Calvert Cliffs

Constellation Energy and its French government-owned partner, Areva, have formed a consortium called Unistar. In October, 2006, they announced their intention to build a third nuclear reactor at the Calvert Cliffs nuclear plant in Calvert County, where there are currently two operating reactors.[4]

Unit 1 began operating in 1974. It was granted a 20-year extension to its initial operating license and is scheduled to continue generating power until 2034. Unit 2 began operations two years after Unit 1 and with its license extension will continue operating until 2036.[5] The two units, both pressurized water reactors, have a combined generating capacity of 1,650 megawatts (MWe) and currently generate more than one-quarter of the electricity produced in Maryland.[6]

Units 1 and 2 were built in the 1960s and 1970s amid a nationwide nuclear craze fueled by massive taxpayer subsidies, overestimates of future electricity demand, and overconfidence in the technology's safety and economic viability. Subsequent construction cost overruns and the accident at the Three Mile Island reactor in 1979 undermined public and market enthusiasm for nuclear power. Many plants in construction were halted. The last plant to be built in the United States was ordered in 1973.[7]

Calvert Cliffs is owned by Constellation Energy through a subsidiary, Calvert Cliffs Nuclear Power Plant, Inc. When Maryland deregulated its electricity market in the late 1990s, ownership of the plant passed from Baltimore Gas and Electric to its affiliate company, Constellation Energy Group and its subsidiary.

In the wake of the 2005 federal Energy Policy Act, which offers more than $13 billion in research and development, construction, operational, and shut-down subsidies for nuclear power, Constellation Energy and other power companies are proposing the construction of new plants around the country. Here in Maryland, Constellation is proposing to construct a 1,600 MWe reactor at the Calvert Cliffs facility.[8] Not only would the reactor double the output of Calvert Cliffs, it would be the largest nuclear reactor in the country.[9] Like the other two reactors, it would be a pressurized water reactor, but of a revised design developed by Areva. A plant of this design has never been operated. Thus, the new

reactor at Calvert Cliffs would be untested and its safety not assured. The 2005 Energy Policy Act extended federal liability insurance protection to any new nuclear reactors built in the United States.

As we will discuss in the next chapter, using Maryland as a guinea pig for the nuclear industry's desired renaissance is an unacceptable economic drain and threat to public health, safety and the environment.

A New Reactor Would Be Bad for Marylanders

The two existing nuclear power units at Calvert Cliffs already create a public health and environmental threat to Maryland. Adding a third reactor to the site would increase those risks, as well as impose a financial burden on the state's taxpayers, and potentially on electricity consumers.

Nuclear Power Is Expensive

Nuclear energy is not a cost-competitive way to produce electricity and relies on extensive public subsidies. Nuclear industry officials have openly admitted that without subsidies, they would have no interest in building more nuclear power plants.[10]

Why Nuclear Power Is Expensive

The driving factor behind the cost of nuclear power is that it is a dangerous power source and nuclear plants must be substantial structures with complex technologies to reduce the release of radiation. Nuclear power plants are expensive for companies—and their ratepayers—to construct; federal subsidies mask much of this expense.

Compared to other power plants, nuclear plants undergo a lengthy licensing process to allow regulators time to review construction, operational and safety plans at the plant. The plant requires safety systems to control the nuclear reaction and prevent discharge of radioactivity to the environment, storage systems to maintain the radioactive waste, security against terrorist destruction at the plant, and insurance in case any of those systems fail. Finally, the lag time between the initial financial investment of licensing and construction and the start of plant operation presents nuclear power plant owners with enormous debt repayment expenses.

The first step in building a nuclear plant is the licensing required due to nuclear power's inherent nature as a potential safety hazard and terrorist target. The licensing process is supposed to help lower the risk of catastrophic damage from the nuclear plant by making sure that the planned location, design, and operation of the plant will not unnecessarily put people at risk of radiation exposure through an accident or terrorist attack. However, the licensing process fails to protect public safety by excluding some types of terrorist attack from consideration and by limiting public participation.

The cost of a thorough licensing process to minimize the chance of a catastrophe should be borne by the owners who decide to build the plant, not taxpayers and ratepayers. Submitting an application to construct and operate a nuclear plant requires extensive design and engineering work, with a total estimated cost of $600 million.[11] Unfortunately, however, in the Energy Policy Act of 2005 the federal government promised energy companies that it will pay for any delays in the license approval process, creating a disincentive for a thorough review of licenses for new plants. This is merely the first of many subsidies that new nuclear power plants are slated to receive from taxpayers. Without these subsidies, nuclear power would not be financially viable. (See "Federal Subsidies to the Nuclear Power Industry.")

Building the plant itself is another large expense. Constellation estimates that the reactor proposed for Calvert Cliffs will cost between $2.5 billion and $3.0 billion.[13] This estimate understates the likely cost of building a new plant. In the 1970s, nuclear power plants became notorious for greatly exceeding original cost projections, a problem that has made investors wary of the technology to this day. Standard & Poor's, which provides credit ratings of companies and projects, considers nuclear power plants extremely risky as investments and assigns projects that include a nuclear plant a risk score twice that of a coal-fired power plant.[14] Most recently, Standard & Poor's declared that "until a plant is completed, we will view [a company's] operating risk as higher than average in order to capture the construction risk in the business risk profile."[15]

The French-government owned Areva, Constellation's partner in expanding Calvert Cliffs, is the only company currently constructing a nuclear plant in Western Europe. The plant that Areva is building in Finland uses the same design as the proposed third Calvert Cliffs reactor. Investors watching the project closely have found nothing to calm their fears about cost

Federal Subsidies to the Nuclear Power Industry

The nuclear power industry is heavily subsidized by federal taxpayers.[12] Some of the largest subsidies included in the 2005 federal Energy Policy Act are:

- $2 billion to pay companies for any costs incurred in the licensing for six new reactors. Covered delays include those that result from action by the Nuclear Regulatory Commission or litigation, even if the delay helps protect public safety.
- Loan guarantees for up to 80 percent of the cost of a nuclear plant. If loans were extended for six plants and half of the plants defaulted on their loans, as projected by the Congressional Budget Office, the cost would be $6 billion.
- $5.7 billion in operating subsidies, such as liability insurance in case of an accident and a tax credit for each kilowatt-hour of electricity produced from a new reactor during its first eight years of operation.
- $1.3 billion for decommissioning old plants.
- $2.9 billion for research and development.

overruns, as construction on the Finnish plant is already 18 months behind schedule.[16] Problems with construction have included an overly porous concrete base, an unsafe steel containment vessel, numerous other safety problems and generally poor construction management.[17] The delays have cost about $922 million (more than a quarter of the original estimated cost) but Areva has said they are "of no surprise."[18] Areva's financial status has declined, with the division that is constructing the Finnish plant delivering the worst performance in the company.[19]

Nuclear power plants, like all power plants, have some continuing operation costs, such as worker salaries, maintenance and fuel. Significant security is needed—but not fully used—in every aspect of nuclear plant operation, from protecting the plant itself to guarding radioactive waste while it is stored onsite. In the three years following the September 11 attacks, nuclear power plant operators across the U.S. spent $1 billion—an average of $3.2 million per plant per year—to enhance security with more guards and other measures, but the Government Accountability Office believes the security standards should still be improved.[20] For example, the security standards required by the Nuclear Regulatory Commission appear to reflect "what industry considered reasonable and feasible to defend against rather than an assessment of the terrorist threat." Were plants properly protected, costs would be higher.

The final major costs related to nuclear power are for disposal of the radioactive waste—a cost that is paid by federal taxpayers—and decommissioning of the plant at the end of its useful life. Radioactive material decays slowly, losing its radioactivity after only hundreds of thousands of years. It remains harmful to humans and other animals for much of that time. Plutonium-239, one of the components of radioactive spent fuel, takes 3,665 years to lose the first 10 percent of its radioactivity, but 24,110 years to lose the next to last 10 percent of its radioactivity, so that it is still harmful for hundreds of thousands of years.[21] The longevity of radioactive waste is part of the reason disposal is such a large cost. Ensuring radioactive waste is securely stored for thousands of years is a nearly impossible task, and trying to achieve it is extremely expensive.

The federal government has announced its intention to open a nuclear waste repository at Yucca Mountain in Nevada, at an estimated total cost of $23 billion.[22] Numerous problems with the Yucca Mountain site and the Department of Energy's preparations there make this cost estimate low and the site an unsafe location for storing waste. Yucca Mountain is made of porous rock through which water can flow easily and allow radioactive material to enter groundwater. Because the site lacks natural barriers to the spread of radioactivity, the Department of Energy is attempting to engineer barriers that could contain radioactive material for hundreds of thousands of years, an expensive but likely futile effort.[23]

Even if Yucca Mountain ever begins accepting waste, however, the nation's nuclear waste will not all fit inside Yucca Mountain. The site will not be able to hold all waste from existing reactors. Waste from new reactors such as the third unit at Calvert Cliffs and other proposed plants will not fit into Yucca Mountain at all. In other words, the full price of storing nuclear waste in the United States is unknown. Not knowing the price of this final step of nuclear power production makes it impossible to calculate nuclear power's true cost.

Another cost of nuclear power is insurance in case of an accident. With so many things that can go wrong with the operation of a nuclear power plant, and because the potential damage in the worst scenarios is catastrophic, insurance for plants is costly. Taxpayers bear most of the risk of insurance through the Price-Anderson Act, which limits the liability of nuclear plant operators in case of an accident.[24] By one estimate, power plant operators would be

responsible for only 2 percent of the cost of a worst-case accident.[25] Taxpayers pay the rest. Without Price-Anderson protection, nuclear power plant operators could not secure insurance to cover the billions of dollars of potential liability in case of a nuclear accident. Price-Anderson, therefore, exposes taxpayers to tremendous risk. And because power plant owners do not have to pay for their own insurance, this subsidy acts as a disincentive for owners to minimize risk of a catastrophic accident.

Once a nuclear power plant has reached the end of its life, the site must be cleaned of all radioactive contamination. Costs vary widely from plant to plant, but the NRC usually requires plant owners to set aside at least $290 million to $370 million for decommissioning.[26] However, the Government Accountability Office (GAO) has concluded that the NRC has not required nuclear power plant operators to set aside adequate funds for decommissioning.[27] Were operators to save enough, the cost of nuclear power would be even higher.

Constellation Likely Will Seek Further Public Subsidies

When all the costs of nuclear power are tallied, it becomes clear that it is a very expensive energy source. While in a healthy market this expense would prevent the construction of new nuclear plants, public subsidies distort financial incentives and could encourage new plants to be constructed.

In addition to paying for their share of federal subsidies to the nuclear industry, Maryland taxpayers will end up paying for some of the cost of a new nuclear plant if a new plant is built. The companies have already secured $300 million dollars in tax breaks from Calvert County, and may look for more from the state of Maryland.

Power companies across the country have been seeking additional public funding before moving forward with construction of a new reactor.[28] An "industry observer," quoted in an industry publication, commented that "unless they [utilities] can be assured of cost recovery and a rate of return, these utilities won't risk billions of dollars on nuclear crap shoots."[29] Duke Energy is seeking permission from the North Carolina Utilities Commission to have ratepayers cover the cost of developing plans for a new nuclear power plant, even if the plant is never built.[30]

Public subsidies are costly for taxpayers, but provide little public benefit. The Calvert County subsidy, for example, amounts to about $4,500 per county taxpayer. When granting the tax break, county leaders argued that building a third reactor would add jobs: approximately 3,000 construction jobs and 425 full-time positions once the plant begins operating.[31] However, few enough jobs are created that each permanent job will cost taxpayers $750,000.[32]

A subsidy from the state of Maryland could take many forms, including tax breaks, assistance with permitting, or direct payment toward the cost of construction. Alternatively, Constellation and Areva could attempt to shift costs and risks to the individuals and companies that buy electricity by seeking full or partial re-regulation of Maryland's electricity market. Re-regulation is not inherently bad for consumers, but re-regulation that pushes the financial risks of a nuclear power plant onto consumers is unacceptable. Taxpayers and ratepayers should not bear any of the risk of constructing a new nuclear reactor.

One notorious example of consumers being forced to pay for nuclear power plants comes from the Pacific Northwest, where ratepayers are still paying for one operating and two half-built nuclear plants constructed by the Washington Public Power Supply System in the 1970s. Cost overruns and rising concern about nuclear power halted construction before completion. The half-built plants generate no revenue, yet the utility still owes $6.1 billion on the plants. With revenue collected from ratepayers, the utility spends $446 million annually on debt payments. The debt will not be paid off until 2018.[33]

Calvert Cliffs Is a Safety Hazard

Nuclear power is inherently dangerous. It produces long-lived, highly radioactive waste that is among the most carcinogenic substances known to humans. No technology has been developed to ensure these long-lived wastes remain isolated from living creatures for the tens of thousands of years it will take for the waste to decay to negligible levels of radioactivity.

The two existing reactors at Calvert Cliffs have already produced more than 900 tons of radioactive waste that is stored at the site. Constructing a third unit will only worsen the problem.

A Primer on Radioactivity

Nuclear power plants generate more than just electricity. The process that produces heat to create steam to turn a turbine also produces large amounts of radioactivity. An unknown but small quantity is released into the air and water regularly.

A nuclear power plant produces energy by splitting uranium atoms into two smaller particles. When a uranium atom splits, it releases a tremendous amount of energy. That energy creates heat and generates steam, which turns a turbine to generate electricity.

The byproduct is radioactivity. The newly created particles and the additional neutrons that have split off are unstable and give off radioactivity. The intensity of radioactivity is measured in curies. The core of an average nuclear power plant contains 16 billion curies. For comparison, this is equal to 1,000 times the amount of long-lived radioactivity released by the bomb dropped by the United States on Hiroshima.[34]

The Health Effects of Radiation

Radiation has the power to break DNA bonds. When humans are exposed to radiation, cells may die or be unable to function, or may begin to multiply rapidly (leading to cancer). When radiation affects a reproductive organ, it can lead to hereditary or genetic defects that are passed along to offspring.

The National Academy of Sciences, in a 2005 study, concluded that there is no safe dose of radiation.[35] Direct exposure to high-level radiation from fuel in the core of a nuclear reactor delivers a lethal dose of radiation within seconds. The amount of absorbed radiation and the damage it does is measured in rem.[36] A dose of 2,000 rem of radiation can cause death within hours.[37] Lower doses of radiation also cause significant damage. Exposure to 5 rem can change blood chemistry, 50 rem can cause vomiting with hours, and 400 rem can cause death within two months.[38] The full health impacts of low-level radiation exposure may not materialize for decades.

Radioactive Material at Calvert Cliffs

As long as a nuclear power plant operates, it generates spent fuel. When uranium atoms are split inside the reactor core, they release atomic particles that trigger other reactions. Ultimately, however, these byproducts of nuclear fission build up and interfere with the efficient release of energy. As a result, approximately one-third of the "spent" nuclear fuel is removed from the reactor each year. Spent fuel must be contained and kept out of the environment for hundreds of thousands of years.[39]

As of 2004, 1,015 tons of waste were stored at Calvert Cliffs. The license extension that will allow the plants to operate until 2034 and 2036 will result in another 690 tons of waste.[40] Adding a third unit with a 1,600 MWe capacity will produce more waste. Assuming that the new reactor produces the same amount of waste each year as the two current reactors combined (which have a 1,650 MWe capacity), the third reactor will produce 1,380 tons of waste in its lifetime.[41]

The United States has never had a plan for safe disposal of spent fuel. When the nation's nuclear power plants were first designed, it was expected that the spent fuel

rods would be removed from the cooling ponds where spent fuel is stored and sent to a facility for reprocessing, where plutonium would be extracted for use in other reactors. After President Ford temporarily halted reprocessing in 1976 and President Carter ordered an end to reprocessing in 1977, the United States ended the reprocessing of spent fuel as a disposal method.[42] However, more recently President Bush has proposed resuming spent fuel reprocessing as part of a push to increase domestic nuclear power generation.[43] Yet reprocessing is not a solution to the problem of radioactive waste, because reprocessing creates radioactive and toxic waste that must be stored. After the reprocessed fuel has been used in a reactor, it, too, is radioactive waste that must be stored.

In the absence of a safe long-term storage solution for nuclear waste, spent fuel often is placed in reactor cooling ponds that were never designed for the long-term storage of nuclear waste.[44] At Calvert Cliffs, the cooling pond is now full, creating several problems. First, fuel ponds that hold more spent fuel than was originally intended present a fire risk if water were ever drained from the pool.[45] An over-full spent fuel pool may be an attractive terrorist target because of its vulnerability and large volume of radiation. Second, older spent fuel must be moved from the cooling pond to dry storage casks near the reactors to make room for newer radioactive waste in the cooling pond. Waste in dry storage casks also may be vulnerable to terrorist attack. A shortage of temporary storage space and the absence of long-term storage plans for spent nuclear fuel are serious problems for many nuclear power plants throughout the country.

Low-level radioactive waste presents another problem. By the time that a third reactor begins operation at Calvert Cliffs, Maryland will no longer be allowed to send its low-level radioactive waste to Barnwell, South Carolina, the site of a regional dump for low-level waste. That low-level waste will have to remain in Maryland.

So long as radioactive waste is stored in Maryland, the potential remains for an accident or terrorist attack that could expose thousands of people to radiation. Storing the waste out of state would create another risk: to people who might be exposed when the waste is transported.

Potential Exposure to Radiation

Releases from Calvert Cliffs

If the reactors at Calvert Cliffs operate as intended, Maryland residents are exposed to daily releases of radiation. An accident or terrorist attack could expose thousands of Marylanders to radioactivity.

The safety history of the U.S. nuclear industry is not reassuring.

Tritium may be released into the air and water because tritium's similarity to hydrogen allows it to easily replace hydrogen in water. In the past several years, multiple nuclear power plants around the country have leaked tritium, which can cause genetic damage and increase the risk of birth defects and cancer.[46]

The last major release of radioactive material from a commercial nuclear reactor in the U.S. was several decades ago, but there have been close calls since then. The worst nuclear reactor accident on U.S. soil occurred at the Three Mile Island (TMI) reactor in Harrisburg, Pennsylvania, on March 28, 1979. A partial meltdown of the reactor's core led 140,000 people to evacuate from the area.[47]

The accident resulted from a combination of human and mechanical error—a plant malfunction combined with operator override of automatic safety systems. Cleanup at the plant has cost approximately $1 billion.[48] In addition, victims of the TMI accident have successfully sued the plant's owner and the nuclear industry for at least $50 million.[49]

The full health consequences of the TMI accident are unknown. One study, conducted by researchers at University of North Carolina at Chapel Hill, suggests that the accident caused an increase in lung

cancer and leukemia rates downwind of the Three Mile Island reactor compared to upwind.[50]

The Three Mile Island accident does not represent a worst-case scenario for the potential impact of a major nuclear accident. A 1982 study by the Sandia National Laboratories found that a serious core accident at a U.S. nuclear reactor could cause hundreds to thousands of deaths immediately.[51] Estimates of early fatalities ranged from 700 to 100,000, depending on the size of the reactor and the proximity of large populations (in 1982).[52] A serious core accident at the two existing Calvert Cliffs reactors could cause 5,600 immediate deaths, 15,000 injuries and 23,000 deaths from cancer, assuming there are no more people living near the reactors than in 1970.[53]

The two existing units at Calvert Cliffs have not had a major incident that attracted public attention recently. The plant does have a history of violations, however. The NRC has levied fines for unsafe practices at the reactors. In 1996, the plant was fined $50,000 for problems with emergency equipment that had been identified in 1992 but had not been repaired four years later.[54] The NRC issued a $176,000 fine in 1997 and a $55,000 fine in 1998 because personnel at Calvert Cliffs had been careless with exposure to radiation.[55]

Other problems have led to warning notices but no fines. Problems have included malfunctioning water pumps and, in 2006, incorrect settings for a circuit breaker that allows an emergency diesel generator to function. The incorrect settings were the result of an error that occurred during installation of the emergency generator in 1996.[56]

In 2001, a sink hole formed outside the turbine room of the plant. By the time the hole was discovered, it had grown large enough that filling it required 40 tons of dirt.[57] The sinkhole was caused by an underground drainage pipe that collapsed. The pipe carried groundwater away from the area under the plant and into the bay. Over the years, saltwater corroded the pipe, allowing dirt into the pipe where it was carried away from the site.

Calvert Cliffs may be vulnerable to other unexpected natural disasters. Although Maryland is not known for its tornadoes, a category five tornado (the strongest category, with winds above 260 miles per hour) formed in Maryland in April 2002, and passed within two miles of the Calvert Cliffs facility.[58]

Meanwhile, Constellation has pared back staffing at the two existing units. In 2001, 1,400 people worked at the plants. However, to reduce costs, Constellation has eliminated 465 positions, cutting the workforce to 935 people.[59] At the same time, the facility was generating record amounts of energy. Fewer staff increases the odds that personnel may be forced to work overtime or that there may not be as many staff available to handle an emergency.

Calvert Cliffs is also vulnerable to a terrorist attack. Nuclear power plants make attractive potential targets for terrorists—either via external assault or internal sabotage. Specific information about security strengths and weaknesses at Calvert Cliffs is not available because of security concerns; only general data about nuclear plants has been released. That general security record of nuclear power plants is far from reassuring.

In tests at 11 nuclear reactors in 2000 and 2001, mock intruders were capable of disabling enough equipment to cause reactor damage at six plants.[60] Prior to September 11, 2001, half of reactors failed to defend themselves against simulated attacks.[61] A 2003 GAO report found significant weaknesses in the NRC's oversight of security at commercial nuclear reactors, including failing to require plants to correct identified security weaknesses and conducting simulated attacks to test security staff and systems in which plant operators were given advance warning and an opportunity to prepare.[62] In September 2004—three years after the September 11, 2001 terrorist attacks—the GAO reported that the NRC had not yet implemented some of the GAO's earlier recommendations and

that the NRC was not yet in a position to assure that plants are able to defend against terrorism.[63] And in March 2006, the GAO was unable to conclude that all nuclear power plants were capable of defending themselves against a plausible terrorist attack, since only about one-third of the plants had conducted the necessary inspections through simulated attacks. The GAO also questioned changes made to the NRC's standards for protection against terrorist attacks, noting "the appearance that changes were made based on what the industry considered reasonable and feasible to defend against rather than on an assessment of the terrorist threat itself."[64] Most recently, the NRC ruled that nuclear power plants do not need to create protections against the possibility of a terrorist attack by plane, despite evidence that the 9/11 attackers had considered targeting a nuclear power plant.[65]

Were an accident or terrorist attack to occur at Calvert Cliffs, evacuation routes from the area around the reactor would be limited and might be insufficient to remove all residents from harm's way. The Calvert Cliffs reactors are in the far southern tip of Calvert County where the county tapers to a point between the Chesapeake Bay and the Patuxent River. The only major road serving the area is Route 2, which runs north/south. In case of an evacuation order, people living south of Calvert Cliffs in Calvert County would need to drive south on Route 2 to the Governor Thomas Johnson Bridge over the Patuxent River to St. Mary's County.

In normal traffic conditions, roads leading to the bridge are frequently congested.[66] During an evacuation, the road could become a bottleneck, preventing residents from escaping radiation released from the plant.

Releases During Waste Transport

The danger to Maryland residents from radioactive waste will not be over once a federal repository is finally constructed. Waste generated at Calvert Cliffs will be stored in spent fuel pools for at least five years before it is placed into casks for on-site storage or shipping. Transporting waste creates a hazard as the waste is shipped via train or truck.

In theory, the federal waste repository at Yucca Mountain will store spent nuclear fuel and other radioactive wastes from commercial reactors around the nation. The logistical challenges of actually achieving this are tremendous. Nationally, 118,000 tons of spent nuclear fuel and 22,280 canisters (typically containing 1 cubic meter of waste) of high-level radioactive waste could be moved to Yucca Mountain if the site is ever opened.[67] The Department of Energy plans for the transportation to occur over the course of 38 years, assuming the department's plans are carried out without a hitch.[68] The waste would be shipped in casks that would each contain as much as 240 times the amount of radioactive material released by the Hiroshima bomb.[69]

Radioactive Waste Management Associates, a consulting firm working for the state of Nevada, has estimated that 100 to 450 accidents will occur as nuclear waste is transported via train and truck to Yucca Mountain.[70] A single serious accident could cause thousands of cancers and cost billions of dollars.[71]

Fortunately, no major accident has occurred during the transport of radioactive material, but many minor ones have. The Radioactive Material Incident Report database maintained by Sandia National Laboratories identifies 402 incidents from 1971 to 1999 in which a vehicle transporting radioactive material killed or injured someone or was so damaged that it could not operate under its own power.[72]

Furthermore, even outside of an accident, emissions from passing casks will deliver involuntary doses of radiation to people living within one-half mile of road and rail routes. The DOE acknowledges that commuters stuck in traffic near a highly radioactive waste shipment would be exposed to the equivalent of one chest x-ray per hour.

In Maryland, waste from Calvert Cliffs

Worst Case Scenario: A Repeat of the Baltimore Rail Tunnel Fire

In July 2001, a freight train traveling through the rail tunnels beneath Baltimore caught fire. The CSX freight train, which was carrying flammable chemicals, derailed and caught fire. The fire burned for several days, with temperatures exceeding 1,500° F. Based on eyewitness reports of a "deep orange" glow from the metal rail cars in the center of the fire, temperatures likely reached 1,650° F.[73]

The casks in which nuclear waste is transported might not contain their cargo in such a fire, because they are designed to withstand fires of 1,475° F for only 30 minutes. A report by Radioactive Waste Management Associates estimated that radioactive material would leak from the cask.[74] This would lead to 200 to 1,400 cancer deaths in the first year after the accident. The material from a single cask would be enough to contaminate a 32-square-mile area. Cleaning up this contamination would cost $13.7 billion. The alternative would be to allow the contamination to remain, causing an additional 4,000 to 28,000 cancer deaths in the following 50 years.[75]

These fatality figures do not include the deaths of firefighters, emergency personnel and others who would respond to the fire.

could be shipped by truck or rail through densely populated areas. If the waste is shipped by truck, the Department of Energy proposes that waste be moved along Route 2, along I-495 around Washington, D.C. and then on I-70 toward Frederick.[76] If waste were shipped by rail, it would travel through Washington, D.C.[77]

A mapping project by the Environmental Working Group found that more than 900,000 Marylanders live within one mile of a proposed nuclear transportation route and 3.1 million live within five miles. The project also found that 163 schools and five hospitals are located within one mile of the routes.[78]

Train and truck accidents are common and could expose thousands of people to radiation. In 2005, large trucks were involved in 57 fatal wrecks in Maryland alone.[79] Nationally, 60,000 tractor-trailers are involved in accidents on interstates annually and in 3,300 of those accidents the truck rolls over, potentially losing its cargo.[80] Transport by train is equally problematic. In 2005, there were 130 train accidents in Maryland, including 24 derailments.[81]

Building a third reactor at Calvert Cliffs could increase the amount of radioactive waste that gets shipped through Maryland communities on its way to the Yucca Mountain depository or a new site, if a repository is ever opened.

Calvert Cliffs Will Not Be Free of Radioactive Material Soon

Neither the opening of a federal waste repository nor the closing of Calvert Cliffs will automatically eliminate the risks that Calvert Cliffs poses to the health of Maryland residents. Even if the Yucca Mountain repository is opened, the site will run out of room before it can take the spent fuel that power plants already operating around the country have stored or will generate in the next few years. Adding a third unit at Calvert Cliffs means that more waste will be stored, indefinitely, here in Maryland.

Congress has approved storing approximately 84,700 tons of waste at the Yucca

Mountain repository. The nation's reactors have already generated 59,400 tons of used nuclear fuel, along with 13,200 tons of defense-related high-level waste.[82] Assuming that commercial reactors continue to generate an additional 2,200 tons of waste annually, by 2011 the 84,700 ton-capacity of Yucca Mountain will have been exceeded. Even before the earliest date at which Yucca Mountain might begin accepting waste, there will be enough waste at sites around the country to fill the repository.

Even if all the spent fuel at Calvert Cliffs is transported elsewhere and the reactors are shut down so that they are no longer generating more waste, the site will remain contaminated with radioactivity for decades. Nuclear power production generates large amounts of "low-level" radioactive waste, much of which would be categorized as "intermediate-level" waste if such a category existed here, as it does in Europe. Nearly every reactor component that has contact with radioactive fuel or water becomes low-level waste. This includes hardware, pipes, control rods, resins, sludges, filters, evaporator bottoms, and poison curtains. Upon decommissioning, the entire nuclear plant, including concrete and steel, will be low-level radioactive waste that must be stored somewhere.

The NRC requires that nuclear power plants that permanently cease operating be "decommissioned," meaning levels of radioactivity in the buildings and on the property must be reduced to a low enough level that the facility can be used for any purpose. The plant owner has 60 years to complete the decommissioning process.[83]

Nuclear Power Is Environmentally Destructive

Constructing a third reactor at Calvert Cliffs will damage the environment by causing environmental harm where uranium is mined and processed.

Nuclear power generation requires uranium for fuel. Uranium mining produces large amounts of waste, similar to coal mining, tainting water and soil with radioactivity and other hazards.

U.S. plants consume more than 40 million pounds of uranium per year.[84] Nuclear power also does not alleviate our dependence on foreign sources of energy, because approximately 75 percent of uranium is imported.[85] Domestically, the largest reserves of uranium are found in Wyoming, New Mexico, Arizona, Colorado, Utah and Texas.[86]

Uranium is extracted from underground or open-pit mines, causing tremendous environmental damage and landscape destruction. "Milling" separates much of the uranium from the rock in which it was embedded. The leftover rock, mixed with water, is held in an impoundment. A different technology, *in situ* leach facilities, extracts uranium by injecting an acidic mixture into wells, causing the uranium to dissolve in groundwater so that it can be pumped to the surface.[87] With any method, uranium and other heavy metals such as arsenic may leach into groundwater and nearby streams. While only two uranium mills are currently operating in the United States, the Department of Energy is still working to remediate contaminated groundwater at five sites where uranium milling formerly occurred.[88]

In Utah, for example, mill tailings from the Atlas Corporation's mining and milling operation sit in a pond next to the Colorado River. Because the pond is in the Colorado River's flood plain, it presents a major threat to the Colorado, which provides drinking water for millions of people downstream in Arizona, Nevada and California.[89]

Although there are no uranium mines or enrichment facilities in Maryland, the state's nuclear power generation contributes to environmental and public health degradation wherever uranium is mined and milled.

The Nuclear Regulatory Commission: An Ineffective Regulator

The public health and environmental risks posed by adding a third reactor at Calvert Cliffs would be less threatening if Marylanders could count on an effective federal regulator to enforce regulations and require operators to fix problems promptly. Unfortunately, little in the NRC's history instills confidence that it can play this regulator role effectively.

Over a period of just two years, the Government Accountability Office (GAO) issued seven reports that detailed the need for improvement in NRC practices to ensure the safety and security of nuclear power plants, the safe storage of radioactive waste, the collection of adequate funds for nuclear decommissioning, and the effective operation of nuclear reactors.[90] In a 2002 internal survey, nearly half of all NRC employees responding thought their careers would be harmed if they raised safety concerns, and nearly one-third of employees who had reported safety concerns replied that they had suffered harassment or intimidation as a result.[91]

The NRC's reviews of nuclear power plant safety are fundamentally flawed. A 2003 Union of Concerned Scientists document identified numerous problems with the reviews, which, combined, lead to an overly optimistic view of the safety of individual reactors.[92]

The most significant failure by the NRC in recent years occurred at the Davis-Besse nuclear plant in Ohio. Workers discovered a football-sized cavity in the reactor's vessel head. Left undetected, the problem could eventually have led to leakage of radioactive coolant from around the reactor core and, possibly, a meltdown. The GAO concluded that the NRC "should have but did not identify or prevent the vessel head corrosion at Davis-Besse" and that the NRC's "process for assessing safety at nuclear power plants is not adequate for detecting early indications of deteriorating safety."[93]

In the past 27 years, safety at 38 nuclear reactors in the U.S. became so severely compromised that the plants had to remain closed for a year or longer to complete repairs to meet minimum safety standards.[94] These problems occurred at plants that are not merely working out the kinks as they begin operation or at facilities of a brand-new design. The problems happened at reactors with many design similarities to plants around the country with the same deficiencies, yet the NRC still struggled to identify safety problems in a timely fashion.

These problems call into question the NRC's ability to safely oversee a new reactor at Calvert Cliffs that is of a new design.

Furthermore, the NRC has refused to take terrorism into account in its licensing decisions, calling the threat of a terrorist attack at any single reactor "too speculative and remote."[95] The NRC has also declined to require reactors to defend against the possibility of a terrorist attack using an airplane, despite evidence that it could be a real threat. Despite the NRC's position, American Nuclear Insurers, which provides insurance to the nuclear industry, has raised its insurance premiums by 30 percent since the September 11, 2001 attacks because of an increased risk of an attack.[96]

The NRC's track record does not inspire confidence that the agency will be able to protect Marylanders from safety problems or a terrorist attack at a new nuclear reactor at Calvert Cliffs.

Policy Recommendations

Any one of the problems listed above—high costs, threats to public health, susceptibility to terrorism, lack of safe long-term storage for nuclear waste, and environmental harm—should be enough to call into question the wisdom of building a third reactor at Calvert Cliffs. As noted earlier, federal officials have provided inadequate oversight of nuclear plants and are likely to raise few objections to adding a third reactor at Calvert Cliffs. Stopping the expansion of Calvert Cliffs will likely lie with Maryland's local and statewide leaders.

Do Not Provide Financial Subsidies

Nuclear energy is an expensive and risky source of power. It is unlikely that any energy company will be able to finance construction of a new plant using private financing. In addition to the federal subsidies that Constellation would receive for a new plant, the company likely will seek additional subsidies from Maryland state or local taxpayers, or from ratepayers.

The company has been promised a $300 million tax break from Calvert County if the reactor is built. The county commissioners should withdraw their financial support of Constellation Energy and its foreign partner and should not offer additional funds.

Maryland should not authorize the use of state funds to help finance expansion of the Calvert Cliffs nuclear plant.

Nor should the cost be passed along to electricity ratepayers by including the capital or financing costs of the power plant in electric rates or exposing ratepayers to any of the financial risks involved in nuclear power plant construction.

Adopt a Conditional Ban

Additionally, Maryland should prohibit the construction of any new nuclear facility unless the United States has a plan for the safe and proper disposal of nuclear waste. The on-site storage of nuclear waste poses one of the greatest safety threats resulting from the operation of nuclear power plants—and current plans for the transport

of nuclear waste in close proximity to populated areas are no more reassuring.

Illinois, Kentucky, Wisconsin, Montana, Maine and California have adopted moratoriums on the construction of new nuclear power plants unless certain conditions are met. The primary condition is a permanent solution for spent fuel.[97] The Kentucky and Maine laws also require that a high-level nuclear waste storage facility be in operation at the time that disposal of nuclear waste must occur. The Wisconsin law requires that a nuclear power plant be judged to be economically advantageous to ratepayers compared with other feasible alternatives.

The Montana law goes several steps further, requiring that there be "no reasonable chance" of the discharge of harmful radioactivity, that the safety systems of the plant be demonstrated as effective, and that nuclear facility owners post a bond equal to 30 percent of the capital cost of the plant to cover decommissioning expenses.[98]

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