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An Atomic Sound

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AN ATOMIC SOUND

Nuclear Energy on the Long Island Sound

Erich Weltsek

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Preface

A Fragment of What Was

Lurking behind a locked chain-link fence stands the seafoam green structure of the Shoreham nuclear power plant—tucked away on the North Shore of Long Island, hardly visible from North Country



Figure 1: The Shoreham Nuclear Power Plant
(Photo Credit: Steven J. Weltsek, *Shoreham*, March 8, 2016)

Road which passes alongside the plant. The iconic pill-bottle shaped structure of the Shoreham plant stands in silence. The silence of the Shoreham plant was the result of a nearly three decade long drama. Across the Long Island Sound another, totally different story unfolded. The Millstone Station plant is located in Waterford, Connecticut. The plant's stout and sprawling structures are clearly visible to Waterford residents and visitors. Millstone at its peak was operating three reactors on site, but is currently generating electricity with two nuclear reactors.

Both Shoreham and Millstone were products of the 1960s. Both plants experienced the aftermath of Three Mile Island. And yet both plants followed different paths: one was eventually decommissioned, and the other continued to operate and expand. Why did these plants have such vastly different outcomes even though they are separated by less than 50 miles? Environmental, socio-political and economic factors influenced the outcomes of Shoreham and Millstone. It was

not simply one of these three factors that led to the relative success of Millstone, but a conglomeration of the three. Conversely, these same three factors spelled out the doom of the Shoreham nuclear power plant.

A Product of Post-War America

Nuclear Concern

The world first learned about the power of nuclear technology in 1945. The technology was harnessed into two war-ending weapons. With World War II's end, the Cold War began as tensions between the United States and USSR grew. With the Cold War came fear of nuclear war, and global mass destruction. Citizens of the United States were advised how to "save" themselves from nuclear blasts by digging bomb shelters in their yards, or by hiding under desks at school. After being introduced like that, it is no surprise that nuclear energy concerned many people. One side of nuclear energy was the promise of clean, cheap and abundant energy. On the other side was a horrible, destructive weapon capable of flattening entire cities.¹ American citizens' hesitance and concern towards nuclear energy stemmed from the explosive unveiling of the power of nuclear technology.

The Future of Energy

Technological advancements and innovation following World War II gave birth to, and drove the nuclear industry. 1946 saw the creation of the Atomic Energy Commission (AEC) by Congress, which created a "program for Government control of the production, ownership, and

¹ James Mahaffey, *Atomic Awakening: A New Look at the History and Future of Nuclear Power* (Cambridge: Pegasus, 2010) pg. XIV-XV.

use of fissionable material.”² The AEC would set regulations, create policies, and hold hearings relating to nuclear technology, be it for a university’s scientific study or a private utility’s commercial energy production. Building on the government’s authority over nuclear technology, in 1953, President Dwight D. Eisenhower launched his *Atoms for Peace* initiative, calling for the growth of peaceful, non-military use of nuclear technology in the wake of World War II.³ Ironically, the first nuclear powered submarine, the *USS Nautilus*, was launched in 1954, a year after *Atoms for Peace* was announced.⁴ As nuclear technology improved, the United States government took steps towards the spread of commercial nuclear energy in the country. In 1958, the United States (through the AEC) commissioned the first commercial nuclear power plant on American soil, the Shippingport Atomic Power Station in Pennsylvania. The AEC and the federal government saw Shippingport as a way to convince the public that nuclear technologies, especially nuclear power were clean and safe and produce energy that was “economically attractive.”⁵ More nuclear plants followed in the 60s and early 70s. By October 1973, the United States was in the grips of the first oil crisis.⁶ As oil prices increased, the search for alternative sources of energy also increased. Two choices became apparent to fuel America’s cities: uranium or coal. Between 1975 and 1982, use of coal to generate electricity increased by 50 percent as oil-burners were converted to coal.⁷ The risks associated with burning coal were well known, stories of “killer smog” and the dangers associated with coal mining had been heard for decades.⁸ The immediate risks of nuclear energy were also well known, the dangers of uranium mining,

² Joan Aron, *Licensed to Kill?: The Nuclear Regulatory Commission and the Shoreham Power Plant* (Pittsburgh: University of Pittsburgh Press, 1998) pg. 13.

³ Mahaffey, *Atomic Awakening*, 228.

⁴ Mahaffey, *Atomic Awakening*, 220.

⁵ Mahaffey, *Atomic Awakening*, 229.

⁶ Spencer R. Weart, *The Rise of Nuclear Fear* (Cambridge: Harvard University Press, 2012) pg. 196.

⁷ *Ibid*, 197.

⁸ *Ibid*, 198.

and concern over radiation leaks and radon gas.⁹ The argument of “soot or atoms” was established during this time - an argument that will be discussed in a later section.

Long Island had a challenging energy situation: a lack of natural resources. There is no coal or oil on Long Island, so all fuel must be transported to the island from the mainland. Pair the lack of natural resources with the pollution associated with coal and oil combustion and a population that doubled between 1950 and 1960: it is not difficult to see why the electric utility on Long Island reached for alternative sources of energy.¹⁰ Nuclear power plants appeared to be the answer to all of Long Island’s energy issues by avoiding the problem of constant refueling, and by being a “clean” source of energy.

Nuclear Energy on the Sound, Pre-1979

Shoreham – The Announcement

On April 13th 1966, John J. Tuohy, president of the Long Island Lighting Company (LILCO) confirmed that land on Long Island was to be purchased for Long Island’s first nuclear power plant. A 450-acre plot of land located in the hamlet of Shoreham within the Town of Brookhaven, Suffolk County was purchased from the Steers Sand and Gravel Corporation. LILCO announced that the nuclear plant’s initial cost would be between \$65-million and \$75-million and construction would begin in 1969 and be completed by 1973.¹¹ The plant at Shoreham would produce enough energy to power 450,000 average homes.¹²

⁹ Ibid, 199.

¹⁰ Aron, *Licensed to Kill?*, 12.

¹¹ “LILCO Buying Nuclear Plant Site in Suffolk,” *Newsday*, April 13, 1966, pg. 11.

¹² Francis X. Clines, “Utility Planning Nuclear Plant in Suffolk County: Park Is Also Proposed for Part of Shoreham Tract,” *The New York Times*, April 14, 1966, pg. 22.

Initial reception of the announcement of the plant was positive. Joan Aron, a professor of political science at New York University and a scholar of the Shoreham nuclear plant, states in her book *Licensed to Kill?*, that Shoreham was “supported by both the public and by state and local officials – by everyone, in fact, except for a small band of antinuclear activists.”¹³ Support for the project came instantly from the town and county government. The Town of Brookhaven’s Supervisor Charles R. Dominy called the Shoreham plant a “stupendous installation.”¹⁴ Dominy expressed Brookhaven’s support by declaring “There has been nothing but support here for this project ... it will be a good clean operation.”¹⁵ Dominy in the same press release gave insight to why Brookhaven supported the project, “[Shoreham] will add another piece of highly assessed property to the town tax rolls.”¹⁶ In addition to support from the local Town government, elected officials at the County level also voiced their support. Suffolk County Executive H. Lee Dennison, supported the project because it would bring “desirable employment” to the county. “Desirable employment” took the form of construction jobs to build the plant, and highly skilled technician jobs to operate it. Between the income generated by the Town and County from taxes, and the creation of jobs in the area, it is clear why elected officials were initially so supportive of the Shoreham project.

The citizens of Shoreham, much like their local government, initially supported LILCO’s nuclear plant. Residents used environmental arguments to justify their support for the new plant. In the months following the announcement, citizens spoke at Town Board supporting LILCO’s new nuclear plant. Some citizens even went as far as to demand assurance from LILCO that the

¹³ Aron, *Licensed to Kill?*, 5.

¹⁴ Francis X. Clines, “Utility Planning Nuclear Plant in Suffolk County: Park Is Also Proposed for Part of Shoreham Tract,” *The New York Times*, April 14, 1966, pg. 22.

¹⁵ “LILCO Buying Nuclear Plant Site in Suffolk,” *Newsday*, April 13, 1966, pg. 11.

¹⁶ *Ibid.*

plant be nuclear powered rather than oil or coal powered.¹⁷ In addition to the concern over air pollution, residents of Shoreham stated that would rather have the 450-acres purchased by LILCO used for nuclear power generation than the mining operations that were proposed for the site. Again, with nuclear came the promise of clean energy, which Long Islanders preferred to the dust and noise that came with an active sand and gravel mine.¹⁸ In addition to quality of life and environmental concerns lending support to the nuclear plant, citizens would also enjoy economic benefits from the plant. School taxes were predicted by the vice president of the Shoreham Civic Association, Robert Tomlinson Jr., to be cut an “average of \$10 or \$12 for each \$100 of assessed valuation” and new job opportunities were to be introduced to the area.¹⁹ Abraham Rabinovich, a writer for *Newsday*, also suggested that those living in Shoreham and the surrounding area had a “relaxed attitude” towards nuclear energy. Rabinovich argues that this “relaxed attitude” was because of Shoreham’s proximity (five miles) to Brookhaven National Laboratory’s nuclear facilities;²⁰ by 1965, Brookhaven National Laboratory had three research reactors in operation. As of 1966, the residents of Shoreham and the surrounding areas showed great support for the proposed power plant. By 1967, the luster of Shoreham’s plant would begin to fade, as a miscalculation by LILCO resulted in the entire project’s demise.

Shoreham’s Early Opposition and Construction Permit Hearings (1967-1973)

On October 17th 1967, the news broke to the public that LILCO had plans for a second nuclear power plant on Long Island. This second plant was to be built near the affluent village of

¹⁷ Abraham Rabinovich, “Prefer Atoms To Coal Soot,” *Newsday*, June 3, 1966, pg. 15.

¹⁸ Ibid.

¹⁹ Ibid.

²⁰ Ibid.

Lloyd Harbor.²¹ To break the news to the community, the mayor of Lloyd Harbor sent a letter to the residents of the village, which assured taxpayers that the plant would provide “massive” tax relief, and insisted that the plant would blend into the rustic waterfront aesthetic of the village.²² The plant at Lloyd Harbor was proposed less than a year after Shoreham’s announcement, before LILCO even applied for a construction permit for Shoreham. The bold move by LILCO to announce two nuclear power plants in such a short period of time would be the beginning of the end of public acceptance of nuclear power on Long Island.

After hearing that a nuclear plant was to be placed in their backyard near their prime waterfront property, citizens of Lloyd Harbor (the Gold Coast of Suffolk County, as it was also known) were “horrified.”²³ Shortly after the announcement, the Lloyd Harbor Study Group (LHSG) was formed, spearheaded by wealthy partners, Ann and William Carl, who were a biologist and an engineer respectively. Over the next year, Mr. and Mrs. Carl rallied support and raised money to fight LILCO and their proposed plant. With such opposition at Lloyd Harbor from its residents and the LHSG, LILCO abandoned the Lloyd Harbor plant by 1969. Even though the plant did not exist and the idea of a plant in Lloyd Harbor was short lived, the proposal catalyzed an environmental movement, crusading against nuclear power on Long Island.²⁴ After their victory against the Lloyd Harbor plant, LHSG set out against LILCO’s plant at Shoreham. Director Emeritus of the Center for History of Physics of the American Institute of Physics Spencer Weart makes note that a poll taken in 1965 showed that a “great majority” of environmentalists opposed nuclear power “unlike most other Americans.”²⁵ This general pro-

²¹ Francis X. Clines, “Utility Asks to Build Nuclear Plant in L.I. Village: Approval of \$150-Million Facility on Shore Sought,” *The New York Times*, October 10, 1967, pg. 31.

²² Ibid.

²³ Aron, *Licensed to Kill?*, 16.

²⁴ Ibid, 17.

²⁵ Weart, *Rise of Nuclear Fear*, 194.

nuclear mindset amongst Americans would shift in the coming years, in the wake of events like Three Mile Island.

On May 24th 1968, LILCO filed with the AEC an application for a construction permit for Shoreham.²⁶ The AEC permitting process was divided into two parts: a review by AEC staff and a public hearing. Generally, public hearings held by the AEC had been uneventful, with hearings lasting from a few days to a few weeks.²⁷ By the end of 1968, LILCO had deemed that the original plan of 540 megawatts at Shoreham was insufficient to the Island's needs. LILCO concluded that Shoreham's output would have to be 820 megawatts to meet the Island's needs. This increase in output required the plant's application for a construction permit to be revised and resubmitted, causing a year delay.²⁸ The application to the AEC would be resubmitted in May 1969.²⁹ The estimated cost of the plant had jumped from \$70 million to \$127 million in 1968 due to "rising labor and construction costs."³⁰ The estimated cost of the plant ballooned again to \$217 million due to the increased output, nearly three times the 1966 estimated cost.³¹

The AEC staff deemed Shoreham safe and approved LILCO's application, moving the process along to public hearings.³² On September 21st 1970, the public hearings began.³³ The Shoreham hearings would become the longest set of hearings in AEC history, dragging on for over two years.³⁴ Neither LILCO nor the AEC were prepared for the opposition they were about to face from the LHSB and their allies. One group to back LHSB and provide name recognition

²⁶ Aron, *Licensed to Kill?*, 17.

²⁷ *Ibid*, 20.

²⁸ *Ibid*, 18.

²⁹ *Ibid*, 19.

³⁰ "Cost of LILCO Atom Plant Almost Doubled in 2 Yrs." *Newsday*, May 29, 1968, pg. 9.

³¹ Aron, 19.

³² Christopher Weber, "AEC Expert: Shoreham Plant Safe," *Newsday*, February 26, 1970, pg. 4.

³³ Carter B. Horsley, "Hearing to Start on L.I. Atom Plant: A.E.C. Takes Up Shoreham Proposal Tomorrow," *The New York Times*, September 20, 1970, pg. 26.

³⁴ Aron, *Licensed to Kill?*, 20.

to their cause was Ralph Nader's Center for the Study of Responsive Law.³⁵ The Lloyd Harbor Study Group was represented in the hearing by experienced lawyer Irving Like. Like's experience allowed him to see that he (and the LHSG) would not succeed in stopping the construction permit from being issued to LILCO, so he adopted a particular strategy in the courtroom, using the hearings as "an educational forum to alert the public to the project's adverse effect on environmental quality."³⁶ This strategy allowed Like and other LHSG witnesses to voice their variety of concerns including: the adequacy of AEC construction standards, environmental impacts of the plant under the National Environmental Policy Act (NEPA), and public health concerns, including questions on how Long Island would be evacuated in the case of an emergency.³⁷

As Irving Like expected, the AEC issued LILCO the construction permit for Shoreham mid-April 1973. The permit was approved with "six conditions" attached by the AEC in response to LHSG's environmental concerns relating to radiation releases, thermal pollution, and protection of wetlands.³⁸ These "six conditions" served as a consolation prize to the LHSG and Like; they could not stop the permit from being issued, but at least received something for their efforts. The Lloyd Harbor Study Group's role in the construction permit hearings had a lasting effect on the destiny of the Shoreham plant, not simply because they delayed the plant for over two years. The Lloyd Harbor Study Group's contribution was that they brought to light some of the major public health and environmental implications surrounding the Shoreham nuclear plant. A particular problem brought to public attention by the Lloyd Harbor Study Group was the

³⁵ Howard Schneider, "New Twists for Atomic-Plant Hearing," *Newsday*, September 24, 1970, pg. 26.

³⁶ Aron, *Licensed to Kill?*, 21-2.

³⁷ *Ibid*, 24-6.

³⁸ David A. Andelman, "A.E.C. Approves L.I. Atom Plant: Building of Power Facility at Shoreham is Allowed," *The New York Times*, April 13, 1973, pg. 44.

possibility of evacuating Long Island in the event of a nuclear disaster, a concern that would trouble many Long Islanders after Three Mile Island and would push Shoreham closer to closure.

Further Complications at Shoreham

Riding the wave of victory following the issuing of the construction permit at Shoreham, LILCO announced a new nuclear project for Jamesport in Suffolk County. By July 1973, LILCO announced a \$600-million dollar, 1150 megawatt plant for Jamesport.³⁹ After the AEC construction permit hearings—and the concerns brought up by LHSG— anti-LILCO and anti-nuclear opposition grew. As a result of this opposition even elected officials began to separate themselves from LILCO, Shoreham and any other nuclear plants planned for Long Island.⁴⁰ By 1977, Suffolk County hired Irving Like to be the county’s voice against the plant at Jamesport.⁴¹ One concern about the Jamesport plant that Like raised was “whether these plants [Shoreham and Jamesport] are needed.”⁴² Like and the County claimed the plants were unnecessary, where the Nuclear Regulatory Commission (born in 1974 from the AEC) and LILCO agreed that the electricity to be created at Jamesport was needed to keep up with Long Island’s power demands.⁴³ Eventually in 1980, New York State had the final say on whether the plant at Jamesport was needed, and turned down all of LILCO’s applications for Jamesport based on economic grounds and post-Three Mile Island nuclear fear.⁴⁴ LILCO’s plans for Jamesport had lasting effects on the Shoreham saga, even though no plant was actually built in Jamesport. According to Joan Aron, LILCO’s ambitions for Jamesport radicalized “a lot of people on Long

³⁹ Tom Incantalupo, “Another A-Plant Battle Takes Shape,” *Newsday*, July 25, 1973, pg. 19.

⁴⁰ Aron, *Licensed to Kill?*, 30.

⁴¹ *Ibid.*, 37.

⁴² *Ibid.*

⁴³ *Ibid.*, 38

⁴⁴ *Ibid.*

Island ... over a plant that was really not needed.”⁴⁵ This radicalization of Long Islanders against the Jamesport plant lingered, furthering distrust of LILCO and opposition to Shoreham.

Long Islanders’ trust of LILCO was not only degraded by LILCO’s plans for Jamesport, but by LILCO’s economic practices. By the end of the 1970s, the price of their prized project at Shoreham ballooned, and the company sank into debt. By 1980 LILCO was over \$1.3 billion dollars in debt.⁴⁶ LILCO’s debt did not pile up overnight, but was accumulated over the years due to construction related costs. After the construction permit was approved and ground was broken at Shoreham, the economic problems began to arise. The AEC (later NRC) regulations for piping and wiring were frequently changed, and as a result were often violated at Shoreham.⁴⁷ In 1974 the NRC found a wiring violation in regards to minimal electrical cable spacing. To fix the violation, the existing cables had to be removed and reinstalled—additional costs that had to come from LILCO’s pocket. The construction of Shoreham was riddled with these kinds of violations that required reinstallation or reconstruction, and as a result construction costs grew.⁴⁸ In addition to dealing with NRC violations at Shoreham, LILCO also faced the labor issues associated with the construction industry such as inefficient workers. A Public Service Commission audit of Shoreham in 1978 found that construction workers at the plant were on average only working for 1.5 hours of a 7 hour work day due to corruption in the construction unions.⁴⁹ As the costs associated with constructing the Shoreham plant grew, the projected cost dramatically increased from \$65 million to \$2.2 billion between 1966 and 1980.⁵⁰ To add insult to injury, by the mid-1970s Long Islanders’ electricity consumption had decreased,

⁴⁵ Aron, *Licensed to Kill?*, 38.

⁴⁶ *Ibid*, 41.

⁴⁷ *Ibid*, 32.

⁴⁸ *Ibid*, 31.

⁴⁹ *Ibid*, 34.

⁵⁰ *Ibid*, 41.

contrary to LILCO's predictions of a 40% increase over five years.⁵¹ With increased spending, and an income lower than expected due to energy conservation, LILCO resorted to charging customers more for their electricity.⁵² When Long Islanders complained about the cost of electricity or requested the abandonment of the Shoreham project to save LILCO money, the utility responded with threats of blackouts or even higher electrical costs.⁵³ Rising costs, delays, and threats associated with the construction of Shoreham expanded the rift between LILCO and Long Islanders. At the same time as the plant at Shoreham was being built, across the sound a nuclear power plant in Waterford, Connecticut was also being build. Waterford's plant had a vastly different history during its construction, avoiding much of the opposition experienced at Shoreham.

Millstone 1965-1979

On April 29th 1965, the headline read: "\$70 Million Plant Called 'Best Thing Since 1801.'" The headline in other words stated that the new nuclear power plant announced for Waterford, Connecticut was thought to be the best thing since the town became incorporated in 1801.⁵⁴ The Millstone Point plant was a joint project of Connecticut Light and Power Company and Western Massachusetts Electric Company. Millstone was set to produce around 600,000 kilowatts of electricity, and be operational by around 1969.⁵⁵ In May of 1965, a survey reinforced this positive view of the power plant. The survey showed that citizens of four New England towns where nuclear plants were proposed, including Waterford, cared more about the tax breaks the

⁵¹ Aron, *Licensed to Kill?*, 37.

⁵² Ibid, 41.

⁵³ Ibid, 42.

⁵⁴ "\$70 Million Plant Called 'Best Thing Since 1801'," *The Hartford Courant*, April 29, 1965, pg. 19D.

⁵⁵ "3 Utilities Plan Big Atomic Plant: \$70 Million Station Will Be Built in Connecticut," *The New York Times*, April 29, 1965, pg. 24.

plants would bring than environmental concerns and the conservation of the area's natural beauty.⁵⁶ That is not to say that there was not a portion of the population who opposed the plant based on environmental concerns, but the majority was in favor of it for economic reasons according to the *New York Times*.⁵⁷ With minimal delays, Millstone Point was licensed, built and began commercial operation by the end of December 1970. Earlier that December, the process of obtaining a second generating unit at Millstone began.

On May 4th 1972, the Long Island Sound experienced a major case of nuclear power plant induced environmental degradation. On that spring day less than two years after the plant began operating, over 10,000 menhaden fish were found dead near Waterford. Scientists concluded the cause of this mass fish kill was thermal pollution caused by the Millstone power plant. The scientists reached this conclusion by measuring the temperature of the water surrounding the nuclear plant, finding the water surrounding Millstone over 22 degrees Fahrenheit warmer than the seasonal average. The 22 degree difference was enough to send the fish into thermal shock.⁵⁸ The thermal pollution problem and the subsequent fish kills would be generally overlooked by the residents of Waterford due to the economic benefit of the plant (reduced real estate taxes) and the fact that the fish kills did not directly affect most of the residents in one way or another.⁵⁹ Thermal pollution would continue to be a nagging problem from Millstone Point's various

⁵⁶ John C. Devlin, "Atom Generators Gaining Approval: Tax Windfalls Sap Protest of Conservationists," *The New York Times*, May 9, 1965, pg. 59.

⁵⁷ Ibid.

⁵⁸ "Fish Kill in L.I. Sound Laid to Power-Plant Discharge," *The New York Times*, May 5, 1972, pg.11.

⁵⁹ Marilyn E. Weigold, *The Long Island Sound: A History of its People, Places and Environment*. (New York: New York University Press, 2004) pg. 184.

reactors, with debates still raging today on what should be done to the plant to reduce its effect on the Sound's ecosystem.⁶⁰

In a ditch 1000 yards away from the Millstone reactor were the smoldering remains of a small airplane. About four months after the aforementioned fish kill, on August 25th 1972, the plane carrying two passengers hit a 27,000 volt wire a short distance from the reactor. Both passengers survived, and the damage was quickly repaired, but the incident exposed the vulnerability of the nuclear plant to the unexpected. Much like with the fish kills a few months earlier, the incident was overlooked and soon forgotten by the residents of Waterford.⁶¹

A major fish kill and a plane crash apparently could not catch Waterford residents' attention and ignite fear, but a radioactive water spill at Millstone in 1975 did. On March 28th 1,200 workers were evacuated from Millstone 1 and 2, which was at the time under control of Northeastern Utilities. An "abnormal occurrence" caused contaminated water to overflow the system. This water was then pumped straight into the Long Island Sound.⁶² The contaminated water was discharged legally into the Sound, with acceptable levels of radiation considered by the AEC not to be harmful to the environment. According to Herbert Davis, Waterford's First Selectman, a resident contacted the Town stating that "this whole thing has got a lot of residents here scared."⁶³ It took this minor radiation leak in 1975 to sow seeds of doubt in the minds of

⁶⁰ Gregory B. Hladky, "Are Millstone's Nuclear Plants Adding to the Sound's Warming Problems?" *The Hartford Courant*, June 22, 2015, <http://www.courant.com/politics/hcmillstone-hot-water-20150622-story.html>.

⁶¹ "Radioactive Water Spill at Plant Alarms Residents in Connecticut," *The New York Times*, March 29, 1975, pg. 22.

⁶² *Ibid.*

⁶³ *Ibid.*

residents of Waterford. Expansion continued at Millstone, however, and by the end of 1975 a second reactor, Unit 2, was in operation.⁶⁴

Even with the events of the recent radiation leak fresh in the minds of residents, a poll conducted by the Oak Ridge Tennessee National Laboratory in 1975-76 found that a staggering 94% of residents in Waterford would “vote in favor of building [Millstone] if they had to do it over.”⁶⁵ The results of this survey showed the highest percentage of acceptance of nuclear power of any surveyed community in the nation.⁶⁶ The poll reinforced Herbert Davis’s 1973 sentiment that “Waterford is riding around in a Cadillac instead of a Chevy because of the plant” due to the significant economic benefits of the plant.⁶⁷ This highly positive view of Millstone would be tested in 1979 after the events at Three Mile Island. After Three Mile Island, questions were raised regarding the logistics of evacuating Waterford and the surrounding cities in the event of a Three Mile Island-like nuclear incident.

Three Mile Island - 1979

Fear of “China Syndrome”

On March 28th, 1979 the United States’ worst nuclear accident unfolded at Three Mile Island Nuclear Generating Station near Harrisburg, Pennsylvania. The disaster was caused by a stuck valve and was worsened by electrical and human errors, causing a partial meltdown at Three Mile Island.⁶⁸ As the plant was melting down, two concerns plagued those in the control

⁶⁴ “Millstone Power Station,” Dominion, accessed March 27, 2016, <https://www.dom.com/corporate/what-we-do/electricity/generation/nuclear/millstone-power-station>.

⁶⁵ “Neighbors Said to Like A Nuclear Power Plant,” *The New York Times*, July 9, 1976, pg. 16.

⁶⁶ Ibid.

⁶⁷ Michael Knight, “Connecticut Town Discovers Its Nuclear Power Plant is a Mixed Blessing,” *The New York Times*, May 22, 1973, pg. 43.

⁶⁸ James Mahaffey, *Atomic Accidents: A History of Nuclear Meltdowns and Disasters: From the Ozark Mountains to Fukushima* (Cambridge: Pegasus, 2015) pg. 339.

room of the plant. The first concern was of the molten uranium-oxide fuel dripping and melting through the containment vessel because the fuel was not being cooled. The second concern was the build-up of a hydrogen gas bubble in the reactor. The presence of the hydrogen bubble posed two threats: the pressure of the hydrogen bubble against the containment vessel causing the vessel to break, and the bubble igniting and exploding. Both of these concerns would have likely caused a plume of radiation to be spread up to 10 miles downwind.⁶⁹ As the media covered the disaster, the concerns of those in the control room soon became the concerns of those near the plant. Luckily for the sake of everyone near the plant, neither of these outcomes unfolded and the reactor reached cold shutdown on April 7th 1979.⁷⁰ According to nuclear engineer Dr. James Mahaffey, Three Mile Island became the “worst industrial disaster in which not one person was harmed,” but still resulted in major changes in the planning of nuclear energy, and had lasting impacts on the public’s view of nuclear energy and shook confidence in atomic technology.⁷¹

An unlikely coincidence, paired with media coverage brought the events of Three Mile Island to the eyes and ears of countless Americans. Just 12 days before the disaster at TMI, on March 16, 1979, *The China Syndrome* hit theaters across the country.⁷² Starring Jane Fonda and Michael Douglas, *The China Syndrome* was a fictional and prophetic tale that spoke to the dangers of nuclear energy. The title of the movie refers to a line in the movie where a scientist explains that if a plant was to have a meltdown, the core would theoretically melt through the earth, all the way to China, thus the China Syndrome. Even though in reality the molten fuel core would not continue to melt through the earth to China as the film’s scientist suggested, the movie

⁶⁹ Mahaffey, *Atomic Accidents*, 353.

⁷⁰ Ibid, 355.

⁷¹ Ibid.

⁷² Ibid, 343.

became a popular tool for members of the media to help the citizens of the nation understand the events at Three Mile Island.⁷³ With the threat of a full blown China Syndrome looming over Pennsylvania, Americans across the country began to worry. This fear was focused around one major issue that would become relevant to both the histories of the plants at Shoreham and Millstone: evacuation.

Upon hearing about the risk of a “hydrogen bomb” or possible explosion of the hydrogen bubble in the reactor at Three Mile Island on Friday March 30th, 42,000 residents were evacuated from around the power plant.⁷⁴ On that same Friday, Pennsylvania governor Dick Thornburgh called for the evacuation of pregnant women and children.⁷⁵ By Sunday, 135,000 people, or 20% of the population located within 20 miles of the plant had evacuated the area.⁷⁶ Between the mass of panicked residents voluntarily fleeing the immediate area, and the call for evacuation of a select portion of the population by the state government, it is not surprising that the concept of evacuating around a nuclear accident was brought to national attention. As a result of TMI, the NRC “encouraged the development and implementation of emergency response plans and preparedness measures.”⁷⁷ The national attention brought to emergency response and preparedness at nuclear plants affected both Millstone and Shoreham. Officials at LILCO “did not expect the accident at Three Mile Island to greatly affect their operations.”⁷⁸ When it was later deemed that evacuating Long Island would be nearly impossible due to its geography,

⁷³ Finis Dunaway, *Seeing Green: The Use and Abuse of American Environmental Images* (Chicago: University of Chicago Press, 2015) pg. 141

⁷⁴ Mahaffey, *Atomic Accidents*, 353.

⁷⁵ Dunaway, *Seeing Green*, 143.

⁷⁶ Mahaffey, *Atomic Accidents*, 353.

⁷⁷ Aron, *Licensed to Kill?*, 48.

⁷⁸ Richard Servero, “Debate on Safety of Nuclear Plants Intensifies in the Tristate Area,” *The New York Times*, April 1, 1979, pg. 31.

LILCO's assumption that Three Mile Island would not affect their Shoreham project would prove dead wrong.⁷⁹

Post Three Mile Island

Shoreham (1979-1982)

Even in the wake of Three Mile Island, LILCO and other New York utilities remained steadfast in their pursuit of nuclear power. The New York State Power Pool made up of New York's electric suppliers, including LILCO, released a report in April 1979 which suggested that more nuclear plants should be constructed in New York in the coming years. The basis of the Power Pool's argument for nuclear was "in view of sharp increases in the price of imported oil," and that "nuclear power can generate power safely."⁸⁰ This report was drafted before the events of Three Mile Island, and yet the Power Pool still decided to publish it after the accident. It is up for interpretation whether the demand for more plants in the report was an economic play by the utility, or based on the utility's genuine concern over the future of New York's energy. Regardless of the utility's reason for publishing the report, the call for new plants can be seen as a disconnect between LILCO and the concerned population of Long Island.

Upon hearing news of the accident at Three Mile Island, a sense of panic filled some residents of Long Island. Some of these concerned residents even went as far as to call LILCO to make sure the not-yet-complete plant at Shoreham was not the plant melting down, or at risk of melting down.⁸¹ This seemingly impossible mistake—thinking that the plant at Three Mile Island was synonymous with Shoreham—can likely be credited to the emotional response these

⁷⁹ Aron, *Licensed to Kill?*, 55.

⁸⁰ David Bird, "Report recommends Construction of 8 More Nuclear Plants in New York," *The New York Times*, April 5, 1979, pg. B14.

⁸¹ Sylvia Moreno, "LILCO Plan: Watch, Wait," *Newsday*, March 31, 1979, pg. 8.

residents had after hearing of the accident in Pennsylvania. Building on the uneasy atmosphere brought on by the accident at Three Mile Island, concerns regarding evacuation of Long Island in the event of an accident at Shoreham were once again expressed by Long Island residents. These were the same concerns regarding evacuation were initially voiced by Irving Like and the Lloyd Harbor Study Group during Shoreham's construction permit hearings earlier in the decade.

The argument regarding evacuation of Long Island in the event of an incident at Shoreham had two sides. One side, in support of the plant, saw evacuation of Long Island as difficult but not impossible, while opponents to the plant saw the task of evacuation as impossible. Tomas Twomey, a lawyer for the Long Island Farm Bureau, who was in opposition to Shoreham was quoted in the *The New York Times* as saying: "Evacuation of the areas around Shoreham... would be virtually impossible because we are on an island, and the only routes of escape would be through tunnels and bridges to the mainland... The roads would be so clogged with panicky drivers that it would be a disaster."⁸² Much of Long Island shared a viewpoint similar to Twomey's. "You Can't Evacuate Long Island" became many resident's battle cry.⁸³

By 1979, LILCO and Suffolk County had what seemed to be a finalized evacuation plan. With the election of a new county executive, and with focus placed on evacuation planning, Suffolk County retracted the initial evacuation plan for Shoreham, and began drafting a second evacuation plan in 1981 which would cost LILCO \$245,000.⁸⁴ LILCO's original plan and Suffolk's new plan were vastly different. LILCO's plan was "simple and straightforward" and assumed evacuation would be an "orderly process."⁸⁵ Suffolk's plan provided a contrary opinion,

⁸² Frances Cerra, "Evacuation Planning At Shoreham Studied," *The New York Times*, April 15, 1979, pg. LI1.

⁸³ Aron, *Licensed to Kill?*, 55.

⁸⁴ *Ibid*, 50.

⁸⁵ *Ibid*, 53.

a “detailed, elaborate, and pessimistic” plan that was based on risk assessments and detailed analysis of many possible types of accidents that could strike Shoreham.⁸⁶ The Suffolk Plan conservatively estimated that the emergency planning zone (EPZ), which was twice as large in the Suffolk Plan as it was in the LILCO Plan, would take fourteen to thirty hours to evacuate in the event of an emergency. The county also collected data through surveys to see how residents would react in the event of an emergency. Unsurprisingly, a county-sponsored survey of residents indicated that there would be a “shadow evacuation,” where residents outside of the EPZ to the west would unnecessarily evacuate, causing traffic that would delay evacuation of those closest to the accident on the east end of Long Island.⁸⁷ In addition, it was found in a survey of emergency service personnel, that ambulance drivers and volunteer firemen would also evacuate the area, ignoring their role in the emergency plan, causing a so-called “role conflict.”⁸⁸ Armed with data indicating “role conflicts” and “shadow evacuations,” the county executive submitted the Suffolk Plan to the county legislature in 1982. Convinced by the plan that evacuation of Long Island was “unacceptable” and “impossible,” the legislature voted to “terminate all emergency planning efforts and requested that the NRC forgo any further licensing action for Shoreham.”⁸⁹ Shoreham’s Achilles heel was exposed. Evacuation became the single most relevant topic of debate that would determine the plant’s future.⁹⁰

Millstone (1979-1986)

On May 20, 1980, retired head of Park City Hospital’s department of radiology, Dr. Isaac Horowitz wrote an article for the *Hartford Courant* to try to calm the hysteria caused by Three

⁸⁶ Aron, *Licensed to Kill?*, 53.

⁸⁷ *Ibid*, 54.

⁸⁸ *Ibid*, 55.

⁸⁹ *Ibid*.

⁹⁰ *Ibid*, 56.

Mile Island. In his article, Dr. Horowitz cited how minimal the amount of radiation released around Three Mile Island was. The doctor then made the comparison that the amount of radiation received by those around Three Mile Island was equal to the amount of radiation received by a person on vacation for six days in a Colorado ski resort.⁹¹ Dr. Horowitz continued writing that the long term effects of Three Mile Island's radiation would be negligible. Dr. Horowitz stated that 90% of a sample Nagasaki and Hiroshima survivors showed "no measurable statistical effects" as a result of the excessive amount of radiation they received following the detonations of atomic weaponry.⁹² By telling readers that 90% of Nagasaki and Hiroshima survivors were found to be unaffected by the radiation released after 30 years of study and large population samples, Dr. Horowitz is making the claim that the radiation released from commercial nuclear plants is nothing to be worried about.⁹³ Using the aforementioned examples, amongst others (including the birth rates of "mongoloid" children in Japan following World War II), Dr. Horowitz argued that "Nuclear is safer, healthier and cheaper than any other source of energy" available in 1980.⁹⁴ It appeared that much of Connecticut shared Dr. Horowitz's pro-nuclear sentiments in the wake of Three Mile Island, and as a result did not voice their concerns regarding evacuation nearly as loudly as their neighbors across the Sound on Long Island.

Following Three Mile Island, the Nuclear Regulatory Commission demanded nuclear plants to take second looks at their evacuation plans, and Millstone Power Station was no exception. Evacuating the residents of Connecticut from around Millstone was not the seemingly impossible task that planning to evacuate Long Island was. Millstone, being in southern

⁹¹ Isaac Horowitz, "More Hysteria Than Risk in Low-Level Radiation," *The Hartford Courant*, May 20, 1980, pg. 17.

⁹² *Ibid.*

⁹³ *Ibid.*

⁹⁴ *Ibid.*

Connecticut, could be evacuated to the north, east and west. The question of how the evacuation plan would function was not the issue; where to find the money to pay for the evacuation plan became the issue. Debates raged over whether the plan should be funded with Waterford's Millstone tax money, or funded some other way.⁹⁵ It was estimated by Waterford's First Selectman Lawrence Bettencourt that funding the evacuation plan using Millstone taxes would take more than \$2.5 million from Waterford, an option unpopular with Waterford residents.⁹⁶ Eventually an agreement was reached and the evacuation plan was adopted. In comparison to Shoreham, the process of creating and implementing an evacuation plan for Millstone was straightforward. Looking at newspaper coverage following Three Mile Island, the biggest concern for the residents of Connecticut did not appear to be if they *could* evacuate, but how they would pay for the evacuation plan. Compared to Shoreham, Millstone escaped the wake of Three Mile Island unscathed, with minimal effect on day to day operation. Millstone following Three Mile Island could be seen as an example of the lingering pro-nuclear mindset for the decade. A national poll by Louis Harris and Associates following the events of Three Mile Island found that "opposition to nuclear power had increased since Three Mile Island, but the public still favors its development."⁹⁷ In addition to the majority of the public favoring nuclear development, the federal government also continued to strongly encourage the growth of the nuclear industry. President Carter continued to publicly support nuclear power following Three Mile Island, and the House of Representatives defeated a proposed six-month moratorium of new nuclear growth following Three Mile Island.⁹⁸ This pro-nuclear push by the federal government

⁹⁵ "Tax Money Use Urged For Evacuation Plans," *The Hartford Courant*, March 13, 1980, pg. 42.

⁹⁶ "Waterford To Fight Bill To Take Millstone Taxes," *The Hartford Courant*, March 1, 1980, pg. 17D.

⁹⁷ Kristi Vaughn, "Nuclear Power's Future Uncertain," *The Hartford Courant*, January 1, 1980, pg. 52.

⁹⁸ *Ibid.*

foreshadows the battle that would ensue to determine the final fate of Shoreham – a battle pitting the state of New York, led by Mario Cuomo against the NRC.

The Plants Today

Final Fate of Shoreham (1983-1994)

With concerns regarding evacuation in *The New York Times* headlines, it was only a matter of time before the State of New York joined in the conversation regarding nuclear energy. In 1983, Mario Cuomo became governor of New York, and almost immediately opposed the federal government's pro-nuclear agenda.⁹⁹ Governor Cuomo appointed a fact-finding commission, led by Dr. John H. Marburger, physicist and president of SUNY Stony Brook in the same year, 1983. The Marburger Commission, as it would be called, was made up of twelve experts in multiple fields relating to the nuclear energy business, including but not limited to, nuclear technology, public health, economics, regulation and suburban studies. Of the twelve members, three were known proponents of the plant, three were known opponents of the plant, and the remaining six were neutral, neither vocally for nor against the plant.¹⁰⁰ The goal of the Marburger Commission was to advise and guide Governor Cuomo, and by extension New York State's actions relating to Shoreham.¹⁰¹ The members of the Marburger Commission struggled to agree on many points, but did conclude that abandoning the almost completed Shoreham (about 99% finished at the time) would not cost more money than operating it.¹⁰² The Marburger Commission also concluded that the plant at Shoreham would have been "unacceptable" by 1980s standards based on LILCO's location selection alone.¹⁰³ Armed with the Marburger

⁹⁹ Aron, *Licensed to Kill?*, 60.

¹⁰⁰ Ibid.

¹⁰¹ Ibid, 61.

¹⁰² Ibid, 62-4.

¹⁰³ Ibid, 62.

Commission's suggestions, and poll information showing that 52% of residents wished that the plant at Shoreham would not be completed, Governor Cuomo took action against the NRC and LILCO.¹⁰⁴

The role of opposing Shoreham slipped out of the hands of small grassroots organizations like Lloyd Harbor Study Group and the general public, into the hands of local and state governments. When the hearings for Shoreham's operating license (a similar process to the aforementioned construction permit hearings) rolled around, LILCO was opposed by Suffolk County and the State of New York.¹⁰⁵ The operating license hearings were in part political; the NRC believed that state and county governments should do their part to get Shoreham up and running, whether or not they supported or opposed the plant's operation.¹⁰⁶ Conversely, Governor Cuomo argued that if the state and county did not want the plant, they had the right to do their part to shut the plant down.¹⁰⁷ After almost two years of fruitless hearings, the argument of whether to grant an operating license for Shoreham was heard by the U.S. Court of Appeals for the D.C. Circuit, and the court issued LILCO a low-power license for Shoreham in 1985.¹⁰⁸ This operating license allowed a nuclear chain reaction, less than 5% of the location's total energy generation, to be started in Shoreham's core. Starting this reaction officially contaminated the plant and tacked on an estimated half a billion dollars to cleanup and decommissioning fees if that was to be Shoreham's fate. LILCO's decision to perform low-level testing at Shoreham was a gamble. Some at LILCO believed that by testing at Shoreham and contaminating the site, there would be no option but to open the plant, and be issued a full operating license.¹⁰⁹ Governor

¹⁰⁴ Aron, *Licensed to Kill?*, 64.

¹⁰⁵ *Ibid.*, 65.

¹⁰⁶ *Ibid.*, 67.

¹⁰⁷ *Ibid.*, 60.

¹⁰⁸ *Ibid.*, 81.

¹⁰⁹ *Ibid.*

Cuomo responded to the low-level testing by saying, “LILCO has for years been gambling with ratepayers’ money and losing. They are doing it again with this decision. One would hope they would learn from their mistakes.”¹¹⁰ Outraged by the low-level testing at Shoreham, Governor Cuomo was determined to shut Shoreham down. Before LILCO could be issued a full-power license, they would have to successfully perform an emergency evacuation drill of Shoreham and the area surrounding the plant. The drill would be supervised by FEMA, who would cast final judgment whether or not the drill was successful.¹¹¹ In February 1986, the exercise was conducted and failed horribly. An NRC licensing board found “fundamental flaws” with LILCO’s showing, and the Shoreham emergency plan did not meet NRC standards.¹¹²

Following the failed emergency plan and the incident at Chernobyl in the USSR, residents were finally fed up with LILCO by July 1986.¹¹³ A movement was growing to have the state legislature “create a public authority that would buy LILCO stock and transfer ownership of LILCO from current shareholders to a government entity.”¹¹⁴ This massive undertaking was supported by 70 percent of Long Island residents, Governor Cuomo, and both the State Senate and Assembly.¹¹⁵ The Long Island Power Authority (LIPA) was officially created to induce a public takeover of LILCO. Eventually LIPA acquired enough of LILCO stock to effectively control the company. Additionally, Governor Cuomo and LILCO reached an “agreement in principle” in 1988, where Shoreham would be sold to LIPA for \$1.¹¹⁶ In return, LILCO would receive rate increases to elevate some of the economic burden brought about by Shoreham.¹¹⁷

¹¹⁰ Aron, *Licensed to Kill?*, 81.

¹¹¹ *Ibid.*, 83.

¹¹² *Ibid.*, 85.

¹¹³ *Ibid.*, 90.

¹¹⁴ *Ibid.*, 90-1.

¹¹⁵ *Ibid.*, 91.

¹¹⁶ *Ibid.*, 97.

¹¹⁷ *Ibid.*

LILCO and LIPA worked together to decommission the plant, beginning in 1989.¹¹⁸ The plant was fully decommissioned in 1994 following the thirty-third and final shipment of radioactive material to Pennsylvania to be used by the Philadelphia Electric Company.¹¹⁹ The costs incurred by LILCO, both through construction and attorney fees would be too much for the company to rebound from. The \$6 billion nuclear plant at Shoreham drove LILCO to merge with Brooklyn Union Gas Company in 1996, leaving LIPA in charge of providing power to Long Island.¹²⁰ Residents today are still paying off Shoreham's debt. As of 2009, an estimated \$3.3 billion dollars of Shoreham's cost remained to be paid through customer's electric bills.¹²¹

Today, the structure of the Shoreham power plant still stands, but on site activity is minimal. What to do with the abandoned structure was a topic of debate in the early 90s before the plant was fully decommissioned. Some ideas for the plant ranged from feasible to far-fetched. One of the more tame suggestions for what to do with Shoreham was to construct a gas-fired plant. Some of the more outlandish suggestions for the site were: the world's largest incinerator, a reactor to produce tritium for nuclear warheads, or a high speed ferry linking Connecticut to Long Island (suggested by Governor Cuomo himself).¹²² Nothing came from the suggestions from the early 90s, and LIPA's plant continued to lay vacant. LIPA continued to provide Long Island's energy up until 2014 when Public Service Enterprise Group (PSEG) Long Island took on energy production, with LIPA overseeing PSEG's performance as a service provider.¹²³ There are currently debates surrounding the future of Shoreham, with the latest

¹¹⁸ Aron, *Licensed to Kill?*, 121.

¹¹⁹ *Ibid*, 126.

¹²⁰ *Ibid*, 141.

¹²¹ John Rather, "Planning the Fate of a Nuclear Plant's Land," *The New York Times*, January 1, 2009, <http://www.nytimes.com/2009/01/04/nyregion/long-island/04shorehamli.html>.

¹²² Aron, *Licensed to Kill?*, 127.

¹²³ "Long Island Power Authority Mission Statement," LIPA, accessed March 27, 2016, <http://www.lipower.org/profile/mission.html>.

proposal calling for the plant be used as a deep water port. A port is already on location, used to ferry in construction materials for the nuclear plant decades ago. Proponents of the port at Shoreham claim that it would reduce the number of trucks crossing Long Island, thus relieving congestion on the Island's roadways, and reducing air pollution from truck exhaust. Opponents cite the estimated \$1 million dollar cost to expand the port as a major downside to the proposed use.¹²⁴ Only time will tell what the future of Shoreham will hold.

Millstone (1986-Present)

Even in the turbulence of the nuclear industry following the events of 1979, Millstone continued to grow. On April 23, 1986, coincidentally just three days before the disaster at Chernobyl, Millstone Unit 3 began commercial operation.¹²⁵ The addition of Unit 3 would mark the peak of Millstone's energy production. This short lived peak would end in 1995 when energy production at Millstone Unit 1 was stopped after allegations of unsafe work practices.¹²⁶ By 1998 all operations at Unit 1 were officially ceased and the process of decommissioning the plant began shortly after. Millstone Unit 1 had been in operation for 28 years by the time of its closure.¹²⁷ As of 2007, the NRC stated in a report that the spent fuel from Millstone Unit 1 (that was removed in 1995) must stay in the spent fuel pool on site until it is safe to move again by 2048. This leaves the tentative final closure date of Millstone Unit 1 at December 31, 2056.¹²⁸ To

¹²⁴“A Deepwater Port Could Change Long Island,” *Newsday*, March 21, 2015,

<http://www.newsday.com/opinion/editorial/a-deepwater-port-could-change-long-island-1.10090345>.

¹²⁵ “NRC Information Digest (NUREG-1350, Volume 27), Appendix A: U.S. Commercial Nuclear Power Reactors - Operating Reactors,” United States Nuclear Regulatory Commission, December 8, 2015,

<http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1350/appa.xls>.

¹²⁶ Julie Miller, “Millstone's Neighbors in a Quandary: Neighbors Are in a Quandary,” *New York Times*, November 5, 1995, pg. CN1.

¹²⁷ “Millstone Unit 1,” United States Nuclear Regulatory Commission, February 6, 2015, <http://www.nrc.gov/info-finder/decommissioning/power-reactor/millstone-unit-1.html>.

¹²⁸ Ibid.

put this in perspective, these fuel rods from Millstone Unit 1 that were removed in 1995 will sit in a cooling pool for approximately twice as many years as the plant was in operation. Northeast Utilities, who oversaw Millstone for most of its life, sold the plant to Dominion Energy in early 2001. Dominion still operates the plant today, including the continuing process of decommissioning Unit 1.¹²⁹ The operating license for Unit 2 is set to expire in 2035.¹³⁰ Similarly, Unit 3's license will expire in 2045.¹³¹ Past these expiration dates, the future of Millstone's energy production is uncertain.

Today, Millstone has been at the center of environmental arguments surrounding thermal pollution and the rising temperatures of the Long Island Sound. Having seawater-cooled reactors at Millstone ties the plant closely to the Long Island Sound. Millstone is dependent on the Sound for water to cool the plant, and in return the ecology of the Sound is disrupted by the thermal pollution released from the plant, and the destruction of fish and other marine life by the pumps providing water to the plant to cool its core. Retrofitting the plant to have cooling towers would reduce the aforementioned environmental impacts to the Sound, but the costly retrofit would be an estimated \$2.6 billion dollars.¹³² The decision whether to build cooling towers at Millstone has still not been decided as of early 2016. Environmentalists and scientists including faculty at Stony Brook University on Long Island, continue to fight for the addition of cooling towers at Millstone out of concern for the health of the Sound's ecology.¹³³

¹²⁹Ibid.

¹³⁰ "Millstone Power Station, Unit 2," United States Nuclear Regulatory Commission, December 1, 2015, <http://www.nrc.gov/info-finder/reactors/mill2.html>.

¹³¹ "Millstone Power Station, Unit 3," United States Nuclear Regulatory Commission, December 1, 2015, <http://www.nrc.gov/info-finder/reactors/mill3.html>.

¹³² Gregory B. Hladky, "Are Millstone's Nuclear Plants Adding to the Sound's Warming Problems?" June 22, 2015, <http://www.courant.com/politics/hc-millstone-hot-water-20150622-story.html>.

¹³³ Ibid.

Conclusion

The Future of Nuclear Energy?

What do these tales of nuclear energy on the northern and southern shores of the Long Island Sound tell us? A conclusion that could be made after reading the histories of the nuclear power plants at Millstone and Shoreham is that picking a suitable community for a nuclear plant is key. Many factors go into finding a right “fit” for a technology, a few being: geographic location, the area’s economic situation, demographics, the era when it is being introduced, or simply the choice of the technology itself. In the case of nuclear technology on the Long Island Sound, enough of these factors led to a proverbial hit at Millstone, where Shoreham was an expensive miss. Does one “hit” at Millstone mean that nuclear energy is “good” and should be implemented everywhere possible? Conversely, does one “miss” at Shoreham mean that nuclear energy is “bad” and should be stopped at all costs? The goal of this discussion section is to offer an objective discussion on the sustainability of nuclear energy, and its future use to combat climate change. A conclusion whether or not nuclear energy is “good” or “bad” will not be made however, as conclusions of that subjectivity can be made by the individual.

What is Sustainability?

Today, one of the more widely accepted definitions of sustainability came from the 1987 Brundtland Report, also known as *Our Common Future*. In the Brundtland report, sustainability is defined as development that “meets the needs of the present without compromising the ability of future generations to meet their own needs.”¹³⁴ The “needs” spoken about in the Brundtland report are social, environmental and economic needs. The needs of sustainability have been

¹³⁴ *Our Common Future* (Oxford: Oxford University Press, 1987).

pictured in a variety of metaphoric models, ranging from a three-legged stool to three columns supporting a roof. Regardless of the model being used to visualize it, if one of the needs is removed, the structure will fail. Often times, the one component of sustainability, the social, is overlooked for economic and environmental benefits—but as the aforementioned models show, all three components are equally important.

One example of the contention between the three components of sustainability can be seen with something as simple as a compact fluorescent lightbulb (CFL). CFLs, prior to the proliferation of LED lightbulbs, were seen as the clear sustainable lightbulb option. CFLs are affordable and use less energy than incandescent bulbs, but contain toxic materials. The CFLs are socially and economically appealing because of their perceived benefits, but fall short environmentally due to their toxic composition. Are CFLs more sustainable than their predecessor, the incandescent lightbulb? Yes. Are CFLs sustainable? Debatable. The point of the lightbulb example is to show that sustainability is not black and white and is ever-changing. With technological advancement, what is considered sustainable today, might not be considered sustainable in the future. Nuclear energy since its inception has been pitched as low cost and non-polluting: does that qualify nuclear energy as sustainable? The following section will lay out both the sustainable, and the not so sustainable aspects of nuclear energy.

Sustainability and Nuclear Energy

The Positives

The promise of cheap and reliable energy was one of the greatest appeals of nuclear energy. In 1954, Lewis Strauss, then a commissioner of the AEC, pitched nuclear technology to

American citizens as energy that would be “too cheap to meter.”¹³⁵ Nuclear plants, as seen with the Shoreham nuclear plant, require significant upfront costs to construct the plant, but future costs for fuel and upkeep are generally low. The opposite is generally found to be true with other more conventional sources of energy such as coal and gas powered plants, where initial cost is comparatively low, but long term costs for fuel are high and unpredictable due to the turbulence of the foreign fuel market.¹³⁶ In the 1960s and 70s, nuclear plants began popping up across the country, but expansion halted in the late 70s largely because of the high up-front costs associated with the plants. As a result of the vigorous expansion and efficiency of nuclear power plants, roughly 20% of America’s electricity today is still generated using nuclear power plants built before the nuclear industry stagnated in the late 1970s.¹³⁷ Nuclear energy can be considered economically sustainable by being a reliable and efficient use of resources that does not depend on imported fossil fuels.

Cheap and reliable energy was not the only appealing factor of nuclear energy. Nuclear, being considered a “clean” source of energy, appealed to Americans as a way to combat air pollution that resulted from the burning of fossil fuels.¹³⁸ As was seen shortly after Shoreham’s announcement in the early 1960s, there was a commonly held view that the future of energy was a choice between “soot or atoms.”¹³⁹ In the 60 and 70s, concerns regarding air pollution focused on sulfur dioxide, nitrogen oxides, carbon dioxide and particulate matter that resulted from burning coal.¹⁴⁰ To many Americans, including President Barack Obama, concerns over air

¹³⁵ Mahaffey, *Atomic Awakening*, xvii.

¹³⁶ *Ibid.*

¹³⁷ *Ibid.*

¹³⁸ Samuel J. Walker “Nuclear Power and the Environment: The Atomic Energy Commission and Thermal Pollution, 1965-1971,” *Technology and Culture* Vol. 30 no.4 (1989): 964–92.

¹³⁹ Abraham Rabinovich, “Prefer Atoms To Coal Soot,” *Newsday*, June 3, 1966, pg. 15.

¹⁴⁰ Samuel J. Walker “Nuclear Power and the Environment: The Atomic Energy Commission and Thermal Pollution, 1965-1971,” *Technology and Culture* Vol. 30 no.4 (1989): 964–92.

pollution from fossil fuel based energy production revolve around carbon emissions, which are closely tied to concerns surrounding global climate change.¹⁴¹ An environmental benefit of nuclear energy production is its lack of gaseous pollution, be it carbon dioxide or particulate. Because of the lack of gaseous pollution produced, nuclear energy can be considered environmentally sustainable in addition to being considered economically sustainable.

The Negatives

In the prior section, nuclear energy was considered an environmentally sustainable source of power because of its lack of carbon emissions. Contrary to that point, nuclear can also be viewed as one of the most environmentally unsustainable means of energy production for two reasons: thermal pollution and radioactive waste. Thermal pollution from nuclear power plants occurs when high temperature water used to cool a reactor is dumped into a body of water, be it an ocean, lake, or river. The localized rise in water temperature can cause direct ecological disruption by causing organisms like plants and fish to die, or indirect disruption to the ecosystem through algal blooms, which wreak havoc on the ecosystem's oxygen levels.¹⁴² The effects of thermal pollution from nuclear power plants can be offset by the construction and utilization of cooling towers, but many plants in the United States including Millstone lack cooling towers.

The problem of dealing with radioactive waste from nuclear power plants does not have an easy fix, like adding a cooling tower to reduce thermal pollution. According to the NRC, the

¹⁴¹ "Fact Sheet: Obama Administration Announces Actions to Ensure that Nuclear Energy Remains a Vibrant Component of the United States' Clean Energy Strategy," The White House, November 6, 2015, <https://www.whitehouse.gov/the-press-office/2015/11/06/fact-sheet-obama-administration-announces-actions-ensure-nuclear-energy>.

¹⁴² Samuel J. Walker "Nuclear Power and the Environment: The Atomic Energy Commission and Thermal Pollution, 1965-1971," *Technology and Culture* Vol. 30 no.4 (1989): 964-92.

process for dealing with radioactive waste is to first cool it by submerging it in pools of water on the site of the power plant, and then after “several years,” transfer the waste to dry cask storage.¹⁴³ “Several years” according to the NRC is anywhere from 5-10 years, but some cases like Millstone, require around 50 years in the cooling pools.¹⁴⁴ The “dry casks” the spent rods are stored in are “typically steel cylinders that are either welded or bolted closed. Each cylinder is surrounded by additional steel, concrete, or other material to provide radiation shielding to workers and members of the public.”¹⁴⁵ The dry casks are then surrounded by additional steel, concrete or “other material” –a storage method that the NRC believes to “provide adequate protection of the public health and safety and the environment.”¹⁴⁶ How is it that a steel and concrete structure can survive 10,000 to 100,000 years, the amount of time the spent fuel rods remain radioactive and pose a threat to human and environmental health?¹⁴⁷ Unfortunately, the method of dry storage in steel and concrete is the best response humanity has yet to come up with to the monumental task of storing nuclear waste.¹⁴⁸ Is having containers of radioactive material on site of the nuclear plant or buried underground really the most environmentally sustainable way to reduce the threat of global climate change? Is it more environmentally sustainable to reduce carbon emissions now, and deal with the nuclear waste later? These questions have no clear answers, and are further muddled when points like national security are added into the discussion.

¹⁴³ “Spent Fuel Storage in Pools and Dry Casks Key Points and Questions & Answers,” United States Nuclear Regulatory Commission, April 13, 2015, <http://www.nrc.gov/waste/spent-fuel-storage/faqs.html>.

¹⁴⁴ Ibid.

¹⁴⁵ Ibid.

¹⁴⁶ Ibid.

¹⁴⁷ James Flynn et al., *One Hundred Centuries of Solitude: Redirecting America’s High-Level Nuclear Waste Policy* (Boulder: Westview Press, 1995) pg. 20

¹⁴⁸ Ibid, x.

Nuclear energy does not automatically mean a disregard for the social aspect of sustainability. With that said, nuclear energy does often fall short when it comes to the social aspect of sustainability. Finding a fit for a nuclear plant in a community is key for social sustainability. If a community is accepting of a nuclear plant, and offers sufficient economic compensation and peace of mind, like at Millstone, then it can be considered socially sustainable. If an electric utility or governmental agency pushes for nuclear energy in a community, like at Shoreham, and the community does not want the plant and/or fears it, then it is not socially sustainable. Even though nuclear is for the most part safe and accidents rare, there is a difficulty breaking the relation between “nuclear energy” and “Three Mile Island”, “Chernobyl”, or recently “Fukushima.” Overall, it is difficult to categorize nuclear energy as sustainable or not. Nuclear energy can be considered economically, environmentally and socially sustainable, thus fulfilling the Brundtland report’s three part definition of sustainability. At the same time, it can be argued that nuclear energy is not in any way sustainable.

Closing Words

Throughout the histories of Shoreham and Millstone, environmental, socio-political and economic factors shaped the outcomes of the two nuclear plants. With a beneficial economic situation and a willing community relaxed towards environmental concern, the Millstone Nuclear Power Station thrived, becoming an example of a successful American nuclear plant. A different story unfolded in Shoreham across the Long Island Sound. Environmental concern ignited a social resistance to LILCO and its nuclear plant at Shoreham. Economic instability soon followed because of LILCO’s mismanagement. As the story of Shoreham unfolded, the resistance to the plant and LILCO snowballed out of control, resulting in its closure. The \$6 billion plant lurks, vacant, its future still uncertain.

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