THE STATUS OF SPENT FUEL STORAGE AT THE SIX NUCLEAR POWER PLANTS LOCATED ON THE SHORES OF LAKE MICHIGAN

by

Jame Schaefer, Chairman
Radioactive Waste Management Study Committee
LAKE MICHIGAN FEDERATION
Board of Directors

May 1979

FOREWORD

On December 9, 1978, the Board of Directors of the Lake Michigan Federation created the Radioactive Waste Management Study Committee to examine the status of spent fuel storage at the six nuclear power plants located on the shores of Lake Michigan -- Big Rock Point, Palisades, Donald C. Cook (Michigan), Zion (Illinois), Point Beach and Kewaunee (Wisconsin). Jane Schaefer (Wisconsin) was asked to chair the Committee and Board members Fay Witz, Tom Murphy, Mal Ross, Mimi Frankel (Illinois), Flo Walsh (Michigan), and Charlotte Read (Indiana) volunteered to participate in the study. After considerable research and cautious deliberations, the Committee reported orally and in writing to the Federation's Board at its April 28, 1979 meeting and recommended the following five resolutions which were unanimously adopted:

I The Lake Michigan Federation should encourage the United States Department of Energy, Nuclear Regulatory Commission, and appropriate elected officials to seriously attend to the development of a sound radioactive waste management program which would provide for the removal of spent fuel from the nuclear power plants around Lake Michigan.

II The Lake Michigan Federation should call for a moratorium on the construction of additional nuclear power plants along the Lake until the uncertainties pertaining to spent fuel disposition are resolved by a workable federal radioactive waste management plan.

III The Lake Michigan Federation should call for prohibition of transshipment of spent nuclear fuel assemblies from other nuclear facilities to nuclear power plants along Lake Michigan.

IV The Radioactive Waste Management Study Committee should remain as a special committee of the Federation's Board to watch-dog the status of spent fuel storage at the nuclear plants located on the shores of Lake Michigan.

V The Lake Michigan Federation should participate in the Keystone Center Radioactive Waste Management Discussion Group's proceedings on public participation.

The following documented rationale was prepared by Committee Chairman Jane Schaefer to facilitate the Federation staff's enacting the provisions of new policy statements and explaining them to interested parties. Questions pertaining to the facts presented and documents cited herein should be directed to Mrs. W. W. Schaefer, 3741 Koehler Drive, Sheboygan, Wisconsin 53081 (414/458-9274). The Executive Director of the Lake Michigan Federation, 53 West Jackson Street, Chicago, Illinois 60604 (312/427-5121) should be contacted for comments regarding Federation action on these official positions.

I The Lake Michigan Federation should encourage the United States Department of Energy, Nuclear Regulatory Commission, and appropriate elected officials to seriously attend to the development of a sound radioactive waste management program which would provide for the removal of spent fuel from the nuclear power plants around Lake Michigan.

Spent fuel is highly radioactive, thermally hot material resulting from the fissioning of uranium fuel in the core of a nuclear reactor. The uranium fuel consists of ceramic pellets of enriched uranium doixide (UO_2) sealed in zirconium alloy tubes approximately 1/2 inch wide by 12 feet long.[1] These fuel rods are bundled together to form assemblies which are subsequently placed in the reactors of nuclear power plants. An assembly of a boiling water reactor (BWR -- e.g., Big Rock Point) contains 49 to 64 fuel rods whereas 196 to 289 rods are grouped together for an assembly of a pressurized water reactor (PWR -- e.g., Donald C. Cook 1 and 2, Palisades, Zion Station 1 and 2, Point Beach 1 and 2, Kewaunee). The average weights of fuel in BWR and PWR assemblies are 0.2 and 0.45 metric tons respectively.[2] After about three years of operation in the reactor, the concentration of fissionable isotopes in the fuel becomes too low while the intensity of the fission products is too high. At this time the fuel is considered inefficient and is removed from the reactor.

Approximately one-third of the assemblies of a PWR nuclear core and one-fourth of those in a BWR are removed annually and new fuel emplaced. "While externally the spent fuel is little changed from new fuel, after irradiation within the fuel rods, some of the UO_2 pellets may have been fractured due to thermal stresses and the composition has changed dramatically. Whereas new fuel is relatively innocuous and can be handled and shipped as a standard commercial product, spent fuel is highly radioactive and produces considerable heat. For these reasons, spent fuel must be cooled and shielded."[3]

Immediately after removal from the reactor at refueling time, the spent fuel assemblies are moved by remote control to a storage pool within the nuclear power plant where the material is immersed in mechanically-controlled circulating coolant water. The spent fuel is placed at the bottom of the storage pool where approximately

---

[1] Draft Environmental Impact Statement on Storage of United States Spent Power Reactor Fuel, United States Department of Energy, DOE/EIS-0015-D, August 1978, II-3, hereafter referred to as DOE Draft EIS.

[2] Draft Generic Environmental Impact Statement on Handling and Storage of Spent Light Water Power Reactor Fuel, United States Nuclear Regulatory Commission, NUREG-0404, March 1978, Volume 1, 2-1, hereafter referred to as NRC Draft Generic EIS.

[3] Ibid., 2-2.

9 feet of water cover the assembly tops, providing the requisite shielding.[4] Impurities in the pool water are removed via filtration and ion exchange treatment.[5] The storage pools of the subject nuclear plants are composed of 3 1/2 to 6 feet thickness of reinforced concrete with stainless steel liners 3/16th of an inch thick.[6] The spent fuel pools range in size from 15,600 cubic feet at Big Rock to 99,528 cubic feet at the Cook plant.[7] The Point Beach and Zion spent fuel storage pools are built into the ground at 6 and 13 feet below grade respectively; the other four facilities' pools are suspended within the plants.[8]

According to the Nuclear Regulatory Commission, the stainless steel liners of the spent fuel storage pools at Zion and Point Beach plants have minor leaks, the locations of which are not precisely known.[9] "At Zion the leak is about 2 gallons per hour and the measured level of the beta gamma activity is in the range of 10^{-3} to 10^{-2} microcuries per cubic centimeter. At Point Beach the leak is extremely small, about 0.002 gallons per hour and has an activity level of about $.75 \times 10^{-5}$ microcuries per cubic centimeter."[10] The leakage that is occurring is collected within the concrete pool or in leak collection channels associated with the stainless steel liner welds, monitored, processed (if appropriate) to remove radioactivity that exceeds permissible levels set by the NRC, and released to Lake Michigan via the low-level radioactive waste circulating water discharge pipes. Radioactive monitoring programs have not detected the occurrence of any leakage into the soil surrounding the plants.[11]

Approximately 460 assemblies of spent fuel weighing altogether about 200 metric tons are discharged annually from the six operating plants located around

---

[4]NRC Draft Generic EIS, Volume 2, B-2.

[5]Ibid., Volume 1, 4-14

[6]Letter from Harold Denton, Director of Office of Nuclear Reactor Regulation, Nuclear Regulatory Commission, to Jame Schaefer, Chairman of Radioactive Waste Management Study Committee, Lake Michigan Federation, April 25, 1979, hereafter referred to as Denton, April 25, 1979.

[7]The dimensions of the six plants' storage pools are indicated in Chart A.

[8]Denton, April 25, 1979.

[9]Ibid.

[10]Letter from Harold Denton to Jame Schaefer, March 8, 1979, hereafter referre to as Denton, March 8, 1979.

[11]Ibid.

Lake Michigan.[12] Each ton of spent fuel contains nearly thirty kilograms of fission products, the radioactive remains of fissioned atoms (e.g., krypton-85, strontium-90, cesium-137, iodine-129) and slightly less than 10 kilograms of transuranic elements (e.g., neptunium-237, plutonium-239, curium-243). The remainder is unburned uranium containing about 0.8 per cent uranium-235.[13]

"The precise composition of [spent fuel] depends on reactor type and length of time the fuel remains in the reactor generating power; longer burnups in the reactor[14] result in higher concentrations of fission products and transuranic elements. The intensity of radioactivity present is very high. Immediately after reactor shutdown, a ton of spent fuel contains about 300 million curies of activity. After about ten years, this level has decayed to about 300 thousand curies. Spent fuel also produces a great deal of heat: one day after reactor shutdown, 30 tons of spent fuel have a heat output of about 10,000 kilowatts; after ten years, this is reduced to about 1 kilowatt per ton."[15] Most of the radioactivity and heat resulting from the waste during the first few hundred years after generation are due to the fission products which have varying periods of half lives[16] ranging from a few hours

---

[12]Chart A delineates the number of assemblies discharged at refueling times per plant.

[13]Nuclear Power Issues and Choices, Ford Foundation/Mitre Corporation, Ballinger Publishing Company, 1977, 246. Isotopic concentration of Uranium-235 in new fuel is slightly over 3 per cent. Environmental Survey of the Reprocessing and Waste Management Portions of LWR Fuel Cycle, USNRC, NUREG-0116, 3-7.

[14]Commonwealth Edison, owner of the Zion plant, recently received approval from the NRC for a higher burnup rate for four assemblies in Unit 2. Letter from A. Schwencer, Chief, Operating Reactors Branch #1, Division of Operating Reactors, NRC to Cordell Reed, Assistant Vice President, Commonwealth Edison Company, Docket Nos. 50-295 and 50-304, March 7, 1979. The utility is now licensed to increase exposure of the four assemblies to 55,000 MWD/MTU; the original specification was 38,000 MWD/MTU. The NRC stated that although there has been no experience with full-size fuel assemblies irradiated to this burnup, there have been tests of single fuel rods to extended burnups of 58,000 MWD/MTU. The NRC concluded that the higher burnup of the four assemblies would have no appreciable environmental impact. Safety Evaluation by the Office of Nuclear Reactor Regulation Supporting Amendment No. 44 to Facility Operating License No. DPR-39 and Amendment No. 41 to Facility Operating License No. DPR-48, Commonwealth Edison Company, Zion Station, Units 1 and 2, Docket Nos. 50-295 and 50-304, NRC. In light of limited data on the potential impact of higher burnups, an Illinois citizens' organization has requested the NRC to prepare a generic environmental impact statement on high burnup fuel in the reactor and in the spent fuel storage pools. Letter to Harold Denton, Director, Office of Nuclear Reactor Regulation, NRC from Catherine Quigg, Research Director, Pollution & Environmental Problems, Box 309, Palatine, Illinois 60067, April 29, 1979.

[15]Nuclear Power Issues and Choices, 246.

[16]A half-life is the amount of time it takes for half of the radioactivity of an element to decay.

to millions of years.[17] More than a hundred different isotopes of fission products are involved. The total activity of the fission products is reduced by a factor of about 10 million approximately 700 years after generation, at which time the dominant source of radioactivity in the spent fuel comes from highly toxic transuranic elements,[18] some of which have half lives of millions of years.[19]

Under normal operating conditions, the only known mechanisms for dispersal of these highly radioactive elements from the spent fuel in underwater storage is through corrosion of defective fuel rods by the pool water.[20] Currently, an estimated 1300 spent fuel assemblies containing approximately 600 metric tons of highly irradiated spent fuel are stored underwater in the six plants' pools.[21] Some of the spent fuel rods in the assemblies are leaking radioactivity at three of the plants: 21 leakers at Big Rock, 18 at Palisades, and 2 at Point Beach.[22] Leakers occasionally originate in the reactor wherein "...fuel cladding develops small cracks or pinholes while at power (on the order of 800° F. temperature at the surface) which tend to close up when removed from the core and stored in the pool..." (where the surface temperature decreases to about 180° F.).[23] According to the NRC's Director of the Office of Nuclear Reactor Regulation, encapsulation of the spent fuel rods that are leaking at the three plants is not being considered at this time[24] to prevent increased dispersal of spent fuel elements into the pool should greater loss of integrity of the leaking rods occur.

Abnormal operating conditions in the spent fuel pools could result in the rupture of the spent fuel rods which would release radionuclides posing hazards to plant workers and to the general public. Potential accidents include fuel assembly drop, penetration of the storage pool by a tornado-generated missile, fire and

---

[17] Half-lives of some of the fission products are: Krypton-85, 10.7 years; strontium-90, 29 years; technicium-99, 210,000 years; iodine-129, 16,000,000 years; iodine-131, 8 days; cesium-137, 30.1 years. NRC Draft Generic EIS, Volume 2, G-10.

[18] Nuclear Power Issues and Choices, 247.

[19] Some of the transuranic elements' half-lives are: Uranium-233, 160,000 years; neptunium-237, 4,100,000 years; plutonium-239, 24,000 years; americium-243, 7,370 years. NRC Draft Generic EIS, Volume 2, G-15.

[20] Ibid., Volume 1, 4-16.

[21] See Chart A for the number of assemblies in storage at each plant.

[22] Denton, March 8, 1979.

[23] Ibid.

[24] Ibid.

explosion, criticality accident (nuclear runaway chain reaction), high pool water activity, waste tank or piping ruptures, lowering of pool water, and loss of cooling.[25] Some of these abnormal conditions (e.g., loss of cooling water and criticality accident) could result from a major "event" at a nuclear power plant rendering the plant operators unable to maintain the vital mechanical systems in the spent fuel pool. A catastrophic rupture of the fuel cladding could cause dispersal of the highly radioactive fuel resulting in contamination of the land around the storage pool and Lake Michigan.[26]

Contamination of the environment could also result from unimpeded leakage of radioactive water and impurities from the spent fuel pool via enlargement of the already existing pinholes in the stainless steel liners of the Zion and Point Beach pools. Ruptures in the reinforced concrete pools could lead to storage pool water contamination of the soil and, quite possibly, the Lake. According to the NRC, "...there is no indication that soil leakage has occurred..."[27] at these plants. Extreme care in storing and handling the spent fuel and cautious monitoring of the spent fuel pool environs are necessary to help prevent dispersal of radionuclides to the environment where health and economic impacts may be sizeable.

Only one of the six plants around Lake Michigan has spent fuel stored away from the reactor (AFR). Point Beach has 114 assemblies stored at the Nuclear Fuel Services facility in West Valley, New York, and 109 assemblies at the General Electric Morris Operation in Grundy County, Illinois.[28] Return of the spent fuel from NFS and GEMO to the Point Beach plant has been contemplated,[29] but the NRC had not been informed of any decision regarding plans to ship the spent fuel from the AFR facilities to Point Beach as of March 8, 1979.[30]

Little commercially-owned space is available at AFR facilities for storage of spent fuel from the six nuclear plants located on the Lake Michigan shoreline. The NFS storage facility is no longer accepting additional assemblies pending New

---

[25] NRC Draft Generic EIS, Volume 1, 4-18 through 4-23.

[26] See Chart A for distances of plants' storage pools from Lake Michigan.

[27] Denton, March 8, 1979.

[28] Ibid.

[29] Application for Amendment to License Nos. DPR-24 and DPR-27, Point Beach Nuclear Plant, Units 1 and 2, Docket Nos. 50-266 and 50-301, NRC, Tables 9.1 and 9.2.

[30] Denton, March 8, 1979.

York State and federal resolution of the disposition of the former reprocessing plant and the radioactive wastes therein. Limited space for additional spent fuel assemblies from nuclear power plants exists at GEMO. A proposal to increase the storage capability of GEMO is now before the NRC.[31] There are no other licensed commercial AFR facilities in the United States.

Nor are there federally-owned temporary storage facilities for commercially-generated spent nuclear fuel. Though originally contemplated as a normal step in the nuclear plant fuel cycle to recover and reuse uranium and plutonium from the spent fuel, commercial reprocessing of spent fuel has been deferred indefinitely by an April 7, 1977 order of the President of the United States who reasoned that reprocessing technology increases opportunities for direct access to materials used in making nuclear weapons.[32] On October 18, 1977, President Jimmy Carter announced his preference that the federal government assume title to the spent nuclear fuel from commercial and foreign reactors for a one-time storage fee.[33] Legislation was introduced in Congress on March 1, 1979 (H.R. 2586) to facilitate the President's "interim" spent fuel storage proposal.

---

[31] General Electric (General Electric Morris Operation) Application to Modify License No. SNM-1265 to Increase Spent Fuel Storage Capacity, Docket. No. 70-1308. Illinois Attorney General William Scott has petitioned the NRC to conduct public hearings before deciding on renewal of GE's license to store nuclear spent fuel at GEMO. GE's license to operate the Morris Operation expires August 31, 1979. Chicago Sun-Times, May 22, 1979, 28.

[32] Just prior to this Presidential announcement, the Ford Foundation/Mitre Corporation study group reported: "There is no compelling national interest to be served by reprocessing. There appears to be little, if any, economic incentive and it is unlikely that reprocessing and recycle could proceed without [federal] subsidy. The non-economic benefits of reprocessing are small: fuel supply for LWRs would be little enhanced...and contemporary waste management risks with reprocessing are likely larger than possible reductions in long-term hazards from disposal. Health hazards and new accident risks argue against reprocessing. But the most serious risks from reprocessing and recycle are the increased opportunities for the proliferation of national weapons capabilities and the terrorist danger associated with plutonium in the fuel cycle." Nuclear Power Issues and Choices, 333. In explaining why there would be increased waste management risks with reprocessing, the authors stated: "The volume of solid waste (cladding hulls, process trash, and so forth) resulting directly from reprocessing and fabrication of mixed oxide fuel...would be rather large and would contain quantities of plutonium and other transuranics comparable to those in the much smaller volume of resolidified high-level waste." Ibid., 249. "The net result is that the volume and heat output of waste from reprocessing and recycle operations requiring permanent disposal is about the same as that of the original spent fuel." Ibid., 329.

[33] DOE Draft EIS, II-1.

A federal decision regarding the ultimate disposition of spent fuel is still pending the development and implementation of a federal radioactive waste management policy. In light of the political, economic, health and waste management adversities of current reprocessing technologies, spent fuel is being viewed as a potential waste form to be stored in geological formations. The President's Interagency Review Group on Nuclear Waste Management has recommended retrievable emplacement of up to 1000 spent fuel assemblies in a proposed "intermediate scale facility" within the controversial Waste Isolation Pilot Project (WIPP) slated to be operable in 1986 near Carlsbad, New Mexico.[34] WIPP is now under consideration by the United States Department of Energy.[35] According to the IRG, current United States full-scale repository design should be based on the ability to receive either solidified reprocessing waste or discarded spent fuel as a waste material; "...reprocessing is not required to assure safe disposal of commercial spent fuel in appropriately chosen geologic environments."[36] The IRG estimates that a full-scale repository for storing high-level waste, which could include spent fuel if so decided by the federal government, might be available between 1988 and 1992 if sited in a salt deposit or 1992 to 1995 if a rock medium such as granite, shale or basalt is chosen.[37] Federal executive and legislative decisions regarding these spent fuel management proposals have not yet been made.

Complicating this decision-making process is the insufficiency of scientific data to assure safe containment of the highly radioactive wastes in specific types of geological settings over long periods of time.[38] With geologists playing an increasing role in data gathering, some information can be generated about the potential suitabili

---

[34] Report to the President by the Interagency Review Group on Nuclear Waste Management, TID-28817, October 1978, vii-viii, hereafter referred to as IRG October 1978.

[35] Draft Environmental Impact Statement, Waste Isolation Pilot Project, U.S. Department of Energy, USDOE/EIS-0026-D, April 1979, 2 Volumes.

[36] Report to the President by the Interagency Review Group on Nuclear Waste Management, TID-29442, March 1979, 73, hereafter referred to as IRG March 1979.

[37] Ibid., 60.

[38] IRG October 1978, vii; IRG March 1979, 38; State of Geological Knowledge Regarding Potential Transport of High-Level Radioactive Waste from Deep Continental Repositories, Report of an Ad Hoc Panel of Earth Scientists, U.S. Environmental Protection Agency, EPA/520/4-78-004; J.D. Bredehoeft, A.W. England, et al, "Geologic Disposal of High-Level Radioactive Wastes--Earth Science Perspectives", Geological Survey, Circular 779, U.S. Department of the Interior, 1978; Report of Task Force for Review of Nuclear Waste Management, U.S. DOE/EP-0004/D, February 1978, 16-17 and 52; Nuclear Energy's Dilemma: Disposing of Hazardous Radioactive Waste Safely, U.S. General Accounting Office, EMD-77-41, September 9, 1977, 13-20, hereafter referred to as Nuclear Energy's Dilemma, GAO.

of the candidate rock types. The IRG believes "...[s]uccessful isolation of radioactive wastes from the biosphere appears technically feasible for periods of thousands of years provided that the systems view is utilized rigorously to evaluate the suitability of sites and designs, to minimize the influence of future human activities and to select a waste form that is compatible with its host rock. Beyond a few thousands years and during the period of time in which actinides and long-lived fission products remain toxic, our capability to predict and therefore our assurance of successful isolation diminishes. Some uncertainties can be bounded or compensated for and, therefore, need not be resolved completely before selecting a site or constructing a repository. In addition, some will be resolved during repository construction. Although some residual uncertainty will always remain, reliance on conservative engineering practices and multiple barriers can compensate for a lack of total knowledge and predictive capability."[39]

Besides the scientific and technical uncertainties regarding the development of a radioactive waste management program, the federal government must struggle with political and social obstacles to the siting of a waste repository.[40] Several states have enacted laws and some are considering bills forbidding disposal of radioactive wastes within their borders.[41] Political resistance appeared when the federal government indicated an interest in northern Wisconsin granite formations and Michigan salt deposits as potential high-level radioactive waste repositories. Public and political opposition was partly responsible for the federal government's abandoning an attempt to develop a radioactive waste disposal facility in salt beds near Lyons, Kansas.[42] Controversy rages over the proposed WIPP facility slated for a salt deposit near Carlsbad, New Mexico. Considerable conflict exists regarding the role, if any, the states should play in the federal development of geological repositories. The IRG recommended that states should not have "veto power" over the siting of a radioactive waste disposal facility; rather, the IRG suggests "consultation and concurrence" as the decision-making process which would allow the federal officials to eventually overrule state objections. The IRG has also suggested that regional sites are selected which would have the effect of spreading political decision making among a number of associated states rather than focusing on a specific state.[43]

---

[39] IRG March 1979, 38.

[40] Nuclear Energy's Dilemma, GAO, i.

[41] Nuclear Power Costs, U.S. House of Representatives Committee on Government Operations, April 26, 1978, 14-15.

[42] Nuclear Energy's Dilemma, GAO, 15.

[43] IRG March 1979, 43.

Several other technologies have been examined for the ultimate disposal of highly radioactive wastes other than storage in mined geological repositories: Placement in deep ocean sediments; placement in very deep drill holes; placement in a mined cavity in a manner that leads to rock melting; transmutation of heavy radionuclides after partitioning of reprocessing waste and subsequent geologic disposal of the fission products; and, ejection into space. While the IRG believes mined repositories will be available the earliest, deep ocean sediment and deep drill hole disposal should be perhaps 10-15 years away from being able to begin implementation. "Transmutation, rock melting and space disposal are more distant because of the scientific, engineering or institutional problems that must be overcome."[44]

THE STOP-GAP MEASURE: Because of current unavailability of storage space for spent fuel elsewhere, the six nuclear plants located on the shores of Lake Michigan have modified or are in the process of modifying their spent fuel pools to provide additional spaces for storage of spent fuel assemblies which must be discharged from the reactor cores so that new fuel can be emplaced.[45] The sizes of the pools have/are not being changed; rather, space between assemblies has been/is being decreased[46] via installation of new high-density racks. Without increased storage capability, the plants eventually would have to cease operating for lack of ability to offload the inefficient part of the nuclear core. Big Rock, Kewaunee, Palisades, and Point Beach would have had to cease generating electricity in 1980 or shortly thereafter due to inability to offload and store the spent fuel. Zion and Cook have anticipated the shortage of storage space well in advance of any threat to continuing operations.

---

[44] IRG March 1979, 35.

[45] Chart B provides the breakdown of compaction proposals already approved or under consideration by the NRC. There is a conflict regarding the status of the Big Rock spent fuel pool. The March 8, 1979 letter from Harold Denton and "Status of Spent Fuel Storage Capability", Operating Reactors Status Report, NUREG-0020, Volume 3, Number 1, January 1979 indicate that Big Rock has authority to store 120 assemblies and that the storage pool will be filled by 1980 with no pending request to amend the operating license to store additional quantities of spent fuel. However, the DOE wrote: "According to the data which DOE has from Consumers Power Company, the Big Rock reactor has already expanded its spent fuel basin several times to store more fuel than originally planned. The utility is nearing completion of a reracking activity which would permit storage of 365 fuel assemblies. This means the reactor would lose the ability to discharge the full core around 1988 and to discharge for annual fuel loading in about 1992." Letter from Michael J. Lawrence, Director, Division of Transportation and Fuel Storage, DOE to Jame Schaefer, Chairman, Radioactive Waste Management Study Committee, Lake Michigan Federation, May 14, 1979. The NRC and DOE are investigating this conflicting information.

887263

[46] Fuel centerline to assembly centerline dimensions have changed from 21 inches to 10.5 inches at Cook, 21 to 10-11 inches at Kewaunee, 11.25 to 10.25 at Palisades, 20 and 15.5 to 10 inches at Point Beach, 21 to 10.35 inches at Zion. Data is unavailable regarding dimension changes at Big Rock which was originally licensed for 12 inch centerline to centerline. Denton, April 25, 1979.

The plants' owners obviously do not expect that off-site storage space will be available within the next decade, and most of the plants anticipate storing spent fuel at least through the mid-1990s. By that time approximately 4,000 metric tons of highly irradiated spent fuel will be stored at the six plants.

The NRC approval of more dense and additional spent fuel storage at the nuclear plants has been granted prior to completion of a generic environmental impact statement assessing the reasonable alternatives for storing spent fuel and the safety of these options. The General Accounting Office, the investigative arm of the United States Congress, has recommended that the "...NRC complete and issue its generic environmental impact statement on spent fuel as soon as possible...and in the interim, limit through licensing restrictions the amount of spent fuel which can be stored in reactor pools to no more than was originally licensed for, unless the reactor would be forced to shut down operations, if increased storage was not allowed at that site.. .. NRC's interim licensing for increased storage capacity may raise public suspicions and concern, because the overall environmental effects -- including safety -- of such actions have not yet been fully determined."[47]

Spent fuel compaction approval has created an abrupt change in the nature of a nuclear power plant. At the time the original license to operate was granted by the NRC, a nuclear plant was contemplated to store spent fuel for only six months after discharge from the core. The extended periods of storage time already granted for Point Beach, Kewaunee, Palisades and Big Rock and under consideration for Zion and Cook indicate that the electric generating plants have now also become long-term storage facilities.[48] And, the uncertainties regarding final disposition of the highly radioactive fuel has resulted in concerns questioning the safety of underwater storage over long periods of time.

A major concern is whether or not the spent fuel will remain intact to allow for safe removal from the six plants for ultimate disposition sometime in the future. According to NRC Commissioner Victor Gilinsky, the United States has had "...satisfactory experience with such storage for periods of about ten years...."[49] However, there is no experience with the stability of spent fuel in underwater storage for longer periods of time -- from 20 to 50 years. The longest storage time reported

---

[47] Nuclear Energy's Dilemma, GAO, 59.

[48] This situation intensifies the impression that the plants' pools may become permanent storage sites.

[49] Victor Gilinsky in Testimony Before the California Energy Resources Conservation and Development Commission, January 31, 1977, hereafter referred to as Gilinsky Testimony.

for zircalloy-clad fuel is 19 years for one fuel element; stainless steel-clad fuel has been stored for 13 years.[50] "...[E]xpert opinion seems to be in general agreement that storage would be safe for longer periods, although further study is needed."[51] "Because of the lack of information on the status of fuel stored underwater for long times, corrosion mechanisms which may affect long-term integrity of spent fuel are not fully understood."[52] The NRC is currently "...considering the potential benefits of requiring additional pool chemistry controls or corrosion surveillance..."[53] as the long overdue, final generic environmental impactment statement on storage of spent fuel is being prepared.

The potential for corrosion of neutron absorber materials and their effects on the spent fuel high-density racks proposed for installation at the Zion plant is currently under study.[54] Of particular concern is the effect of the pool water chemistry on these racks which are prone to swelling and may entrap the spent fuel assemblies, thus preventing removal or causing rupture of the cladding upon attempts to dislodge the assemblies from the racks.

Because of our short-term experience with underwater storage of spent fuel, our ability to accurately ascertain the environmental, health, and safety risks of spent fuel storage beyond 20 years is limited.[55] Compacted and increased storage of spent fuel at the six nuclear power plants thus necessitates even greater management caution in light of the amounts of spent fuel assemblies now stored or planned for storage on the Lakeshore. The active mechanical systems providing the requisite

---

[50] A. B. Johnson, Behavior of Spent Nuclear Fuel in Water Pool Storage, Battelle Northwest Laboratory, September 1977, 14-15.

[51] Gilinsky Testimony.

[52] Status of Nuclear Fuel Reprocessing, Spent Fuel Storage and High-Level Waste Disposal, California Energy Resources Conservation and Development Commission, January 11, 1978, 103. Mechanisms requiring further study are accelerated corrosion, microstructural changes, alterations in mechanical properties, stress corrosion cracking, intergranular corrosion, and hydrogen absorption and precipitation by the zirconium alloys. NRC Draft Generic EIS, Volume 2, H-25.

[53] Denton, April 25, 1979.

[54] "Director's Decision Under 10 CFR 2.206 Request", Northern States Power Company (Monticello Nuclear Generating Plant, Unit 1) Docket No. 50-263, NRC, April 24, 1979, 3-5.

[55] The fission product radionuclides of primary concern under conditions of long-term spent fuel storage are krypton-85, cesium-134 through 137, and possibly iodine-129 which are present in significant quantities, are soluble in water, and biologically mobile. NRC Draft Generic EIS, Volume 1, 4-14.

cooling and purifying of the spent fuel pool environs will have to be carefully maintained by the plants' operators and cautiously monitored by the NRC.

Compacted spent fuel storage at the six nuclear power plants located on the shores of Lake Michigan is a "stop-gap" measure which must remain under close surveillance by the Lake Michigan Federation. Because of the potential threat to the health and welfare of the people who use Lake Michigan for recreational and occupational purposes, spent fuel should be transferred from the storage pools of the six nuclear plants to a more secure and isolated location. The federal government must gather the requisite data and make the appropriate decisions to facilitate the disposition of spent fuel from the Lake area. There is no assurance at the present time that the spent fuel now stored at the plants will ever be removed from the storage pools for disposal or processing elsewhere. As NRC Commissioner Gilinsky testified, if an alternative form of spent fuel storage is not available, "...the answer must be continued interim storage in pools."[56] The NRC, the DOE, and our elected federal officials must develop a sound radioactive waste management program which would provide for the removal of spent fuel from the six plants around Lake Michigan.

II The Lake Michigan Federation should call for a moratorium on the construction of additional nuclear power plants along the Lake until the uncertainties pertaining to spent fuel disposition are resolved by a workable federal radioactive waste management plan.

Spent fuel is being accumulated at the six nuclear power plants along Lake Michigan. Storage of the spent fuel discharged from the reactors is contemplated for much longer periods of time than was originally planned when the plants were licensed. Approval of modification of the methods of storing spent fuel at the plants through re-racking to allow for more dense placement of the spent fuel assemblies has been granted or is under consideration by the NRC -- though the generic environmental impact statement assessing the safety of such storage and other methods has not been completed. A federal decision regarding the disposition of spent fuel has not been made. Sufficient temporary away-from-reactor storage is not available. And, there are many scientific, technical, political and social obstacles to spent fuel disposal in geological settings. Until a decision regarding the disposition of spent fuel has been made and the federal government has a workable radioactive waste management program which provides for the removal of spent fuel from the storage pools of

---

[56] Gilinsky Testimony.

the six nuclear power plants now operating on the shores of Lake Michigan, additional nuclear plants should not be built around the Lake. The licensing process for the two nuclear-powered electricity generating plants proposed to be constructed near Sheboygan, Wisconsin and Gary, Indiana should be halted.

III The Lake Michigan Federation should call for prohibition of trans-shipment of spent nuclear fuel assemblies from other nuclear facilities to nuclear power plants along Lake Michigan.

Currently each of the six nuclear power plants now operating on the shores of Lake Michigan is licensed to store only the spent fuel discharged from its own on-site reactor(s) in the plant's storage pool(s). The possibility of storage of spent fuel generated by other domestic commercial or foreign reactors is not ruled out, however.[57] "All applications for such storage would be considered on a case-by-case basis."[58] The DOE considers trans-shipment of spent fuel between nuclear power plants within the same utility as an integral part of meeting spent fuel storage requirements in the near future.[59] As of March 8, 1979, the NRC has not received applications for license amendments to store spent fuel from another reactor at any of the six nuclear power plants along the Lake.[60]

Because of the liabilities inherent in storing spent fuel along Lake Michigan and particularly in some reactors in highly-populated areas, only the spent fuel discharged from the reactors should be stored at each of the six plants' spent fuel storage pools. Additional quantities of spent fuel from any other plant should not be trans-shipped to any of the six plants now operating on the shores of Lake Michigan. Trans-shipment would exacerbate the spent fuel storage situation already modified at the plants, increase opportunities for accidents in handling and transporting the spent fuel, and magnify the appearance of a long-term, perhaps "terminal" storage facility for highly-radioactive spent fuel.

---

[57] Denton, March 8, 1979.

[58] Ibid.

[59] Spent Fuel Storage Requirements -- The Need for Away-From-Reactor Storage, US DOE/ET-0075, January 1979, 2+, hereafter referred to as Spent Fuel Storage Requirements, DOE.

[60] "To date, one utility in another region of the country has been authorized to store spent fuel from one of its reactors -- H.B. Robinson -- in the storage facilities at its Brunswick facility some distance away." Denton, March 8, 1979. Also refer to Spent Fuel Storage Requirements, DOE, B-2 and B-4.

IV The Radioactive Waste Management Study Committee should remain as a special committee of the Federation to watch-dog the status of spent fuel storage at the nuclear plants located on the shores of Lake Michigan.

The need for keeping abreast of the spent fuel storage situation around Lake Michigan is self-evident. The Radioactive Waste Management Study Committee of the LMF Board of Directors should continue to research this difficult dilemma and make recommendations to the Board when appropriate.

The Study Committee is currently examining: The need for encapsulating the defective and leaking spent fuel rods at Palisades, Point Beach and Big Rock; the necessity for locating the pinhole leaks in the stainless steel pool liners at Point Beach and Zion; the desirability of encouraging the development of funds in escrow for long-term maintenance of the spent fuel at the plants and eventual removal of the spent fuel to an ultimate destination;[61] and the advisability of endorsing legislation before the United States Congress to facilitate the disposition of spent fuel and the development of a sound radioactive waste management policy.

V The Lake Michigan Federation should participate in the Keystone Center Radioactive Waste Management Discussion Group's proceedings on public participation.

The Keystone Center Radioactive Waste Management Discussion Group was formed in 1976 under the auspices of the Keystone Center for Continuing Education, located in Keystone, Colorado, to facilitate an interdisciplinary dialogue on radioactive waste management among the academia, environmental movement and independent citizens organizations, and the private nuclear industry. Discussion Group members have met informally since 1976 and in July 1978 the full group[62] agreed on the feasibility of convening several workshops to formulate recommendations pertaining to radioactive waste management that all can agree on -- nuclear critics and advocates alike.

---

[61] The NRC will no longer issue a uranium mill license or renew an existing license unless the mill owner submits a reclamation plan for mill tailings and a bonding arrangement to finance the plan when mill operations cease. Cleaning Up The Remains of Nuclear Facilities -- A Multibillion Dollar Problem, U.S. General Accounting Office, EMD-77-46, June 16, 1977, 12. A similar arrangement might be pursued to assure funds for spent fuel disposition.

[62] Dr. Irwin Bupp--Harvard, Dr. L. James Colby--Allied Chemical Corporation, Robert Craig--Keystone Center for Continuing Education, Kenneth Davis--Bechtel Power Corporation, Dr. David Deese--Harvard, Daniel Ford--Union of Concerned Scientists, James Harding--Friends of the Earth, Dr. Charles D. Hollister--Woods Hole Oceanographic Institute, Dr. Terry Lash--Natural Resources Defense Council, Dr. Vince Taylor--Pan Heuristics, Dr. Joel Primack--UC Santa Cruz, Dr. Peter Montague--Southwest Research and Information Center, Alan McGowan--Scientists Institute for Public Information.

Members of the Keystone Group met in August and September 1978 to discuss and make recommendations to the Interagency Review Group on Nuclear Waste Management whose subgroups had issued drafts of their findings and suggestions to the President of the United States. In December 1978, the Discussion Group members reviewed the critical situation of spent fuel storage at nuclear power plants in the country and made recommendations regarding disposition to the President's IRG and Office of Science and Technology Policy. Technical issues related to high-level radioactive waste repository siting was the topic of discussion at the April 1979 meeting.

On June 17-20, 1979, the Keystone Center Radioactive Waste Management Discussion Group will hold a meeting on issues related to public understanding and participation in the development and acceptance of radioactive waste management policy. Forty people representing the various sectors of society involved in nuclear power and in particular the radioactive waste dilemma are expected to participate in the workshop -- including the original Discussion Group members, representatives of the National Governors' Conference and National Association of State Legislatures, Staff Director of the United States Senate Subcommittee on Energy, Nuclear Proliferation and Federal Services, and representatives of the various "publics" who have expressed interest in and concern for the development of a sound radioactive waste management program in the United States. Discussion Group participants will develop a list of practical suggestions for improving current state and federal programs for public participation and draft a general statement emphasizing broad-scale public involvement in the development and implementation of a radioactive waste management program in our country.

Because people now and in the future will use Lake Michigan for their pleasures and occupations, they are both individually and collectively "publics" with the need to protect and preserve Lake Michigan from radioactive contamination due to the storage of highly irradiated spent fuel through the creation of and implementation of a sound nuclear waste management program. The Lake Michigan Federation is comprised of many sectors of these publics -- fishermen, environmentalists, homeowners, boating enthusiasts, businessmen, consumers, and laborers. The Federation should identify their concerns by participating in the Keystone Center Radioactive Waste Management Discussion Group in June and help pave the way for their education and representation in the radioactive waste disposal decision-making process.

Jame Schaefer has been invited to participate in the June meeting of the Keystone Group and has agreed to voice the concerns and needs of Lake Michigan's various publics as a representative of Lake Michigan Federation.

* * *

CHART A

Facility	Core Size[1]	Approximate Number of Assemblies Discharged Annually[2]	Estimated Number of Assemblies Currently in Storage Pools[3]	Storage Pool Dimensions[4] (in feet)	Storage Pool Distance from the Lake (in feet)[5]
BIG ROCK	84	21	83	26x20x30d	330
COOK 1 & 2	193 each	128	193	58x39x44d	400
KEWAUNEE	121	40	160	19x50x40d	660
PALISADES	204	68	273	39x15x38d	290
POINT BEACH 1 & 2	121 each	80	220	18x68x40d	500
ZION 1 & 2	193 each	128	368	60x33x41d	600

[1]"Status of Spent Fuel Storage Capability", Operating Reactors Status Report, NUREG-0020, Volume 3, Number 1, January 1979.

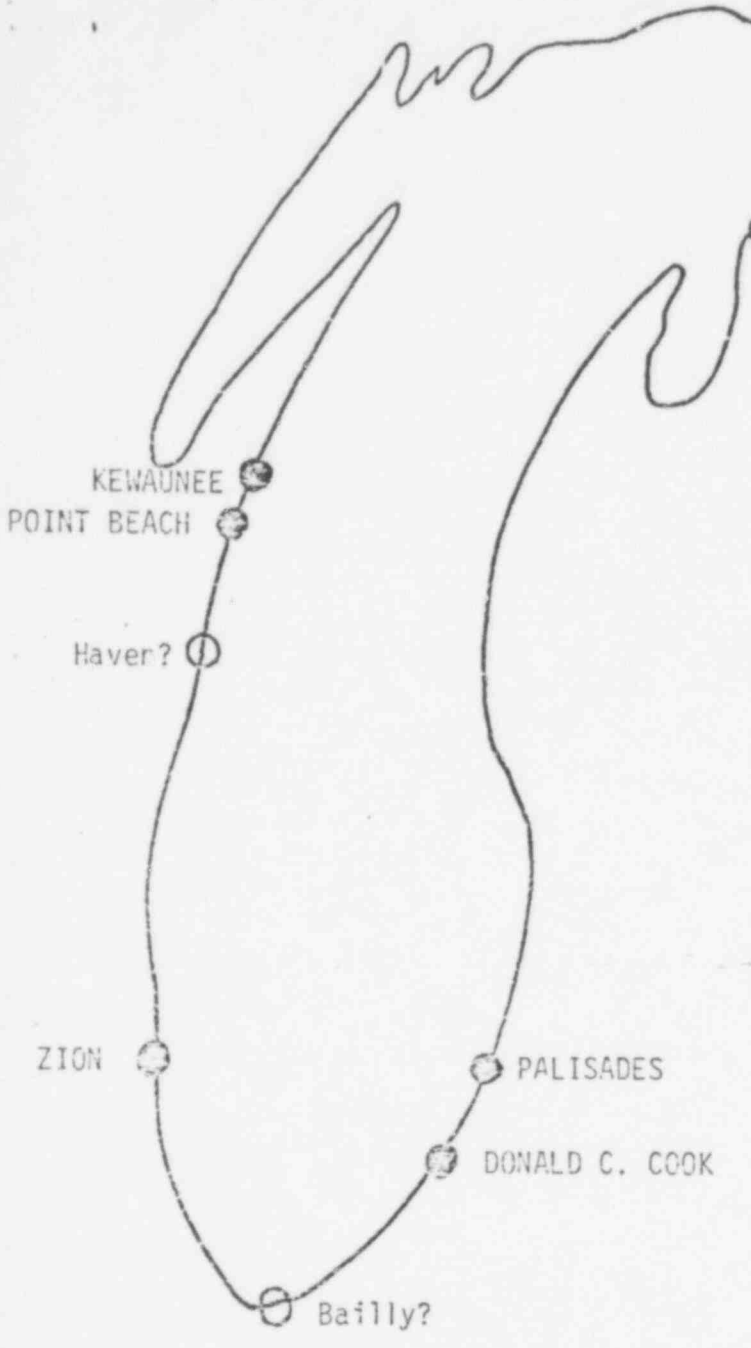
[2]Estimation of assemblies normally discharged based on 1/4 of the assemblies removed from Big Rock (BWR) and 1/3 of the assemblies removed from the other plants (PW

[3]"Status of Spent Fuel Storage Capability" and adding the estimated additional fuel assemblies to be discharged from the reactor since January 1, 1979 and stored in the spent fuel pools.

[4]Denton, April 25, 1979.

[5]Ibid.

687270



BIG ROCK POINT -- Big Rock Point, Michigan
Consumers Power Company

PALISADES -- South Haven, Michigan
Consumers Power Company

DONALD C. COOK -- Bridgman, Michigan
Indiana & Michigan Electric Company

ZION STATION -- Zion, Illinois
Commonwealth Edison Company

POINT BEACH -- Two Creeks, Wisconsin
Wisconsin Electric Power Company

KEWAUNEE -- Carlton, Wisconsin
Wisconsin Public Service Corporation
Wisconsin Power & Light Company
Madison Gas & Electric Company

Request for license to construct under review:

Bailly -- Gary, Indiana
Northern Indiana Public Service Company

Haven -- Sheboygan, Wisconsin
Wisconsin Electric Power Company
Wisconsin Power & Light Company
Wisconsin Public Service Corporation

CHART 8

Facility	Number of Assemblies Originally Licensed to Store[1]	Date Increased Capacity Authorized by NRC[2]	Number of Assemblies Currently Authorized to Store[1, 6]	Date Scheduled for Completing Review and Issuance of Safety Evaluation and Environmental Appraisal[1]	Estimated Date Storage Capacity will be Filled[1, 6]
BIG ROCK	120	N/A	N/A (365)[4]	N/A N/A	1980 (1992)[4]
COOK 1 & 2	500	N/A	2050[5]	4/79	1995
KEWAUNEE	168	3/79	990	Complete	1996
PALISADES	276	6/77	798	Complete	1985
POINT BEACH 1 & 2[3]	206	10/75 4/79	351 1502	Complete Complete	1980 1996
ZION 1 & 2	340	8/76 N/A	868[5] 2112[5]	Complete 3/79[7]	1983 1992

[1]Denton, March 8, 1979.

[2]Denton, April 25, 1979.

[3]Point Beach has 223 assemblies stored at AFR facilities. See text page 5.

[4]Conflict in NRC and DOE records. Refer to text footnote 45 on page 9.

[5]Number of assemblies when increase under consideration is authorized.

[6]"Status of Spent Fuel Storage Capability"

887272

[7]NRC hearings on the Zion amendment request are scheduled for June 11, 1979 in Illinois.