# ALONG THE LAKEFRONT, "MENACING UNKNOWNS"

## *Citizen Interventions and Environmental Foresight in Nuclear Power Plant Hearings on Lake Michigan, 1970 – 1978*

A photograph of '70s Zion, Illinois.

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# INTRODUCTION

40 MILES NORTH OF Chicago, on a state beach in Lake County, Illinois, two shuttered nuclear reactor units cast long shadows over the currents of Lake Michigan lapping steadily at the shoreline. Once servicing a city of millions with 1,040 megawatts each of electric output, the behemoth buildings of the Zion Nuclear Power Station are now coated in streaks of brown rust. One reactor unit tilts slightly to the west. A blue sign posted by Exelon, a leading nuclear power operator, warns in bold letters, "Restricted Area. Authorized Personnel Only." Until the plant was taken offline in 1998, it powered homes and businesses, making streetlamps hum in Chicago for 25 years.[1] The story of the city and the plant which served it can be told as one of man's capacity for scientific discovery, harnessing the atom to faithfully meet the rising energy demands of the world's fastest growing economy. This same story has a third, often overlooked stakeholder: the 400-acres of Lake Michigan waterfront upon which the plant sits and the rich aquatic life just below the surface.

The nuclear energy profile of Illinois is impressive relative to the rest of the country. With six plants in operation, nuclear fission powered 58% of the state's electricity in 2021 and accounts for one-eighth of U.S. nuclear power generation — more than any other state.[2] Yet these statistics belie the bleaker realities of today's nuclear enterprise, which has required extensive state financing to stay financially viable.[3] It is widely understood that America's competitive power market led by cheap natural gas, as well as a lack of political appetite for resolving long-term hazardous waste disposal, has resulted in many utility operators taking their nuclear reactors offline. The Zion plant is one of 32 nuclear power units which have been closed in the last several decades, part of a slow decommissioning trend that began in the 1990s after the industry peaked in the 1970s and 1980s.[4] Only one new plant, the Vogtle site in Georgia, has been ordered and constructed since 2000.[5]

This is not the future which the first administration of the Atomic Age had forecasted in the aftermath of splitting the atom. President Truman signed the Atomic Energy Act into law in 1946, encouraging the development of nuclear technology for peaceful generation of electricity and ushering in the optimistic vocabulary of nuclear energy in the postwar era. In the 1960s, a sharp rebound in energy demand prompted the nation's steepest climb in greenhouse gas emissions, and nuclear power began to see its anticipated heyday.[6] Private investors, along with industry leaders such as

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**1** The U.S. Nuclear Regulatory Commission (NRC), "Zion Station Units 1 & 2," March 9, 2021. https://www.nrc.gov/info-finder/decommissioning/power-reactor/zion-nuclear-power-station-units-1-2.html.

**2** The U.S. Energy Information Administration (EIA), *Illinois State Energy Profile*, June 17, 2021. https://www.eia.gov/state/print.php?sid=IL.

**3** While American nuclear power has more extensive private sector engagement compared to the rest of the world, it has also required more government support than most other industries nationwide in the form of loan guarantees, tax credits, and funding for research & development. Energy alternatives and the issue of storing high-level nuclear waste are listed as the central challenges to the U.S. sector by the World Nuclear Association, which represents major reactor vendors, engineering companies, and uranium mining companies. See: World Nuclear Association, *US Nuclear Power Policy*, August, 2021. https://world-nuclear.org/information-library/country-profiles/countries-t-z/usa-nuclear-power-policy.aspx.

**4** "Decommissioning Nuclear Facilities," World Nuclear Association, Updated May 2021. http://www.world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-wastes/decommissioning-nuclear-facilities.aspx.

**5** "Vogtle," U.S. Department of Energy, Updated March 2019. https://www.energy.gov/lpo/vogtle.

**6** For energy demand and greenhouse gas emissions, see: Robert Suits, Matteson, and Moyer. "Energy Transitions in U.S. History, 1800-2019," (Chicago: University of Chicago, 2020) https://us-sankey.rcc.uchicago.edu. For nuclear energy proliferation, see John L. Jurewitz, "The U.S. Nuclear Power Industry: Past, Present, and Possible Futures," *Energy & Environment* 13, No.2 (2002): 207-240.

General Electric and Westinghouse, committed themselves to the development of commercial nuclear plant equipment. At the 1964 New York World's Fair, GE sponsored the "Progressland Pavilion" to tell the story of electricity's purported future. With artistic finesse, the exhibition performed a public demonstration of nuclear fission for 14 million visitors, who then shuffled on to gape at the "Medallion City," a phantasm of a future in which available electricity would be practically infinite, too cheap to even meter.[7] Utility operators completed roughly 90% of all nuclear plant orders in U.S. history in the decade between 1964 and 1974, and dozens of plants went online for the first time.[8]

In his environmental history of North America, scientist and historian Timothy Flannery argues that the American economy has long adhered to an "unalterable ethic" of frontierism, a self-image of "free and heroic creatures… vending ever new technologies to the world."[9] Nuclear power constitutes one such technology, and water quickly became its physical frontier. To fuel the energy-intensive American electric grid, conventional Light-Water Reactors (LWRs) split atoms apart through the process of nuclear fission, expelling energy from burst chemical bonds in the form of heat. The heat then boils large quantities of water into hot, pressurized steam, spinning heavy turbine blades and generating electricity. A second large pool of water is used to cool the steam back into its liquid state for continued use.[10] Consequently, reactor units were sited along lakes, oceans, rivers, and bays in the latter half of the twentieth century. States like Illinois, Wisconsin, and Michigan in the Great Lakes Basin provided the natural hub of the new nuclear industry, offering over 4,000 miles of shoreline for facilities which required quick access to ample amounts of cooling water.

In a 1970 Senate hearing on "The Environmental Effects of Energy Generation on Lake Michigan," Senator Philip Hart of Detroit articulated a problem unfolding before his constituents, who faced "the need to reconcile [their] increasing demand for electrical power with [their] developing desire for an environment that is both healthy and pleasant."[11] Speaking to mounting anxieties over radioactive and thermal waste disposal, Hart cautioned that, "the uninvited companion of economic progress too often is an unseen environmental hazard," and requested that the proposals for a dozen nuclear power plants along Lake Michigan, including plans for the Zion Power Plant, be seriously considered as "a case study in this larger nationwide problem."[12] In the hour that followed Hart's remarks, Mary Sinclair, a local activist speaking for the West Michigan Environmental Action Council, challenged the nuclear site proposals with a list of concerns that included hot wastewater; the risk of radioactive effluent entering fragile aquatic ecosystems; and more broadly, the "serious disagreement" between "competent scientists" on waste standards. Sinclair claimed to speak for "the first citizens of the nuclear age," requesting answers to the technical unknowns of the new power source.[13]

The apprehensions expressed in the 1970 Senate hearing fell in step with the seismic environmental movements building in the late 1960s, many of which centered on issues in the Great Lakes Basin. The nation's embattled freshwater lakes were being arduously rehabilitated from the disastrous effects of invasive species, industrial and chemical pollutants, and runaway algae growth. In America's cultural memory, water has often appeared in the guise of the eternal frontier:

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**7** "Progressland: A Walt Disney Presentation," 1964-65 New York World's Fair Corporation (New York, NY, 1963) http://www.nywf64.com/genele08.shtml.

**8** Jurewitz, "U.S. Nuclear Power Industry," 215.

**9** Timothy Flannery, *The Eternal Frontier: An Ecological History of North America and Its Peoples* (New York, NY: Grove Press, 2001), 335-352.

**10** "Nuclear explained," U.S. Energy Information Administration, EIA, Updated April 6, 2021, https://www.eia.gov/energyexplained/nuclear/nuclear-power-plants.php.

**11** U.S. Congress, Senate, Committee on Commerce, *Environmental Effects of Energy Generation on Lake Michigan*, 93rd Cong., 2nd sess., 30 March 1970.

**12** U.S. Congress, *Environmental Effects*, 2.

**13** U.S. Congress, *Environmental Effects*, 2-14.

regenerative, boundless, resilient. The study of ecology, increasingly professionalized by the midcentury, had begun to challenge America's romantic tradition of water wealth. In the Midwest, human activity had been altering the biology of the Great Lakes in a visible way with algae growth and dead zones, galvanizing a new environmental consciousness for its residents, which found purchase in the public hearings held by administrative agencies for nuclear power programs.[14]

At the helm of a new decade, citizen interventions against nuclear power in the 1970s evidenced a shift in the region's care for environmentalism, from retroactively addressing damage already done to a prudent accounting for the future ecological health of the lakes. The local debates ignited over nuclear power from 1970 to 1979 have had cultural staying power, casting a pall over the industry today. Considered with historical distance, the voices of environmentalists on the siting of nuclear power plants, unearthed in public transcripts and newspaper pages, present an early example of long-term planning for environmental catastrophe played out on a local scale.

# APRÈS NOUS, LE DELUGE

## *Scholarship on Mid-Century American Environmentalism*

THE TERM "ENVIRONMENTALISM" emerges from the mid-twentieth century as both a movement and an idea, propelled by popular science and biochemical disasters that wreaked visible havoc. Rachel Carson's *Silent Spring* would come to bookend the popularly understood story of humans and the environment over the last 60 years. Beginning in 1962 with the chemical pollution of DDT, this story included triumphant lawsuits in the wake of the Clean Air Act of 1972 and later, the Exxon Valdez oil spill in 1989. The growing field of environmental history aims to read between these lines and identify the ways in which the term 'environment' has come to be understood, cutting across themes of technology, risk, control, and culture.

Nature has played the part of the silent victim in modern history, responding unpredictably to industrial and urban growth and each time provoking a sudden realization of the consequences of human action. As put by author Jennifer Thomson in *The Wild and the Toxic*, history often conceptualizes the environment as "the backdrop for the central drama of human existence."[15] The project of environmental historians is to assign the nonhuman world its own historical agency. With this lens, the environment figures centrally as a force that has shaped human society and economy as much as we have tried to shape, rearrange, and pave over it. In the same respect, the history of American nuclear power has been largely determined by the contiguous siting of nuclear plants next to bodies of water. In line with Thompson's point, water presents a major actor rather than set dressing, and the hostile attitudes that many have come to foster towards nuclear power is partially a product of the sensitive ecologies upon which it has depended. The political realities of nuclear power today can be better chartered by the industry's recent environmental history. To do so requires a careful tracing of modern environmentalism, the field of 'environmental futures,' and the placement of nuclear technologies in that broader framework.

There exists an abundance of scholarship on the emergence of American environmentalism in the postwar decades. Historians Paul Warde, Libby Robin, and Sverker Sörlin have marked 1948 as the beginning of the conceptual revolution of the environment, when two widely-read books sounded alarms about resource scarcity. William Vogt's *Road to Survival* and Fairfield Osbon's *Our Plundered Planet* carried forward Malthusian concerns about population growth into the postwar years, warning that, "by excessive breeding and abuse of the land mankind has backed itself into

**14** Terence Kehoe, *Cleaning Up the Great Lakes* (Dekalb, IL: Northern Illinois University Press, 1997), 130-135.

**15** Jennifer Thompson, *The Wild and the Toxic: American Environmentalism and the Politics of Health* (The University of North Carolina Press, 2019), 3.

an ecological trap."[16] The narrative portended that the safety valve would soon close for a country built on the idea of frontier economies, sharpening a social sense of existential risk. Warde and his co-authors highlight Vogt and Osborn as academic scientists who used their field of expertise to extrapolate on the shared fate of human survival. With "punchy prose" and chapters like "The History of Our Future," they succeeded in moving readers by bringing the planet's possible futures into contact with its ravaged present.[17] In the same decade, Warde and others argue, scientific research gained traction and new levels of funding from the Eisenhower administration, equipping natural studies with data and computer modeling which could scale the environment as one cohesive discipline from microorganisms to ozone layers. These predictive technologies brought into sharper focus the environmental stresses of the commercially productive postwar years.[18]

Other scholarship points to a conceptual framework for 'environment' founded on toxicity reports and human health effects. Etienne Benson writes that postwar consumerism ushered in an extensive array of products, with the often pernicious presence of byproducts and chemicals, creating a culture of anxiety around "unintentional mass poisonings."[19] Jennifer Thompson corroborates this viewpoint, writing that before—and poignantly after—Carson's *Silent Spring*, environmentalism became fixated on concerns over human health and the "environmentally threatened body," made vulnerable by the hundreds of new chemicals developed every year to keep pace with the rising demands of a prosperous middle class.[20]

From this array of historical work, a broader picture of mid-century environmentalism emerges, straddling two opposing positions: on the one hand, a movement led by an understanding that technology can't keep pace with population, and on the other hand, a growing awareness that population can't keep pace with technology. The former is influenced by natural constraints on our inputs, the other by the toxic accumulation of our outputs. In both arguments, science acts as a harbinger of the long-term, influencing the conceptual framing of 'environment' in public life and contributing to foreboding narratives of an end of our days.

Nuclear technology proved to be an apogee of these tensions, positioned as either mankind's mastery over natural limits or its hubristic finger on the red trigger of nuclear winter. Warde et al note that the pressures of population growth were absorbed as "a call to ingenuity," and "nothing exemplified these trends better than the sometimes wild optimism surrounding nuclear power" as an energy source without natural limits.[21] On the other hand, the existing body of scholarship on anti-nuclear movements speaks to a widespread cultural distrust of manmade technology. Environmental historian Ralph Lutts substantiates this argument, accounting for civilian anxieties over radioactive fallout from nuclear testing schemes in the 1950s. Radionuclides from testing schemes became sources of ubiquitous and alarming toxicity entering food, bones, and breast milk with decades-long half-lives.[22] In either case, historians agree that the debates over nuclear

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**16** Paul Warde, Libby Robin, and Sverker Sörlin. *The Environment: A History of the Idea*. (Johns Hopkins University Press, 2018), 11. The Malthusian Theory of Population was popularized in the late 18th century by Thomas Robert Malthus, projecting that population growth would outpace food production to a crisis point of low living standards. For the rebirth of Malthusianism in postwar America, see: Tom Robertson, *The Malthusian Moment: Global Population Growth and the Birth of American Environmentalism*; Björn-Ola Linner, *The Return of Malthus: Environmentalism and Post-War Population Resource Crises*.

**17** Warde, Robin, and Sörlin. *Environment: A History of the Idea*, 17.

**18** Warde, Robin, and Sörlin. *Environment: A History of the Idea*, 25.

**19** Etienne Benson, *Surroundings: A History of Environments and Environmentalisms* (Chicago: The University of Chicago Press, 2020), 136.

**20** Thomson, *Wild and the Toxic*, 67.

**21** Warde, Robin, and Sörlin. *Environment: A History of the Idea*, 67.

**22** Ralph H. Lutts, "Chemical Fallout: Rachel Carson's Silent Spring, Radioactive Fallout, and the Environmental

technology helped dramatically to scale the public's environmental consciousness from the relative safety of their backyards to a more planetary level. Among other historians, Lutts's descriptions of radioactive fallout—invisible isotopes prone to accumulate in the body and biosphere—demonstrates that the question of how to safely manage the atom "forced a public education in the ecological food chain."[23] Nuclear accidents were a matter of atmosphere, wind, and soil potentially sweeping radioactive particulates throughout an entire ecosystem.

With a different temporal and geographical focus, Kate Brown's environmental history of the 1986 Chernobyl accident delivers a sobering account of the global level of public knowledge and institutional foresight of the risks posed by nuclear accident to the larger environment.[24] Using "historical whispers" in the archives from workers, farmers, and nurses in the field, Brown has pulled forward a picture of a "public at scientific stalemate," ill-equipped with the necessary knowledge and risk assessment to manage the fallout from the blown reactor.[25] Among many shortcomings, the Soviet apparatus had failed to anticipate how different ecologies would bioaccumulate radioactive material, from preservationist bogs to interactive food chains of surrounding forests.[26] In Brown's conclusion, Chernobyl was "an acceleration on a timeline of destruction," a tragically inevitable failure of environmental foresight. Her work squares with other historical scholarship on 'environmental future governance,' the faculties of society and politics which have attempted—or grossly failed at—studying and charting the environmental long-term.[27]

Nuclear energy sits in the thematic crosshairs of technology and the future, an evolving area of historical study. Historians Jenny Andersson and Anne-Greet Keizer have explored the construction of the long-term by examining institutes for future studies in Sweden and the Netherlands from the 1970s. These institutes were supported by scientists and governments in order to make predictive statements about the future course of population, land, and economy.[28] Their discussion is revealing of a historical pattern in the 1960s and 1970s, wherein the governance of the idea of the long-term—on scales to the year 2000 to 2100—was sculpted just as much by bottom-up public participation as it was by top-down scientific expertise and policymakers. Founded in a compelling case study of Scandinavian public policy, there exist few other examples of this dialogic and habitual process of the environmental long-term. A regional network of citizen environmentalists along the Lake Michigan Basin present one such example — an effort of grassroots lobbying to map the possible environmental hazards posed by nuclear technology not yet fully operational. For these environmentalists, the longer-term futures of the lake environment, rather than the singular present, became their category of intervention.[29]

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Movement," *Environmental Review* 9, no. 3 (1985): 210-225.

**23** Lutts, "Radioactive Fallout and the Environmental Movement," 222.

**24** Kate Brown, *Manual for Survival: An Environmental History of the Chernobyl Disaster* (New York, NY: W. W. Norton & Company, 2019), 1-108.

**25** Brown, *Manual for Survival*, 5, 90.

**26** Brown, *Manual for Survival*, 137-140.

**27** Jenny Andersson and Anne-Greet Keizer, "Governing the future: science, policy and public participation in the construction of the long term in the Netherlands and Sweden," *History and Technology* 30, Nos. 1-2, 104-122, 2014.

**28** Andersson and Keizer, "Governing the future," 111. The aforementioned 'institutes for futures studies' were, in part, responding to the controversial Limits to Growth book published by the Club of Rome in 1972. Written by an international team of researchers housed at the Massachusetts Institute of Technology, the publication used data modeling to present alternative futures for mankind, based on five factors of agricultural output, industrial output, resource depletion, pollution, and population growth. The book was an emblematic moment in the postwar science of the future, employing predictive technologies to consider best practices for national and economic security in the long-term.

**29** Andersson and Keizer, "Governing the future," 106, on "temporal categories of intervention."

The story of environmentalism is well-documented in the Great Lakes Basin, where fervent pockets of activism changed the physical, political, and economic landscape. Environmental historian Terence Kehoe delivers an insightful accounting of the public policy changes from the 1950s to 1970s along the nation's largest freshwater bodies. Kehoe argues the 1960s ushered in a new era of "public interest," which unraveled the traditions of systematic and informal cooperation between regulatory agencies and industrialists.[30] Grassroots activists called for more stringent standardization, which Great Lakes states responded to with the formation of three environmental protection agencies. Dave Dempsey, a historian of the Great Lakes, further recounts the professionalization of environmental grassroots in the 1970s, as they incorporated across state borders and, for the first time, recruited paid expert personnel.[31] As a result, both historians find that the 1970s witnessed a litigious climate along the lakes, during which heightened environmental activism counterbalanced the cooperative relationships between industry and government, each with a different stake in the lake environment. Unlike other industries leaving known and measurable pollutants in their wake, the risks of the nascent nuclear power sector were difficult to assess, posing unique challenges for involved parties. The following case study will demonstrate how the roll-out of nuclear industry along Lake Michigan became characterized by challenges of uncertainty, public knowledge, and foresight.[32]

This thesis will primarily build from the findings of ecologists, economic historians, environmental archivists, and historians of the 1960s and 1970s. A variety of books dating to the 1980s contribute a strong ecological narrative of Lake Michigan's water quality in the twentieth century. The scientific edge of my research is particularly supported by ecological reports on the state of Lake Michigan published by the Aquatic Ecosystem Health and Management Society. The Stanford University Atomic Energy Commission Archives have been an instrumental resource of public hearings transcripts, offering crucial insight into citizen interventions. By placing these witnesses of natural and human character into conversation with broader historiographical work on American environmentalism, I aim to provide a compelling lens on local debates over nuclear energy as part of a larger history of American environmental conscience.

Faced with a highly technical energy industry and a new level of scientific politics, citizen intervenors across Lake Michigan's home states caused a string of construction delays in the early 1970s. This thesis seeks to trace the tensions between the nuclear opportunities propositioned by the Atomic Energy Commission and the goals set by skeptical environmental advocates as they grappled with the unfamiliar vocabulary of nuclear technology. This patchwork of citizen interventions will be examined as a practice of unexplored cost-accounting for the future, from which we have much to learn when we rely on the widespread diffusion of high technology to assuage specters of energy crisis, resource exhaustion, or other environmental, existential risk.

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**30** Kehoe, *Cleaning Up the Great Lakes*, 101-103.

**31** Dave Dempsey, *On the Brink: The Great Lakes in the 21st Century* (East Lansing: Michigan State University Press, 2004), 227-259.

**32** Kehoe, *Cleaning Up the Great Lakes*, 154. On Kehoe's accounting of thermal pollution hearings from 1970 – 1974, see *Cleaning Up the Great Lakes*, 151-157. On Dempsey's record of Lee Botts and the Lake Michigan Federation, see *On the Brink*, 169-170.

# 1. WRITING A SOCIAL CONTRACT FOR THE SPACESHIP EARTH

## *A Brief Intellectual History of the Earth Sciences*

> *The future is an elusive abstraction we almost don't believe in; looking straight at it requires us to confront our fears and anxieties, the possibility of misfortune, and the fact of our mortality.*
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> *— Marcia Bjornerud, foreword to Vincent Ialenti's* Deep Time Reckoning, *2020*

ON A SPRING DAY in 1970, the Neenah-Menasha League of Women Voters in Wisconsin hosted a debate that centered two competing philosophies on the management of nuclear power. For several years prior, sites along the shoreline of Lake Michigan had been reviewed and selected for the construction of seven nuclear plants, and thus a concerned audience sat in the debate hall with trepidation towards the new energy sector building in their backyards. Glenn Reed, who managed the nuclear power division of a regional utility company, spoke with urgency about accelerating plant construction in order to sustain current standards of living.[33] With the capabilities of nuclear power, Reed prophetically imagined "an Earth with 10 billion people on it, living above a dismal, Malthusian level" thanks to reliable and low-cost uranium stores. The audience then turned their attention to Vance Van Lannen, a member of the Wisconsin Ecological Society, who raised concerns about the byproducts of nuclear reactors. Alluding to water pollution problems fresh in the minds of lakefront communities, namely the bioaccumulation of DDT and other synthetic chemicals, Van Lannen cautioned that radioactive and thermal waste could pose significant long-term risks to the lake ecosystem. He concluded with the statement, "regulations should not be made according to how much waste the environment can hold, but according to how much can be kept out."[34]

The debate touched a chord which would echo across the Great Lakes region during the following decade. Glen Reed's promise and Vance Van Lennen's circumspection form the central impasse of nuclear power programs in the 1970s. It arrived with the idea of 'environment' as a crisis concept, born from a new conceptualization of the Earth as a closed system, with scarce inputs to fuel us and ensuing outputs disposed of into the biosphere.[35] Often considered as localized skepticism harbored by protective communities, interventions against nuclear power plants along Lake Michigan can be studied in the fold of a broader conceptual shift in 'environment' taking place over the immediate postwar decades, which confronted methods of input with the products of output; which isolated nuclear stakeholders against each other in their respective goals for the future Earth; and which laid environmentalists with an expensive burden of proof against the expeditious construction timelines of nuclear industry. Debates and delays characterized the roll-out of nuclear energy in the 1970s, the origins of which can be traced through an intellectual framework for environmental foresight that spanned from 1946 through to the economic boom of the 1960s.

The Atomic Energy Act was signed into law in 1946, after which President Truman authorized the Atomic Energy Commission (AEC) to effectively transfer part of the atom from the military wheelhouse to civilian control.[36] Headquartered in the former wartime offices of the Joint Chiefs of Staff, the AEC signaled the government's commitment to pacifying the atom and including civilian welfare in its goals for nuclear discovery. In the same year, public administrators Dean Acheson and David Lilienthal published

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**33** Bill Hurrle, "The World's Waste Load," *News-Record* (Neenah, WI) April 15, 1970.

**34** Hurrle, "World's Waste Load," 7.

**35** Warde, Robin, and Sörlin, *Environment: A History of the Idea*, 32.

**36** Alice Buck, "The Atomic Energy Commission," U.S. Department of Energy, July 1983.

the *Report on the International Control of Atomic Energy*, calling for an international body of oversight. At a time when relations between the Soviet Union and the United States had begun to cool, the Acheson-Lilienthal Plan hoped to motivate cooperation between western and Soviet science in an effort to accelerate the pace of research and institute broad-based standards for nuclear plants.[37] They recognized that "the technology developed for the realization of atomic weapons are … the same technology which play so essential a part in man's almost universal striving to improve his standard of living."[38] While atomic energy promised to sustain future growth in population and economy, argued the report, the science was incomplete and "advances in knowledge must be expected."[39] One year after the atomic bomb was detonated over Japan, the report presaged that the nuclear power industry would be an ongoing experiment in both technology and politics, a fact of an energy sector with both unprecedented potential and risk.

Almost a decade after the Acheson-Lilienthal Report hit the press, the U.S. government had achieved relatively little headway in standardizing nuclear power facilities. In a 1955 Sunday Star article titled "10-Year Co-Existence with the Atom Finds World on Tenterhooks," a retired general reiterated the same concerns with regulating nuclear power, remarking that "this great new source of energy will impose an awful responsibility on those who control it."[40] Regulation remained an open question because the project of nuclear power had yet to be realized. Upon entering office in 1953, President Eisenhower announced his "Atoms for Peace" program to the United Nations General Assembly in New York, with the messaging of "my country wants to be constructive, not destructive."[41] With an optimism towards "mankind's God-given capacity to build," Eisenhower aimed to drum up an international cooperative spirit towards the immediate development of nuclear energy:

> *The United States knows that peaceful power from atomic energy is no dream of the future… Who can doubt that, if the entire body of the world's scientists and engineers had adequate amounts of fissionable material with which to test and develop their ideas, this capability would rapidly be transformed into universal, efficient and economic usage?*[42]

The program was predicated on the achievement of nuclear power programs with swift pace and immense scale. However, by the end of the 1950s proponents of the Atoms for Peace campaign were frustrated by a lack of concrete progress in the actualization of the industry and an international authority to regulate it. Senator John Pastore from Rhode Island told the Senate, "the international agreement is not worth the paper it is written on unless we build reactors which will convert special nuclear material into electricity and power."[43] A Baltimore city newspaper ran an advice column with the chairman of the AEC, Lewis Strauss, to which a housewife from McKees Rocks, Pennsylvania asked "how soon can the present generation look forward to the use of atomic heat for their homes?"[44] Strauss echoed her hopeful tone, reassuring that "ultimately atomic energy will heat and light our homes, propel our ships and planes, and give us healthier lives

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**37** Dean Acheson, David E. Lilienthal et al., "A Report on the International Control of Atomic Energy," Committee on Atomic Energy (U.S. State Department: Washington, D.C., 1946), 1-60.

**38** Acheson, Lilienthal et al., "Control of Atomic Energy," 9.

**39** Acheson, Lilienthal et al., "Control of Atomic Energy," 20.

**40** Eugene M. Zuckert, "Some Proposals for Speeding Up the 'Atoms for Peace' Program," The Sunday Star (Washington, D.C.), September 8, 1957, A-27.

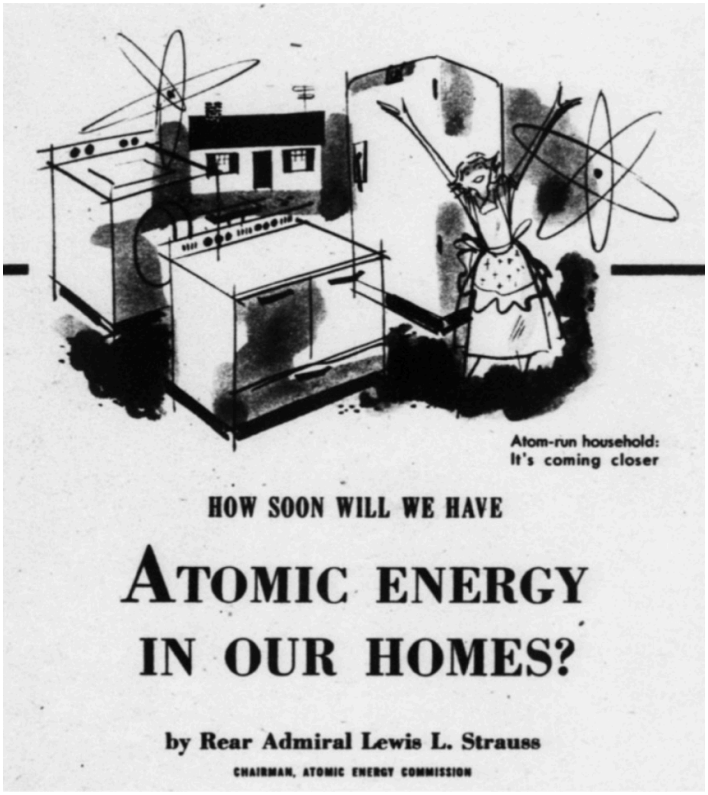
**41** Dwight D. Eisenhower, "Atoms for Peace: Address to the 470th Plenary Meeting of the United Nations General Assembly," (speech, New York, NY, December 8, 1953), International Atomic Energy Agency, https://www.iaea.org/about/history/atoms-for-peace-speech.

**42** Eisenhower, "Atoms for Peace," 1953.

**43** Zuckert, "Speeding Up the 'Atoms for Peace' Program," A-27.

**44** Lewis L. Strauss, "How Soon Will We Have Atomic Energy in Our Homes?" *The Baltimore Sun* (Baltimore, MD), April 24, 1955.

with more comfort and leisure." For many, the novelty of nuclear power meant shaking the qualms of the present, the uneasy projections of peak oil reserves and the notion of breathing dirty air.[45] But Strauss had taken care not to over-promise, acknowledging that nuclear power was not yet cost-competitive with coal, oil, and natural gas – only that "steady progress is being made."




*The Baltimore Sun*, 1955: *"Atom-run household: It's coming closer."* [1]

In reality, the progress was more exponential than additive, accelerating in the mid- to late-1960s.[46] In 1963, the independent research group Resources for the Future (RFF) published a thousand pages of projections of population, urban, and economic growth for the decades to come.[47] Population was expected to grow annually at a rate of 1.5%, Gross National Product could potentially see 110% growth by the year 1980, and the nation would expand its investment in residential housing by 132%. Most strikingly, researchers anticipated that energy consumption would soar from 45 to 79 quadrillion British thermal units (BTUs) by 1980.[48] The report was reflective of a new sense of urgency coming to bear on the energy economy, in turn reviving the promise of nuclear energy to fuel the advanced welfare of American society without the natural limits of coal and petroleum reserves.

The Acheson-Lilienthal plan was but one attempt at international collaboration to sustain the nation's future needs. This goal had reverberated through the International Geophysical Year (IGY) of 1957, a year-long scientific program which interrupted Cold War divisions to engage 60,000 participating scientists from 67 nations in a multidisciplinary study of the Earth.[49] The "year" lasted eighteen months in total, representing a dozen earth sciences in an enterprise of data collection and intellectual exchange. Both the U.S. and the Soviet Union successfully launched satellites into Earth's outer orbit, contributing to a nascent understanding of the planet from the viewpoint of space: a singular and limited entity.[50] At the conclusion of the 1950s, U.S. science emerged from a decade of relative isolation and mistrust of foreign colleagues, compounded by the tactics of the Red Scare, to acknowledge its place in global systems science. In addition to satellite launches and a mass of data analyses, the result of the IGY was a conceptual shift in the imagination of the

**45** "Peak theory" was introduced in 1949 by geologist Marion King Hubbert, who posited that global oil reserves would peak at the middle of its life cycle in the 1970s, thereafter accelerating towards resource depletion by 2000. This is commonly referred to as the Hubbert curve, since disproven by the hydraulic drilling innovations of the 21st century. See M. King Hubbert, "Energy from Fossil Fuels," *Science* 109, no. 2823 (Feb. 4, 1949).

**46** Jurewitz, "U.S. Nuclear Power Industry," 209.

**47** Hans Landsberg, "Energy in Transition: A View from 1960," *The Energy Journal* 6, No. 2 (April 1985), pp. 1-18.

**48** Landsberg, "Energy in Transition," 13.

**49** Christy Collis and Klaus Dodds, "Assault on the unknown: the historical and political geographies of the International Geophysical Year (1957-58)" *Journal of Historical Geography* 34, 2008, 556-573.

**50** Collis and Dodds, "International Geophysical Year," 559.

Earth shared by the global scientific community.[51] In 1959, Solly Zuckerman, a scientific advisor to the United Kingdom Parliament, coined the term "environmental sciences" to describe the growing field of interdisciplinary natural studies, which had been cutting across math, physics, and computer science to deliver groundbreaking studies on the planet as an integrated system.[52]

Other fields of study felt compelled by the new planetary perspective, and the global environment was fostered as a political, cultural, and economic concept as well as a scientific one. "We are now in the middle of a long process of transition in the nature of the image which man has of himself and his environment," wrote economist Kenneth Boulding, whose work had been preoccupied with crises of population growth, resource scarcity, and environmental cataclysm.[53] In March of 1966, Resources for the Future held its annual forum in D.C., where Boulding presented his influential piece "the Economics of the Coming Spaceship Earth," an attempt to chart the future course of human economy given new information about Earth's exhaustible natural resources.

Boulding's essay contrasted the "image of the frontier, possibly one of the oldest images of mankind," with a new "notion of the spherical earth and a closed sphere of human activity."[54] The former he dubbed "the cowboy economy," associated with the reckless abandon and romantic visions of economic growth which had characterized the last century. The latter, a closed system of coagulating matter and energy, Boulding called "the spaceship Earth." Input materials are produced, consumed, and discharged as waste into reservoirs of atmosphere, water, or soil. Parroting the law of the conservation of energy, he wrote that matter is neither created nor destroyed in a closed system, only converted from input to output, fuel to waste.[55] In a limitable sphere exists both the specter of exhausting our inputs and the possibility that we will clog our "planetary sinks" with the resulting waste.[56] "The shadow of the future spaceship, indeed, is already falling over our spendthrift merriment," Boulding concluded, noting the darker premonitions of the decade's economic growth.

The 1960s was well on its way to fulfilling the projections that Resources for the Future had made, electrifying the home with refrigeration technology, air conditioning, and conventional toaster ovens. By the end of the decade, residential and commercial sectors were demanding 1,200 more watts of electricity per capita.[57] Predictions of resource scarcity cast a pall over these new technical luxuries, precipitously increasing energy demand.[58] At the other end, the imagery of silenced birds, dying lakes, and smoggy air carried forward by environmental movements lent truth to the waste repositories of Boulding's "spaceship Earth." To heed Boulding's point, the image which communities held of themselves and their environment underwent significant change from the 1940s into the 1960s. Nuclear energy agitated this narrative, with visions of unlimited inputs to growth and anxieties of living with its unnatural byproducts.

As the issue of energy insecurity became more prevalent, major equipment vendors, utilities, and construction firms saw economic opportunity in the nuclear enterprise. The slow development of nuclear capacity began to accelerate toward the end of the decade, and between 1964 and 1969, the equipment parts

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**51** Collis and Dodds, "International Geophysical Year," 566.

**52** Warde, Robin, and Sörlin, *Environment: A History of the Idea*, 28-29.

**53** Kenneth Boulding, "The Economics of the Coming Spaceship Earth," *Resources for the Future* (Baltimore, MD: Johns Hopkins University Press, 1966), 1-14.

**54** Boulding, "Spaceship Earth," 1.

**55** Boulding, "Spaceship Earth," 8.

**56** Fredrik Albritton Jonsson and Carl Wennerlind, *Scarcity; Economy and Nature in the Age of Capitalism* (Cambridge, MA: Harvard University Press, 2023).

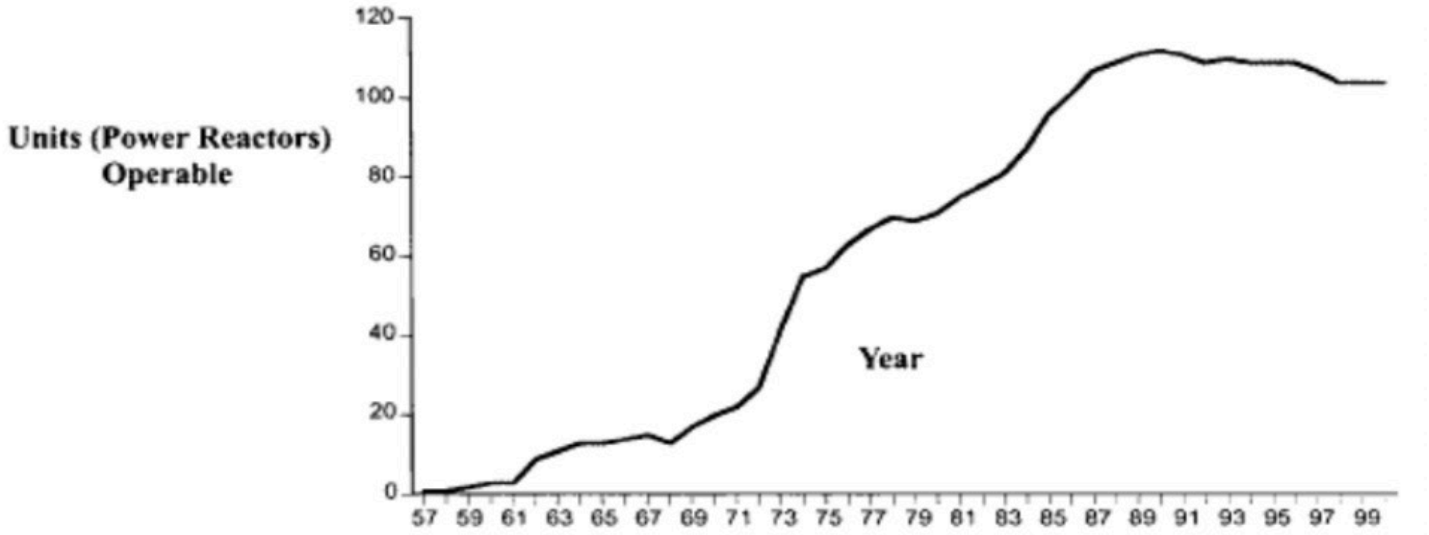
**57** Suits, Matteson, and Moyer. "Energy Transitions in U.S. History, 1800-2019," (Chicago: University of Chicago, 2020) https://us-sankey.rcc.uchicago.edu.

**58** Warde, Robin, and Sörlin, *Environment: A History of the Idea*, 30.

for 81 nuclear plants had been ordered in the U.S.—an ambitious trend of investments that equated 45,000 megawatts of fission-generated electricity.[59]

Relative to the early optimism of the 1950s, the roll-out of nuclear energy which eventually came to fruition in the late-1960s to 1970s was met with a different climate of public opinion, one that accounted for an idea of the 'environment' not only as stock, but also sinks: bodies of water and earth that had become increasingly contaminated with the toxins and waste products of human activity.[60] In the original text of Eisenhower's 1953 'Atom for Peace' speech to the U.N., he set out the goals of accumulating "fissionable materials" and providing "abundant electrical energy" for "power-starved areas."[61] From its inception, the focal point of civilian nuclear energy centered on the challenges of provision, with little mention of its waste. The environmental themes of waste management in the Neenah, Wisconsin debate in 1970 may have come as a surprise to atomic administrators of earlier decades, but it resonates with the notion of 'environment' that had since entered political orbit. Twenty years past the signage of the Atomic Energy Act, blueprints were finally drawn up for nuclear reactors along Lake Michigan and communities had become more familiar with the fragility of their surrounding ecosystem.

Reactors were set to occupy lowland marshes, windswept dunes of sand and cherry shrubs, and forests of dwarf birch and cottonwood trees.[62] They would eject wastewater into the nation's greatest freshwater resource, where aquatic food webs of phytoplankton and algae were already imbalanced by chemical and industrial pollutants. The radioisotopes produced within their steel- and concrete-wrapped walls issued questions of their possible leakage into the contours of the surrounding landscape. The past would indeed be prologue. The debate in that spring of 1970, which would continue to unfold in AEC hearings and Senate chambers throughout the decade, was an attempt to understand and balance the highly technical inputs of nuclear energy with the unknown outputs of its production.




John L. Jurewitz, "Operable U.S. Nuclear Power Units (1957 – 2000)," *Energy & Environment* 2002, pp. 201 [2]

**59** Jurewitz, "U.S. Nuclear Power Industry," 207-221.

**60** Jonsson and Wennerlind, "Planetary Scarcity."

**61** Eisenhower, "Atoms for Peace," 1953.

**62** "Draft Environmental Statement," Directorate of Licensing for the Zion Nuclear Power Station Units 1 & 2 of the Commonwealth Edison Company No. 50-295, *U.S. Atomic Energy Commission* (June, 1972).

"Photo of Zion Construction Site Looking Northeast," *AEC* (January 1972) [3]

# 2. LEE BOTTS

## *The Chicago Activist on Thermal Pollution*

> *The affluent society has become an effluent society. The 6 percent of the world's population in the United States produced 70 percent or more of the world's solid wastes.*
>
> *— Walter S. Howard, "Man's Population – Environment Crisis," January 1971*

WHILE RADIOACTIVE WASTE presented a menacing unknown for environmentalists and the public at large, it was not the waste product of nuclear power which dominated its initial phase in the early 1970s. Thermal pollution, the ejection of hot wastewater, had long been understood as a consequence of utility plants creating conditions of heat for electricity. At the time, over 70% of hot wastewater could be traced to the electric power industry. The Federal Power Commission predicted that the industry would contribute five times more thermal pollution from 1970 to 1990. This projection was due to the expected proliferation of nuclear facilities, which release up to 50% more hot water than conventional fossil fuel plants.[63]

There had been a developing public understanding of how thermal pollution from nuclear plants came to be: nuclear fission generated electricity by creating conditions hot enough to manufacture steam, which moves the plant's large turbines. Cooling water from the lake was injected to bring down the temperature and hence suffered the opposite effect, often heated by the steam up to 30 degrees Fahrenheit warmer.[64] As it stood, standard practice was to discharge this heated wastewater back into the lake. In 1968, a federal study concluded that 40 billion British thermal units (BTUs) were released into Lake Michigan every hour.[65] Fish populations tend to use coastal zones as breeding grounds, and their eggs are particularly sensitive to temperature changes. In consequence, public officials designated by the Federal Water Pollution Control Act recorded ten significant fish kills in the 1960s.[66]

One month after the Neenah debate, in May of 1970, the "Conference on Pollution of Lake Michigan and its Tributary Basin" was called to session. The speaking agenda ranged from sewage treatment to the environmental impact of military base camps to invasive mussels.[67] Thermoelectric pollution was one of the few purely ecological phenomena discussed by conferees, hot plumes of wastewater that did not pose significant risks to human health or industry. The issue had managed to catalyze a lively back-and-forth throughout the conference, with a motley roster of speakers on both sides of the nuclear energy fence. Governor Warren Knowles of Wisconsin opened the conference by

**63** Kehoe, *Cleaning Up the Great Lakes*, 157.

**64** J. Samuel Walker, "Nuclear Power and the Environment: The Atomic Energy Commission and Thermal Pollution, 1965-1971," *Technology and Culture* 30, No. 4 (Baltimore, MD: Johns Hopkins University Press) October 1989: 964-992.

**65** Walker, "Nuclear Power and the Environment," 970-971.

**66** Walker, "Nuclear Power and the Environment," 971.

**67** U.S. Department of the Interior, Federal Water Quality Administration, *Proceedings of the Conference on Pollution of Lake Michigan and its Tributary Basin* (Milwaukee, WI), March 31 – April 1, 1970: 2-252.

acknowledging "a new climate of public opinion," one that involves "broad public interest now evident in ecology and the environment."[68] For an environmental politics that increasingly embraced an "ecosystem approach" inclusive of human and nonhuman interactions, thermal pollution fit the bill.

Representatives from electric power companies made clear that "because of the thermodynamics involved in the process of generating electricity, locations along substantial water courses are essential."[69] A research group for commercial fisheries presented their own findings that thermal pollution had the potential to destroy "important nursery areas" and possibly "the species that is associated with it"—at the least, "decrease incubation periods" by anywhere from twenty-two to forty-one days.[70] The director of the Wisconsin Ecological Society noted "there are many menacing unknowns. If we see a scientist take one position on hot water, another can be found to take the other."[71] Presented with conflicting scientific information, the bottom line for most advocacy groups was to request further information.

Without speculating on the technical and controversial unknowns of radioactive waste, thermal waste offered environmental advocates a course of action to indirectly lobby the AEC with public information requests—a tactical choice for slowing construction timelines.[72] The issue of thermal pollution can be understood as representative of the larger nuclear power debate, a highly technical process of powering American livelihood in competition for use of the nation's largest freshwater resource. Lakefront communities had learned to tell the signs of the inexorable risks posed by rapidly expanding industry, jaded by the protracted environmental calamities brought on by large chemical companies and steel industrialists. As the first generation to contract large-scale nuclear power capabilities, grassroots organizers along the Great Lakes expressed their preference to "err on the side of prudence and care," for the first time finding themselves at the table in the roll-out of an entire industrial sector.[73]

By the time the conference attendees had returned from their lunch break in Chicago and the second session was called to order, nuclear plants had already come to dominate the day's proceedings. Local activist Lee Botts took the stand that afternoon, leveling a menu of demands at agency and utility representatives. A woman of tenacious and energetic character, raised by the 1930s Dust Bowl years in Oklahoma, Botts had ascended as one of Chicago's leading environmentalist figures following her unflagging efforts in the Save the Dunes movement in Indiana.[74] She was known to command respect from environmentalists and industrialists alike for her direct and informed questions, and often served as an effective arbiter between contentious players. At the conference, Botts formally represented the Open Lands Project (OLP), a self-defined "clearinghouse" to process and disseminate new information on the region's ecological status for various grassroots groups.

Under the executive leadership of Gunnar Peterson, an impassioned local conservationist, Botts had been on the OLP's professional staff for only two years before amassing enough contacts in the advocacy space to spin off her own working group that year in 1970, the Lake Michigan Federation (LMF).[75] At a time when non-profit bodies were becoming increasingly professionalized and the nationally coordinated efforts of the Sierra Club had proven staying power, Botts had been laboring to bring diffuse local groups—from members of the regional Audubon Society, League of Women Voters, and other citizens of the

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**68** U.S. Dept of Interior, *Conference on Pollution of Lake Michigan*, 5-7.

**69** U.S. Dept of Interior, *Conference on Pollution of Lake Michigan*, 153.

**70** U.S. Dept of Interior, *Conference on Pollution of Lake Michigan*, 33-35.

**71** U.S. Dept of Interior, *Conference on Pollution of Lake Michigan*, 241-242.

**72** Paul Culhane, interview by Catherine Veronis, April 5th, 2022, in Chicago, IL, transcript in possession of the author.

**73** U.S. Dept of Interior, *Conference on Pollution of Lake Michigan*, 241-242.

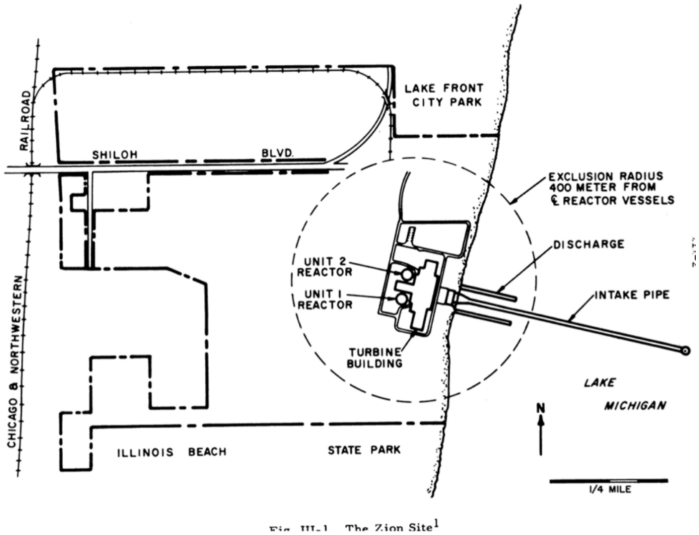
**74** Beth Botts, interview by Catherine Veronis, April 5th, 2022, in Chicago, IL, transcript in possession of the author.

**75** Paul J. Culhane, "The Lake Michigan Federation: Evaluation of an Environmental Interest Group," (Evanston, IL: Northwestern University Center for Urban Affairs, 1974), 1-6.

environmentalist milieu—into LMF's organizational structure.[76] While the OLP levied indirect pressure on government actors by raising public awareness through educational programs, Botts and the LMF centered a more activist philosophy—to field, respond to, and participate in policy advocacy for specific issues concerning the health of the lake environment, a ready and effective touchpoint for concerned citizens sharing the shore.[77]

In its first year, the LMF was already well on its way to becoming one of the main outfits in Chicago on the topic of nuclear power, strategically investigating thermal pollution through consultations with ecologists, document release requests from government and utility reps, and other avenues of fact-gathering.[78] At the conference, Botts spoke to a lack of sure consensus on the long-term environmental impacts of powering the basin's grid with nuclear reactors. Her statement evinced doubt about the engineering company contracted to build both the Zion plant in Illinois and the Two Rivers plant in Wisconsin, whose executive leadership had recently contradicted itself on the disposal of hot wastewater. The company issued plans to discharge Zion's effluent hundreds of feet out in the lake, deep below the surface—Botts raised alarm that this plan for Zion came directly after their expressed confidence in releasing the Two Rivers plant's wastewater at surface level, along the shore.[79]


"Mrs. Lee Botts, Public Say-So" from the Herald-Press in St. Joseph, MI, article titled "Nuclear Plant Critic Wants Bigger Say," September 21, 1973
[5]




"The Zion Site" from "Draft Environmental Statement," *AEC* 1972
Note: the discharge pipe near the 400-meter radius from reactor vessels, from which thermal effluent would be ejected.
[4]

Addressing this climate of ambiguity, Botts remarked that "the public is so afraid and so uncertain whether environmental protection is shared as a goal, to which economic gain must be subservient."[80] Her demand for more robust evaluation was shared by Fran Schnanig from the Glencoe League of Women Voters, who straightforwardly asked, "can we slow down the construction of the Zion plant until there is adequate knowledge?"[81] The conference's agenda had been divided between the deteriorating effects of past economic activity—from phosphorus detergent to steel mill pollution—and a developing future picture of energy and industry operating at the lakefront. Against the backdrop of "an ignorant and uncaring past," Botts professed a collective desire to "avoid having to meet

**76** Paul Culhane, interview by Catherine Veronis, April 5th, 2022, in Chicago, IL, transcript in possession of the author.
**77** Dempsey, *On the Brink*, 170-171.
**78** Culhane, "The Lake Michigan Federation," 33.
**79** U.S. Dept of Interior, *Conference on Pollution of Lake Michigan*, 205-B.
**80** U.S. Dept of Interior, *Conference on Pollution of Lake Michigan*, 205-E.
**81** U.S. Dept of Interior, *Conference on Pollution of Lake Michigan*, 147.

together five years hence."[82] Faced with either inadequate or inconsumable knowledge, the controversy of thermal pollution signaled a newly attentive foresight for an ecosystem historically transgressed.

When President Truman authorized the AEC in 1946, it had been with the established goal of confirming civilian control of the new energy source—and years later, the Commission found itself at odds with a deluge of civilian concerns. The regulatory body was run by five commissioners, appointed by the President and excluded from the normal recruitment patterns of the Civil Service system.[83] Commissioners could deny a license to a nuclear operator if it held the opinion that "it would be adverse to the health and safety of the public," a standard that was up to them to define.[84] The AEC was required to hold a public hearing to grant a construction permit, but the final license would be automatically granted unless the public suggested a need for more hearings with their participation. Prior to the late 1960s, there was little interest in public hearings and they were sparsely attended, largely because there were few plants yet to license.[85]

To accelerate his 'Atoms for Peace' campaign, the Eisenhower Administration amended the Atomic Energy Act in 1954 to endow the AEC with broad licensing authority, an uncharacteristic level of flexibility for a government agency.[86] Also uncharacteristic of administrative agencies, the AEC had the dual mandate of the "promotion" and "regulation" of nuclear power, tasked with both incentivizing entrepreneurship and the continued oversight of the enterprise.[87] This left room for scrutiny later on, and citizen groups leveled accusations that the AEC was intrinsically biased towards the goals of industry. The government's system for insuring nuclear plants did not help their case. Private investors were hesitant against nuclear power unless the government would alleviate some of their liability, and in 1957, Congress passed the Price-Anderson Act to partially insure the industry with a no-fault system of government fiat, wherein nuclear operators would be responsible for a certain amount of damages, after which the federal government would provide coverage. Following the act, residential homeowners could find "nuclear accident" in the fine print of their home insurance policies.[88]

On the regulatory end of the AEC's dual mandate, these governing documents had come to define "the health and safety of the public" in a strictly human sense, leaving environmental matters out of the regulatory scope. By the time environmentalists raised alarm bells over the possible waste products of nuclear power, there was only one extant report from the AEC on the possibility of reactor accident or leakage. In 1957, a team of research scientists from the Brookhaven National Laboratory composed a report on the "Theoretical Possibilities and Consequences of Major Accidents in Large Nuclear Power Plants (WASH-740)." The study singularly assessed "injury to persons and damage to property," and concluded little cause for concern.[89] With even the most pessimistic parameters in place, they estimated that the average American faced 1 in 50 million odds of being killed in a reactor accident. A decade later, at the helm of the 1970s with a dozen plants in some phase of construction, there had been no publicly issued update on WASH-740 and no movement by the AEC to calculate holistic risks to the environment. Regarding the future of nuclear energy along Lake Michigan, the burden of proof for environmental impact was divided unevenly between the agency, the utilities, and the public.

Across conference agendas, petitions, and pamphlets, the broad consensus reached by a medley of

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**82** U.S. Dept of Interior, *Conference on Pollution of Lake Michigan*, 200.

**83** Alice Buck, "The Atomic Energy Commission," U.S. Department of Energy, July 1983.

**84** Davis, *Citizen's Guide*, 627.

**85** Kehoe, *Cleaning Up the Great Lakes*, 156.

**86** Buck, "Atomic Energy Commission," 11.

**87** Buck, "Atomic Energy Commission," 5.

**88** Jurewitz, "U.S. Nuclear Power Industry," 220.

**89** U.S. Department of Energy, Office of Scientific and Technical Information, "Theoretical Possibilities and Consequences of Major Accidents in Large Nuclear Power Plants," WASH-740 (AEC), March 1957.

environmental activists in 1970 was to make demands for further research and risk assessment before plants were issued construction permits. The problem arose that the agency in charge of issuing permits, the AEC, denied responsibility for the regulation of thermal pollution and most other environmental concerns.[90] The AEC maintained that the scope of their regulatory power was radioactive exposure to human populations. Without pressure from the main regulatory body of the industry, power companies had little incentive to front the costs of environmental assessments, and thus advocacy groups were left to hire costly private research specialists or find another pressure point which may lead to environmental concessions.[91]

A strategy of grassroots organizing had recent precedent. That same spring of 1970, a slew of local environmental groups joined with the Sierra Club to contest arrangements made by the Consumers Power Company for a nuclear station in South Haven, Michigan.[92] The patchwork of organizers collected over 35,000 signatures over the issue of thermal pollution, tying up Consumers Power in an expensive year of construction delays. In the early months of 1971, representatives from the company announced they would be investing in a $15 million cooling tower to process the heated water before discharging it back into the lake, amongst other waste management concerns.[93] Copies of the settlement circulated widely, landing in the hands of several utility companies along Lake Michigan. Detroit Edison subsequently spent $20 million on two cooling towers at their Fermi plant. Utility companies weighed the costs of legal battles with citizen groups and the EPA against the higher investment costs of cooling equipment, and in turn, anchored environmentalists with newfound political capital.

The following year of 1971 complicated matters further for utility companies and the AEC. A group of biologists from Johns Hopkins University discovered significant threats to the Chesapeake blue crab population posed by the prospect of thermal pollution from a power plant under construction. *Calvert Cliffs' Coordinating Committee v. the AEC* was decided in a D.C. circuit court in favor of the longevity of the blue crab, invoking the recently established National Environmental Policy Act of 1970 (NEPA) and requiring all nuclear power plants deliver an environmental impact report in order to qualify for a construction permit.[94] The fallout from *Calvert Cliffs* was painful for utility companies who had hoped to see near-term returns on their investment. Environmental impact reports necessitated a close analysis of a plant's value chain, including all various inputs and outputs, upstream and downstream, from its daily operation. Moreover, the court's decision to invoke NEPA applied both retroactively and prospectively, insisting that assessments be completed for plants already operational and delaying the construction timeline of those breaking ground.[95]

Under new judicial pressure, the AEC's Directorate of Licensing released its draft environmental statement from 1972 for Zion Nuclear Power Station. They described the local wildlife as that common to lowland marshes, including old black oaks, prickly pear cactus, and the rare pink orchid. They noted that during the spring, the inshore waters are rich with nutrients and plankton, important to the biological productivity of the lake.[96] With attention to thermal effects, regulators

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**90** Kehoe, *Cleaning Up the Great Lakes*, 159.

**91** Steve Ebbin and Raphael Kasper, *Citizen Groups and the Nuclear Power Controversy: Uses of Scientific and Technological Information* (Cambridge, Mass.: MIT Press, 1974): 139-41.

**92** Frances Gendlin, "The Palisades Protest: A Pattern of Citizen Intervention," *Bulletin of the Atomic Scientists* 27 (November 1971): 53-55.

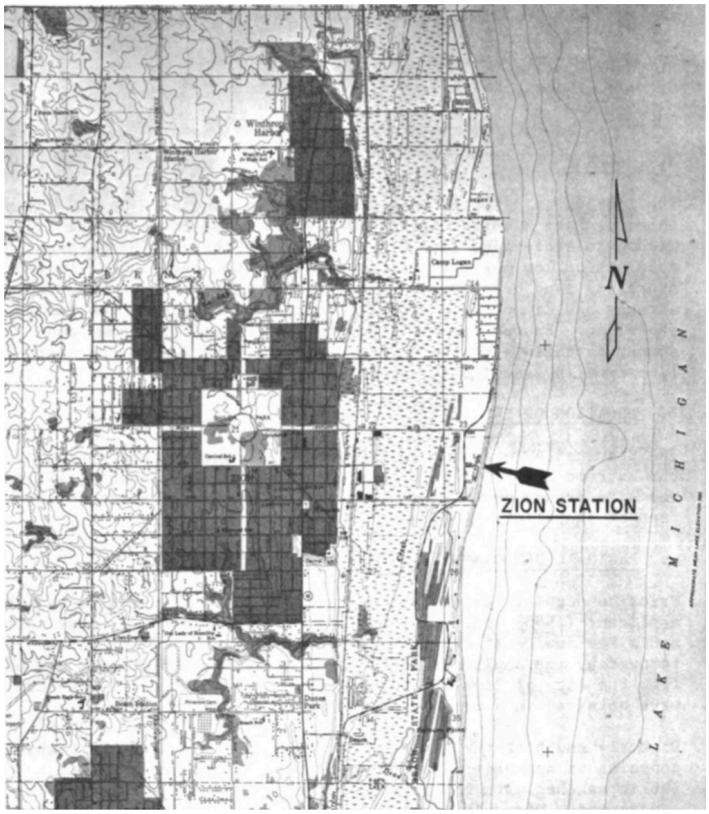
**93** Ebbin and Kasper, *Citizen Groups and the Nuclear Power Controversy*, 145.

**94** James Bieber, "Calvert Cliffs' Coordinating Committee v. AEC: The AEC Learns the True Meaning of the National Environmental Policy Act of 1969," *Environmental Law* 3, No. 2 (Portland, Ore.: Lewis & Clark Law School, 1973): 316-33.

**95** Calvert Cliffs' Coord. Com. V. Atomic Energy Commission, 449 F.2d 1109 (D.C. Cir. 1971).

**96** "Draft Environmental Statement," Directorate of Licensing for the Zion Nuclear Power Station Units 1 & 2 of the Commonwealth Edison Company Nos. 50-295, U.S. Atomic Energy Commission, June 1972.

concluded that the plant carried the potential to heat local waters with 15 billion BTUs per hour, but that Zion had the fortuitous coincidence of finding itself in a "sterile zone," where fish prefer not to hatch their eggs thanks to raucous currents. The main concern for the future operation of the plant would be trace elements of radioactive waste, due to the unsolved issue that "during reactor operation, small amounts of radioactive fission products leak from the fuel rods in the reactor cooling water."[97] The regulators projected very low probability of radioactive pollution and found less cause for concern over thermal waste, concluding the statement by issuing Commonwealth Edison further construction permits. Zion became operational in 1973, following the acceptance of its final environmental impact review.



"Zion Station and Environs," AEC 1972 [6]

Dubbed the Magna Carta for environmental reviews, the purpose statement of the National Environmental Policy Act (NEPA) reads: "to declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man."[98] The economic prosperity of the decade before NEPA's passing had many implications for "the welfare of man," with prosperous housing, home appliances, chemical, and industrial market activity. Plastic was mass-produced for the first time, more households owned motor vehicles, and the median family income grew by double digit percentages.[99] The Act spelled out the challenge of the next decade, to strike a "harmony between man and his environment" while maintaining his newly elevated level of welfare. Utility companies and activists like Lee Botts were answering the same call, with different stakeholders in mind.

The Open Lands Project hosted its own four-state conference during the contentious spring of 1970, putting its $40,000 annual operating funds towards a collection of speakers and their diverse perspectives on a range of issues.[100] Held by the Zion site in Illinois State Beach Park, the OLP conference centered the nuclear power debate, inclusive of industry advocates. The superintendent overseeing the soon-to-be Zion station, Jack Bitel, spoke on behalf of nuclear entrepreneurship, remarking that over the next nine years Commonwealth Edison would have to double the amount of electricity it currently provides to meet forecasted demand. James Hughes, an executive at ComEd's Waukegan plant and known adversary of Lee Botts, argued that "there doesn't appear to be any other answer to the problem of providing electricity than nuclear power… in order to produce the same amount of electricity produced in the Zion plant on a daily basis it would take 210 carloads of coal. That works out to about nine million tons of coal per year as compared with 110 tons of fuel needed

**97** "Draft Environmental Statement," AEC, V-5.

**98** National Environmental Policy Act (NEPA), 42 U.S.C. 4321 (1970).

**99** "Income of Families and Persons in the United States: 1960," *United States Census Bureau*, January 17, 1962.

**100** Ron Yates, "Open Lands Project Announces New Role," *Chicago Tribune* (Chicago, IL) May 14, 1970.


No way to quickly convert to nuclear power

M C. WERTZ
l Press Writer
. (AP)—Nuclear

"There is just no way in my mind to start today and have a

he termed "an environmental panic," caused construction de-

wholesale series of interventions. Various organizations

process as established by the Atomic Energy Act, with public

ation based in Chicago, dis- agreed that there had been any

legitimate question

Dixon Evening Telegraph, January 1974 [7]

to run the Zion reactor cores."[101] Upon completion in 1973, the Zion plant would be Edison's largest nuclear plant and, at a capacity of 2.2 million kilowatts, among the largest in the world. Excitement over the prospect of the Zion plant was tempered by the voice of environmental advocates, determined that the industry coming to replace coal would not land them with another pattern of ubiquitous and poisonous fallout down the road.

The events of 1970 and 1971 rendered the licensing process more complex and expensive for utility executives and had begun to shed certain doubt on the viability of investments into the nuclear enterprise.[102] Yet in Washington, D.C., there was little option for nuclear slowdowns in the eyes of the Nixon Administration, grappling with rising foreign oil prices and the inimical 1973 embargo on U.S. petroleum imports. In a special message to Congress on the energy crisis, President Nixon cast his vision for Project Independence, a series of legislative initiatives to achieve self-sufficiency in energy by 1980. Addressing the ongoing delays in the energy industry, particularly with regards to nuclear plant construction, Nixon remarked that the "Federal Government must be a catalyst for industrial initiative. It must clear away the red tape that lies in the way of expanding our supplies."[103] In 1973, his administration estimated that Americans had consumed 18 million barrels of petroleum a day, but domestic production was capped at 11 million. If the trend continued, Nixon feared that half of U.S. oil consumption would depend on imports by 1980.[104]

A central aim of the administration's agenda for energy independence was to "accelerate the licensing and construction of nuclear facilities and streamline the site selection process for energy facilities."[105] Towards that end, the administration divided and replaced the AEC with the Energy Research & Development Association (ERDA) for the purpose of producing and scaling nuclear power and established the Nuclear Regulatory Commission (NRC) for the licensing and governance of nuclear plants. These two agencies would carry out the AEC's dual mandate of promotion and regulation simultaneously, rather than waiting to act in sequence. At the time, the process of planning, licensing, and building a nuclear reactor was a 9- to 10-year endeavor. With Project Independence, Nixon hoped to slash that cycle down to 5 to 6 years, specifying an ambitious target of 1,000 nuclear plants by the year 2000.[106]

Back in Illinois, Commonwealth Edison's frustrated vice president Bryan Lee wrote in the local Dixon Evening Telegraph that "nuclear power probably won't be much help in meeting President Nixon's goal of making the nation self-sufficient in energy by 1980." The executive spotlighted "an environmental panic," "a wholesale series of interventions," and a "duplication of reviews."[107] Converting to a nuclear grid required longer planning horizons than anticipated, causing some utility companies to jump ship and build a coal-fired plant instead. The paper gave Botts space to respond, in which she defended the rigor of environmental reviews. She concluded that "the public, not utilities, must weigh the need for more power against the impact on the environment." Another newspaper in St. Joseph, Michigan interviewed Botts in

**101** Ron Yates, "Open Lands Project Announces New Role," 1.

**102** Linda Cohen, "Innovation and Atomic Energy: Nuclear Power Regulation, 1966-Present" *Law and Contemporary Problems* 43, No. 1, 1979, 67-72.

**103** Richard Nixon, "Public Papers of the Presidents of the United States: Richard Nixon, 1974," Office of the Federal Register, National Archives and Records Service (Washington, DC: 1975), 14.

**104** Nixon, "Public Papers," 23.

**105** Nixon, "Public Papers," 18.

**106** Nixon, "Public Papers," 26.

**107** William C. Wertz, "No way to quickly convert to nuclear power," *Dixon Evening Telegraph* (Dixon, IL) January 4, 1974.

response to the national soul-searching on nuclear power. Described as a "peppery little Chicagoan," despite her command of two multi-state organizations, the paper quoted Botts' concerns about the federal government's treatment of nuclear energy as an emergency industry, noting that waste disposal problems remained unsolved.[108] Botts replied, "the time to raise questions and get the answers is now, when there are a handful of plants, not the year 2000 when hundreds are operating."

Uncertainty, rather than renunciation or conspiracy, formed the central current of the interventions led by Botts, the LMF, and its network of environmental advocates. With a presidential administration hoping to obviate the red tape around nuclear power licensing, the organization which she represented and its stakeholders requested more time and calculation. Where consulted science pointed in one direction, another accredited expert would often speak to the adverse. An article from 1970 titled "Nuclear Power Plants' Effects Are Still Uncertain" details a dispute in Bridgman, Michigan, an upper middle-class suburb where homeowners had initiated a suit against Indiana Michigan Power to halt the development of the Donald C. Cook plant on the lake's shoreline.[109] The power company responded by contracting researchers from the University of Michigan's engineering department to conduct an extensive, five-year investigation into the local climatic impact of the power plant's thermal discharge. A network of twelve meteorological stations were positioned around the Cook plant and neighboring Palisades reactors, collecting data on wind speeds, precipitation logs, dune erosion, water temperature, and fog levels two years before and two years after operation would begin.[110]

To the study, which I&M claimed, "will constitute a major contribution to the existing body of scientific knowledge in this field," Dr. C. G. Enke, an Associate Professor of Chemistry at Michigan State University, rebuked as "the absolute minimum concern for the environment that will allow them to continue their plant

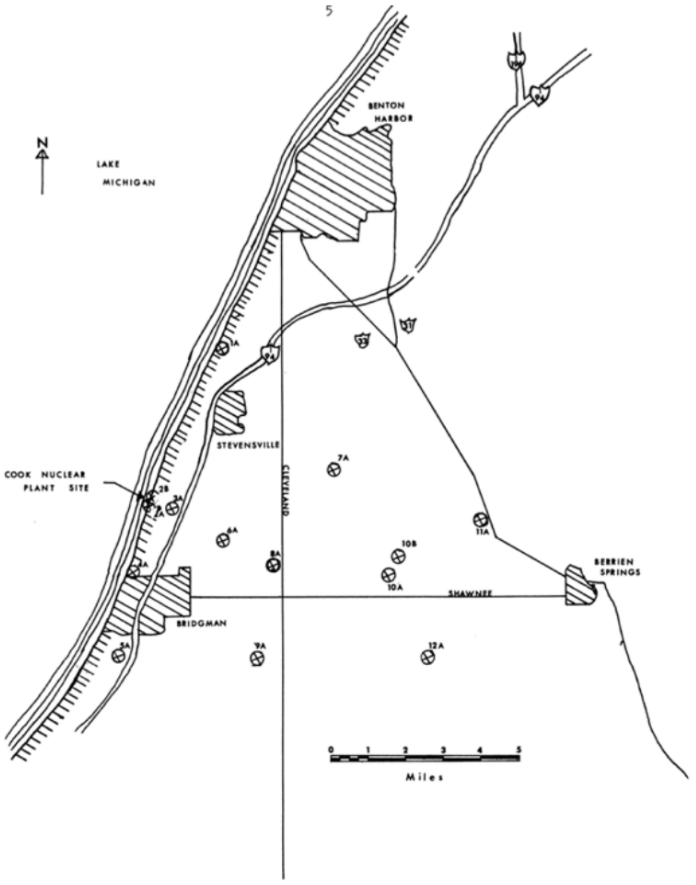


Figure 1. Locations of network stations

"Locations of network stations" from DRDA Project 320157, University of Michigan, 1974 [8]

construction."[111] Enke argued that the thermal pollution could potentially choke the lake with "huge algae farms" in the distant future. He further noted that the study would not be complete until after the plant had been put online, and as such, "the environmental effects of the operation of this plant as planned is a huge experiment to be carried at the public's risk and expense."[112] Enke called for government regulators to establish controls which would operate as preventative measures, rather than a remedy down the road.

The ever-present voice on thermal pollution, Botts chimed in: "in spite of the serious dispute about the consequences, only the public so far has questioned

**108** Brandon Brown, "Nuclear Plant Critic Wants Bigger Say," *The Herald-Press* (Saint Joseph, MI) September 21, 1973, 4.

**109** "Nuclear Power Plants' Effects Are Uncertain," *The Herald-Palladium* (Benton Harbor, MI) Mar. 31, 1970, 10.

**110** Dennis G. Baker and Edward Ryznar, "An investigation of the meteorological impact of a once-through cooling system at the Donald C. Cook nuclear plant," University of Michigan, June 1974: 1-67.

**111** Herald-Palladium, "Nuclear Power Plants' Effects Are Uncertain," 10.

**112** Herald-Palladium, "Nuclear Power Plants' Effects Are Uncertain," 10.

whether the lake can survive its function as a cooling pond, when it is already dying of its burden of municipal sewage, agricultural fertilizers, and industrial wastes." Her statement crystallizes the larger role which she and her allies played. Without the upward pressure of local intervenors raising the question of thermal pollution, the studies and statements which worked to provide an answer may not have taken place. Botts and the organization of environmental advocates around her formed the key spokespeople of the Lake, widening the scope of risk assessment to include ecological concerns. From 1970 to 1974, the deliberations over nuclear power programs along Lake Michigan deliver historical evidence that the environmental movement, newly empowered with political might, was attempting to establish a long-term public responsibility for the lake's natural resources.

In a conversation which centered on the existential risks of energy crisis, a decade-long convention of citizen intervenors, utility executives, and the AEC debated whether this responsibility would take the shape of experimental innovation or more careful behavior towards an already stressed environment. The people engaged in these local debates over Zion and its cousin stations, crossing swords on newspaper pages and in conference halls, are representative of a larger picture of scientific politics, which had the effect of increasingly isolating citizen groups against government and industry. Even so, industry agents like Bryan Lee asserted that regulatory agencies bent a knee to uninformed public skepticism and put in place restrictive environmental standards, raising costs and creating delays. This work will continue to revisit the validity of that claim, in an effort to rehabilitate episodes of participatory decision-making in the history of nuclear power and understand how we have historically introduced high technology in the public sphere as a panacea to environmental crisis.

# 3. IF YOU'RE EXPLAINING YOU'RE LOSING

## *Citizen Intervention, Long-Term Waste Disposal, & the Burden of Proof*

> *The trouble concerns the fact that the "truths" of the modern scientific world view, though they can be demonstrated in mathematical formulas and proved technologically, will no longer lend themselves to normal expression in speech and thought … It could be that we, who are earth-bound creatures and have begun to act as though we were dwellers of the universe, will forever be unable to understand, that is, to think and speak about the things which nevertheless we are able to do.*
>
> *— Hannah Arendt, The Human Condition, 1958*

THE DEBATES OVER THERMAL pollution in the early years of the 1970s fixated on one disconcerting but localized waste product of nuclear programs. These interventions invited new levels of foresight and intergenerational advocacy on behalf of human and natural populations in Lake Michigan's basin. Thermal pollution also, evidently, existed at the surface of a troubling well of waste disposal challenges in the nuclear industry, including the murkier issue of long-term hazardous waste storage. Public hearings in the Great Lakes states invited commentary on radioactive waste products, but administrative and utility representatives were less responsive to conjectures made by citizen groups about the possible dangers of radioisotopes in their communities. Thermal pollution appeared a more manageable hurdle in the short run.

The question of long-term radioactive waste disposal remained open-ended in the 1970s but was not lost from the public eye. In the opening sequence to her 1961 re-edition of *The Sea Around Us*, on the origins and

science of the world's oceans, Rachel Carson expressed certain fear over the fate of the seabed and deep marine life due to the dumping of high-level radioactive waste from nuclear testing schemes:

> *In unlocking the secrets of the atom, modern man has found himself confronted with a frightening problem – what to do with the most dangerous materials that have ever existed in all the earth's history, the by-products of atomic fission. The stark problem that faces him is whether he can dispose of these lethal substances without rendering the earth inhabitable… by its very vastness and its seeming remoteness, the sea has invited the attention of those who have the problem of disposal.*[113]

Licensed by the AEC, administrators in the U.S. had disposed of more than 85,000 concrete-wrapped containers of hazardous waste into the sea between 1946 and 1970, totaling an estimated 94,673 curies.[114] Radioactive waste disposal in bodies of water ceased in 1970, but the Ocean Dumping Act of 1974 brought the issue back to public concern. The act, among other legislative initiatives and hearings, planned to deal with the poisonous byproducts of a nuclear energy industry attempting to rapidly scale by the end of the decade. While presidents and energy economists chafed against the specter of energy insecurity—a problem of inputs—environmentalists had become more insightful towards the outputs of nuclear power generation. In the limitable sphere of the spaceship Earth, the problem of disposal is laid bare. Already deterred by the time-consuming scrutiny of *Calvert Cliffs* and environmental impact reviews, various stakeholders in Nixon's Project Independence attempted to navigate the daunting problem of hazardous disposal, as they simultaneously planned to accelerate the commercial development of nuclear power plants.

Proponents of Project Independence and energy entrepreneurs hoped to see 200 nuclear plants sited and constructed by the year 1980.[115] In February of 1974, one month after Nixon spoke in front of Congress to set in motion his goals for self-sufficiency, the Joint Committee on Atomic Energy held a Congressional hearing to assess "the state of the nuclear industry."[116] Towards the goal of reducing plant construction to six years, Senator Chet Holifield from California, a staunch proponent of nuclear energy, shared his sobering opinion:

> *The facts and the prospects do not justify that kind of optimism. Technologies do not advance that quickly, materials are not that readily available, investment funds are not that readily forthcoming… I surmise that the year 2000 is a more realistic goal for Project Independence than 1980… the oil embargo has found a nation unprepared.*[117]

Holifield expressed his disappointment at the delays and interventions which had made nuclear commissions more costly, of both dollars and time. The Chairman of the Joint Committee, Melvin Price, remarked that "it is time to collect enough resources and 'doers' in Government and industry to permit us to move to the 'action stage' and leave the 'study stage' behind us."[118] To expeditiously move plants along the construction timeline, the Joint Committee surmised that great cooperation of all parties – including the general public – and a recognition of 'national purpose'

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**113** Rachel Carson, *The Sea Around Us* (Oxford: Oxford University Press, 1951), xi.

**114** U.S. Congress, Senate, Joint Committee on Atomic Energy, *Assessing the Policies, Plans, and Programs of the Executive Branch for the Safe Storage and Disposal of Radioactive Wastes Produced in the Commercial Nuclear Fuel Cycle*, 94th, 1st sess. (November, 1975),49. "Curies" are a unit of measurement that denotes the intensity of radioactivity in a substance. For reference, between 1 and 6 million curies of just the radioactive element cesium-137 were released from the Chernobyl reactor in 1986 (at least 50 million were released in total). See: Kate Brown, *Manual for Survival: A Chernobyl Guide to the Future* (Boston: W.W. Norton & Co, 2019) for more on relative curie amounts.

**115** Nixon, "Public Papers," 23.

**116** U.S. Congress, Senate, Joint Committee on Atomic Energy, *Developments in the Energy Industry in General and the Nuclear Power Industry in Particular*, 93rd, 2nd sess. (Feb. 1974), 259-486.

**117** U.S. Congress, *Developments in the Energy Industry*, 367.

**118** U.S. Congress, *Developments in the Energy Industry*, 481.

would be required to realize the next stage of the nuclear era. Other speakers at the hearing cast doubt that such a level of cooperation would indeed be possible. The Atomic Industrial Forum (AIF), an industrial policy organization, had been requested to survey utility sponsors in order to identify the most effective ways to provide governmental assistance for their operations. The AIF questionnaire was enlightening on several key issues. Thirty-seven operators from 95 nuclear plants agreed that the impact of the *Calvert Cliffs* decision had "by far been the largest single cause" of delays due to changes in licensing and regulatory standards.[119] It totaled 113.9 plant-months of decay.[120] In total, 51% of all delays were because of licensing.

Other delay factors included late delivery of component parts and labor shortages, but utility operators uniformly agreed that every factor compounded another, resembling a cascade. If a plant was tangled up in a protracted licensing process, then they would have to divert their technical personnel to prepare environmental statements and field questions from the public at AEC hearings, thus creating a "loss of manpower" problem. One respondent claimed that his plant endured a six-month delay with technical personnel diverted to answer more than 1,000 questions at licensing hearings. When asked what would be most effective at speeding up completion, respondents most frequently selected "eliminate the public hearing at the operating license stage."[121] The "cooperation of all parties involved" necessary to meet the "action-stage" of the nuclear operation would be most expeditious with the exclusion of one large body of stakeholders: the public.

Following suit, the Joint Committee held another hearing the very next month in March of 1974 to reevaluate their licensing process. For several days, members of Congress debated the extent to which everyday citizens should be given a platform in the process of putting a nuclear plant online.[122] Speaking for the environmental NGO Friends of the Earth, Anthony Z. Roisman argued that the entire process could be made

**Table 3** Details on delays due to changes imposed by modifications in licensing and regulatory requirements

| Delay factor | No. of plants delayed | Maximum months of delay* | Average months of delay* | Total plant-months of delay |
|---|---|---|---|---|
| **Safety** | | | | |
| Pipe break outside containment | 16 | 9 | 2.6 | 40.9 |
| Other | 8 | 3 | 3.0 | 23.9 |
| Design and performance of ECCS | 10 | 6 | 2.4 | 23.0 |
| Containment and effluent release | 5 | 6 | 4.6 | 22.8 |
| Problems related to fuel densification | 0 | 0 | 0 | 0 |
| **Environmental** | | | | |
| Other (including impact of Calvert Cliffs court decision) | 11 | 16 | 10.4 | 113.9 |
| Off-site exposures and releases | 12 | 9 | 2.8 | 33.9 |
| Differences between AEC, EPA and state limits | 4 | 1 | 1.0 | 4.0 |
| On-site exposures and releases | 3 | 1 | 0.7 | 2.2 |

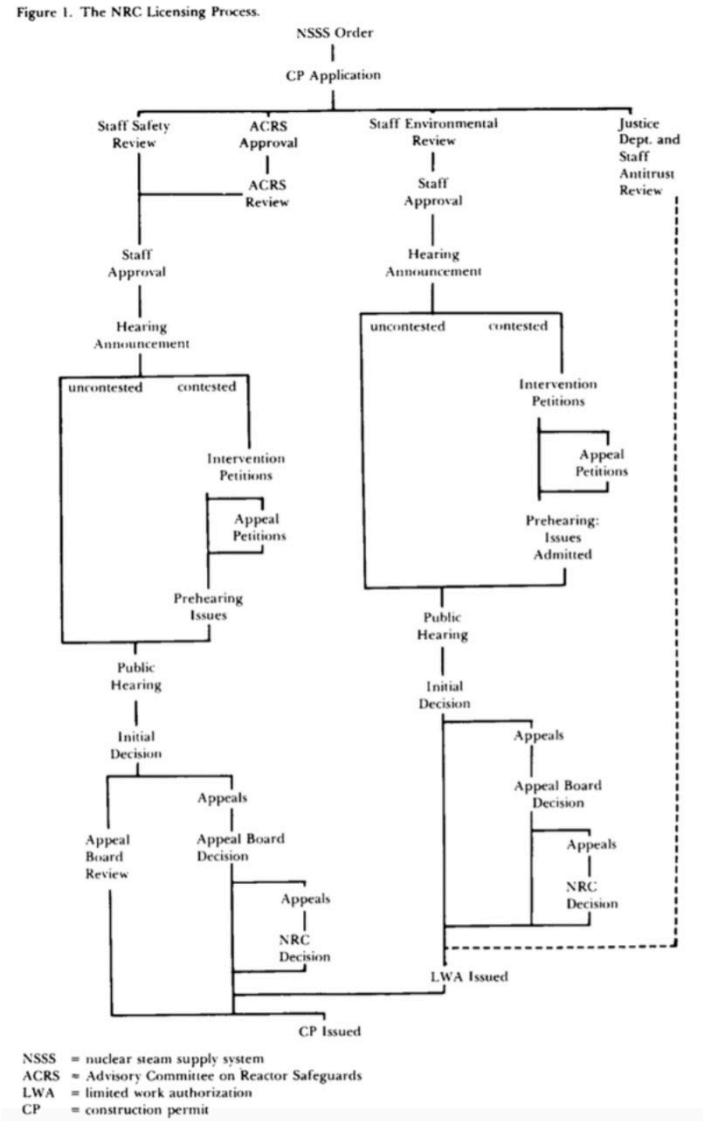
"Details on delays due to changes imposed by modifications in licensing and regulatory requirements," *AIF* 1974 [9]

**119** U.S. Congress, *Developments in the Energy Industry*, 459.

**120** A "plant-month" is a unit of time used to measure construction delay. It is equal to the average delay multiplied by the number of plants affected.

**121** U.S. Congress, *Developments in the Energy Industry*, 459.

**122** U.S. Congress, Joint Committee on Atomic Energy, *Overview of Nuclear Powerplant Siting and Licensing*




Linda Cohen, "The NRC Licensing Process," *Law and Contemporary Problems*, 1979 [10]

more expeditious if the public intervenor were given funds, in which case environmental advocacy groups would be enabled to hire and consult experts, accumulate information, and pinpoint the right questions to ask at public hearings.[123] Roisman claimed that, at present, citizen groups felt isolated from and disadvantaged by the level of technical knowledge which other stakeholders could lay claim to. He remarked that the present system, "although giving lip service to public participation in licensing proceedings," did little to provide private citizens with the adequate means to participate. "I ask you gentleman to put yourselves in the place of the public intervenor who wishes to have a point made and lacks the funds to hire the technical experts they know exist who would make that point… They are left with little alternative but to use the device of the extensive, and I conceive often not particularly valuable, cross-examination."[124] Confronted with the challenging and unfamiliar language of a highly technical power source, intervenors had managed to significantly clog licensing hearings with an endless array of questions. Those arguing in favor of public financing for advocacy groups hoped that they would source their own technical personnel to pose and answer more specific questions, rather than diverting the manpower of utility companies. Where administrators neglected to consider the environment upon which reactors would be built, intervenors felt they shouldered the burden of proof.[125]

In the same year of 1974, a study funded by the National Science Foundation and supported by the Massachusetts Institute of Technology consulted various players in the nuclear power controversy to understand why the industry had become so polarized between industry leaders and grassroots organizers.[126] Looking at AEC licensures on a case-by-case basis, they concluded that the hearings were "an adversarial process which is essentially hostile to the goal of arriving at scientific truth," wherein the "weight of influence, talent, money, power, policy, and decision-making lies with government and industry" and as a result citizen groups are limited "to raising questions about matters concerning which they possess little knowledge or expertise."[127] As evidenced by the demands made by Lee Botts and her constituents in the LMF on the issue of thermal pollution, citizens and environmentalists of the Great Lakes ecosystem felt left in the dark by the construction of a power industry, proving itself agnostic to environmental concerns.

Senator Holifield found the opposite to be the

*Process*, 93rd, 2nd Sess. (March, 1974), 1-95.

**123** U.S. Congress, *Overview of Siting and Licensing Process*, 73.

**124** U.S. Congress, *Overview of Siting and Licensing Process*, 79.

**125** Kehoe, *Cleaning Up the Great Lakes*, 152.

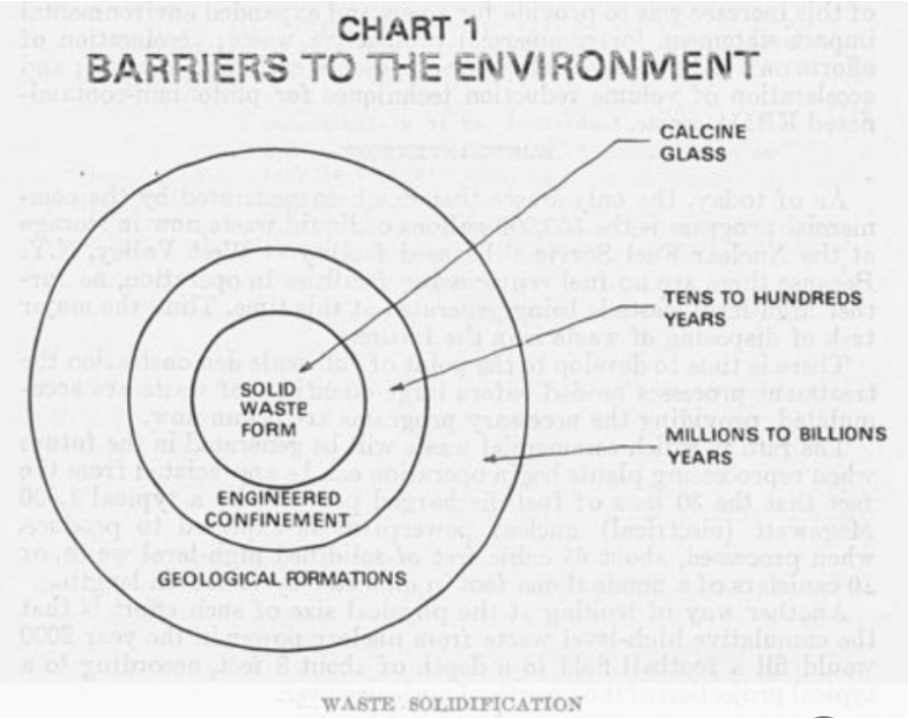
**126** Ebbin and Kasper, *Citizen Groups and the Nuclear Power Controversy*, 1-32.

**127** Ebbin and Kasper, *Citizen Groups and the Nuclear Power Controversy*, 2.

case. "If you subsidize intervenors in administrative proceedings, you are creating incentives for a new breed of harassment experts," he remarked.[128] To leave the "study stage" behind and more effectively meet the needs of an embargoed nation, the "public" nature of public hearings was harshly reexamined. In the same breath, the Joint Committee, ERDA, and NRC were experimenting in the mid-1970s with both technology and politics to address the complex problem of where to put radioactive waste. Citizen intervenors felt that the problem of waste disposal, certain to involve vessels of earth as storage basins, was due justification for their increased presence and requests for funds.

With Congress contemplating near-term goals of nuclear power 'scale-up,' the distant future began to enter the frame. Not unlike the estimation that Lake Michigan would provide an adequate sink for increased thermal pollution, the ERDA proposed other bodies of lake, land, and ocean as candidates for the storage and disposal of long-term radioactive waste. At the time, there were six main types of commercial fuel cycle wastes from Light-Water Reactors, the most common type of facility built in the 20th century. These included spent fuel removed directly from the reactor, high-level waste from the fission reaction, general waste from the plant which had been contaminated above a threshold of radioactive content (called "transuranic waste"), and non-nuclear 'secondary' waste, such as storage containers, decaying from the substances they enclosed.[129] By 1975, the ERDA had begun to examine places on Earth's surface—and below it—which could feasibly hold these waste products until the year 2000, and ideally, time immemorial.

Among consideration were underground salt beds in New Mexico, arctic ice sheets, extraterrestrial disposal in outer space, and injections beneath deep-sea beds.[130] In 1974, the ERDA released construction plans for nuclear waste disposal (coinciding with the passage of the Ocean Dumping Act), but quickly withdrew these plans from the public after a deluge of environmental concerns. Speaking on behalf of the ERDA, Frank Baranowski summarized that "the effective management of nuclear wastes in a manner which effectively protects man and his environment still has major unsolved problems."[131] He estimated that the nation's nuclear industry could be expected to produce 3 million gallons of high-level waste by the year 2000, enough to "fill a football field to a depth of about 8 feet" and if the necessary technologies were developed soon, they could begin processing a 5-yard section of that field annually.[132] Baranowski hoped that waste disposal could enter a 'scale-up' stage in the next decade, commercializing storage technology across the industry. But the main challenge remained that no one had yet answered how to safely and permanently isolate high-level waste from humans and




"Chart 1: Barriers to the Environment," *ERDA* 1975, pg. 210 [11]

**128** U.S. Congress, *Developments in the Energy Industry*, 486.
**129** U.S. Congress, *The Safe Storage and Disposal of Radioactive Wastes*, 8-9.
**130** U.S. Congress, *The Safe Storage and Disposal of Radioactive Wastes*, 10-13.
**131** U.S. Congress, *The Safe Storage and Disposal of Radioactive Wastes*, 18.
**132** U.S. Congress, *The Safe Storage and Disposal of Radioactive Wastes*, 13.

the environments upon which they depended.

The ERDA was developing storage strategies that would sustain solid radioactive waste for at least the next quarter-century, until the year 2000. Drilling into deep geologic formations like salt and seabeds promised vaguer notions of perennial storage, as indicated by the "millions to billions" label on organization's design of a multi-barrier protection system. Most pressing, however, was the issue of "interim storage," as spent fuel had been presently accumulating in water basins at reactor sites, with scarce plans to move and dispose of the hazardous waste when the storage tanks on-site would inevitably fill to capacity. Representatives from the EPA decried that nuclear power came with a "hidden commitment," one which investors and administrators refused to confront head-on, which was the ongoing expense of waste management.[133] Manipulating, transporting, and monitoring hazardous waste required a flow, not a stock, of invested capital from both industry and government. At the 1975 hearing, Dr. William D. Rowe of the EPA estimated that it could total over $7 billion to develop the needed technologies by the year 2000 and expressed worry over the "possibility that an interim engineered storage system may become permanent solely due to economic costs."[134] While nuclear energy could surmount natural limits on man's production of energy, it could not escape another fundamental problem of nature: that of planetary sinks.[135]

The issue of waste disposal quickly made headlines in the Great Lakes region. The Governor of Michigan's Task Force on Nuclear Waste Disposal had proposed a dumping site in salt beds near the city of Alpena, Michigan. In testimonies before the task force staff, members of the public – including Michigan's Attorney General Frank Kelley – worried about the risks posed to Lake Huron and groundwater aquifers if the salt beds were to have leakage problems.[136] With the ERDA planning to formally select its dump sites in the following year of 1978, public officials in Michigan had been rapidly reviewing bill proposals to block the Alpena dump.

Across the state border in Illinois, groups of environmentalists and concerned residents raised their alarm at another waste proposal from the Zion Power Station. Commonwealth Edison was grazing against the capacity of their pool for spent fuel, and thus made formal requests to the NRC to expand the pool for sixteen times more containment.[137] The requests were evocative of the EPA's anxieties that hastily constructed interim storage would be turned into more permanent repositories of nuclear waste. In June of 1979, in the ballroom of a Holiday Inn, a heated back-and-forth was exchanged between a commissioner of the NRC and Catherine Quigg, the Research Director of a citizens' environmental group based in Palatine, IL. Similar to the leakage concerns held by Michiganders in Alpena, Quigg testified to the probability of a "loss of water" accident from the pool, arguing that it could contaminate over 150,000 square miles of land and lakewater.[138] Quigg was followed by a series of concerned citizens, mostly women and local homeowners, collectively aggrieved that "the waste element, in particular, suffers from inadequate attention and cannot be ignored any longer."[139] "They expressed anxieties that Zion lies in a tornado belt and in the flight path to Waukegan airport (what if a plane went down?) along with the possibility of sabotage or war. Every speech was met with audience applause. One citizen proclaimed, "I don't want any more waste now nor next year, nor do my children want to be stuck with it," frustrated with

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**133** U.S. Congress, *The Safe Storage and Disposal of Radioactive Wastes*, 37-40.

**134** U.S. Congress, *The Safe Storage and Disposal of Radioactive Wastes*, 41.

**135** Albritton Jonsson, Wennerlind, *Scarcity: Economy and Nature in the Age of Capitalism*.

**136** Combined Wire Services, "Kelley says dumping nuclear waste near Alpena could contaminate big cities," *Battle Creek Enquirer* (Battle Creek, MI) March 16, 1977.

**137** Nuclear Regulatory Commission, "On the Matter of the Zion Station, Units 1 and 2: Spent Fuel Pool Expansion," June 1979, 493-514.

**138** NRC, "Spent Fuel Pool Expansion," 493.

**139** NRC, "Spent Fuel Pool Expansion," 505.

the perceived irresponsible hope "that sometime in the future someone will take care of it and pay for it."[140]

Almost a decade after the debate in Neenah, Wisconsin over the environmental merits of nuclear power, the problem of managing man's outputs from the atom remained unsolved. Vance Van Lannen, the advocate from the Wisconsin Ecological Society, had cautioned with the philosophy that nuclear energy should be approached "not according to how much waste the environment can hold, but according to how much can be kept out." The industry was trending towards the former.

# 4. CONCLUSION

THE ZION PLANT SOUGHT to expand its temporary waste storage six years after its license had been approved and put online. Today, the shuttered reactors have undergone a decade-long process of slow deconstruction. Public officials are still debating the problem of a long-term disposal site for the remaining radioactive waste from the Zion plant—that spent fuel remains in Illinois State Beach Park.[141] The Zion reactors were taken offline for financial reasons, mainly high operating costs, not for risks posed to environmental or human safety. In effect, the nearer-term challenge of 'input,' how to safely generate nuclear power for the electric grid, has been a successful project in Illinois and other areas of the country. But the more distant problem of 'output,' the waste products of reactor activity, has continued to meet with sparse financial and political appetite.

The public debates over nuclear power in the 1970s present a moment of historical evidence that we are not well-trained to manage problems of environmental consequence in the long-term. The mid-decade 'scale-up stage' and the continued reliance on interim storage basins sheds light on a political myopia which has continued to characterize the fate of nuclear energy. However, in a unique case study of future governance, citizens' environmental groups led by activists like Lee Botts applied a new level of environmental foresight to the challenges of waste disposal posed by nuclear power. In an industrial and federal enterprise which responded to goals of national security, jobs, profit, and livelihood, these networks of grassroots activism added 'environment' to the political calculus, and in doing so, managed to distort and carefully reconsider the parameters of time which the nuclear industry and administrative agencies intended to work with. For an administration thinking most frequently on a scale of 1975 to 2000, environmentalists along the lakeshore hoped that the waters would be clean enough for far-distant future generations of human and animal life. As evidenced by the interventions against thermal pollution and radioactive waste storage, the citizen interventions along Lake Michigan represented a shift in environmental decision-making from retrospect to prospect, from input to output, towards governing the long-term future. ◆

**140** NRC, "Spent Fuel Pool Expansion," 514.

**141** Sheryl Devore, "Spent fuel rods stored in Zion raise safety, economic concerns," *The Chicago Tribune*, October 30 2015, https://www.chicagotribune.com/suburbs/lake-county-news-sun/ct-lns-zion-nuclear-plant-st-1031-20151030-story.html.

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