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Appendices

final generic environmental impact statement

on

HANDLING AND STORAGE OF SPENT LIGHT WATER POWER REACTOR FUEL

AUGUST 1979

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FINAL GENERIC ENVIRONMENTAL IMPACT STATEMENT

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APPENDICES

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Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission

APPENDICES

APPENDIX A

LIGHT WATER REACTOR FUEL CYCLE

Electricity may be generated from nuclear power by a variety of technologies. Commercial nuclear power in the United States has principally used light water reactor technology. One of the products of this technology is plutonium, which has potential use as nuclear fuel. Spent fuel may be recycled into new fuel or disposed of as shown in the fuel cycle steps illustrated in Figure A.1. In this appendix the various stages of the fuel cycle are described.

There are many similarities between nuclear powered and fossil fueled electric generating systems. In both, a heat source transforms water into steam that operates turbine-generators producing electricity. The primary functional difference between the two systems lies in the nature of the heat source. In a fossil fueled system, heat is produced by the combustion of oil, coal, or natural gas in a boiler; the heat of a nuclear steam supply system is produced by the process of fission in a nuclear reactor.

Nuclear fission results from a free neutron* splitting the nuclei of specific isotopic forms of certain elements (fissionable, or fissile, materials) into two nearly equal parts that become the nuclei of two lighter elements termed fission products. Relatively large amounts of heat and two or three free neutrons are released in the process. Under proper conditions, the free neutrons may strike other fissionable atoms, causing a repeat of the process. When conditions are such that the process proceeds at a self-sustaining rate, "criticality," or a nuclear chain reaction, is achieved.

Nuclear reactors are devices designed to permit nuclear fission under highly controlled safety and radiological conditions to achieve specific ends. In the case of nuclear power reactors, the end sought is controlled release of heat to generate steam to turn turbine-generators.

There are only three basic fissile materials--uranium-233, uranium-235, and plutonium--that can be used as reactor fuel. Uranium-235 is the only fissile material occurring to any significant degree in nature. Uranium-233 is produced when the nucleus of a thorium-232 atom absorbs a free neutron (neutron irradiation), and plutonium is produced by the neutron irradiation of uranium-238, the most abundant naturally occurring uranium isotope. Because they can be transformed into fissile materials, thorium-232 and uranium-238 are called "fertile." Nuclear reactor fuel usually consists of a mixture of fissile and fertile isotopes. As the fissile isotopes fission, some of the fertile material is converted into new fissile isotopes, thus providing additional fuel for the reactor.

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*Neutrons are one of several types of "subatomic" particles that form the nucleus of an atom.

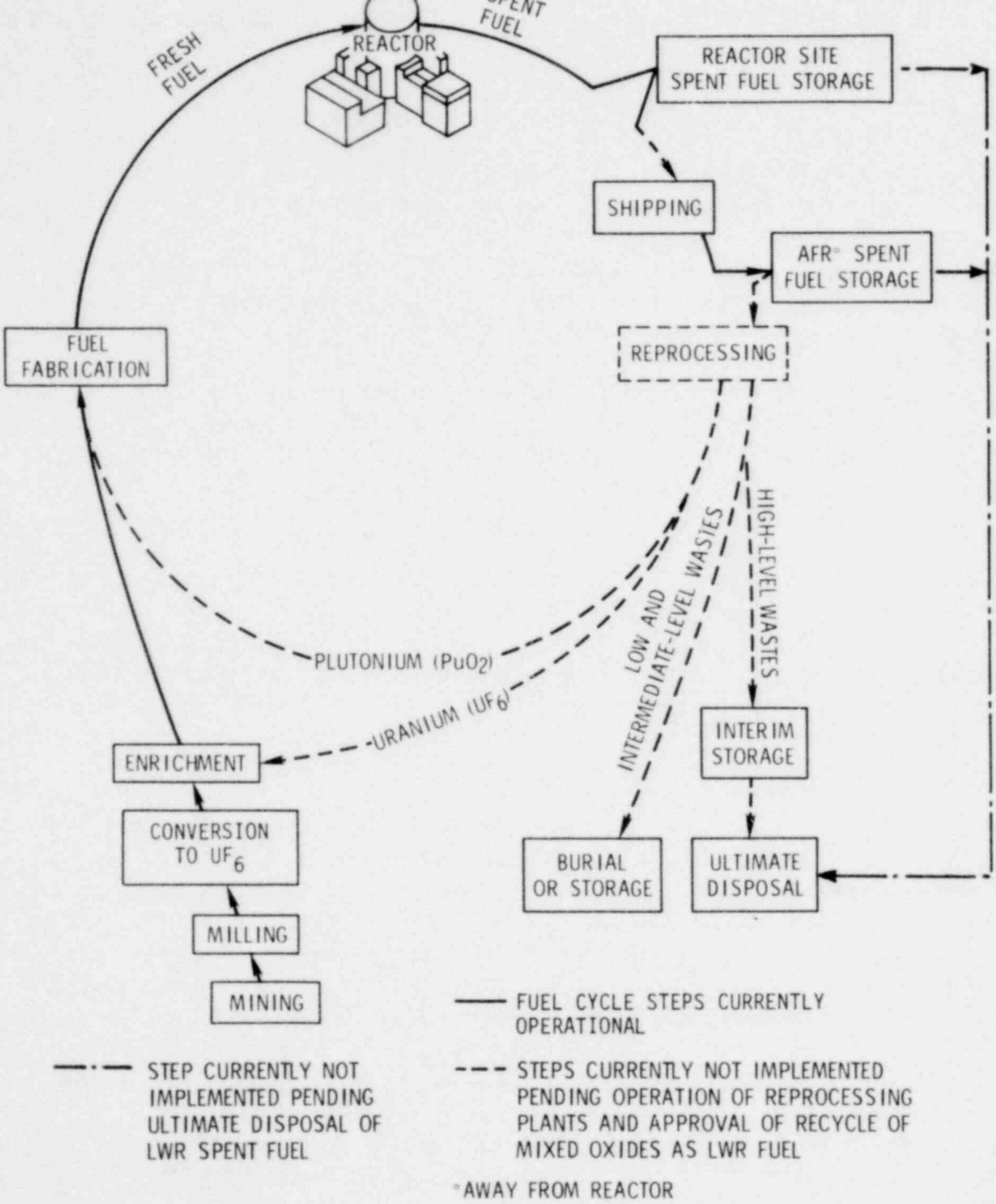

Figure A.1. Schematic Diagram of Light Water Reactor Fuel Cycle.

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Numerous types of nuclear reactors of differing levels of sophistication, designed for various applications, and using assorted types of fuel have been developed. Those used in the United States for commercial generation of electricity are predominantly of the light water moderated type. Other types may gain increased commercial application in the future. Fuel for present light water reactors (LWR's) consists of uranium artificially enriched from a natural level of 0.7% uranium-235 to about 2-4% uranium-235. Thus uranium-235 is the principal fissile isotope in fresh LWR fuel.*

Since fission depends on free neutrons striking fissile atoms, the rate of fission in a reactor core is controlled by regulating the availability of free neutrons. This is accomplished by use of movable control rods containing compounds that are not fissionable but that will readily absorb neutrons, thereby making them unavailable to continue the chain reaction. The rate of fission can be increased or decreased by raising or lowering the control rods in the core (exposing less or more of the neutron-absorbing compound). Some reactors have two sets of control rods--one for routine regulation of fission rate under normal operating conditions, and one set to quickly shut down the reactor in case of "off-normal" conditions.

Ordinary (light) water plays a dual role in light water reactors, serving as both moderator and coolant. Fissile materials in LWR fuel have a greater tendency to fission when exposed to collisions of relatively slow-moving neutrons; however, when initially released during fission, neutrons move at high speeds. Water circulated through the reactor core "moderates," or slows down, these neutrons, increasing the probability that the neutrons will strike a fissile atom and cause that atom to fission. The same circulating water also acts as the reactor coolant, removing the heat generated during nuclear fission.

There are two kinds of LWR's--pressurized water reactors (PWR's) and boiling water reactors (BWR's). The names refer to the condition, or physical state, of the water in the reactor core (Figure A.2). In PWR's, the water is kept under considerable pressure to permit it to absorb a great deal of heat without boiling. The heated water is circulated from the reactor core to a steam generator, where the heat passes across the walls of heat exchanger tubes, turning the water in a second circulating water system into the steam that turns the turbine-generators. Thus, under normal operating conditions the water that cools the core of a PWR does not come into contact with the electrical generating turbine. In BWR's, as the name implies, the cooling water is allowed to boil in the core, directly producing steam that operates the turbine generators.

The development of a commercial nuclear electric generating industry during the past two decades has given rise to a number of industrial operations to produce and process uranium fuel. The operations involved are collectively referred to as the nuclear, or light water reactor, fuel cycle, and consist of the following activities:

1. Mining of uranium ore;

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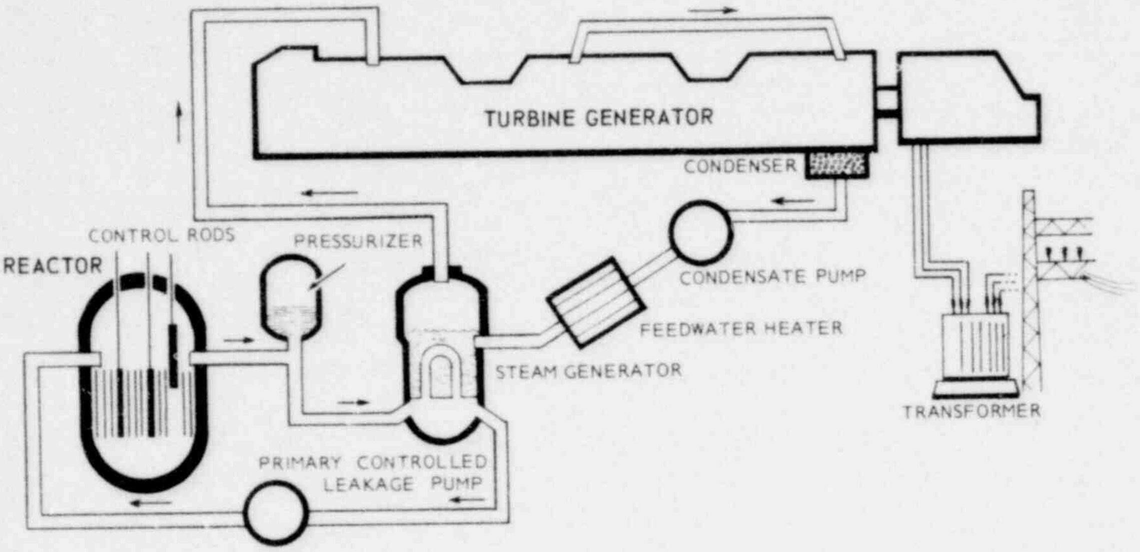
*As operation of the reactor proceeds, however, part of the fertile uranium-238 is converted into fissile plutonium-239 through neutron irradiation, and fissioning of this plutonium provides about a third of the power generated by an LWR.

A. PRESSURIZED WATER REACTOR



B. BOILING WATER REACTOR

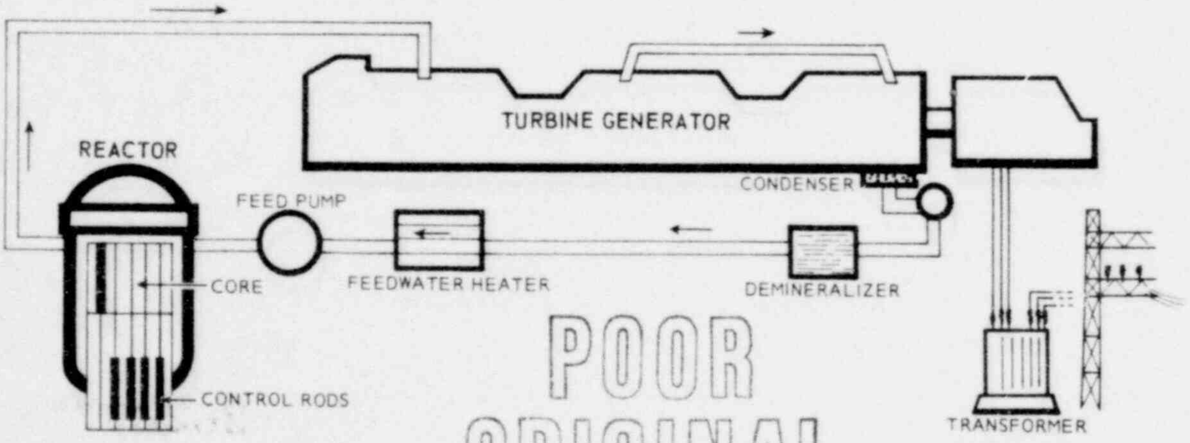


Figure A.2 Schematic Diagrams of Pressurized Water (A) and Boiling Water (B) Reactor Generating Systems. From "The Environmental Impact of Electrical Power Generation: Nuclear and Fossil," WASH-1261, 1973.

2. Milling of the ore to produce a semirefined concentrate (U_3O_8);

3. Conversion of U_3O_8 into uranium hexafluoride (UF_6);

4. Enrichment of UF_6 to about 2 to 4% in the isotope uranium-235;

5. Conversion of the enriched UF_6 to uranium dioxide (UO_2) and fabrication of UO_2 into reactor fuel (fuel fabrication);

6. Storage of the spent fuel;

7. Reprocessing of spent fuel (after its use in a reactor) to recover reusable uranium and plutonium;

8. (Waste Management) - Storage and ultimate disposal of the radioactive wastes and/or spent fuel generated at various stages of the fuel cycle; and

9. Transportation of radioactive material to and from various facilities involved in the fuel cycle.

At present, the fuel cycle is open ended because no spent fuel may be reprocessed commercially to recover usable uranium and plutonium.[1]

Each stage of the fuel cycle, Figure A.1, is described in the following paragraphs:

· Mining -- The initial step in producing LWR fuel is mining of uranium ore. General techniques used to mine the ore are similar in most respects to those in other mining operations. Both open pit and underground mining are used, depending on the depth of the deposit and the nature of the overburden. Natural uranium ore is not sufficiently radioactive to necessitate special packaging or transportation procedures.

In the United States the majority of known uranium deposits are in the West; New Mexico, Wyoming, Colorado, and Utah produce nearly 90% of the uranium mined in the United States.[2] The United States deposits are among the largest in the world, but there are other major deposits in Canada, Australia, South Africa, and South West Africa.

The Atomic Energy Act of 1954 provides that all uranium processed in Federally owned uranium enrichment plants (see below) for use as fuel in U. S. power reactors must be of U. S. origin. This restriction, however, is to be gradually lifted. While there are more than sufficient uranium resources (known reserves and probable resources) in the United States to fuel for its lifetime the nuclear capacity projected for the year 2000,[3] economic factors may dictate that the United States will, within a few years, become an importer of uranium.

· Milling -- After being mined, uranium ore is shipped to a mill (usually in proximity to the mine) for initial processing, which involves crushing, grinding, and chemical treatment (acid or sodium carbonate leaching and precipitation) to extract the uranium as a semi-refined product, primarily U_3O_8, commonly called yellowcake. The yellowcake is drummed for shipment to a uranium hexafluoride conversion plant, the next step in the uranium fuel cycle. Yellowcake is normally shipped by truck or train in standard metal drums.

Waste products, or tailings, of the milling process are pumped to open tailing ponds for storage. The ponds are designed so as to prevent release of contaminated wastes to surrounding terrestrial or aquatic habitats.

- Conversion to UF_6 -- The gaseous diffusion enrichment process by which the uranium-235 content of uranium fuel is increased from the naturally occurring 0.7% to 2 to 4% requires that the uranium be in the form of uranium hexafluoride (UF_6). At normal room temperature UF_6 is a white solid, but at slightly elevated temperatures it becomes a gas, a property that makes the compound suitable for the enrichment process.

The U_3O_8 from a uranium mill is purified and converted into UF_6 at one of two commercial conversion plants in the United States--the Allied Chemical Plant at Metropolis, Illinois, or the Kerr-McGee Plant at Sequoyah, Oklahoma. Each plant uses a different process to produce the UF_6. The Allied plant employs a "dry" or Hydrofluor process that involves a series of reduction, hydrofluorination, and fluorination steps in fluidized bed reactors, followed by fractional distillation to recover the purified UF_6. At the Kerr-McGee plant, a "wet" process is used. A chemical solvent extraction is used initially to produce a high purity uranium dioxide feed that is subjected to reduction, hydrofluorination and fluorination. UF_6 is normally shipped from the conversion plants to the enrichment plants by truck in 10- or 14-ton metal cylinders.

- Enrichment -- As previously indicated, commercial LWR's in the United States operate with uranium fuel enriched to 2 to 4% in the fissile isotope uranium-235. The enrichment process is conducted at three government-owned gaseous diffusion plants located at Oak Ridge, Tennessee; Paducah, Kentucky; and Portsmouth, Ohio.

The gaseous diffusion enrichment process permits the separation of UF_6 gas into two streams--one stream enriched in the uranium-235 isotope (product stream) and one depleted in uranium-235 (tails stream). The process takes advantage of the fact that the average velocities of gas molecules at a given temperature are inversely proportional to their mass. Thus in a gaseous mixture of molecules of differing mass (in this case $^{235}UF_6$ and $^{238}UF_6$) the velocity of the lighter molecules ($^{235}UF_6$) is greater than that of the heavier molecules ($^{238}UF_6$). The UF_6 gas is pumped through a chamber (called a stage) divided into two sections by a thin porous membrane. The pressure of one section is slightly lower than in the other. Because of their greater velocity, the lighter molecules ($^{235}UF_6$) will strike the dividing barrier more frequently and thus have a greater probability of passing through one of the holes in the membrane. This results in separation of the gas into two streams--one with a higher percentage and one with a lower percentage of uranium-235 than natural uranium. The degree of separation that can be achieved in any one stage is rather small, and thus UF_6 is passed through many such stages to achieve the desired enrichment of the product stream (enrichment to 4% uranium-235 requires about 1,200 stages).[2]

The enriched UF_6 is considered a fissile material, thus requiring the use of special shipping containers and transportation procedures to protect public health and safety.

- Fuel Fabrication -- Enriched UF_6 is next shipped to a fuel fabrication facility to convert the enriched uranium into its final fuel form (UO_2 pellets) and to fabricate fuel assemblies.

The slightly enriched UF_6 is subjected to a series of chemical treatments to convert it to uranium dioxide (UO_2). The bulk UO_2 is mechanically and thermally treated to produce high-density ceramic fuel pellets of specific size, and the pellets are placed in metal-clad fuel rods. After they are completed and inspected, a number of fuel rods are clustered together into fuel assemblies and shipped to nuclear power stations for insertion into the reactor cores.

A number of United States companies are engaged in the fabrication of fuel for commercial power reactors. These include the four United States manufacturers of LWR's (Babcock and Wilcox, Combustion Engineering, General Electric, and Westinghouse) and others (e.g., Exxon Nuclear Co. and General Atomic). These companies operate plants with varying fabrication capabilities. Some have complete facilities for production of uranium pellets and fabrication of fuel assemblies; operations at others are limited (such as production of UO_2 only).

- Spent Fuel Storage -- Typically spent fuel is held in the reactor storage pool for several months to several years. The various options for longer term storage, such as long-term wet storage and long-term dry storage, are discussed in detail in the body of this document.

- Spent Fuel Reprocessing -- Reprocessing is the chemical treatment of spent reactor fuel to separate residual uranium and plutonium from the radioactive wastes produced during reactor operation. The process involves opening of the fuel rods, nitric acid leaching of contained materials, solvent extraction of uranium and plutonium nitrates from the fission products, and a partitioning step to separate the uranium and plutonium. After purification, the uranyl nitrate is converted into UF_6, and the plutonium nitrate is converted into plutonium dioxide (PuO_2). These two products can then be recycled to the appropriate step of the fuel cycle for reuse.

Because of the high radioactivity of spent reactor fuel, the reprocessing operations must be carried out remotely in buildings incorporating multiple levels of confinement and redundant safety systems to insure protection of workers, the public, and the environment.

As indicated earlier, commercial operation of reprocessing plants has been deferred indefinitely[1] by the Nuclear Regulatory Commission in deference to the President's policy on nonproliferation.[4] As a result the generic study on plutonium recycle[5] has been terminated.[1]

The U. S. reprocessing plants are Nuclear Fuel Services (NFS) at West Valley, New York; General Electric at Morris, Illinois; and Barnwell Nuclear Fuel Plant (BNFP) at Barnwell, South Carolina, (owned by Allied-General Nuclear Services). NFS began operation in 1966 but is currently shut down. Construction of the GE Morris plant is complete, but preoperational testing revealed a number of technical problems. GE has decided to close the plant, though spent fuel storage facilities are available for use. BNFP cannot receive any operating license for commercial reprocessing under present regulatory decisions.[1]

- Waste Management -- The potentially hazardous nature of radioactive material generated by the nuclear fuel cycle necessitates waste management schemes that are considerably more complex and stringent that those used by most conventional industries.

Gaseous, liquid, and solid radioactive wastes are generated at all stages of the fuel cycle. The term "waste" includes (1) the mining and mill tailings generated in the recovery of uranium from ores; (2) process wastes generated by the operations involved in the production of reactor fuels; (3) radioactive materials generated during reactor operation--materials made radioactive by exposure to neutrons, materials that are contaminated with radioactive materials and filters and ion exchange resins generated during purification of the primary water system; and (4) the fission products and transuranic nuclides separated from it during reprocessing. These are in the form of high level wastes which are concentrated fission products and low level wastes of various forms which may or may not contain transuranic elements.

All nuclear facilities generating or processing potentially harmful amounts of radioactive materials are equipped with radioactive waste treatment systems designed to contain, detect, collect and treat these radioactive materials so as to prevent exposure of workers, the public, and the environment to dangerous levels of radiation under normal or credible accident conditions.

Radioactive waste management programs must take into account not only the type and intensity of radiation emitted by the waste, but also must consider the duration of the hazard. By definition, radioactive materials are unstable isotopes that decay, emitting radiation in the process. The emission of radiation continues until the decay process results in the formation of a stable isotope. The rate of decay varies from isotope to isotope, and is expressed as an isotope's half-life. The half-life is the time required for any given amount of an isotope to be reduced by one-half through radioactive decay. For example, starting with 20 kilograms of a radioactive material with a half-life of two years, ten kilograms of the isotope would remain after the first two years, five kilograms after four years, and so on, until eventually the amount remaining would be undetectable. The half-lives of various radioactive isotopes produced by reactor operation range from seconds for some of the more short-lived isotopes to centuries for the more long-lived ones. Therefore, management schemes must not only provide immediate protection from the radiation emitted by radioactive wastes, but must also ensure that the waste generated now will not endanger the health and safety of future generations.

Uranium mill tailings, normally in the form of a slurry, are discharged to a tailings pond designed to promote concentration of the contained solids by evaporation and minimize the dispersal of the contained (natural) radioactive materials to the local environment. A draft generic environmental impact statement on uranium milling, published in April 1979,[3] recommends criteria on acceptable methods of disposal of mill tailings. All mill operators are now required to develop tailings management and disposal plans which meet NRC interim criteria. These criteria require the disposal of tailings in such a way as to return the disposal area to essentially (natural) background conditions.

The bulk of the next higher category of radioactive waste--low-level waste emitting beta or gamma radiation--are generated by the treatment of the waste streams of nuclear plants. Low level wastes generate a negligible amount of heat, and because of the nature of the radiation emitted, require a minimal amount of protective shielding. After appropriate treatment and packaging, low level wastes usually are shipped to one of six licensed burial sites in the United States. Only three of these sites are presently operational. Although these burial operations are conducted by commercial firms, the sites are all on State or Federally owned land to insure perpetual maintenance and controlled access.

Transuranic wastes generate a relatively small amount of heat and require less shielding than the most dangerous levels of radioactive waste, but still contain sufficient levels of penetrating, long-lived isotopes to warrant nearly perpetual containment. Included in this category would be the hulls of fuel rods after treatment at a reprocessing plant and certain other wastes contaminated with plutonium and other transuranic isotopes during operations at reprocessing and fabrication plants.

The greatest challenge to the radioactive waste management field is the handling, storage, and particularly the ultimate disposal of the high level radioactive wastes generated by the reprocessing of spent reactor fuel, or if reprocessing is not implemented, the spent fuel itself. These high level wastes will consist of large concentrations of long-lived radioisotopes that emit intense and penetrating radiation and have high heat-generation rates. These wastes include the various fission products generated by irradiation of reactor fuel. Also requiring special precautions are other materials sufficiently contaminated with plutonium to warrant treatment as high level wastes.[6]

High level radioactive waste requires extraordinary handling, packaging, and storage techniques. A number of schemes for ultimate disposal of radioactive waste have been evaluated. Although no specific method has been chosen, some form of geologic disposal is favored. Also under study are various concepts for safe interim storage pending decisions on ultimate disposal.[7]

- Transportation -- The transport of radioactive materials occurs at all stages of the nuclear fuel cycle and is regulated primarily by the Nuclear Regulatory Commission and the Department of Transportation. Regulations are designed to protect transportation workers and the public from exposure to dangerously high levels of radiation even if a transportation accident should occur. Major emphasis is placed on design of packaging and shipping containers, with these designs incorporating the degree of protection warranted by the nature of the material being shipped. Attention is also given to procedures to be followed during transit.

Within the United States, bulk shipment of radioactive materials is by truck or rail over public transportation routes. Like other stages in the fuel cycle, transportation procedures incorporate safeguards designed to prevent the theft or diversion of radioactive material.

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3. U.S. Nuclear Regulatory Commission, "Draft Generic Environmental Statement on Uranium Milling, NUREG-0511, Section 3.2.2, April 1979. Available upon request from Director, Division of Technical Information and Document Control, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

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APPENDIX B

HANDLING AND STORAGE OF SPENT FUEL

1.0 PRESENT PRACTICE

The present-generation nuclear power plants were designed and constructed during the late 1950's and the 1960's. Reactor manufacturers maintained organizational components that performed internal design reviews and audits to ensure the safety and reliability of the nuclear power plants being built. As a part of the information provided to various utilities, a "Technical Description" describing the plant design in detail was developed. For each proposed station this information was reconstituted into a second document called a "Preliminary Safety Analysis Report" (PSAR) and ultimately into a "Final Safety Analysis Report" (FSAR). These were submitted to the Atomic Energy Commission (AEC) for review and approval. There followed a permit to construct and later a license to operate the plant. The PSAR and FSAR concentrated primarily on the safety aspects of nuclear power plants and included analyses of the most severe accidents postulated. The design basis for fuel storage pools was described in the PSAR's and FSAR's. In short, the design basis for fuel storage pools underwent a series of judgements and evaluations starting with the designer, reviewed by the internal safety committees, and finally reviewed by the AEC (now reviewed by NRC), the Advisory Committee on Reactor Safeguards (ACRS), and the Atomic Safety and Licensing Board (ASLB) in public hearings. From this design basis information and operating experience, many standards and criteria have been developed for use by those who are designing fuel storage pools today or who are providing for increased capacity in fuel storage pools in operating nuclear power plants.

Reactors of the current generation typically have storage space for about one and one-third cores. The spent fuel racks were not designed for spacing as close as is possible (i.e., compact storage, see Chapter 3.0). An equivalent of one core's discharge capability is preferred to be unused and available for a complete maintenance or emergency discharge of the operating core, termed full core reserve (FCR). At present, each reactor pool typically stores only fuel used in its own reactor.

1.1 SPENT FUEL POOL CONFIGURATION AND STORAGE CAPACITY

The water-filled fuel storage pool has been chosen for storage of spent fuel assemblies at reactor stations primarily because of the convenience and effectiveness provided. Water is used for shielding and cooling and as a transparent medium to facilitate fuel handling operations.

The configuration of the fuel storage pools is essentially the same for all nuclear power plants. The pools are rectangular in horizontal cross section and 39 to 40 feet deep. Fuel assemblies are placed in storage racks at the bottom of the pool. The racks hold the fuel assemblies in a vertical position and maintain the spacing between assemblies. Insertion or removal of fuel assemblies is accomplished vertically from above the racks. The 13.5 to 14.5 foot long fuel rods must remain submerged during fuel removal from or insertion into the racks; thus for this reason alone, the water must be at least 28-30 feet deep. An additional 8 to 10 feet of water is required for shielding. This amount of shielding water is needed for a high burnup fuel assembly just removed from the reactor. The total depth of most pools thus must be about 40 feet. The direct radiation at the pool surface from the fuel stored at the bottom of the pool is very low because the water depth of about 25 feet is equivalent to about 10 or 11 feet of concrete in shielding value.

The pool is filled with pure, demineralized water (for BWR's), or demineralized water to which borate (usually in the form of boric acid) has been added (for PWR's). The reason for the difference is that a PWR uses the "chemical shim" neutron absorber (borate) in the primary system, and the fuel storage pool is also borated in order to match the primary system during refueling. The BWR does not use the chemical shim in the primary system and therefore borate is not added to BWR storage pools. The PWR pool is slightly acidic (pH of 5-6), and the BWR pool is neutral (pH of 7). Both storage media effectively provide the three basic requirements of shielding, cooling, and transparency for fuel handling. Design temperatures are 120-125°F maximum for normal operation and 150°F for abnormal operation. Experience to date shows pools are operating at 100°F or less. Consequently, the fuel is stored in a low temperature, low corrosion environment. The corrosiveness of the neutral to slightly acidic fluid is acceptably low for the three major materials used--stainless steel, Zircaloy, and aluminum.

The pools are constructed of reinforced concrete with sufficient thickness to meet radiation shielding and structural requirements. Each pool is lined with stainless steel plates (3/16" to 1/4" thick) welded together to ensure a leaktight system. The liners are provided with various leak detection systems. Skimmer systems and filter-demineralizer systems are provided to clean the pool water. These cleanup systems are in addition to the pool cooling system that removes decay heat from the stored fuel.

BWR refueling systems are designed with the fuel storage pool on the reactor operating floor. In most cases the operating floor is elevated in the reactor building above ground level about 90 to 95 feet, while the bottom of the pool is 50 to 55 feet above ground level. This feature necessitates some additional requirements over those for pools located at ground level. Primarily, the pool and rack structure is designed to higher seismic loadings because of the amplification factors that are caused by the movement of the building in a seismic event. Also, the pool loadings require additional evaluations when the ground support is not available. More recent BWR designs provide for ground-level storage pools. When the BWR reactor is shut down for refueling, the reactor is cooled, opened, and filled with water to the same level as the refueling pool. A second pool adjacent to the reactor is used to store internal reactor components (dryer and separator). With this system a single refueling bridge and grapple is used to carry out all refueling operations, from removal of the spent fuel from the reactor to its placement in storage positions in the fuel storage pool.

The PWR refueling system uses a ground-level fuel storage pool that is exterior to the reactor building in the fuel or auxiliary building. When the reactor is shut down for refueling, it is opened and the water level is raised to the refueling level. Fuel is removed from the reactor by a fuel handling grapple system. Fuel assemblies are passed horizontally through a transfer tube into a transfer canal. In the canal, the fuel is again raised to a vertical position, picked up by a second grapple system, and moved to the fuel storage pool, where it is placed in a rack.

The storage pool ranges from 30 to 60 feet long and from 20 to 40 feet wide. The storage area varies with the amount of fuel to be stored, which in turn depends on the type and size of reactor. In addition, the pool must accommodate the amount of non-fuel equipment to be stored in the pool and the number of fuel handling operations to be carried out in the pool. Physically, the cross-sectional area of a fuel assembly for a BWR is smaller than for a PWR. Both assemblies are about the same length, but the BWR assembly is about 5 1/2 inches square, while the PWR assembly is 7 1/2 inches to 8 1/2 inches square. The net result is that there are more fuel assemblies in a BWR than in a PWR for the same size reactor.

Reactivity is greater in a PWR assembly than in a BWR assembly. Because of this, PWR fuel requires greater spacing (assembly to assembly) in the fuel storage pool than is required for BWR fuel for the same criticality limits. Separate storage space is not required in the PWR pools for control clusters or for burnable neutron absorbers. These items are stored in the fuel assemblies themselves; in BWR pools separate storage is required for control blades and poison curtains plus fuel channels. Space is also needed in the BWR fuel storage pool for equipment to remove or install fuel channels. Pool size is influenced as well by the number of fuel assemblies that are discharged at each refueling. A PWR discharges 1/3 of the core with each refueling and a BWR discharges approximately 1/4 of the core. Table B.1 typifies the number of fuel assemblies that are stored for a range of reactor sizes and for the two reactor types. Typical schedules for refueling and accumulation of fuel assemblies are given in Appendix D.

Table B.1. Fuel Assembly Storage Requirements in Relation to Reactor Size and Type

Rated Power	Reactor Type	Typical Number of Assemblies Reactor Core Size	 Fuel Discharged per Refueling	 Fuel Storage Pool Capacity
500-600 MWe	PWR	121	40	162
700-800 MWe	PWR	157	52	210
1000-1100 MWe	PWR	193	64	260
500-600 MWe	BWR	484	90-120	740
700-800 MWe	BWR	724	100-170	1160
1000-1100 MWe	BWR	764	150-190	1160

1.2 SAFETY CONSIDERATIONS

1.2.1 Codes, Standards, and Regulatory Guides

To ensure the protection of the environment and the public from release of dangerous amounts of radiation from the spent fuel in storage, certain standards and codes are applied during the design, fabrication, erection, testing, and operation of the spent fuel storage facility.

Since there are many codes, standards and guides employed for the thousands of components involved, only the major ones that relate more directly to the containment of radiation will be discussed below.

General Design Criterion 1, "Quality Standards and Records" of Appendix A to the Code of Federal Regulations 10 CFR 50, "Licensing of Production and Utilization Facilities," calls for standards commensurate with the importance of the safety function to be used in the design, fabrication, erection, and testing of all safety-related structures, systems and components. In particular, Section 50.55a, "Codes and Standards," applies to the reactor primary coolant pressure-containing components and establishes the highest quality classification for these components, but does not include other safety-related components of a nuclear facility. In recognition of this fact, the U. S. Nuclear Regulatory Commission issued Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants."

The ". . . commensurate with the importance of the safety function . . ." portion of the above is arranged in four quality group classifications in descending levels of safety importance called A, B, C, and D in the NRC Regulatory Guide 1.26. This guide has a table that cross-references each safety class of the ASME Boiler and Pressure Vessel Code, Section III, Nuclear Power Plant Components, with the equivalent code classes as 1, 2, 3, CS, and MC. Classes 1, 2, and 3 recognize the level of importance to safety in the same manner as Regulatory Guide 1.26 (CS is for reactor core structure and MC is for the reactor containment vessel). It is recognized in Regulatory Guide 1.26 that the ASME code is largely for the mechanical pressure-containing components, and it is stated that Regulatory Guide 1.26 should be used as a guide for classifying other systems, such as instrument and service air, diesel generators, ventilation, etc.

Regulatory Guide 1.26 calls for the cooling water systems used for heat removal from spent fuel storage pools to be Quality Group Class C. It also states that all other systems not specifically covered in the Guide and whose failure could result in offsite dosage greater than 0.5 rem to an individual must be Quality Group Class C. An interpretation of the latter can be found in the American National Standards Institute (ANSI) publication N18.2 - "Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants," and the American Nuclear Society (ANS) document N212 - "Nuclear Safety Criteria for the Design of Stationary Boiling Water Reactor Plants."

These documents establish four levels, or classes, important to safety called "Safety Classifications 1, 2, 3, and Non-Nuclear," in descending order of safety importance.

The definitions are similar to the NRC Regulatory Guide 1.26 quality group classifications and give the ASME-III and IEEE code cross references. All components whose failure could lead to an offsite dose in excess of 0.5 rem are given a Safety Class 3, a Seismic Category I, and require a quality assurance program.

To ensure that the various codes and standards as called for in the NRC regulations will in fact be applied, an Appendix B was added to 10 CFR Part 50 called "Quality Assurance Criteria for Nuclear Power Plants." This appendix lists and describes, in general, 18 criteria to be adhered to in the design, purchase, fabrication, handling, shipping, storing, cleaning, erecting, installing, inspecting, testing, operating, maintaining, repairing, refueling, and modifying of all safety-related structures, systems, and components.

Since Appendix B is general, ANSI N45.2, "Quality Assurance Program Requirements for Nuclear Power Plants" was issued to give pertinent details required to comply with Appendix B. This standard is continually being added to and will eventually cover every significant activity from the initial planning to the end result of a nuclear safety-related project.

In addition to ANSI N45.2, NRC Regulatory Guides such as 1.70.6 "Quality Assurance during Design and Construction," 1.70.9 "Design of Seismic Category I Structures," and 1.33 "Quality Assurance Requirements - (Operation)" have been issued to further ensure that all safety-related structures, systems, and components will conform to the intended quality levels commensurate with the importance of the safety function. See also Appendix D, Table D.1 for NRC Regulatory Guides corresponding to ANSI 45.2 standards.

The following NRC Regulatory Guides such as have a specific application to spent fuel storage facilities at nuclear power plants:

1.13 Fuel Storage Facility Design Basis (endorses ANSI N 210);
1.25 Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in Fuel Handling and Storage Facilities for BWR and PWR Reactors;
1.29 Seismic Design Classification;
1.55 Concrete Placement in Category I Structures.

These guides were issued to call for certain technical requirements to be met to ensure the integrity of the stored spent fuel such that loss of cooling capability cannot occur and leakage of radiation is always under control.

The following NRC Regulatory Guides also apply to fuel storage at fuel reprocessing plants:

3.4 Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors (this Guide calls for ANSI N16.1-1969 to be applied);
3.6 Guide to Content of Technical Specifications for Fuel Reprocessing Plants (this applies if changes are contemplated in the plant).

Every nuclear power plant, reprocessing plant and spent fuel storage installation must have a Safety Analysis Report (SAR) prepared. A Preliminary Safety Analysis Report must be issued before construction can be started, and a Final Safety Analysis Report must be issued before the power or reprocessing plant can be licensed to operate. Storage in a spent fuel storage installation is licensed under single-step procedure and the submitted SAR should be essentially in final form. Prior to submission of an SAR to the NRC for review, the applicant should have designed and analyzed the plant in sufficient detail to conclude that it can be built and operated safely. The SAR is the principal document in which the applicant provides the information needed by the NRC or the public to understand the basis upon which this conclusion has been reached.

In reviewing the SAR for a nuclear power plant, the NRC uses a review plan that ensures nothing significant is overlooked. This plan is called a "Regulatory Standard Review Plan" (SRP) and follows the same format as another document prepared by the NRC to be used as a guide by the applicant during his preparation of the SAR. This other document is called "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants." There are several sections in the report that relate to spent fuel storage, such as Sections 9.1.2, "Spent Fuel Storage," 9.1.3 "Spent Fuel Pool Cooling and Cleanup System," 9.1.4 "Fuel Handling System," 9.4.2 "Spent Fuel Pool Area Ventilation System," 15.7.4 "Fuel Handling Accidents," and 15.7.5 "Spent Fuel Cask Drop Accidents."

The sections relating to spent fuel storage in the SRP provide guidance to the reviewer to ensure that the SAR contains the information needed to demonstrate that the spent fuel will be stored in a manner that will always provide adequate cooling and control of radiation.

1.2.2 Cask Handling

In NRC Regulatory Guide 1.13, "Fuel Storage Facility Design Basis," it is asked that provision be made to prevent a cask drop that could damage the stored spent fuel or result in loss of pool water. This means that the pool must be designed to withstand a cask drop, the crane system must be designed to be single-failure proof, such that a single failure will not result in loss of safety function, or the cask must be precluded from travel over the spent fuel storage area.

NRC Regulatory Guide 1.104, "Overhead Handling Systems for Nuclear Power Plants," lists several requirements that should be incorporated into a crane system to ensure that stored spent fuel is not endangered and that NRC Regulatory Guide 1.13 and Standard Review Plan Section 9.1.4, "Fuel Handling System," will be satisfied.

For existing cranes and storage pools that do not meet this criterion, failure mode and effects analysis of the entire crane system is made to determine where single failure needs correcting. For the single-failure-proof criteria, the hook and cable systems are being made redundant and a minimum of one dynamic and two mechanical brakes are being supplied. A whole new trolley, cabling, and load block may be required. Meanwhile, because of the long delivery time, administrative controls can be instituted to confine the path that the crane is allowed to take from the receiving area to the pool and back to the receiving area for shipment. This requires that a complete cask impact study be made for the entire area to determine this path so that in the event of a cask drop, no safety-related system or components are endangered. A maximum permissible distance between the bottom of the cask and the floor may be required.

Most plant designs allow the load block to enter the pool water during raising or lowering of the cask at the spent fuel cask loading station. This could pose a potential problem with corrosion and contamination of the wire ropes and load block assembly (and the attendant accumulation of radioactive materials because of the difficulty of decontamination). Contaminated water could be transferred to the overhead drum and then drip on equipment and personnel. If bearings lubricated with grease or oil are used in the load block, there will be a possibility of lubricant contaminating the pool water. At the GE Morris Operation, provisions have been made to preclude entry of the load block into the water by using hook extensions about 30 feet long and a transfer step in the pool.

Standard Review Plan 15.7.5 covers the cask drop accident that involves only the spent fuel in the cask. In this case, if the cask drop is greater than 30 feet, or the impact limiter is removed from the cask during handling, then a radiological analysis must be performed to determine the offsite dose. The limits are given in 10 CFR Part 100.

1.2.3 Fuel Handling

General Design Criterion 61, "Fuel Storage and Handling Criteria for Nuclear Power Plants," of Appendix A to 10 CFR Part 50 requires that the spent fuel storage and handling systems be designed to ensure adequate safety under normal and postulated accident conditions. The requirements to meet "adequate safety" are given in NRC Regulatory Guide 1.26 which specifies failures of safety-related systems shall not result in offsite dose to an individual greater than 0.5 rem. NRC Regulatory Guide 1.13, "Spent Fuel Storage Facility Design Basis," calls for certain design features to ensure compliance with Design Criterion 61 of Appendix A to 10 CFR Part 50.

These features result in the requirements for a controlled leakage system for the fuel pool, with the design of the ventilation and filtration system based on an inventory of radioactive materials available for leakage from the building after an accident as given in NRC Regulatory Guide 1.25, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors."

Since the fuel handling equipment handles only one fuel assembly at a time, the maximum consequence of an accident is limited. A fuel assembly has been dropped at several reactor sites and no radioactivity increase was measured at, or within, the site boundary.

Most fuel handling accidents consist of dropping the fuel assembly as a consequence of improper fuel grapple finger engagement. If the drop occurs over the reactor core, the fuel in the core or the core grid plate may be damaged. Accidents of this nature have occurred and no radioactive material was released. Fuel assemblies can be damaged during removal from the core when the spacer grid snags an adjacent fuel assembly spacer grid and the grids are torn. This can only occur in a PWR. There has been no radioactive material released as a result of this type of accident.

1.2.4 Rack Design Criteria to Prevent Criticality

In accordance with Standard Review Plan 9.1.2, the design of the storage racks is reviewed against the following criteria:

a. The center-to-center spacing between fuel assemblies in the storage racks is sufficient to maintain the array, when fully loaded and flooded with nonborated water, in a subcritical condition. A k_{eff} of less than about 0.95 for this condition is acceptable, provided that uncertainties due to the calculational model and due to tolerances in the rack design are properly accounted for.

b. The design of the storage racks is such that a fuel assembly cannot be inserted anywhere other than a design location.

c. The storage pool and racks are classified and designed to seismic Category I requirements. Failures of systems or structures not designed to seismic Category I standards and located in the vicinity of the spent fuel storage facility will not cause a decrease in the degree of subcriticality provided.

d. The storage racks and the anchorages are designed to withstand the maximum uplift forces available from the crane without an increase in k_{eff} or a decrease in pool water inventory.

e. The spent fuel storage pool and racks are designed to preclude damage from dropped heavy objects.

f. Sharing of storage facilities in multi-unit plants will not increase the potential for the loss of pool water or decrease the degree of subcriticality provided

The essential portions of the spent fuel storage system are designed to provide protection from the effects of earthquakes, floods, hurricanes, tornadoes, and internally or externally generated missiles. Flood protection and missile protection criteria are discussed in the standard review plans for Chapter 3 of the SAR.

1.2.5 Seismic Considerations in Safety Studies

General Design Criterion 2, "Design Basis for Protection Against Natural Phenomena," of Appendix A to 10 CFR Part 50, requires that nuclear power plant structures, systems, and components important to safety be designed to withstand the effects of earthquakes without loss of capability to perform their safety functions. Regulatory Guide 1.29, "Seismic Design Classification" requires that the spent fuel storage pool be designed to seismic Category I requirements.

Regulatory Guide 1.70.9, "Additional Information, Design of Seismic Category I Structures," requires the following to be delineated for both the fuel storage building and its foundation:

- Description
- Applicable codes, standards, and specifications
- Loads and load combinations for all operating modes and seismic loads
- Design and analysis procedure
- Structural acceptance criteria
- Materials, quality control and special construction techniques
- Testing and in-service inspection requirements.

The principal reasons for designing the specified seismic Category I systems or components to perform their safety function during and after the maximum earthquake are to ensure that (a) decay heat from the stored fuel will be removed and (b) there will be no change of fuel geometry that can result in criticality.

The spent fuel racks are analyzed to verify their seismic and structural capability in the installed condition when fully loaded with fuel assemblies. Loading combinations and allowable stress limits are in accordance with NRC Standard Review Plans 3.8.4 and 9.1.2. The loads to be considered are: buoyancy, deadweight, operating basis earthquake, design basis earthquake, hydrodynamic mass effects, mechanical damage loads from a drop of a spent fuel assembly, thermal gradient, and crane uplift if crane hook or fuel snags the fuel rack.

The following NRC Standard Review Plans are used by the NRC to confirm the adequacy of the seismic analysis:

3.7.1	Seismic Input
3.7.2	Seismic System Analysis
3.7.3	Seismic Subsystem Analysis
3.7.4	Seismic Instrumentation Program
3.8.4	Other Category I Structures
3.8.5	Foundations

1.3 DESIGN REQUIREMENTS FOR SPENT FUEL STORAGE

1.3.1 Criticality

The concept of criticality, which is an important consideration for storage of spent fuel assemblies, involves the ability of an array of fuel to sustain a neutron chain reaction.

The dynamics of neutron chain reactions are dependent on the relative abundance and spatial distributions of materials in the array. The materials of principal interest are the fissionable uranium-235, uranium-238 and structural materials that absorb neutrons without causing fission, and water, which moderates high energy fission neutrons to thermal energies at which there is a high probability of capture and fission of uranium-235. Hydrogen in the water also parasitically absorbs a small fraction of the neutrons.

Neutron populations that exist because of a neutron chain reaction exhibit characteristics analogous to the behavior exhibited by populations of bacteria, animals, or even humans. Each member may be assigned a probable lifetime, a probability of producing progeny, and a mean number of progeny per birth event. An effective neutron generation lifetime is on the order of 0.09 seconds, and if a neutron absorption results in fission, it will, on the average, result in the birth of slightly less than 2.5 neutrons. Neutrons released by fission may be absorbed by materials other than uranium-235. Such events, which are dependent on design, may occur with high enough frequency to make a self-sustaining chain reaction impossible.

A measure of the ability of an array to sustain a neutron chain reaction is called the multiplication factor:

$$k = \frac{\text{neutron population in generation (n+1)}}{\text{neutron population in generation (n)}}$$

The term "reactivity" is commonly used and is defined as $(k-1)/k$.

Descriptions of reactors or fuel storage pools often use the terms k and k_{eff}. This terminology is in recognition of the fact that in finite arrays, some neutrons escape or leak from the system before being absorbed. It is analytically convenient to describe the properties of an infinite array, k , and then make allowances for neutron leakage to define an effective value, k_{eff}. It is common practice in fuel storage pool analyses to describe the fuel assemblies in terms of k , assuming they are in an infinite array spaced close together as they would be in a power reactor. Values of k are also defined for a fuel assembly and its associated rack and water spacing for a typical repeating "cell" in a pool array. Values of k_{eff} described for a storage pool array take into account the neutron leakage from the pool composed of such repeating cells. The neutron leakage actually is a very small fraction because of large dimensions of the pool.

If k_{eff} is greater than unity, the neutron population released by fission events is expanding; if k_{eff} is less than unity, the population is decreasing. An array is defined as "critical" if k_{eff} is exactly unity and a steady-state population exists. Power level of an array is proportional to the rate of uranium-235 fissions, which in turn is proportional to the neutron population.

In a power reactor, the abundance and distribution of neutron absorber and neutron moderator or neutron moderator materials can be remotely controlled to maintain the steady-state neutron population that results in a steady-state fission rate and power level. Power level is increased to the desired level by making k_{eff} slightly greater than one, and then adjusting the reactor core to a critical state when the desired power is reached. If reactor shutdown is necessary, k_{eff} can be rapidly made much less than one by insertion of high neutron absorber materials, e.g., control rods or a boron solution added to the coolant.

In contrast, a spent fuel storage facility is designed so that it is always subcritical ($k_{eff} < 1$) by a safe margin even under accident conditions, including the case when all fuel it contains is fresh. This limits the amount of fuel that can be stored within a given pool, although the limit is a function of materials used in the fixed storage racks, as discussed in Section 3.1.2 and Appendix D. Very detailed analytical procedures, carefully benchmarked for accuracy, are employed to ensure that criticality criteria are met.

The design multiplication factor limit for abnormal conditions is $k_{eff} \leq 0.95$. During normal operations at a fuel storage pool, the carrying of heavy objects by overhead cranes over the portions of the pool occupied by fuel is not permitted. These cranes are used to load and unload fuel bundles from storage racks. It is possible that an assembly and grapple or grapples could be dropped onto a fuel storage rack, causing structural damage that could potentially increase k_{eff}. Structural deformations can be computed given the nature of the impact forces and location. Conservative design necessitates making judgements as to worst cases, which then can be analyzed for criticality hazards. A dropped bundle may be considered to lie on top of a storage rack, or to fall between two racks.

The storage rack k_{eff} may also be affected by structural damage induced by an earthquake. Seismic analysis of the rack when subject to design earthquake loads is required, followed by criticality analysis if deformation occurs.

Storage racks are designed to mechanically preclude storing fuel assemblies at other than design locations. Neutron absorbers used in storage racks must be integral, non-removable parts of the rack. This eliminates the possibility of accidental criticality due to removal of the absorbers. Periodic in-service inspection is required to assure absorber integrity.

Total loss of water moderation reduces k_{eff}. However, a decrease in water density, such as would occur at elevated pool temperatures, may increase k_{eff}. For this reason, criticality analyses for fuel storage pools account for changes in k_{eff} that could occur for water temperatures up to 212°F.

Given a specific LWR fuel assembly design, the criticality of the fuel is largely determined by the fissile content of the fuel pellets. That is, the uranium-235 enrichment of the uranium (plus the plutonium-239 and plutonium-241 fractions in plutonium-bearing assemblies) directly affects the fuel assembly reactivity.

A spent fuel storage pool at a specific nuclear power plant must be designed for fuel of a particular design having a prescribed maximum fissile material content, and hence having a limited value of reactivity. When the fuel is placed in a storage array or rack, the pool will have an effective reactivity that is determined by the geometry and composition of the rack, as well as by the fuel assembly reactivity. The single most important geometrical factor is the assembly-to-assembly spacing, or pitch. At small spacings, the reactor core configuration is approached with a concomitant increase in reactivity. Conversely, at large spacing, the fuel assemblies are separated by enough intervening material and water for neutron absorption so that adjacent assemblies have little effect on each other. The same effect can be obtained by using materials with high neutron absorption cross sections surrounding the stored fuel. For this case, the fuel assemblies can be moved close together and still maintain a low reactivity.

The effects of spacing and fuel enrichment on spent fuel pool reactivity are illustrated in Table B.2 for a typical PWR 15 x 15 fuel assembly stored in a stainless steel rack utilizing stainless members to hold and locate the elements. The 3.3% enriched fuel is representative of the fuel used in the rack design for the Zion reactor (Commonwealth Edison Company), while the 3.1% enriched fuel is representative of the Turkey Point reactor (Florida Power & Light Company). The reactivity values are for a pool (at 212°F) that is uniformly loaded with fuel. A water temperature of 212°F is selected because this is the maximum temperature of an open pool of water at atmospheric pressure. The assumption for this case is that all pool cooling is lost for some reason. At lower temperatures, this type of storage array has a slightly lower multiplication factor.

Table B.2. Multiplication Factor (k_{eff}) of a PWR* Fuel Storage Pool

	k_{eff} vs Fuel Assembly Spacing (pitch)	
Fuel Enrichment	16 inches	21 inches
3.1 Wt % ^{235}U	0.862	0.843
3.3 Wt % ^{235}U	0.874	0.855
3.5 Wt % ^{235}U	0.885	0.865

*Fuel design data: 15 x 15 array with 21 water rods; 0.563" pitch; 0.3649" diameter pellet; 0.3819/0.4305" clad ID/OD; Zircaloy-clad; 92% theoretical density UO_2; pool at 212°F.

1.3.2 Rack Design

BWR and PWR racks are designed differently. The BWR uses a rack design (see Figure B.1) which is supplied by the reactor manufacturer. The outline dimensions are 14.5 feet high by 5.5 feet long by 1.5 feet wide. Individual rack positions have a 6 inch-square opening to receive the

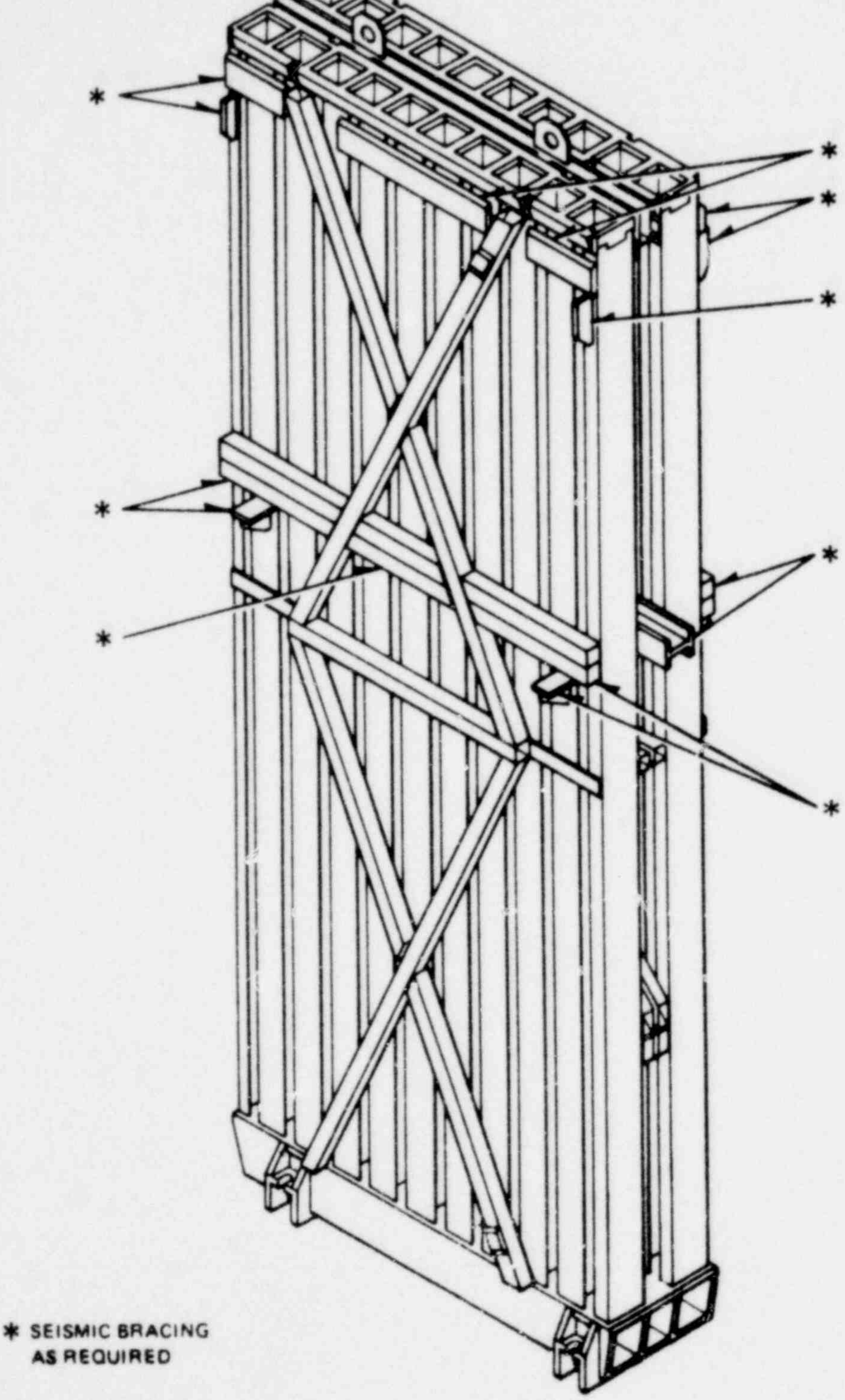


Figure B.1 Typical BWR Spent Fuel Storage Rack.

5.5 inch-square fuel assembly. The two rows of fuel assemblies are separated by a distance of 5.5 inches. Racks are supported at the base by four 1 inch diameter swing bolts. In high seismic areas, the racks are provided with cross-pool supports that reduce the rack loading in the short dimension. The BWR pool also has special racks for storage of control blades and fuel channels. These racks are described in Section 1.3.5 of this appendix.

The PWR racks are generally provided by the architect-engineer (AE) or purchased by the utility to specifications of the reactor manufacturer. This arrangement allows a number of rack design variations. However, most racks are made of stainless steel using preformed angles to form corners for support of the fuel. A typical rack is shown in Figure B.2. The racks are nominally 14 to 14.5 feet high and may have a 1- or 2-foot base. Most of the racks have a 20- to 21-inch center-to-center spacing for the fuel assemblies in a square array. The individual spaces in the rack are 8 to 9 inches square to receive fuel assemblies 7.5 to 8.5 inches square. Individual racks may be square or rectangular in cross section, with a maximum square dimension of about 8 feet. This dimension is dictated by shipping considerations.

Racks are designed with various methods of support for seismic restraint. The BWR uses swing bolts mounted to the floor of the pool with or without horizontal restraints. The floor mountings are supported by anchors in the concrete. These anchors are welded to the pool liner and are capable of taking the tension, compression, and shear loads that result from a seismic event. Some PWR racks are also mounted to the floor with anchors in the concrete. Other attachments used for seismic support in PWR pools include racks welded to pool floor embedments, horizontal supports welded to pool wall embedments, spring-loaded wall supports resting against (not attached to) the wall, friction-loaded supports with threaded adjustments that rest against the pool walls, and various combinations of these methods of restraint. Where the loading is in tension, anchors are required. Where the loading is compressive, it can be borne by the pool liner as backed up by reinforced concrete. In case of pool modifications (see Section 3.1.2 and Appendix D), it is required that the original design loads of the anchors not be exceeded when new racks are installed.

All racks are designed to allow water to flow under them in order to ensure adequate cooling of irradiated fuel. Sufficient space is provided underneath and around the rack so that the natural circulation of the water is not restricted under normal or abnormal circumstances. In this way, there is no significant increase in fuel temperature whether or not the pool cooling system is operating.

All racks are designed to Seismic Category I requirements to ensure that they remain functional during a seismic event. Specifically, the fuel is to remain vertical and the spacing between assemblies is to be maintained in order to provide a continued limitation on the neutron multiplication factor (k_{eff}). The rack is designed to maintain fuel spacing even when objects are dropped onto the racks.

The dimensions and tolerances for the fuel storage spaces are so arranged that fuel assemblies can be easily inserted and withdrawn. Manufacturing tolerances usually allow for a maximum bow from top to bottom of the storage space of about 1/8 inch. Tight tolerances are also maintained for twist and parallelism within the storage spaces in order to facilitate fuel movement.

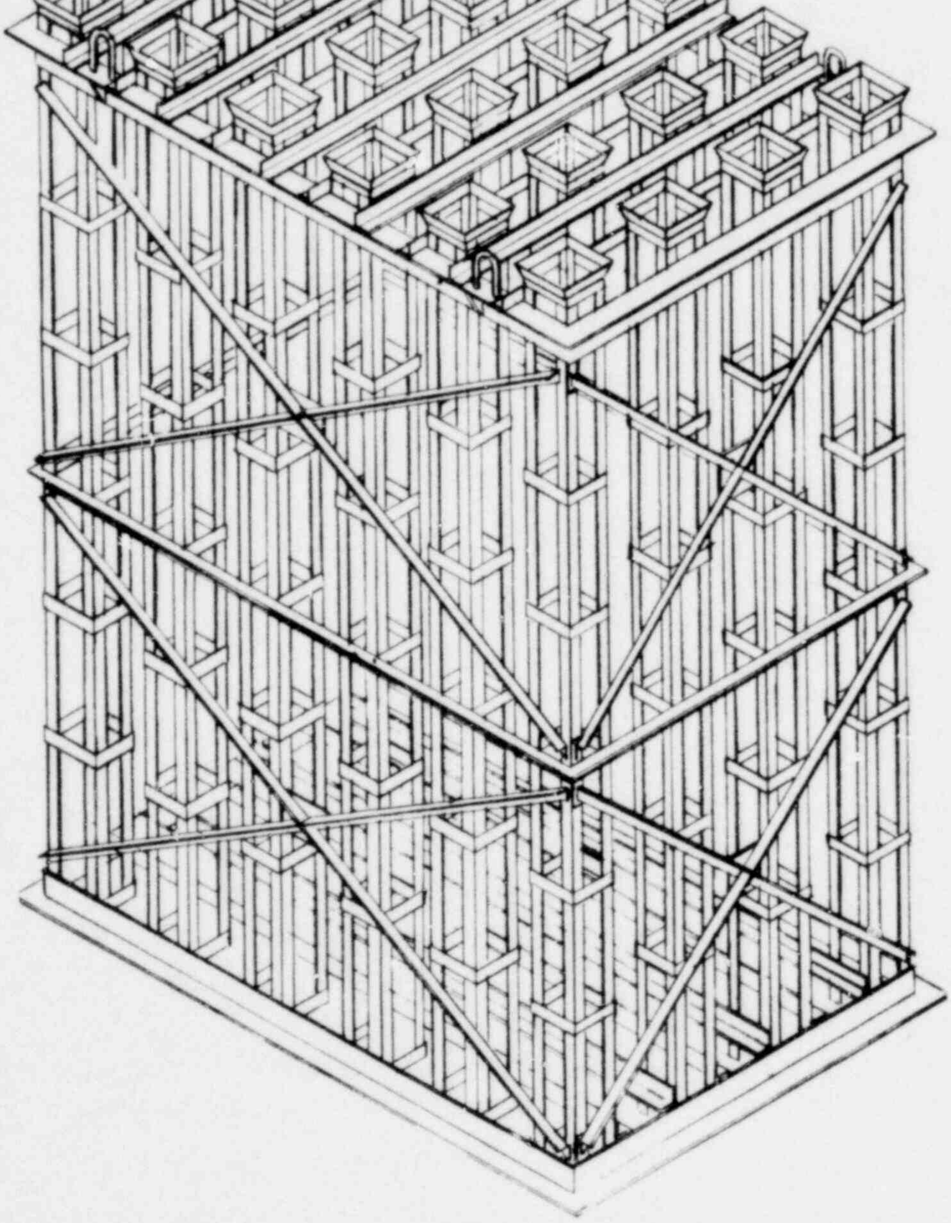


Figure B.2 Typical PWR Open Frame Fuel Storage Rack.

The materials used for construction of fuel storage racks (stainless steel and aluminum) are compatible with the fuel storage medium (pure or borated water). Consequently, very little maintenance is required. BWR racks are readily removable. PWR racks are removable in some plants, but are welded in place at others.

To alleviate the shortage of spent fuel storage space, it has been the practice of the utilities to expand the capacity of their present storage pools by utilizing unused spaces and by replacing storage racks with more space-efficient racks that meet safety requirements. Methods for accomplishing this are described in Appendix D.[1]

1.3.3 Spent Fuel Pool Cooling and Water Purification

When the fuel is removed from the reactor and placed into the fuel storage pool, the decay of fission products within the fuel rods continues to generate a certain amount of heat. The amount of heat produced by a given fuel assembly decreases with time in storage as fission products decay into stable, non-heat-producing elements. Heat generated by the spent fuel is usually treated for two different cases in the design of cooling systems. For the normal case, the quantity and age of the spent fuel that may be stored in the fuel pool as a result of normal reactor refueling are considered. The abnormal case assumes that the fuel pool is filled with fuel, including the discharge of a full core load of fuel. The fuel pool cooling system (FPCS) must be capable of removing the heat generated in these two cases. However, in some plants, the residual heat removal system (RHRS) can be used to supply additional cooling capacity for the abnormal case because all fuel has been transferred from the reactor to the fuel pool.

Figure B.3 shows a diagram of a typical spent fuel pool cooling system. This system actually consists of two interconnected systems. Either system is capable of removing the quantity of heat produced by the normal case. The maximum allowable pool water temperature is specified in each plant's FSAR. For the normal case, the specified maximum temperature is usually about 125°F. This temperature is based not on safety considerations, but on consideration of economics and the fact that plant personnel may be required to work in a humid atmosphere.

For the abnormal case (full core unload case), use of both systems and possibly the RHRS will be necessary to remove the heat. For this case, the maximum design temperature at most plants is in the range of 140° to 150°F. This level is based on the temperature limit of the purification system resins.

There are some differences in the methods of cooling the fuel pools in various plants because of differences in reactor manufacture and in plant age. However, all plants use systems basically similar to that described above.

The actual cooling of the fuel within the pool is by natural circulation flow of the water. The intake for the FPCS is located at the top of the pool so that the pool water at the highest temperature will flow through the FPCS. All piping connections and penetrations are near the top of the pool to prevent inadvertent lowering of the water level due to maloperation. The cold water returned to the pool is carried to the bottom by natural circulation, where it flows beneath the fuel racks. As each fuel assembly heats the water surrounding it, this water rises and the cold water below rises through the fuel assembly. The design of the fuel storage racks

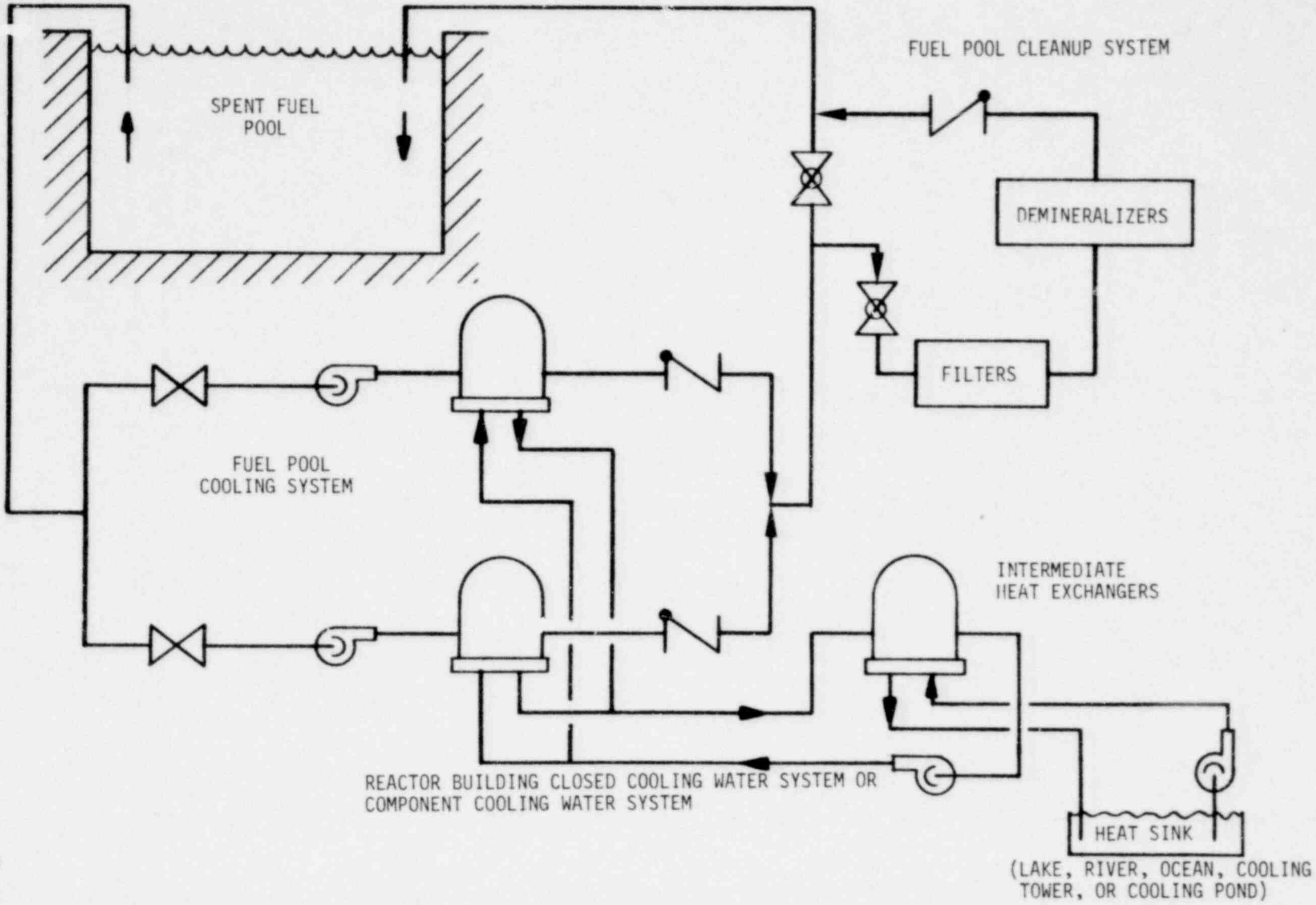


Figure B.3 Spent Fuel Pool Cooling and Cleanup System.

must allow an adequate flow path beneath the racks and along the length of the fuel assembly to provide adequate cooling by this natural circulation.

A water cleanup system that is usually incorporated into the FPCS may be designed to handle all, or only part, of the FPCS flow. The purpose of this system is to remove the various types of contaminants that may accumulate in the pool. Some of the sources of contamination are radioactive fission products and activation products on the fuel surface, leaking fuel rods, and dirt that falls into the pool from the operating area. Failure to remove this foreign matter reduces pool visibility, thus making working conditions more difficult. Also, radioactive contamination results in higher radiation levels in the operating area.

The cleanup system is connected to the FPCS and consists of filters and demineralizers. The filters remove the particulate matter from the pool water and the demineralizers remove dissolved materials to maintain the proper water clarity and to keep radioactivity at a low value.

The pH for the BWR pool is maintained at a neutral 7, while the PWR is maintained at a pH of 5 to 6, depending on the borate concentration. In the BWR system standard anion and cation resin beds are used to remove dissolved fission products and impurities. The filter system includes a filter aid that can be removed and processed in the radwaste system. Sometimes a Powdex system, consisting of a fine-grained demineralizer resin and a filter system in one package, is used. The Powdex system, filter system, or the demineralizer system can be regenerated or disposed in the radwaste system. Also, connections are made to the radwaste system to process the fuel storage pool water if necessary. The BWR cleanup system is usually a full-flow system that can be bypassed, if necessary, in order to increase the system cooling capacity.

The PWR system is a bypass filter-demineralizer system that has some special requirements in that the water is borated. This system uses borated resins in the demineralizers in order to prevent boric acid removal but maintain the capability to remove other dissolved impurities from the fuel storage pool water. Many of these systems use cartridge-type filters and demineralizers that are removed and disposed of as solid waste when the resins are spent or the filter is plugged. Connections are made to the chemical and volume control system, primarily for maintaining the proper concentration of borate in the water, but also for additional cleaning of the pool water as required. The temporary loss of pool cleanup capability would not present any significant problem to plant operation. However, long-term loss of cleanup capability could interfere with fuel pool operations.

1.3.4 Seismic Design

Criteria exist for the seismic design of spent fuel storage facilities. These criteria exist in the form of NRC Regulatory Guides, NRC Standard Review Plans, ANSI Standards, the Code of Federal Regulations, and the ASME Boiler and Pressure Vessel Code. The specific documents applicable to fuel storage facility seismic design are referenced in Table D.1 of Appendix D.

Most of these documents have been issued since 1971. Prior to 1971, some of these documents were used in draft form as fuel storage facility design criteria.

The documents currently in use for design criteria have been developed on the basis of the experience gained in the design of previous fuel storage facilities. The design of early fuel storage facilities was based on criteria established by the designers. These criteria and the designs and analyses based upon them were evaluated by the AEC as a part of the power plant licensing review.

The original seismic criteria for fuel storage facility design established by the facility designers were based on the power plant general design criteria. The first criterion applied to the seismic design of the facility was that the plant design earthquake could not result in the stored fuel becoming a critical assembly. This meant that fuel storage racks were required to maintain the fuel in a subcritical geometric arrangement. A limit of $k_{eff} \leq 0.90$ was used to provide an adequate safety margin for normal operations, and a limit of $k_{eff} \leq 0.95$ was used for abnormal events. More sophisticated computational techniques are now available and the present design limit is $k_{eff} \leq 0.95$.

The next criterion was that adequate cooling must be provided for the stored fuel. This meant that the fuel must remain submersed in water. It was not necessary for the fuel pool cooling systems to remain operative after the earthquake, since submersion of the fuel in 212°F water (the maximum possible pool temperature) would provide adequate cooling. However, this did require that a system designed to withstand the earthquake be available to supply water to the fuel pool to make up for evaporative losses. Another criterion was that the earthquake must not cause a loss of adequate shielding for the stored fuel. The shielding is provided by the fuel pool water and the pool structure.

All of the above criteria require that the fuel pool structure be designed to withstand the safe shutdown earthquake without significant damage or loss of the cooling water from the pool. Loss of water from the pool in excess of the makeup capability must be prevented so that the fuel cooling and shielding criteria are met. Significant structural damage to the pool might also change geometric fuel spacing and affect criticality. For these reasons, all fuel storage pools at reactors have been designed as Category I seismic structures.

The seismic design criteria stated above have evolved into the criteria presently used in design of fuel storage facilities. Although the criteria in the documents listed are more specific for the various components of the fuel storage facility, the basic principles of fuel storage facility design do not differ significantly.

1.3.5 Nonfuel Equipment Storage in Pool

In Section 3.1.2, the storage of nonfuel items was mentioned. In the BWR system, control blades are stored in racks shown in Figure B.4, and fuel channels are stored in racks shown in Figure B.5. Other items stored in the fuel storage pool include in-core instrumentation, jet pumps, temporary control curtains (used in some reactors for the first core cycle), and other pieces of hardware removed from the reactor vessel. All of these are cut into small pieces and placed in a cask and shipped offsite after short periods of radioactive decay. While in the pool, the items are stored in a pit, suspended from the walls, or laid on the floor.

For PWR nuclear power plants, control rod clusters are stored in fuel assemblies. Fuel channels are not used in PWR's. Consequently, storage of non-fuel items is confined to instrumentation and small items that are removed from the reactor vessel.

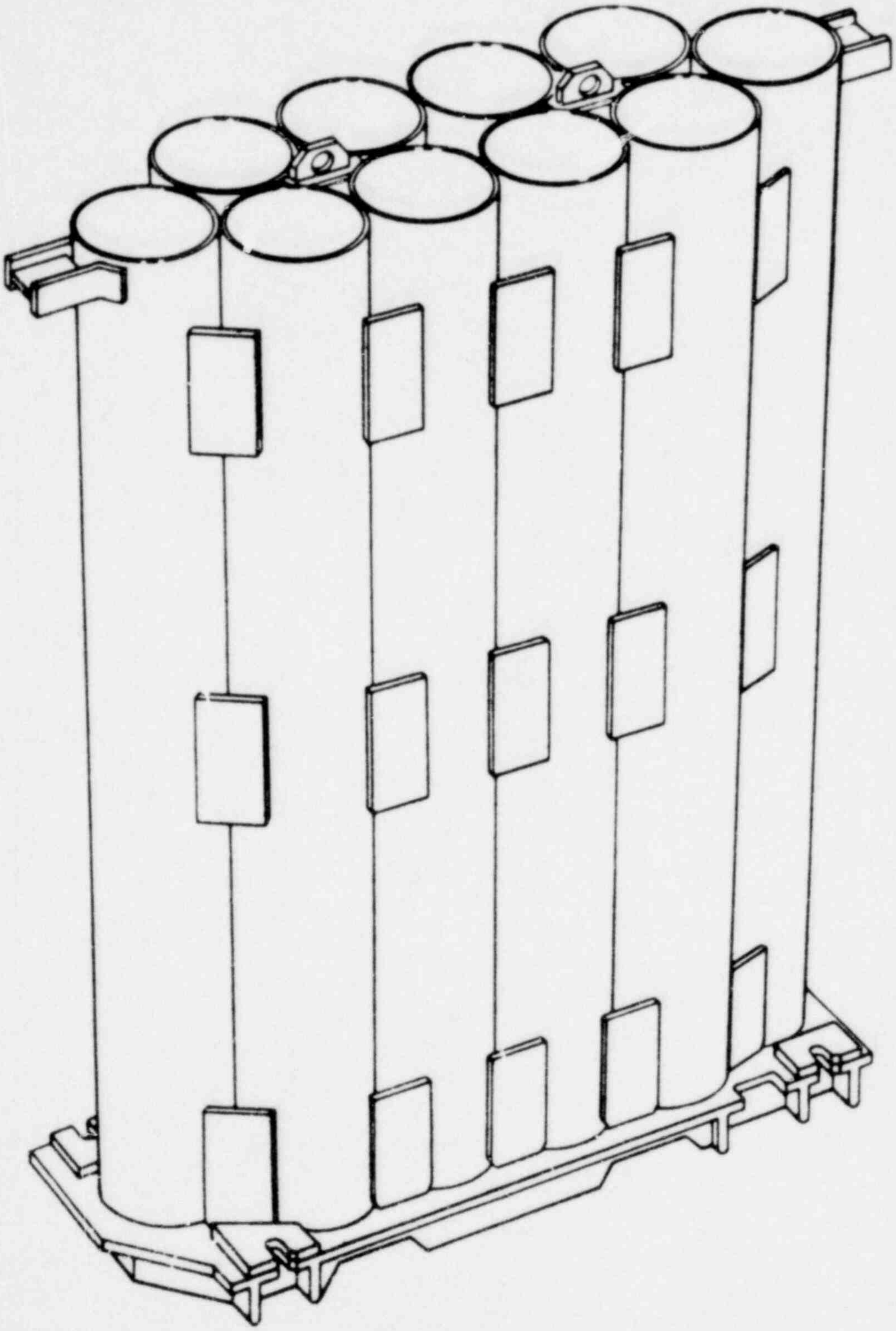


Figure B.4 BWR Control Rod and Defective Fuel Storage Rack.

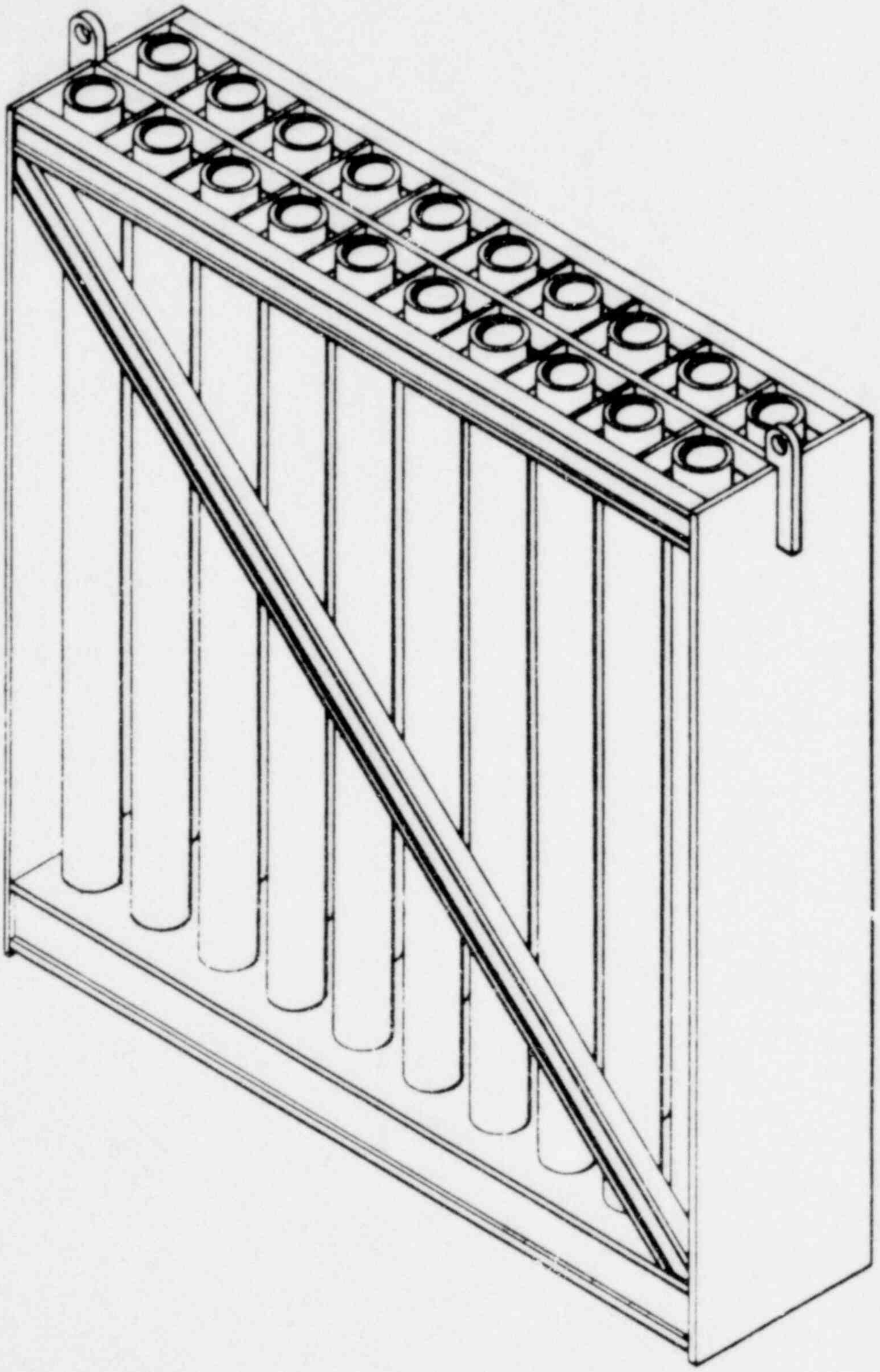


Figure B.5 BWR Channel Storage Rack.

All items removed from the reactor vessel either in a BWR or a PWR have a potential for being radioactive either from direct neutron irradiation or from the plateout of activation or fission products. The activity levels depend primarily on the integrated neutron flux that the components have received. Consequently, these items are stored in the pool and surveyed to determine the means of decontamination and reuse, or decontamination and disposal, as required.

1.4 FUEL HANDLING

1.4.1 Fuel Handling Criteria

This section gives the basic criteria for establishing the design, operating, and maintenance requirements for the handling of new and spent fuel in the power plant. It also describes the fuel handling process for BWR's and PWR's. The power plants used as examples are the Duane Arnold Energy Center (BWR) and the Kewaunee Nuclear Power Plant (PWR). Although detailed plant and equipment arrangements, facility size, and quantity of spent fuel to be handled vary from plant to plant, the processes described herein are representative of each type of plant.

There is some similarity of areas and equipment used in BWR's and PWR's. The terminology used here is that which has become more or less traditional for each type of power plant. As a result, some of the areas and equipment in each type of plant that appear to be similar are identified with different nomenclature.

Basic criteria for establishing the design, operation, and maintenance of components used in the fuel handling process are as follows:

a. Applicable parts of ANSI N212, "Nuclear Safety Criteria for the Design of Stationary Boiling Water Reactors;"

b. Applicable parts of ANSI N18.2, "Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants;"

c. Applicable parts of ANSI N210, "Design Objectives for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Stations;"

d. 10 CFR 50, Appendix A, "General Design Criteria for Nuclear Power Plants;"

e. 10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants;"

f. NRC Standard Review Plan 9.1.2, "Spent Fuel Storage," February 1975;

g. NRC Standard Review Plan 9.1.4, "Fuel Handling Systems," May 1975;

h. ANSI N45.2.11, "Quality Assurance Requirements for the Design of Nuclear Power Plants."

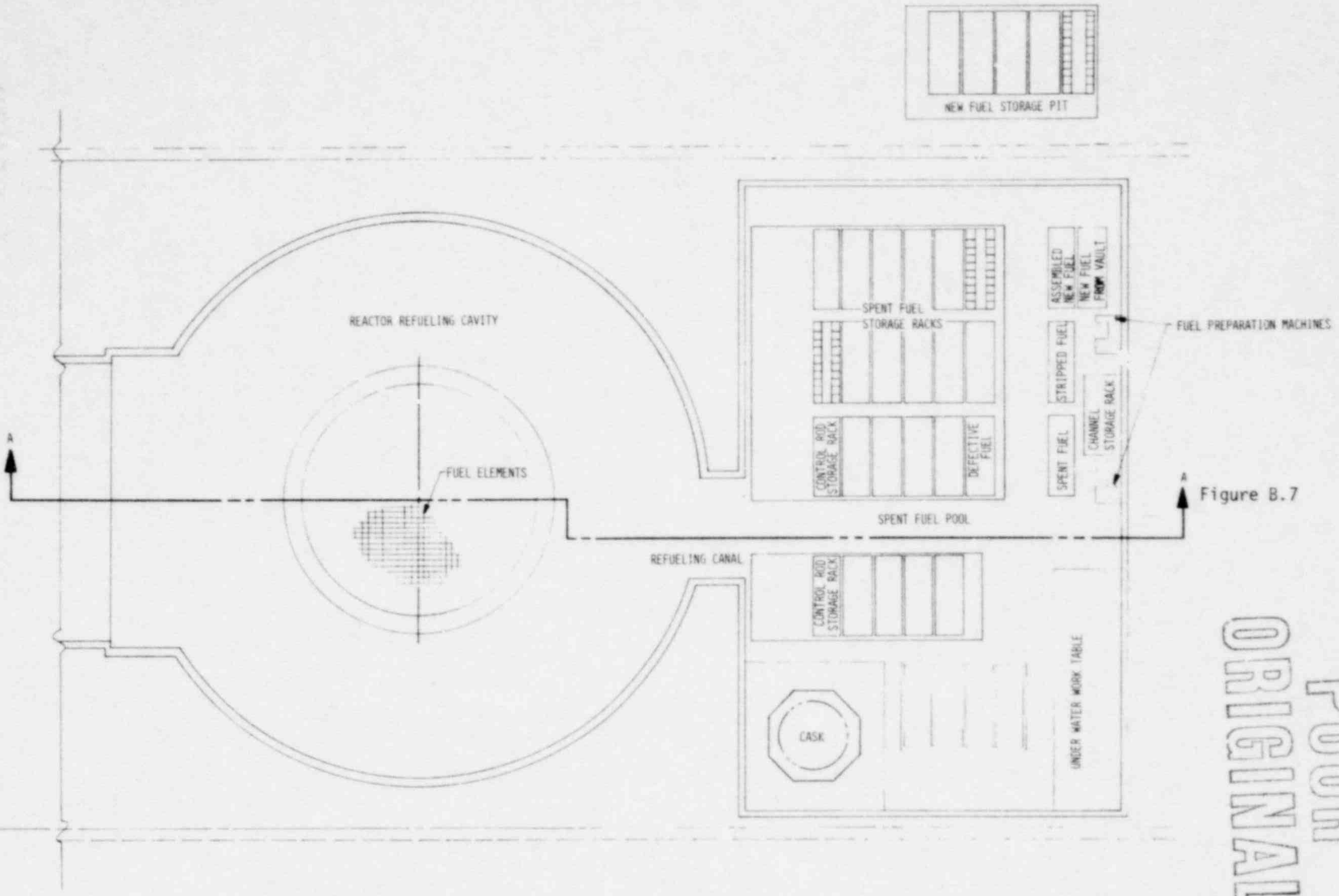
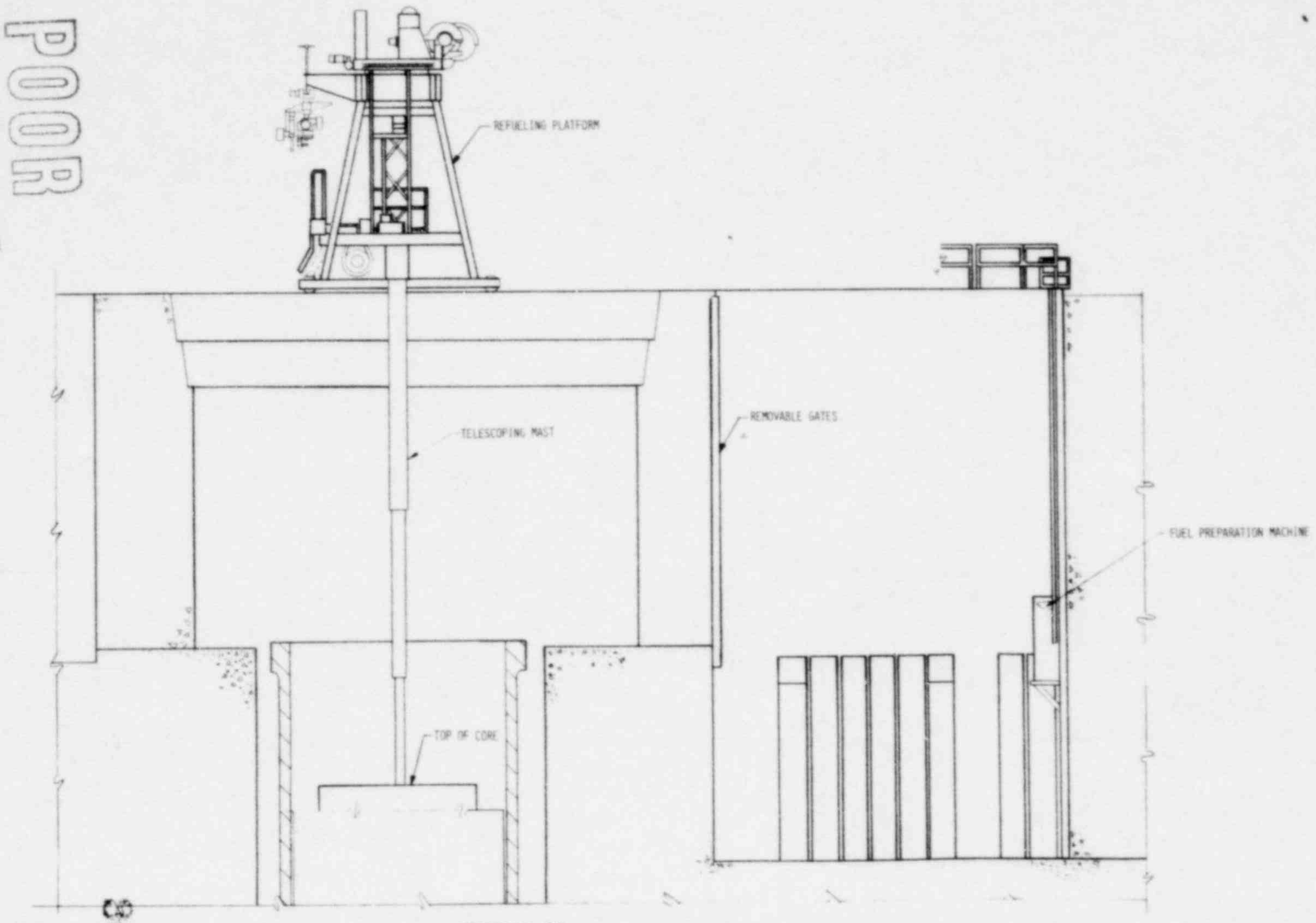


Figure B.6 Fuel Handling Facilities Plan - BWR.

POOR ORIGINAL



SECTION AA

Figure B.7 Fuel Handling Facilities Cross-Section - BWR.

862327

POOR ORIGINAL

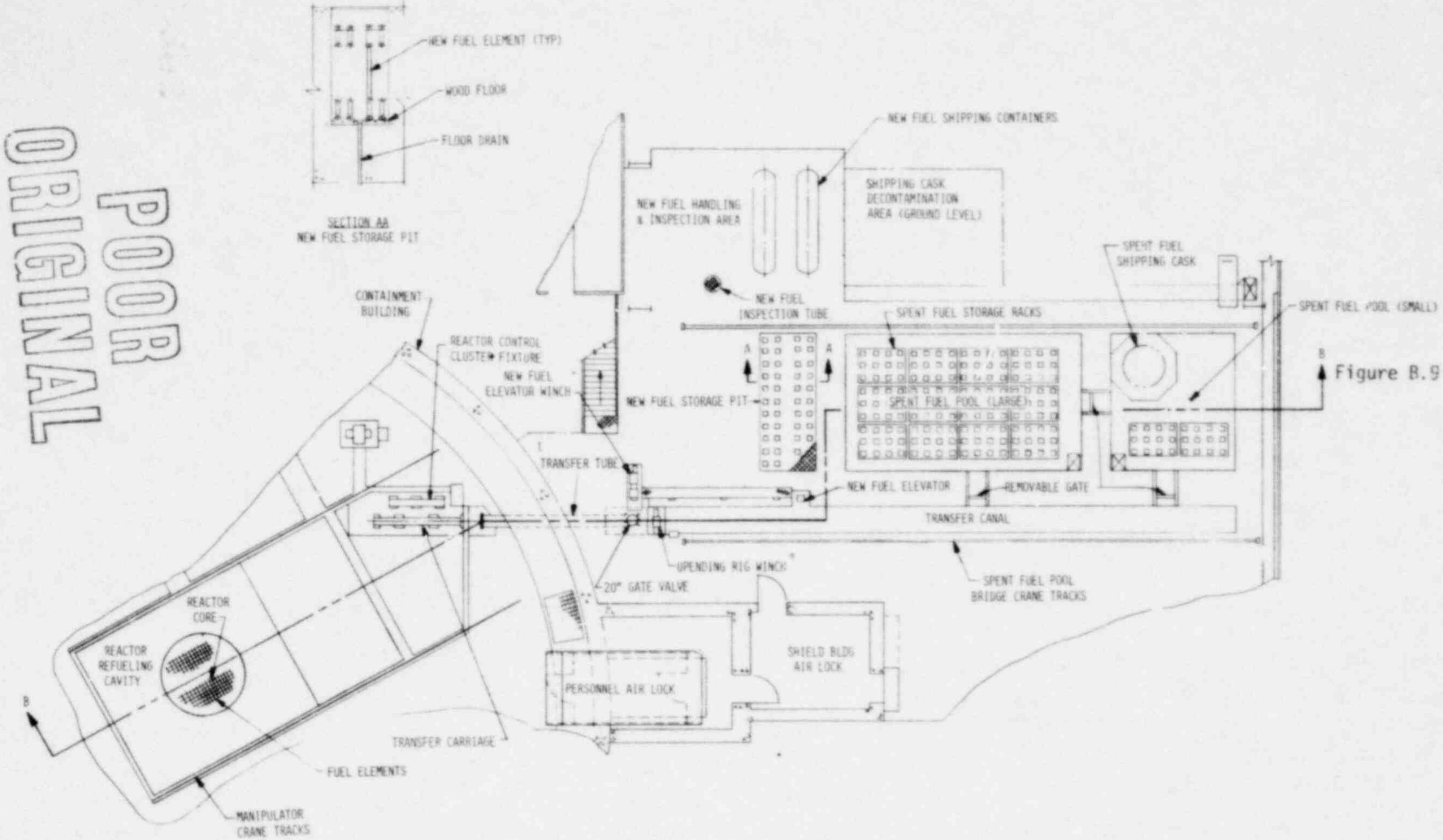


Figure B.8 Fuel Handling Facilities Plan - PWR.

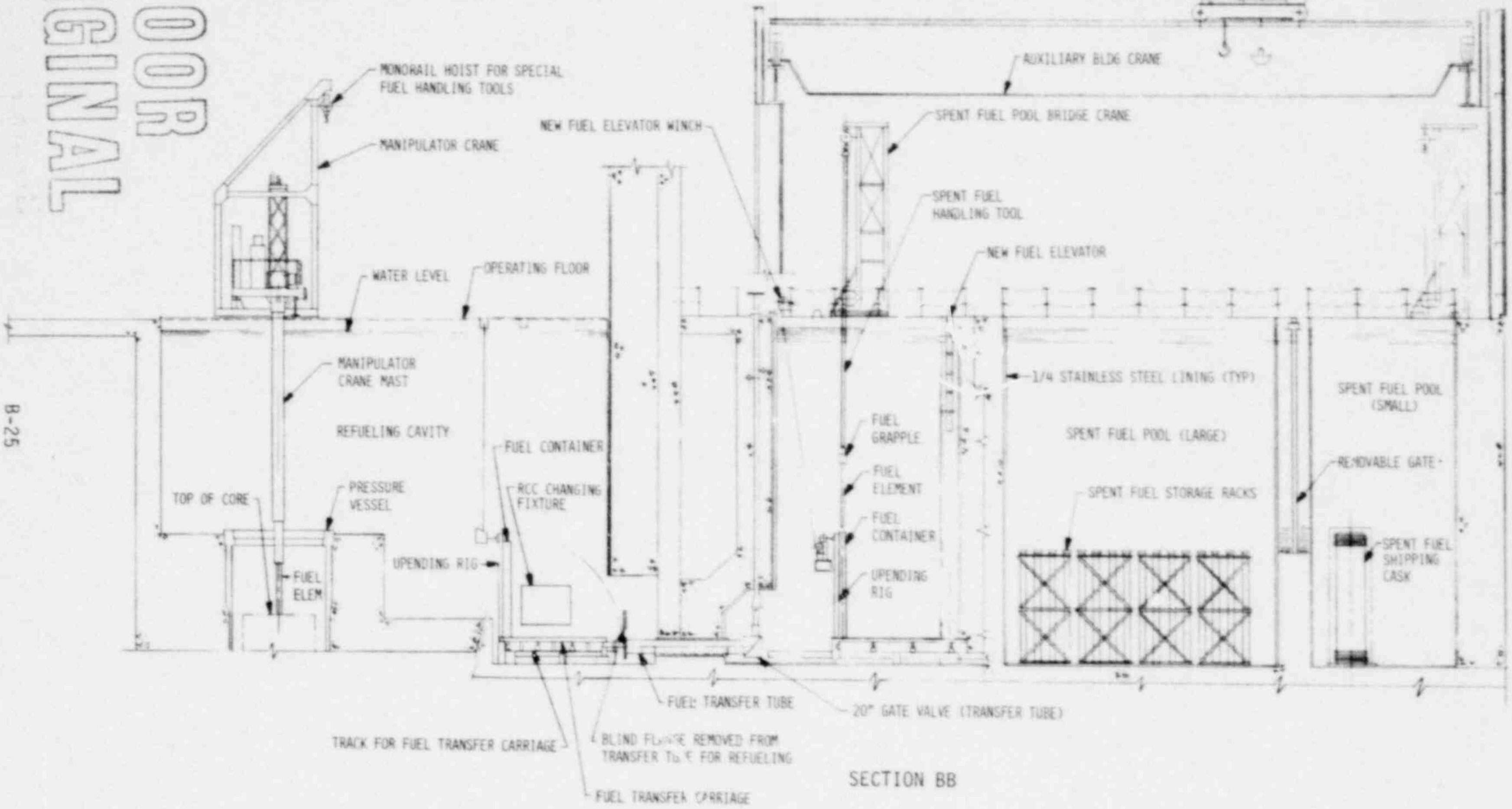


Figure B.9 Refueling Handling System Section - PWR.

1.4.2 Equipment Design

The major fuel handling equipment and facilities are identified on Figures B.6 through B.9. The equipment associated with fuel handling is shown in Figures B.7 and B.9. The main function of the equipment is to move fuel into and out of the reactor and to store it in the fuel storage pool. From the safety standpoint there are three main considerations:

- Maintenance of shielding over the fuel;
- Prevention of fission product release;
- Prevention of loss of water from the fuel storage pool.

The equipment is somewhat similar for both the BWR and the PWR in that grapples and refueling bridges are used to move the fuel. The refueling operation for the BWR is carried out in one building with a single refueling bridge. The PWR requires transfer of fuel from the reactor building to the refueling or auxiliary building. For this operation, two refueling bridges are required, one in each building.

In order to maintain shielding, grapples are designed so that if equipment fails, the fuel assemblies will come no closer to the water surface than eight or ten feet. This limits the radiation level at the surface to less than the maximum 2.5 mR per hour allowed per ANSI N210. The equipment is designed so that the minimum water depth over the fuel is maintained even if the hoist or grapple mechanism is at the top of its travel.

The second requirement is related mainly to possible damage to fuel that is dropped. To prevent the dropping of fuel, the grapples are positive latching devices that cannot be released while the fuel is being transported. Electrical interlocks are provided to prevent fuel movement when the latch is not properly engaged. Fuel has been dropped on occasion without serious damage to the fuel or measurable offsite release of radioactivity. The experience has resulted in improved grapple designs.

The third requirement is to ensure water supply for shielding the fuel and for cooling. The potential for significant water loss is evaluated and the appropriate design and procedural methods are used to prevent or mitigate the effects of potential accidents. The main consideration is the shipping cask and its movement. Provisions are made to limit damage from a cask drop or to provide redundant crane features to prevent the cask drop.

1.4.3 BWR Refueling Operation

The major facilities required for fuel handling at BWR's consist of the following (all are in the reactor building, accessible from the refueling floor level, except as noted):

a. Reactor refueling cavity

b. Spent fuel storage pool with storage racks

c. New fuel storage vault with storage racks

d. Shipping cask pad area (located in pool)

e. New fuel inspection area

f. Fuel preparation area (located in pool)

g. Shipping cask decontamination area (located at ground level).

The principal items of equipment required to perform a refueling cycle are as follows:

a. Fuel preparation machine

b. New fuel inspection stand

c. Refueling platform

d. Reactor building crane

e. Jib crane.

There also is a complement of other equipment to facilitate the refueling process. These items include slings, grapples, actuating poles, wrenches, underwater lights, viewing aids, and an underwater TV system.

Before the start of a refueling operation, new fuel must be received and inspected. It must also be prepared for final assembly into the reactor. This is accomplished by first placing it in the new fuel racks in the pool. It is then channeled and stored in the assembled new fuel rack in the pool where it is ready for use.

To start refueling operations, the reactor is shut down and allowed to cool, both thermally and radioactively. During the cooldown period, the reactor shield blocks and the drywell head are removed.

After cooldown, first the reactor vessel head insulation and then the vessel head are removed. The water is raised to the refueling level, the pool gates are removed, and the steam dryers and separator are placed in a pool provided for them. At this time the fuel assemblies are free from equipment interferences and are ready for removal from the reactor. The water has been adjusted to the correct height and all refueling equipment has been operationally tested.

To start the refueling sequence, the refueling platform is positioned over the fuel assembly to be removed using predetermined coordinates read from position indicators on the refueling platform. The fuel grapple is united with the spent fuel assembly, then raised to a predetermined height to clear the reactor vessel and still leave sufficient water depth over the fuel assembly to eliminate any radiation hazard to personnel.

The refueling platform then moves the spent fuel assembly through the refueling canal to the spent fuel storage pool. The spent fuel is positioned over a designated vacant cavity in the spent fuel storage rack, lowered into the rack, and the fuel grapple is disengaged.

To install new fuel, the processes are carried out in reverse order. The reactor is then returned to an operating condition, thus completing the refueling cycle.

Reuseable fuel channels are removed from the fuel prior to offsite shipment. A section of the fuel storage pool is designated as a work area during refueling. The equipment in the work area is used for dechanneling the spent fuel and installing channels (new or used) on the new fuel.

The equipment used for preparing new and spent fuel includes a monorail jib hoist with trolley, grapple poles, hand-actuated grapples, portable underwater lights, underwater work table, and a channel handling boom located between the two fuel preparation machines.

To ship spent fuel offsite, spent fuel assemblies are loaded into a specially designed, shielded, and cooled shipping cask. To load spent fuel, the reactor building crane is used to lower the shipping cask into the fuel pool and set it on the cask pad area in a vertical position. The cask closure is then removed. Through use of the refueling platform, the spent fuel assemblies are placed in the shipping cask. The cask closure is then reinstalled and sealed. The reactor building crane is used to move the cask from the pool to the shipping cask decontamination area. The cask is washed down to remove any contamination that may have been picked up in the pool. The cask is then loaded onto rail or truck transportation for shipment off the site.

1.4.4 PWR Refueling Operation

The PWR refueling operation is fundamentally the same as that for the BWR except for the transfer between the reactor and refueling, or auxiliary, building. For this operation the fuel is placed in a container located on the transfer carriage, lowered to a horizontal position, driven through the fuel transfer tube to the transfer canal by an air motor, and raised to a vertical position for transfer to the fuel storage pool.

There are only two basic differences between PWR and BWR refueling procedures: (1) the removal of control clusters from PWR fuel prior to the transfer tube operation, and (2) the stripping of fuel channels from BWR fuel assemblies.

Figures B.8 and B.9 show a refueling handling system for a PWR.

1.4.5 Mixed Oxide Fuel Considerations

Plutonium that is recovered from spent fuel at reprocessing plants is a fissionable material and could be used in new fuel assemblies in place of uranium-235. Plans to recycle plutonium this way are well developed, although generic approval for commercial-scale recycle has been deferred indefinitely by the NRC.[2,3] Detailed designs of such fuel assemblies generally are mechanically identical to standard uranium fuel assemblies. Plutonium is blended with uranium-235 and natural uranium. All metals are in oxide form and therefore, the mixture is called "mixed-oxide." Mixed oxide fuel assemblies could be used interchangeably with standard uranium fuel assemblies. Consequently, reactivity characteristics of the two fuel types are designed to be approximately the same. Reactors which have been operating with mixed oxide fuel on a demonstration basis include Big Rock Point, Dresden 1, and Quad Cities 1.

Because the physical features and reactivity characteristics of standard uranium fuel assemblies and mixed oxide fuel assemblies are essentially the same, there are no unique requirements for handling or storing one type versus the other.

1.5 TRANSPORTATION PRACTICES

Irradiated nuclear fuel has been transported in the United States since the mid-1940's, with numerous shipping cask designs developed because of the variety of AEC (DOE), military, research, and commercial nuclear reactors in service. Experience gained in the design and use of these casks, plus stringent NRC and Department of Transportation (DOT) regulations,[4,5] have led to the present generation of LWR shipping casks.

All spent LWR fuel transported in the United States currently is shipped in heavily shielded casks by truck or rail. Truck casks weigh 25-35 tons when fully loaded and will normally accommodate 1 to 3 PWR or 2 to 7 BWR fuel elements. Rail casks can weigh in excess of 100 tons fully loaded and can take 7 to 12 PWR or 18 to 22 BWR fuel elements. Barge shipment remains unexploited.[6] Since air shipment of plutonium in any form is presently precluded by law,[6] spent fuel cannot be transported by air.

The primary reliance for safety in transport of irradiated nuclear fuels is based on the shipping cask design. Cask design and operation are influenced by regulations imposed by the NRC, DOT, and the individual states. These regulations are described below.

1.5.1 Regulatory and State Requirements

Strict criteria regarding allowable radiation levels, criticality safety, heat dissipation, and release of radioactive materials have been established for spent fuel shipping casks. Cask design must prevent loss or dispersal of spent fuel under normal operating and severe design base accident conditions.

Primary responsibility for overseeing the transportation of radioactive materials in the United States rests with the DOT and NRC. State requirements are normally auxiliary regulations that pertain to transportation routes in highway weight limits, or require additional safety measures.

Some degree of overlap does exist between the NRC and DOT, but a memorandum of understanding signed in 1966 and revised in March of 1973[7] generally delineates the authority of the DOT as setting standards for marking, labeling, safety in shipment (radiation levels, temperatures, etc.), regulating shippers and carriers, and approving various packages as suitable for transport of radioactive materials. The authority of the NRC (then AEC) was set forth as reviewing and approving shipping containers for fissile, Type B, and large quantities of radioactive materials as defined by Title 49 CFR 173.389. This represents almost all radioactive materials.

1.5.1.1 Federal

NRC regulations for the transport of radioactive materials are set forth in "Standards for Protection Against Radiation" (10 CFR Part 20), and "Packaging of Radioactive Materials for Transport and Transportation of Radioactive Material Under Certain Conditions" (10 CFR Part 71).

The packaging and shipping requirements for transport of radioactive materials are a function of the quantity, type, and fissile characteristics of the isotopes being shipped. The "transport group" of an isotope refers to any one of seven groups into which radioactive materials in normal form are classified according to toxicity and potential hazard in transport as defined by Title 49 CFR Part 173.389.[8] Because of the presence of plutonium and other highly toxic isotopes, irradiated nuclear fuel is classified as Transport Group 1, the most restrictive grouping.

The quantities of isotopes which can be shipped as Type A, Type B, or large quantities vary with the transport group.[9] Spent nuclear fuel is shipped under a large-quantity designation.

Shipments of fissile material are classified as either Fissile Class I, II, or III, as defined by Title 49 CFR Part 173.389.[10] Spent fuel shipments are rated as the most restrictive class, Fissile Class III, which requires special arrangments between the shipper and carrier to ensure nuclear criticality safety for shipment.

The general NRC criteria for packaging and shipment of radioactive materials are given in 10 CFR Part 71, Subparts B, C, and D. Because of the large-quantity designation for irradiated fuel shipments, spent fuel casks must also be designed to meet hypothetical accident conditions when applied sequentially.[11] The hypothetical accident conditions and the resultant cask condition, as set forth, represent what are considered reasonably conservative estimates of what a transportation accident might involve.

To show that a cask design will meet the conditions of 10 CFR Part 71, each applicant is required to submit a detailed Safety Analysis Report (SAR) to the NRC. This SAR contains three basic parts.[12] The first covers such general information as a description of the cask, contents, and operational features. The second part is for technical information, including structural assessment, heat transfer analysis, containment evaluation, shielding, and criticality. The final part deals with fabrication and operation of the cask, including operating procedures, acceptance tests, maintenance program, and quality assurance. The SAR is the principal means for the applicant to provide information to demonstrate that the cask design meets the requirements of 10 CFR Part 71. Analyses of cask handling and drop accidents and how they affect the shipping and receiving facilities are covered in the SAR's required for those facilities under 10 CFR Part 50, "Licensing of Production and Utilization Facilities."

NRC regulations for transportation of radioactive materials are also included in 10 CFR Part 20, and require a receiver to check any package (cask) for smearable contamination within 3 hours after receipt and to notify the carrier and the NRC immediately if contamination levels above 22,000 dpm/100 cm^2 are found.[13] Records must be kept of all such cask surveys and monitorings. Licensees must also maintain and follow established procedures for opening or handling any shipping cask.

Security requirements for the protection of irradiated reactor fuel during transportation are included in Section 73.37 of 10 CFR Part 73, "Requirements for Physical Protection of Irradiated Reactor Fuel in Transit."

DOT regulations for transportation of radioactive materials are given in 49 CFR ("Transportation") Parts 170-179. These regulations set the criteria for radiation levels, surface temperatures, surface contamination levels, bill of lading information, labeling, placarding, shipper certification, accident response, and general packaging.

In 1974 the DOT proposed a new labeling system for hazardous materials called the DOT HI system.[15] If adopted, this system will alter the information given below and would require additional emergency response information to be carried with the shipment.

Spent fuel casks are transported in exclusive-use vehicles and must be filled only by the consignor and opened only by the consignee. Allowable radiation limits for exclusive-use vehicles are:[16]

a. 1000 mR/hr at 3 feet from the external surface of the package (cask) (closed vehicles only);

b. 200 mR/hr at any point on the external surface of the vehicle (truck or rail car) (closed vehicles only);

c. 10 mR/hr at 6 feet from the external surface of the vehicle;

d. 2 mR/hr in any normally occupied position in the vehicle.

Because of the large size of the packages used for shipping irradiated fuel, the limiting factor will be the radiation level at either three feet from the surface of the package or six feet from the vehicle. Therefore, the radiation levels at the package surface will be considerably below those allowed by the regulation.

Based on actual experience, radiation levels around some irradiated fuel casks may exceed 200 mrem/hr at the surface of the cask, but will meet the limitations of 1000 mrem/hr for closed vehicle shipments. In order to meet the limitation of 10 mrem/hr at six feet from the vehicle surface, the level will rarely exceed about 50 or 60 mrem/hr at the vehicle surface, or 25 mrem/hr at three feet from the truck or rail car.

Although a radiation level of 2 mrem/hr is permitted in a truck cab, the level based on actual experience is unlikely to exceed 0.2 mrem/hr, because of the distance from the cask and shielding provided by intervening material.[17]

Surface contamination levels must be 2200 dpm/100 cm^2 or less for beta-gamma (β-γ) radiation, and less than or equal to 220 dpm/100 cm^2 for alpha (α) radiation.[18]

Heat generated within shipping casks must be dissipated so as not to affect the efficiency of the cask or to damage the contents. Maximum accessible external surface temperature of a package (cask) transported as an exclusive use shipment must be 180°F or less.[19]

Shipping papers for spent fuel shipments must include identification of contents, weight, volume, transport group, list of radionuclides, physical or chemical form, required labels, placards, fissile class, activity, and shipping certificate.[20]

Following any accident, immediate notification must be given to the DOT, and a detailed report must be submitted within 15 days.[21]

1.5.1.2 State and Local

State and local regulations on the transport of nuclear materials are normally limited to those requirements for any type of vehicle traffic, such as gross vehicle weight and dimensions. Overweight shipments are sometimes subject to limitations on routing and time of operation. In addition, some states have adopted or are considering regulations to cover the following:[22]

a. Routing restrictions, speed limits, or blanket prohibitions on shipments;

b. Advance notification of shipments and approval by states;

c. Inspection of shipments;

d. Pilot vehicles or escorts;

e. Special training of drivers, additional monitoring personnel, and emergency plans;

f. Requiring drivers to carry copies of state regulations;

g. Special-use trains;

h. Classifying drivers as radiation workers;

i. Emergency preparedness by state officials.

The effect each of the above can have on transportation of spent fuel will vary from state to state and will have to be evaluated on an individual basis.

1.5.1.3 Other

Attempts by the American Association of Railroads to impose a requirement that all spent fuel shipments by rail be on a special train limited to a maximum speed of 35 mph and to levy a surcharge of approximately $19 per train mile for this service have been overruled by the Interstate Commerce Commission.

Although no spent fuel shipments are made by either barge or air at present, regulations covering the transport of radioactive materials by such means are contained in 49 CFR Parts 170-199.

1.5.2 Description of Casks

At present, all spent fuel shipments in the United States are by truck or rail casks. Truck casks are more mobile and much lighter than rail casks. Truck casks are limited to a loaded weight of about 25 tons because of the maximum 73,280-pound load limit (tractor-trailer included) for most highways. Weights up to 35 tons are usually acceptable on an overweight basis, although most states will require certain restrictions, such as routings, time of travel, or early notification of shipment. Rail casks weigh about 100 tons fully loaded, and have a much larger fuel element capacity. (It would take six trips with a truck cask to carry the same amount of fuel that could be transported in a fully loaded rail cask.)

One advantage to truck casks is the faster turn-around time, about three to four days being necessary for a 3200-kilometer round trip with a truck cask, compared with nine days for a rail cask.[17] Experience at one reprocessing plant showed two round trips of 177 kilometers each were possible in slightly more than 4 hours each with a truck cask.[23] Truck casks will still be needed for those reactors without rail facilities. Table B.3 summarizes those casks in the United States that are either presently licensed or known to be in the planning/fabrication stage and that are capable of transporting spent LWR fuel.

The majority of those casks presently licensed or known to be in the planning/fabrication stage in the United States are discussed in more detail below. Not included are a few other spent fuel casks that are designed for very specific types of fuel and that will not generally handle present-day LWR fuels.

1.5.2.1 Truck Casks

NFS-4--The Nuclear Fuel Services NFS-4 is a water-filled 1 PWR/2 BWR truck cask. The license application was submitted in January 1972, with final AEC approval in November 1972. The first two casks were completed in 1973. The cask has an internal cavity 452 cm long by 34 cm in diameter, with interchangeable baskets for either PWR or BWR fuel elements. Surrounding the cavity for gamma shielding and structural strength is 16.8 cm of lead and about 4 cm of stainless steel (in several layers). Neutron shielding is provided around the body by 11.4 cm of borated water-antifreeze solution. The cask lid is held down with high-strength bolts and sealed with Teflon O-rings. Stainless-steel-encased balsa wood impact limiters are provided around the side and ends of the cask.

Heat rejection is by convection through the water coolant in the cavity to the inner wall, conduction to the neutron shield, convection to the outer wall, and convection plus radiation to the atmosphere. Maximum heat rejection capacity is 11.5 kW. Maximum design conditions for the inner cavity during normal transport are 174°C at 150 psig. Normal pressure upon receipt is almost always less than 5 psig, however, so the design is quite conservative. Under the maximum fire accident, the cask will withstand 222°C at 948 psig with no loss of containment.

TN-8--The Transnuclear TN-8 is a 40-ton truck cask designed to transport 3 PWR assemblies in an air atmosphere. The TN-8 will normally travel under overweight restrictions, although several could be placed together on a rail car. A license was granted by the AEC in 1974. Casks of the same design are presently operated in Europe. The TN-8 has an inner cavity length of 427 cm, with three separate cubicles of 24 x 24 cm for the individual elements. Shielding is by 18.5 cm of lead and 6 cm of steel (in several layers). Neutron shielding is provided by 15 cm of borated solid resin. Shock absorbing covers are attached to the top and bottom of the cask.

Maximum design heat generation is based on 35.5 kW. During normal operation the maximum temperature of the inner shell(s) is 115°C. Heat rejection is via conduction through the cask body to

Table B.3. Spent Fuel Casks

Cask*	Primary Transport Mode	Weight Loaded, tons**	Capacity in Elements, PWR/BWR	Fluid in Cavity	Cavity Length/Dia., cm	Design Heat Generation Rate, kW	Major Shielding	Neutron Shielding	Casks Available April 1979
NFS-4	Truck	25	1/2	Water	452/34	11.5	Lead and steel	Borated H_2O antifreeze	6
NLI-1/2	Truck	24	1/2	Helium	452/32	10.6	Lead and steel	Water	5
NLI-10/24	Rail	97	10/24	Helium	455/114	77	Lead and steel	Water	2
TN-8	Truck/rail	40	3 PWR	Air	427/170	35.5	Lead and steel	Borated solid resin	2
TN-9	Truck/rail	38	7 BWR	Air	452/170	24.5	Lead and steel	Borated solid resin	1
TN-12***	Rail	107	12/32	Air	467	135	Steel	Borated solid resin	-
IF-300	Rail	68	7/18	Water	458/95	61.5	Uranium and steel	Water	4

*Cask initials:
NFS = Nuclear Fuel Services, Inc.
NLI = NL Industries (previously National Lead Company)
TN = Trans Nucleaire
IF = "Irradiated Fuel", symbol used by General Electric Corporation.

**Not including auxiliaries.

***Not authorized by U.S. Nuclear Regulatory Commission.

the outer wall, with convection and radiation from copper cooling fins on the outside. Pressure is stated to be atmospheric during transport. The cavity design pressure is 110 psig.

A unique feature of the TN-8 is a cylindrical shell which is placed around the outside of the cask before it is lowered into a loading or unloading pool. The annular space is filled with clean water during loading. This, along with other devices to protect the ends of the cask, minimizes contamination of the cask surface and therefore reduces decontamination time and expense.[24-26]

TN-9--The Transnuclear TN-9 is essentially identical to the TN-8 except the TN-9 is designed for seven BWR elements. The inner cask cavities are 25 cm longer, with the cask design heat generation rate equal to 24.5 kW.[24-26]

NLI 1/2--The National Lead Industries NLI 1/2 is a 24-ton helium-filled, 1 PWR/2 BWR truck cask. The cask can be used with an optional 600 mm inner container that provides an additional level of confinement. Initial issue of the SAR was in 1972, with NRC approval granted in March 1975. The cask has a cavity length of 452 cm and a diameter of 34 cm, or 32 cm if the optional inner container is used. Shielding around the body is provided by 7 cm of depleted uranium, 5.4 cm of lead, and 3.8 cm of steel (in several layers). Neutron shielding is provided by 12.7 cm of water. Two lids are used to seal the cask at the top. Depleted uranium and steel are used for shielding on the ends.[27]

Maximum heat generation rate is based on 10.6 kW. Maximum fuel temperature under conditions of normal transport is conservatively estimated at 545°C. Normal maximum design pressure is 120 psig when the inner container is used, or 22.5 psig when it is absent. Maximum fuel temperature during a fire accident condition is 594°C. The cask has a pressure rating of 543 psig at 454°C when the inner container is used, and 264 psig at 454°C when it is absent.[27]

At the present time, there are five NLI-1/2 casks in the United States, and there are plans to fabricate five more eventually.[26,27]

1.5.2.2 Rail Casks

TN-12--The Transnuclear TN-12 is a 107-ton rail cask capable of accommodating 12 PWR or 32 BWR fuel elements in an air atmosphere. This cask is undergoing licensing review in Europe, and once a license is obtained there, the company plans to submit its application to the NRC for use in the United States.

The cask has an inner cavity 373 cm long, and has an extension that will allow use of the cask for fuel elements up to 502 cm long. Total loaded cask weight is 116 tons with the extension in place.

Numerous features designed to improve operation and reduce operator dose commitments are said to be included as a result of the company's experience in Europe. The cask uses a solid stainless steel body for gamma shielding and a borated solid resin for neutron attenuation. Maximum heat rejection is based on 135 kW. Design pressure is 425 psig.[24,25]

NLI 10/24--The National Lead Industries NLI 10/24, authorized by NRC in June 1976, is a 97-ton, helium-filled, 10 PWR/24 BWR rail cask. Of four initially placed under construction, two have been delivered.

The cavity is 455 cm long by 114 cm in diameter. The cask has two interchangeable aluminum baskets for use with PWR or BWR fuel. Gamma shielding is provided by 15 cm of lead plus about 5-8.6 cm of stainless steel (in several layers). Neutron shielding is provided by 23 cm of water. Depleted uranium shielding is used on the cask ends and at strategic locations in the cask wall. Impact structures are used to protect the cask ends and sides. Two closure heads are used.

Maximum heat generation rate is based on 77 kW (including an axial peaking factor of 1.1). Two auxiliary cooling systems are provided to circulate water through channels alongside the inner cavity. Auxiliary cooling is not needed for the cask during fire accident conditions. Without auxiliary cooling and at maximum heat generation rate (including 1.1 axial peaking factor), the average fuel temperature is 348°C. Without the cooling system in operation, heat dissipation is by conduction through the body to the neutron shield, convection to the outer surface, and convection plus radiation from the finned outer surface to the atmosphere. Maximum fuel temperature during fire accident conditions is 533°C. Normal cavity pressure during transport is expected to be about 23 psig, with a maximum internal pressure of 105 psig occurring in the fire accident.[28]

IF-300--The General Electric IF-300 is a 68-ton water-filled rail cask capable of transporting seven PWR or 18 BWR fuel elements. Licensing was begun in January 1971 and approval was granted by the AEC in 1973.

The IF-300 is provided with two interchangeable stainless steel baskets, one for each type of fuel. Gamma shielding around the body is provided by a combination of 10 cm depleted uranium clad with stainless steel. Shielding around the cask ends is provided by 7.6 cm of depleted uranium clad in stainless steel. Neutron shielding is provided by the water in the cask plus an annular layer outside the gamma shield. The outer wall and ends of the cask are finned for impact protection.

Maximum heat generation is based on 76.7 kW. Cooling is provided by convection to the inner cavity wall, conduction to the outer neutron shield and convection to the corrugated outer wall. Forced air impingement is used to cool the outer shell. During normal operation, the maximum fuel temperature is expected to be 163°C. If the forced air impingement system is lost, the temperature will rise to a maximum of 221°C. If shielding water is lost from the outer compartment, the maximum fuel temperature could reach 788°C, but only after all the inner cavity water had boiled off. It has been conservatively estimated that this would require more than two days.[29]

1.5.3 Description of Handling Operations

1.5.3.1 Reactor Operations

Cask handling operations will vary between reactors and with different types of casks, but in general, almost all reactors will have certain common facilities. These include spent fuel storage pool, cask loading pool, cask decontamination area, cask and fuel handling cranes, and miscellaneous underwater tools and viewing equipment.

The spent fuel storage pool provides interim storage from the time spent fuel is discharged from the reactor until it is transported off the reactor site. The cask loading pool is a small pool normally adjacent to the spent fuel storage pool. These two pools are separated by an isolation gate so that operations conducted in one do not interfere with operations in the other. In the cask decontamination area (usually adjacent to the storage pool) the external surface of a shipping cask can be cleaned and decontaminated before and after it has been placed in the cask loading pool. Because of differences in weight between the fuel assemblies and the spent fuel casks, separate cranes are used to handle each.

The empty fuel cask is removed from the truck or rail car by the cask handling crane, placed in the decontamination/washdown area, and checked for smearable contamination levels. After it is rinsed to remove dirt and road grime, the cask is transferred to the cask unloading pool. The cask lid is removed and set aside. The pool is filled with water as necessary to ensure a safe depth of water over the cask for loading. The isolation gate between the two pools is opened, and irradiated fuel elements are transferred one at a time to the waiting cask using the fuel handling crane. Damaged or ruptured fuel elements may be shipped inside canisters.

Once the cask is filled, the isolation gate is closed and the cask lid replaced. Normally the cask will be raised a few feet out of the unloading pool so that two or three bolts can be inserted into the lid to hold it in place. As the cask is raised further, it can be hosed down to remove most of the contaminated pool water.

The cask is transferred to the decontamination or washdown area. The exterior is decontaminated and the interior is drained or flushed, as necessary. The lid bolts are torqued down as required and the seal pressure tested. Smears are then taken of the cask body. If contamination levels are within limits, the cask is put back on the truck or rail car, the auxiliary cooling system is hooked up (if present), and the personnel barrier is put in place.

1.5.3.2 Transportation

Truck transportation of spent fuel is similar to any non-nuclear transportation of heavy loads, with the exception that some states have extra restrictions, especially for overweight loads. DOT regulations require transport of radioactive materials with no unnecessary delays,[30] and for extra caution to be taken whenever a situation arises that the truck must be parked for any length of time.

Rail transportation of spent fuel has been limited by the speed limit and "special train" requirement imposed by the American Association of Railroads but now overruled by the Interstate Commerce Commission. There may also be certain routing restrictions imposed by the states or cities such as New York or necessitated by poor track conditions in some areas.

1.5.3.3 Cask Unloading

The unloading sequence for a spent fuel cask will be essentially the same whether the receiving facility is a reprocessing plant storage pool, an independent storage pool, or another reactor storage pool.

The cask personnel barrier is first checked for smearable contamination and then removed. The spent fuel cask is then checked for smearable contamination levels. If the levels are within DOT limits, the cask is washed down to remove road dirt and grime, normally in an outside area. If contamination levels are above DOT limits, the washdown and decontamination is done indoors where the washdown liquids are collected and sent to a liquid waste disposal system. If levels are above 10 CFR Part 20.205 limits, the NRC is notified immediately.

The cask tie-downs are removed and the cask is transferred to a test or decontamination pit. If it is a wet cask, the interior pressure and temperature are checked and the water sampled. Depending on contamination limits, the water is either flushed out or left in the cask. For a dry cask, a cask cool-down system may be hooked up if necessary to cool the fuel temperature to a level where the cask can be placed into an unloading pool without flashing or boiling in the cask.[31]

Once the cask temperatures are reduced to acceptable levels, the cask is lowered into an unloading pool. Normally, the lid bolts will be loosened and all but 2 or 3 removed before the cask is submerged. When the cask has been lowered into the unloading pool, the lid is removed and set aside. Fuel element identification numbers are checked against shipping records, and then the elements are removed one at a time to waiting cannisters in the unloading pool. The isolation gate between the unloading pool and the storage pool is opened and the fuel cannisters are moved one at a time to the latter. The isolation gate is then closed, the cask internals inspected and the lid replaced. The cask is lifted a few feet out of the pool, two to three bolts are attached to the lid, and the cask is transferred to the decontamination pit. Normally, the cask will be washed during removal from the pool.

In the decontamination area, the cask internals are drained, the lid tightened to specifications, and the exterior decontaminated. Smears are taken to check for compliance with DOT limits.

When radioactivity levels are acceptable, the cask is placed on the carrying vehicle. Tie-downs are secured and the personnel barrier is replaced. The cask is then stored or released for further use.

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1.5.4 Availability of Casks

There were approximately 14 truck and 6 rail casks licensed and available for the transport of spent nuclear fuels in the United States by the early part of 1979. The staff's estimate of cask requirements is discussed in Section 3.2 and Appendix E.

Future availability of casks is affected by licensing, design time, fabrication problems, lead casting or uranium casting and machining capabilities, lead times for special items, quality assurance, and capital availability or economic incentive. The time required for procurement of different casks can vary greatly, but should range from two to five years.

1.5.4.1 Licensing

Licensing is the critical path item for most nuclear facilities but is not always so for spent fuel casks. It is the goal of the NRC to rule on a license application for transport containers within 12 months after issuance of the Safety Analysis Report.[12] Whether this goal is reached or not depends upon the complexity or innovativeness of design, completeness of the SAR, and response time to NRC questions.

Once a license application is approved there is little further licensing time for additional individual casks as long as the design is not altered, since the original SAR will stand for all future identical models. Quality assurance, testing procedures, and inspections will naturally still have to be carried out and any modification of design will require an amendment to the SAR.

1.5.4.2 Design Time

Design time is largely a function of cask complexity and project organization. Detailed design of a cask could take from one to three years to complete, depending on these parameters. As with licensing, once the initial model has been completed, design time for future models is minimal providing no major revisions are made. Most of the detailed design should be completed prior to issuance of the SAR.

1.5.4.3 Fabrication

Fabrication time is largely dependent on the complexity of design and project organization.

There are few companies in the United States with adequate crane capacity or room to fabricate 100-ton casks, and the number with adequate lead-pouring capabilities is fewer. Only a few companies in the United States are capable of handling and machining depleted uranium. Most of these same companies do have acceptable quality assurance programs so that should not be a limitation on the choice of fabricator.

The ability to realize these problems, to spot long-term procurement items, to recognize parts that are difficult to fabricate, to schedule accordingly, and to minimize fabrication time requires competent and experienced project management. Balancing all these factors, it should take from 10 months to 3 years to fabricate a truck cask, and from 1.5-4 years to fabricate a rail cask.

1.5.4.4 Quality Assurance and Control

All fabricators for such critical items as spent fuel casks are required to have rigorous quality assurance programs that must be described to the NRC upon submission of the SAR.[17]

Specific requirements are delineated in 10 CFR Part 71 for various observations and tests required before a cask is initially approved and before each subsequent use. Such tests include shielding, pressure testing, and heat dissipation checks prior to initial use, and proper assembly, proper closing, correct valving, pressure, and presence of neutron absorbers before each subsequent use.[32] Fabricators are also subject to inspection by the DOT, NRC, and licensee (if different from fabricator). Depending upon complexity of design or effectiveness of the quality assurance program, from 5 to 25% of cask fabrication time is devoted to quality assurance activities.

1.5.5 Safety Considerations

Spent fuel shipping casks must meet stringent hypothetical accident conditions. A full description of these conditions and the radiological effects on the general public are covered in Reference 14. Following is a brief summary of these safety considerations.

Each applicant for a license is required by 10 CFR Part 71 to do a detailed nuclear safety analysis on the package involved to ensure it will remain subcritical during normal and hypothetical accident conditions. For Fissile Class III, as defined by 49 CFR Part 173.389, which includes packages such as spent fuel casks, the analysis must show that two packages (casks) side by side undergoing the same hypothetical accident conditions and ending up in the most reactive geometric arrangement and with close reflection on all sides will still be subcritical.[33]

The design basis accident conditions are intended to be as severe a set of hypothetical accident conditions as could be imagined, yet still be credible. Spent fuel casks must be designed to meet these conditions with no loss of containment capability. The risks associated with such accidents have been evaluated and it has been determined that the chance that physical harm of any significance resulting from radioactivity release or radiation levels that could occur during a rail or truck cask accident is very small.[17]

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33. See Reference 4, Section 71.40.

APPENDIX C

TERMINATION CASE CONSIDERATIONS

1.0 INTRODUCTION

The operation of coal-fired power plants to replace nuclear plants that would be shut down after there is no further spent fuel storage space available to them (Alternative 4) is considered in this appendix. Nuclear generating capacity fo the years 1979 through 2000 that would require shutdown and replacement is taken from Table 3.2 of Volume 1 for Alternative 1 without FCR.

Plants burning coal from five different sources which reflect representative choices for various regional locations of a model plant are discussed. The coal is characterized and emissions from the plants on the basis of a single day's operation at full capacity are listed. Two model plants are then selected for consideration on an annual basis. The first is assumed to burn Illinois No. 5 coal (high sulfur) and the second Wyoming coal (low sulfur).

1.1 THE MODEL PLANT

For analytical purposes, electricity was assumed to be generated by model 1,000-MWe conventional coal fired power plants. Based on current technology, each plant would consist of a boiler system with either pulverized-coal burners or cyclone furnaces, a flue gas cleanup system consisting of electrostatic precipitators for particulate removal, and limestone scrubbers for SO_2 reduction. The flue gas would be emitted from a stack 300 meters high with a diameter of 6 meters. In a dry-bottom pulverized-coal burner, most of the fly ash is produced in suspension, so about 80% of the ash content of the coal is entrained in the flue gas, resulting in high particulate emissions; while in a cyclone furnace, 60-70% of the ash is removed in liquid form as slag in the furnace, and only 30-40% becomes entrained in the flue gas. At the higher operating temperatures of a cyclone furnace, more atmospheric nitrogen is oxidized and therefore more NO_x is emitted in the flue gas than would occur from a pulverized-coal burner. Characteristics and efficiencies of the flue gas cleanup system are presented in Section 6.0 of this appendix.

Improvements in the heat transfer system have been directed toward increased efficiency. In conventional electric power generating plants, the heat transfer system leads to the production of superheated steam, and in large-scale commercial applications to the production of steam at supercritical pressures. This steam is used to drive the main turbines and generators. Modern fossil fuel fired steam electric power generating plants produce steam at 3,500 pounds per square inch gauge pressure superheated to 1,000°F with 1,000°F reheat, and require 8,500-9,500 Btu to produce a kilowatt-hour of electricity[1] (2.5-2.8 kWt/kWe), for an efficiency rate of 36-40 percent. Therefore, the 1,000-MWe model plant would have to operate at 2,500-2,800 MWt. The exact figure within this range would depend on several factors (see Table C.1).

Table C.1. Power Budgets for 1000-MWe Cyclone Furnace and Pulverized-Coal Burner, with Cooling Lake or Natural-Draft Wet Cooling Tower (MWt)

	Coal Moisture, %					
	0	2.5	5.0	10.0	20.0	40.0
Net Power	1000	1000	1000	1000	1000	1000
Auxiliary Power	170	170	170	170	170	170
Condenser Loss	1150(1165)[a]	1150(1165)	1150(1165)	1150(1165)	1150(1165)	1150(1165)
Stack Loss						
Dry Flue Gas	260	260	260	260	260	260
Moisture	0	11	22	45	90	180
Combustibles	0(50)[b]	0(50)	0(50)	0(50)	0(50)	0(50)
Totals						
Cyclone Furnace (Cooling Lake)	2580	2591	2612	2625	2680	2780
Cyclone Furnace (Cooling Tower)	2595	2606	2627	2640	2695	2795
Pulverized-Coal Burner (Cooling Lake)	2630	2641	2662	2685	2730	2830
Pulverized-Coal Burner (Cooling Tower)	2645	2666	2677	2700	2745	2845

[a] Condenser loss for a cyclone furnace or pulverized-coal burner with natural-draft wet cooling tower is 15 additional MW, or 1165 MW.

[b] The stack loss of combustibles for a pulverized-coal burner with cooling lake or natural-draft cooling tower is 50 additional MW.

2.0 ANCILLARY STRUCTURES

Except at minemouth plants, coal is normally delivered as periodic shipments of large tonnage, yet the input stream of the burner feed system must continuously be controlled to maintain a steady power input. Even at minemouth plants it is not feasible to match the delivery schedule to the instantaneous consumption rate. Imposed between the delivery and the consumption of the coal is a considerable amount of ancillary equipment[1,2] that serves to control the coal supply to the burner feed system.

The coal receiving and unloading facility must be suited to the mode of delivery. From the unloading facility, the coal is moved to either of two stockpiles: the live storage pile or the reserve storage pile. The live storage pile must contain, as a minimum, sufficient tonnage to maintain a steady supply to the burners between scheduled coal shipments, but with the smallest practical surplus. The permanent storage stockpile will typically hold a 100-day supply (a 50-day supply at minemouth plants[2]) to protect against interruptions in delivery. The pile arrangement allows easy movement of coal from permanent to live storage by crawler tractors with push blades.

The coal is conveyed from the live storage pile to a crusher house and on to a 1,500-ton-capacity surge bin. The surge bine is the primary device for smoothing out the delivery of coal to the burner feed system. The conveyor which feeds the surge bin is equipped with a sampler which continuously monitors the Btu equivalence of the coal so that the tonnage of coal required to meet boiler load demand can be estimated. The surge bin is also equipped with collectors to remove excess dust and reduce the risk of explosion. The coal is conveyed from the surge bin either to silos or to bunkers which feed the burners or the furnaces. A boiler fired by pulverized-coal burners has a pulverizer incorporated in the feed system from each silo, and the pulverized coal must be mixed with a measured amount of preheated air.

3.0 FUEL REQUIREMENTS

The data from which coal consumption can be estimated are the plant design thermal capacity (MWt), the heating value of the coal (Btu/lb), and the plant load factor. For example, a plant requiring 2,66 MWt (Table C.1), utilizing coal with 2.5% moisture and 15,000 Btu/lb, would consume 303 tons/hr at full capacity, and 182 tons/hr at 60% capacity. Assuming the plant normally operates at 60% capacity, 4370 tons/day would have to be delivered to the plant. Similarly, the 100-day reserve stockpile would require 437,000 tons of coal. Based on 1,750 tons per acre-foot,[3] this stockpile would require a volume of 250 acre-feet. The annual fuel requirements for such a plant would be 1,595,000 tons.

Both pulverized-coal burners and cyclone furnaces require the use of ignitors during startup and shutdown and for flame stabilization. These ignitors burn oil and/or natural gas. For the model plant, natural gas ignitors would consume approximately 660,000 million cubic feet per year (data from Ref. 2, adjusted to 1,000-MWe plant output).

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4.0 COAL STORAGE AREAS

The coal storage areas serve as the primary buffers for uninterrupted coal supply. There are two aspects of conventional coal delivery which can interrupt the coal supply to the plant.

First, the daily tonnage delivered typically arrives as one or two bulk shipments rather than as a continuous stream. Secondly, deliveries are subject to unscheduled interruptions because of labor problems (mine disasters) or transportation problems (derailments, floods). These two potential sources of interruption are compensated for by establishing two stockpiles (live storage and reserve storage) which are managed for different objectives, as described in the following two sections.

4.1 Live Storage

As calculated in Section 3.0 of this appendix, the plant with a cooling tower and pulverized-coal burner, utilizing coal with 2.5% moisture and 15,000 Btu/lb heating value, would consume slightly more than five tons of coal per minute at 100% capacity and 3.5 tons a minute at 60% capacity.

Because of technical considerations in the handling of fresh coal, the optimum size for the live coal storage pile is the minimum described above; the maximum acceptable size is scarcely larger. Because coal is formed under reducing conditions, it begins to oxidize slowly whenever it is brought into contact with air. Thus, the Btu value of the coal in stockpiles decreases over time. Since this low-temperature oxidation is a surface action, the amount of oxidation occurring is inversely proportional to the time since the coal was cut from the mine. To minimize the loss in heating value, the residence time of coal in live storage is minimized by maintaining the smallest practical pile.

In addition, the relatively high amount of low temperature oxidation in freshly cut coal leads to a relatively high rate of heat production. Unless this heat is dissipated quickly, spontaneous combustion may result. Hence, the live storage coal is maintained in small, loosely stacked piles to maximize heat dispersal and minimize risk of fire, although this maximizes the exposure of coal to the air.

4.2. Reserve Storage

A reserve storage stockpile of coal is maintained at the plant site in order that plant operations can continue in the event of an unscheduled interruption in delivery (such as rail or mine strikes). Normally, a 100-day reserve supply is maintained. However, minemouth plants may stockpile only a 50-day supply at the plant site since it may be possible to move additional coal from mine site stockpiles if necessary.

Because of the long residence time for the coal in the reserve stockpile, the rate of low temperature oxidation may reach a very low value. The pile is well compacted to minimize the access of air to the coal. For present purposes, the midrange of industry practice[1] has been taken as a typical amount of compaction for reserve storage piles.

An additional constraint on emergency reserve stockpiles is safety. The pile must be checked periodically for hot spots. If these hot spots are not removed to the boiler feed stream as they are discovered, spontaneous combustion will probably occur, and may result in sizable losses of coal.

5.0 EMISSION ABATEMENT METHODS

Coal combustion for electric power generation results in emission of sulfur oxides, nitrogen oxides, and particulate matter or fly ash. Other emissions which lately have earned considerable interest are trace elements and radionuclides.[4-6] On June 19, 1978, the U.S. Environmental Protection Agency promulgated regulations for the Prevention of Significant Deterioration (PSD) of Air Quality[7] as was mandated by the Clean Air Act Amendments of 1977 (PL 95-95). These regulations set maximum increases in particulate matter and sulfur dioxide for three classes of areas designated as Class I, II and III. Class I is generally categorized as the areas in which the least amount of additional pollutants will be allowed, Class III as the areas in which the largest increments will be allowed, and Class II as all other applicable areas unless designated otherwise. State implementation plans, with provisions for meeting the National Ambient Air Quality Standards, were to be prepared by December 31, 1978, and if acceptable to the EPA, made effective by July 1, 1979.

On May 25, 1979, the EPA established New Source Performance Standards[8] that established a 1.2-pound-per-million-Btu limit based on a 30-day rolling average for sulfur dioxide emissions released from new coal-fired power plants. This limit also called for a 90% reduction in sulfur dioxide emissions down to a 0.6-pound-per-million-Btu level and a minimum of 70% reduction for emissions below the 0.6-pound level. Sulfur removed through coal washing or in the fly ash and bottom ash would be credited towards achievement of the standard.

The Clean Air Act applies to "major sources," defined for power plants as any sources emitting more than 100 tons per year of specified pollutants. The Model 1,000-MWe Coal-Fired Power Plant would be covered under this act. In attempting to comply with these regulations, the operator of a new or existing coal-burning power plant has available a wide array of air pollution control devices and techniques to reduce emissions to within allowable levels. The various pollution control technologies differ in extent of development, performance efficiency, reliability, cost, and operational problems.

5.1 Particulate (Fly Ash) Control

Under the EPA regulations promulgated on June 19, 1978, the maximum allowable ambient air increases in particulate matter (in micrograms per cubic meter) as annual mean and 24-hour maxima are 5 and 10, 19 and 37, and 37 and 75 for Classes I, II and III, respectively.

5.1.1 Electrostatic Precipitators

Electrostatic precipitators, used conventionally for control of particulate emissions in coal fired electric generating stations, consist of a chamber (or chambers) through which passes the flue gas containing entrained ash particles. These chambers contain flat parallel plates from 6 to 12 inches apart, with rod or wire electrodes between them.[9,10] A high voltage is applied to the electrodes, the wire or rod serving as the negative discharge electrode and the grounded collection plate as the positive electrode. A direct-current, high-voltage corona is established in the interelectrode space around the discharge electrode, ionizing the molecules of electronegative gases, such as O_2, CO_2, and SO_2, present in the flue gas. Under the action of the electrical field, the gas ions move rapidly toward the collecting electrode and transfer their charge to the particles by colliding with them. Once the charged particles are in the electric field, they are directed toward the collection electrode where they are deposited, the magnitude of the force depending on the particle charge and the intensity of the field. The accumulated dust is removed from the collection electrode by rapping at intervals to dislodge the deposit. It is then collected in a hopper underneath the electrode compartment to await removal and ultimate disposal.

High overall mass collection efficiencies (> 99% and up to 99.9%) can be achieved at a low pressure drop through the precipitator and at a low power requirement.[11] From 0.1-1% of the total fly ash escapes the precipitator, and the size of escaped particles is smaller than 1 or 2 microns.[12] Recent tests have shown that fractional collection efficiencies generally follow theoretical predictions, decreasing with decreasing particle size to some minimum at around 0.2 to 0.5 micron and then increasing in collection efficiency for particles of smaller sizes.[11]

In general, electrostatic precipitators are relatively compact, and maintenance and downtime are relatively low. The performance or collection efficiency, however, depends on fly ash resistivity, which in turn is determined by flue gas temperature and the sulfur content of the coal being burned. Low-sulfur coal produces a high-resistivity fly ash that reduces the collection efficiency at temperatures typical of conventional cold precipitators, which operate near 300°F.[9,13,14]

This difficulty may be circumvented by use of hot precipitators which operate at 600°F or more and give high collection efficiencies that are insensitive to coal sulfur content. The higher operating temperatures are achieved by placing precipitators upstream of the air heater rather than in the downstream position typical for cold precipitators. Hot precipitators are coming into increased use with the growing dependence on low-sulfur coals.[15-17]

5.1.2 Wet Scrubbers

Wet scrubbers generally remove particles by impacting them with water droplets. However, particle collection in wet scrubbers currently in use may involve three mechanisms: inertial impaction, interception, and diffusion.[11] Particles larger than about 1 micron in diameter (the diameter of the collector droplet) are collected primarily through inertial impaction, while particles of 1 micron are collected through interception. Diffusion into the collector droplet governs the collection of particles smaller than about 0.1 micron. Particles in the size range of 0.1 to 1 micron are the most difficult to collect, as is the case with other collecting devices.[11]

Removal of particulate matter may employ any of the following types of scrubbers: plate column, packed-bed, preformed spray, gas atomized spray (e.g., Venturi scrubber), centrifugal, and moving-bed. For power plant application, the most widely used types are the Venturi and the moving-bed scrubbers.[10]

5.2 SO_x CONTROL

A number of near-term options for air quality control systems have been developed, or are in the process of being developed, which are designed to meet SO_2 emission standards of coal fired power plants.[18] These include (1) use of low-sulfur coal, (2) coal beneficiation, (3) flue-gas desulfurization, and (4) coal beneficiation combined with flue-gas desulfurization.

5.2.1 Low-Sulfur Coal

Under the New Source Performance Standards, even the use of low-sulfur coal will require flue-gas desulfurization to meet the prescribed limits. However, the requirements will be less stringent. Typically, a plant burning low-sulfur coal would require only a 70% reduction in sulfur dioxide emission to achieve a level below 0.6 pounds per million Btu, whereas higher sulfur coal would require a 90% reduction to even achieve levels that exceed the 0.6 pound value.

5.2.2 Coal Beneficiation

Coal beneficiation consists of crushing the coal and separating the heavier pyritic-sulfur-bearing particles (3-1/2 times as dense as the coal itself) from the lighter coal by physical or mechanical means.[18] Organic sulfur cannot be removed by beneficiation and therefore places a limit on sulfur removal. The process of beneficiation also significantly reduces the ash content of coal, as well as the levels of trace heavy metals.

Sulfur reduction as high as 46% can result, depending on the level of beneficiation. Reduction of ash by as much as 65% is possible, increasing the net heating value of the coal as much as 20% and decreasing the sulfur content by 55% on a Btu basis. Under the New Source Performance Standards, sulfur reduction by coal beneficiation will be credited towards achievement of the SO_2 emission limits.

5.2.3 Flue-Gas Desulfurization

A flue-gas desulfurization system is classified as a "throwaway" system because it produces a waste sludge by-product, or as a "regenerable" system because it regenerates the sorbent and produces sulfuric acid or a sulfur by-product. Four of the most developed control systems are: (1) lime/limestone scrubbing, (2) double alkali scrubbing, (3) magnesia scrubbing, and (4) the Wellman-Lord process.[10] The first two are throwaway systems, while the last two are regenerable. These four systems represent approximately 90% of the systems in operation or under construction, with the lime/limestone scrubbing processes receiving the widest application.[10,18]

5.2.4 Coal Beneficiation Combined with Flue Gas Desulfurization

Sulfur removal through beneficiation is not sufficient to permit the direct burning of coal under applicable emission standards. However, beneficiation coupled with flue gas desulfurization (FGD) reduces the demands on an FGD system, resulting in capital and operating cost reduction.[18] In addition, beneficiation reduces ash content, increases the calorific rating of the coal, and, if done at the mine site, substantially reduces shipping costs. Beneficiation prior to flue gas scrubbing reduces the quantity of sludge generated at the power plant site, shifting the burden of solid waste to the mine site, where it is more amenable to disposal.

5.2.5 Intermittent Control Systems

Previous to the enactment of the 1977 Clean Air Act Amendments, the strategy of intermittent rather than continuous emission control was a cost-effective technique for compliance with emission standards[19] when the aim was to control short-term ground-level concentrations of SO_x near the source, rather than overall emissions. During normal or favorable meteorological conditions, the intermittent emission control technique relied on the relationship between ambient air quality and stack height at which SO_2 emission occurs for the diffusion of the pollantant well above ground level. During unusual or unfavorable atmospheric conditions, such as inversion, either of two emission abatement methods was resorted to: (1) fuel switching (temporarily burning a supply of low-sulfur fuel) or (2) load switching, or assigning a portion of the electrical load to another generating station that has available capacity and can comply with emission standards

Because atmospheric dispersion rates vary widely, reliability of an intermittent control system (ICS) to meet air quality standards greatly depends on the accuracy of air quality forecasting, design of control system, and dependability of system components. Constraints on ICS implementation include local weather, terrain, stack height, and emission parameters. Economic considerations connected with modifying the coal handling, feeding, and firing systems of power plants to permit switching to low-sulfur coal are also included in determining the feasibility of implementing an ICS.

Capital and operating costs for an ICS are significantly less than for an FGD system,[19] but the use of the ICS for meeting all SO_2 ambient air quality standards has not been demonstrated.[18] This method, however, is no longer permitted.

5.3 NO_x CONTROL

Coal combustion remains as the largest stationary source contributor (42%) to NO_x emissions.[20] Coal contributes 63 percent of the NO_x emitted from electrical power generation. NO_x formed in combustion originates from two distinct sources: (1) the thermal fixation of atmospheric nitrogen in the combustion air to form NO_x, made possible by the high temperatures in coal fired furnaces, and (2) NO_x production from the conversion of chemically bound nitrogen in the coal.

A number of NO_x control options have been studied in the past, including the use of synthetic fuels, fuel additives, fluidized-bed boilers, and flue gas treatment, but modification of the combustion process appears to be the most viable means of reducing NO_x formation from stationary sources.[20,21]

Overall control of excess air consistent with efficient burner operation appears to be the simplest method for NO_x reduction. This approach reduces the concentration of oxygen available for combination with atmospheric or coal-bound nitrogen, thus minimizing the formation of NO_x. In actual practice, however, a certain amount of excess air is always required to avoid the production of unburned fuel and smoke resulting from poor combustion. A decrease in excess air can also lead to furnace slagging, with increased maintenance and possible operating problems.[20]

Another possible approach to NO_x control is through staged combustion.[20,21] This operation consists of firing the operating burners in the lower burner rows or levels with substoichiometric quantities of air, and providing the additional air required for the burn-out of combustibles through the air registers of the uppermost row or level, keeping the quantity of overall excess air as low as possible. The effect is to create two combustion zones--a primary reducing zone and a lower-temperature post-flame oxidizing zone.

Control of excess air and staged combustion appears to have similar results in the control of NO_x formation. Reported data on reductions of NO_x emission levels are in the range of 50 to 65%.[21,22]

6.0 AIRBORNE COMBUSTION EMISSIONS AS A FUNCTION OF COAL TYPE

This section discusses atmospheric emissions of sulfur oxides, particulate material, and trace elements as a result of coal combustion during the generation of electrical power. The calculations are done for a standardized 1,000-MWe power plant for a variety of coals which reflect representative choices for various regional locations of the model plant. The only variations in coal treatment and plant configuration are the inclusion of a coal-cleaning step for Appalachian and Eastern Interior coals having a high pyritic sulfur content. Calculations also were performed of quantities of emissions released on an annual basis for two model plants, the first burning Illinois coal (high sulfur) and the second Wyoming coal (low sulfur). A plant capacity factor of 60% was assumed. Results of the calculations are presented in Figures C.1 through C.11 for the years 1979 through 2000. The number of plants required in terms of total generating capacity for each year is taken from Table 3.2 of Volume 1 for Alternative 1 without FCR.

Coal choices for each of the model plants are as follows. The Northern Appalachian plant is assumed to utilize coal from the Pittsburgh seam of Pennsylvania, which constitutes one of the main sources of minable coal reserves in the state. Coal from the Upper Elkhorn No. 3 seam of eastern Kentucky, a large resource with a relatively low sulfur content, is used in calculations for the Southern Appalachian plant. The Eastern Interior plant is assumed to burn coal from one of two sources, the Illinois No. 5 seam or Wyoming subbituminous coal. The latter choice is considered feasible since Wyoming coals are currently used in some Illinois and Michigan power plants. Calculations are performed separately for each of these two coals, and blending is not considered. The Four Corners plant is assumed to utilize coal from the Wepo formation of the Black Mesa Field of Arizona. A plant located in the Pacific Northwest utilizes coal delivered from Wyoming by train.

All results presented in the text were calculated assuming that the plants operate at 100% of capacity over a one-day period.

Coal containing a high percentage of pyritic sulfur can be mechanically cleaned to reduce the amount of noncombustible material and sulfur content. The lignites and subbituminous coals which constitute the bulk of western coal production have low sulfur contents and are generally not cleaned. Coal from the Upper Elkhorn No. 3 seam of Kentucky was also not assumed to be cleaned because, like many southern Appalachian coals, its low pyritic sulfur content makes cleaning of only small benefit. Coals from the Pittsburgh bed of Pennsylvania and the Illinois No. 5 bed have high pyritic sulfur contents[23] and were assumed to be cleaned before combustion. Results of cleaning these two coals are given in Table C.2.

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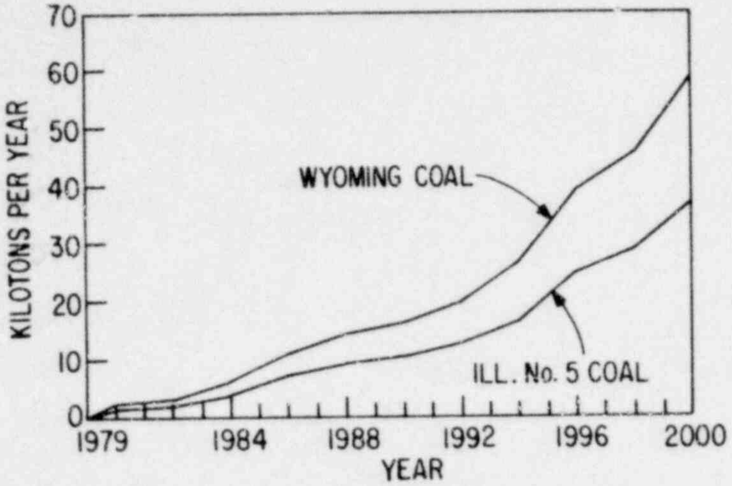


Fig. C.1. Particulate Emissions.

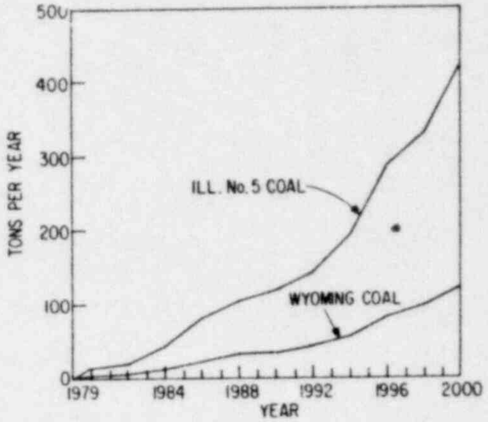


Fig. C.2. Zinc Emissions.

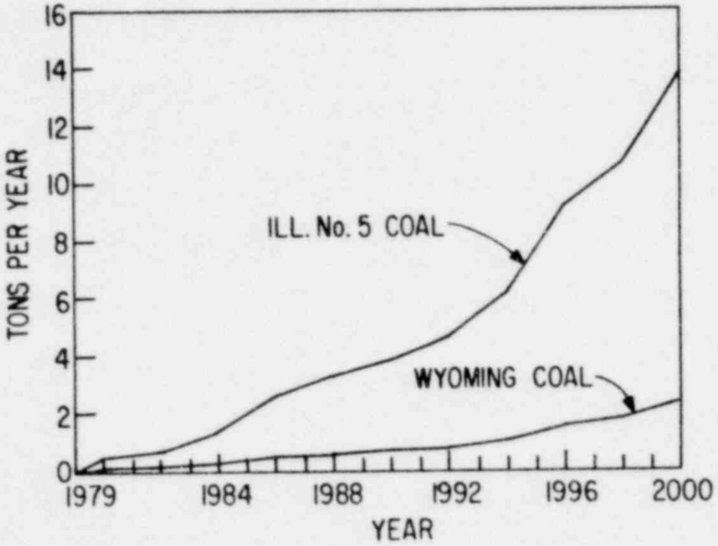


Fig. C.3. Cadmium Emissions.

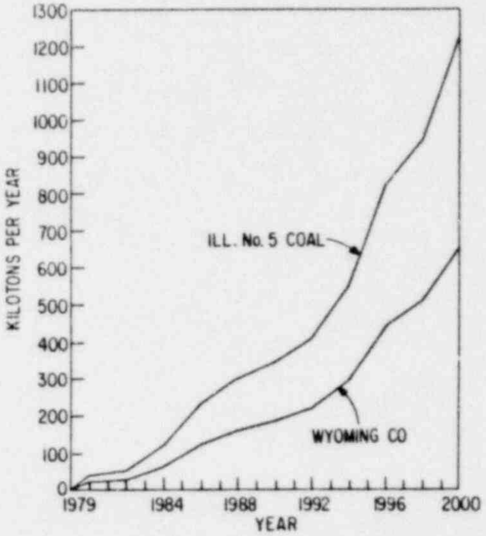


Fig. C.4. SO_2 Emissions.

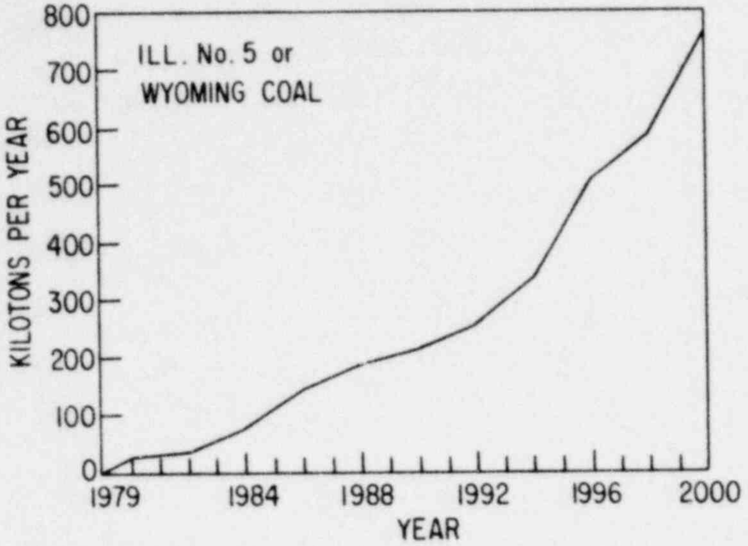


Fig. C.5. NO_x Emissions.

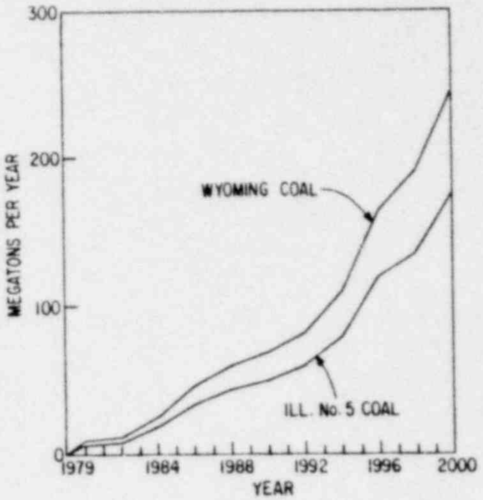


Fig. C.6. Annual Coal Requirements.

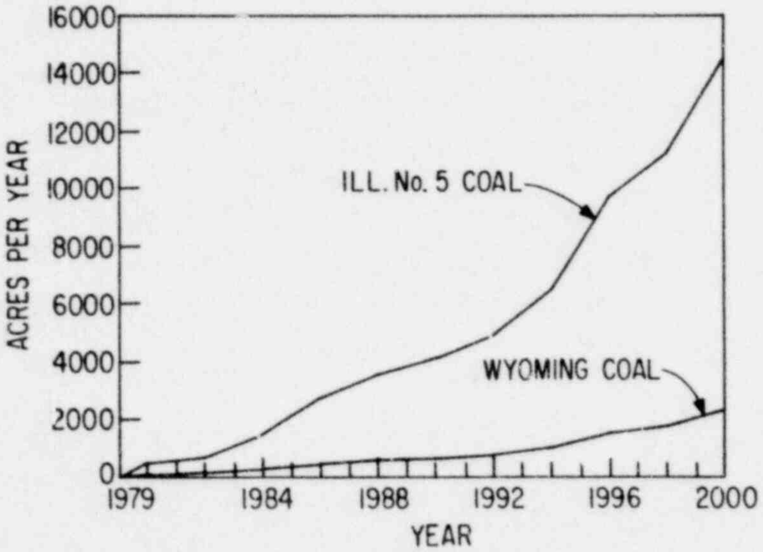


Fig. C.7. Land Disturbed by Surface Mining.

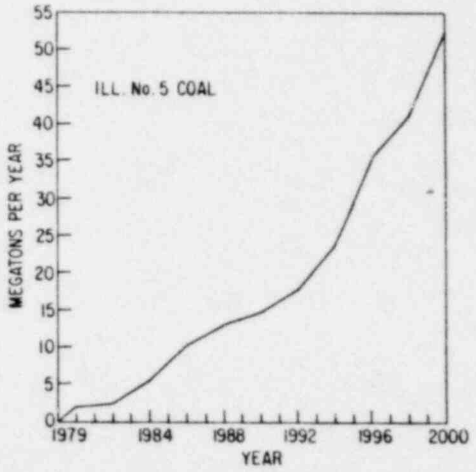


Fig. C.8. Coal Washing Wastes.

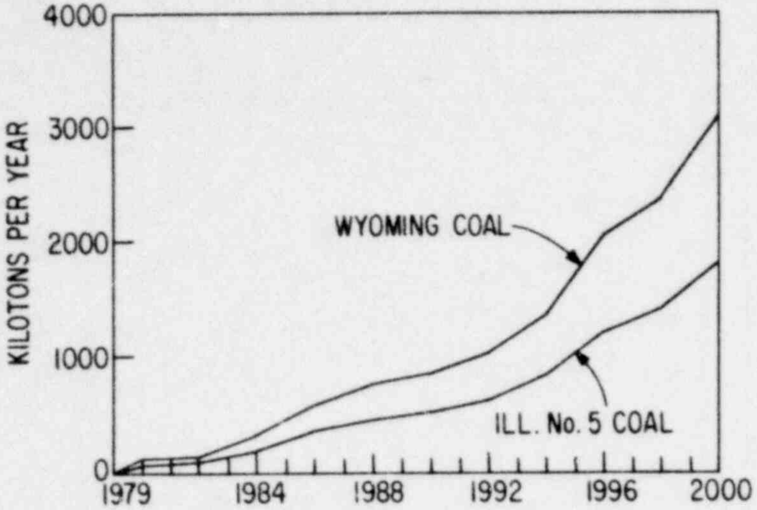


Fig. C.9. Bottom Ash Discharged.

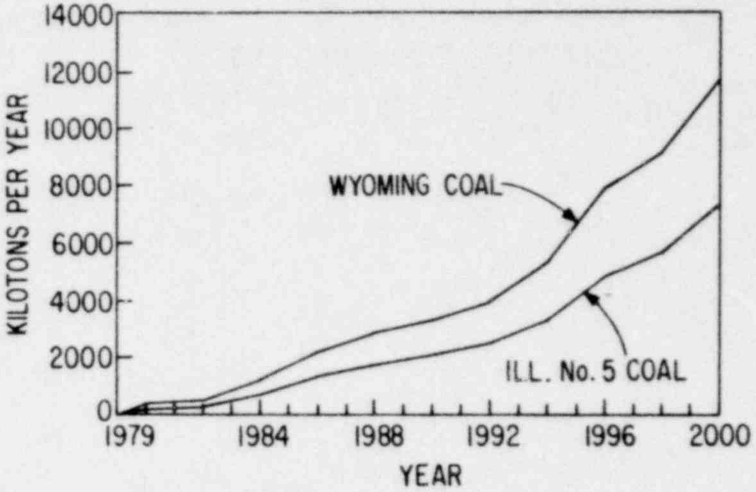


Fig. C.10. Fly Ash Collected.

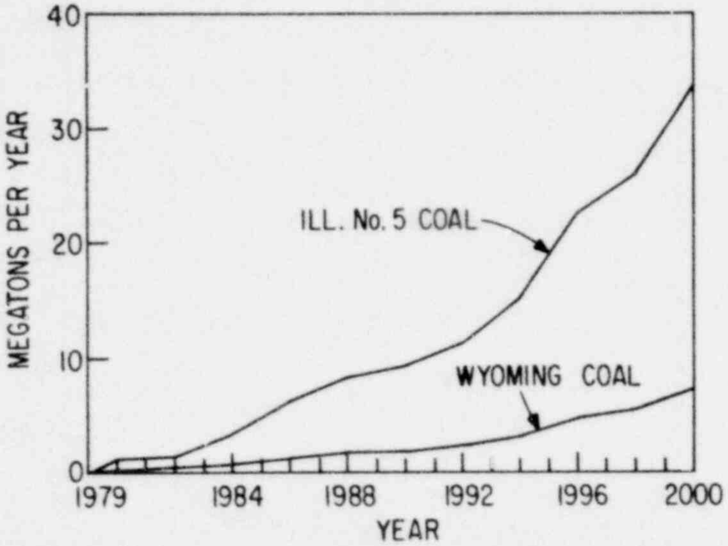


Fig. C.11. SO_2 Scrubber Sludge.

Table C.2. Sulfur and Ash Contents of Two Coals before and after Cleaning (percent)

Coal Type	Total Sulfur Content		Total Ash Content	
	Before Cleaning	After Cleaning	Before Cleaning	After Cleaning
Pennsylvania Pittsburgh	2.0	1.26	7.5	3.6
Illinois No. 5	3.5	2.45	10.0	5.2

Table C.3 summarizes coal consumption rates for a 1000-MWe generating plant using the coals chosen for each of the five regions, and includes raw coal needs for the two coals assumed to be cleaned. The coal consumption was calculated using a plant thermal efficiency of 40%. Raw coal needs were determined from the yield of the cleaning process.

Table C.3. Coal Consumption by Model 1,000 MWe Power Plants and Raw Coal Needs for Washed Coals (short tons)

Plant Location	Coal Sources	Coal Consumption, tons/day	Raw Coal Needed If Washed, tons/day
Northern Appalachia	Pittsburgh (Pennsylvania)	7,480	10,200
Southern Appalachia	Upper Elkhorn No. 3 (Kentucky)	7,210	-
Eastern Interior	Illinois No. 5	8,980	11,700
	Anderson, Canyon, and Wyodak-Anderson (Wyoming)	12,500	-
Four Corners	Wepo Formation	8,810	-
Pacific Northwest	Anderson, Canyon, and Wyodak-Anderson (Wyoming)	12,500	-

Note: The data in this table assume 100% capacity factors for the model plant.

6.1 Fly Ash

Table C.4 gives bottom ash, collected fly ash, and atmospheric fly ash emissions for each of the model plants. The calculations were made for cyclone boilers assuming that 65% of the combustion ash appears as bottom ash, and for dry-bottom pulverized-coal boilers assuming that bottom ash constitutes 20% of the total. The remaining ash fractions were assumed to be fly ash. Atmospheric emissions were calculated assuming use of an electrostatic precipitator with a 99.5% collection efficiency.

6.2 Sulfur

Sulfur dioxide emissions were calculated assuming complete conversion of the sulfur in coal into sulfur dioxide. A limestone scrubber was assumed to be installed on each plant. Either a 90%

Table C.4. Bottom Ash, Collected Fly Ash, and Atmospheris Fly Ash Production Rates in Short Tons/Day for Model Plants in Different Locations

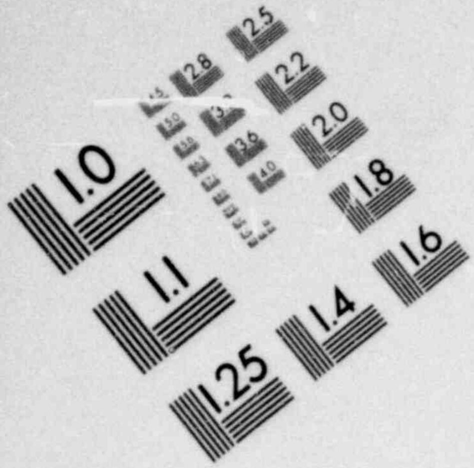
Plant Location	Coal Bed	Coal Ash Content, %	Bottom Ash, tons/day		Collected Fly Ash, tons/day		Atmospheric Fly Ash Emission, tons/day	
			Cycl.[a]	Pulv.[b]	Cycl.	Pulv.	Cycl.	Pulv.
Northern Appalachia	Pittsburgh (Pennsylvania)	3.6[c]	175	54	60	210	0.29	1.1
Southern Appalachia	Kentucky Upper Elkhorn No. 3	3.9	180	56	60	220	0.30	1.1
Eastern Interior	Illinois No. 5	5.2[c]	300	93	105	370	0.50	1.9
	Wyoming	6.0	485	150	165	600	0.81	3.0
Four Corners	Wepo	5.2	295	92	95	360	0.49	1.8
Pacific Northwest	Wyoming	6.0	485	150	165	600	0.81	3.0

Note: The data in this table assume 100% capacity factors for the model plants.

[a] Cyclone boilers.

[b] Dry-bottom pulverized-coal burners.

[c] Ash content after cleaning.



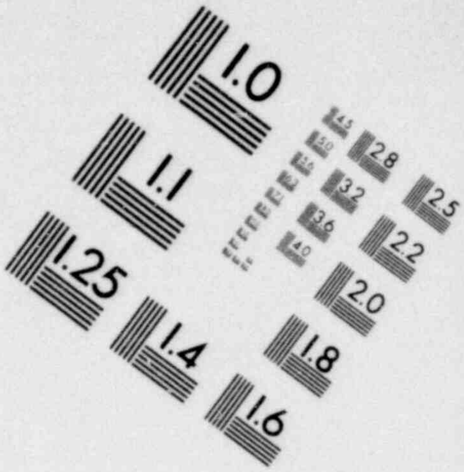
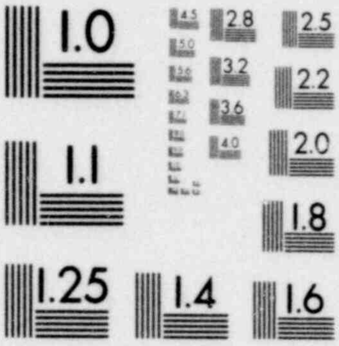
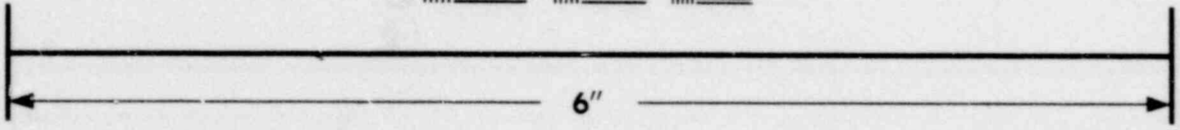
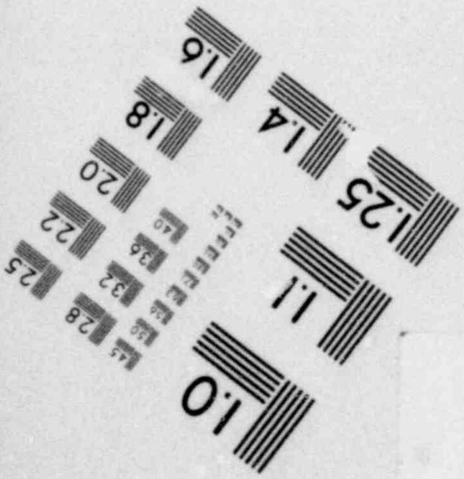
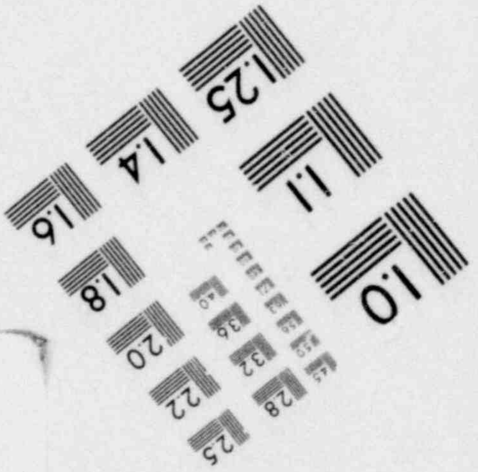


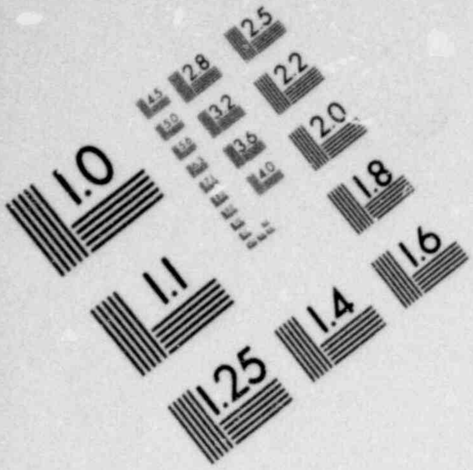
IMAGE EVALUATION TEST TARGET (MT-3)

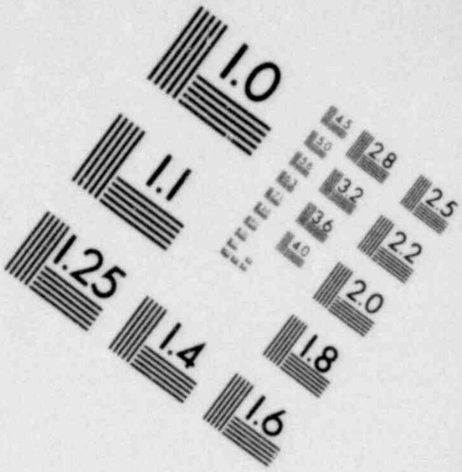












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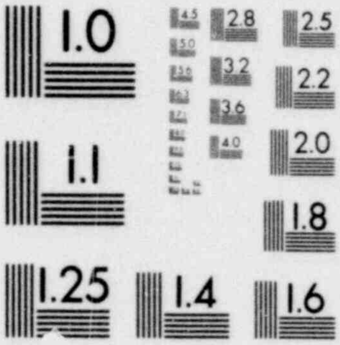

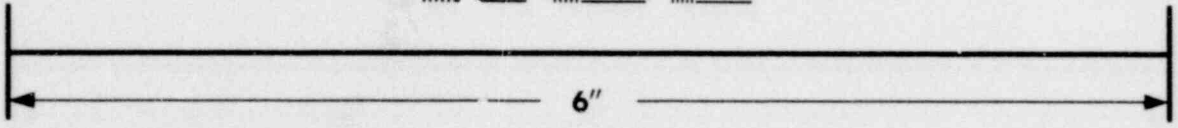

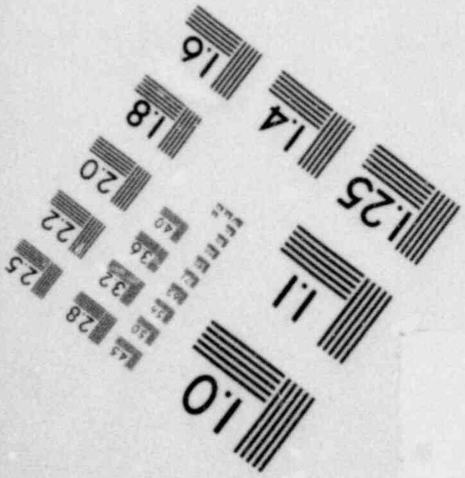

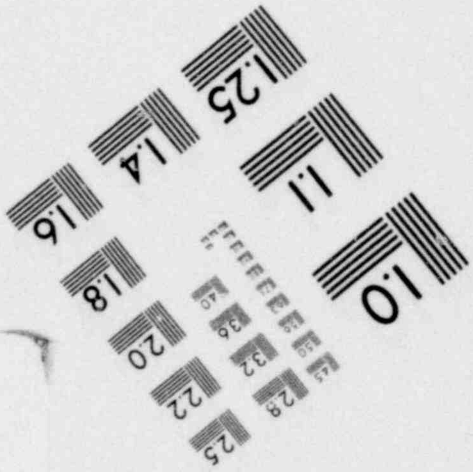

or 70% reduction in SO_2 emission as necessary to meet the New Source Performance Standard was also assumed, the higher sulfur-containing coals utilizing the 90% value and the lower sulfur-containing coals, the 70% value. Sulfur removal through coal washing was credited towards these values. SO_2 emission calculations are summarized in Table C.5.

6.3 Trace Elements

Coal trace element contents may be highly variable from one location to another and even within a given mine; it should also be recognized that the data for some elements and localities are based on limited statistics.

Atmospheric emissions of trace elements are summarized in Tables C.6 and C.7. The emission rates in Table C.6 were calculated assuming that 65% of the ash produced during combustion appears as bottom ash, a typical figure for a cyclone-fed boiler. The rates in Table C.7 were calculated for a case in which 20% of the total ash is bottom ash, consistent with a dry-bottom pulverized-coal boiler. The calculations were based upon the partition factors developed by Klein, Andren, and Bolton.[24] For coals from the Pittsburgh and Illinois No. 5 seams, it was assumed that cleaning does not reduce the trace element concentration of the coal. This was a highly conservative assumption, since the concentrations in coal of some trace elements appear to be effectively reduced by cleaning. The assumption was made only because of the sparse data on trace element washabilities of coal. This procedure should be reviewed if significant environmental impacts are noted later for atmospheric emissions of some elements.

Table C.5. Atmospheric Sulfur Dioxide Emission Rates and Scrubber Sludge Generation Rates by Model Plants

Plant Location	Coal Bed	% Sulfur	Pounds SO_2 per Million Btu[a]	SO_2 Emitted with Scrubbing,[a] tons/day	Amount of Limestone Scrubber Sludge Produced, tons/day: Dry	Amount of Limestone Scrubber Sludge Produced, tons/day: Wet (50% Solids)
Northern Appalachian	Pittsburgh	2.0 (1.26)[b]	2.90 (1.32)[b]	30	430	860
Southern Appalachia	Upper Elkhorn #3	0.9	1.27	13	315	630
Eastern Interior	Illinois #5	3.5 (2.45)[b]	6.14 (4.30)[b]	62	1030	2060
	Wyoming	0.45	1.10	34	215	430
Four Corners	Wepo	0.6	1.04	32	205	410
Pacific	Wyoming	0.45	1.10	34	215	430

Note: The data in this table assume 100% capacity factor for the model plants.

[a] EPA New Source Performance Standards, May 25, 1979.

[b] After cleaning.

Table C.6. Atmospheric Discharges of Trace Elements (short tons/day) from Five Model Plants Utilizing Cyclone Burners

Trace Element	Northern Appalachian, Pittsburgh Bed	Southern Appalachian, Upper Elkhorn #3 Bed	Eastern Interior, Ill. #5 Bed	Eastern Interior, Wyodak-Anderson (Wyoming) Bed	Four Corners, Wepo Formation	Pacific Northwest, Wyodak-Anderson (Wyoming) Bed	Range of Values
Arsenic (As)	0.0017	0.00059	0.00068	0.00012	0.00022	0.00012	0.00012-0.0017
Barium (Ba)	0.0016	0.0017	0.0012	0.0045	0.00094	0.0045	0.00094-0.0045
Cadmium (Cd)	-[a]	-	0.00060	0.00011	<0.00011	0.00011	<0.00011-0.00060
Chromium (Cr)	0.00083	0.00063	0.0011	0.00024	0.00036	0.00024	0.00024-0.0011
Cobalt (Co)	0.00046	0.00037	0.00042	0.00016	-	0.00016	0.00016-0.00046
Lead (Pb)	0.0014	0.0010	0.0096	0.00019	0.0011	0.00019	0.00019-0.0096
Manganese (Mn)	0.00033	0.00039	0.0012	0.00026	0.00016	0.00026	0.00016-0.0012
Mercury (Hg)[b]	0.0013	-	0.0013	0.00040	0.00036	0.00040	0.00036-0.0013
Selenium (Se)[c]	0.0040	0.0032	0.0024	0.0010	0.0024	0.0010	0.0010-0.0040
Vanadium (V)	0.00086	0.00072	0.0010	0.00047	0.00027	0.00047	0.00027-0.0010
Zinc (Zn)	0.0029	0.0019	0.020	0.0058	0.0014	0.0058	0.0014-0.020

Note: Data permitting calculation of atmospheric emission rates of copper, molybdenum, and nickel are not available at this writing. However, Klein et al. ("Occurrence and Distribution of Potentially Volatile Trace Elements in Coal," Environ. Geol. Note No. 72, Ill. Geol. Surv., 1974) note that copper and molybdenum are markedly enriched in the fly ash fraction not collected by electrostatic precipitators, and Natusch et al. ("Toxic Trace Elements: Preferential Concentration in Respirable Particles," Science 183:202-204, 1974) have demonstrated that nickel also concentrates preferentially on smaller fly ash particles.

The data in this table assume 100% capacity factors for the model plants.

[a] Dashes indicate no data.

[b] Assumes 90% of Hg in coal is discharged to atmosphere as vapor.

[c] Assumes 13% of Se in coal is discharged to atmosphere as vapor in addition to the small portion absorbed on fugitive fly ash.

Table C.7. Atmospheric Discharges of Trace Elements (short tons/day) from Five Model Plants Utilizing Pulverized Coal Burners

Trace Element	Northern Appalachian, Pittsburgh Bed	Southern Appalachian, Upper Elkhorn #3 Bed	Eastern Interior, Ill. #5 Bed	Eastern Interior, Wyodak-Anderson (Wyoming) Bed	Four Corners, Wepo Formation	Pacific Northwest, Wyodak-Anderson (Wyoming) Bed	Range of Values
Arsenic (As)	0.0022	0.00077	0.00088	0.00016	0.00029	0.00016	0.00016-0.0022
Barium (Ba)	0.0034	0.0037	0.0026	0.010	0.0021	0.010	0.0021-0.010
Cadmium (Cd)	-[a]	-	0.00070	0.00012	0.00013	0.00012	0.00012-0.00070
Chromium (Cr)	0.0021	0.0016	0.0028	0.00063	0.00094	0.00063	0.00063-0.0028
Cobalt (Co)	0.00093	0.00074	0.00085	0.00032	-	0.00032	0.00032-0.00093
Lead (Pb)	0.0015	0.0011	0.010	0.00021	0.0012	0.00021	0.00021-0.010
Manganese (Mn)	0.00090	0.0011	0.0034	0.00072	0.00045	0.00072	0.00045-0.0034
Mercury (Hg)[b]	0.0013	-	0.0013	0.00040	0.00036	0.00040	0.00036-0.0013
Selenium (Se)[c]	0.0040	0.0032	0.0024	0.0010	0.0024	0.0010	0.0010-0.0040
Vanadium (V)	0.0026	0.0022	0.0030	0.0014	0.00083	0.0014	0.00083-0.0030
Zinc (Zn)	0.0031	0.0020	0.022	0.0063	0.0015	0.0063	0.0015-0.022

Note: Data permitting calculation of atmospheric emission rates of copper, molybdenum, and nickel are not available at this writing. However, Klein et al. ("Occurrence and Distribution of Potentially Volatile Trace Elements in Coal," Environ. Geol. Note No. 72, Ill. Geol. Surv., 1974) note that copper and molybdenum are markedly enriched in the fly ash fraction not collected by electrostatic precipitators, and Natusch et al. ("Toxic Trace Elements: Preferential Concentration in Respirable Particles," Science 183:202-204, 1974) have demonstrated that nickel also concentrates preferentially on smaller fly ash particles.

The data in this table assume 100% capacity factors for the model plants.

[a] Dashes indicate no data.

[b] Assumes 90% of Hg in coal is discharged to atmosphere as vapor.

[c] Assumes 13% of Se in coal is discharged to atmosphere as vapor in addition to the small portion absorbed on fugitive fly ash.

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APPENDIX D

INCREASING FUEL STORAGE CAPACITY

1.0 COMPACT STORAGE AT POWER PLANTS

1.1 INTRODUCTION

The method of expanding storage capacity used for any particular plant is determined by a number of factors which must be considered by the owner. These include:

1. Period for which in-plant storage is required;
2. Scheduled availability of offsite storage or other disposal means;
3. The extent of unused floor space in the spent fuel pool;
4. The amount of spent fuel already in storage;
5. The difficulty of removal of existing racks and their disposal;
6. Plant seismic design criteria;
7. The licensability of various options (see also Section 3.2 of the statement).

There are additional factors which bear upon the selection of a storage expansion system. These include the following:

1. Ability of the existing spent fuel pool heat transfer system to accommodate the additional heat load or the feasibility of adding more cooling capacity if required (heat output of aged spent fuel drops off rapidly);
2. Ability of the spent fuel pool structure to withstand the additional loadings under seismic conditions from the new racks when loaded with spent fuel;
3. Ability of the fuel pool filtering and purification system to accommodate the additional loading of spent fuel or the feasibility of adding more water purification capacity;
4. Ability to accommodate or dispose of nonfuel-bearing reactor parts such as control rods, fuel channels, core instrumentation, and other minor parts which are stored underwater; and
5. The pool depth (this may be a factor in two-tier stacking of fuel but does not have much effect on pool surface radiation if the older fuel with long storage is in the upper racks).

The following paragraphs discuss the various aspects of increasing spent fuel pool storage capacity at power plants. Some of the attributes of increasing storage capacity are:

1. No external shipment of spent fuel is necessary;
2. No additional handling of shipping casks is necessary;
3. Additionally stored fuel is under the same safety requirements as the originally stored fuel;
4. The same service systems, such as pool cooling water and filtering, can be used as for the originally stored fuel; and
5. The additional storage space is available in the shortest period of time when compared with other alternatives.

One of the major considerations in compact storage is that of fuel assembly spacing to ensure that the fuel storage facility is always subcritical by a safe margin, even under accident conditions. The current requirement that the multiplication factor k_{eff} must be 0.95 or less for spent fuel rack designs is given in NRC Standard Review Plan, Section 9.1.2. Past design practice used spacings which allowed calculated k_{eff} values of 0.90 or less, using less sophisticated computational techniques and hence a greater error allowance.

As originally designed, the spent fuel storage racks are spaced closer in BWR storage pools than in PWR pools. The spacing is closer in BWR's because each fuel element is smaller and contains less fuel (about 1/2 that of the PWR). The further reduction of spacing is more difficult in BWR's. If the matrix of the BWR storage racks were brought closer together than the original design, the calculated k_{eff} would become greater than allowable. The only alternative left for closer packed arrays for the BWR is the use of neutron absorbing materials as part of the rack construction. The materials which can be considered are stainless steel, Boral (a mixture of B_4C in aluminum) and stainless steel with a small amount of boron. The use of neutron absorber materials in rack construction is now a standard means of spent fuel storage rack design.

Selected examples showing how pool storage capacity for PWR and BWR plants can be increased using the above concepts are given later in this appendix. Old racks would be disposed of in accordance with NRC regulations.

1.2 DESIGN CRITERIA

The purpose of this section is to identify those criteria and reference documents that are available to guide and direct new fuel storage pool construction and the modification of existing facilities. As mentioned above, the early fuel storage pool designs were developed from codes that were available at the time, and then the designs were subjected to a number of reviews during design and construction and prior to operation. The technology that has evolved from this process is currently recorded in various documents that are available for use by engineers and designers.

Table D.1 lists codes, standards, and licensing documents commonly used in the design of fuel storage facilities. Additional standards are referred to in the listed documents. This section describes some of the more important parameters, criteria, and design bases derived from these documents. Consideration is given to criticality, seismic, structural, heat generation, cooling, fuel storage pool radiation, water cleanup, in-service inspection, accidents, and construction standards.

1.2.1 Criticality

PSAR's and FSAR's of existing power plants show values for k_{eff} generally considerably less than 0.95. The pool design was not optimized since the original plan was to accommodate only a few discharges of fuel in the pool before shipment of fuel to a reprocessor. Generally, the fuel assembly spacing has been more conservative than necessary. As a result, it is possible to provide closer spacing with neutron absorbers or medium spacing with stainless steel (low cross section neutron absorber) and still meet the k_{eff} requirements. In some cases the original pool size was optimized in order to take advantage of closer fuel spacing. Expansion of the fuel storage capacity in such a plant would be more difficult.

In the design of the fuel storage pools for expansion of storage capacity, k_{eff} remains at 0.95 or less, but only when design margins have been included for the following items:

- Accuracy of calculation
- Possible accidents which could increase the multiplication factor
- Consideration of dry storage of new fuel if pool is needed during initial fuel loading.

Table D.1. Applicable Standards

		NRC Regulatory Guides		
Number	Guide Number	Title	Date	Revision
1	1.13	Spent Fuel Storage Facility Design Basis (Safety Guide 13)	12/75	1
2	1.25	Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors (Safety Guide 25)	3/23/72	0
3	1.26	Quality Group Classifications and Standards for Water-, Steam-, and Radio-Waste-Containing Components of Nuclear Power Plants (Safety Guide 26)	2/76	3
4	1.29	Seismic Design Classifications (Safety Guide 29)	9/78	3
5	1.31	Control of Ferrite Content of Stainless Steel Weld Material (Safety Guide 31)	5/78	3
6	1.33	Quality Assurance Program Requirements (Operations) (Safety Guide 33)	3/78	2
7	1.55	Concrete Placement in Category I Structures	6/73	0
7a	3.43	Nuclear Criticality Safety in the Storage of Fissile Materials	4/79	1

Table D.1. Continued

NRC Standard Review Plans

Number	Standard Section	Title	Issue
8	3.8.4	Other Seismic Category I Structures	Issued November 1975
9	-	Draft Environmental Standard Review Plans for the Environmental Review of Construction Permit Applications for Nuclear Power Plants, Part I	Draft published January 1977
10	9.1.2	Spent Fuel Storage	Revision 2
11	9.1.3	Spent Fuel Pool Cooling and Cleanup System	November 1975
12	9.1.4	Fuel Handling System	Revision 1
13	9.2.5	Ultimate Heat Sink	Revision 1

Code of Federal Regulations

	Title
14	10 CFR 50, Appendix A, General Design Criterion 2, 4, 5, 44, 45, 46, 61, 62, and 63
15	10 CFR 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants

American National Standards Institute and American Nuclear Society

	Standard Number	Title	
16	N212	Nuclear Safety Criteria for the Design of Stationary Boiling Water Reactor Plants	Trial Use May 1974
17	ANSI N210	Design Objectives for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Stations	Issued 1976
18	ANSI N18.2	Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants	Issued 1973

American National Standards Institute and American Nuclear Society

Number	Standard Number	Title	Status	Corresponding NRC Reg. Guide
19	ANSI N45.2, Rev. 1	Quality Assurance Program Requirements for Nuclear Power Plants	Issued 1977	1.28 & 1.33
20	ANSI N45.2.1	Cleaning of Fluid Systems and Associated Components during the Construction Phase of Nuclear Power Plants	Issued 1973	1.37
21	ANSI N45.2.2	Packaging, Shipping, Receiving, Storage, and Handling of Items for Nuclear Power Plants (During the Construction Phase)	Issued 1972	1.38
22	ANSI N45.2.3	Housekeeping during the Construction Phase of Nuclear Power Plants	Issued 1973	1.39
23	ANSI N45.2.4	Installation, Inspection and Testing Requirements for Instrumentation and Electric Equipment during the Construction of Nuclear Power Generating Stations	Issued 1972	1.30
24	ANSI N45.2.5	Supplementary Quality Assurance Requirements and Installation, Inspection, and Testing of Structural Concrete and Structural Steel during the Construction Phase of Nuclear Power Plants	Issued 1974	1.94
25	ANSI N45.2.6	Qualifications of Inspections, Examination, and Testing Personnel for the Construction Phase of Nuclear Power Plants	Issued 1973	1.58

Table D.1. Continued

American National Standards Institute and American Nuclear Society

Number	Standard Number	Title	Status	Corresponding NRC Reg. Guide
26	ANSI N45.2.8	Supplementary Quality Assurance Requirements for Installation, Inspection and Testing of Mechanical Equipment and Systems for the Construction Phase of Nuclear Power Plants	Issued 1975	1.116
27	ANSI N45.2.9	Requirements for Collection, Storage and Maintenance of Quality Assurance Records for Nuclear Power Plants	Issued 1974	1.88
28	ANSI N45.2.10	Quality Assurance Terms and Definitions	Issued 1973	1.74
29	ANSI N45.2.11	Quality Assurance Requirements for the Design of Nuclear Power Plants	Issued 1974	1.64
30	ANSI N45.2.12	Requirements for Auditing of Quality Assurance Programs for Nuclear Power Plants	Draft 4, Rev. 2, April 1976	
31	ANSI N45.2.13	Quality Assurance Requirements for Control of Procurement of Equipment, Materials and Services for Nuclear Power Plants	Issued 1976	1.123
32	ANS 5.1 (N18.6)	Proposed Standard, Design Energy Release Rates following Shutdown of Uranium-Fueled Thermal Reactors	Draft, October 1971	

ASME Boiler and Pressure Vessel Code

	Code Section	Title
33	Section II	Material Specifications
34	Section III Subsection NF	Nuclear Power Plant Components, Division I, Component Supports
35	Section III NA-4000	Nuclear Power Plant Components, Division I, Quality Assurance

IEEE Standards

Number	Standard Number	Title
36	323	Qualifying Class I Equipment for Nuclear Power Generating Stations
37	344	Seismic Qualification of Class I Electric Equipment for Nuclear Power Generating Stations

Reports and Specifications*

38	Preliminary Safety Analysis Report (PSAR)
39	Final Safety Analysis Report (FSAR)
40	Plant Technical Specifications
41	Plant Environmental Impact Report (EIR)

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*These reports and specifications are provided for each nuclear power plant by the applicant.

1.2.2 Seismic and Structural

For storage pools at nuclear power plants the following equipment has been built to the indicated seismic classifications:

System, Equipment or Structure	Seismic Classification
Fuel pool structure	1
Fuel storage racks	1
Fuel pool makeup system	1
Fuel pool cooling and filtering system	2
Fuel handling system	2

(See listings 4, 16, 17, [illegible] in Table D.1.)

New expanded fuel storage pools will use the same criteria. The difference between the older designs and the newer ones is that methods of calculation have improved. The older designs were based on static seismic calculations; newer designs are based on dynamic analysis using finite element stress analysis. A conservative static analysis may produce a design equal to, or possibly more conservative than, a dynamic analysis. Both are satisfactory.

From the structural standpoint, a rack of a given design must not only be capable of meeting seismic design requirements and operating requirements, but also must be capable of being transported to the reactor site and installed without being damaged. Sometimes this requirement is controlling.

Design loadings and load combinations are defined by adaptations of Listings 8 and 9 in Table D.1. Typical loading combinations are shown in Table D.2.

Table D.2. Spent Fuel Rack Loading Combinations and Allowable Limits

Loading Combination*	Allowable Limit
D + B + Q	S**
D + B + E + H	S
D + B + E' + H	Yield Stress
D + B + M	***
D + B + U	***

*"Loading Combination" symbols: B = Buoyance load; D = Deadweight load; E = Seismic operating basis earthquake load; E' = Seismic design basis earthquake load; H = Hydrodynamic mass effect; M = Mechanical damage loads; Q = Thermal gradient load; U = Uplift load.

**S is the working stress limit per applicable code requirements.

***The final configuration of rack array shall maintain $k_{eff} < 0.95$. Energy absorbing members whose local or general strain exceed 50% of the materials ultimate strain shall be assumed as nonexistent for further energy absorption. Structural members, welds, or bolts to maintain subcriticality shall be analyzed using a minimum safety factor of 1.33 base on yield or buckling, whichever is lowest.

1.2.3 Heat Generation

Considerable data are available from operating nuclear power plants to derive a calculation base for computing spent fuel heat generation. Listings 16 and 32 in Table D.1 are used to evaluate heat generation for long-term storage of fuel. Both standards are conservative and include margins to ensure that the calculation does not provide an underprediction of future heat loads. The data base itself has been proven accurate without the margins.

With respect to the addition of fuel storage capacity to an operating nuclear power plant, the addition of heat removal capacity is not necessary in the general case. This is because: (1) the heat generation of fuel in long term storage (1 year or longer) is only a small percentage of the total heat load for which the fuel pool cooling systems are designed; (2) the original cooling systems were conservatively designed using the infinite irradiation curve as a basis and without taking credit for finite irradiation. This assumption provides a large margin in the calculation.

1.2.4 Fuel Pool Cooling

There are two considerations for pool cooling. The first is the capacity of the external cooling system and the second is the local pool circulation and natural convection. The pool cooling systems are divided into two subsystems in order to assure cooling at all times and are backed up by the residual heat removal (RHR) or the shutdown system for special cases, such as the discharge of all fuel from a reactor core. There are many variations to this pattern, such as independent pool cooling systems with larger capacity, but the essential features of adequate cooling and redundancy are incorporated in all systems.

The fuel pool heat exchangers are cooled by the reactor building closed cooling water system (BWR) or the component cooling water system (PWR). These two systems are cooled by service water from a river, lake, ocean, cooling tower, or spray pond as the case may be. This method of cooling is selected to prevent potential release of small amounts of radioactive isotopes which may be present in the fuel storage pool water.

The maximum fuel storage temperatures that are permitted or expected are 52°C (125°F) for two fuel pool cooling subsystems operating or 66°C (150°F) for one subsystem operating. The cooling system equipment is designed with a rating that ensures adequate cooling at all times. The design basis calculations include a prediction of stored fuel heat generation and maximum cooling water temperature. Suitable design margins are included to ensure that the heat generation is not underpredicted and that the cooling system will perform satisfactorily. Most of the older fuel storage pool cooling systems include sufficient design margin so that additional cooling capacity is not required even with the addition of more fuel to the pool than originally included in the design. This is due to the low heat generation of fuel in long term storage as well as the large design margins.

Listing 1 in Table D.1 requires that fuel storage pool cooling systems be designed to prevent draining the pool.

In summary, the pool cooling systems are conservatively designed and generally will accommodate increased fuel storage without an increase in cooling capacity.

The second evaluation needed is to determine the natural circulation within the fuel storage pool and identify any flow restrictions that may cause some fuel assemblies to heat up more than the rest. The period of interest for this calculation is the first few weeks after a refueling discharge or a full core discharge has been made. After this period the cooling requirements are greatly reduced because of the decay of short-lived fission products.

1.2.5 Fuel Storage Pool Radiation Protection

The depth of the fuel storage pools is about 12 meters and is established by shielding requirements from stored fuel and from fuel being moved within the pool (see Listing 17 in Table D.1). Because fuel is stored at the bottom of the pool, direct radiation levels are very low at the pool surface. Radiation levels above the pool are primarily a function of water purity. The walls and bottom of the pools are provided with 5 to 10 feet of concrete and may also be resting in the ground. Consequently, direct radiation through the sides and bottom from stored fuel is very low.

Another contribution to radiation from the fuel storage pool is radioactive isotopes in the pool water. The sources of radioactive isotopes are from fuel leaks, mixing pool water with reactor water, or activation products on the outside of the fuel carried from the reactor. A pool cleanup system is provided to remove radioactive isotopes from the water.

1.2.6 Water Cleanup

Fuel pools are equipped with cleanup systems to remove contamination from the pool water. The systems include filters and anion and cation demineralizers. These systems are designed to remove radioactive and nonradioactive contamination in order to maintain the proper pool chemistry and keep the pool surface radiation at acceptable levels. The cleanup systems are designed so that they can be bypassed at any time additional pool cooling is required for short periods of high heat load. Full flow and bypass cleanup systems are used. Pool clarity and radiation limits must be maintained by the systems (see Listing 17 in Table D.1).

1.2.7 In-Service Inspection

The general condition of fuel storage racks can be determined by visual inspection from the pool surface. More detailed inspection can be carried out by visual equipment such as borescopes and periscopes inserted into the pool to inspect for evidence of corrosion or cracks in structural welds. Fuel pool expansion where neutron absorbers are used to provide closer packing of stored fuel may require additional inspection in order to establish the condition of the neutron absorbers. This can be done by the provision of test coupons of the same material which can be removed for metallographic and chemical examination as required.

1.2.8 Accident Considerations

The design of new storage racks incorporates the same design requirements as were used for the original racks and pool structure:

a. Maintain maximum k_{eff} for normal and abnormal occurrences
    (1) Clean water (in PWR)
    (2) Fuel drop accidents
    (3) Stuck fuel assembly crane uplift forces
    (4) Seismic events
    (5) Horizontal movement of fuel before complete removal from rack
    (6) Placing a fuel assembly along the outside of the rack

b. Prevent draining the pool
    (1) Design of cooling system
    (2) Design of makeup system

c. Establish offsite doses as may result from a fuel drop accident (Listing 2 in Table D.1)

d. Provide adequate seismic design for pool and rack structures

e. Maintain onsite radiation level within the same limits

f. Protect stored fuel from natural events (floods, tornadoes, tsunami, missiles, etc.).

The addition of fuel to be stored for extended periods of time does not override any of the above considerations. This is because the amount of fuel stored does not affect the way fuel is moved. Specifically, fuel assemblies are moved one at a time. Consequently, the fuel drop accident involves the drop of one assembly, so an offsite dose calculation for this case does not change. The fuel drop accident provides the maximum potential offsite dose. The calculation is conservative because actual experience with fuel dropping in the pool has not resulted in serious damage to the fuel as assumed for the calculation in Listing 2 in Table D.1.

1.3 PROBLEMS AND LIMITATIONS OF STORAGE EXPANSION

1.3.1 Upgrading Seismic Design Analysis

Methods of calculating the seismic responses of building and equipment have been improved. Older systems were calculated with a static evaluation, while current practice is to use a dynamic calculation. The dynamic calculation provides a truer picture of seismic response than the static, but the resulting design is not necessarily more conservative because the static design is based on the maximum acceleration only. The dynamic calculation takes advantage of the resonant frequencies of the structure and uses the actual seismic input spectrum imposed on the structure to determine loads and stresses.

In order to backfit additional spent fuel storage pool capacity to existing power plants, the pool structures and the new rack structures require analysis to assure that all functions and requirements will be met. The addition of weight (racks and fuel) to the fuel storage pool is not necessarily a problem, because the major loading in the pool comes from the contained water in the pool. The addition of racks and extra fuel amounts to only a small percentage additional static loading. The pool walls are 5 to 8 feet thick to provide shielding and generally are adequate to provide the seismic support. Also, for both vertical and horizontal loadings, most structures include design margins that can be used to accommodate new loadings There is little chance to add to the pool structure that is already in place. Consequently, if the above factors do not combine to provide for the desired pool storage capacity increase, the increase may be limited.

On a comparative basis, the PWR pool structures are subjected to lower seismic loadings than the BWR pool structures because of the position in the building. The PWR pool structure is located at ground level, while the earlier BWR pools are elevated (pool floor is about 15 m above ground level). This elevation causes an increase in the seismic loadings imposed on the pool and rack structures because of amplification from the building movement. These increased loadings need to be accounted for in the BWR design. Later BWR designs have spent fuel storage pools located at ground level.

1.3.2 Pools with Existing Fuel

Many operating plants have spent fuel already stored in their spent fuel pools. The replacement of existing racks with new racks means the movement of fuel from the old racks to new racks.

Since the fuel must remain under water for shielding and cooling, the task of replacing old racks must be accomplished entirely under water. In addition, the movement of fuel from old to new racks causes a problem in maintaining the structural integrity of the racks during the rack installation process. It is necessary that no heavy objects, such as new or old racks, be moved directly over racks which have fuel in storage.

The method proposed to accomplish the replacement generally has the following features:

a. All stored fuel is moved to racks on one side of the pool;

b. Empty racks on the otherside of pool are removed and decontaminated;

c. Old racks with fuel are temporarily restrained for seismic integrity if required;

d. New racks are installed in vacated spaces;

e. New racks are temporarily restrained for seismic integrity if required;

f. Spent fuel is moved from old racks to new racks;

g. Remaining old racks are removed and decontaminated;

h. Entire new rack system is structurally tied and supported as necessary.

Some of the techniques used for performing the work under water are:

> Remote handling - Underwater cutting and handling tools are designed specially for the task or are available commercially. Care must be taken against dropping parts to the bottom of the pool and the dispersion of metal chips or other contamination from the work process.
>
> Divers - Underwater divers can be used in areas where the radiation level is low and when it is very difficult to perform the work by remote handling equipment.

If a small amount of fuel is in storage in the pool, it may be possible to transfer the fuel to another pool of the utility or to another storage facility. In this way, the pool can be drained for easier installation of new racks.

1.3.3 Availability of Materials for Racks

The materials of construction used in spent fuel storage racks are stainless steel (Type 304), aluminum, and neutron absorption materials.

A typical stainless steel rack installation for a PWR will be using from 300,000 to 500,000 pounds of stainless steel. Assuming that over the next 10 years 150 plants refit their spent fuel pools with high density racks, a total of 22,000 to 37,000 tons, or about 2,200 to 3,700 tons per year, of stainless steel will be required. This is about 0.15 to 0.25% of the current total yearly production in the United States and should have a small impact upon the total supply.

Assuming that, in addition, about 50 plants (BWR) will use aluminum racks amounting to about 150,000 to 300,000 pounds of aluminum per plant or a total of 3,750 to 7,500 tons of aluminum over a 10-year period, the yearly use of aluminum would be about 375 to 750 tons per year. The current total fabricated aluminum production in the United States is about 4 million tons per year. Again the aluminum use for fuel racks would be insignificant.

If it is assumed that about 50 of the total pool expansions (in the next 10 years) will use a neutron absorbing material as an integral part of the rack construction, an estimate can be made of the production requirements. The two materials most commonly considered for neutron absorbing materials are Boral plate and boron stainless steel plate.

Boral plate is a sole source product of the Brooks Perkins Corp. of Cadillac, Michigan. The neutron absorbing material is boron carbide (B_4C) which is dispersed in aluminum. The material is clad with aluminum on both sides as well as exposed edges. Boral plate is available in nominal 1/4" and 1/8" thickness. The production capability of Boral plate in the United States has not been reported in any known documentation. The manufacturer, however, is capable of producing 2 million square feet a year or more if necessary.

Boron contained in stainless steel is another neutron absorbing material that is used in rack design. This material is produced mainly in the United States by the Carpenter Technology Corp. in Reading, Pennsylvania. It is presently produced with a nominal 1% boron content and in nominal 1/8" thickness. The production capability of boron stainless steel has not been reported in any known documentation.

Other neutron absorbing materials include boron carbide (B_4C), and cadmium. The tubes of boron carbide are used in some current rack designs and also as a control material in BWR reactors. The source of boron carbide used in Boral is capable of meeting the demand and boron carbide is not in limited supply. Cadmium has not been developed as a neutron absorbing material for spent fuel storage racks.

1.3.4 Pool Cooling

This subject is discussed in several previous sections. The original pool cooling systems have considerable margin which can be used to accommodate additional fuel loading without an increase in cooling capacity. Pool temperature is not a safety consideration with respect to protection of the stored fuel but is a matter of concern relative to pool clarity and humidity in the refueling area. Calculations are made assuming all the maximum conditions are occurring at the same time plus additional margins to assure that the maximum pool temperatures are not underpredicted. Pool temperature is a transient condition because even with a full core discharge, the heat generation rate decreases rapidly with time. As a result, the maximum pool temperatures are realized only for a short period of time measurable in days. These considerations lead to two means of accommodating existing pool cooling systems even if higher than normal pool temperatures are indicated: (a) place a restriction on fuel movement when a specified fuel pool temperature is reached and (b) provide additional interconnections with other plant cooling systems, such as the shutdown system, the component cooling system, the reactor building cooling water system, or the turbine condenser

Additional pool cooling capacity can be provided in some cases, if needed; however, backfitting additional capacity is difficult.

1.3.5 Allowable Construction Practices

There are limitations on how new storage racks may be installed. These limitations represent industry accepted practices in response to Safety Guide 13. Considerable effort is expended during construction to ensure that the fuel pool storage system is leaktight and will stay that way. When the pool is completed and checked out, there is a reluctance to make any changes that might cause leaks in the liner. These considerations lead to the following practical limitations:

a. No attachments can be made to the pool liner that were not built as embedments into the concrete and sealed to the liner during the original construction. This is true of both floor and wall mountings. Also, no modifications can be made to existing embedments for added strength. Because of this limitation, only compressive loads can be applied to the pool walls or floors by devices resting against the liner but not attached to the liner.

b. Horizontal supports to the walls of the pool must accommodate thermal expansion as well as provide seismic restraint.

c. Both floor mountings and wall supports may be required.

Other practices include the following:

a. No movement of racks or heavy objects over stored fuel.

b. Evaluation of seismic pool wall movements that must be accommodated by the fuel storage rack design.

c. Seismic restraint of old racks with stored fuel during installation of new racks.

d. Seismic restraint of new racks during installation.

e. Decontamination of old racks as required following removal from the pools.

1.4 COMPACT STORAGE EXAMPLES--REACTOR PLANTS

The following four examples show how spent fuel storage capacity has been increased for typical power plants in operation or under construction. Plants now in the early phases of design are not covered since utilities, acting with foresight, can design larger storage pools as required to meet future storage requirements, thereby making rack retrofit unnecessary.

To examine the several unique features of various rack designs and the special considerations required for each type of plant, representative examples of both BWR and PWR plants have been chosen for study. In each case, where a means of increasing storage capacity is described, the approach chosen is not intended to be unique in terms of detailed methods. It is recognized that each utility may choose variations in the approach selected, including different rack designs, use of aisle space, seismic bracing, and hold-down bolting. Therefore, the selection of these typical cases is for illustrative purposes only. The actual modification for a particular plant may vary considerably from these examples.

The following plants are used as representative examples in the following discussion:

CASE	PLANT NAME	TYPE	CURRENT PLANT STATUS
A	Zion, Units 1 and 2	PWR	Operational
B	Monticello	BWR	Operational
C	Beaver Valley, Unit 1	PWR	Operational
D	WPPSS Nuclear Project 2	BWR	Construction

CASE A: EXAMPLE OF INCREASE IN SPENT FUEL STORAGE CAPACITY IN AN OPERATING PWR PLANT

Plant Type: PWR One spent fuel pool for two units
NSSS Supplier: Westinghouse
Plant Capacity: 1040 MWe per reactor
Spent Fuel Pool Capacity as Designed: 340 spaces for 2 units
Number of Fuel Assemblies in Core: 193 per reactor
Original Spacing of Racks: 53 cm on centers

Figure D.1 shows the spent fuel pool layout as originally designed. The pool is 20 m long x 10 m wide x 12 m deep. As shown, the pool contains 12 racks holding 25 assemblies each and 4 smaller racks holding 10 assemblies each. Each rack is free standing, being supported solely by its bolting to the pool floor. The pool is completely lined with stainless steel that has been tested during construction for leak tightness. The pool is provided with additional spaces and bolts for 4 additional racks of the 25-assembly type. There is also space for the insertion of a spent fuel shipping cask in one corner of the pool. The cask area is enclosed with two wall dividers that prevent the cask from falling on the fuel racks should the cask drop or start to tip.

In the refueling process, fuel is removed from the reactor and brought into the storage pool, all under water. The fuel is moved to the storage racks from the receiving area by the use of an overhead bridge crane that can move over all the racks of the pool. At all times during the fuel movement a water level of at least nine feet above the top of the fuel assembly is maintained in order to provide shielding for the operators working around the pool area.

Figure D.2 shows the same pool as above but with increased storage capacity. The 12 racks that each formerly held 25 assemblies were replaced with new racks holding 49 assemblies. The 4 racks that each held 10 assemblies were replaced with new racks holding 21 assemblies. In addition, the space reserved for future racks was filled with 4 racks of the 49-assembly type. The replacement of existing racks with new racks expanded pool storage capacity from 340 to 868 spaces. This compaction was accomplished with spent fuel present in the pool.

Figure D.3 shows a detail of the new rack design. The new design provides a "neutron flux trap" by the use of nominal 1/8"-thick stainless steel square tubes for each fuel space. The fast neutrons are allowed to pass through the stainless steel, but are moderated (slowed down) by the water between tubes. The slower neutrons are then more easily absorbed by the stainless steel

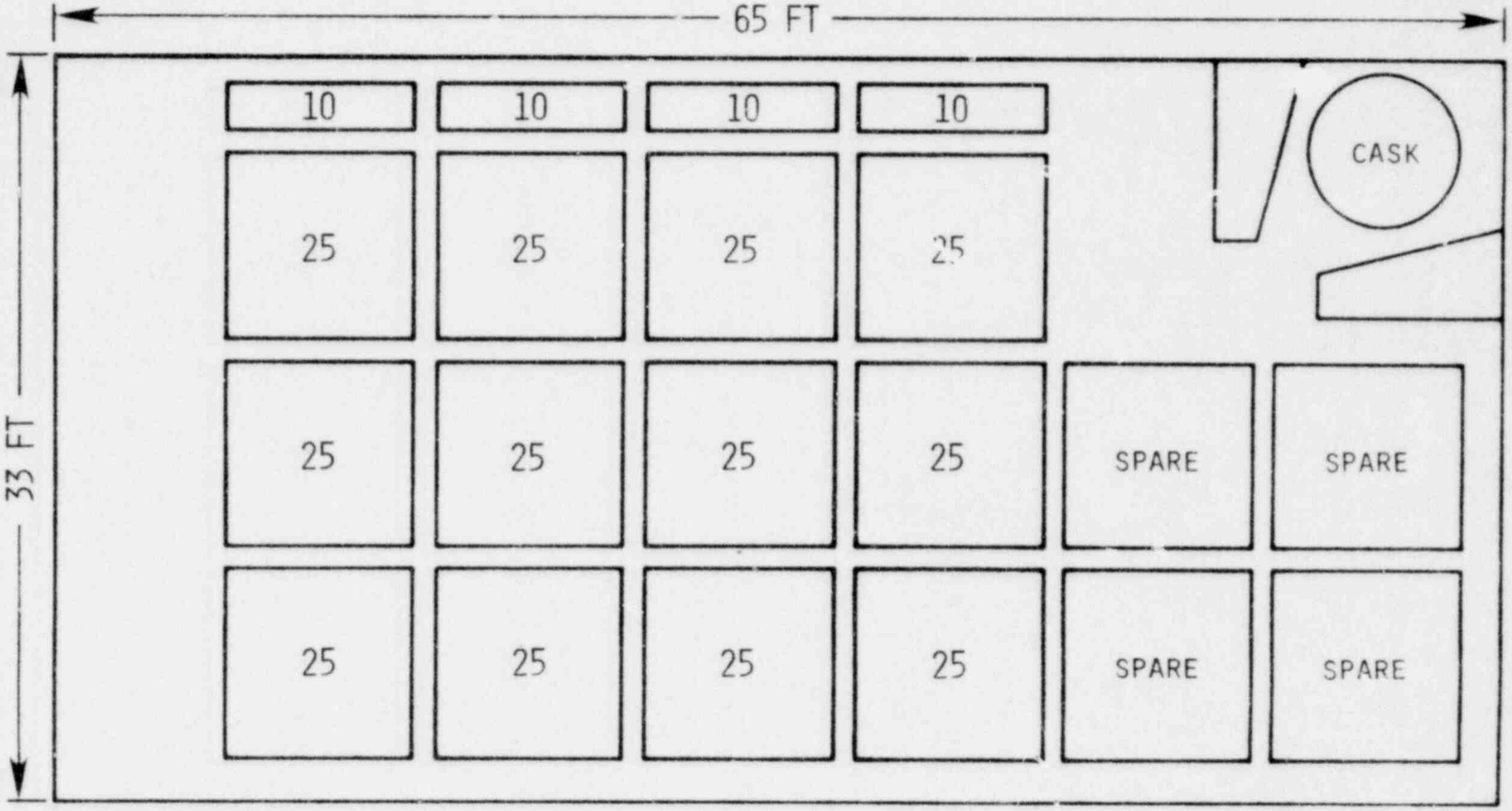

Figure D.1 Case A Spent Fuel Storage Pool (original design).

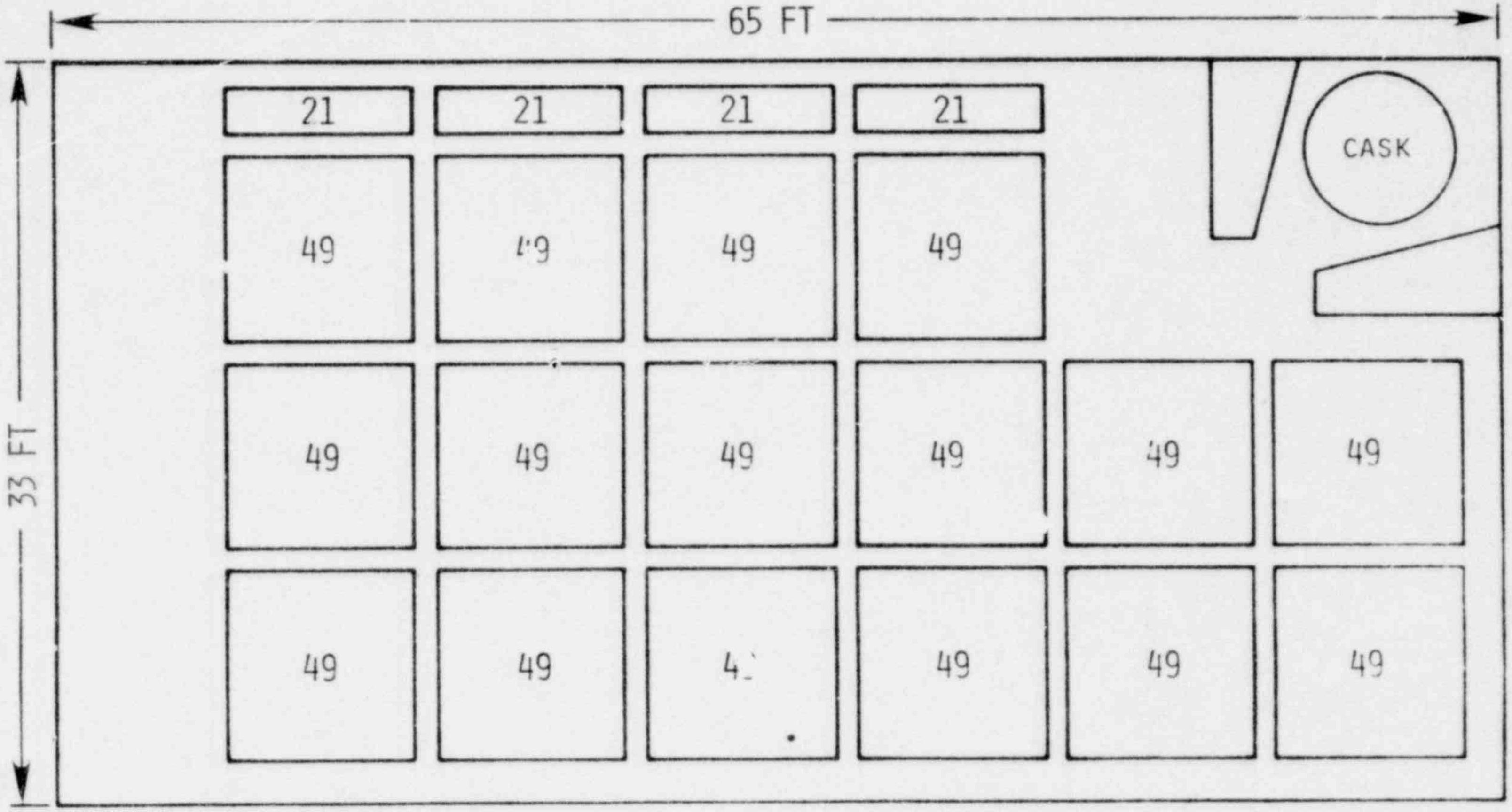

Figure D.2 Case A Expanded Spent Fuel Storage Pool (Total Capacity - 868 Spaces).

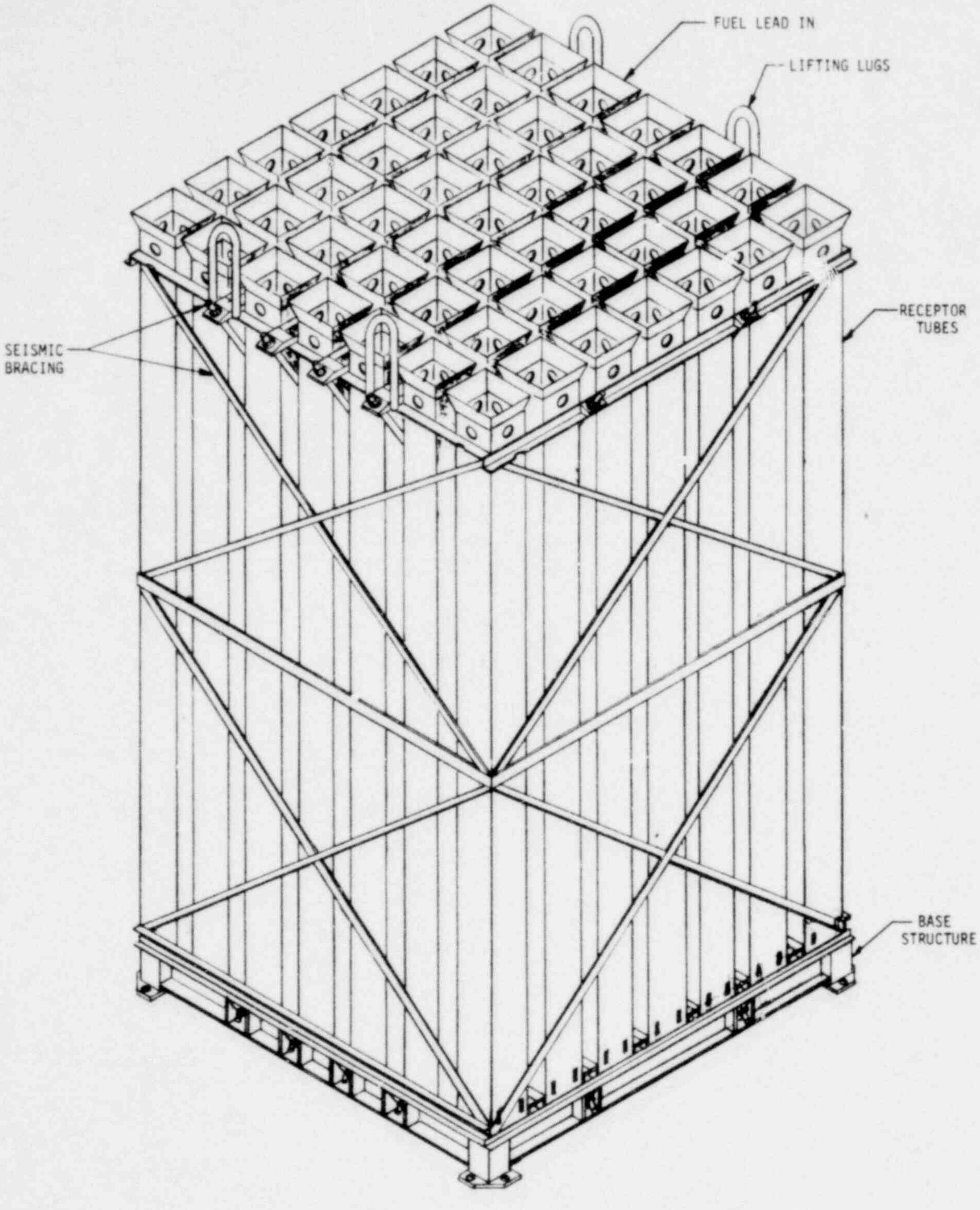

Figure D.3 Case A Typical Spent Fuel Rack Designed for Increased Capacity-PWR Stainless Steel.

of the adjacent tube. The new rack uses the same hold-down bolting as the old racks. Structural calculations have shown that the bolting is adequate for the seismic conditions of the plant. The k_{eff} has been calculated to be less than 0.95 under "worst case" conditions of tolerances, fuel position, and enrichment.

An additional increase in storage capacity at the Zion reactor is now pending license review by the NRC. This additional compaction would expand the fuel storage capacity to 2112 spaces.

CASE B: EXAMPLE OF INCREASE IN SPENT FUEL STORAGE CAPACITY IN AN OPERATING BWR PLANT

Type of Plant: BWR (Mark I Containment)
NSSS Supplier: General Electric
Plant Capacity: 545 MWe
Spent Fuel Capacity as Designed: 740 spaces
Number of Fuel Assemblies in Core: 484
Original Spacing of Racks: Nominal 30 cm

The spent fuel storage pool as originally designed is shown in Figure D.4. The pool initially contained 37 spent fuel racks for BWR fuel, with each rack providing storage space for up to 20 assemblies, or 740 spaces total. This is equivalent to approximately 150% of a full core load. In addition to providing storage racks for spent fuel, the pool contained racks for 130 control rods, storage of defective fuel, a work table, and space for storage of shipping casks (not shown). The storage pool is 12 m long by 8 m wide by 11.6 m deep.

The NRC has approved an increase in spent fuel storage capacity for Monticello to 2237 BWR assemblies. The increase in storage capacity is being accomplished through the use of storage racks containing Boral, a neutron-absorbing material. Each storage rack is capable of storing 169 assemblies in a 13 x 13 array. There are presently four of these racks installed. A total of 13 racks are planned. In addition to the storage space provided by these racks, there is room for the storage of 40 more assemblies, resulting in the total of 2237 spaces.

Criticality studies for the new rack arrangement were required in order to determine that the proposed design meets subcriticality requirements. A structural and seismic analysis demonstrated that the new rack design was capable of meeting all the necessary seismic and structural requirements.

CASE C: EXAMPLE OF INCREASE IN SPENT FUEL STORAGE CAPACITY IN AN OPERATING PWR PLANT (before any fuel has been placed in the storage pool)

Plant Type: PWR 1 spent fuel pool for 2 units
NSSS Supplier: Westinghouse
Plant Capacity: 852 MWe
Spent Fuel Pool Capacity as Designed: 272 spaces for 2 units
Number of Fuel Assemblies in Core: 157
Original Spacing of Racks: 53 cm on centers

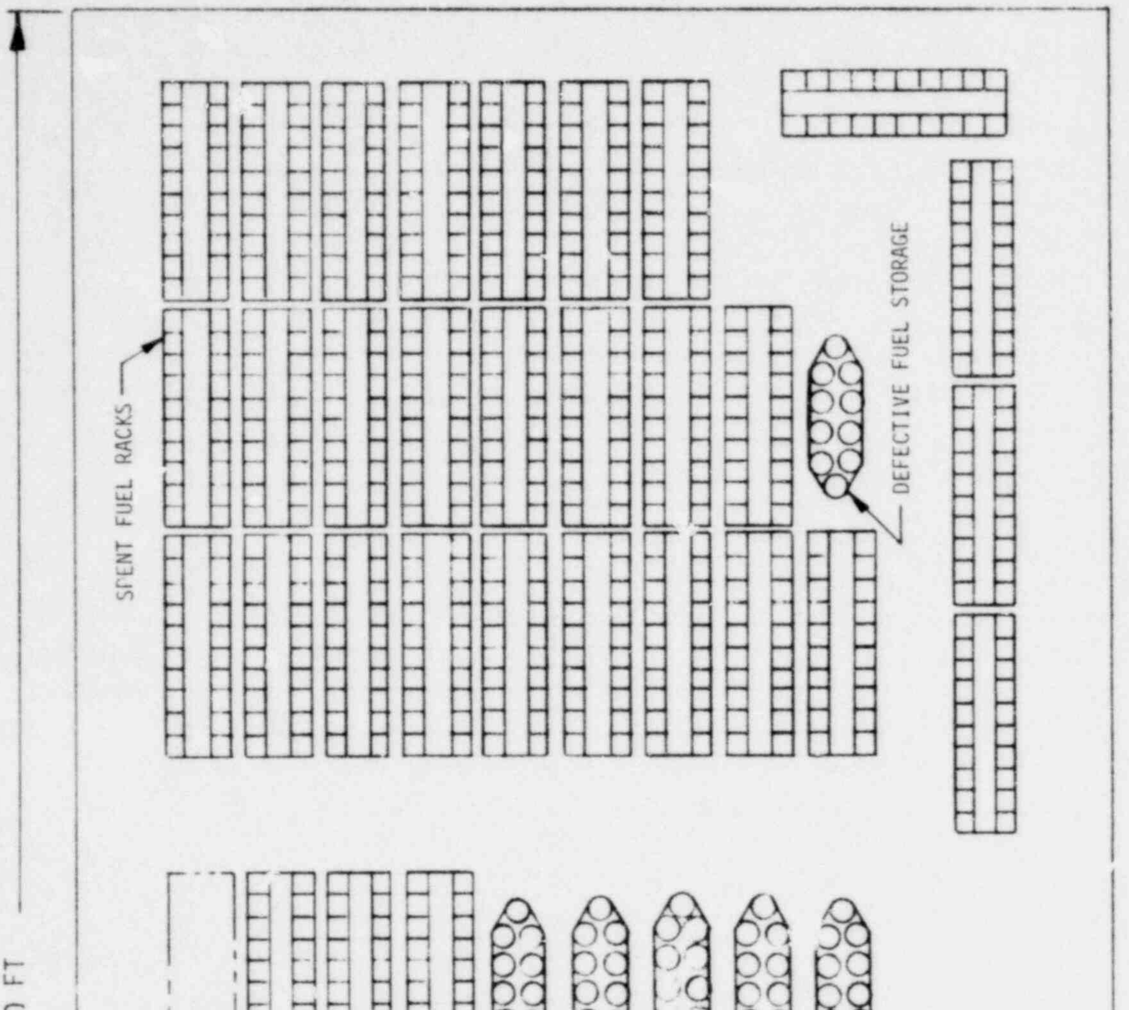

Figure D.4 Case B Spent Fuel Storage Pool (original arrangement).

The spent fuel pool under study in Case C is a conventional, stainless-steel-lined, concrete structure providing space for the spent fuel storage racks, shipping cask, the new fuel elevator, and fuel transfer and upending equipment. The pool is divided into three areas: the fuel transfer mechanism area, the spent fuel storage area, and the spent fuel cask laydown area.

The spent fuel rack originally designed was a free-standing, stainless-steel structure providing the storage space for 272 spent fuel assemblies. This is equivalent to approximately 1-2/3 cores with space for 11 spare assemblies. The spent fuel assemblies were to be placed in vertical cells within the rack, continuously grouped in parallel rows at approximately 53 cm centers in both directions. The spacing between assemblies was designed to prevent criticality, and the racks were arranged in such a way as to ensure that the spacing between fuel elements would not be less than that prescribed.

Pool storage capacity was increased from the 272 spaces to the present 833 spaces by using a "neutron flux trap" rack constructed of stainless steel. This compaction was completed shortly after the reactor began operation and before any spent fuel was stored in it. These racks were designed to meet the applicable seismic and criticality requirements.

CASE D: EXAMPLE OF INCREASE IN SPENT FUEL STORAGE CAPACITY IN A BWR PLANT UNDER CONSTRUCTION

Type of Plant: BWR (Mark II Containment)
NSSS Supplier: General Electric
Plant Capacity: 1,103 MWe
Spent Fuel Capacity as Designed: 1,020 spaces
Number of Fuel Assemblies in Core: 764
Original Spacing of Racks: 61 cm on centers

Figure D.5 shows the spent fuel pool layout as originally designed. The storage pool was to provide storage space for 1,020 fuel assemblies, which is approximately equivalent to 130% of a full core load. Originally, the racks were to be of aluminum construction and modular design, with each rack assembly (two modules) providing storage space for up to 20 fuel assemblies. Single rack modules with space for 10 fuel assemblies were also to be used. All racks would have had common mounting dimensions to facilitate rack rearrangement or placement, ensuring optimum pool space utilization. Individual rack assemblies were to be supported and retained in place using swing bolts and a beam framework structure designed to transfer loading to the pool floor and wall surfaces.

As originally designed, the spent fuel pool contained additional storage space for control rods, defective fuel, and guide tube racks as shown in the figure. Space was also provided in one corner of the pool for storage of a spent fuel shipping cask. Wall dividers were to be used to separate the shipping cask from the spent fuel racks to prevent accidental damage to the latter should the cask be dropped or tipped.

Spent fuel storage has been increased to 2658 spaces using high-density storage racks containing neutron-absorbing material. The new racks are constructed of stainless steel encasing boron carbide plates. These new racks are designed to maintain k_{eff} within acceptable limits. The design and eventual installation of the racks must satisfy all seismic criteria.

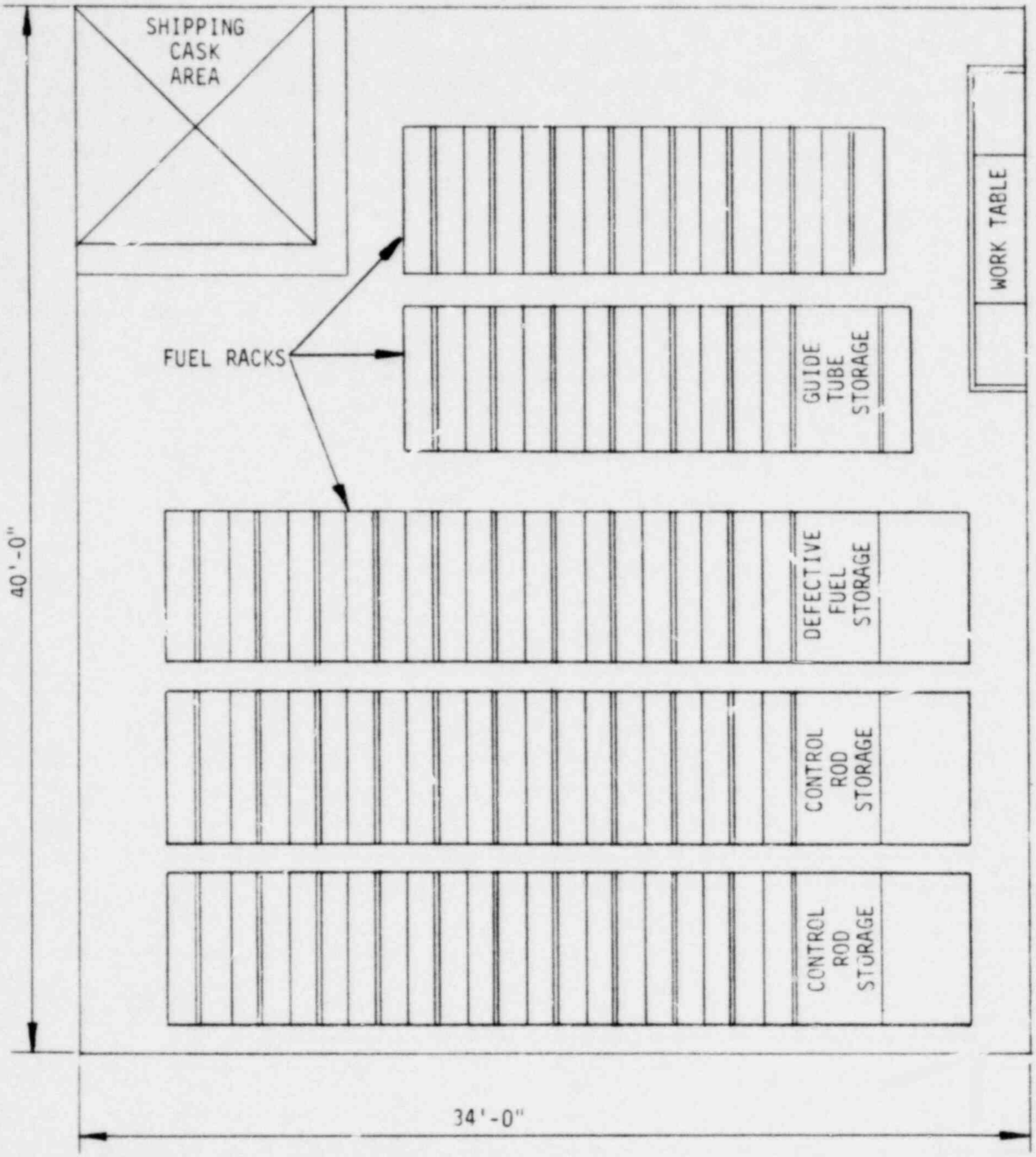

Figure D.5 Case D Spent Fuel Storage Pool (original design).

2.0 INCREASING FUEL STORAGE CAPACITY AT REPROCESSING PLANTS

2.1 METHODS OF INCREASING FUEL STORAGE CAPACITIES

Increased fuel storage capacity at reprocessing plants can be achieved by methods similar to those described above in Section 1.0 of this appendix:

1. Fill unused pool area with existing type racks,
2. Replace nonfuel racks (such as for high level waste canisters) with racks which can accept fuel,
3. Replace existing racks with racks of closer spacing. This option can be further divided into:
    a. Spaced closer if unnecessary margin from critical existed in original design.
    b. Spaced closer by use of neutron absorber materials in the rack construction.
4. Increase the size of the pool,
5. Two-tier stacking of fuel racks,
6. Fill unused pool space with new racks having closer spacing,
7. Any combination of the above.

2.2 EXAMPLE OF INCREASING FUEL STORAGE CAPACITY AT A REPROCESSING PLANT

The licensed expansion of the storage capacity at the GE Morris facility in 1975 is described below as an example of increasing fuel storage capability at a reprocessing plant. The description is based on the Safety Evaluation Report[1] prepared by the NRC Division of Fuel Cycle and Material Safety related to the license amendment for the GE Morris fuel storage facility. Figure D.6 shows a layout of the GE Morris fuel storage facility. Truck or rail casks can be received.

A storage basin originally intended for the storage of sealed containers of solidified high-level waste is connected to the fuel storage basin. This storage basin also can be used for additional storage of spent fuel.

The license modifications to the facility increased the storage capacity from approximately 100 MT to 750 MT of spent fuel based on the addition of new baskets and racks (GE uses the term "baskets," which corresponds to the term "canisters" used by NFS and AGNS). The modified storage system utilizes uniformly spaced baskets consisting of vertical sections of stainless steel pipe in a close-packed square array. The baskets are 26.25 inches square. Baskets for the storage of spent BWR fuel bundles consist of nine 8-inch, Schedule 10 stainless steel pipes, while those for spent PWR fuel bundles consist of four 12-inch, Schedule 5 stainless steel pipes. The pipes are attached firmly together at the top and the bottom and supported by a substructure, forming an independently movable unit. The outside substructure dimensions of the PWR and BWR baskets are identical and fit interchangeably in the racks provided for support. The racks, or grids,

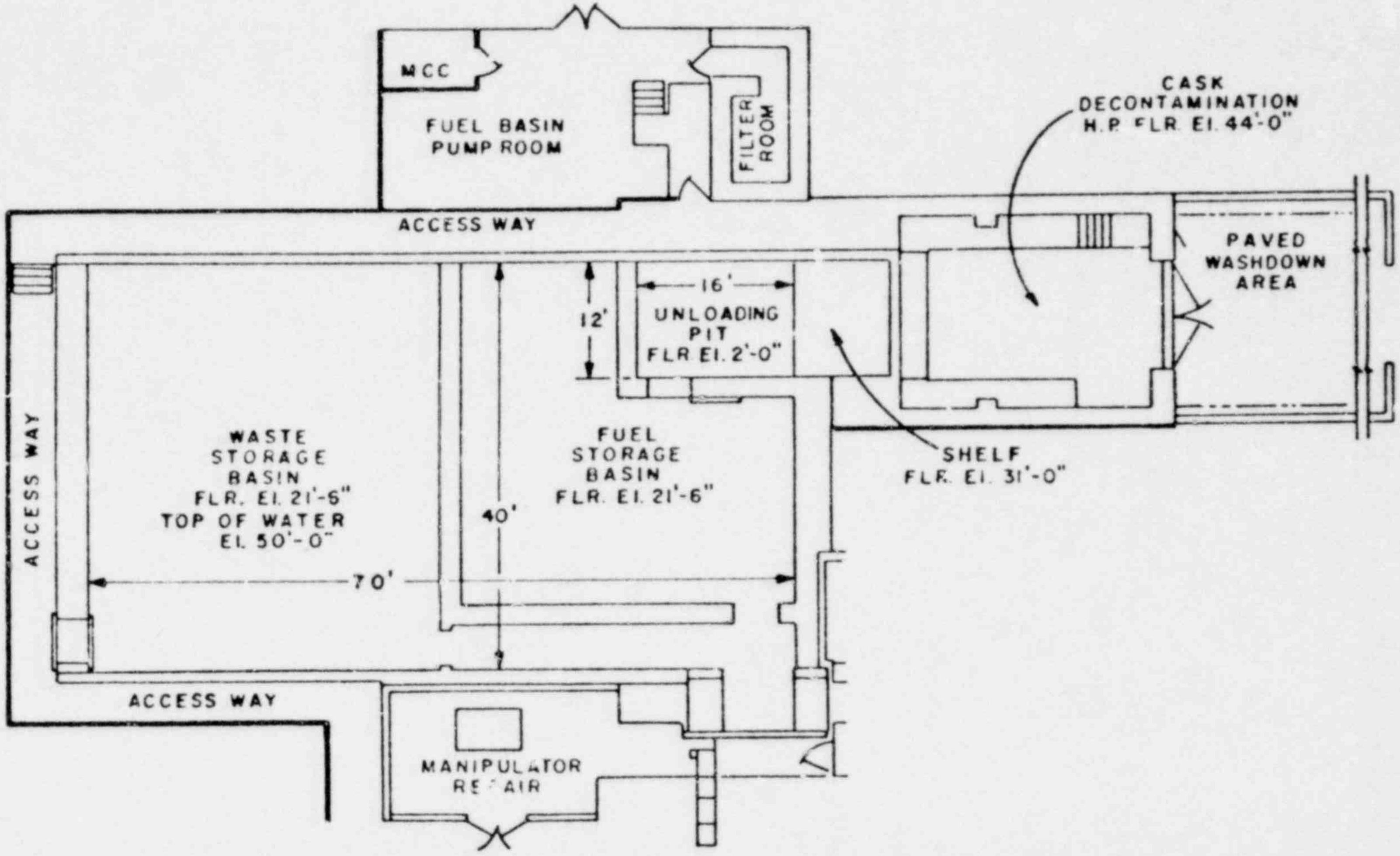

Figure D.6 GE Morris Fuel Storage Facility.

are installed on the pool floor on 69 cm square spacing. The storage baskets incorporate cam-activated latches which lock the basket into the supporting rack.

The increased storage capacity necessitated changes to existing systems for handling the increased heat load and the increased radioactive contamination of the pool water.

The storage facility originally had independent cooling systems serving the fuel storage basin and the waste storage basin. The fuel storage basin cooling system is divided into a primary system and a backup system, each with a heat removal capacity of 7.5×10^6 Btu/hr. To help maintain water clarity, all carbon steel piping exposed to the pool water and the carbon steel heat exchanger in the primary cooling system was replaced with stainless steel. Since the backup system will not normally be used, the carbon steel heat exchanger will not be replaced.

The maximum heat load for both basins filled with the projected spent fuels is approximately 6.5×10^6 Btu/hr. Thus, the primary and backup systems each have adequate capacity to dissipate the maximum projected heat load. In the unlikely event that both cooling systems become inoperative it would be approximately three days before the pool would boil. Makeup water is available for adding to the pool during this period from either of the two wells onsite or from the nearby Kankakee River. Routine inspections and continuous monitoring are conducted to detect any basin leaks.

The original water cleanup system consists of a 950-liters-per-minute pump which delivered water from the skimmers or vacuum hoses through a Powdex filter and back to the basin. Sludge from the filter collected in a small tank and ultimately transferred to the low-activity waste vault, a 2.3 million-liter underground carbon steel tank. To increase the cleanup capacity of the system and serve as a backup to the existing filter during abnormal operating conditions, a new ion exchange demineralizer, using mixed bed cation-anion resin, was installed downstream of the existing filter. Spent resins are discharged to the low-activity waste vault.

The ventilation system has been maintained as originally installed. Fresh air supplied to the cask decontamination area and the basin area flows through the separations plant "canyon" and the process cells into an exhaust duct, through a sand filter, and is discharged through a 300-foot stack to the atmosphere. Canopy hoods for placement over possible leaking fuel elements in storage also vent to the canyon.

Liquid and slurry wastes generated by the fuel storage operation consist largely of cask coolant decontamination solutions, ion exchange resins, and filter media from the pool water cleanup systems. They are transferred to the low-activity waste vault. The low level solid wastes generated in cask decontamination, laboratory operations, and other work at the site are packaged in drums and shipped to a commercial waste burial site. The replaced baskets and hold-down grids will be decontaminated, disassembled, and sent to the burial site.

The management of these wastes is consistent with the plans developed, reviewed, and approved for operation of the spent fuel recovery facility. By comparison, the quantity of wastes produced by the expanded spent fuel storage operation will be small. Disposal of low level wastes is the subject of ongoing study by the NRC.

It was initially recognized that a basket drop could occur just inside the fuel storage pool in such a way that the basket might tip into the unloading pit, spilling all elements out of the basket and allowing them to fall in a critical configuration at the bottom of the unloading pit. To alleviate this potential accident, a structure was designed to restrain the basket from tipping into the unloading pit. The restraining mechanism is a frame located in front of the gate between the storage pool and unloading pit and attached to the wall of the unloading pit.

The basin facilities have been designed to resist seismic phenomena under maximum earthquake conditions and the new storage-basket-grid complex has undergone rigorous seismic shock testing to demonstrate its reliability under earthquake conditions.[2]

It was assumed that a tornado-generated missile has the potential of striking as many as 6 BWR or 4 PWR spent fuel assemblies and that the rods in these assemblies would fail. These could result in the calculated release from the plenums of about 6,500 Ci of ^{85}Kr, 0.009 Ci of ^{129}I, and 0.246 Ci of ^{131}I (30% and 10% of the noble gas and iodine inventories, respectively). Without taking credit for dissolution of the iodine in the pool water, this could result in a whole body exposure of less than two mrem and a thyroid exposure of 61 mrem to an individual residing at the site boundary. These exposures are factors of 8×10^{-5} and 2×10^{-4}, respectively, lower than the accident exposure guidelines in 10 CFR Part 100.

Although a criticality incident in the spent fuel storage pool is very unlikely, the consequences which would result should one occur have been evaluated; it was assumed that a criticality excursion involving four PWR fuel elements (about 1.6 metric tons of uranium) occurred as a result of the impact of a tornado-generated missile. The evaluation assumed a total of 10^{19} fissions per metric ton of uranium and that all the fuel rods became defective and released noble gases and iodines during a guideline exposure time of two hours. The escape-rate coefficients for noble gases and iodines were taken to be 6.5×10^{-8}/sec and 1.3×10^{-8}/sec, respectively.[3] Fission yields were calculated with the ORIGEN code. No credit was taken for the dissolution of the iodines in the pool water. The site boundary exposures were calculated to be 0.2 mrem to the whole body and 3 mrem to the thyroid. These exposures are factors of 8×10^{-6} and 1×10^{-5} respectively, lower than accident exposure guidelines in 10 CFR Part 100.

References

1. "General Electric, Morris Operation Facility, Safety Evaluation Report Related to License Amendment for SNM-1265," December 3, 1975, Docket No. 70-1308. Available for review in NRC PDR.

2. M. J. Rosenfield et al., "Seismic Shock Environment Test of Simulated Nuclear Fuel Storage Basket," Dept. of the Army Construction Engineering Research Laboratory, Technical Report M-150, August 1975. Available at public technical libraries.

3. Westinghouse Electric Corporation, "Westinghouse Reference Safety Analysis Report," RESAR 41, December 1973, Docket No. STN-50-480. Available for review in NRC PDR.

APPENDIX E.

SPENT FUEL TRANSSHIPMENT

The general approach used to assess spent fuel transshipment as an alternative method of spent fuel storage is presented in Section 3.2 of Volume 1. This appendix provides the detailed results of the analysis of effects of transshipment on away-from-reactor spent fuel storage requirements for two growth rates of nuclear generating capacity. A detailed discussion on the spent fuel generation for these two rates of growth is given in Appendix F.

One way to minimize the away-from-reactor (AFR) storage requirements for spent fuel up to the year 2000 is to allow transshipment between operating reactors. Transshipment would allow plants whose spent fuel storage pools were filled to ship spent fuel to newer plants with unfilled storage capacity. Two cases were considered in this document; transshipment within a utility system (intrautility case) and transshipment between any two reactors in the country regardless of ownership (unlimited transshipment case). The spent fuel storage requirements in a given year for the latter case are obtained by adding all the available at-reactor (AR) storage and subtracting from this total the amount of spent fuel requiring storage. A negative value means that AFR storage is required. The complete transshipment results are given in Section 3.2 of Volume 1 and are not repeated here. Transfer of spent fuel between separate storage pools at a given reactor site is assumed to take place as required.

Tables E.1 (230 GWe) and E.2 (280 GWe) summarize the results for the intrautility transshipment case. These tables list which utilities will run out of spent fuel storage space in a given year. As discussed in detail in Appendix F, it is possible for a utility to appear on the list in a given year (i.e., run out of spent fuel storage), drop off the list when a new reactor in this utility starts up (making more storage space available for the spent fuel backlog), and then reappear on the list when the utility again runs out of storage space. If this occurs, the spent fuel will show as a need for AFR storage in the year it first loses space. However, the backlog of spent fuel is assumed to be returned to the utility as soon as the new reactor is available to receive spent fuel.

Shipping cask requirements were developed for shipment of spent fuel to an independent spent fuel storage installation (ISFSI) as a bounding case. The other two cases considered in this document (intrautility transshipment and unlimited transshipment) would have smaller shipping cask requirements since much of the spent fuel would be shipped a shorter distance (about 150 miles) to another reactor site. The nine assumptions used in determining cask requirements were:

(1) The shipping distance from a reactor to an ISFSI is assumed to be 1000 miles;

(2) All shipments are made by truck;

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Table E.1. Away-from-Reactor Spent Fuel Storage Requirements (in MTHM) by Owner for 230 GWe Capacity in the Year 2000

With Full Core Reserve				Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe	Utility	Annual Discharges	Storage Available[b]	MWe
1979				1979			
Southern California Edison	23	-23	436				
Total	23	-23	436	Total	-	-	-
1980				1980			
Total	-	-	-	Total	-	-	-
1981				1981			
Total	-	-	-	Total	-	-	-
1982				1982			
Florida Power & Light	79	-36	2,188				
Total	79	-36	2,188	Total	-	-	-
1983				1983			
Baltimore Gas & Electric	65	-1	1,690				
Carolina Power & Light	74	-21	2,342				
Florida Power & Light	79	-116	2,188				
Jersey Central Power & Light	28	-16	650				
Maine Yankee Atomic Power	32	-26	790				
Omaha Public Power District	20	-12	457				
Total	298	-191	8,117	Total	-	-	-
1984				1984			
Baltimore Gas & Electric	65	-65	1,690	Florida Power & Light	79	-27	2,188
Carolina Power & Light	79	-101	2,342				
Florida Power & Light	79	-195	2,188				
Georgia Power	50	-13	1,539				
Jersey Central Power & Light	28	-44	650				
Maine Yankee Atomic Power	32	-58	790				

Table E.1. Continued

With Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe
1984 (Continued)			
Omaha Public Power District	20	-32	457
Sacramento Mun. Util. District	27	-15	918
Total	381	-523	10,574
1985			
Baltimore Gas & Electric	65	-130	1,690
Carolina Power & Light	79	-180	2,342
Georgia Power	50	-63	1,539
Jersey Central Power & Light	28	-72	650
Maine Yankee Atomic Power	32	-90	790
Northeast Nuclear Energy	61	-49	1,490
Northern States Power	60	-25	1,605
Omaha Public Power District	20	-52	457
Portland General Electric	29	-3	1,130
Sacramento Mun. Util. District	27	-42	918
Total	452	-706	12,611
1986			
Baltimore Gas & Electric	65	-195	1,690
Boston Edison	29	0	655
Carolina Power & Light	79	-260	2,342
Georgia Power	56	-119	1,539
Jersey Central Power & Light	28	-100	650
Maine Yankee Atomic Power	32	-123	790
Metropolitan Edison	53	-32	,725
Northeast Nuclear Energy	61	-110	1,490
Northern States Power	60	-85	1,605
Omaha Public Power District	20	-72	457
Portland General Electric	29	-32	1,130
Rochester Gas & Electric	18	-1	490
Sacramento Mun. Util. District	27	-68	918
Total	557	-1,196	15,481

Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[b]	MWe
1984 (Continued)			
Total	79	-27	2,188
1985			
Baltimore Gas & Electric	65	-32	1,690
Total	65	-32	1,690
1986			
Baltimore Gas & Electric	65	-97	1,690
Carolina Power & Light	79	-77	2,342
Georgia Power	56	-7	1,539
Maine Yankee Atomic Power	32	-25	790
Omaha Public Power District	20	-12	457
Total	252	-218	6,818

Table E.1. Continued

With Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe
1987			
Arkansas Power & Light	53	-37	1,800
Baltimore Gas & Electric	65	-260	1,690
Boston Edison	29	-29	655
Carolina Power & Light	79	-127	2,342
Florida Power & Light	79	-42	2,188
Georgia Power	56	-175	1,539
Maine Yankee Atomic Power	32	-155	790
Metropolitan Edison	53	-85	1,725
Northeast Nuclear Energy	61	-171	1,490
Northern States Power	60	-145	1,605
Omaha Public Power District	20	-91	457
Portland General Electric	29	-60	1,130
Rochester Gas & Electric	18	-19	490
Sacramento Mun. Util. District	27	-95	918
Vermont Yankee Nuclear Power	18	-18	514
Total	680	-1,510	19,333
1988			
Arkansas Power & Light	53	-90	1,800
Baltimore Gas & Electric	65	-324	1,690
Boston Edison	29	-58	655
Carolina Power & Light	79	-206	2,342
Florida Power & Light	104	-145	3,030
Georgia Power	56	-231	1,539
Maine Yankee Atomic Power	32	-188	790
Metropolitan Edison	53	-138	1,725
Northeast Nuclear Energy	61	-233	1,490
Northern States Power	60	-205	1,605
Omaha Public Power District	20	-111	457
Portland General Electric	29	-89	1,130
Power Authority of State of NY	28	-25	821
Rochester Gas & Electric	18	-37	490
Sacramento Mun. Util. District	27	-122	918
Vermont Yankee Nuclear Power	18	-36	514
Total	732	-2,239	20,996

Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[b]	MWe
1987			
Baltimore Gas & Electric	65	-162	1,690
Georgia Power	56	-63	1,539
Maine Yankee Atomic Power	32	-58	790
Omaha Public Power District	20	-32	457
Sacramento Mun. Util. District	27	-15	918
Total	200	-330	5,394
1988			
Arkansas Power & Light	53	-10	1,800
Baltimore Gas & Electric	65	-227	1,690
Georgia Power	56	-119	1,539
Maine Yankee Atomic Power	32	-90	790
Northeast Nuclear Energy	61	-19	1,490
Northern States Power	60	-54	1,605
Omaha Public Power District	20	-51	457
Portland General Electric	29	-2	1,130
Sacramento Mun. Util. District	27	-42	918
Total	403	-615	11,419

Table E.1. Continued

With Full Core Reserve				Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe	Utility	Annual Discharges	Storage Available[b]	MWe
1989				1989			
Arkansas Power & Light	53	-143	1,800	Arkansas Power & Light	53	-63	1,800
Baltimore Gas & Electric	65	-389	1,690	Baltimore Gas & Electric	65	-292	1,690
Boston Edison	29	-87	655	Carolina Power & Light	79	-33	2,342
Carolina Power & Light	79	-286	2,342	Florida Power & Light	104	-81	3,030
Florida Power & Light	104	-249	3,030	Maine Yankee Atomic Power	32	-122	790
Georgia Power	56	-27	1,539	Metropolitan Edison	53	-32	1,725
Maine Yankee Atomic Power	32	-220	790	Northeast Nuclear Energy	61	-80	1,490
Metropolitan Edison	53	-191	1,725	Northern States Power	60	-114	1,605
Northeast Nuclear Energy	61	-294	1,490	Omaha Public Power District	20	-71	457
Northern States Power	60	-266	1,605	Portland General Electric	29	-31	1,130
Omaha Public Power District	20	-131	457	Rochester Gas & Electric	18	-1	490
Portland General Electric	29	-118	1,130	Sacramento Mun. Util. District	27	-68	918
Power Authority of State of NY	28	-53	821				
Rochester Gas & Electric	18	-55	490				
Sacramento Mun. Util. District	27	-148	918				
Toledo Edison	27	-14	906				
Vermont Yankee Nuclear Power	18	-55	514				
Total	759	-2,725	21,902	Total	601	-983	17,467
1990				1990			
Arkansas Power & Light	53	-196	1,800	Arkansas Power & Light	53	-117	1,800
Baltimore Gas & Electric	65	-454	1,690	Baltimore Gas & Electric	65	-356	1,690
Boston Edison	29	-116	655	Boston Edison	29	0	655
Carolina Power & Light	97	-100	3,257	Florida Power & Light	104	-184	3,030
Consolidated Edison	58	-37	1,746	Maine Yankee Atomic Power	32	-155	790
Florida Power & Light	104	-352	3,030	Metropolitan Edison	53	-85	1,725
Maine Yankee Atomic Power	32	-252	790	Northern States Power	60	-175	1,605
Metropolitan Edison	53	-244	1,725	Omaha Public Power District	20	-91	457
Nebraska Public Power District	27	-11	778	Portland General Electric	29	-60	1,130
Northern States Power	60	-326	1,605	Rochester Gas & Electric	18	-18	490
Omaha Public Power District	20	-151	457	Sacramento Mun. Util. District	27	-95	918
Portland General Electric	29	-147	1,130				
Power Authority of State of NY	28	-81	821				
Rochester Gas & Electric	18	-73	490				
Sacramento Mun. Util. District	27	-175	918				
Toledo Edison	27	-41	906				
Vermont Yankee Nuclear Power	18	-73	514				
Total	744	-2,829	22,312	Total	489	-1,336	14,290

Table E.1. Continued

With Full Core Reserve

Utility	Annual Discharges	Storage Available[a]	MWe
1991			
Arkansas Power & Light	53	-249	1,800
Baltimore Gas & Electric	65	-519	1,690
Boston Edison	29	-145	655
Consolidated Edison	58	-95	1,746
Consumers Power	88	-32	2,256
Florida Power & Light	104	-456	3,030
Maine Yankee Atomic Power	32	-285	790
Metropolitan Edison	53	-297	1,725
Nebraska Public Power District	27	-39	778
Northeast Nuclear Energy	61	-59	1,490
Northern States Power	60	-125	1,605
Omaha Public Power District	20	-171	457
Pacific Gas & Electric	66	-9	2,255
Portland General Electric	29	-176	1,130
Power Authority of State of NY	28	-109	821
Sacramento Mun. Util. District	27	-201	918
Toledo Edison	27	-67	906
Vermont Yankee Nuclear Power	18	-92	514
Total	845	-3,125	24,566
1992			
Arkansas Power & Light	53	-302	1,800
Baltimore Gas & Electric	65	-584	1,690
Boston Edison	29	-174	655
Cincinnati Gas & Electric	84	-1	810
Commonwealth Edison	394	-95	11,882
Conn. Yankee Atomic Power	23	-2	575
Consolidated Edison	58	-153	1,746
Consumers Power	88	-120	2,256
Florida Power & Light	112	-567	3,030
Jersey Central Power & Light	52	-48	1,720
Maine Yankee Atomic Power	32	-317	790
Metropolitan Edison	53	-351	1,725
Nebraska Public Power District	27	-66	778
Northeast Nuclear Energy	61	-120	1,490
Northern States Power	60	-186	1,605
Omaha Public Power District	20	-190	457

Without Full Core Reserve

Utility	Annual Discharges	Storage Available[b]	MWe
1991			
Arkansas Power & Light	53	-170	1,800
Baltimore Gas & Electric	65	-421	1,690
Boston Edison	29	-29	655
Florida Power & Light	104	-288	3,030
Maine Yankee Atomic Power	32	-187	790
Metropolitan Edison	53	-138	1,725
Omaha Public Power District	20	-111	457
Portland General Electric	29	-89	1,130
Sacramento Mun. Util. District	27	-122	918
Vermont Yankee Nuclear Power	18	-18	514
Total	429	-1,572	12,709
1992			
Arkansas Power & Light	53	-223	1,800
Baltimore Gas & Electric	65	-486	1,690
Boston Edison	29	-58	655
Florida Power & Light	112	-399	3,030
Maine Yankee Atomic Power	32	-220	790
Metropolitan Edison	53	-191	1,725
Omaha Public Power District	20	-131	457
Portland General Electric	29	-117	1,130
Power Authority of State of NY	28	-25	821
Sacramento Mun. Util. District	27	-148	918
Vermont Yankee Nuclear Power	18	-36	514

Table E.1. Continued

With Full Core Reserve Utility	Annual Discharges	Storage Available[a]	MWe
1992 (Continued)			
Pacific Gas & Electric	66	-76	2,255
Portland General Electric	29	-204	1,130
Power Authority of State of NY	28	-137	821
Sacramento Mun. Util. District	27	-228	918
Southern California Edison	88	-59	2,716
Vermont Yankee Nuclear Power	18	-110	514
Total	1,468	-4,090	41,363
1993			
Alabama Power Company	47	-46	1,658
Arkansas Power & Light	53	-356	1,800
Baltimore Gas & Electric	65	-648	1,690
Boston Edison	29	-203	655
Cincinnati Gas & Electric	84	-85	810
Commonwealth Edison	394	-79	11,882
Conn. Yankee Atomic Power	23	-26	575
Consolidated Edison	58	-210	1,746
Consumers Power	101	-204	2,256
Dairyland Power	4	-3	50
Florida Power & Light	112	-679	3,030
Jersey Central Power & Light	52	-100	1,720
Maine Yankee Atomic Power	32	-350	790
Metropolitan Edison	53	-404	1,725
Nebraska Public Power District	27	-93	778
Northern States Power	60	-246	1,605
Omaha Public Power District	20	-210	457
Pacific Gas & Electric	92	-133	2,255
Power Authority of State of NY	28	-165	821
Sacramento Mun. Util. District	27	-254	918
Southern California Edison	88	-147	2,716
Vermont Yankee Nuclear Power	18	-128	514
Virginia Electric & Power	137	-130	5,308
Total	1,604	-4,899	45,759

Without Full Core Reserve Utility	Annual Discharges	Storage Available[b]	MWe
1992 (Continued)			
Total	466	-2,034	13,530
1993			
Arkansas Power & Light	53	-276	1,800
Baltimore Gas & Electric	65	-551	1,690
Boston Edison	29	-87	655
Consolidated Edison	58	-36	1,746
Consumers Power	101	-32	2,256
Florida Power & Light	112	-511	3,030
Maine Yankee Atomic Power	32	-252	790
Metropolitan Edison	53	-244	1,725
Northern States Power	60	-8	1,605
Omaha Public Power District	20	-150	457
Pacific Gas & Electric	92	-46	2,255
Power Authority of State of NY	28	-53	821
Sacramento Mun. Util. District	27	-175	918
Southern California Edison	88	-50	2,716
Vermont Yankee Nuclear Power	18	-55	514
Total	835	-2,526	22,979

Table E.1. Continued

With Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe
1994			
Alabama Power Company	47	-93	1,658
Arkansas Power & Light	53	-409	1,800
Baltimore Gas & Electric	65	-713	1,690
Boston Edison	29	-232	655
Cincinnati Gas & Electric	84	-169	810
Commonwealth Edison	394	-473	11,882
Conn. Yankee Atomic Power	23	-49	575
Consolidated Edison	58	-268	1,746
Consumers Power	84	-287	2,184
Dairyland Power	4	-7	50
Florida Power & Light	112	-791	3,030
Georgia Power	99	-67	3,739
Iowa Electric Power & Light	18	-2	538
Jersey Central Power & Light	60	-161	1,720
Maine Yankee Atomic Power	32	-382	790
Metropolitan Edison	53	-457	1,725
Nebraska Public Power District	27	-121	778
Northern States Power	82	-328	2,755
Omaha Public Power District	20	-230	457
Sacramento Mun. Util. District	27	-281	918
South Carolina Electric & Gas	23	-22	900
Southern California Edison	88	-235	2,716
Vermont Yankee Nuclear Power	18	-147	514
Virginia Electric & Power	137	-266	5,308
Wisconsin Michigan Electric	36	-36	994
Total	1,674	-6,225	49,932
1995			
Alabama Power Company	47	-140	1,658
Arkansas Power & Light	53	-462	1,800
Baltimore Gas & Electric	65	-778	1,690
Boston Edison	29	-261	655
Cincinnati Gas & Electric	84	-253	810
Commonwealth Edison	394	-311	11,882
Conn. Yankee Atomic Power	23	-72	575
Consolidated Edison	58	-325	1,746
Consumers Power	84	-371	2,184

Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[b]	MWe
1994			
Alabama Power Company	47	22	1,658
Arkansas Power & Light	53	-329	1,800
Baltimore Gas & Electric	65	-61[illegible]	1,690
Boston Edison	29	-116	655
Consolidated Edison	58	-94	1,746
Consumers Power	84	-116	2,184
Florida Power & Light	112	[illegible]	3,030
Maine Yankee Atomic Power	32	-2[illegible]	790
Metropolitan Edison	53	-29[illegible]	1,725
Nebraska Public Power District	27	-11	778
Northern States Power	82	-90	2,755
Omaha Public Power District	20	-170	[illegible]
Sacramento Mun. Util. District	27	-201	918
Southern California Edison	88	-138	2,716
Vermont Yankee Nuclear Power	18	-73	514
Virginia Electric & Power	137	-125	5,[illegible]
Total	931	-3,305	28,724
1995			
Alabama Power Company	47	-69	1,658
Arkansas Power & Light	53	-382	1,800
Baltimore Gas & Electric	65	-680	1,690
Boston Edison	29	-145	655
Cincinnati Gas & Electric	84	-1	810
Conn. Yankee Atomic Power	23	-2	575
Consolidated Edison	58	-152	1,746
Consumers Power	84	-200	2,184
Florida Power & Light	112	-734	3,030

Table E.1. Continued

With Full Core Reserve

Utility	Annual Discharges	Storage Available[a]	MWe
1995 (Continued)			
Dairyland Power	4	-10	50
Florida Power & Light	112	-902	3,030
Georgia Power	99	-166	3,739
Iowa Electric Power & Light	18	-21	538
Jersey Central Power & Light	60	-221	1,720
Maine Yankee Atomic Power	32	-414	790
Metropolitan Edison	53	-510	1,725
Nebraska Public Power District	27	-148	778
Northern States Power	82	-409	2,755
Omaha Public Power District	20	-250	457
Sacramento Mun. Util. District	27	-307	918
South Carolina Electric & Gas	23	-45	900
Southern California Edison	88	-324	2,716
Vermont Yankee Nuclear Power	18	-165	514
Virginia Electric & Power	137	-403	5,308
Wisconsin Michigan Electric	36	-72	994
Total	1,674	-7,342	49,932
1996			
Alabama Power Company	47	-186	1,658
Arkansas Power & Light	53	-515	1,800
Baltimore Gas & Electric	65	-843	1,690
Cincinnati Gas & Electric	84	-338	810
Commonwealth Edison	423	-734	13,062
Conn. Yankee Atomic Power	23	-96	575
Consolidated Edison	58	-383	1,746
Consumers Power	84	-455	2,184
Dairyland Power	4	-14	50
Florida Power & Light	112	-1,014	3,030
Florida Power Corporation	27	-9	825
Georgia Power	106	-273	3,739
Iowa Electric Power & Light	18	-39	538
Jersey Central Power & Light	60	-281	1,720
Louisiana Power & Light	31	-29	1,267
Maine Yankee Atomic Power	32	-447	790
Metropolitan Edison	53	-563	1,725
Nebraska Public Power District	27	-176	778

Without Full Core Reserve

Utility	Annual Discharges	Storage Available[b]	MWe
1995 (Continued)			
Jersey Central Power & Light	60	-11	1,720
Maine Yankee Atomic Power	32	-317	790
Metropolitan Edison	53	-351	1,725
Nebraska Public Power District	27	-39	778
Northern States Power	82	-171	2,755
Omaha Public Power District	20	-190	457
Sacramento Mun. Util. District	27	-228	918
Southern California Edison	88	-226	2,716
Vermont Yankee Nuclear Power	18	-92	514
Virginia Electric & Power	137	-262	5,308
Wisconsin Michigan Electric	36	-17	994
Total	1,135	-4,268	[illegible],823
1996			
Alabama Power Company	47	-116	1,658
Arkansas Power & Light	53	-435	1,800
Baltimore Gas & Electric	65	-745	1,690
Cincinnati Gas & Electric	84	-86	810
Conn. Yankee Atomic Power	23	-25	575
Consolidated Edison	58	-209	1,746
Consumers Power	84	-283	2,184
Florida Power & Light	112	-846	3,030
Georgia Power	106	-74	3,739
Jersey Central Power & Light	60	-72	1,720
Maine Yankee Atomic Power	32	-349	790
Metropolitan Edison	53	-404	1,725
Nebraska Public Power District	27	-66	778
Northern States Power	82	-253	2,755
Omaha Public Power District	20	-210	457
Sacramento Mun. Util. District	27	-254	918
Southern California Edison	88	-314	2,716
Vermont Yankee Nuclear Power	18	-110	514

Table E.1. Continued

With Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe
1996 (Continued)			
Northern States Power	82	-491	2,755
Omaha Public Power District	20	-270	457
Rochester Gas & Electric	38	-1	1,640
Sacramento Mun. Util. District	27	-334	918
South Carolina Electric & Gas	23	-69	900
Southern California Edison	88	-412	2,716
Vermont Yankee Nuclear Power	18	-184	514
Virginia Electric & Power	137	-540	5,308
Wisconsin Michigan Electric	36	-108	994
Total	1,776	-8,802	54,189
1997			
Alabama Power Company	47	-233	1,658
Arkansas Power & Light	53	-568	1,800
Baltimore Gas & Electric	65	-908	1,690
Boston Edison	29	-26	655
Cincinnati Gas & Electric	84	-422	810
Commonwealth Edison	423	-1,157	13,062
Conn. Yankee Atomic Power	23	-119	575
Consolidated Edison	58	-441	1,746
Consumers Power	84	-539	2,184
Dairyland Power	4	-17	50
Florida Power & Light	112	-1,125	3,030
Florida Power Corporation	27	-36	825
Georgia Power	114	-386	3,739
Iowa Electric Power & Light	18	-58	538
Jersey Central Power & Light	60	-342	1,720
Louisiana Power & Light	31	-60	1,267
Maine Yankee Atomic Power	32	-479	790
Metropolitan Edison	53	-616	1,725
Nebraska Public Power District	27	-203	778
Northern States Power	82	-573	2,755
Omaha Public Power District	20	-289	457
Power Authority of State of NY	52	-8	2,071
Rochester Gas & Electric	38	-39	1,640
Sacramento Mun. Util. District	27	-360	918

Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[b]	MWe
1996 (Continued)			
Virginia Electric & Power	137	-399	5,308
Wisconsin Michigan Electric	36	-53	994
Total	1,212	-5,303	35,907
1997			
Alabama Power Company	47	-162	1,658
Arkansas Power & Light	53	-488	1,800
Baltimore Gas & Electric	65	-810	1,690
Cincinnati Gas & Electric	84	-170	810
Commonwealth Edison	423	-308	13,062
Conn. Yankee Atomic Power	23	-49	575
Consolidated Edison	58	-267	1,746
Consumers Power	84	-367	2,184
Dairyland Power	4	-3	50
Florida Power & Light	112	-957	3,030
Georgia Power	114	-188	3,739
Jersey Central Power & Light	60	-132	1,720
Maine Yankee Atomic Power	32	-382	790
Metropolitan Edison	53	-457	1,725
Nebraska Public Power District	27	-93	778
Northern States Power	82	-335	2,755
Omaha Public Power District	20	-230	457
Sacramento Mun. Util. District	27	-281	918
South Carolina Electric & Gas	23	-22	900
Southern California Edison	88	-402	2,716
Vermont Yankee Nuclear Power	18	-128	514
Virginia Electric & Power	137	-536	5,308
Wisconsin Michigan Electric	36	-89	994

Table E.1. Continued

With Full Core Reserve				Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe	Utility	Annual Discharges	Storage Available[b]	MWe
1997 (Continued)				1997 (Continued)			
South Carolina Electric & Gas	23	-92	900				
Southern California Edison	88	-500	2,716				
Texas Utilities Generating	58	-26	2,300				
Vermont Yankee Nuclear Power	18	-202	514				
Virginia Electric & Power	137	-677	5,308				
Wisconsin Michigan Electric	36	-144	994				
Wisconsin Public Service	18	-1	535				
Total	1,940	-10,645	59,750	Total	1,670	-6,855	49,919
1998				1998			
Alabama Power Company	47	-280	1,658	Alabama Power Company	47	-209	1,658
Arkansas Power & Light	53	-621	1,800	Arkansas Power & Light	53	-541	1,800
Baltimore Gas & Electric	65	-972	1,690	Baltimore Gas & Electric	65	-875	1,690
Boston Edison	29	-55	655	Cincinnati Gas & Electric	84	-294	810
Carolina Power & Light	197	-9	7,252	Commonwealth Edison	452	-760	14,242
Cincinnati Gas & Electric	84	-506	810	Conn. Yankee Atomic Power	71	-119	575
Commonwealth Edison	452	-1,610	14,242	Consolidated Edison	58	-324	1,746
Conn. Yankee Atomic Power	71	-119	575	Consumers Power	84	-451	2,184
Consolidated Edison	58	-498	1,746	Dairyland Power	4	-7	50
Consumers Power	84	-622	2,184	Florida Power & Light	112	-1,069	3,030
Dairyland Power	4	-21	50	Georgia Power	114	-301	3,739
Duke Power	346	-126	13,651	Iowa Electric Power & Light	18	-2	538
Duquesne Light	47	-27	1,704	Jersey Central Power & Light	60	-193	1,720
Florida Power & Light	112	-1,237	3,030	Maine Yankee Atomic Power	32	-414	790
Florida Power Corporation	27	-62	825	Metropolitan Edison	53	-510	1,725
Georgia Power	114	-500	3,739	Nebraska Public Power District	27	-121	778
Indiana & Michigan Electric	58	-42	2,154	Northern States Power	89	-424	2,755
Iowa Electric Power & Light	18	-76	538	Omaha Public Power District	20	-249	457
Jersey Central Power & Light	60	-402	1,720	Sacramento Mun. Util. District	27	-307	918
Louisiana Power & Light	31	-90	1,267	South Carolina Electric & Gas	23	-45	900
Maine Yankee Atomic Power	32	-512	790	Southern California Edison	135	-538	2,716
Metropolitan Edison	53	-669	1,725	Vermont Yankee Nuclear Power	18	-147	514
Nebraska Public Power District	27	-230	778	Virginia Electric & Power	137	-672	5,308
Northern States Power	89	-662	2,755	Wisconsin Michigan Electric	36	-125	994
Omaha Public Power District	20	-309	457				
Power Authority of State of NY	52	-60	2,071				

Table E.1. Continued

With Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe
1998 (Continued)			
Rochester Gas & Electric	45	-84	1,640
Sacramento Mun. Util. District	27	-387	918
South Carolina Electric & Gas	23	-116	900
Southern California Edison	135	-635	2,716
Texas Utilities Generating	58	-83	2,300
Vermont Yankee Nuclear Power	18	-220	514
Virginia Electric & Power	137	-814	5,308
Wisconsin Michigan Electric	36	-180	994
Wisconsin Public Service	18	-18	535
Total	2,725	-12,857	85,691
1999			
Alabama Power Company	47	-327	1,658
Arkansas Power & Light	53	-674	1,800
Baltimore Gas & Electric	65	-1,037	1,690
Boston Edison	53	-108	1,905
Carolina Power & Light	222	-231	8,502
Cincinnati Gas & Electric	84	-590	810
Commonwealth Edison	452	-2,062	14,242
Conn. Yankee Atomic Power	0[c]	-119	0
Consolidated Edison	58	-556	1,746
Consumers Power	84	-706	2,184
Dairyland Power	14	-21	50
Duke Power	346	-473	13,651
Duquesne Light	47	-74	1,704
Florida Power & Light	112	-1,349	3,030
Florida Power Corporation	27	-89	825
Georgia Power	114	-614	3,739
Indiana & Michigan Electric	58	-99	2,154
Iowa Electric Power & Light	18	-94	538
Jersey Central Power & Light	144	-435	1,720
Kansas Gas & Electric	29	-27	1,150
Louisiana Power & Light	31	-121	1,267
Maine Yankee Atomic Power	32	-544	790
Metropolitan Edison	53	-722	1,725
Nebraska Public Power District	27	-258	778

Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[b]	MWe
1998 (Continued)			
Total	1,819	-8,658	51,687
1999			
Alabama Power Company	47	-256	1,658
Arkansas Power & Light	53	-594	1,800
Baltimore Gas & Electric	65	-940	1,690
Cincinnati Gas & Electric	84	-338	810
Commonwealth Edison	452	-1,213	14,242
Conn. Yankee Atomic Power	0[c]	-119	0
Consolidated Edison	58	-382	1,746
Consumers Power	84	-535	2,184
Dairyland Power	14	-21	50
Duke Power	346	-13	13,651
Duquesne Light	47	-4	1,704
Florida Power & Light	112	-1,180	3,030
Florida Power Corporation	27	-9	825
Georgia Power	114	-415	3,739
Iowa Electric Power & Light	18	-21	538
Jersey Central Power & Light	144	-337	1,720
Louisiana Power & Light	31	-29	1,267
Maine Yankee Atomic Power	32	-446	790
Metropolitan Edison	53	-563	1,725
Nebraska Public Power District	27	-148	778
Northern States Power	89	-513	2,755
Omaha Public Power District	20	-269	457
Sacramento Mun. Util. District	27	-334	918
South Carolina Electric & Gas	23	-68	900

Table E.1. Continued

With Full Core Reserve

Utility	Annual Discharges	Storage Available[a]	MWe
1999 (Continued)			
Niagara Mohawk Power	145	-8	1,690
Northern States Power	89	-751	2,755
Omaha Public Power District	20	-329	457
Pennsylvania Power & Light	76	-61	2,104
Power Authority of State of NY	52	-113	2,071
Rochester Gas & Electric	45	-128	1,640
Sacramento Mun. Util. District	27	-414	918
South Carolina Electric & Gas	23	-139	900
Southern California Edison	65	-673	2,280
Tennessee Valley Authority	568	-181	20,105
Texas Utilities Generating	58	-141	2,300
Vermont Yankee Nuclear Power	18	-239	514
Virginia Electric & Power	137	-945	5,308
Wisconsin Michigan Electric	36	-216	994
Wisconsin Public Service	18	-36	535
Total	3,546	-15,704	112,229
2000			
Alabama Power Company	47	-374	1,658
Arkansas Power & Light	53	-727	1,800
Baltimore Gas & Electric	65	-1,102	1,690
Boston Edison	53	-162	1,905
Carolina Power & Light	222	-452	8,502
Cincinnati Gas & Electric	84	-674	810
Commonwealth Edison	452	-2,515	14,242
Conn. Yankee Atomic Power	0	-119	0
Consolidated Edison	58	-613	1,746
Consumers Power	84	-790	2,184
Dairyland Power	0	-21	0
Duke Power	378	-851	14,901
Duquesne Light	47	-121	1,704
Florida Power & Light	112	-1,460	3,030
Florida Power Corporation	27	-115	825
Georgia Power	114	-727	3,739
Indiana & Michigan Electric	58	-157	2,154
Iowa Electric Power & Light	18	-113	538

Without Full Core Reserve

Utility	Annual Discharges	Storage Available[b]	MWe
1999 (Continued)			
Southern California Edison	65	-603	2,280
Texas Utilities Generating	58	-54	2,300
Vermont Yankee Nuclear Power	18	-165	514
Virginia Electric & Power	137	-809	5,308
Wisconsin Michigan Electric	36	-161	994
Total	2,280	-10,539	70,373
2000			
Alabama Power Company	47	-303	1,658
Arkansas Power & Light	53	-648	1,800
Baltimore Gas & Electric	65	-1,004	1,690
Carolina Power & Light	222	-101	8,502
Cincinnati Gas & Electric	84	-422	810
Commonwealth Edison	452	-1,665	14,242
Conn. Yankee Atomic Power	0	-119	0
Consolidated Edison	58	-440	1,746
Consumers Power	84	-618	2,184
Dairyland Power	0	-21	0
Duke Power	378	-392	14,901
Duquesne Light	47	-50	1,704
Florida Power & Light	112	-1,292	3,030
Florida Power Corporation	27	-36	825
Georgia Power	114	-528	3,739
Iowa Electric Power & Light	18	-39	538
Jersey Central Power & Light	32	-369	1,070
Louisiana Power & Light	31	-59	1,267

Table E.1. Continued

With Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe
2000 (Continued)			
Jersey Central Power & Light	32	-467	1,070
Kansas Gas & Electric	29	-56	1,150
Louisiana Power & Light	31	-152	1,267
Maine Yankee Atomic Power	32	-576	790
Metropolitan Edison	53	-775	1,725
Nebraska Public Power District	27	-285	778
Niagara Mohawk Power	38	-46	1,080
Northeast Nuclear Energy	149	-80	5,009
Northern States Power	89	-840	2,755
Omaha Public Power District	20	-349	457
Pennsylvania Power & Light	76	-138	2,104
Philadelphia Electric	201	-68	6,760
Power Authority of State of NY	52	-165	2,071
Public Service of Indiana	58	-54	2,260
Rochester Gas & Electric	81	-155	1,640
Sacramento Mun. Util. District	27	-440	918
South Carolina Electric & Gas	23	-162	900
Southern California Edison	65	-738	2,280
Tennessee Valley Authority	568	-749	20,10[illegible]
Texas Utilities Generating	58	-198	2,300
Vermont Yankee Nuclear Power	18	-257	514
Virginia Electric & Power	137	-1,082	5,308
Washington PPSS	171	-71	6,105
Wisconsin Michigan Electric	72	-288	994
Wisconsin Public Service	18	-54	535
Total	3,997	-19,341	132,303

Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[b]	MWe
2000 (Continued)			
Maine Yankee Atomic Power	32	-479	790
Metropolitan Edison	53	-616	1,725
Nebraska Public Power District	27	-176	778
Northern States Power	89	-602	2,755
Omaha Public Power District	20	-289	457
Rochester Gas & Electric	81	-75	1,640
Sacramento Mun. Util. District	27	-360	918
South Carolina Electric & Gas	23	-92	900
Southern California Edison	65	-667	2,280
Texas Utilities Generating	58	-112	2,300
Vermont Yankee Nuclear Power	18	-184	514
Virginia Electric & Power	137	-946	5,308
Wisconsin Michigan Electric	72	-234	994
Wisconsin Public Service	18	0	535
Total	2,543	-12,938	81,600

[a] The negative numbers in this column indicate that away-from-reactor storage in the amount shown will be required if full-core reserve is to be maintained. .

[b] The negative numbers in this column indicate that all at-reactor spent fuel storage capacity has been used, and away-from-reactor storage in the amount shown will be required for continuation of operation of the utility's nuclear plants.

[c] 0 discharge means that all of the reactors for that utility are shut down due to age.

Table E.2. Away-from-Reactor Spent Fuel Storage Requirements (in MTHM) by Owner for 280 GWe Capacity in the Year 2000

With Full Core Reserve				Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe	Utility	Annual Discharges	Storage Available[b]	MWe
1979				1979			
Southern California Edison	23	-23	436				
Total	23	-23	436	Total	-	-	-
1980				1980			
Total	-	-	-	Total	-	-	-
1981				1981			
Total	-	-	-	Total	-	-	-
1982				1982			
Florida Power & Light	79	-36	2,188				
Total	79	-36	2,188	Total	-	-	-
1983				1983			
Baltimore Gas & Electric	65	-1	1,690				
Carolina Power & Light	74	-21	2,342				
Jersey Central Power & Light	28	-16	650				
Maine Yankee Atomic Power	32	-26	790				
Omaha Public Power District	20	-12	457				
Total	219	-76	5,929	Total	-	-	-
1984				1984			
Baltimore Gas & Electric	65	-65	1,690				
Carolina Power & Light	79	-101	2,342				
Georgia Power	50	-13	1,539				
Jersey Central Power & Light	28	-44	650				
Maine Yankee Atomic Power	32	-58	790				
Omaha Public Power District	20	-32	457				
Sacramento Mun. Util. District	27	-15	918				
Total	301	-328	8,386	Total	-	-	-

Table E.2. Continued

With Full Core Reserve				Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe	Utility	Annual Discharges	Storage Available[b]	MWe
1985				1985			
Baltimore Gas & Electric	65	-130	1,690	Baltimore Gas & Electric	65	-32	1,690
Georgia Power	50	-63	1,539				
Maine Yankee Atomic Power	32	-90	790				
Northeast Nuclear Energy	61	-49	1,490				
Northern States Power	60	-25	1,605				
Omaha Public Power District	20	-52	457				
Portland General Electric	29	-3	1,130				
Sacramento Mun. Util. District	27	-42	918				
Total	344	-453	9,619	Total	65	-32	1,690
1986				1986			
Baltimore Gas & Electric	65	-195	1,690	Baltimore Gas & Electric	65	-97	1,690
Boston Edison	29	-1	655	Maine Yankee Atomic Power	32	-25	790
Carolina Power & Light	79	-48	2,342	Omaha Public Power District	20	-12	457
Maine Yankee Atomic Power	32	-123	790				
Metropolitan Edison	53	-32	1,725				
Northeast Nuclear Energy	61	-110	1,490				
Northern States Power	60	-85	1,605				
Omaha Public Power District	20	-72	457				
Portland General Electric	29	-32	1,130				
Rochester Gas & Electric	18	-1	490				
Sacramento Mun. Util. District	27	-68	918				
Total	473	-765	13,292	Total	117	-134	2,937
1987				1987			
Arkansas Power & Light	53	-37	1,800	Baltimore Gas & Electric	65	-162	1,690
Baltimore Gas & Electric	65	-260	1,690	Maine Yankee Atomic Power	32	-58	790
Boston Edison	29	-29	655	Omaha Public Power District	20	-32	457
Florida Power & Light	104	-90	3,030	Sacramento Mun. Util. District	27	-15	918
Maine Yankee Atomic Power	32	-155	790				
Metropolitan Edison	53	-85	1,725				
Northeast Nuclear Energy	61	-171	1,490				
Northern States Power	60	-145	1,605				
Omaha Public Power District	20	-91	457				
Portland General Electric	29	-60	1,130				

Table E.2. Continued

With Full Core Reserve				Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe	Utility	Annual Discharges	Storage Available[b]	MWe
1987 (Continued)				1987 (Continued)			
Rochester Gas & Electric	18	-19	490				
Sacramento Mun. Util. District	27	-95	918				
Vermont Yankee Nuclear Power	18	-18	514				
Total	569	-1,256	16,294	Total	144	-266	3,855
1988				1988			
Arkansas Power & Light	53	-90	1,800	Arkansas Power & Light	53	-10	1,800
Baltimore Gas & Electric	65	-324	1,690	Baltimore Gas & Electric	65	-227	1,690
Boston Edison	29	-58	655	Florida Power & Light	104	-26	3,030
Florida Power & Light	104	-194	3,030	Maine Yankee Atomic Power	32	-90	790
Maine Yankee Atomic Power	32	-188	790	Omaha Public Power District	20	-51	457
Metropolitan Edison	53	-138	1,725	Portland General Electric	29	-2	1,130
Omaha Public Power District	20	-111	457	Sacramento Mun. Util. District	27	-42	918
Portland General Electric	29	-89	1,130				
Power Authority of State of NY	28	-25	821				
Sacramento Mun. Util. District	27	-122	918				
Vermont Yankee Nuclear Power	18	-36	514				
Total	457	-1375	13,530	Total	329	-448	9,815
1989				1989			
Arkansas Power & Light	53	-143	1,800	Arkansas Power & Light	53	-63	1,800
Baltimore Gas & Electric	65	-389	1,690	Baltimore Gas & Electric	65	-292	1,690
Boston Edison	29	-87	655	Florida Power & Light	104	-129	3,030
Florida Power & Light	104	-297	3,030	Maine Yankee Atomic Power	32	-122	790
Maine Yankee Atomic Power	32	-220	790	Metropolitan Edison	53	-32	1,725
Metropolitan Edison	53	-131	1,725	Omaha Public Power District	20	-71	457
Northern States Power	60	-5	1,605	Portland General Electric	29	-31	1,130
Omaha Public Power District	20	-131	457	Sacramento Mun. Util. District	27	-68	918
Portland General Electric	29	-118	1,130				
Power Authority of State of NY	28	-53	821				
Sacramento Mun. Util. District	27	-148	918				
Vermont Yankee Nuclear Power	18	-55	514				
Total	518	-1,838	15,135	Total	382	-809	11,540

Table E.2. Continued

With Full Core Reserve				Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe	Utility	Annual Discharges	Storage Available[b]	MWe
1990				1990			
Arkansas Power & Light	53	-196	1,800	Arkansas Power & Light	53	-117	1,800
Baltimore Gas & Electric	65	-454	1,690	Baltimore Gas & Electric	65	-356	1,690
Boston Edison	29	-116	655	Boston Edison	29	-1	655
Consolidated Edison	58	-37	1,746	Florida Power & Light	112	-241	3,030
Florida Power & Light	112	-409	3,030	Maine Yankee Atomic Power	32	-155	790
Maine Yankee Atomic Power	32	-252	790	Metropolitan Edison	53	-85	1,725
Metropolitan Edison	53	-244	1,725	Omaha Public Power District	20	-91	457
Nebraska Public Power District	27	-11	778	Sacramento Mun. Util. District	27	-95	918
Northern States Power	60	-65	1,605				
Omaha Public Power District	20	-151	457				
Power Authority of State of NY	28	-81	821				
Sacramento Mun. Util. District	27	-175	918				
Vermont Yankee Nuclear Power	18	-73	514				
Total	582	-2,265	16,529	Total	390	-1,139	11,065
1991				1991			
Arkansas Power & Light	53	-249	1,800	Arkansas Power & Light	53	-170	1,800
Baltimore Gas & Electric	65	-519	1,690	Baltimore Gas & Electric	65	-421	1,690
Boston Edison	29	-145	655	Boston Edison	29	-29	655
Cincinnati Gas & Electric	84	-1	810	Florida Power & Light	112	-352	3,030
Consolidated Edison	58	-95	1,746	Maine Yankee Atomic Power	32	-187	790
Consumers Power	88	-85	2,256	Metropolitan Edison	53	-138	1,725
Florida Power & Light	112	-521	3,030	Omaha Public Power District	20	-111	457
Jersey Central Power & Light	52	-44	1,720	Sacramento Mun. Util. District	27	-122	918
Maine Yankee Atomic Power	32	-285	790	Vermont Yankee Nuclear Power	18	-18	514
Metropolitan Edison	53	-297	1,725				
Nebraska Public Power District	27	-39	778				
Northern States Power	82	-147	2,755				
Omaha Public Power District	20	-171	457				
Power Authority of State of NY	28	-109	821				
Sacramento Mun. Util. District	27	-201	918				
Southern California Edison	88	-3	2,716				
Vermont Yankee Nuclear Power	18	-92	514				
Total	916	-3,002	25,181	Total	409	-1,548	11,579

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Table E.2. Continued

With Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe
1992			
Arkansas Power & Light	53	-302	1,800
Baltimore Gas & Electric	65	-584	1,690
Cincinnati Gas & Electric	84	-85	810
Conn. Yankee Atomic Power	23	-2	575
Consolidated Edison	58	-153	1,746
Consumers Power	88	-173	2,256
Florida Power & Light	112	-632	3,030
Jersey Central Power & Light	60	-105	1,720
Maine Yankee Atomic Power	32	-317	790
Metropolitan Edison	53	-351	1,725
Nebraska Public Power District	27	-66	778
Northern States Power	82	-229	2,755
Omaha Public Power District	20	-190	457
Power Authority of State of NY	28	-137	821
Sacramento Mun. Util. District	27	-228	918
Southern California Edison	88	-91	2,716
Vermont Yankee Nuclear Power	18	-110	514
Virginia Electric & Power	137	-52	5,308
Total	1,055	-3,807	30,409
1993			
Alabama Power Company	47	-46	1,658
Arkansas Power & Light	53	-356	1,800
Baltimore Gas & Electric	65	-648	1,690
Cincinnati Gas & Electric	84	-169	810
Conn. Yankee Atomic Power	23	-26	575
Consolidated Edison	58	-210	1,746
Consumers Power	101	-257	2,256
Dairyland Power	4	-3	50
Florida Power & Light	112	-744	3,030
Georgia Power	106	-105	3,739
Jersey Central Power & Light	60	-165	1,720
Maine Yankee Atomic Power	32	-350	790
Metropolitan Edison	53	-404	1,725

Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[b]	MWe
1992			
Arkansas Power & Light	53	-223	1,800
Baltimore Gas & Electric	65	-486	1,690
Florida Power & Light	112	-464	3,030
Maine Yankee Atomic Power	32	-220	790
Metropolitan Edison	53	-191	1,725
Omaha Public Power District	20	-131	457
Power Authority of State of NY	28	-25	821
Sacramento Mun. Util. District	27	-148	918
Vermont Yankee Nuclear Power	18	-36	514
Total	408	-1,923	11,745
1993			
Arkansas Power & Light	53	-276	1,800
Baltimore Gas & Light	65	-551	1,690
Consolidated Edison	58	-36	1,746
Consumers Power	101	-85	2,256
Florida Power & Light	112	-576	3,030
Maine Yankee Atomic Power	32	-252	790
Metropolitan Edison	53	-244	1,725
Northern States Power	82	-73	2,755
Omaha Public Power District	20	-150	457
Sacramento Mun. Util. District	27	-175	918
Southern California Edison	88	-82	2,716
Vermont Yankee Nuclear Power	18	-55	514
Virginia Electric & Power	137	-53	5,308

Table E.2. Continued

With Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe
1993 (Continued)			
Nebraska Public Power District	27	-93	778
Northern States Power	82	-311	2,755
Omaha Public Power District	20	-210	457
Sacramento Mun. Util. District	27	-254	918
South Carolina Electric & Gas	23	-22	900
Southern California Edison	88	-180	2,716
Vermont Yankee Nuclear Power	18	-128	514
Virginia Electric & Power	137	-189	5,308
Total	1,220	-4,869	35,935
1994			
Alabama Power Company	47	-93	1,658
Arkansas Power & Light	53	-409	1,800
Baltimore Gas & Electric	65	-713	1,690
Cincinnati Gas & Electric	84	-253	810
Commonwealth Edison	452	-178	14,242
Conn. Yankee Atomic Power	23	-49	575
Consolidated Edison	58	-268	1,746
Consumers Power	84	-341	2,184
Dairyland Power	4	-7	50
Florida Power & Light	112	-855	3,030
Georgia Power	114	-218	3,739
Iowa Electric Power & Light	18	-2	538
Jersey Central Power & Light	60	-225	1,720
Louisiana Power & Light	31	-29	1,267
Maine Yankee Atomic Power	32	-382	790
Metropolitan Edison	53	-457	1,725
Nebraska Public Power District	27	-121	778
Northern States Power	82	-392	2,755
Omaha Public Power District	20	-230	457
Sacramento Mun. Util. District	27	-281	918
South Carolina Electric & Gas	23	-45	900
Southern California Edison	88	-268	2,716
Vermont Yankee Nuclear Power	18	-147	514
Virginia Electric & Power	137	-326	5,308
Wisconsin Michigan Electric	36	-36	994
Total	1,748	-6,325	52,904

Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[b]	MWe
1993 (Continued)			
Total	845	-2,508	25,705
1994			
Alabama Power Company	47	-22	1,658
Arkansas Power & Light	53	-329	1,800
Baltimore Gas & Electric	65	-616	1,690
Cincinnati Gas & Electric	84	-1	810
Consolidated Edison	58	-94	1,746
Consumers Power	84	-169	2,184
Florida Power & Light	112	-687	3,030
Georgia Power	114	-20	3,739
Jersey Central Power & Light	60	-16	1,720
Maine Yankee Atomic Power	32	-284	790
Metropolitan Edison	53	-297	1,725
Nebraska Public Power District	27	-11	778
Northern States Power	82	-154	2,755
Omaha Public Power District	20	-170	457
Sacramento Mun. Util. District	27	-201	918
Southern California Edison	88	-170	2,716
Vermont Yankee Nuclear Power	18	-73	514
Virginia Electric & Power	137	-190	5,308
Total	1,160	-3,506	34,338

Table E.2. Continued

With Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe
1995			
Alabama Power Company	47	-140	1,658
Arkansas Power & Light	53	-462	1,800
Baltimore Gas & Light	65	-778	1,690
Cincinnati Gas & Electric	84	-338	810
Commonwealth Edison	452	-630	14,242
Conn. Yankee Atomic Power	23	-72	575
Consolidated Edison	58	-325	1,746
Consumers Power	84	-424	2,184
Dairyland Power	4	-10	50
Florida Power & Light	112	-967	3,030
Gerogia Power	114	-332	3,739
Iowa Electric Power & Light	18	-21	538
Jersey Central Power & Light	60	-286	1,720
Louisiana Power & Light	31	-60	1,267
Maine Yankee Atomic Power	32	-414	790
Metropolitan Edison	53	-510	1,725
Nebraska Public Power District	27	-148	778
Northern States Power	89	-481	2,755
Omaha Public Power District	20	-250	457
Rochester Gas & Electric	45	-30	1,640
Sacramento Mun. Util. District	27	-307	918
South Carolina Electric & Gas	23	-69	900
Southern California Edison	88	-356	2,716
Vermont Yankee Nuclear Power	18	-165	514
Virginia Electric & Power	137	-463	5,308
Wisconsin Michigan Electric	36	-72	994
Total	1,800	-8,110	54,544
1996			
Alabama Power Company	47	-186	1,658
Arkansas Power & Light	53	-515	1,800
Baltimore Gas & Electric	65	-843	1,690
Boston Edison	53	-46	1,905
Cincinnati Gas & Electric	84	-422	810
Commonwealth Edison	452	-1,083	14,242
Conn. Yankee Atomic Power	23	-96	575

Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[b]	MWe
1995			
Alabama Power Company	47	-69	1,658
Arkansas Power & Light	53	-382	1,800
Baltimore Gas & Electric	65	-680	1,690
Cincinnati Gas & Electric	84	-86	810
Conn. Yankee Atomic Power	23	-2	575
Consolidated Edison	58	-152	1,746
Consumers Power	84	-253	2,184
Florida Power & Light	112	-799	3,030
Georgia Power	114	-133	3,739
Jersey Central Power & Light	60	-76	1,720
Maine Yankee Atomic Power	32	-317	790
Metropolitan Edison	53	-351	1,725
Nebraska Public Power District	27	-39	778
Northern States Power	89	-243	2,755
Omaha Public Power District	20	-190	457
Sacramento Mun. Util. District	27	-228	918
Southern California Edison	88	-258	2,716
Vermont Yankee Nuclear Power	18	-92	514
Virginia Electric & Power	137	-327	5,308
Wisconsin Michigan Electric	36	-17	994
Total	1,227	-4,6[illegible]	35,907
1996			
Alabama Power Company	47	-116	1,658
Arkansas Power & Light	53	-435	1,800
Baltimore Gas & Electric	65	-745	1,690
Cincinnati Gas & Electric	84	-170	810
Commonwealth Edison	452	-233	14,242
Conn. Yankee Atomic Power	23	-25	575
Consolidated Edison	58	-209	1,746

Table E.2. Continued

With Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe
1996 (Continued)			
Consolidated Edison	58	-383	1,746
Consumers Power	84	-508	2,184
Dairyland Power	4	-14	50
Duke Power	378	-100	14,901
Florida Power & Light	112	-1,079	3,030
Florida Power Corporation	27	-9	825
Georgia Power	114	-446	3,739
Iowa Electric Power & Light	18	-39	538
Jersey Central Power & Light	60	-346	1,720
Louisiana Power & Light	31	-90	1,267
Maine Yankee Atomic Power	32	-447	790
Metropolitan Edison	53	-563	1,725
Nebraska Public Power District	27	-176	778
Northern States Power	89	-570	2,755
Omaha Public Power District	20	-270	457
Rochester Gas & Electric	45	-74	1,640
Sacramento Mun. Util. District	27	-334	918
South Carolina Electric & Gas	23	-92	900
Southern California Edison	88	-446	2,716
Texas Utilities Generating	58	-54	2,300
Vermont Yankee Nuclear Power	18	-184	514
Virginia Electric & Power	137	-599	5,308
Wisconsin Michigan Electric	36	-108	994
Total	2,316	-10,119	74,475
1997			
Alabama Power Company	47	-233	1,658
Arkansas Power & Light	53	568	1,800
Baltimore Gas & Electric	65	-908	1,690
Boston Edison	53	-99	1,905
Carolina Power & Light	222	-191	8,502
Cincinnati Gas & Electric	84	-506	810
Commonwealth Edison	460	-1,542	14,242
Conn. Yankee Atomic Power	23	-119	575
Consolidated Edison	58	-441	1,746
Consumers Power	84	-592	2,184

Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[b]	MWe
1996 (Continued)			
Consumers Power	84	-337	2,184
Florida Power & Light	112	-910	3,030
Georgia Power	114	-247	3,739
Jersey Central Power & Light	60	-137	1,720
Maine Yankee Atomic Power	32	-349	790
Metropolitan Edison	53	-404	1,725
Nebraska Public Power District	27	-66	778
Northern States Power	89	-332	2,755
Omaha Public Power District	20	-210	457
Sacramento Mun. Util. District	27	-254	918
South Carolina Electric & Gas	23	-22	900
Southern California Edison	88	-347	2,716
Vermont Yankee Nuclear Power	18	-110	514
Virginia Electric & Power	137	-464	5,308
Wisconsin Michigan Electric	36	-53	994
Total	1,703	-6,173	51,049
1997			
Alabama Power Company	47	-162	1,658
Arkansas Power & Light	53	-488	1,800
Baltimore Gas & Electric	65	-810	1,690
Cincinnati Gas & Electric	84	-254	810
Commonwealth Edison	460	-693	14,242
Conn. Yankee Atomic Power	23	-49	575
Consolidated Edison	58	-267	1,746
Consumers Power	84	-420	2,184
Dairyland Power	4	-3	50
Duke Power	378	-19	14,901

Table E.2. Continued

With Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe
1997 (Continued)			
Dairyland Power	4	-17	50
Duke Power	378	-479	14,901
Duquesne Light	47	-27	1,704
Florida Power & Light	112	-1,190	3,030
Florida Power Corporation	27	-36	825
Georgia Power	114	-559	3,739
Iowa Electric Power & Light	18	-58	538
Jersey Central Power & Light	60	-407	1,720
Kansas Gas & Electric	29	-27	1,150
Louisiana Power & Light	31	-121	1,267
Maine Yankee Atomic Power	32	-479	790
Metropolitan Edison	53	-616	1,725
Nebraska Public Power District	27	-203	778
Northern States Power	89	-659	2,755
Omaha Public Power District	20	-289	457
Power Authority of State of NY	52	-32	2,071
Rochester Gas & Electric	45	-119	1,640
Sacramento Mun. Util. District	27	-360	918
South Carolina Electric & Gas	23	-116	900
Southern California Edison	88	-532	2,716
Texas Utilities Generating	58	-112	2,300
Vermont Yankee Nuclear Power	18	-202	514
Virginia Electric & Power	137	-736	5,308
Wisconsin Michigan Electric	36	-144	994
Wisconsin Public Service	18	-1	535
Total	2,691	-12,720	88,437
1998			
Alabama Power Company	47	-280	1,658
Arkansas Power & Light	53	-621	1,800
Baltimore Gas & Electric	65	-972	1,690
Boston Edison	53	-152	1,905
Carolina Power & Light	230	-420	8,502
Cincinnati Gas & Electric	84	-590	810
Commonwealth Edison	460	-2,002	14,242
Conn. Yankee Atomic Power	71	-119	575
Consolidated Edison	58	-498	1,746

Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[b]	MWe
1997 (Continued)			
Florida Power & Light	112	-1,022	3,030
Georgia Power	114	-360	3,739
Jersey Central Power & Light	60	-197	1,720
Louisiana Power & Light	31	-29	1,267
Maine Yankee Atomic Power	32	-382	790
Metropolitan Edison	53	-457	1,725
Nebraska Public Power District	27	-93	778
Northern States Power	89	-421	2,755
Omaha Public Power District	20	-230	457
Sacramento Mun. Util. District	27	-281	918
South Carolina Electric & Gas	23	-45	900
Southern California Edison	88	-435	2,716
Texas Utilities Generating	58	-25	2,300
Vermont Yankee Nuclear Power	18	-128	514
Virginia Electric & Power	137	-600	5,308
Wisconsin Michigan Electric	36	-89	994
Total	2,180	-7,960	69,567
1998			
Alabama Power Company	47	-209	1,658
Arkansas Power & Light	53	-541	1,800
Baltimore Gas & Electric	65	-875	1,690
Carolina Power & Light	230	-69	8,502
Cincinnati Gas & Electric	84	-338	810
Commonwealth Edison	460	-1,153	14,242
Conn. Yankee Atomic Power	71	-119	575
Consolidated Edison	58	-324	1,746
Consumers Power	84	-504	2,184

Table E.2. Continued

With Full Core Reserve				Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe	Utility	Annual Discharges	Storage Available[b]	MWe
1998 (Continued)				1998 (Continued)			
Consumers Power	84	-675	2,184	Dairyland Power	4	-7	50
Dairyland Power	4	-21	50	Duke Power	387	-406	14,901
Duke Power	387	-865	14,901	Duquesne Light	47	-4	1,704
Duquesne Light	47	-74	1,704	Florida Power & Light	112	-1,134	3,030
Florida Power & Light	112	-1,302	3,030	Georgia Power	114	-474	3,739
Florida Power Corporation	27	-62	825	Iowa Electric Power & Light	18	-2	538
Georgia Power	114	-673	3,739	Jersey Central Power & Light	60	-257	1,720
Indiana & Michigan Electric	58	-42	2,154	Louisiana Power & Light	31	-59	1,267
Iowa Electric Power & Light	18	-76	538	Maine Yankee Atomic Power	32	-414	790
Jersey Central Power & Light	60	-467	1,720	Metropolitan Edison	53	-510	1,725
Kansas Gas & Electric	29	-56	1,150	Nebraska Public Power District	27	-121	778
Louisiana Power & Light	31	-152	1,267	Northern States Power	89	-510	2,755
Maine Yankee Atomic Power	32	-512	790	Omaha Public Power District	20	-249	457
Metropolitan Edison	53	-669	1,725	Rochester Gas & Electric	45	-29	1,640
Nebraska Public Power District	27	-230	778	Sacramento Mun. Util. District	27	-307	918
Northeast Nuclear Energy	156	-89	5,009	South Carolina Electric & Gas	23	-68	900
Northern States Power	89	-748	2,755	Southern California Edison	135	-570	2,716
Omaha Public Power District	20	-309	457	Texas Utilities Generating	58	-83	2,300
Pennsylvania Power & Light	76	-61	2,104	Vermont Yankee Nuclear Power	18	-147	514
Power Authority of State of NY	52	-85	2,071	Virginia Electric & Power	137	-737	5,308
Public Service of Indiana	58	-54	2,260	Wisconsin Michigan Electric	36	-125	994
Rochester Gas & Electric	45	-163	1,640				
Sacramento Mun. Util. District	27	-387	918				
South Carolina Electric & Gas	23	-139	900				
Southern California Edison	135	-668	2,716				
Tennessee Valley Authority	568	-353	20,105				
Texas Utilities Generating	58	-170	2,300				
Vermont Yankee Nuclear Power	18	-220	514				
Virginia Electric & Power	137	-873	5,308				
Washington PPSS	171	-31	6,105				
Wisconsin Michigan Electric	36	-180	994				
Wisconsin Public Service	18	-18	535				
Total	3,888	-16,081	126,174	Total	2,622	-10,347	81,951

Table E.2. Continued

With Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe
1999			
Alabama Power Company	47	-327	1,658
Arkansas Power & Light	53	-674	1,800
Boston Edison	61	-214	1,905
Baltimore Gas & Electric	65	-1,037	1,690
Carolina Power & Light	230	-650	8,502
Cincinnati Gas & Electric	84	-674	810
Commonwealth Edison	467	-2,469	14,242
Conn. Yankee Atomic Power	0[c]	-119	0
Consolidated Edison	58	-556	1,746
Consumers Power	84	-759	2,184
Dairyland Power	14	-21	50
Duke Power	387	-1,252	14,901
Duquesne Light	47	-121	1,704
Florida Power & Light	112	-1,413	3,030
Florida Power Corporation	27	89	825
Georgia Power	114	-786	3,739
Indiana & Michigan Electric	58	-59	2,[illegible]54
Iowa Electric Power & Light	18	-94	538
Jersey Central Power & Light	144	-499	1,720
Kansas Gas & Electric	29	-85	1,150
Louisiana Power & Light	31	-182	1,267
Maine Yankee Atomic Power	32	-544	790
Metropolitan Edison	53	-722	1,725
Nebraska Public Power District	27	-258	778
Niagara Mohawk Power	145	-123	1,690
Northeast Nuclear Energy	163	-252	5,009
Northern States Power	89	-837	2,755
Omaha Public Power District	20	-329	457
Pennsylvania Power & Light	76	-138	2,104
Philadelphia Electric	218	-214	6,760
Portland General Electric	94	-46	3,630
Power Authority of State of NY	52	-137	2,071
Public Service of Indiana	58	-112	2,260
Rochester Gas & Electric	45	-208	1,640
Sacramento Mun. Util. District	27	-414	918
South Carolina Electric & Gas	23	-162	900
Southern California Edison	65	-733	2,280
Tennessee Valley Authority	568	-921	20,105
Texas Utilities Generating	58	-227	2,300

Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[b]	MWe
1999			
Alabama Power Company	47	-256	1,658
Arkansas Power & Light	53	-594	1,800
Boston Edison	61	-1	1,905
Baltimore Gas & Electric	65	-940	1,690
Carolina Power & Light	230	-299	8,502
Cincinnati Gas & Electric	84	-422	810
Commonwealth Edison	467	-1,620	14,242
Conn. Yankee Atomic Power	0[c]	-119	
Consolidated Edison	58	-382	1,746
Consumers Power	84	-588	2,184
Dairyland Power	14	-21	50
Duke Power	387	-792	14,901
Duquesne Light	47	-50	1,704
Florida Power & Light	112	-1,245	3,030
Florida Power Corporation	27	-9	825
Georgia Power	114	-588	3,739
Iowa Electric Power & Light	18	-21	538
Jersey Central Power & Light	144	-402	1,720
Louisiana Power & Light	31	-90	1,267
Maine Yankee Atomic Power	32	-446	790
Metropolitan Edison	53	-563	1,725
Nebraska Public Power District	27	-148	778
Northern States Power	89	-599	2,755
Omaha Public Power District	20	-269	457
Public Service of Indiana	58	-25	2,260
Rochester Gas & Electric	45	-74	1,640
Sacramento Mun. Util. District	27	-334	918
South Carolina Electric & Gas	23	-92	900
Southern California Edison	65	-635	2,280
Tennessee Valley Authority	568	-123	20,105
Texas Utilities Generating	58	-140	2,300
Vermont Yankee Nuclear Power	18	-165	514
Virginia Electric & Power	137	-874	5,308
Wisconsin Michigan Electric	36	-161	994

Table E.2. Continued

With Full Core Reserve				Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe	Utility	Annual Discharges	Storage Available[b]	MWe
1999 (Continued)				1999 (Continued)			
Toledo Edison	80	-13	2,718				
Vermont Yankee Nuclear Power	18	-239	514				
Virginia Electric & Power	137	-1,010	5,308				
Washington PPSS	171	-202	6,105				
Wisconsin Michigan Electric	36	-216	994				
Wisconsin Public Service	18	-36	535				
Total	4,400	-20,216	139,961	Total	3,297	-13,088	106,035
2000				2000			
Alabama Power Company	47	-374	1,658	Alabama Power Company	47	-303	1,658
Arkansas Power & Light	53	-727	1,800	Arkansas Power & Light	53	-648	1,800
Baltimore Gas & Electric	65	-1,102	1,690	Baltimore Gas & Electric	65	-1,004	1,690
Boston Edison	61	-275	1,905	Boston Edison	61	-61	1,905
Carolina Power & Light	238	-888	8,502	Carolina Power & Light	238	-537	8,502
Cincinnati Gas & Electric	84	-758	810	Cincinnati Gas & Electric	84	-506	810
Commonwealth Edison	467	-2,937	14,242	Commonwealth Edison	467	-2,087	14,242
Conn. Yankee Atomic Power	0	-119	0	Conn. Yankee Atomic Power	0	-119	0
Consolidated Edison	58	-613	1,746	Consolidated Edison	58	-440	1,746
Consumers Power	84	-843	2,184	Consumers Power	84	-671	2,184
Dairyland Power	0	-21	0	Dairyland Power	0	-21	0
Duke Power	395	-1,647	14,901	Duke Power	395	-1,187	14,901
Duquesne Light	47	-168	1,704	Duquesne Light	47	-97	1,704
Florida Power & Light	112	-1,525	3,030	Florida Power & Light	112	-1,357	3,030
Florida Power Corporation	27	-115	825	Florida Power Corporation	27	-36	825
Georgia Power	114	-900	3,739	Georgia Power	114	-701	3,739
Houston Power & Light	94	-44	3,680	Iowa Electric Power & Light	18	-39	538
Indiana & Michigan Electric	58	-157	2,154	Jersey Central Power & Light	32	-434	1,070
Iowa Electric Power & Light	18	-113	538	Kansas Gas & Electric	29	-27	1,150
Jersey Central Power & Light	32	-532	1,070	Louisiana Power & Light	31	-121	1,267
Kansas Gas & Electric	29	-114	1,150	Maine Yankee Atomic Power	32	-479	790
Louisiana Power & Light	31	-213	1,267	Metropolitan Edison	53	-616	1,725
Maine Yankee Atomic Power	32	-576	790	Nebraska Public Power District	27	-176	778
Metropolitan Edison	53	-775	1,725	Niagara Mohawk Power	38	-8	1,080
Mississippi Power & Light	78	-63	2,500	Northeast Nuclear Energy	163	-66	5,009
Nebraska Public Power District	27	-285	778	Northern States Power	89	-688	2,75[illegible]
Niagara Mohawk Power	38	-161	1,080	Omaha Public Power District	20	-289	45[illegible]
Northeast Nuclear Energy	163	-416	5,009	Pennsylvania Power & Light	76	-61	2,104

Table E.2. Continued

With Full Core Reserve				Without Full Core Reserve			
Utility	Annual Discharges	Storage Available[a]	MWe	Utility	Annual Discharges	Storage Available[b]	MWe
2000 (Continued)				2000 (Continued)			
Northern Indiana Public Service	22	-18	660	Philadelphia Electric	218	-28	6,760
Northern States Power	89	-926	2,755	Public Service of Indiana	58	-83	2,260
Omaha Public Power District	20	-349	457	Rochester Gas & Electric	81	-155	1,640
Pacific Gas & Electric	131	-8	4,550	Sacramento Mun. Util. District	27	-360	918
Pennsylvania Power & Light	76	-214	2,104	South Carolina Electric & Gas	23	-115	900
Philadelphia Electric	218	-431	6,760	Southern California Edison	65	-700	2,280
Portland General Electric	94	-140	3,630	Tennessee Valley Authority	568	-691	20,105
Power Authority of State of NY	60	-197	2,071	Texas Utilities Generating	58	-198	2,300
Public Service G & E of NJ	134	-130	4,339	Toledo Edison	80	-13	2,718
Public Service of Indiana	58	-170	2,260	Vermont Yankee Nuclear Power	18	-184	514
Public Service of New Hamp.	58	-54	2,388	Virginia Electric & Power	137	-1,011	5,308
Rochester Gas & Electric	81	-234	1,640	Washington PPSS	171	-20	6,105
Sacramento Mun. Util. District	27	-440	918	Wisconsin Michigan Electric	72	-234	994
South Carolina Electric & Gas	23	-186	900	Wisconsin Public Service	18	-1	535
Southern California Edison	65	-797	2,280				
Tennessee Valley Authority	568	-1,489	20,105				
Texas Utilities Generating	58	-285	2,300				
Toledo Edison	80	-93	2,718				
Union Electric	58	-54	2,300				
Vermont Yankee Nuclear Power	18	-257	514				
Virginia Electric & Power	137	-1,147	5,308				
Washington PPSS	171	-374	6,105				
Wisconsin Michigan Electric	72	-288	994				
Wisconsin Public Service	18	-54	535				
Total	4,840	-24,798	159,068	Total	4,053	-16,571	130,796

[a] The negative numbers in this column indicate that away-from-reactor storage in the amount shown will be required if full-core reserve is to be maintained.

[b] The negative numbers in this column indicate that all at-reactor spent fuel storage capacity has been used, and away-from-reactor storage in the amount shown will be required for continuation of operation of the utility's nuclear plants.

[c] 0 discharge means that all of the reactors for that utility are shut down due to age.

(3) Each truck cask holds 1 PWR or 2 BWR assemblies;

(4) A BWR assembly contains 0.20 MTHM and a PWR assembly 0.45 MTHM;

(5) The cask load/unload times are six hours for each operation;

(6) The speed of the truck is 35 mph;

(7) All transshipment operations are conducted on a 24-hour basis;

(8) There are an equal number of transshipments involving BWR spent fuel as PWR spent fuel;

(9) The shipping casks are available for usage 300 days during the year.

From assumptions (3), (4), and (8), the average amount of heavy metal being transported at each shipment is 0.425 MTHM. The number of cask-days required for a round-trip shipment to the ISFSI, a distance of 2000 miles, is:

$$6\ \text{hr} + \frac{2000\ \text{miles}}{35\ \text{mph}} + 6\ \text{hr} = 2.88\ \text{cask-days}$$

On a metric ton basis, the cask requirement is 6.78 cask-days per MTHM. In this analysis, shipment by truck rather than rail has been assumed. Thus, the cask requirements given in this appendix should be viewed as being conservative, as the use of rail casks could reduce significantly the number of casks required. Table E.3 summarizes the annual amount of spent fuel that must be shipped to an ISFSI if there is no transshipment of spent fuel between reactor sites. Four cases are presented; with and without full core reserve for the two rates of nuclear capacity growth.

The annual shipping cask requirements (in cask-days) (Table E.4) were obtained by multiplying the annual metric tonnage that must be shipped by 6.78 cask-days for the 2000-mile round trip distance to the ISFSI. The number of shipping casks required in any year can be obtained by dividing the requirements shown in Table E.4 by the number of days in each year that a shipping cask is available for usage (300 days). Table E.5 summarizes the shipping cask requirements for the four cases analyzed.

Since each shipment of spent fuel involves transporting 0.425 MTHM a round trip distance of 2000 miles, the shipment-mile figure on a metric ton basis is about 4700 shipment-miles per MTHM. Table E.6 contains the shipment-miles for transporting the spent fuel to an ISFSI for the four cases considered. Only one-half of the shipment-miles shown in Table E.6 would be with spent fuel in the shipping casks. On the return trip, the shipping cask would be empty.

The results given in this appendix are meant to give an indication of the magnitude of the shipping cask requirements in the future and are not meant to accurately predict the number of shipping casks that will be required in any given year. The latter would require a detailed reactor-by-reactor analysis, which is beyond the scope of this report.

Table E.3. Annual Requirements for Shipping Spent Fuel to an Independent Spent Fuel Storage Installation (MTHM)*

Year	230 GWe with FCR	230 GWe without FCR	280 GWe with FCR	280 GWe without FCR
1979	40	0	40	0
1980	100	10	100	10
1981	170	100	170	100
1982	210	130	210	130
1983	360	120	360	120
1984	580	190	580	190
1985	690	370	690	370
1986	790	480	790	480
1987	900	640	900	640
1988	970	710	830	670
1989	1070	810	1020	780
1990	940	770	1090	840
1991	1190	950	1170	950
1992	1230	1030	1440	1030
1993	1520	1250	1610	1290
1994	1720	1320	1820	1370
1995	2040	1520	2130	1670
1996	2210	1810	2470	1890
1997	2440	2050	2790	2150
1998	2800	2200	3060	2620
1999	2840	2630	3170	2870
2000	3030	2790	3400	3040

*The generating capacities shown are for the year 2000.

Table E.4. Annual Requirements for Shipping Casks for Shipments to an Independent Fuel Storage Installation (truck cask-days)*

Year	230 GWe with FCR	230 GWe without FCR	280 GWe with FCR	280 GWe without FCR
1979	270	0	270	0
1980	680	68	680	68
1981	1,150	680	1,150	680
1982	1,420	880	1,420	880
1983	2,440	810	2,440	810
1984	3,930	1,290	3,930	1,290
1985	4,680	2,510	4,680	2,510
1986	5,360	3,250	5,360	3,250
1987	6,100	4,340	6,100	4,340
1988	6,580	4,810	5,630	4,540
1989	7,260	5,490	6,920	5,290
1990	6,370	5,220	7,390	5,700
1991	8,070	6,440	7,930	6,440
1992	8,340	6,980	9,760	6,980
1993	10,310	8,480	10,920	8,750
1994	11,660	8,950	12,340	9,290
1995	13,830	10,310	14,440	11,320
1996	14,980	12,270	16,750	12,810
1997	16,540	13,900	18,920	14,580
1998	18,980	14,920	20,750	17,760
1999	19,260	17,830	21,490	19,460
2000	20,540	18,920	23,050	20,610

*The generating capacities shown are for the year 2000.

Table E.5. Annual Requirements for Truck Casks for Shipping Spent Fuel to an Independent Spent Fuel Storage Installation*

Year	230 GWe with FCR	230 GWe without FCR	280 GWe with FCR	280 GWe without FCR
1979	1	0	1	0
1980	3	1	3	1
1981	4	3	4	3
1982	5	3	5	3
1983	9	3	9	3
1984	14	5	14	5
1985	16	9	16	9
1986	18	11	18	11
1987	21	15	21	15
1988	22	17	19	16
1989	25	19	24	18
1990	22	18	25	19
1991	27	22	27	22
1992	28	24	33	24
1993	35	29	37	30
1994	39	30	42	31
1995	47	35	49	38
1996	50	41	56	43
1997	56	47	64	49
1998	64	50	70	60
1999	65	60	72	65
2000	69	64	77	69

*The generating capacities shown are for the year 2000.

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Table E.6. Annual Shipping Distances for Transporting Spent Fuel to an Independent Spent Fuel Storage Installation (million miles)*

Year	230 GWe with FCR	230 GWe without FCR	280 GWe with FCR	280 GWe without FCR
1979	0.19	0.00	0.19	0.00
1980	0.47	0.05	0.47	0.05
1981	0.80	0.47	0.80	0.47
1982	0.99	0.61	0.99	0.61
1983	1.69	0.56	1.69	0.56
1984	2.73	0.89	2.73	0.89
1985	3.25	1.74	3.25	1.74
1986	3.72	2.26	3.72	2.26
1987	4.24	3.01	4.24	3.01
1988	4.56	3.34	3.91	3.15
1989	5.04	3.81	4.80	3.67
1990	4.42	3.62	5.13	3.95
1991	5.60	4.47	5.51	4.47
1992	5.79	4.85	6.78	4.85
1993	7.15	5.88	7.58	6.07
1994	8.09	6.21	8.56	6.45
1995	9.60	7.15	10.02	7.86
1996	10.40	8.52	11.62	8.89
1997	11.48	9.65	13.13	10.12
1998	13.18	10.35	14.40	12.33
1999	13.37	12.38	14.92	13.51
2000	14.26	13.13	16.00	14.31

*The generating capacities shown are for the year 2000.

APPENDIX F.

SPENT FUEL GENERATION AND STORAGE DATA

This appendix describes the methods used to estimate the future spent fuel discharges and at-reactor (AR) storage space (Sec. 1.0) and gives the results of applying this model to determine the away-from-reactor (AFR) storage requirements for two rates of growth of nuclear reactor capacity (Sec. 2.0).

1.0 SPENT FUEL GENERATION MODEL

In order to predict the amount of spent fuel that will accumulate, it is necessary to estimate the amount of spent fuel that will be discharged in the future. Assuming no reprocessing or final disposal of spent fuel, the accumulation of spent fuel is dependent upon two major factors: (1) the growth rate of nuclear power plant installations and (2) the amount of spent fuel annually discharged from operating plants. This latter factor is dependent upon the specific operation of the plant. This appendix details the assumptions used to estimate the amount of spent fuel that will require attention in the future and the rationale for using those assumptions.

1.1 Growth of Nuclear Power Plants

The basis of the assumed rate of growth of nuclear power reactors for this document is given in Section 1.3 of Volume 1. However, since the future growth of nuclear power reactor capacity is uncertain, the results for two rates of growth are given in the appendix. The lower growth rate assumes that in the year 2000, there will be 230 GWe of nuclear generating capacity installed, with 202 GWe discharging fuel (the reference growth rate). The difference between the number of reactors installed and those discharging fuel is due to the length of time between fuel loading and first discharge. This is discussed further in Section 1.2 of this appendix. To address the sensitivity of the rate of growth of nuclear power reactors to the need for AFR storage, a higher growth rate was also analyzed. This higher growth rate assumes that 280 GWe of nuclear power will be installed in the year 2000, with 246 GWe discharging fuel. These two growth rates are shown in Figure F.1.

The number of reactor plants presently operating was taken from the U.S. Nuclear Regulatory Commission "Operating Units Status Report--Licensed Operating Reactors," NUREG-0020 (Gray Book).[1] These are shown in Table F.1. This table also contains additional information on the spent fuel storage situation at these plants.

Table F.2 lists all reactors used in these analyses for the two growth rates of nuclear capacity. The list of operating reactors was taken from the Gray Book. For the future, the reactors

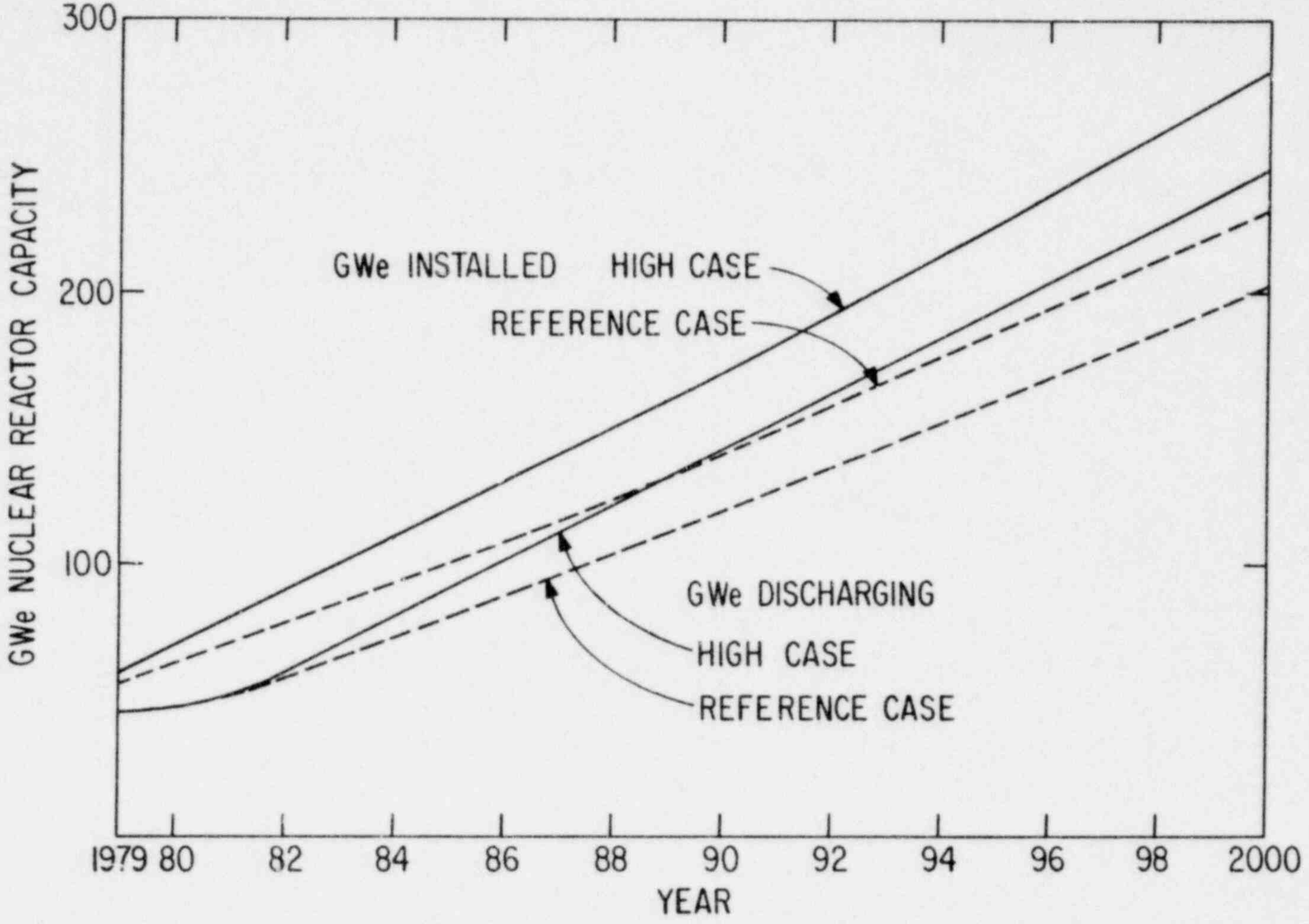

Fig. F.1 GWe Installed and Discharging, by Year, for Reference Case (230 GWe installed in year 2000) and High Case (280 GWe installed in year 2000).

Table F.1. Status of Spent Fuel Storage Capacity for Operating Reactors
(data as of 12-31-78)

FACILITY	CORE SIZE (A)* (# OF ASSM.)	PRESENT AUTHORIZED STORAGE FUEL CAP. (FUEL ASSEMBLIES)	NO. OF ASSEMBLIES STORED	REMAINING CAPACITY (# OF ASSM.)	REMAINING CAP. IF PENDING REQ. APPROVED (# OF ASSM.)	SCHEDULED DATE FOR NEXT REFUELING	(B)* WILL FILL PRESENT AUTHORIZED CAP.
PRESSURIZED WATER REACTOR							
ARKANSAS 1	177	590(C)*	112(C)*	478(C)*		3-79	1988
ARKANSAS 2 (D)*	177	486	0	486		5-80	1988
BEAVER VALLEY 1	157	833(C)*	0(C)*	833(C)*		4-79	1 99
CALVERT CLIFFS 1	217	1056(C)*	228(C)*	828(C)*		4-79	1985
CALVERT CLIFFS 2	217		0			10-79	1985
COOK 1	193	500	129	371	1921	N/S	
COOK 2 (D)*	193	772 (L)*	0	772 (L)*			1993
CRYSTAL RIVER 3	177	256	4	252	1159	4-79	1999
DAVIS BESSE 1	177	260(C)*	0(C)*	260(C)*	735	4-79	
FARLEY 1	157	675(C)*	0(C)*	675(C)*		3-79	1994
FT. CALHOUN	133	483	157	326		1-80	1986
GINNA	121	595	156	439		3-79	1989
HADDAM NECK	157	1168	288	880		1-79	1995
INDIAN POINT 1	0	828	160	668		N/S	
INDIAN POINT 2	193	482	132	350		79	1984
INDIAN POINT 3	193	837	64	773		N/S	1991
KEWAUNEE	121	168	120	48	870	5-79	2000
MAINE YANKEE	217	953	433	520		N/S	1986
MILLSTONE 2	217	667(C)*	72(C)*	595(C)*		3-79	1987
NORTH ANNA 1	157	400(C)*	0(C)*	400(C)*	966	11-79	1998
OCONEE 1	177	771(C)*	489(C)*	282(C)*	679	N/S	1980
OCONEE 2	177		0			N/S	1980
OCONEE 3	177		0			7-79	1980
PALISADES	204	798	273	525		N/S	1986
PT. BEACH 1	121	351(C)*	180(C)*	171(C)*	1322	9-79	1995
PT. BEACH 2	121		0			3-79	1995
PRAIRIE ISLAND 1	121	687(C)*	200(C)*	487(C)*		4-79	1985
PRAIRIE ISLAND 2	121		0			12-79	1985
RANCHO SECO	177	579	112	467		3-80	1987
ROBINSON 2	157	576	299	277(E)*		5-79	1984 (G)*
SALEM 1	193	264(C)*	0(C)*	264(C)*	1170	4-79	1996
SAN ONOFRE 1	157	216(C)*	58(C)*	158(C)*		3-80	1993
ST LUCIE 1	217	728(C)*	60(C)*	668(C)*		4-79	1995
SURRY 1	157	1044(C)*	436(C)*	608(C)*		N/S	1984
SURRY 2	157		0			2-79	1984
THREE MILE ISLAND 1	177	752	160	592		3-79	1989
THREE MILE ISLAND 2	177	442	0	442		9-79	1989
TROJAN	193	651	64	587		9-79	1988
TURKEY POINT 3	157	621(C)*	346(C)*	275(C)*		1-79	1981
TURKEY POINT 4	157		0			4-79	1981
YANKEE ROWE	76	391	149	242	572	N/S	
ZION 1	193	868(C)*	308(C)*	560(C)*	1804	9-79	1993
ZION 2	193		0			2-79	1993

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*=SEE FOOTNOTES ON LAST PAGE OF REPORT

N/S=NOT SCHEDULED YET

POOR
ORIGINAL

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Table F.1. Continued

FACILITY	CORE SIZE (A)* (# OF ASSM.)	PRESENT AUTHORIZED STORAGE FUEL CAP. (FUEL ASSEMBLIES)	NO. OF ASSEMBLIES STORED	REMAINING CAPACITY (# OF ASSM.)	REMAINING CAP. IF PENDING REQ. APPROVED (# OF ASSM.)	SCHEDULED DATE FOR NEXT REFUELING	(B)* WILL FILL PRESENT AUTHORIZED CAP.
BOILING WATER REACTOR							
BIG ROCK POINT	84	193	62	131		1-79	1985
BROWNS FERRY 1	764	3471(C)*	324(C)*	3147(C)*		N/S	1996
BROWNS FERRY 2	764	3471	132	3339		4-79	1996
BROWNS FERRY 3	764	3471	208	3263		8-79	1996
BRUNSWICK 1	560	2088(C)(F)*	144(K)*	1944(C)*		1-79	1986
BRUNSWICK 2	560	(F)*	0			3-79	1986
COOPER	548	2366	284	2082		4-79	1994
DRESDEN 1	464	672(C)*	221(C)*	451(C)*		N/S	1993
DRESDEN 2	724	2840	1069	1771	6491	3-79	1993
DRESDEN 3	724					9-79	1993
DUANE ARNOLD	368	2050	276	1774		N/S	1998
FITZPATRICK	560	760	268	492	1752	3-80	1992
HATCH 1	560	840(C)*	260(C)*	580(C)*		3-79	1986
HATCH 2	560	1120	0	1120		3-80	1986
HUMBOLDT BAY	172	487	251	236		N/S	1984
LACROSSE	72	134	113	21	327	2-79	1997
MILLSTONE 1	580	2184	629	1555		4-79	1989
MONTICELLO	484	2237	616	1621		N/S	1992
NINE MILE POINT 1	532	1984(C)*	660(C)*	1324(C)*	2349	3-79	
OYSTER CREEK	560	1800	620	1130		9-79	1987
PEACH BOTTOM 2	764	2816(C)*	618(C)*	2198(C)*		3-80	1991
PEACH BOTTOM 3	764	2816	440	2376		9-79	1991
PILGRIM 1	580	2320	580	1740		1-80	1990
QUAD CITIES 1	724	1460(C)*	151(C)*	1309(C)*		1-79	1984
QUAD CITIES 2	724	1460	745	715		10-79	1984
VERMONT YANKEE	368	2000	894	1106		10-79	1991

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*=SEE FOOTNOTES ON LAST PAGE OF REPORT

N/S=NOT SCHEDULED YET

(A) AT EACH REFUELING OUTAGE APPROXIMATELY 1/3 OF A PWR CORE AND 1/4 OF A BWR CORE IS OFF-LOADED.
(B) SOME OF THESE DATES HAVE BEEN ADJUSTED BY STAFF ASSUMPTIONS.
(C) THIS IS THE TOTAL FOR BOTH UNITS.
(D) PLANT NOT IN COMMERCIAL OPERATION.
(E) INCLUDES SPENT FUEL STORED AT BRUNSWICK AND SPARE AVAILABLE AT BRUNSWICK.
(F) ATHORIZED A TOTAL OF 2088 BWR AND 304 PWR ASSEMBLIES FOR BOTH PO OLS.
(G) ROBINSON 2 ASSEMBLIES BEING SHIPPED TO BRUNSWICK FOR STORAGE.
(H) CAPACITY IS IN METRIC TONS OF URANIUM: 1 MTU=2 PWR ASSEMBLIES OR 5 BWR ASSEMBLIES.
(I) NO LONGER ACCEPTING SPENT FUEL.
(J) RACKED FOR 700 MTU.
(K) 144 BWR AND 140 PWR ASSEMBLIES STORED.
(L) ESTIMATED

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Table F.2. Reactor Data Used in this Study

Reactor	Utility	Code^a	MWE	Assemblies	Fuel Loading Date	
					230 GWe	280 GWe
***						
* ALLENS CREEK	HOUSTON POWER & LIGHT	UB 7	1180	732	92	90
* ARKANSAS 1	ARKANSAS POWER & LIGHT	P 1	850	177	73	73
* ARKANSAS 2	ARKANSAS POWER & LIGHT	P 2	950	177	78	78
* BAILLY 1	NORTHERN INDIANA PUBLIC SERVICE	CB 1	660	444	87	85
* BEAVER VALLEY 1	DUQUESNE LIGHT	P 3	852	157	75	75
* BEAVER VALLEY 2	DUQUESNE LIGHT	CP 1	852	157	88	86
* BELLEFONTE 1	TENNESSEE VALLEY AUTHORITY	CP 2	1235	205	82	81
* BELLEFONTE 2	TENNESSEE VALLEY AUTHORITY	CP 3	1235	205	84	82
* BIG ROCK POINT	CONSUMERS POWER	B 1	72	84	62	62
* BLACK FOX 1	PUBLIC SERVICE OF OKLAHOMA	CB 2	1150	764	86	84
* BLACK FOX 2	PUBLIC SERVICE OF OKLAHOMA	CB 3	1150	764	89	87
* BRAIDWOOD 1	COMMONWEALTH EDISON	CP 4	1120	193	82	81
* BRAIDWOOD 2	COMMONWEALTH EDISON	CP 5	1120	193	84	83
* BROWNS FERRY 1	TENNESSEE VALLEY AUTHORITY	B 2	1065	764	73	73
* BROWNS FERRY 2	TENNESSEE VALLEY AUTHORITY	B 3	1065	764	74	74
* BROWNS FERRY 3	TENNESSEE VALLEY AUTHORITY	B 4	1065	764	76	76
* BRUNSWICK 1	CAROLINA POWER & LIGHT	B 5	821	560	76	76
* BRUNSWICK 2	CAROLINA POWER & LIGHT	B 6	821	560	74	74
* BYRON 1	COMMONWEALTH EDISON	CP 6	1120	193	82	81
* BYRON 2	COMMONWEALTH EDISON	CP 7	1120	193	85	83
* CALLAWAY 1	UNION ELECTRIC	CP 8	1150	193	84	83
* CALLAWAY 2	UNION ELECTRIC	CP 9	1150	193	91	88
* CALVERT CLIFFS 1	BALTIMORE GAS & ELECTRIC	P 4	845	217	74	74
* CALVERT CLIFFS 2	BALTIMORE GAS & ELECTRIC	P 5	845	217	76	76
* CAROLINA 1	CAROLINA POWER & LIGHT	UP22	1250	217	94	91
* CAROLINA 2	CAROLINA POWER & LIGHT	UP23	1250	217	96	93
* CARROLL COUNTY 1	COMMONWEALTH EDISON	UB 3	1180	732	93	89
* CARROLL COUNTY 2	COMMONWEALTH EDISON	UB 6	1180	732	95	91
* CATAWBA 1	DUKE POWER	CP10	1145	193	82	81
* CATAWBA 2	DUKE POWER	CP11	1145	193	85	83
* CENTRAL VIRGINIA 1	AMERICAN ELECTRIC COMPANY	UP 2	1250	217	92	89
* CENTRAL VIRGINIA 2	AMERICAN ELECTRIC COMPANY	UP 7	1250	217	94	91
* CHEROKEE 1	DUKE POWER	CP12	1280	241	89	86
* CHEROKEE 2	DUKE POWER	CP13	1280	241	91	88
* CHEROKEE 3	DUKE POWER	CP14	1280	241	91	88
* CLINTON 1	ILLINOIS POWER	CB 4	950	592	84	83
* CLINTON 2	ILLINOIS POWER	CB 5	950	592	91	88
* COMANCHE PEAK 1	TEXAS UTILITIES GENERATING	CP15	1150	193	81	80
* COMANCHE PEAK 2	TEXAS UTILITIES GENERATING	CP16	1150	193	85	83
* COOK 1	INDIANA & MICHIGAN ELECTRIC	P 6	1054	193	74	74
* COOK 2	INDIANA & MICHIGAN ELECTRIC	P 7	1100	193	77	77
* COOPER	NEBRASKA PUBLIC POWER DISTRICT	B 7	778	548	73	73
* CRYSTAL RIVER 3	FLORIDA POWER CORP.	P 8	825	177	76	76
* DAVIS BESSE 1	TOLEDO EDISON	P 9	906	177	76	76
* DAVIS BESSE 2	TOLEDO EDISON	CP17	906	177	92	89
* DAVIS BESSE 3	TOLEDO EDISON	CP18	906	177	92	89
* DIABLO CANYON 1	PACIFIC GAS & ELECTRIC	CP19	1084	193	79	79
* DIABLO CANYON 2	PACIFIC GAS & ELECTRIC	CP20	1106	193	79	79
* DRESDEN 1	COMMONWEALTH EDISON	B 8	200	464	59	59
* DRESDEN 2	COMMONWEALTH EDISON	B 9	794	724	71	71
* DRESDEN 3	COMMONWEALTH EDISON	B10	794	724	70	70
* DUANE ARNOLD	IOWA ELECTRIC POWER & LIGHT	B11	538	368	74	74
* ENRICO FERMI 2	DETROIT EDISON	CB 6	1123	762	81	80
* ERIE 1	OHIO EDISON COMPANY	UP 4	1250	217	92	89
* ERIE 2	OHIO EDISON COMPANY	UP10	1250	217	94	91
* FARLEY 1	ALABAMA POWER COMPANY	P10	829	157	76	76
* FARLEY 2	ALABAMA POWER COMPANY	CP21	829	157	80	80
* FITZPATRICK	POWER AUTHORITY OF STATE OF NEW YORK	B12	821	560	74	74
* FORKED RIVER	JERSEY CENTRAL POWER & LIGHT	CP22	1070	217	87	85
* FT. CALHOUN	OMAHA PUBLIC POWER DISTRICT	P11	457	133	72	72
* FULTON 1	PHILADELPHIA ELECTRIC	UP25	1250	217	94	91
* FULTON 2	PHILADELPHIA ELECTRIC	UP26	1250	217	96	92
* GINNA	ROCHESTER GAS & ELECTRIC	P12	490	121	69	69

Table F.2. Continued

Reactor	Utility	Code[a]	MWE	Assemblies	Fuel Loading Date 230 GWe	 280 GWe
* GRAND GULF 1	MISSISSIPPI POWER & LIGHT	CB 7	1250	784	81	81
* GRAND GULF 2	MISSISSIPPI POWER & LIGHT	CB 8	1250	784	87	85
* GREEN COUNTY	POWER AUTHORITY OF STATE OF NEW YORK	UP13	1250	217	94	93
* GREENWOOD 1	DETROIT EDISON	UP12	1250	217	92	89
* GREENWOOD 2	DETROIT EDISON	UP16	1250	217	95	91
* HADDAM NECK	CONNECTICUT YANKEE ATOMIC POWER	P13	575	157	67	67
* HARRIS 1	CAROLINA POWER & LIGHT	CP23	915	157	87	85
* HARRIS 2	CAROLINA POWER & LIGHT	CP24	915	157	90	87
* HARRIS 3	CAROLINA POWER & LIGHT	CP25	915	157	91	88
* HARRIS 4	CAROLINA POWER & LIGHT	CP26	915	157	91	88
* HARTSVILLE A-1	TENNESSEE VALLEY AUTHORITY	CB 9	1205	732	84	82
* HARTSVILLE A-2	TENNESSEE VALLEY AUTHORITY	CB10	1205	732	86	84
* HARTSVILLE B-1	TENNESSEE VALLEY AUTHORITY	CB11	1205	732	85	84
* HARTSVILLE B-2	TENNESSEE VALLEY AUTHORITY	CB12	1205	732	87	85
* HATCH 1	GEORGIA POWER	B13	717	560	74	74
* HATCH 2	GEORGIA POWER	B14	822	560	78	78
* HAVEN	WISCONSIN ELECTRIC POWER	UP14	1250	217	95	91
* HOPE CREEK 1	PUBLIC SERVIC GAS & ELECTRIC OF NJ	CB13	1067	764	88	86
* HOPE CREEK 2	PUBLIC SERVIC GAS & ELECTRIC OF NJ	CB14	1067	764	90	87
* HUMBOLDT BAY	PACIFIC GAS & ELECTRIC	B15	65	172	62	62
* INDIAN POINT 1	CONSOLIDATED EDISON	P14	0	0	61	61
* INDIAN POINT 2	CONSOLIDATED EDISON	P15	873	193	72	72
* INDIAN POINT 3	CONSOLIDATED EDISON	P16	873	193	75	75
* JAMESPORT 1	LONG ISLAND LIGHTING	UP15	1250	217	92	90
* JAMESPORT 2	LONG ISLAND LIGHTING	UP17	1250	217	95	[illegible]
* KEWAUNEE	WISCONSIN PUBLIC SERVICE	P17	535	121	73	73
* LACROSSE	DAIRYLAND POWER	B16	50	72	68	68
* LASALLE 1	COMMONWEALTH EDISON	CB15	1078	764	79	79
* LASALLE 2	COMMONWEALTH EDISON	CB16	1078	764	80	80
* LIMERICK 1	PHILADELPHIA ELECTRIC	CB17	1065	764	86	84
* LIMERICK 2	PHILADELPHIA ELECTRIC	CB18	1065	764	89	87
* MAINE YANKEE	MAINE YANKEE ATOMIC POWER	P18	790	217	71	71
* MARBLE HILL 1	PUBLIC SERVICE OF INDIANA	CP27	1130	193	84	82
* MARBLE HILL 2	PUBLIC SERVICE OF INDIANA	CP28	1130	193	87	85
* MCGUIRE 1	DUKE POWER	CP29	1180	157	79	79
* MCGUIRE 2	DUKE POWER	CP30	1180	193	[illegible]	81
* MIDLAND 1	CONSUMERS POWER	CP31	492	177	83	82
* MIDLAND 2	CONSUMERS POWER	CP32	887	177	82	81
* MILLSTONE 1	NORTHEAST NUCLEAR ENERGY	B17	660	580	70	70
* MILLSTONE 2	NORTHEAST NUCLEAR ENERGY	P19	830	217	74	74
* MILLSTONE 3	NORTHEAST NUCLEAR ENERGY	CP33	1159	193	90	88
* MONTAGUE 1	NORTHEAST NUCLEAR ENERGY	UB 2	1180	732	93	89
* MONTAGUE 2	NORTHEAST NUCLEAR ENERGY	UB 5	1180	732	95	91
* MONTICELLO	NORTHERN STATES POWER	B18	545	484	70	70
* NEW ENGLAND 1	NEW ENGLAND POWER & LIGHT	UP18	1250	217	93	90
* NEW ENGLAND 2	NEW ENGLAND POWER & LIGHT	UP20	1250	217	95	92
* NEW YORK 1	NY STATE ELECTRIC & GAS COMPANY	UP19	1250	217	93	90
* NEW YORK 2	NY STATE ELECTRIC & GAS COMPANY	UP21	1250	217	95	92
* NINE MILE POINT 1	NIAGARA MOHAWK POWER	B19	[illegible]	532	68	68
* NINE MILE POINT 2	NIAGARA MOHAWK POWER	CB19	1080	764	89	86
* NORTH ANNA 1	VIRGINIA ELECTRIC & POWER	P20	907	157	77	77
* NORTH ANNA 2	VIRGINIA ELECTRIC & POWER	CP34	943	157	79	79
* NORTH ANNA 3	VIRGINIA ELECTRIC & POWER	CP35	907	145	83	82
* NORTH ANNA 4	VIRGINIA ELECTRIC & POWER	CP36	907	145	86	84
* OCONEE 1	DUKE POWER	P22	887	177	72	72
* OCONEE 2	DUKE POWER	P23	887	177	73	73
* OCONEE 3	DUKE POWER	P24	887	177	73	73
* OYSTER CREEK	JERSEY CENTRAL POWER & LIGHT	B20	650	560	68	68
* PALISADES	CONSUMERS POWER	P25	805	204	70	70
* PALO VERDE 1	ARIZONA PUBLIC SERVICE	CP37	1270	241	83	82
* PALO VERDE 2	ARIZONA PUBLIC SERVICE	CP38	1270	241	88	85
* PALO VERDE 3	ARIZONA PUBLIC SERVICE	CP39	1270	241	90	87
* PALO VERDE 4	ARIZONA PUBLIC SERVICE	UP 5	1250	217	93	90
* PALO VERDE 5	ARIZONA PUBLIC SERVICE	UP11	1250	217	96	92
* PEACH BOTTOM 2	PHILADELPHIA ELECTRIC	B21	1065	764	73	73
* PEACH BOTTOM 3	PHILADELPHIA ELECTRIC	B22	1065	764	73	73

Table F.2. Continued

Reactor	Utility	Code[a]	MWE	Assemblies	Fuel Loading Date 230 GWe	Fuel Loading Date 280 GWe
• PEBBLE SPRINGS 1	PORTLAND GENERAL ELECTRIC	UP 1	1250	217	93	90
• PEBBLE SPRINGS 2	PORTLAND GENERAL ELECTRIC	UP 6	1250	217	96	92
• PERKINS 1	DUKE POWER	UP 3	1250	217	93	89
• PERKINS 2	DUKE POWER	UP 8	1250	217	95	91
• PERKINS 3	DUKE POWER	UP24	1250	217	97	93
• PERRY 1	CLEVELAND ELECTRIC & ILLUMINATING	CB20	1205	732	85	83
• PERRY 2	CLEVELAND ELECTRIC & ILLUMINATING	CB21	1205	732	88	85
• PHIPPS BEND 1	TENNESSEE VALLEY AUTHORITY	CB22	1220	732	87	84
• PHIPPS BEND 2	TENNESSEE VALLEY AUTHORITY	CB23	1220	732	89	86
• PILGRIM 1	BOSTON EDISON	B23	655	580	70	70
• PILGRIM 2	BOSTON EDISON	UP 9	1250	217	96	92
• PRAIRIE ISLAND 1	NORTHERN STATES POWER	P28	530	121	72	72
• PRAIRIE ISLAND 2	NORTHERN STATES POWER	P29	530	121	73	73
• PT. BEACH 1	WISCONSIN MICHIGAN ELECTRIC	P26	497	121	69	69
• PT. BEACH 2	WISCONSIN MICHIGAN ELECTRIC	P27	497	121	71	71
• QUAD CITIES 1	COMMONWEALTH EDISON	B24	789	724	72	71
• QUAD CITIES 2	COMMONWEALTH EDISON	B25	789	724	72	72
• RANCHO SECO	SACRAMENTO MUNICIPAL UTILITIES DISTRICT	P30	918	177	74	74
• RIVER BEND 1	GULF STATES UTILITIES	CB24	934	592	89	86
• RIVER BEND 2	GULF STATES UTILITIES	CB25	934	592	92	89
• ROBINSON 2	CAROLINA POWER & LIGHT	P31	700	157	70	70
• SALEM 1	PUBLIC SERVIC GAS & ELECTRIC OF NJ	P32	1090	193	76	76
• SALEM 2	PUBLIC SERVIC GAS & ELECTRIC OF NJ	CP40	1115	193	79	79
• SAN ONOFRE 1	SOUTHERN CALIFORNIA EDISON	P33	436	157	67	67
• SAN ONOFRE 2	SOUTHERN CALIFORNIA EDISON	CP41	1140	217	80	80
• SAN ONOFRE 3	SOUTHERN CALIFORNIA EDISON	CP42	1140	217	83	82
• SEABROOK 1	PUBLIC SERVICE OF NEW HAMPSHIRE	CP43	1194	193	86	84
• SEABROOK 2	PUBLIC SERVICE OF NEW HAMPSHIRE	CP44	1194	193	89	87
• SEQUOYAH 1	TENNESSEE VALLEY AUTHORITY	CP46	1140	193	79	79
• SEQUOYAH 2	TENNESSEE VALLEY AUTHORITY	CP45	1140	193	80	79
• SHOREHAM	LONG ISLAND LIGHTING	CB26	854	560	81	80
• SKAGIT 1	PUGET SOUND POWER & LIGHT	UB 1	1180	732	94	90
• SKAGIT 2	PUGET SOUND POWER & LIGHT	UB 4	1180	732	96	92
• SOUTH TEXAS 1	HOUSTON POWER & LIGHT	CP47	1250	193	83	82
• SOUTH TEXAS 2	HOUSTON POWER & LIGHT	CP48	1250	193	86	84
• ST LUCIE 1	FLORIDA POWER & LIGHT	P34	802	217	75	75
• ST LUCIE 2	FLORIDA POWER & LIGHT	CP49	842	217	85	83
• STANISLAUS 1	PACIFIC GAS & ELECTRIC	UB 8	1180	732	94	90
• STANISLAUS 2	PACIFIC GAS & ELECTRIC	UB 9	1180	732	96	92
• STERLING 1	ROCHESTER GAS & ELECTRIC	CP50	1150	177	91	88
• SUMMER 1	SOUTH CAROLINA ELECTRIC & GAS	CP51	900	157	81	80
• SURRY 1	VIRGINIA ELECTRIC & POWER	P35	822	157	71	71
• SURRY 2	VIRGINIA ELECTRIC & POWER	P36	822	157	72	72
• SUSQUEHANNA 1	PENNSYLVANIA POWER & LIGHT	CB27	1052	764	81	80
• SUSQUEHANNA 2	PENNSYLVANIA POWER & LIGHT	CB28	1052	764	83	82
• THREE MILE ISLAND 1	METROPOLITAN EDISON	P37	819	177	73	73
• THREE MILE ISLAND 2	METROPOLITAN EDISON	P38	906	177	78	78
• TROJAN	PORTLAND GENERAL ELECTRIC	P39	1130	193	75	75
• TURKEY POINT 3	FLORIDA POWER & LIGHT	P40	693	157	71	71
• TURKEY POINT 4	FLORIDA POWER & LIGHT	P41	693	157	72	72
• TYRONE	NORTHERN STATES POWER	CP52	1150	193	91	88
• VERMONT YANKEE	VERMONT YANKEE NUCLEAR POWER	B26	514	368	71	71
• VOGTLE 1	GEORGIA POWER	CP53	1100	193	89	86
• VOGTLE 2	GEORGIA POWER	CP54	1100	193	90	87
• WASHINGTON NUCLEAR 1	WASHINGTON PPSS	CP55	1251	205	85	83
• WASHINGTON NUCLEAR 2	WASHINGTON PPSS	CB29	1103	764	80	80
• WASHINGTON NUCLEAR 3	WASHINGTON PPSS	CP56	1242	241	87	85
• WASHINGTON NUCLEAR 4	WASHINGTON PPSS	CP57	1267	205	88	86
• WASHINGTON NUCLEAR 5	WASHINGTON PPSS	CP58	1242	241	90	87
• WATERFORD 3	LOUISIANA POWER & LIGHT	CP59	1267	205	83	81
• WATTS BAR 1	TENNESSEE VALLEY AUTHORITY	CP60	1165	193	80	80
• WATTS BAR 2	TENNESSEE VALLEY AUTHORITY	CP61	1165	193	81	81
• WOLF CREEK 1	KANSAS GAS & ELECTRIC	CP62	1150	193	86	84
• YANKEE ROWE	YANKEE ATOMIC ELECTRIC	P42	175	76	60	60
• YELLOW CREEK 1	TENNESSEE VALLEY AUTHORITY	CP63	1285	193	88	86
• YELLOW CREEK 2	TENNESSEE VALLEY AUTHORITY	CP64	1285	193	90	87

Table F.2. Continued

Reactor	Utility	Code[a]	MWE	Assemblies	Fuel Loading Date 230 GWe	Fuel Loading Date 280 GWe
* ZIMMER 1	CINCINNATI GAS & ELECTRIC	CP65	810	560	80	79
* ZION 1	COMMONWEALTH EDISON	P43	1040	193	72	72
* ZION 2	COMMONWEALTH EDISON	P44	1040	193	73	73
* 230 B		FB 1	1180	732	97	97
* 230 B		FB 2	1180	732	97	97
* 230 P		FP 1	1250	217	97	97
* 230 P		FP 2	1250	217	97	97
* 230 P		FP 3	1250	217	97	97
* 230 P		FP 4	1250	217	97	97
* 280 B		FB 3	1180	732		93
* 280 B		FB 4	1180	732		93
* 280 B		FB 5	1180	732		93
* 280 B		FB 6	1180	732		94
* 280 B		FB 7	1180	732		94
* 280 B		FB 8	1180	732		94
* 280 B		FB 9	1180	732		95
* 280 B		FB10	1180	732		95
* 280 B		FB11	1180	732		95
* 280 B		FB12	1180	732		96
* 280 B		FB13	1180	732		96
* 280 B		FB14	1180	732		96
* 280 B		FB15	1180	732		97
* 280 P		FP 5	1250	217		93
* 280 P		FP 6	1250	217		93
* 280 P		FP 7	1250	217		93
* 280 P		FP 8	1250	217		94
* 280 P		FP 9	1250	217		94
* 280 P		FP10	1250	217		94
* 280 P		FP11	1250	217		94
* 280 P		FP12	1250	217		94
* 280 P		FP13	1250	217		94
* 280 P		FP14	1250	217		95
* 280 P		FP15	1250	217		95
* 280 P		FP16	1250	217		95
* 280 P		FP17	1250	217		95
* 280 P		FP18	1250	217		95
* 280 P		FP19	1250	217		95
* 280 P		FP20	1250	217		96
* 280 P		FP21	1250	217		96
* 280 P		FP22	1250	217		96
* 280 P		FP23	1250	217		96
* 280 P		FP24	1250	217		96
* 280 P		FP25	1250	217		96
* 280 P		FP26	1250	217		97
* 280 P		FP27	1250	217		97

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[a] Reactor code (all as of 12/31/78):

B or P - operating boiling or pressurized water reactor.
CB or CP - boiling or pressurized water reactor under construction.
UB or UP - reactor named but unlicensed (no site), not under construction.
FB or FP - reactor unnamed, unsited, and not yet under construction.

Numeric values added to the above letter code to provide a unique identifier for each reactor.

listed in the NRC's "Construction Status Report--Nuclear Power Plants," NUREG-0030 (Yellow Book)[2] were assumed to come online at dates which correspond to the two growth rates considered in this appendix. Some reactors have different fuel-loading dates for the two cases.

Since the number of reactors presently listed in the Gray and Yellow Books is not enough to reach the projected level of nuclear capacity by the year 2000, it is necessary to supplement these with additional reactors. The number of power reactors presently planned by utilities in addition to those with construction permits are contained in the NRC's "Program Summary Report," NUREG-0380, (Brown Book).[3] These planned reactors have names and owners, but do not have a power rating. In addition to these planned reactors, others which presently are not planned by any utility are needed to reach the assumed level of nuclear capacity by the year 2000. These unplanned reactors are not assigned to any utility. The latter two sets of reactors are assumed to have a mix of approximately two PWR's for each BWR. The PWR's are assumed to have 217 assemblies, each containing 0.45 metric tons (MT) of uranium, and would have a power level of 1250 MWe. The BWR's are assumed to have 732 assemblies, each containing 0.20 MT of uranium, and having a power level of 1180 MWe. These two sets of data for PWR's and BWR's are representative of reactors presently under construction. No reactors with fuel loading dates after 1997 are shown in this table because such reactors would not discharge fuel until after 2000. However, the spent fuel storage space of these reactors is available for use and is included in the results given in this document. The code column in Table F.2 describes the status of each plant.

The reactor plants are assumed to have a 30-year operational lifetime from the date of commercial operation. Thus, the generating capacity that goes offline before 2000 due to age (Table F.3) must be replaced in order to reach the assumed level of nuclear capacity in the year 2000.

1.2 Fuel Discharge Rates

A model for the discharging rate of spent fuel was developed by analyzing data on the history of operating plants. The model discharge schedule used in this study is shown below:

Number of Years in Operation Following Date of Commercial Operation	Fraction of Core Discharged per year	
	PWR	BWR
1	0.0	0.0
2-5	0.25	0.20
6	0.33	0.20
7-29	0.33	0.25
30	1.0	1.0

A one-year period between the initial fuel loading and the start of commercial operation is assumed for this document. Hence, the first discharge occurs three years following fuel loading (two years following start of commercial operation). The model used for this study divides the reactor life into two segments: (1) before the first core has been discharged, and (2) after the first core has been discharged.

Table F.3. Reactors That Go Offline before 2000 because of Age

Facility	Owner	Power Rating (MWe)	Assumed Year of Shutdown
Dresden 1	Commonwealth Edison	200	1990
Yankee Rowe	Yankee Atomic Electric	175	1991
Big Rock Point	Consumers Power	72	1993
Humbolt Bay	Pacific Gas & Electric	65	1993
Haddam Neck	Connecticut Yankee Atomic Power	575	1998
San Onofre 1	Southern California Edison	436	1998
LaCrosse	Dairyland Power	50	1999
Nine Mile Point 1	Niagra Mohawk Power	610	1999
Oyster Creek	Jersey Central Power & Light	650	1999
Ginna	Rochester Gas & Electric	490	2000
Point Beach 1	Wisconsin Michigan Electric	497	2000

For those years of operation prior to complete discharge of the first core, nuclear reactors tend to discharge less fuel annually because of required testing and operational procedures. This is evident by the length of time until discharge of the first core (see Tables F.4 and F.5). Accordingly, the model has a first cycle which lasts two years, followed by yearly discharges of 20% of the core for BWR's and 25% for PWR's until the first core has been fully discharged. Hence, it will take five years to fully discharge the first core for a PWR and six years for a BWR following the date of commercial operation. After the first core has been fully discharged, annual discharges of 1/3 of a core for PWR's and 1/4 of a core for BWR's is assumed. After the 30-year lifetime of the reactor, the entire core would be discharged.

This model is based on information given in the Gray Book, with modifications when additional information was available. Table F.4 shows the operational record of plants that have discharged their first core as of November 1, 1977. Over the 14-month period from November 1, 1977, to December 31, 1978, the PWR's shown in Table F.4 discharged a total of 641 assemblies. The annual discharge rate for PWR's that have discharged their first core is then:

$$\text{Percentage discharged} = \frac{641}{1959} \times \frac{12}{14} \times 100 = 28.0\%$$

The 14-month period was used to reduce the number of reactors which did not have a refueling outage. For BWR's that have discharged their first core, the annual rate of fuel discharges from the data in Table F.4 is:

$$\text{Percentage discharged} = \frac{1146}{4012} \times \frac{12}{14} \times 100 = 24.5\%$$

Table F.5 shows the operational record of plants that are two years old but had not discharged their first core as of November 1, 1977. The annual discharge rate for PWR's in this category is:

$$\text{Percentage discharged} = \frac{1089}{2764} \times \frac{12}{14} \times 100 = 33.8\%$$

The annual discharge rate for BWR's in this category is:

$$\text{Percentage discharged} = \frac{2395}{8820} \times \frac{12}{14} \times 100 = 23.3\%$$

These calculations show that the assumption of discharging 1/3 of a PWR core and 1/4 of a BWR is valid. However, also included in Tables F.4 and F.5 are estimates of the length of time to fully discharge the first core. These time periods are somewhat longer than would be expected by discharging 1/3 of a PWR core and 1/4 of a BWR core annually. This discrepancy is probably due to the operational problems when the reactor is first put online. The first few fuel cycles may also be a bit irregular during the breaking-in period.

By having the model divided into two sections, it is possible to match both the length of time to discharge the first core and the annual discharging rates. The model agrees very well for PWR's on the length of time to discharge the first core (five years). The model underpredicts the value for BWR's (six years), which will result in an overestimate of discharge rates for BWR spent fuel. Most of the reactors which will come online in the future will be of the large (greater than 1000 MWe) variety. Thus, it is not valid to predict discharges for these plants based on smaller plants, especially those in Table F.4. By placing more emphasis on the data in

Table F.4. Reactors That Had Discharged Their First Core as of November 1, 1977[a]

Facility	Core Size, No. of Assemblies	No. of Assemblies Discharged between 11/1/77-12/31/78	Years to Discharge First Core Following Commercial Operation (estimated)
PWR's			
Ginna	121	32	5
Haddam Neck	157	56	7
Maine Yankee	217	72	--[c]
Palisades	204	68	6
Point Beach 1 & 2[b]	121 each	104 total	5
Robinson 2	157	39	6
San Onofre	157	52	--[c]
Surry 1 & 2[b]	157 each	144 total	6
Turkey Point 3 & 4[b]	157 each	74 total	5
Yankee Rowe	76	0	--[c]
	1959	641	
BWR's			
Big Rock Point	84	22	--[c]
Dresden 1	464	0	--[c]
Dresden 2	724	193	--[c]
Dresden 3	724	176	--[c]
LaCrosse	72	0	8
Monticello	484	132	6
Nine Mile Point	532	0	9
Oyster Creek	560	245	9
Vermont Yankee	368	378	8
	4012	1146	

---

[a] Not included in this table are Humbolt Bay and Indian Point 1, both of which are not presently in operation.

[b] Treated together because the values for spent fuel in storage are given together in the Gray Book.

[c] Unable to make estimate.

Table F.5. Reactors Two Years Old as of November 1, 1977 That Had Not Discharged Their First Core

Facility	Core Size, No. of Assemblies	No. of Assemblies Discharged between 11/1/77-12/31/78	Projected Years to Discharge First Core Following Commercial Operation
PWR's			
Arkansas 1	177	53	5
Calvert Cliffs 1	217	72	4
Cook 1	193	64	5
Ft. Calhoun	133	80	4
Indian Point 2	193	60	7
Kewaunee	121	40	5
Oconee 1, 2, & 3[a]	177 each	200 total	5
Prairie Island 1 & 2[a]	121 each	80 total	5
Rancho Seco	177	112	7
Three Mile Island 1	177	56	5
Zion 1 & 2	193 each	188 total	5
	2764	1089	
BWR's			
Brown's Ferry 1	764	324	8
Brown's Ferry 2	764	132	8
Brunswick 2	560	140	7
Cooper	548	164	8
Duane Arnold	368	88	5
Fitzpatrick	560	136	7
Hatch 1	560	168	7
Millstone 1	580	125	8
Peach Bottom 2	764	258	6
Peach Bottom 3	764	252	6
Pilgrim 1	580	428	6
Quad Cities 1 & 2[b]	724 each	180 total	8
	8820	2395	

[a] Treated together because the values for spent fuel in storage are given together in the Gray Book.

[b] Treated together because spent fuel has been transferred between storage pools.

Table F.5, which contains larger plants than does Table F.4, the model seems to fit the data well enough for purposes of estimation.

The amount of fuel annually discharged is independent of the plant capacity factor and fuel burnup in this model. This is based on a study of the Gray Book which shows the insensitivity of these factors to discharge rates. The discharge rates given in this model are indicative of those presently occurring. If longer fuel cycles (with increased fuel enrichment and burnup) are obtained in the future, this model could overestimate the amount of spent fuel to be discharged from reactors.

1.3 Use of Storage Space

For this document, the available space to store spent fuel is assumed to be limited to that remaining in the storage pools of the reactors presently operating and of those reactors which will come online by the year 2000. The spent fuel storage space remaining at NFS West Valley, GE Morris, or AGNS Barnwell is assumed to be unavailable for additional spent fuel storage. The spent fuel presently stored at West Valley and Morris is assumed to remain there. The assemblies are assumed to be stored intact without being disassembled to increase storage availability.

The sizes of the storage pools are taken from the Gray Book for operating plants; it is assumed that any planned increased storage capacity shown there will be accomplished. For the plants not yet constructed, the spent fuel storage capacity is estimated to be 3.75 cores for BWR's and 4 cores for PWR's. This value is based on the present storage capacity obtainable by use of high-density storage racks and is consistent with the data given in the Gray Book.

Two cases were considered for each nuclear growth rate: (1) with and (2) without full core reserve remaining in the spent fuel pool. For sites with multiple reactors, the full core reserve case would involve maintaining one full core reserve for the site, not one for each reactor. The unplanned reactors would have one full core reserve each. While maintaining full core reserve is desirable from an operational standpoint, it is not considered necessary to the safe operation of the nuclear power plant. In the without full core reserve case, the spent fuel storage pool is used until completely full, at which time it is necessary to store spent fuel elsewhere.

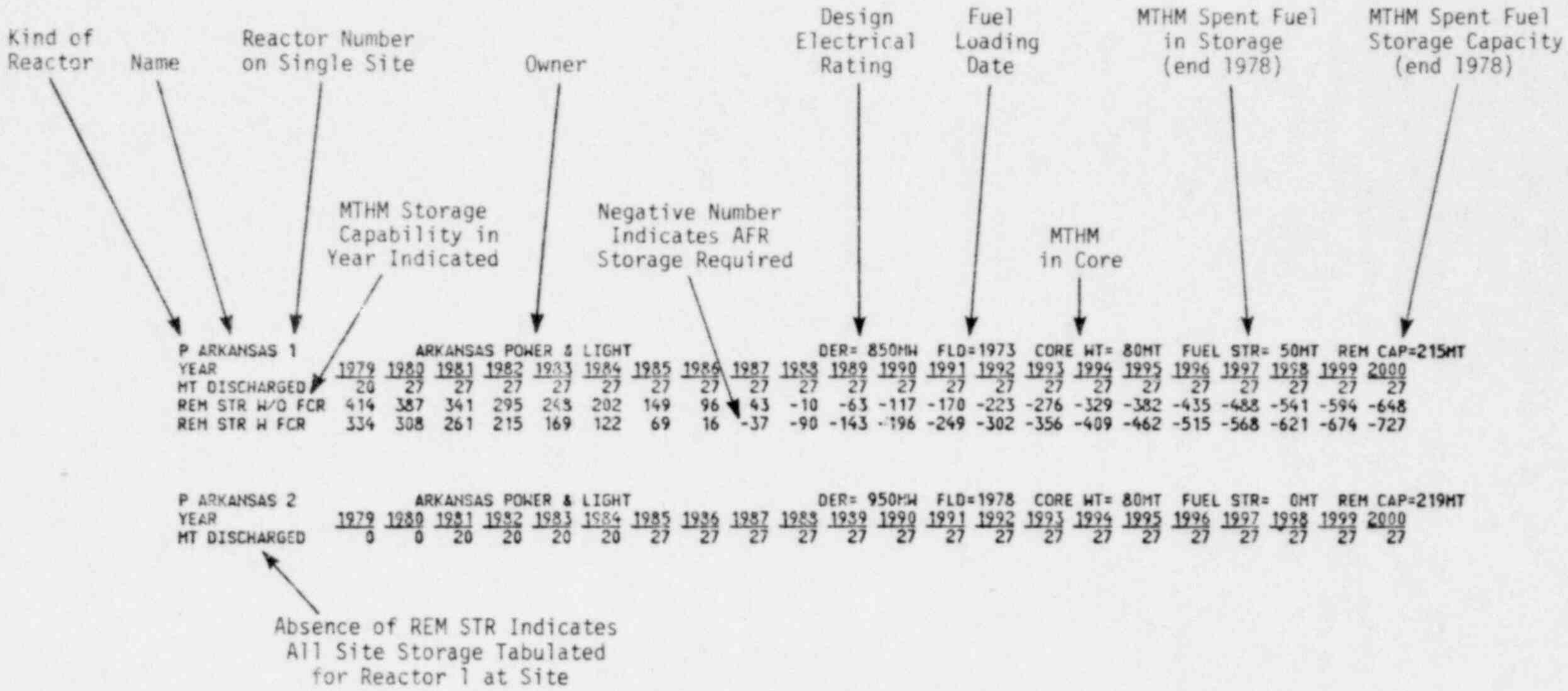
Nuclear power plants often have two or more nuclear reactors within the same complex. One current site (Palo Verde) is licensed to contain as many as five reactors. For this document, all the reactors at a given site are assumed to have access to all of the storage space at that site. However, the spent fuel storage pool of a reactor is available for spent fuel storage only after fuel has been loaded into the reactor. Thus, for multiple reactor sites, spent fuel from one reactor can be stored in the pool serving another reactor only after the fuel loading date for the latter reactor. Therefore, one reactor could lose spent fuel storage space before the other reactors at that same site were online, and as a result, the site would have no available spent fuel storage space until another reactor was brought online.

If a given site contains both a BWR and PWR (such as Millstone 1 and 2), it is assumed that the spent fuel from either plant can be stored in either pool. The differences in rack construction for PWR and BWR spent fuel is not considered in this analysis. The available space in a spent fuel pool is considered only in terms of metric tons heavy metal (MTHM) of spent fuel, not the number of assemblies. To determine the storage capacity in terms of assemblies, all BWR fuel is assumed to contain 0.20 MTHM per assembly and PWR fuel 0.45 MTHM per assembly.

2.0 SPENT FUEL STORAGE DATA, 1979 - 2000

Tables F.6 and F.7 contain the list of reactors discharging fuel through 2000, with the remaining at-reactor storage available given in terms of metric tons heavy metal. These lists are based on the model described in Section 1.2 of this appendix. The remaining storage for the reference growth rate (230 GWe by the year 2000) is given in Table F.6, and for the higher growth rate (280 GWe by 2000) in Table F.7. These tables contain a reactor-by-reactor analysis of the fuel storage requirements until the year 2000. For each reactor, the following data are given: the reactor type (PWR or BWR), the reactor name, the owner, the plant power rating, the fuel loading date, the core weight (obtained by multiplying the number of assemblies by 0.20 for BWR's and 0.45 for PWR's), the amount in storage as of December 31, 1978, the amount that can be accommodated in the remaining storage space, the amount of spent fuel discharged annually, remaining storage capacity without maintaining full core reserve, and the remaining storage capacity with full core reserve [all material quantities are expressed in terms of metric tons heavy metal (MTHM)]. When two or more plants are at one site, the discharging values are shown separately, but the total available remaining space is given with the first reactor.

Tables F.8 and F.9 show the year in which reactor sites will run out of spent fuel storage space and require AFR storage. These tables were obtained from the data given in Tables F.6 and F.7 using the assumptions given in Section 1.3 of this appendix for use of storage space at a site. Table F.8 contains the with full core reserve and without full core reserve cases for the reference growth rate, and Table F.9 contains these results for the higher growth rate of nuclear capacity. The remaining storage for each reactor is given in terms of MTHM. As discussed in Section 1 of this appendix, it is possible for a reactor site to lose spent fuel storage capacity until another reactor at that site has fuel loaded into it. At that time, the backlog of spent fuel at the site can be stored in the spent fuel pool of the new reactor. This may alleviate or at least lessen the need for AFR storage for that reactor site for a few years.



```
P ARKANSAS 1            ARKANSAS POWER & LIGHT                     DER= 850MW   FLD=1973   CORE WT= 80MT   FUEL STR= 50MT   REM CAP=215MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        20   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27
REM STR W/O FCR     414  387  341  295  243  202  149   96   43  -10  -63 -117 -170 -223 -276 -329 -382 -435 -488 -541 -594 -648
REM STR W FCR       334  308  261  215  169  122   69   16  -37  -90 -143 -196 -249 -302 -356 -409 -462 -515 -568 -621 -674 -727

P ARKANSAS 2            ARKANSAS POWER & LIGHT                     DER= 950MW   FLD=1978   CORE WT= 80MT   FUEL STR=  0MT   REM CAP=219MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED         0    0   20   20   20   20   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27
```

Information Code for Individual Reactors for Tables F.6 and F.7.

863078

Table F.6. Storage (with and without FCR), Discharges and Pertinent Information for Individual Reactors Used in Data Base for 230 GWe Installed in Year 2000

B ALLENS CREEK HOUSTON POWER & LIGHT DER=1180MW FLD=1992 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED														0	0	0	29	29	29	29	29	37
REM STR W/O FCR														556	556	556	527	498	469	440	410	374
REM STR W FCR														410	410	410	381	352	322	293	264	227

P ARKANSAS 1 ARKANSAS POWER & LIGHT DER= 850MW FLD=1973 CORE WT= 80MT FUEL STR= 50MT REM CAP=215MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	20	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
REM STR W/O FCR	414	387	341	295	248	202	149	96	43	-10	-63	-117	-170	-223	-276	-329	-382	-435	-488	-541	-594	-648
REM STR W FCR	334	308	261	215	169	122	69	16	-37	-90	-143	-196	-249	-302	-356	-409	-462	-515	-568	-621	-674	-727

P ARKANSAS 2 ARKANSAS POWER & LIGHT DER= 950MW FLD=1978 CORE WT= 80MT FUEL STR= 0MT REM CAP=219MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	0	0	20	20	20	20	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27

B BAILLY 1 NORTHERN INDIANA PUBLIC SERVICE DER= 660MW FLD=1987 CORE WT= 89MT FUEL STR= 0MT REM CAP=338MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED									0	0	0	18	18	18	18	18	22	22	22	22	22	22
REM STR W/O FCR									338	338	338	320	302	284	266	249	226	204	182	160	138	115
REM STR W FCR									249	249	249	231	213	195	178	160	138	115	93	71	49	27

P BEAVER VALLEY 1 DUQUESNE LIGHT DER= 852MW FLD=1975 CORE WT= 71MT FUEL STR= 0MT REM CAP=375MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	18	18	18	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
REM STR W/O FCR	357	340	322	299	275	252	229	205	182	441	418	394	353	312	271	230	184	137	90	43	-4	-50
REM STR W FCR	287	269	252	228	205	181	158	135	111	370	347	324	283	242	201	160	113	66	19	-27	-74	-121

P BEAVER VALLEY 2 DUQUESNE LIGHT DER= 852MW FLD=1988 CORE WT= 71MT FUEL STR= 0MT REM CAP=283MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED										0	0	0	18	18	18	18	23	23	23	23	23	23

P BELLEFONTE 1 TENNESSEE VALLEY AUTHORITY DER=1235MW FLD=1982 CORE WT= 92MT FUEL STR= 0MT REM CAP=369MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED				0	0	0	23	23	23	23	31	31	31	31	31	31	31	31	31	31	31	31
REM STR W/O FCR				369	369	738	715	692	646	600	547	493	432	371	310	248	187	126	65	4	-58	-119
REM STR W FCR				277	277	646	623	600	554	508	455	401	340	279	217	156	95	34	-27	-89	-150	-211

P BELLEFONTE 2 TENNESSEE VALLEY AUTHORITY DER=1235MW FLD=1984 CORE WT= 92MT FUEL STR= 0MT REM CAP=369MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED						0	0	0	23	23	23	23	31	31	31	31	31	31	31	31	31	31

B BIG ROCK POINT CONSUMERS POWER DER= 72MW FLD=1962 CORE WT= 17MT FUEL STR= 12MT REM CAP= 26MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	4	4	4	4	4	4	4	4	4	4	4	4	4	4	17	0	0	0	0	0	0	0
REM STR W/O FCR	22	18	14	9	5	1	-3	-7	-12	-16	-20	-24	-28	-33	-49	-49	-49	-49	-49	-49	-49	-49
REM STR W FCR	5	1	-3	-7	-12	-16	-20	-24	-28	-33	-37	-41	-45	-49	-49	-49	-49	-49	-49	-49	-49	-49

B BLACK FOX 1 PUBLIC SERVICE OF OKLAHOMA DER=1150MW FLD=1986 CORE WT=153MT FUEL STR= 0MT REM CAP=581MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED								0	0	0	31	31	31	31	31	38	38	38	38	38	38	38
REM STR W/O FCR								581	581	581	1131	1100	1070	1009	947	879	810	741	665	588	512	435
REM STR W FCR								428	428	428	978	948	917	856	795	726	657	588	512	435	359	283

B BLACK FOX 2 PUBLIC SERVICE OF OKLAHOMA DER=1150MW FLD=1989 CORE WT=153MT FUEL STR= 0MT REM CAP=581MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED											0	0	0	31	31	31	31	31	38	38	38	38

P BRAIDWOOD 1 COMMONWEALTH EDISON DER=1120MW FLD=1982 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED				0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR				347	347	695	673	652	608	565	515	464	407	349	292	234	176	119	61	4	-54	-112
REM STR W FCR				261	261	608	586	565	522	478	428	378	320	262	205	147	90	32	-26	-83	-141	-198

P BRAIDWOOD 2 COMMONWEALTH EDISON DER=1120MW FLD=1984 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED						0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29

B BROWNS FERRY 1 TENNESSEE VALLEY AUTHORITY DER=1065MW FLD=1973 CORE WT=153MT FUEL STR= 65MT REM CAP=629MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	31	31	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38
REM STR W/O FCR	1858	1766	1667	1560	1453	1338	1224	1109	994	880	765	651	536	421	307	192	78	-37	-152	-266	-381	-495
REM STR W FCR	1705	1613	1514	1407	1300	1185	1071	956	842	727	612	498	383	269	154	39	-75	-190	-304	-419	-534	-648

B BROWNS FERRY 2 TENNESSEE VALLEY AUTHORITY DER=1065MW FLD=1974 CORE WT=153MT FUEL STR= 26MT REM CAP=668MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	31	31	31	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38

B BROWNS FERRY 3 TENNESSEE VALLEY AUTHORITY DER=1065MW FLD=1976 CORE WT=153MT FUEL STR= 42MT REM CAP=653MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	31	31	31	31	31	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38

B BRUNSWICK 1 CAROLINA POWER & LIGHT DER= 821MW FLD=1976 CORE WT=112MT FUEL STR= 29MT REM CAP=389MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	22	22	22	22	22	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
REM STR W/O FCR	344	299	254	204	154	98	42	-14	-70	-126	-182	-238	-294	-350	-406	-462	-518	-574	-630	-686	-742	-798
REM STR W FCR	232	187	142	92	42	-14	-70	-126	-182	-238	-294	-350	-406	-462	-518	-574	-630	-686	-742	-798	-854	-910

B BRUNSWICK 2 CAROLINA POWER & LIGHT DER= 821MW FLD=1974 CORE WT=112MT FUEL STR= 0MT REM CAP= 0MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	22	22	22	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28

P BYRON 1 COMMONWEALTH EDISON DER=1120MW FLD=1982 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED				0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR				347	347	347	673	652	630	587	536	486	436	378	320	263	205	148	90	32	-25	-83
REM STR W FCR				261	261	261	586	565	543	500	450	393	349	291	234	176	118	61	3	-54	-112	-170

P BYRON 2 COMMONWEALTH EDISON DER=1120MW FLD=1985 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED							0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29

Table F.6. Continued

P CALLAWAY 1 UNION ELECTRIC DER=1150MW FLD=1984 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED						0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR						347	347	347	326	304	283	261	580	551	522	472	421	371	320	263	205	148
REM STR W FCR						261	261	261	239	217	196	174	493	464	435	385	334	284	234	176	118	61

P CALLAWAY 2 UNION ELECTRIC DER=1150MW FLD=1991 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED													0	0	0	22	22	22	22	29	29	29

P CALVERT CLIFFS 1 BALTIMORE GAS & ELECTRIC DER= 845MW FLD=1974 CORE WT= 98MT FUEL STR=103MT REM CAP=373MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	24	24	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
REM STR W/O FCR	324	275	219	162	97	32	-32	-97	-162	-227	-292	-356	-421	-486	-551	-616	-680	-745	-810	-875	-940	-1004
REM STR W FCR	226	178	121	64	-0	-65	-130	-195	-260	-324	-389	-454	-519	-584	-648	-713	-778	-843	-908	-972	-1037	-1102

P CALVERT CLIFFS 2 BALTIMORE GAS & ELECTRIC DER= 845MW FLD=1976 CORE WT= 98MT FUEL STR= 0MT REM CAP= 0MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	24	24	24	24	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32

P CAROLINA 1 CAROLINA POWER & LIGHT DER=1250MW FLD=1994 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED																0	0	0	24	24	24	24
REM STR W/O FCR																391	391	781	757	733	684	635
REM STR W FCR																293	293	684	659	635	586	538

P CAROLINA 2 CAROLINA POWER & LIGHT DER=1250MW FLD=1996 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED																		0	0	0	24	24

B CARROLL COUNTY 1 COMMONWEALTH EDISON DER=1180MW FLD=1993 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED															0	0	0	29	29	29	29	29
REM STR W/O FCR															556	556	1113	1084	1054	996	938	879
REM STR W FCR															410	410	966	937	908	850	791	733

B CARROLL COUNTY 2 COMMONWEALTH EDISON DER=1180MW FLD=1995 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED																	0	0	0	29	29	29

P CATAWBA 1 DUKE POWER DER=1145MW FLD=1982 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED				0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR				347	347	347	673	652	630	587	536	486	436	378	320	263	205	148	90	32	-25	-83
REM STR W FCR				261	261	261	586	565	543	500	450	399	349	291	234	176	118	61	3	-54	-112	-170

P CATAWBA 2 DUKE POWER DER=1145MW FLD=1985 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED							0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29

P CENTRAL VIRGINIA 1 AMERICAN ELECTRIC COMPANY DER=1250MW FLD=1992 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED														0	0	0	24	24	24	24	32	32
REM STR W/O FCR														391	391	781	757	733	684	635	579	522
REM STR W FCR														293	293	684	659	635	586	538	481	424

P CENTRAL VIRGINIA 2 AMERICAN ELECTRIC COMPANY DER=1250MW FLD=1994 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED																0	0	0	24	24	24	24

P CHEROKEE 1 DUKE POWER DER=1280MW FLD=1989 CORE WT=108MT FUEL STR= 0MT REM CAP=434MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED											0	0	0	27	27	27	27	36	36	36	36	36
REM STR W/O FCR											434	434	1301	1274	1247	1166	1085	995	905	797	689	581
REM STR W FCR											325	325	1193	1166	1139	1058	977	887	797	689	581	473

P CHEROKEE 2 DUKE POWER DER=1280MW FLD=1991 CORE WT=108MT FUEL STR= 0MT REM CAP=434MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED													0	0	0	27	27	27	27	36	36	36

P CHEROKEE 3 DUKE POWER DER=1280MW FLD=1991 CORE WT=108MT FUEL STR= 0MT REM CAP=434MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED													0	0	0	27	27	27	27	36	36	36

B CLINTON 1 ILLINOIS POWER DER= 950MW FLD=1984 CORE WT=118MT FUEL STR= 0MT REM CAP=450MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED						0	0	0	24	24	24	24	24	30	30	30	30	30	30	30	30	30
REM STR W/O FCR						450	450	450	426	403	379	356	782	752	723	670	616	563	510	457	398	338
REM STR W FCR						332	332	332	308	284	261	237	664	634	604	551	498	445	392	338	27[illegible]	220

B CLINTON 2 ILLINOIS POWER DER= 950MW FLD=1991 CORE WT=118MT FUEL STR= 0MT REM CAP=450MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED													0	0	0	24	24	24	24	24	30	30

P COMANCHE PEAK 1 TEXAS UTILITTES GENERATING DER=1150MW FLD=1981 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED			0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR			347	347	347	326	652	630	608	558	508	457	407	349	292	234	176	119	61	4	-54	-112
REM STR W FCR			261	261	261	239	565	543	522	471	421	370	320	262	205	147	90	32	-26	-83	-141	-198

P COMANCHE PEAK 2 TEXAS UTILITTES GENERATING DER=1150MW FLD=1985 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED							0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29

P COOK 1 INDIANA & MICHIGAN ELECTRIC DER=1054MW FLD=1974 CORE WT= 87MT FUEL STR= 58MT REM CAP=167MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	22	22	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR	843	821	792	764	735	706	677	648	620	591	562	533	504	476	447	418	389	360	332	103	274	245
REM STR W FCR	756	734	706	677	648	619	590	562	533	504	475	446	418	389	360	331	302	274	245	16	187	158

P COOK 2 INDIANA & MICHIGAN ELECTRIC DER=1100MW FLD=1977 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR	347	326	304	283	261	232	203	175	146	117	88	59	31	2	-27	-56	-85	-113	-142	-171	-200	-229
REM STR W FCR	261	239	217	196	174	145	117	88	59	30	1	-27	-56	-85	-114	-143	-171	-200	-229	-258	-287	-315

Table F.6. Continued

B COOPER NEBRASKA PUBLIC POWER DISTRICT DER= 778MW FLD=1973 CORE WT=110MT FUEL STR= 57MT REM CAP=416MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	22	22	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
REM STR W/O FCR	394	372	345	318	290	263	235	208	181	153	126	98	71	44	16	-11	-39	-66	-93	-121	-148	-176
REM STR W FCR	285	263	235	208	181	153	126	98	71	44	16	-11	-39	-66	-93	-121	-148	-176	-203	-230	-258	-285

P CRYSTAL RIVER 3 FLORIDA POWER CORP. DER= 825MW FLD=1976 CORE WT= 80MT FUEL STR= 2MT REM CAP=113MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	20	20	20	20	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
REM STR W/O FCR	502	482	462	442	416	389	363	336	310	283	257	230	203	177	150	124	97	71	44	18	-9	-36
REM STR W FCR	422	402	383	363	336	310	283	257	230	203	177	150	124	97	71	44	18	-9	-36	-62	-89	-115

P DAVIS BESSE 1 TOLEDO EDISON DER= 906MW FLD=1976 CORE WT= 80MT FUEL STR= 0MT REM CAP=117MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	20	20	20	20	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
REM STR W/O FCR	311	291	271	252	225	198	172	145	119	92	66	39	13	623	597	570	504	438	372	306	226	146
REM STR W FCR	231	212	192	172	145	119	92	66	39	13	-14	-41	-67	544	517	491	424	358	292	226	146	67

P DAVIS BESSE 2 TOLEDO EDISON DER= 906MW FLD=1992 CORE WT= 80MT FUEL STR= 0MT REM CAP=319MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED														0	0	0	20	20	20	20	27	27

P DAVIS BESSE 3 TOLEDO EDISON DER= 906MW FLD=1992 CORE WT= 80MT FUEL STR= 0MT REM CAP=319MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED														0	0	0	20	20	20	20	27	27

P DIABLO CANYON 1 PACIFIC GAS & ELECTRIC DER=1084MW FLD=1979 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR	695	695	695	652	608	565	522	464	407	349	292	234	176	119	61	4	-54	-112	-169	-227	-284	-342
REM STR W FCR	608	608	608	565	522	478	435	378	320	262	205	147	90	32	-26	-83	-141	-198	-256	-314	-371	-429

P DIABLO CANYON 2 PACIFIC GAS & ELECTRIC DER=1106MW FLD=1979 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29

B DRESDEN 1 COMMONWEALTH EDISON DER= 200MW FLD=1959 CORE WT= 93MT FUEL STR= 44MT REM CAP= 90MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	23	23	23	23	23	23	23	23	23	23	23	93	0	0	0	0	0	0	0	0	0	0
REM STR W/O FCR	1293	1197	1102	1006	910	815	71[illegible]	6[illegible]	528	432	337	172	99	27	-46	-118	-190	-263	-335	-408	-480	-552
REM STR W FCR	1148	1052	957	861	766	670	57[illegible]	47[illegible]	383	288	192	27	-46	-118	-190	-263	-335	-408	-480	-552	-625	-697

B DRESDEN 2 COMMONWEALTH EDISON DER= 794MW FLD=1971 CORE WT=145MT FUEL STR=214MT REM CAP=354MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36

B DRESDEN 3 COMMONWEALTH EDISON DER= 794MW FLD=1970 CORE WT=145MT FUEL STR= 0MT REM CAP= 0MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36

B DUANE ARNOLD IOWA ELECTRIC POWER & LIGHT DER= 538MW FLD=1974 CORE WT= 74MT FUEL STR= 55MT REM CAP=355MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	15	15	15	18	18	18	18	13	18	18	18	18	18	18	18	18	18	18	18	18	18	18
REM STR W/O FCR	340	325	310	292	274	255	237	218	200	182	163	145	126	108	90	71	53	34	16	-2	-21	-39
REM STR W FCR	266	252	237	218	200	182	163	145	126	108	90	71	53	34	16	-2	-21	-39	-58	-76	-94	-113

B ENRICO FERMI 2 DETROIT EDISON DER=1123MW FLD=1981 CORE WT=152MT FUEL STR= 0MT REM CAP=579MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED			0	0	0	30	30	30	30	30	38	38	38	38	38	38	38	38	38	38	38	38
REM STR W/O FCR			579	579	579	549	518	488	458	427	389	351	313	274	236	198	160	122	83	45	7	-31
REM STR W FCR			427	427	427	396	366	336	305	275	237	198	160	122	84	46	7	-31	-69	-107	-145	-184

P ERIE 1 OHIO EDISON COMPANY DER=1250MW FLD=1992 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED														0	0	0	24	24	24	24	32	32
REM STR W/O FCR														391	391	781	757	733	684	635	579	522
REM STR W FCR														293	293	684	659	635	586	538	481	424

P ERIE 2 OHIO EDISON COMPANY DER=1250MW FLD=1994 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED																0	0	0	24	24	24	24

P FARLEY 1 ALABAMA POWER COMPANY DER= 829MW FLD=1976 CORE WT= 71MT FUEL STR= 0MT REM CAP=304MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	18	18	18	18	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
REM STR W/O FCR	286	551	534	516	475	434	393	352	306	259	212	165	118	72	25	-22	-69	-116	-162	-209	-256	-303
REM STR W FCR	216	481	463	446	405	364	323	282	235	188	141	95	48	1	-46	-93	-140	-186	-233	-280	-327	-374

P FARLEY 2 ALABAMA POWER COMPANY DER= 829MW FLD=1980 CORE WT= 71MT FUEL STR= 0MT REM CAP=283MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED		0	0	0	18	18	18	18	23	23	23	23	23	23	23	23	23	23	23	23	23	23

B FITZPATRICK POWER AUTHORITY OF STATE OF NEW YORK DER= 821MW FLD=1974 CORE WT=112MT FUEL STR= 54MT REM CAP= 98MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	22	22	22	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
REM STR W/O FCR	328	306	283	255	227	199	171	143	115	87	59	31	3	-25	-53	-81	-109	-137	-165	-193	-221	-249
REM STR W FCR	216	194	171	143	115	87	59	31	3	-25	-53	-81	-109	137	-165	-193	-221	-249	-277	-305	-333	-361

P FORKED RIVER JERSEY CENTRAL POWER & LIGHT DER=1070MW FLD=1987 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED									0	0	0	24	24	24	24	32	32	32	32	32	32	32
REM STR W/O FCR									391	391	391	366	342	318	293	261	229	196	164	131	99	67
REM STR W FCR									293	293	293	269	244	220	196	163	131	99	66	34	1	-31

P FT. CALHOUN OMAHA PUBLIC POWER DISTRICT DER= 457MW FLD=1972 CORE WT= 60MT FUEL STR= 71MT REM CAP=147MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
REM STR W/O FCR	127	107	87	68	48	28	8	-12	-32	-51	-71	-91	-111	-131	-150	-170	-190	-210	-230	-249	-269	-289
REM STR W FCR	67	47	27	8	-12	-32	-52	-72	-91	-111	-131	-151	-171	-190	-210	-230	-250	-270	-289	-309	-329	-349

Table F.6. Continued

P FULTON 1 PHILADELPHIA ELECTRIC DER=1250MW FLD=1994 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED																0	0	0	24	24	24	24
REM STR W/O FCR																391	391	781	757	733	684	635
REM STR W FCR																293	293	684	659	635	586	538

P FULTON 2 PHILADELPHIA ELECTRIC DER=1250MW FLD=1996 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED																		0	0	0	24	24

P GINNA ROCHESTER GAS & ELECTRIC DER= 490MW FLD=1969 CORE WT= 54MT FUEL STR= 70MT REM CAP=198MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	54
REM STR W/O FCR	180	162	144	126	108	90	72	54	36	18	-0	-18	-36	-54	-72	-90	-108	-126	-144	-162	-100	-235
REM STR W FCR	125	107	89	71	53	35	17	-1	-19	-37	-55	-73	-91	-109	-127	-145	-163	-181	-199	-217	-235	-235

B GRAND GULF 1 MISSISSIPPI POWER & LIGHT DER=1250MW FLD=1981 CORE WT=157MT FUEL STR= 0MT REM CAP=596MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED			0	0	0	31	31	31	31	31	39	39	39	39	39	39	39	39	39	39	39	39
REM STR W/O FCR			596	596	596	565	533	502	1066	1035	996	925	855	784	713	643	564	486	408	329	251	172
REM STR W FCR			439	439	439	408	376	345	910	878	839	768	698	627	557	486	408	329	251	172	94	16

B GRAND GULF 2 MISSISSIPPI POWER & LIGHT DER=1250MW FLD=1987 CORE WT=157MT FUEL STR= 0MT REM CAP=596MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED									0	0	0	31	31	31	31	31	39	39	39	39	39	39

P GREEN COUNTY POWER AUTHORITY OF STATE OF NEW YORK DER=1250MW FLD=1994 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED																0	0	0	24	24	24	24
REM STR W/O FCR																391	391	391	366	342	318	293
REM STR W FCR																293	293	293	269	244	220	196

P GREENWOOD 1 DETROIT EDISON DER=1250MW FLD=1992 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED														0	0	0	24	24	24	24	32	32
REM STR W/O FCR														391	391	391	757	733	708	660	603	546
REM STR W FCR														293	293	293	659	635	611	562	505	449

P GREENWOOD 2 DETROIT EDISON DER=1250MW FLD=1995 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED																	0	0	0	24	24	24

P HADDAM NECK CONNECTICUT YANKEE ATOMIC POWER DER= 575MW FLD=1967 CORE WT= 71MT FUEL STR=130MT REM CAP=396MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	71	0	0
REM STR W/O FCR	373	349	326	302	279	256	232	209	185	162	139	115	92	68	45	22	-2	-25	-49	-119	-119	-119
REM STR W FCR	302	279	255	232	208	185	162	138	115	91	68	45	21	-2	-26	-49	-72	-96	-119	-119	-119	-119

P HARRIS 1 CAROLINA POWER & LIGHT DER= 915MW FLD=1987 CORE WT= 71MT FUEL STR= 0MT REM CAP=283MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED									0	0	0	18	18	18	18	23	23	23	23	23	23	23
REM STR W/O FCR									283	283	283	548	1095	1078	1043	967	891	815	733	639	545	452
REM STR W FCR									212	212	212	477	1025	1007	972	896	820	744	662	568	475	381

P HARRIS 2 CAROLINA POWER & LIGHT DER= 915MW FLD=1990 CORE WT= 71MT FUEL STR= 0MT REM CAP=283MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED												0	0	0	18	18	18	18	23	23	23	23

P HARRIS 3 CAROLINA POWER & LIGHT DER= 915MW FLD=1991 CORE WT= 71MT FUEL STR= 0MT REM CAP=283MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED													0	0	0	18	18	18	18	23	23	23

P HARRIS 4 CAROLINA POWER & LIGHT DER= 915MW FLD=1991 CORE WT= 71MT FUEL STR= 0MT REM CAP=283MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED													0	0	0	18	18	18	18	23	23	23

B HARTSVILLE A-1 TENNESSEE VALLEY AUTHORITY DER=1205MW FLD=1984 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED						0	0	0	29	29	29	29	29	37	37	37	37	37	37	37	37	37
REM STR W/O FCR						556	1113	1669	2196	2138	2050	1934	1817	1693	1561	1422	1276	1129	983	836	690	544
REM STR W FCR						410	966	1523	2050	1992	1904	1787	1670	1546	1415	1276	1129	983	836	690	544	397

B HARTSVILLE A-2 TENNESSEE VALLEY AUTHORITY DER=1205MW FLD=1986 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED								0	0	0	29	29	29	29	29	37	37	37	37	37	37	37

B HARTSVILLE B-1 TENNESSEE VALLEY AUTHORITY DER=1205MW FLD=1985 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED							0	0	0	29	29	29	29	29	37	37	37	37	37	37	37	37

B HARTSVILLE B-2 TENNESSEE VALLEY AUTHORITY DER=1205MW FLD=1987 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED									0	0	0	29	29	29	29	29	37	37	37	37	37	37

B HATCH 1 GEORGIA POWER DER= 717MW FLD=1974 CORE WT=112MT FUEL STR= 52MT REM CAP=116MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	22	22	22	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
REM STR W/O FCR	318	295	250	200	150	99	49	-7	-63	-119	-175	-231	-287	-343	-399	-455	-511	-567	-623	-679	-735	-791
REM STR W FCR	206	183	138	88	38	-13	-63	-119	-175	-231	-287	-343	-399	-455	-511	-567	-623	-679	-735	-791	-847	-903

B HATCH 2 GEORGIA POWER DER= 822MW FLD=1978 CORE WT=112MT FUEL STR= 0MT REM CAP=224MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	0	0	22	22	22	22	22	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28

P HAVEN WISCONSIN ELECTRIC POWER DER=1250MW FLD=1995 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED																	0	0	0	24	24	24
REM STR W/O FCR																	391	391	391	366	342	318
REM STR W FCR																	293	293	293	269	244	220

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Table F.6. Continued

B HOPE CREEK 1 PUBLIC SERVIC GAS & ELECTRIC OF NJ DER=1067MW FLD=1988 CORE WT=153MT FUEL STR= 0MT REM CAP=581MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED										0	0	0	31	31	31	31	31	38	38	38	38	38
REM STR W/O FCR										581	581	1162	1131	1100	1039	978	917	848	779	703	626	550
REM STR W FCR										428	428	1009	978	948	886	825	764	695	626	550	474	397

B HOPE CREEK 2 PUBLIC SERVIC GAS & ELECTRIC OF NJ DER=1067MW FLD=1990 CORE WT=153MT FUEL STR= 0MT REM CAP=581MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED												0	0	0	31	31	31	31	31	38	38	38

B HUMBOLDT BAY PACIFIC GAS & ELECTRIC DER= 65MW FLD=1962 CORE WT= 34MT FUEL STR= 50MT REM CAP= 47MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	9	9	9	9	9	9	9	9	9	9	9	9	9	9	34	0	0	0	0	0	0	0
REM STR W/O FCR	39	30	21	13	4	-4	-13	-22	-30	-39	-47	-56	-65	-73	-108	-108	-108	-108	-108	-108	-108	-108
REM STR W FCR	4	-4	-13	-22	-30	-39	-47	-56	-65	-73	-82	-90	-99	-108	-108	-108	-108	-108	-108	-108	-108	-108

P INDIAN POINT 1 CONSOLIDATED EDISON DER= 0MW FLD=1961 CORE WT= 0MT FUEL STR= 72MT REM CAP=301MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REM STR W/O FCR	301	301	301	301	301	301	301	301	301	301	301	301	301	301	301	301	301	301	301	301	301	301
REM STR W FCR	301	301	301	301	301	301	301	301	301	301	301	301	301	301	301	301	301	301	301	301	301	301

P INDIAN POINT 2 CONSOLIDATED EDISON DER= 873MW FLD=1972 CORE WT= 87MT FUEL STR= 59MT REM CAP=158MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR	129	100	71	42	14	-15	-44	-73	-102	-131	-159	-188	-217	-246	-275	-303	-332	-361	-390	-419	-447	-476
REM STR W FCR	42	13	-16	-45	-73	-102	-131	-160	-189	-217	-246	-275	-304	-333	-361	-390	-419	-448	-477	-505	-534	-563

P INDIAN POINT 3 CONSOLIDATED EDISON DER= 873MW FLD=1975 CORE WT= 87MT FUEL STR= 29MT REM CAP=348MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR	326	305	283	254	225	197	168	139	110	81	53	24	-5	-34	-63	-91	-120	-149	-178	-207	-235	-264
REM STR W FCR	239	218	196	167	139	110	81	52	23	-5	-34	-63	-92	-121	-149	-178	-207	-236	-265	-293	-322	-351

P JAMESPORT 1 LONG ISLAND LIGHTING DER=1250MW FLD=1992 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED														0	0	0	24	24	24	24	32	32
REM STR W/O FCR														391	391	391	757	733	708	660	603	546
REM STR W FCR														293	293	293	659	635	611	562	505	449

P JAMESPORT 2 LONG ISLAND LIGHTING DER=1250MW FLD=1995 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED																	0	0	0	24	24	24

P KEWAUNEE WISCONSIN PUBLIC SERVICE DER= 535MW FLD=1973 CORE WT= 54MT FUEL STR= 54MT REM CAP= 22[illegible]

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	14	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
REM STR W/O FCR	378	360	342	324	306	288	270	252	234	216	198	180	162	144	126	108	90	72	54	36	18	0
REM STR W FCR	324	306	288	270	252	234	216	198	180	162	144	126	108	90	72	54	36	18	-0	-18	-36	-54

B LACROSSE DAIRYLAND POWER DER= 50MW FLD=1968 CORE WT= 14MT FUEL STR= 23MT REM CAP= 4MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	14	0
REM STR W/O FCR	62	58	55	51	47	44	40	37	33	29	26	22	19	15	11	8	4	1	-3	-7	-21	-21
REM STR W FCR	47	44	40	37	33	29	26	22	19	15	11	8	4	1	-3	-7	-10	-14	-17	-21	-21	-21

B LASALLE 1 COMMONWEALTH EDISON DER=1078MW FLD=1979 CORE WT=153MT FUEL STR= 0MT REM CAP=581MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	0	0	0	31	31	31	31	31	38	38	38	38	38	38	38	38	38	38	38	38	38	38
REM STR W/O FCR	581	1162	1162	1131	1070	1009	947	886	817	741	665	588	512	435	359	283	206	130	53	-23	-99	-176
REM STR W FCR	428	1009	1009	978	917	856	795	733	665	588	512	435	359	283	206	130	53	-23	-99	-176	-252	-329

B LASALLE 2 COMMONWEALTH EDISON DER=1078MW FLD=1980 CORE WT=153MT FUEL STR= 0MT REM CAP=581MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED		0	0	0	31	31	31	31	31	38	38	38	38	38	38	38	38	38	38	38	38	38

B LIMERICK 1 PHILADELPHIA ELECTRIC DER=1065MW FLD=1986 CORE WT=153MT FUEL STR= 0MT REM CAP=581MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED								0	0	0	31	31	31	31	31	38	38	38	38	38	38	38
REM STR W/O FCR								581	581	581	1131	1100	1070	1039	947	879	810	741	665	588	512	435
REM STR W FCR								428	428	428	978	948	917	856	795	726	657	588	512	435	359	283

B LIMERICK 2 PHILADELPHIA ELECTRIC DER=1065MW FLD=1989 CORE WT=153MT FUEL STR= 0MT REM CAP=581MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED											0	0	0	31	31	31	31	31	38	38	38	38

P MAINE YANKEE MAINE YANKEE ATOMIC POWER DER= 790MW FLD=1971 CORE WT= 98MT FUEL STR=195MT REM CAP=234MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
REM STR W/O FCR	202	169	137	104	72	40	7	-25	-58	-90	-122	-155	-187	-220	-252	-284	-317	-349	-382	-414	-446	-479
REM STR W FCR	104	72	39	7	-26	-58	-90	-123	-155	-188	-220	-252	-285	-317	-350	-382	-414	-447	-479	-512	-544	-576

P MARBLE HILL 1 PUBLIC SERVICE OF INDIANA DER=1130MW FLD=1984 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED						0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR						347	347	347	673	652	630	587	536	486	436	378	320	263	205	148	90	32
REM STR W FCR						261	261	261	586	565	543	500	450	399	349	291	234	176	118	61	3	-54

P MARBLE HILL 2 PUBLIC SERVICE OF INDIANA DER=1130MW FLD=1987 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED									0	0	0	22	22	22	22	29	29	29	29	29	29	29

P MCGUIRE 1 DUKE POWER DER=1180MW FLD=1979 CORE WT= 71MT FUEL STR= 0MT REM CAP=283MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	0	0	0	18	18	18	18	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
REM STR W/O FCR	283	283	283	612	595	577	538	493	448	403	351	299	247	194	142	90	38	-14	-67	-119	-171	-223
REM STR W FCR	212	212	212	526	508	491	451	406	361	316	264	212	160	108	55	3	-49	-101	-153	-206	-258	-310

P MCGUIRE 2 DUKE POWER DER=1180MW FLD=1982 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED				0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29

Table F.6. Continued

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P MIDLAND 1         CONSUMERS POWER                          DER= 492MW  FLD=1983  CORE WT= 80MT  FUEL STR=  0MT  REM CAP=319MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                               0    0    0   20   20   20   20   27   27   27   27   27   27   27   27   27   27   27
REM STR W/O FCR                           637  637  617  578  538  499  452  399  346  293  240  187  134   81   27  -26  -79 -132
REM STR W FCR                             558  558  538  498  459  419  373  320  266  213  160  107   54    1  -52 -105 -158 -212

P MIDLAND 2         CONSUMERS POWER                          DER= 887MW  FLD=1982  CORE WT= 80MT  FUEL STR=  0MT  REM CAP=319MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                          0    0    0   20   20   20   20   27   27   27   27   27   27   27   27   27   27   27   27

B MILLSTONE 1       NORTHEAST NUCLEAR ENERGY                 DER= 660MW  FLD=1970  CORE WT=116MT  FUEL STR=126MT  REM CAP=311MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29
REM STR W/O FCR     282  253  224  195  166  137  108   79   50   21   -8  -37  -66  -95 -124 -153 -182 -211 -240 -269 -298 -327
REM STR W FCR       166  137  108   79   50   21   -8  -37  -66  -95 -124 -153 -182 -211 -240 -269 -298 -327 -356 -385 -414 -443

P MILLSTONE 2       NORTHEAST NUCLEAR ENERGY                 DER= 830MW  FLD=1974  CORE WT= 98MT  FUEL STR= 32MT  REM CAP=268MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        24   24   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32
REM STR W/O FCR     243  219  187  154  122   90   57   25   -8  -40  -72  243  210  178  124   70   16  -38  -99 -161 -222 -283
REM STR W FCR       146  122   89   57   24   -8  -41  -73 -105 -138 -170  156  123   91   37  -17  -71 -125 -186 -248 -309 -370

P MILLSTONE 3       NORTHEAST NUCLEAR ENERGY                 DER=1159MW  FLD=1990  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                 0    0    0   22   22   22   22   29   29   29   29

B MONTAGUE 1        NORTHEAST NUCLEAR ENERGY                 DER=1180MW  FLD=1993  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                0    0    0   29   29   29   29   29
REM STR W/O FCR                                                                            556  556 1113 1084 1054  996  938  879
REM STR W FCR                                                                              410  410  966  937  908  850  791  733

B MONTAGUE 2        NORTHEAST NUCLEAR ENERGY                 DER=1180MW  FLD=1995  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                          0    0    0   29   29   29

B MONTICELLO        NORTHERN STATES POWER                    DER= 545MW  FLD=1970  CORE WT= 97MT  FUEL STR=12[illegible]MT  REM CAP=324MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        24   24   24   24   24   24   24   24   24   24   24   24   24   24   24   24   24   24   24   24   24   24
REM STR W/O FCR     300  276  252  227  203  179  155  131  106   82   58   34   10  -15  -39  -63  -87 -111 -136 -160 -184 -208
REM STR W FCR       203  179  155  131  106   82   58   34   10  -15  -39  -63  -87 -111 -136 -160 -184 -208 -232 -257 -281 -305

P NEW ENGLAND 1     NEW ENGLAND POWER & LIGHT                DER=1250MW  FLD=1993  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                0    0    0   24   24   24   24   32
REM STR W/O FCR                                                                            391  391  781  757  733  684  635  579
REM STR W FCR                                                                              293  293  684  659  635  586  538  481

P NEW ENGLAND 2     NEW ENGLAND POWER & LIGHT                DER=1250MW  FLD=1995  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                          0    0    0   24   24   24

P NEW YORK 1        NY STATE ELECTRIC & GAS COMPANY          DER=1250MW  FLD=1993  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                0    0    0   24   24   24   24   32
REM STR W/O FCR                                                                            391  391  781  757  733  684  635  579
REM STR W FCR                                                                              293  293  684  659  635  586  538  481

P NEW YORK 2        NY STATE ELECTRIC & GAS COMPANY          DER=1250MW  FLD=1995  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                          0    0    0   24   24   24

B NINE MILE POINT 1   NIAGARA MOHAWK POWER                   DER= 610MW  FLD=1968  CORE WT=106MT  FUEL STR=132MT  REM CAP=265MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27  106    0
REM STR W/O FCR     443  417  390  363  337  310  284  257  230  204  758  731  705  648  590  533  476  419  354  289  145  106
REM STR W FCR       337  310  284  257  230  204  177  151  124   97  652  625  598  541  484  427  370  266  201  136   -8  -46

B NINE MILE POINT 2   NIAGARA MOHAWK POWER                   DER=1080MW  FLD=1989  CORE WT=153MT  FUEL STR=  0MT  REM CAP=581MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                            0    0    0   31   31   31   31   31   38   38   38   38

P NORTH ANNA 1      VIRGINIA ELECTRIC & POWER                DER= 907MW  FLD=1977  CORE WT= 71MT  FUEL STR=  0MT  REM CAP=180MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED         0   18   18   18   18   23   23   23   23   23   23   23   23   23   23   23   23   23   23   23   23   23
REM STR W/O FCR     717  700  682  647  873  832  791  989  926  863  784  699  615  530  440  350  260  170   80  -10 -100 -190
REM STR W FCR       647  629  612  576  802  761  720  918  855  792  713  629  544  459  369  279  189   99    9  -81 -165 -255

P NORTH ANNA 2      VIRGINIA ELECTRIC & POWER                DER= 943MW  FLD=1979  CORE WT= 71MT  FUEL STR=  0MT  REM CAP=283MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED         0    0    0   18   18   18   18   23   23   23   23   23   23   23   23   23   23   23   23   23   23   23

P NORTH ANNA 3      VIRGINIA ELECTRIC & POWER                DER= 907MW  FLD=1983  CORE WT= 65MT  FUEL STR=  0MT  REM CAP=261MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                               0    0    0   16   16   16   16   22   22   22   22   22   22   22   22   22   22   22

P NORTH ANNA 4      VIRGINIA ELECTRIC & POWER                DER= 907MW  FLD=1986  CORE WT= 65MT  FUEL STR=  0MT  REM CAP=261MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                              0    0    0   16   16   16   16   22   22   22   22   22   22   22   22

P OCONEE 1          DUKE POWER                               DER= 887MW  FLD=1972  CORE WT= 80MT  FUEL STR=220MT  REM CAP=127MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27
REM STR W/O FCR      61  -19  -99 -178 -258 -338 -417 -497 -576 -656 -736 -815 -895 -975-1054-1134-1214-1293-1373-1453-1532-1612
REM STR W FCR       -19  -99 -178 -258 -338 -417 -497 -576 -656 -736 -815 -895 -975-1054-1134-1214-1293-1373-1453-1532-1612-1692

P OCONEE 2          DUKE POWER                               DER= 887MW  FLD=1973  CORE WT= 80MT  FUEL STR=  0MT  REM CAP=  0MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        20   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27

P OCONEE 3          DUKE POWER                               DER= 887MW  FLD=1973  CORE WT= 80MT  FUEL STR=  0MT  REM CAP=  0MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        20   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27
```

Table F.6. Continued

B OYSTER CREEK JERSEY CENTRAL POWER & LIGHT DER= 650MW FLD=1968 CORE WT=112MT FUEL STR=124MT REM CAP=236MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	112	0
REM STR W/O FCR	208	180	152	124	96	68	40	12	-16	-44	-72	-100	-128	-156	-184	-212	-240	-268	-296	-324	-436	-436
REM STR W FCR	96	68	40	12	-16	-44	-72	-100	-128	-156	-184	-212	-240	-268	-296	-324	-352	-380	-408	-436	-436	-436

P PALISADES CONSUMERS POWER DER= 805MW FLD=1970 CORE WT= 92MT FUEL STR=123MT REM CAP=236MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
REM STR W/O FCR	206	175	144	114	83	53	22	-9	-39	-70	-100	-131	-162	-192	-223	-253	-284	-315	-345	-376	-406	-437
REM STR W FCR	114	83	53	22	-9	-39	-70	-100	-131	-162	-192	-223	-253	-284	-315	-345	-376	-406	-437	-468	-498	-529

P PALO VERDE 1 ARIZONA PUBLIC SERVICE DER=1270MW FLD=1983 CORE WT=108MT FUEL STR= 0MT REM CAP=434MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED					0	0	0	27	27	27	27	36	36	36	36	36	36	36	36	36	36	36
REM STR W/O FCR					434	434	434	407	380	787	760	1157	1094	1031	1332	1242	1143	1410	1278	1146	989	824
REM STR W FCR					325	325	325	298	271	678	651	1049	986	923	1234	1144	1045	1313	1180	1048	891	727

P PALO VERDE 2 ARIZONA PUBLIC SERVICE DER=1270MW FLD=1988 CORE WT=108MT FUEL STR= 0MT REM CAP=434MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED										0	0	0	27	27	27	27	36	36	36	36	36	36

P PALO VERDE 3 ARIZONA PUBLIC SERVICE DER=1270MW FLD=1990 CORE WT=108MT FUEL STR= 0MT REM CAP=434MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED												0	0	0	27	27	27	27	36	36	36	36

P PALO VERDE 4 ARIZONA PUBLIC SERVICE DER=1250MW FLD=1993 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED															0	0	0	24	24	24	24	32

P PALO VERDE 5 ARIZONA PUBLIC SERVICE DER=1250MW FLD=1996 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED																		0	0	0	24	24

B PEACH BOTTOM 2 PHILADELPHIA ELECTRIC DER=1065MW FLD=1973 CORE WT=153MT FUEL STR=124MT REM CAP=440MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	31	31	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38
REM STR W/O FCR	854	792	716	640	563	487	410	334	258	181	105	28	-48	-124	-201	-277	-354	-430	-506	-583	-659	-736
REM STR W FCR	701	640	563	487	410	334	258	181	105	28	-48	-124	-201	-277	-354	-430	-506	-583	-659	-736	-812	-888

B PEACH BOTTOM 3 PHILADELPHIA ELECTRIC DER=1065MW FLD=1973 CORE WT=153MT FUEL STR= 88MT REM CAP=475MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	31	31	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38

P PEBBLE SPRINGS 1 PORTLAND GENERAL ELECTRIC DER=1250MW FLD=1993 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED															0	0	0	24	24	24	24	32
REM STR W/O FCR															391	391	391	757	733	708	660	603
REM STR W FCR															293	293	293	659	635	611	562	505

P PEBBLE SPRINGS 2 PORTLAND GENERAL ELECTRIC DER=1250MW FLD=1996 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED																		0	0	0	24	24

P PERKINS 1 DUKE POWER DER=1250MW FLD=1993 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED															0	0	0	24	24	24	24	32
REM STR W/O FCR															391	391	781	757	1123	1075	1026	945
REM STR W FCR															293	293	684	659	1026	977	928	847

P PERKINS 2 DUKE POWER DER=1250MW FLD=1995 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED																	0	0	0	24	24	24

P PERKINS 3 DUKE POWER DER=1250MW FLD=1997 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED																			0	0	0	24

B PERRY 1 CLEVELAND ELECTRIC & ILLUMINATING DER=1205MW FLD=1985 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED							0	0	0	29	29	29	29	29	37	37	37	37	37	37	37	37
REM STR W/O FCR							556	556	556	1084	1054	1025	967	908	843	777	711	638	565	491	418	345
REM STR W FCR							410	410	410	937	908	879	820	762	696	630	565	491	418	345	272	199

B PERRY 2 CLEVELAND ELECTRIC & ILLUMINATING DER=1205MW FLD=1988 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED										0	0	0	29	29	29	29	29	37	37	37	37	37

B PHIPPS BEND 1 TENNESSEE VALLEY AUTHORITY DER=1220MW FLD=1987 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED									0	0	0	29	29	29	29	29	37	37	37	37	37	37
REM STR W/O FCR									556	556	1113	1084	1054	996	938	879	813	748	674	601	528	455
REM STR W FCR									410	410	966	937	908	850	791	733	667	601	528	455	382	308

B PHIPPS BEND 2 TENNESSEE VALLEY AUTHORITY DER=1220MW FLD=1989 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED											0	0	0	29	29	29	29	29	37	37	37	37

B PILGRIM 1 BOSTON EDISON DER= 655MW FLD=1970 CORE WT=116MT FUEL STR=116MT REM CAP=348MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR	319	290	261	232	203	174	145	116	87	58	29	0	-29	-58	-87	-116	-145	-174	-203	-232	-261	-290
REM STR W FCR	203	174	145	116	87	58	29	0	-29	-58	-87	-116	-145	-174	-203	-232	-261	-290	-319	-348	-377	-406

P PILGRIM 2 BOSTON EDISON DER=1250MW FLD=1996 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED																		0	0	0	24	24
REM STR W/O FCR																		391	391	391	366	342
REM STR W FCR																		293	293	293	269	244

POOR ORIGINAL

Table F.6. Continued

```
P PRAIRIE ISLAND 1     NORTHERN STATES POWER                    DER= 530MW  FLD=1972  CORE WT= 54MT  FUEL STR= 90MT  REM CAP=219MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18
REM STR W/O FCR     188  152  116   80   44    8  -28  -64 -100 -136 -172 -208 -244 -280 -316 -352 -388 -424 -460 -496 -532 -568
REM STR W FCR       133   97   61   25  -11  -47  -83 -119 -155 -191 -227 -263 -299 -335 -371 -407 -443 -479 -515 -551 -587 -623

P PRAIRIE ISLAND 2     NORTHERN STATES POWER                    DER= 530MW  FLD=1973  CORE WT= 54MT  FUEL STR=  0MT  REM CAP=  0MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        14   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18

P PT. BEACH 1          WISCONSIN MICHIGAN ELECTRIC              DER= 497MW  FLD=1969  CORE WT= 54MT  FUEL STR= 81MT  REM CAP= 77MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   54
REM STR W/O FCR     559  523  487  451  415  379  343  307  271  235  199  163  127   91   55   19  -17  -53  -89 -125 -161 -234
REM STR W FCR       504  468  432  396  360  324  288  252  216  180  144  108   72   36    0  -36  -72 -108 -144 -180 -216 -288

P PT. BEACH 2          WISCONSIN MICHIGAN ELECTRIC              DER= 497MW  FLD=1971  CORE WT= 54MT  FUEL STR=  0MT  REM CAP=  0MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18

B QUAD CITIES 1        COMMONWEALTH EDISON                      DER= 789MW  FLD=1972  CORE WT=145MT  FUEL STR= 30MT  REM CAP=262MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        29   73   36   36   36   36   36   36   36   36   36   36   36   36   36   36   36   36   36   36   36   36
REM STR W/O FCR     347  274  202  130   57  -15  -88 -160 -232 -305 -377 -450 -522 -594 -667 -739 -812 -884 -956-1029-1101-1174
REM STR W FCR       202  130   57  -15  -88 -160 -232 -305 -377 -450 -522 -594 -667 -739 -812 -884 -956-1029-1101-1174-1246-1318

B QUAD CITIES 2        COMMONWEALTH EDISON                      DER= 789MW  FLD=1972  CORE WT=145MT  FUEL STR=149MT  REM CAP=143MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        29   36   36   36   36   36   36   36   36   36   36   36   36   36   36   36   36   36   36   36   36   36

P RANCHO SECO          SACRAMENTO MUNICIPAL UTILITIES DISTRICT  DER= 918MW  FLD=1974  CORE WT= 80MT  FUEL STR= 50MT  REM CAP=210MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        20   20   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27
REM STR W/O FCR     190  171  144  117   91   64   38   11  -15  -42  -68  -95 -122 -148 -175 -201 -228 -254 -281 -307 -334 -360
REM STR W FCR       111   91   64   38   11  -15  -42  -68  -95 -122 -148 -175 -201 -228 -254 -281 -307 -334 -360 -387 -414 -440

B RIVER BEND 1         GULF STATES UTILITIES                    DER= 934MW  FLD=1989  CORE WT=118MT  FUEL STR=  0MT  REM CAP=450MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                         0    0    0   24   24   24   24   24   30   30   30   30
REM STR W/O FCR                                                     450  450  450  876  853  829  782  735  682  628  575  516
REM STR W FCR                                                       332  332  332  758  734  711  664  616  563  510  457  398

B RIVER BEND 2         GULF STATES UTILITIES                    DER= 934MW  FLD=1992  CORE WT=118MT  FUEL STR=  0MT  REM CAP=450MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                        0    0    0   24   24   24   24   24   30

P ROBINSON 2           CAROLINA POWER & LIGHT                   DER= 700MW  FLD=1970  CORE WT= 71MT  FUEL STR=135MT  REM CAP=125MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        23   23   23   23   23   23   23   23   23   23   23   23   23   23   23   23   23   23   23   23   23   23
REM STR W/O FCR     101   78   54   31    8  -16  -39  -63  -86 -109 -133 -156 -180 -203 -226 -250 -273 -297 -320 -343 -367 -390
REM STR W FCR        31    7  -16  -40  -63  -86 -110 -133 -157 -180 -203 -227 -250 -274 -297 -320 -344 -367 -391 -414 -437 -461

P SALEM 1              PUBLIC SERVIC GAS & ELECTRIC OF NJ       DER=1090MW  FLD=1976  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=119MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        22   22   22   22   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29
REM STR W/O FCR     852  831  809  766  716  665  615  557  500  442  384  327  269  212  154   96   39  -19  -77 -134 -192 -249
REM STR W FCR       765  744  722  679  629  578  528  470  413  355  297  240  182  125   67    9  -48 -106 -163 -221 -279 -336

P SALEM 2              PUBLIC SERVIC GAS & ELECTRIC OF NJ       DER=1115MW  FLD=1979  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED         0    0    0   22   22   22   22   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29

P SAN ONOFRE 1         SOUTHERN CALIFORNIA EDISON               DER= 436MW  FLD=1967  CORE WT= 71MT  FUEL STR= 26MT  REM CAP= 71MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        23   23   23   23   23   23   23   23   23   23   23   23   23   23   23   23   23   23   23   71    0    0
REM STR W/O FCR      48  415  392  368  711  663  616  544  464  383  303  215  127   39  -50 -138 -226 -314 -402 -538 -603 -667
REM STR W FCR       -23  344  321  270  613  566  518  446  366  286  206  117   29  -59 -147 -235 -324 -412 -500 -635 -673 -738

P SAN ONOFRE 2         SOUTHERN CALIFORNIA EDISON               DER=1140MW  FLD=1980  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED              0    0    0   24   24   24   24   32   32   32   32   32   32   32   32   32   32   32   32   32   32

P SAN ONOFRE 3         SOUTHERN CALIFORNIA EDISON               DER=1140MW  FLD=1983  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                             0    0    0   24   24   24   24   32   32   32   32   32   32   32   32   32   32   32

P SEABROOK 1           PUBLIC SERVICE OF NEW HAMPSHIRE          DER=1194MW  FLD=1986  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                            0    0    0   22   22   22   22   29   29   29   29   29   29   29   29
REM STR W/O FCR                                        347  347  347  673  652  630  587  536  486  436  378  320  263  205  148
REM STR W FCR                                          261  261  261  586  565  543  500  450  399  349  291  234  176  118   61

P SEABROOK 2           PUBLIC SERVICE OF NEW HAMPSHIRE          DER=1194MW  FLD=1989  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHAPGED                                                         0    0    0   22   22   22   22   29   29   29   29   29

P SEQUOYAH 1           TENNESSEE VALLEY AUTHORITY               DER=1140MW  FLD=1979  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED         0    0    0   22   22   22   22   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29
REM STR W/O FCR     347  695  695  673  630  587  544  493  436  378  320  263  205  148   90   32  -25  -83 -140 -198 -256 -313
REM STR W FCR       261  608  608  586  543  500  457  406  349  291  234  176  118   61    3  -54 -112 -170 -227 -285 -342 -400

P SEQUOYAH 2           TENNESSEE VALLEY AUTHORITY               DER=1140MW  FLD=1980  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED         0    0    0   22   22   22   22   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29

B SHOREHAM             LONG ISLAND LIGHTING                     DER= 854MW  FLD=1981  CORE WT=112MT  FUEL STR=  0MT  REM CAP=426MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                   0    0    0   22   22   22   22   22   28   28   28   28   28   28   28   28   28   28   28   28
REM STR W/O FCR                426  426  426  403  381  358  336  314  286  258  230  202  174  146  118   90   62   34    6  -22
REM STR W FCR                  314  314  314  291  269  246  224  202  174  146  118   90   62   34    6  -22  -50  -78 -106 -134
```

Table F.6. Continued

B SKAGIT 1 PUGET SOUND POWER & LIGHT DER=1180MW FLD=1994 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED																0	0	0	29	29	29	29
REM STR W/O FCR																556	556	1113	1084	1054	996	938
REM STR W FCR																410	410	966	937	908	850	791

B SKAGIT 2 PUGET SOUND POWER & LIGHT DER=1180MW FLD=1996 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED																		0	0	0	29	29

P SOUTH TEXAS 1 HOUSTON POWER & LIGHT DER=1250MW FLD=1983 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED					0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR					347	347	347	673	652	630	587	536	486	436	378	320	263	205	148	90	32	-25
REM STR W FCR					261	261	261	586	565	543	500	450	399	349	291	234	176	118	61	3	-54	-112

P SOUTH TEXAS 2 HOUSTON POWER & LIGHT DER=1250MW FLD=1986 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED								0	0	0	22	22	22	22	29	25	29	29	29	29	29	29

P ST LUCIE 1 FLORIDA POWER & LIGHT DER= 802MW FLD=1975 CORE WT= 98MT FUEL STR= 27MT REM CAP=301MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	24	24	24	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
REM STR W/O FCR	276	252	228	195	163	131	489	456	424	367	311	254	197	132	68	3	-62	-127	-192	-257	-321	-386
REM STR W FCR	179	154	130	98	65	33	391	359	326	270	213	156	99	35	-30	-95	-160	-225	-289	-354	-419	-484

P ST LUCIE 2 FLORIDA POWER & LIGHT DER= 842MW FLD=1985 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED							0	0	0	24	24	24	24	32	32	32	32	32	32	32	32	32

B STANISLAUS 1 PACIFIC GAS & ELECTRIC DER=1180MW FLD=1994 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED																0	0	0	29	29	29	29
REM STR W/O FCR																556	556	1113	1084	1054	996	938
REM STR W FCR																410	410	966	937	908	850	791

B STANISLAUS 2 PACIFIC GAS & ELECTRIC DER=1180MW FLD=1996 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED																		0	0	0	29	29

P STERLING 1 ROCHESTER GAS & ELECTRIC DER=1150MW FLD=1991 CORE WT= 80MT FUEL STR= 0MT REM CAP=319MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED													0	0	0	20	20	20	20	27	27	27
REM STR W/O FCR													319	319	319	299	279	259	239	213	186	160
REM STR W FCR													239	239	239	219	199	180	160	133	107	80

P SUMMER 1 SOUTH CAROLINA ELECTRIC & GAS DER= 900MW FLD=1981 CORE WT= 71MT FUEL STR= 0MT REM CAP=283MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED			0	0	0	18	18	18	18	23	23	23	23	23	23	23	23	23	23	23	23	23
REM STR W/O FCR			283	283	283	265	248	230	212	189	166	142	119	95	72	49	25	2	-22	-45	-68	-92
REM STR W FCR			212	212	212	194	177	159	142	118	95	72	48	25	1	-22	-45	-69	-92	-116	-139	-162

P SURRY 1 VIRGINIA ELECTRIC & POWER DER= 822MW FLD=1971 CORE WT= 71MT FUEL STR=156MT REM CAP=274MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
REM STR W/O FCR	227	180	133	86	40	-7	-54	-101	-148	-194	-241	-288	-335	-382	-428	-475	-522	-569	-616	-662	-709	-756
REM STR W FCR	156	109	63	16	-31	-78	-125	-171	-218	-265	-312	-359	-405	-452	-499	-546	-593	-639	-686	-733	-780	-827

P SURRY 2 VIRGINIA ELECTRIC & POWER DER= 822MW FLD=1972 CORE WT= 71MT FUEL STR= 0MT REM CAP= 0MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23

B SUSQUEHANNA 1 PENNSYLVANIA POWER & LIGHT DER=1052MW FLD=1981 CORE WT=153MT FUEL STR= 0MT REM CAP=581MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED			0	0	0	31	31	31	31	31	38	38	38	38	38	38	38	38	38	38	38	38
REM STR W/O FCR			581	581	1162	1131	1100	1039	978	917	848	779	703	626	550	474	397	321	244	168	92	15
REM STR W FCR			428	428	1009	978	948	886	825	764	695	626	550	474	397	321	244	168	92	15	-61	-138

B SUSQUEHANNA 2 PENNSYLVANIA POWER & LIGHT DER=1052MW FLD=1983 CORE WT=153MT FUEL STR= 0MT REM CAP=581MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED					0	0	0	31	31	31	31	31	38	38	38	38	38	38	38	38	38	38

P THREE MILE ISLAND 1 METROPOLITAN EDISON DER= 819MW FLD=1973 CORE WT= 80MT FUEL STR= 72MT REM CAP=266MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	20	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
REM STR W/O FCR	247	220	194	167	140	114	87	61	34	8	-19	-45	-72	-99	-125	-152	-178	-205	-231	-258	-284	-311
REM STR W FCR	167	140	114	87	61	34	8	-19	-45	-72	-99	-125	-152	-178	-205	-231	-258	-284	-311	-338	-364	-391

P THREE MILE ISLAND 2 METROPOLITAN EDISON DER= 906MW FLD=1978 CORE WT= 80MT FUEL STR= 0MT REM CAP=199MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	0	0	20	20	20	20	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
REM STR W/O FCR	199	199	179	159	140	120	93	67	40	14	-13	-40	-66	-93	-119	-146	-172	-199	-225	-252	-279	-305
REM STR W FCR	119	119	99	80	60	40	14	-13	-40	-66	-93	-119	-146	-172	-199	-225	-252	-279	-305	-332	-358	-385

P TROJAN PORTLAND GENERAL ELECTRIC DER=1130MW FLD=1975 CORE WT= 87MT FUEL STR= 29MT REM CAP=264MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR	243	221	199	171	142	113	84	55	27	-2	-31	-60	-89	-117	-146	-175	-204	-233	-261	-290	-319	-348
REM STR W FCR	156	134	113	84	55	26	-3	-32	-60	-89	-118	-147	-176	-204	-233	-262	-291	-320	-348	-377	-406	-435

P TURKEY POINT 3 FLORIDA POWER & LIGHT DER= 693MW FLD=1971 CORE WT= 71MT FUEL STR=156MT REM CAP=124MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
REM STR W/O FCR	77	30	-17	-63	-110	-157	-204	-251	-297	-344	-391	-438	-485	-531	-578	-625	-672	-719	-765	-812	-859	-906
REM STR W FCR	6	-41	-87	-134	-181	-228	-275	-321	-368	-415	-462	-509	-555	-602	-649	-696	-743	-789	-836	-883	-930	-977

P TURKEY POINT 4 FLORIDA POWER & LIGHT DER= 693MW FLD=1972 CORE WT= 71MT FUEL STR= 0MT REM CAP= 0MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23

Table F.6. Continued

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P TYRONE                NORTHERN STATES POWER                     DER=1150MW  FLD=1991  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                 0    0    0   22   22   22   22   29   29   29
REM STR W/O FCR                                                             347  347  347  326  304  283  261  232  203  175
REM STR W FCR                                                               261  261  261  239  217  196  174  145  117   88

B VERMONT YANKEE        VERMONT YANKEE NUCLEAR POWER              DER= 514MW  FLD=1971  CORE WT= 74MT  FUEL STR=179MT  REM CAP=221MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18
REM STR W/O FCR     203  184  166  148  129  111   92   74   56   37   19    0  -18  -36  -55  -73  -92 -110 -128 -147 -165 -184
REM STR W FCR       129  111   92   74   56   37   19    0  -18  -36  -55  -73  -92 -110 -128 -147 -165 -184 -202 -220 -239 -257

P VOGTLE 1              GEORGIA POWER                             DER=1100MW  FLD=1989  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                       0    0    0   22   22   22   22   29   29   29   29   29
REM STR W/O FCR                                                   347  695  695  673  630  587  544  493  436  378  320  263
REM STR W FCR                                                     261  608  608  586  543  500  457  406  349  291  234  176

P VOGTLE 2              GEORGIA POWER                             DER=1100MW  FLD=1990  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                            0    0    0   22   22   22   22   29   29   29   29

P WASHINGTON NUCLEAR 1  WASHINGTON PPSS                           DER=1251MW  FLD=1985  CORE WT= 92MT  FUEL STR=  0MT  REM CAP=369MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                         0    0    0   23   23   23   23   31   31   31   31   31   31   31   31   31
REM STR W/O FCR                                     369  369  369  715  692  669  623  570  516  463  401  340  279  218  157   95
REM STR W FCR                                       277  277  277  623  600  577  531  477  424  370  309  248  187  126   64    3

B WASHINGTON NUCLEAR 2  WASHINGTON PPSS                           DER=1103MW  FLD=1980  CORE WT=153MT  FUEL STR=  0MT  REM CAP=581MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED             0    0    0   31   31   31   31   31   38   38   38   38   38   38   38   38   38   38   38   38   38
REM STR W/O FCR         581  581  581  550  520  489  458  428  390  351  313  275  237  199  160  122   84   46    8  -31  -69
REM STR W FCR           428  428  428  397  367  336  306  275  237  199  160  122   84   46    8  -31  -69 -107 -145 -183 -222

P WASHINGTON NUCLEAR 3  WASHINGTON PPSS                           DER=1242MW  FLD=1987  CORE WT=108MT  FUEL STR=  0MT  REM CAP=434MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                   0    0    0   27   27   27   27   36   36   36   36   36   36   36
REM STR W/O FCR                                               434  434  434  841  814  787  733  670  607  544  472  400  328  256
REM STR W FCR                                                 325  325  325  732  705  678  624  561  498  435  363  291  219  147

P WASHINGTON NUCLEAR 4  WASHINGTON PPSS                           DER=1267MW  FLD=1988  CORE WT= 92MT  FUEL STR=  0MT  REM CAP=369MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                        0    0    0   23   23   23   23   31   31   31   31   31   31

P WASHINGTON NUCLEAR 5  WASHINGTON PPSS                           DER=1242MW  FLD=1990  CORE WT=108MT  FUEL STR=  0MT  REM CAP=434MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                            0    0    0   27   27   27   27   36   36   36   36

P WATERFORD 3           LOUISIANA POWER & LIGHT                   DER=1267MW  FLD=1983  CORE WT= 92MT  FUEL STR=  0MT  REM CAP=369MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                           0    0    0   23   23   23   23   31   31   31   31   31   31   31   31   31   31   31
REM STR W/O FCR                       369  369  369  346  323  300  277  247  216  185  155  124   94   63   32    2  -29  -59
REM STR W FCR                         277  277  277  254  231  208  185  154  124   93   63   32    1  -29  -60  -90 -121 -152

P WATTS BAR 1           TENNESSEE VALLEY AUTHORITY                DER=1165MW  FLD=1980  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED             0    0    0   22   22   22   22   29   29   29   29   29   29   29   29   29   29   29   29   29   29
REM STR W/O FCR         347  695  695  673  630  587  544  493  436  378  320  263  205  148   90   32  -25  -83 -140 -198 -256
REM STR W FCR           261  608  608  586  543  500  437  406  349  291  234  176  118   61    3  -54 -112 -170 -227 -285 -342

P WATTS BAR 2           TENNESSEE VALLEY AUTHORITY                DER=1165MW  FLD=1981  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                  0    0    0   22   22   22   22   29   29   29   29   29   29   29   29   29   29   29   29   29

P WOLF CREEK 1          KANSAS GAS & ELECTRIC                     DER-1150MW  FLD=1986  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                              0    0    0   22   22   22   22   29   29   29   29   29   29   29   29
REM STR W/O FCR                                          347  347  347  326  304  283  261  232  203  175  146  117   88   59   31
REM STR W FCR                                            261  261  261  239  217  196  174  145  117   88   59   30    1  -27  -56

P YANKEE ROWE           YANKEE ATOMIC ELECTRIC                    DER= 175MW  FLD=1960  CORE WT= 34MT  FUEL STR= 67MT  REM CAP=109MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        11   11   11   11   11   11   11   11   11   11   11   11   34    0    0    0    0    0    0    0    0    0
REM STR W/O FCR     246  235  224  212  201  190  179  167  156  145  134  122   88   88   88   88   88   88   88   88   88   88
REM STR W FCR       212  201  189  178  167  156  144  133  122  111   99   88   88   88   88   88   88   88   88   88   88   88

P YELLOW CREEK 1        TENNESSEE VALLEY AUTHORITY                DER=1285MW  FLD=1988  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                        0    0    0   22   22   22   22   29   29   29   29   29   29
REM STR W/O FCR                                                    347  347  695  673  652  608  565  515  464  407  349  292  234
REM STR W FCR                                                      261  261  608  586  565  522  478  428  378  320  262  205  147

P YELLOW CREEK 2        TENNESSEE VALLEY AUTHORITY                DER=1285MW  FLD=1990  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                            0    0    0   22   22   22   22   29   29   29   29

P ZIMMER 1              CINCINNATI GAS & ELECTRIC                 DER= 810MW  FLD=1980  CORE WT=252MT  FUEL STR=  0MT  REM CAP=008MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED             0    0    0   63   63   63   63   84   84   84   84   84   84   84   84   84   84   84   84   84   84
REM STR W/O FCR        1008 1008 1008  945  882  819  756  672  588  504  419  335  251  167   83   -1  -86 -170 -254 -338 -422
REM STR W FCR           756  756  756  693  630  567  504  420  336  252  167   83   -1  -85 -169 -253 -338 -422 -506 -590 -674

P ZION 1                COMMONWEALTH EDISON                       DER=1040MW  FLD=1972  CORE WT= 87MT  FUEL STR=139MT  REM CAP=252MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29
REM STR W/O FCR     761  704  646  589  531  473  416  358  301  243  185  128   70   13  -45 -103 -160 -218 -275 -333 -391 -448
REM STR W FCR       675  617  559  502  444  387  329  271  214  156   99   41  -17  -74 -132 -189 -247 -305 -362 -420 -477 -535

P ZION 2                COMMONWEALTH EDISON                       DER=1040MW  FLD=1973  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=  0MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        22   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29
```

Table F.6. Continued

```
B 230 B                                                               DER=1180MW  FLD=1997  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                                    0    0    0   29
REM STR W/O FCR                                                                                                556  556  556  527
REM STR W FCR                                                                                                  410  410  410  381

B 230 B                                                               DER=1180MW  FLD=1997  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                                    0    0    0   29
REM STR W/O FCR                                                                                                556  556  556  527
REM STR W FCR                                                                                                  410  410  410  381

P 230 P                                                               DER=1250MW  FLD=1997  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                                    0    0    0   24
REM STR W/O FCR                                                                                                391  391  391  366
REM STR W FCR                                                                                                  293  293  293  269

P 230 P                                                               DER=1250MW  FLD=1997  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                                    0    0    0   24
REM STR W/O FCR                                                                                                391  391  391  366
REM STR W FCR                                                                                                  293  293  293  269

P 230 P                                                               DER=1250MW  FLD=1997  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                                    0    0    0   24
REM STR W/O FCR                                                                                                391  391  391  366
REM STR W FCR                                                                                                  293  293  293  269

P 230 P                                                               DER=1250MW  FLD=1997  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                                    0    0    0   24
REM STR W/O FCR                                                                                                391  391  391  366
REM STR W FCR                                                                                                  293  293  293  269
```

Table F.6-A. Summary Alternative 3 (Unlimited Transshipment) Showing Discharges and Remaining Storage for Each Year, with and without FCR (230 GWe Installed in Year 2000)

SUMMARY TOTALS

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
MT DISCHARGED	1427	1524	1642	1852	2097	2298	2443	2650	2847	3051	3296
REM STR W/O FCR	1047	1112	1181	1316	1458	1630	1726	1837	1969	2040	2204
REM STR W FCR	15976	17501	18286	17802	18359	18043	18279	18176	18321	17596	17870

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	3609	3725	3959	4209	4387	4633	4849	5106	5460	5721	5793
REM STR W/O FCR	2421	2418	2479	2539	2566	2710	2887	3023	3157	3244	3278
REM STR W FCR	17047	16086	14808	13050	11153	9887	7962	5247	-146	-5710	-11454

POOR ORIGINAL

Table F.7. Storage (with and without FCR), Discharges, and Pertinent Information for Individual Reactors Used in Data Base for 280 GWe Installed in Year 2000

B ALLENS CREEK HOUSTON POWER & LIGHT DER=1180MW FLD=1990 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED												0	0	0	29	29	29	29	29	37	37	37
REM STR W/O FCR												556	556	556	527	498	469	440	410	374	337	301
REM STR W FCR												410	410	410	381	352	322	293	264	227	191	154

P ARKANSAS 1 ARKANSAS POWER & LIGHT DER= 850MW FLD=1973 CORE WT= 80MT FUEL STR= 50MT REM CAP=215MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	20	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
REM STR W/O FCR	414	387	341	295	248	202	149	96	43	-10	-63	-117	-170	-223	-276	-329	-382	-435	-488	-541	-594	-648
REM STR W FCR	334	308	261	215	169	122	69	16	-37	-90	-143	-196	-249	-302	-356	-409	-462	-515	-568	-621	-674	-727

P ARKANSAS 2 ARKANSAS POWER & LIGHT DER= 950MW FLD=1978 CORE WT= 80MT FUEL STR= 0MT REM CAP=219MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	0	0	20	20	20	20	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27

B BAILLY 1 NORTHERN INDIANA PUBLIC SERVICE DER= 660MW FLD=1985 CORE WT= 89MT FUEL STR= 0MT REM CAP=338MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED							0	0	0	18	18	18	18	18	22	22	22	22	22	22	22	22
REM STR W/O FCR							338	338	338	320	302	284	266	249	226	204	182	160	138	115	93	71
REM STR W FCR							249	249	249	231	213	195	178	160	138	115	93	71	49	27	4	-18

P BEAVER VALLEY 1 DUQUESNE LIGHT DER= 852MW FLD=1975 CORE WT= 71MT FUEL STR= 0MT REM CAP=375MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	18	18	18	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
REM STR W/O FCR	357	340	322	299	275	252	229	488	464	441	400	359	318	277	230	184	137	90	43	-4	-50	-97
REM STR W FCR	287	269	252	228	205	181	158	417	394	370	329	288	248	207	160	113	66	19	-27	-74	-121	-168

P BEAVER VALLEY 2 DUQUESNE LIGHT DER= 852MW FLD=1986 CORE WT= 71MT FUEL STR= 0MT REM CAP=283MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED								0	0	0	18	18	18	18	23	23	23	23	23	23	23	23

P BELLEFONTE 1 TENNESSEE VALLEY AUTHORITY DER=1235MW FLD=1981 CORE WT= 92MT FUEL STR= 0MT REM CAP=369MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED			0	0	0	23	23	23	23	31	31	31	31	31	31	31	31	31	31	31	31	31
REM STR W/O FCR			369	738	738	715	669	623	577	524	463	401	340	279	218	157	95	34	-27	-88	-149	-211
REM STR W FCR			277	646	646	623	577	531	485	432	370	309	248	187	126	64	3	-58	-119	-180	-242	-303

P BELLEFONTE 2 TENNESSEE VALLEY AUTHORITY DER=1235MW FLD=1982 CORE WT= 92MT FUEL STR= 0MT REM CAP=369MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED				0	0	0	23	23	23	23	31	31	31	31	31	31	31	31	31	31	31	31

B BIG ROCK POINT CONSUMERS POWER DER= 72MW FLD=1962 CORE WT= 17MT FUEL STR= 12MT REM CAP= 26MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	4	4	4	4	4	4	4	4	4	4	4	4	4	4	17		0	0	0	0	0	0
REM STR W/O FCR	22	18	14	9	5	1	-3	-7	-12	-16	-20	-24	-28	-33	-49	-49	-49	-49	-49	-49	49	-49
REM STR W FCR	5	1	-3	-7	-12	-16	-20	-24	-28	-33	-37	-41	-45	-49	-49	-49	-49	-49	-49	-49	-49	-49

B BLACK FOX 1 PUBLIC SERVICE OF OKLAHOMA DER=1150MW FLD=1984 CORE WT=153MT FUEL STR= 0MT REM CAP=581MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED						0	0	0	31	31	31	31	31	33	38	38	38	33	33	33	33	35
REM STR W/O FCR						581	581	581	1131	1100	1070	1009	947	879	810	741	665	588	512	435	359	283
REM STR W FCR						428	428	428	978	948	917	856	795	726	657	588	512	435	359	283	206	130

B BLACK FOX 2 PUBLIC SERVICE OF OKLAHOMA DER=1150MW FLD=1987 CORE WT=153MT FUEL STR= 0MT REM CAP=581MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED									0	0	0	31	31	31	31	31	33	33	33	33	33	33

P BRAIDWOOD 1 COMMONWEALTH EDISON DER=1120MW FLD=1981 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED			0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR			347	347	695	673	652	608	565	515	464	407	349	292	234	176	119	61	4	-54	-112	-169
REM STR W FCR			261	261	608	586	565	522	478	428	378	320	262	205	147	90	32	-26	-83	-141	-198	-256

P BRAIDWOOD 2 COMMONWEALTH EDISON DER=1120MW FLD=1983 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED					0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29

B BROWNS FERRY 1 TENNESSEE VALLEY AUTHORITY DER=1065MW FLD=1973 CORE WT=153MT FUEL STR= 65MT REM CAP=629MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	31	31	33	38	33	38	38	38	38	33	38	33	33	33	38	38	38	33	38	38	33	33
REM STR W/O FCR	1858	1766	1667	1560	1453	1338	1224	1109	994	880	765	651	536	421	307	192	78	-37	-152	-266	-381	-495
REM STR W FCR	1705	1613	1514	1407	1300	1185	1071	956	842	727	612	498	383	269	154	39	-75	-190	-304	-419	-534	-648

B BROWNS FERRY 2 TENNESSEE VALLEY AUTHORITY DER=1065MW FLD=1974 CORE WT=153MT FUEL STR= 26MT REM CAP=668MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	31	31	31	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38

B BROWNS FERRY 3 TENNESSEE VALLEY AUTHORITY DER=1065MW FLD=1976 CORE WT=153MT FUEL STR= 42MT REM CAP=653MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	31	31	31	31	31	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38

B BRUNSWICK 1 CAROLINA POWER & LIGHT DER= 821MW FLD=1976 CORE WT=112MT FUEL STR= 29MT REM CAP=389MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	22	22	22	22	22	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
REM STR W/O FCR	344	299	254	204	154	98	42	-14	-70	-126	-182	-238	-294	-350	-406	-462	-518	-574	-630	-686	-742	-798
REM STR W FCR	232	187	142	92	42	-14	-70	-126	-182	-238	-294	-350	-406	-462	-518	-574	-630	-686	-742	-798	-854	-910

B BRUNSWICK 2 CAROLINA POWER & LIGHT DER= 821MW FLD=1974 CORE WT=112MT FUEL STR= 0MT REM CAP= 0MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	22	22	22	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28

P BYRON 1 COMMONWEALTH EDISON DER=1120MW FLD=1981 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED			0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR			347	347	695	673	652	608	565	515	464	407	349	292	234	176	119	61	4	-54	-112	-169
REM STR W FCR			261	261	608	586	565	522	478	428	378	320	262	205	147	90	32	-26	-83	-141	-198	-256

P BYRON 2 COMMONWEALTH EDISON DER=1120MW FLD=1983 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED					0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29

Table F.7. Continued

```
P CALLAWAY 1          UNION ELECTRIC                     DER=1150MW  FLD=1983  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                              0    0    0   22   22   22   22   29   29   29   29   29   29   29   29   29   29   29
REM STR W/O FCR                          347  347  347  326  304  630  603  580  529  479  428  378  320  263  205  148   90   32
REM STR W FCR                            261  261  261  239  217  543  522  493  442  392  342  291  234  176  118   61    3  -54

P CALLAWAY 2          UNION ELECTRIC                     DER=1150MW  FLD=1986  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                   0    0    0   22   22   22   22   29   29   29   29   29   29

P CALVERT CLIFFS 1    BALTIMORE GAS & ELECTRIC           DER= 845MW  FLD=1974  CORE WT= 98MT  FUEL STR=103MT  REM CAP=373MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        24   24   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32
REM STR W/O FCR     324  275  219  162   97   32  -32  -97 -162 -227 -292 -356 -421 -486 -551 -616 -680 -745 -810 -875 -940-1004
REM STR W FCR       226  178  121   64   -0  -65 -130 -195 -260 -324 -389 -454 -519 -584 -648 -713 -778 -843 -908 -972-1037-1102

P CALVERT CLIFFS 2    BALTIMORE GAS & ELECTRIC           DER= 845MW  FLD=1976  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=  0MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        24   24   24   24   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32

P CAROLINA 1          CAROLINA POWER & LIGHT             DER=1250MW  FLD=1991  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                         0    0    0   24   24   24   24   32   32   32
REM STR W/O FCR                                                                     391  391  781  757  733  684  635  579  522  457
REM STR W FCR                                                                       293  293  684  659  635  586  538  481  424  360

P CAROLINA 2          CAROLINA POWER & LIGHT             DER=1250MW  FLD=1993  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                   0    0    0   24   24   24   24   32

B CARROLL COUNTY 1    COMMONWEALTH EDISON                DER=1120MW  FLD=1989  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                        0    0    0   29   29   29   29   29   37   37   37   37
REM STR W/O FCR                                                    555  555 1113 1034 1054  996  938  879  813  748  674  601
REM STR W FCR                                                      410  410  966  937  903  850  791  733  667  601  528  455

B CARROLL COUNTY 2    COMMONWEALTH EDISON                DER=1180MW  FLD=1991  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                         0    0    0   29   29   29   29   29   37   37

P CATAWBA 1           DUKE POWER                         DER=1145MW  FLD=1981  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                0    0    0   22   22   22   22   29   29   29   29   29   29   29   29   29   29   29   29   29
REM STR W/O FCR            347  347  695  673  652  608  565  515  464  407  349  292  234  176  119   61    4  -54 -112 -169
REM STR W FCR              261  261  608  586  565  522  478  428  378  320  262  205  147   90   32  -26  -83 -141 -193 -256

P CATAWBA 2           DUKE POWER                         DER=1145MW  FLD=1983  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                              0    0    0   22   22   22   22   29   29   29   29   29   29   29   29   29   29   29

P CENTRAL VIRGINIA 1  AMERICAN ELECTRIC COMPANY          DER=1250MW  FLD=1989  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                        0    0    0   24   24   24   24   32   32   32   32   32
REM STR W/O FCR                                                    391  391  781  757  733  684  635  579  522  457  392  323
REM STR W FCR                                                      293  293  684  659  635  586  538  481  424  360  295  230

P CENTRAL VIRGINIA 2  AMERICAN ELECTRIC COMPANY          DER=1250MW  FLD=1991  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                         0    0    0   24   24   24   24   32   32   32

P CHEROKEE 1          DUKE POWER                         DER=1280MW  FLD=1986  CORE WT=108MT  FUEL STR=  0MT  REM CAP=434MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                             0    0    0   27   27   27   27   36   36   36   36   36   36   36   36
REM STR W/O FCR                                         434  434 1331 1274 1247 1166 1085  995  905  797  689  581  473  365  257
REM STR W FCR                                           325  325 1193 1166 1139 1058  977  887  797  689  581  473  365  257  149

P CHEROKEE 2          DUKE POWER                         DER=1280MW  FLD=1988  CORE WT=108MT  FUEL STR=  0MT  REM CAP=434MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                   0    0    0   27   27   27   27   36   36   36   36   36   36

P CHEROKEE 3          DUKE POWER                         DER=1280MW  FLD=1988  CORE WT=108MT  FUEL STR=  0MT  REM CAP=434MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                   0    0    0   27   27   27   27   36   36   36   36   36   36

B CLINTON 1           ILLINOIS POWER                     DER= 950MW  FLD=1983  CORE WT=112MT  FUEL STR=  0MT  REM CAP=450MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                              0    0    0   24   24   24   24   24   30   30   30   30   30   30   30   30   30   30
REM STR W/O FCR                          450  450  450  426  403  829  806  782  729  676  622  569  515  457  398  338  279  220
REM STR W FCR                            332  332  332  308  284  711  687  664  610  557  504  451  398  338  279  220  161  102

B CLINTON 2           ILLINOIS POWER                     DER= 950MW  FLD=1988  CORE WT=112MT  FUEL STR=  0MT  REM CAP=450MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                   0    0    0   24   24   24   24   24   30   30   30   30   30

P COMANCHE PEAK 1     TEXAS UTILITIES GENERATING         DER=1150MW  FLD=1980  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED           0    0    0   22   22   22   22   29   29   29   29   29   29   29   29   29   29   29   29   29   29
REM STR W/O FCR       347  347  347  673  652  630  587  536  486  436  378  320  263  205  148   90   32  -25  -83 -140 -198
REM STR W FCR         261  261  261  586  565  543  500  450  399  349  291  234  176  118   61    3  -54 -112 -170 -227 -285

P COMANCHE PEAK 2     TEXAS UTILITIES GENERATING         DER=1150MW  FLD=1983  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                              0    0    0   22   22   22   22   29   29   29   29   29   29   29   29   29   29   29
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POOR
ORIGINAL

Table F.7. Continued

P COOK 1 INDIANA & MICHIGAN ELECTRIC DER=1054MW FLD=1974 CORE WT= 87MT FUEL STR= 53MT REM CAP=167MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	22	22	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR	843	821	792	764	735	706	677	648	620	591	562	533	504	476	447	418	389	360	332	303	274	245
REM STR W FCR	756	734	706	677	648	619	590	562	533	504	475	446	418	389	360	331	302	274	245	216	187	158

P COOK 2 INDIANA & MICHIGAN ELECTRIC DER=1100MW FLD=1977 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR	347	326	304	283	261	232	203	175	146	117	88	59	31	2	-27	-56	-85	-113	-142	-171	-200	-229
REM STR W FCR	261	239	217	196	174	145	116	88	59	30	1	-27	-56	-85	-114	-143	-171	-200	-229	-258	-287	-315

B COOPER NEBRASKA PUBLIC POWER DISTRICT DER= 778MW FLD=1973 CORE WT=110MT FUEL STR= 57MT REM CAP=416MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	22	22	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
REM STR W/O FCR	394	372	345	318	290	263	235	208	181	153	126	98	71	44	16	-11	-39	-66	-93	-121	-148	-176
REM STR W FCR	285	263	235	208	181	153	126	98	71	44	16	-11	-39	-66	-93	-121	-148	-176	-203	-230	-258	-285

P CRYSTAL RIVER 3 FLORIDA POWER CORP. DER= 825MW FLD=1976 CORE WT= 80MT FUEL STR= 2MT REM CAP=113MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	20	20	20	20	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
REM STR W/O FCR	502	482	462	442	416	389	363	336	310	283	257	230	203	177	150	124	97	71	44	18	-9	-36
REM STR W FCR	422	402	383	363	336	310	283	257	230	203	177	150	124	97	71	44	18	-9	-36	-62	-89	-115

P DAVIS BESSE 1 TOLEDO EDISON DER= 906MW FLD=1976 CORE WT= 80MT FUEL STR= 0MT REM CAP=117MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	20	20	20	20	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
REM STR W/O FCR	311	291	271	252	225	198	172	145	119	92	703	676	650	584	518	451	385	305	226	146	67	-13
REM STR W FCR	231	212	192	172	145	119	92	66	39	13	623	597	570	504	438	372	306	226	146	67	-13	-93

P DAVIS BESSE 2 TOLEDO EDISON DER= 906MW FLD=1989 CORE WT= 80MT FUEL STR= 0MT REM CAP=319MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED											0	0	0	20	20	20	20	27	27	27	27	27

P DAVIS BESSE 3 TOLEDO EDISON DER= 906MW FLD=1989 CORE WT= 80MT FUEL STR= 0MT REM CAP=319MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED											0	0	0	20	20	20	20	27	27	27	27	27

P DIABLO CANYON 1 PACIFIC GAS & ELECTRIC DER=1054MW FLD=1979 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR	695	695	695	652	608	565	522	464	407	349	292	234	176	119	61	4	-54	-112	-169	-227	-284	-342
REM STR W FCR	608	608	608	565	522	478	435	378	320	262	205	147	90	32	-26	-83	-141	-198	-256	-314	-371	-429

P DIABLO CANYON 2 PACIFIC GAS & ELECTRIC DER=1106MW FLD=1979 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29

B DRESDEN 1 COMMONWEALTH EDISON DER= 200MW FLD=1959 CORE WT= 93MT FUEL STR= 46MT REM CAP= 90MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	23	23	23	23	23	23	23	23	23	23	23	23	0	0	0	0	0	0	0	0	0	0
REM STR W/O FCR	1293	1197	1102	1006	910	815	719	624	528	432	337	172	99	27	-46	-118	-190	-263	-335	-408	-480	-552
REM STR W FCR	1148	1052	957	861	766	670	574	479	383	288	192	27	-46	-118	-190	-263	-335	-408	-480	-552	-625	-697

B DRESDEN 2 COMMONWEALTH EDISON DER= 794MW FLD=1971 CORE WT=145MT FUEL STR=214MT REM CAP=354MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	36	36	36	36	35	35	36	36	36	36	36	36	35	35	36	35	36	35	36	36	36	36

B DRESDEN 3 COMMONWEALTH EDISON DER= 794MW FLD=1970 CORE WT=145MT FUEL STR= 0MT REM CAP= 0MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	36	36	36	36	36	36	36	36	36	36	36	35	36	36	35	35	35	35	36	35	35	36

B DUANE ARNOLD IOWA ELECTRIC POWER & LIGHT DER= 538MW FLD=1974 CORE WT= 74MT FUEL STR= 55MT REM CAP=355MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	15	15	15	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
REM STR W/O FCR	340	325	310	292	274	255	237	218	200	182	163	145	126	108	90	71	53	34	16	-2	-21	-39
REM STR W FCR	266	252	237	219	200	182	163	145	126	108	90	71	53	34	16	-2	-21	-39	-58	-76	-94	-113

B ENRICO FERMI 2 DETROIT EDISON DER=1123MW FLD=1980 CORE WT=152MT FUEL STR= 0MT REM CAP=579MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED		0	0	0	30	30	30	30	30	38	38	38	38	38	38	38	38	38	38	38	38	38
REM STR W/O FCR		579	579	579	549	518	488	458	427	389	351	313	274	236	198	160	122	83	45	7	-31	-69
REM STR W FCR		427	427	427	396	366	336	305	275	237	198	160	122	84	46	7	-31	-69	-107	-145	-184	-222

P ERIE 1 OHIO EDISON COMPANY DER=1250MW FLD=1989 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED											0	0	0	24	24	24	24	32	32	32	32	32
REM STR W/O FCR											391	391	781	757	733	684	635	579	522	457	392	328
REM STR W FCR											293	293	684	659	635	586	538	481	424	360	295	230

P ERIE 2 OHIO EDISON COMPANY DER=1250MW FLD=1991 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED													0	0	0	24	24	24	24	32	32	32

P FARLEY 1 ALABAMA POWER COMPANY DER= 829MW FLD=1976 CORE WT= 71MT FUEL STR= 0MT REM CAP=304MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	18	18	18	18	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
REM STR W/O FCR	286	551	534	516	475	434	393	352	306	259	212	165	118	72	25	-22	-69	-116	-162	-209	-256	-303
REM STR W FCR	216	481	463	446	405	364	323	282	235	188	141	95	48	1	-46	-93	-140	-186	-233	-280	-327	-374

P FARLEY 2 ALABAMA POWER COMPANY DER= 829MW FLD=1980 CORE WT= 71MT FUEL STR= 0MT REM CAP=283MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED		0	0	0	18	18	18	18	23	23	23	23	23	23	23	23	23	23	23	23	23	23

B FITZPATRICK POWER AUTHORITY OF STATE OF NEW YORK DER= 821MW FLD=1974 CORE WT=112MT FUEL STR= 54MT REM CAP= 98MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	22	22	22	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
REM STR W/O FCR	328	306	283	255	227	199	171	143	115	87	59	31	3	-25	-53	-81	-109	-137	-165	-193	-221	-249
REM STR W FCR	216	194	171	143	115	87	59	31	3	-25	-53	-81	-109	-137	-165	-193	-221	-249	-277	-305	-333	-361

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Table F.7. Continued

P FORKED RIVER JERSEY CENTRAL POWER & LIGHT DER=1070MW FLD=1985 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED							0	0	0	24	24	24	24	32	32	32	32	32	32	32	32	32
REM STR W/O FCR							391	391	391	366	342	318	293	261	229	196	164	131	99	67	34	2
REM STR W FCR							293	293	293	269	244	220	196	163	131	99	66	34	1	-31	-63	-96

P FT. CALHOUN OMAHA PUBLIC POWER DISTRICT DER= 457MW FLD=1972 CORE WT= 60MT FUEL STR= 71MT REM CAP=147MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
REM STR W/O FCR	127	107	87	68	48	28	8	-12	-32	-51	-71	-91	-111	-131	-150	-170	-190	-210	-230	-249	-269	-289
REM STR W FCR	67	47	27	8	-12	-32	-52	-72	-91	-111	-131	-151	-171	-190	-210	-230	-250	-270	-289	-309	-329	-349

P FULTON 1 PHILADELPHIA ELECTRIC DER=1250MW FLD=1991 CORE WT= 93MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED													0	0	0	24	24	24	24	32	32	32
REM STR W/O FCR													391	781	781	757	703	660	611	554	490	425
REM STR W FCR													293	684	634	659	611	562	513	457	392	327

P FULTON 2 PHILADELPHIA ELECTRIC DER=1250MW FLD=1992 CORE WT= 93MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED														0	0	0	24	24	24	24	32	32

P GINNA ROCHESTER GAS & ELECTRIC DER= 490MW FLD=1969 CORE WT= 54MT FUEL STR= 70MT REM CAP=193MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	54
REM STR W/O FCR	180	162	144	126	108	90	72	54	36	18	-0	-18	-36	-54	-72	-90	-108	-126	-144	-162	-180	-235
REM STR W FCR	125	107	89	71	53	35	17	-1	-19	-37	-55	-73	-91	-109	-127	-145	-163	-181	-199	-217	-235	-235

B GRAND GULF 1 MISSISSIPPI POWER & LIGHT DER=1250MW FLD=1981 CORE WT=157MT FUEL STR= 0MT REM CAP=596MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED			0	0	0	31	31	31	31	31	39	39	39	39	39	39	39	39	39	39	39	39
REM STR W/O FCR			596	596	596	565	1129	1098	1036	1004	933	862	792	721	643	564	486	408	329	251	172	94
REM STR W FCR			439	439	439	408	972	941	910	847	776	706	635	564	486	408	329	251	172	94	16	-63

B GRAND GULF 2 MISSISSIPPI POWER & LIGHT DER=1250MW FLD=1985 CORE WT=157MT FUEL STR= 0MT REM CAP=596MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED							0	0	0	31	31	31	31	31	39	39	39	39	39	39	39	39

P GREEN COUNTY POWER AUTHORITY OF STATE OF NEW YORK DER=1250MW FLD=1993 CORE WT= 93MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED															0	0	0	24	24	24	24	32
REM STR W/O FCR															391	391	391	366	342	318	293	261
REM STR W FCR															293	293	293	269	244	220	196	163

P GREENWOOD 1 DETROIT EDISON DER=1250MW FLD=1989 CORE WT= 93MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED											0	0	0	24	24	24	24	32	32	32	32	32
REM STR W/O FCR											391	391	781	757	733	684	635	579	522	457	392	323
REM STR W FCR											293	293	684	659	635	586	533	431	424	360	295	230

P GREENWOOD 2 DETROIT EDISON DER=1250MW FLD=1991 CORE WT= 95MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED													0	0	0	24	24	24	24	32	32	32

P HADDAM NECK CONNECTICUT YANKEE ATOMIC POWER DER= 575MW FLD=1967 CORE WT= 71MT FUEL STR=130MT REM CAP=396MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	71	0	0
REM STR W/O FCR	373	349	326	302	279	255	232	209	185	162	139	115	92	68	45	22	-2	-25	-49	-119	-119	-119
REM STR W FCR	302	279	255	232	208	185	162	138	115	91	68	45	21	-2	-26	-49	-72	-96	-119	-119	-119	-119

P HARRIS 1 CAROLINA POWER & LIGHT DER= 915MW FLD=1985 CORE WT= 71MT FUEL STR= 0MT REM CAP=283MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED							0	0	0	18	18	18	18	23	23	23	23	23	23	23	23	23
REM STR W/O FCR							283	283	565	1113	1095	1060	990	914	838	755	662	569	475	382	288	194
REM STR W FCR							212	212	495	1042	1025	990	919	843	767	685	592	498	405	311	217	124

P HARRIS 2 CAROLINA POWER & LIGHT DER= 915MW FLD=1987 CORE WT= 71MT FUEL STR= 0MT REM CAP=283MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED									0	0	0	18	18	18	18	23	23	23	23	23	23	23

P HARRIS 3 CAROLINA POWER & LIGHT DER= 915MW FLD=1988 CORE WT= 71MT FUEL STR= 0MT REM CAP=283MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED										0	0	0	18	18	18	18	23	23	23	23	23	23

P HARRIS 4 CAROLINA POWER & LIGHT DER= 915MW FLD=1988 CORE WT= 71MT FUEL STR= 0MT REM CAP=283MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED										0	0	0	18	18	18	18	23	23	23	23	23	23

B HARTSVILLE A-1 TENNESSEE VALLEY AUTHORITY DER=1205MW FLD=1982 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED				0	0	0	29	29	29	29	29	37	37	37	37	37	37	37	37	37	37	37
REM STR W/O FCR				556	556	1669	2196	2167	2080	1963	1846	1722	1598	1459	1312	1166	1019	873	727	580	434	287
REM STR W FCR				410	410	1523	2050	2021	1933	1816	1700	1575	1451	1312	1166	1019	873	727	580	434	287	141

B HARTSVILLE A-2 TENNESSEE VALLEY AUTHORITY DER=1205MW FLD=1984 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED						0	0	0	29	29	29	29	29	37	37	37	37	37	37	37	37	37

B HARTSVILLE B-1 TENNESSEE VALLEY AUTHORITY DER=1205MW FLD=1984 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED						0	0	0	29	29	29	29	29	37	37	37	37	37	37	37	37	37

B HARTSVILLE B-2 TENNESSEE VALLEY AUTHORITY DER=1205MW FLD=1985 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED							0	0	0	29	29	29	29	29	37	37	37	37	37	37	37	37

Table F.7. Continued

```
B HATCH 1               GEORGIA POWER                                     DER= 717MW  FLD=1974  CORE WT=112MT  FUEL STR= 52MT  REM CAP=116MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED         22   22   22   28   28   28   28   28   28   28   28   28   28   28   28   28   28   28   28   28   28   28
REM STR W/O FCR      318  295  250  200  150   99   49   -7  -63 -119 -175 -231 -287 -343 -399 -455 -511 -567 -623 -679 -735 -791
REM STR W FCR        206  183  138   88   38  -13  -63 -119 -175 -231 -287 -343 -399 -455 -511 -567 -623 -679 -735 -791 -847 -903

B HATCH 2               GEORGIA POWER                                     DER= 822MW  FLD=1978  CORE WT=112MT  FUEL STR=  0MT  REM CAP=224MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED          0    0   22   22   22   22   22   28   28   28   28   28   28   28   28   28   28   28   28   28   28   28

P HAVEN                 WISCONSIN ELECTRIC POWER                          DER=1250MW  FLD=1991  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                  0    0    0   24   24   24   24   32   32   32
REM STR W/O FCR                                                              391  391  391  366  342  318  293  261  229  196
REM STR W FCR                                                                293  293  293  269  244  220  196  163  131   99

B HOPE CREEK 1          PUBLIC SERVIC GAS & ELECTRIC OF NJ                DER=1067MW  FLD=1986  CORE WT=153MT  FUEL STR=  0MT  REM CAP=581MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                            0    0    0   31   31   31   31   31   38   38   38   38   38   38   38
REM STR W/O FCR                                        581 1162 1162 1131 1070 1009  947  886  817  741  665  588  512  435  359
REM STR W FCR                                          428 1009 1009  978  917  856  795  733  665  588  512  435  359  283  206

B HOPE CREEK 2          PUBLIC SERVIC GAS & ELECTRIC OF NJ                DER=1067MW  FLD=1987  CORE WT=153MT  FUEL STR=  0MT  REM CAP=581MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                 0    0    0   31   31   31   31   31   38   38   38   38   38   38

B HUMBOLDT BAY          PACIFIC GAS & ELECTRIC                            DER=  65MW  FLD=1962  CORE WT= 34MT  FUEL STR= 50MT  REM CAP= 47MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED          9    9    9    9    9    9    9    9    9    9    9    9    9    9   34    0    0    0    0    0    0    0
REM STR W/O FCR       39   30   21   13    4   -4  -13  -22  -30  -39  -47  -56  -65  -73 -108 -108 -108 -108 -108 -108 -108 -108
REM STR W FCR          4   -4  -13  -22  -30  -39  -47  -56  -65  -73  -82  -90  -99 -108 -108 -108 -108 -108 -108 -108 -108 -108

P INDIAN POINT 1        CONSOLIDATED EDISON                               DER=   0MW  FLD=1961  CORE WT=  0MT  FUEL STR= 72MT  REM CAP=301MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED          0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
REM STR W/O FCR      301  301  301  301  301  301  301  301  301  301  301  301  301  301  301  301  301  301  301  301  301  301
REM STR W FCR        301  301  301  301  301  301  301  301  301  301  301  301  301  301  301  301  301  301  301  301  301  301

P INDIAN POINT 2        CONSOLIDATED EDISON                               DER= 873MW  FLD=1972  CORE WT= 87MT  FUEL STR= 59MT  REM CAP=158MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED         29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29
REM STR W/O FCR      129  100   71   42   14  -15  -44  -73 -102 -131 -159 -188 -217 -246 -275 -303 -332 -361 -390 -419 -447 -476
REM STR W FCR         42   13  -16  -45  -73 -102 -131 -160 -189 -217 -246 -275 -304 -333 -361 -390 -419 -448 -477 -505 -534 -563

P INDIAN POINT 3        CONSOLIDATED EDISON                               DER= 873MW  FLD=1975  CORE WT= 87MT  FUEL STR= 29MT  REM CAP=348MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED         22   22   22   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29
REM STR W/O FCR      326  305  283  254  225  197  168  139  110   81   53   24   -5  -34  -63  -91 -120 -149 -178 -207 -235 -264
REM STR W FCR        239  218  196  167  139  110   81   52   23   -5  -34  -63  -92 -121 -149 -178 -207 -236 -265 -293 -322 -351

P JAMESPORT 1           LONG ISLAND LIGHTING                              DER=1250MW  FLD=1990  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                     0    0    0   24   24   24   24   32   32   32   32
REM STR W/O FCR                                                              391  391  781  757  733  684  635  579  522  457  392
REM STR W FCR                                                                293  293  684  659  635  586  538  481  424  360  295

P JAMESPORT 2           LONG ISLAND LIGHTING                              DER=1250MW  FLD=1992  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                               0    0    0   24   24   24   24   32   32

P KEWAUNEE              WISCONSIN PUBLIC SERVICE                          DER= 535MW  FLD=1973  CORE WT= 49MT  FUEL STR= 54MT  REM CAP= 22MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED         14   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18   18
REM STR W/O FCR      373  360  342  324  306  288  270  252  234  216  198  180  162  144  126  108   90   72   54   36   18    0
REM STR W FCR        324  306  288  270  252  234  216  198  180  162  144  126  108   90   72   54   36   18   -0  -18  -36  -54

B LACROSSE              DAIRYLAND POWER                                   DER=  50MW  FLD=1968  CORE WT= 15MT  FUEL STR= 23MT  REM CAP=  4MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED          4    4    4    4    4    4    4    4    4    4    4    4    4    4    4    4    4    4    4    4   14    0
REM STR W/O FCR       62   58   55   51   47   44   40   37   33   29   26   22   19   15   11    8    4    1   -3   -7  -21  -21
REM STR W FCR         47   44   40   37   33   29   26   22   19   15   11    8    4    1   -3   -7  -10  -14  -17  -21  -21  -21

B LASALLE 1             COMMONWEALTH EDISON                               DER=1078MW  FLD=1979  CORE WT=153MT  FUEL STR=  0MT  REM CAP=581MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED          0    0    0   31   31   31   31   31   38   38   38   38   38   38   38   38   38   38   38   38   38   38
REM STR W/O FCR      581 1162 1162 1131 1070 1009  947  886  817  741  665  588  512  435  359  283  206  130   53  -23  -99 -176
REM STR W FCR        428 1009 1009  978  917  856  795  733  665  588  512  435  359  283  206  130   53  -23  -99 -176 -252 -329

B LASALLE 2             COMMONWEALTH EDISON                               DER=1078MW  FLD=1980  CORE WT=153MT  FUEL STR=  0MT  REM CAP=581MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED               0    0    0   31   31   31   31   31   38   38   38   38   38   38   38   38   38   38   38   38   38

B LIMERICK 1            PHILADELPHIA ELECTRIC                             DER=1065MW  FLD=1984  CORE WT=153MT  FUEL STR=  0MT  REM CAP=581MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                  0    0    0   31   31   31   31   31   38   38   38   38   38   38   38   38   38
REM STR W/O FCR                              581  581  581 1131 1100 1070 1009  947  879  810  741  665  588  512  435  359  283
REM STR W FCR                                428  428  428  978  948  917  856  795  726  657  588  512  435  359  283  206  130

B LIMERICK 2            PHILADELPHIA ELECTRIC                             DER=1065MW  FLD=1987  CORE WT=153MT  FUEL STR=  0MT  REM CAP=581MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                 0    0    0   31   31   31   31   31   38   38   38   38   38   38
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Table F.7. Continued

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P MAINE YANKEE       MAINE YANKEE ATOMIC POWER      DER= 790MW  FLD=1971  CORE WT= 98MT  FUEL STR=195MT  REM CAP=234MT
YEAR            1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED     32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32
REM STR W/O FCR  202  169  137  104   72   40    7  -25  -58  -90 -122 -155 -187 -220 -252 -284 -317 -349 -382 -414 -446 -479
REM STR W FCR    104   72   39    7  -26  -58  -90 -123 -155 -183 -220 -252 -285 -317 -350 -382 -414 -447 -479 -512 -544 -576

P MARBLE HILL 1      PUBLIC SERVICE OF INDIANA      DER=1130MW  FLD=1982  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR            1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                       0    0    0   22   22   22   22   29   29   29   29   29   29   29   29   29   29   29   29
REM STR W/O FCR                   347  347  347  673  652  630  587  536  406  436  378  320  263  205  148   90   32  -25  -83
REM STR W FCR                     261  261  261  586  565  543  500  450  399  349  291  234  176  118   61    3  -54 -112 -170

P MARBLE HILL 2      PUBLIC SERVICE OF INDIANA      DER=1130MW  FLD=1985  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR            1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                      0    0    0   22   22   22   22   29   29   29   29   29   29   29   29   29

P MCGUIRE 1          DUKE POWER                     DER=1180MW  FLD=1979  CORE WT= 71MT  FUEL STR=  0MT  REM CAP=283MT
YEAR            1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED      0    0    0   18   18   18   18   23   23   23   23   23   23   23   23   23   23   23   23   23   23   23
REM STR W/O FCR  283  283  630  612  595  556  517  472  427  374  322  270  218  166  113   61    9  -43  -95 -148 -200 -252
REM STR W FCR    212  212  543  526  503  469  430  385  340  288  235  183  131   79   27  -26  -78 -130 -182 -234 -287 -339

P MCGUIRE 2          DUKE POWER                     DER=1180MW  FLD=1981  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR            1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                  0    0    0   22   22   22   22   29   29   29   29   29   29   29   29   29   29   29   29   29

P MIDLAND 1          CONSUMERS POWER                DER= 492MW  FLD=1982  CORE WT= 80MT  FUEL STR=  0MT  REM CAP=319MT
YEAR            1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                       0    0    0   20   20   20   20   27   27   27   27   27   27   27   27   27   27   27   27
REM STR W/O FCR                   637  637  617  578  538  499  452  399  346  293  240  187  134   81   27  -26  -79 -132 -185
REM STR W FCR                     558  558  538  498  459  419  373  320  266  213  160  107   54    1  -52 -105 -158 -212 -265

P MIDLAND 2          CONSUMERS POWER                DER= 887MW  FLD=1981  CORE WT= 80MT  FUEL STR=  0MT  REM CAP=319MT
YEAR            1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                  0    0    0   20   20   20   20   27   27   27   27   27   27   27   27   27   27   27   27   27

B MILLSTONE 1        NORTHEAST NUCLEAR ENERGY       DER= 660MW  FLD=1970  CORE WT=116MT  FUEL STR=126MT  REM CAP=311MT
YEAR            1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED     29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29
REM STR W/O FCR  282  253  224  195  166  137  108   79   50   21   -8  -37  -66  -95 -124 -153 -182 -211 -240 -269 -293 -327
REM STR W FCR    166  137  108   79 [illegible]   21   -8  -37  -66  -95 -124 -153 -182 -211 -240 -269 -298 -327 -356 -385 -414 -443

P MILLSTONE 2        NORTHEAST NUCLEAR ENERGY       DER= 830MW  FLD=1974  CORE WT= 98MT  FUEL STR= 32MT  REM CAP=268MT
YEAR            1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED     24   24   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32   32
REM STR W/O FCR  243  219  187  154  122   90   57   25   -8  307  275  243  189  135   81   27  -35  -96 -157 -218 -279 -341
REM STR W FCR    146  122   89   57   24   -8  -41  -73 -105  221  188  156  102   48   -6  -60 -122 -183 -244 -305 -366 -428

P MILLSTONE 3        NORTHEAST NUCLEAR ENERGY       DER=1159MW  FLD=1988  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR            1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                     0    0    0   22   22   22   22   29   29   29   29   29   29

B MONTAGUE 1         NORTHEAST NUCLEAR ENERGY       DER=1150MW  FLD=1989  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR            1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                          0    0    0   29   29   29   29   29   37   37   37   37
REM STR W/O FCR                                                      556  556 1113 1084 1054  996  933  879  813  748  674  601
REM STR W FCR                                                        410  410  966  937  903  850  791  733  667  601  528  455

B MONTAGUE 2         NORTHEAST NUCLEAR ENERGY       DER=1150MW  FLD=1991  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR            1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                    0    0    0   29   29   29   29   29   37   37

B MONTICELLO         NORTHERN STATES POWER          DER= 545MW  FLD=1970  CORE WT= 97MT  FUEL STR=123MT  REM CAP=324MT
YEAR            1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED     24   24   24   24   24   24   24   24   24   24   24   24   24   24   24   24   24   24   24   24   24   24
REM STR W/O FCR  300  276  252  227  203  179  155  131  106   82   58   34   10  -15  -39  -63  -87 -111 -135 -160 -184 -208
REM STR W FCR    203  179  155  131  106   82   58   34   10  -15  -39  -63  -87 -111 -136 -160 -184 -208 -232 -257 -281 -305

P NEW ENGLAND 1      NEW ENGLAND POWER & LIGHT      DER=1250MW  FLD=1990  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR            1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                               0    0    0   24   24   24   24   32   32   32   32
REM STR W/O FCR                                                           391  391  781  757  733  684  635  579  522  457  392
REM STR W FCR                                                             293  293  684  659  635  586  538  481  424  360  295

P NEW ENGLAND 2      NEW ENGLAND POWER & LIGHT      DER=1250MW  FLD=1992  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR            1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                         0    0    0   24   24   24   24   32   32

P NEW YORK 1         NY STATE ELECTRIC & GAS COMPANY  DER=1250MW  FLD=1990  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR            1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                               0    0    0   24   24   24   24   32   32   32   32
REM STR W/O FCR                                                           391  391  781  757  733  684  635  579  522  457  392
REM STR W FCR                                                             293  293  684  659  635  586  533  481  424  360  295

P NEW YORK 2         NY STATE ELECTRIC & GAS COMPANY  DER=1250MW  FLD=1992  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR            1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                         0    0    0   24   24   24   24   32   32

  NINE MILE POINT 1  NIAGARA MOHAWK POWER           DER= 610MW  FLD=1969  CORE WT=106MT  FUEL STR=132MT  REM CAP=265MT
YEAR            1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED     27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27   27  106    0
REM STR W/O FCR  443  417  390  363  337  310  284  833  811  785  727  670  613  556  499  434  369  304  239  175   30   -8
REM STR W FCR    337  310  284  257  230  204  177  685  658  632  575  517  460  403  346  281  216  151   87   22 -123 -161

B NINE MILE POINT 2  NIAGARA MOHAWK POWER           DER=1080MW  FLD=1986  CORE WT=153MT  FUEL STR=  0MT  REM CAP=581MT
YEAR            1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                           0    0    0   31   31   31   31   31   38   38   38   38   38   38   38
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POOR ORIGINAL

POOR ORIGINAL

Table F.7. Continued

P NORTH ANNA 1 VIRGINIA ELECTRIC & POWER DER= 907MW FLD=1977 CORE WT= 71MT FUEL STR= 0MT REM CAP=180MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	0	13	13	18	18	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
REM STR W/O FCR	717	700	682	905	873	1093	1036	973	894	815	730	645	555	465	375	285	195	105	15	-75	-165	-255
REM STR W FCR	647	629	612	843	808	1028	971	908	828	749	665	580	490	400	310	220	130	40	-50	-140	-230	-320

P NORTH ANNA 2 VIRGINIA ELECTRIC & POWER DER= 943MW FLD=1979 CORE WT= 71MT FUEL STR= 0MT REM CAP=283MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	0	0	0	18	18	18	18	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23

P NORTH ANNA 3 VIRGINIA ELECTRIC & POWER DER= 907MW FLD=1982 CORE WT= 65MT FUEL STR= 0MT REM CAP=261MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED				0	0	0	16	16	16	16	22	22	22	22	22	22	22	22	22	22	22	22

P NORTH ANNA 4 VIRGINIA ELECTRIC & POWER DER= 907MW FLD=1984 CORE WT= 65MT FUEL STR= 0MT REM CAP=261MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED						0	0	0	16	16	16	16	22	22	22	22	22	22	22	22	22	22

P OCONEE 1 DUKE POWER DER= 887MW FLD=1972 CORE WT= 80MT FUEL STR=220MT REM CAP=127MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
REM STR W/O FCR	61	-19	-99	-178	-258	-338	-417	-497	-576	-656	-736	-815	-895	-975	-1054	-1134	-1214	-1293	-1373	-1453	-1532	-1612
REM STR W FCR	-19	-99	-178	-258	-338	-417	-497	-576	-656	-736	-815	-895	-975	-1054	-1134	-1214	-1293	-1373	-1453	-1532	-1612	-1692

P OCONEE 2 DUKE POWER DER= 887MW FLD=1973 CORE WT= 80MT FUEL STR= 0MT REM CAP= 0MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	20	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27

P OCONEE 3 DUKE POWER DER= 887MW FLD=1973 CORE WT= 80MT FUEL STR= 0MT REM CAP= 0MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	20	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27

B OYSTER CREEK JERSEY CENTRAL POWER & LIGHT DER= 650MW FLD=1968 CORE WT=112MT FUEL STR=124MT REM CAP=236MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	112	0
REM STR W/O FCR	208	180	152	124	96	68	40	12	-16	-44	-72	-100	-128	-156	-184	-212	-240	-268	-296	-324	-436	-436
REM STR W FCR	96	68	40	12	-16	-44	-72	-100	-128	-156	-184	-212	-240	-268	-296	-324	-352	-380	-408	-436	-436	-436

P PALISADES CONSUMERS POWER DER= 805MW FLD=1970 CORE WT= 92MT FUEL STR=123MT REM CAP=236MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
REM STR W/O FCR	206	175	144	114	83	53	22	-9	-39	-70	-100	-131	-162	-192	-223	-253	-284	-315	-345	-376	-406	-437
REM STR W FCR	114	83	53	22	-9	-39	-70	-100	-131	-162	-192	-223	-253	-284	-315	-345	-376	-406	-437	-468	-498	-529

P PALO VERDE 1 ARIZONA PUBLIC SERVICE DER=1270MW FLD=1982 CORE WT=103MT FUEL STR= 0MT REM CAP=434MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED				0	0	0	27	27	27	27	36	36	36	36	36	36	36	36	36	36	36	36
REM STR W/O FCR				434	434	434	841	814	1220	1166	1103	1404	1314	1606	1482	1350	1193	1037	872	707	535	362
REM STR W FCR				325	325	325	732	705	1112	1058	995	1306	1216	1508	1385	1252	1096	939	774	610	437	264

P PALO VERDE 2 ARIZONA PUBLIC SERVICE DER=1270MW FLD=1985 CORE WT=105MT FUEL STR= 0MT REM CAP=434MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED							0	0	0	27	27	27	27	36	36	36	36	36	36	36	36	36

P PALO VERDE 3 ARIZONA PUBLIC SERVICE DER=1270MW FLD=1987 CORE WT=105MT FUEL STR= 0MT REM CAP=434MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED									0	0	0	27	27	27	27	36	36	36	36	36	36	36

P PALO VERDE 4 ARIZONA PUBLIC SERVICE DER=1250MW FLD=1990 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED												0	0	0	24	24	24	24	32	32	32	32

P PALO VERDE 5 ARIZONA PUBLIC SERVICE DER=1250MW FLD=1992 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED														0	0	0	24	24	24	24	32	32

B PEACH BOTTOM 2 PHILADELPHIA ELECTRIC DER=1065MW FLD=1973 CORE WT=153MT FUEL STR=124MT REM CAP=440MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	31	31	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38
REM STR W/O FCR	854	792	716	640	563	487	410	334	258	181	105	28	-48	-124	-201	-277	-354	-430	-506	-583	-659	-736
REM STR W FCR	701	640	563	487	410	334	258	181	105	28	-48	-124	-201	-277	-354	-430	-506	-583	-659	-736	-812	-888

B PEACH BOTTOM 3 PHILADELPHIA ELECTRIC DER=1065MW FLD=1973 CORE WT=153MT FUEL STR= 80MT REM CAP=475MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	31	31	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38

P PEBBLE SPRINGS 1 PORTLAND GENERAL ELECTRIC DER=1250MW FLD=1990 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED												0	0	0	24	24	24	24	32	32	32	32
REM STR W/O FCR												391	391	781	757	733	684	635	579	522	457	392
REM STR W FCR												293	293	684	659	635	586	538	481	424	360	295

P PEBBLE SPRINGS 2 PORTLAND GENERAL ELECTRIC DER=1250MW FLD=1992 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED														0	0	0	24	24	24	24	32	32

P PERKINS 1 DUKE POWER DER=1250MW FLD=1989 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED											0	0	0	24	24	24	24	32	32	32	32	32
REM STR W/O FCR											391	391	781	757	1123	1075	1026	945	864	775	686	589
REM STR W FCR											293	293	684	659	1026	977	928	847	765	677	588	491

P PERKINS 2 DUKE POWER DER=1250MW FLD=1991 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED													0	0	0	24	24	24	24	32	32	32

P PERKINS 3 DUKE POWER DER=1250MW FLD=1993 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED															0	0	0	24	24	24	24	32

POOR ORIGINAL

Table F.7. Continued

B PERRY 1 CLEVELAND ELECTRIC & ILLUMINATING DER=1205MW FLD=1983 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED					0	0	0	29	29	29	29	29	37	37	37	37	37	37	37	37	37	37
REM STR W/O FCR					556	556	1113	1084	1054	996	938	879	813	748	674	601	528	455	382	308	235	162
REM STR W FCR					410	410	966	937	908	850	791	733	667	601	528	455	382	308	235	162	89	16

B PERRY 2 CLEVELAND ELECTRIC & ILLUMINATING DER=1205MW FLD=1985 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED							0	0	9	29	29	29	29	29	37	37	37	37	37	37	37	37

B PHIPPS BEND 1 TENNESSEE VALLEY AUTHORITY DER=1220MW FLD=1984 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED						0	0	0	29	29	29	29	29	37	37	37	37	37	37	37	37	37
REM STR W/O FCR						556	556	1113	1084	1054	996	938	879	813	748	674	601	528	455	382	308	235
REM STR W FCR						410	410	966	937	908	850	791	733	667	601	528	455	382	308	235	162	89

B PHIPPS BEND 2 TENNESSEE VALLEY AUTHORITY DER=1220MW FLD=1986 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED								0	0	0	29	29	29	29	29	37	37	37	37	37	37	37

B PILGRIM 1 BOSTON EDISON DER= 655MW FLD=1970 CORE WT=116MT FUEL STR=116MT REM CAP=348MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR	319	290	261	232	203	174	145	116	87	58	29	0	-29	-58	-87	-116	-145	-174	-203	-232	-261	-290
REM STR W FCR	203	174	145	116	87	58	29	0	-29	-58	-87	-116	-145	-174	-203	-232	-261	-290	-319	-348	-377	-406

P PILGRIM 2 BOSTON EDISON DER=1250MW FLD=1992 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED														0	0	0	24	24	24	24	32	32
REM STR W/O FCR														391	391	391	366	342	318	293	261	229
REM STR W FCR														293	293	293	269	244	220	196	163	131

P PRAIRIE ISLAND 1 NORTHERN STATES POWER DER= 530MW FLD=1972 CORE WT= 54MT FUEL STR= 90MT REM CAP=219MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
REM STR W/O FCR	188	152	116	80	44	8	-28	-64	-100	-136	-172	-208	-244	-280	-316	-352	-388	-424	-460	-496	-532	-568
REM STR W FCR	133	97	61	25	-11	-47	-83	-119	-155	-191	-227	-263	-299	-335	-371	-407	-443	-479	-515	-551	-587	-623

P PRAIRIE ISLAND 2 NORTHERN STATES POWER DER= 530MW FLD=1973 CORE WT= 54MT FUEL STR= 0MT REM CAP= 0MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	14	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18

P PT. BEACH 1 WISCONSIN MICHIGAN ELECTRIC DER= 497MW FLD=1969 CORE WT= 54MT FUEL STR= 81MT REM CAP= 77MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	54
REM STR W/O FCR	559	523	487	451	415	379	343	307	271	235	199	163	127	91	55	19	-17	-53	-89	-125	-161	-234
REM STR W FCR	504	468	432	396	360	324	288	252	216	180	144	108	72	36	0	-36	-72	-108	-144	-180	-216	-288

P PT. BEACH 2 WISCONSIN MICHIGAN ELECTRIC DER= 497MW FLD=1971 CORE WT= 54MT FUEL STR= 0MT REM CAP= 0MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18

B QUAD CITIES 1 COMMONWEALTH EDISON DER= 789MW FLD=1972 CORE WT=145MT FUEL STR= 30MT REM CAP=262MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	29	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
REM STR W/O FCR	347	274	202	130	57	-15	-88	-160	-232	-305	-377	-450	-522	-594	-667	-739	-812	-884	-956	-1029	-1101	-1174
REM STR W FCR	202	130	57	-15	-88	-160	-232	-305	-377	-450	-522	-594	-667	-739	-812	-884	-956	-1029	-1101	-1174	-1246	-1318

B QUAD CITIES 2 COMMONWEALTH EDISON DER= 789MW FLD=1972 CORE WT=145MT FUEL STR=149MT REM CAP=143MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	29	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36

P RANCHO SECO SACRAMENTO MUNICIPAL UTILITIES DISTRICT DER= 918MW FLD=1974 CORE WT= 80MT FUEL STR= 50MT REM CAP=210MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	23	20	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
REM STR W/O FCR	190	171	144	117	91	64	38	11	-15	-42	-68	-95	-122	-148	-175	-201	-228	-254	-281	-307	-334	-360
REM STR W FCR	111	91	64	38	11	-15	-42	-68	-95	-122	-148	-175	-201	-228	-254	-281	-307	-334	-360	-387	-414	-440

B RIVER BEND 1 GULF STATES UTILITIES DER= 934MW FLD=1986 CORE WT=118MT FUEL STR= 0MT REM CAP=450MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED								0	0	0	24	24	24	24	24	30	30	30	30	30	30	30
REM STR W/O FCR								450	450	450	876	853	829	782	735	682	623	575	516	457	398	338
REM STR W FCR								332	332	332	758	734	711	664	616	563	510	457	398	338	279	220

B RIVER BEND 2 GULF STATES UTILITIES DER= 934MW FLD=1989 CORE WT=118MT FUEL STR= 0MT REM CAP=450MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED											0	0	0	24	24	24	24	24	30	30	30	30

P ROBINSON 2 CAROLINA POWER & LIGHT DER= 700MW FLD=1970 CORE WT= 71MT FUEL STR=135MT REM CAP=125MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
REM STR W/O FCR	101	78	54	31	8	-16	-39	-63	-86	-109	-133	-156	-180	-203	-226	-250	-273	-297	-320	-343	-367	-390
REM STR W FCR	31	7	-16	-40	-63	-86	-110	-133	-157	-180	-203	-227	-250	-274	-297	-320	-344	-367	-391	-414	-437	-461

P SALEM 1 PUBLIC SERVIC GAS & ELECTRIC OF NJ DER=1090MW FLD=1976 CORE WT= 87MT FUEL STR= 0MT REM CAP=119MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR	852	831	809	766	718	665	615	557	500	442	384	327	269	212	154	96	39	-19	-77	-134	-192	-249
REM STR W FCR	765	744	722	679	629	578	528	470	413	355	297	240	182	125	67	9	-48	-105	-163	-221	-279	-336

P SALEM 2 PUBLIC SERVIC GAS & ELECTRIC OF NJ DER=1115MW FLD=1979 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29

Table F.7. Continued

P SAN ONOFRE 1 SOUTHERN CALIFORNIA EDISON DER= 436MW FLD=1967 CORE WT= 71MT FUEL STR= 26MT REM CAP= 71MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	71	0	0
REM STR W/O FCR	43	415	392	759	711	663	591	519	439	359	271	183	95	6	-82	-170	-258	-347	-435	-570	-635	-700
REM STR W FCR	-23	317	294	661	613	565	494	422	342	261	173	85	-3	-91	-180	-268	-356	-444	-532	-668	-733	-797

P SAN ONOFRE 2 SOUTHERN CALIFORNIA EDISON DER=1140MW FLD=1980 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED		0	0	0	24	24	24	24	32	32	32	32	32	32	32	32	32	32	32	32	32	32

P SAN ONOFRE 3 SOUTHERN CALIFORNIA EDISON DER=1140MW FLD=1982 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED				0	0	0	24	24	24	24	32	32	32	32	32	32	32	32	32	32	32	32

P SEABROOK 1 PUBLIC SERVICE OF NEW HAMPSHIRE DER=1194MW FLD=1984 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED						0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR						347	347	347	673	652	630	587	536	486	436	378	320	263	205	148	90	32
REM STR W FCR						261	261	261	586	565	543	500	450	399	349	291	234	176	118	61	3	-54

P SEABROOK 2 PUBLIC SERVICE OF NEW HAMPSHIRE DER=1194MW FLD=1987 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED									0	0	0	22	22	22	22	29	29	29	29	29	29	29

P SEQUOYAH 1 TENNESSEE VALLEY AUTHORITY DER=1140MW FLD=1979 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR	695	695	695	652	608	565	522	464	407	349	292	234	176	119	61	4	-54	-112	-169	-227	-284	-342
REM STR W FCR	608	608	608	565	522	478	435	378	320	262	205	147	90	32	-26	-83	-141	-198	-256	-314	-371	-429

P SEQUOYAH 2 TENNESSEE VALLEY AUTHORITY DER=1140MW FLD=1979 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29

B SHOREHAM LONG ISLAND LIGHTING DER= 854MW FLD=1980 CORE WT=112MT FUEL STR= 0MT REM CAP=426MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED		0	0	0	22	22	22	22	22	28	28	28	28	28	23	28	28	28	28	28	28	23
REM STR W/O FCR		426	426	426	403	381	358	336	314	286	258	230	202	174	146	118	90	62	34	6	-22	-50
REM STR W FCR		314	314	314	291	269	246	224	202	174	146	118	90	62	34	6	-22	-50	-78	-106	-134	-162

B SKAGIT 1 PUGET SOUND POWER & LIGHT DER=1180MW FLD=1990 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED												0	0	0	29	29	29	29	29	37	37	37
REM STR W/O FCR												556	556	1113	1084	1054	996	938	879	813	748	674
REM STR W FCR												410	410	966	937	908	850	791	733	667	601	528

B SKAGIT 2 PUGET SOUND POWER & LIGHT DER=1180MW FLD=1992 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED														0	0	0	29	29	29	29	29	37

P SOUTH TEXAS 1 HOUSTON POWER & LIGHT DER=1250MW FLD=1982 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED				0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR				347	347	695	673	652	608	565	515	464	407	349	292	234	176	119	61	4	-54	-112
REM STR W FCR				261	261	608	586	565	522	478	428	378	320	262	205	147	90	32	-26	-83	-141	-198

P SOUTH TEXAS 2 HOUSTON POWER & LIGHT DER=1250MW FLD=1984 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED						0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29

P ST LUCIE 1 FLORIDA POWER & LIGHT DER= 802MW FLD=1975 CORE WT= 98MT FUEL STR= 27MT REM CAP=301MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	24	24	24	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
REM STR W/O FCR	276	252	228	195	554	521	489	432	375	319	262	197	132	65	3	-62	-127	-192	-257	-321	-386	-451
REM STR W FCR	179	154	130	98	456	423	391	334	278	221	164	99	35	-30	-95	-160	-225	-289	-354	-419	-484	-549

P ST LUCIE 2 FLORIDA POWER & LIGHT DER= 842MW FLD=1983 CORE WT= 98MT FUEL STR= 0MT REM CAP=391MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED					0	0	0	24	24	24	24	32	32	32	32	32	32	32	32	32	32	32

B STANISLAUS 1 PACIFIC GAS & ELECTRIC DER=1180MW FLD=1990 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED												0	0	0	29	29	29	29	29	37	37	37
REM STR W/O FCR												556	556	1113	1084	1054	996	938	879	813	748	674
REM STR W FCR												410	410	966	937	908	850	791	733	667	601	528

B STANISLAUS 2 PACIFIC GAS & ELECTRIC DER=1180MW FLD=1992 CORE WT=146MT FUEL STR= 0MT REM CAP=556MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED														0	0	0	29	29	29	29	29	37

P STERLING 1 ROCHESTER GAS & ELECTRIC DER=1150MW FLD=1988 CORE WT= 80MT FUEL STR= 0MT REM CAP=319MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED										0	0	0	20	20	20	20	27	27	27	27	27	27
REM STR W/O FCR										319	319	319	299	279	259	239	213	186	160	133	107	80
REM STR W FCR										239	239	239	219	199	180	160	133	107	80	54	27	0

P SUMMER 1 SOUTH CAROLINA ELECTRIC & GAS DER= 900MW FLD=1980 CORE WT= 71MT FUEL STR= 0MT REM CAP=283MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED		0	0	0	18	18	18	18	23	23	23	23	23	23	23	23	23	23	23	23	23	23
REM STR W/O FCR		283	283	283	265	248	230	212	189	166	142	119	95	72	49	25	2	-22	-45	-68	-92	-115
REM STR W FCR		212	212	212	194	177	159	142	118	95	72	48	25	1	-22	-45	-69	-92	-116	-139	-162	-185

P SURRY 1 VIRGINIA ELECTRIC & POWER DER= 822MW FLD=1971 CORE WT= 71MT FUEL STR=196MT REM CAP=274MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
REM STR W/O FCR	227	180	133	86	40	-7	-54	-101	-148	-194	-241	-288	-335	-382	-428	-475	-522	-569	-616	-662	-709	-756
REM STR W FCR	156	109	63	16	-31	-78	-125	-171	-218	-265	-312	-359	-405	-452	-499	-546	-593	-639	-686	-733	-780	-827

P SURRY 2 VIRGINIA ELECTRIC & POWER DER= 822MW FLD=1972 CORE WT= 71MT FUEL STR= 0MT REM CAP= 0MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23

POOR ORIGINAL

Table F.7. Continued

B SUSQUEHANNA 1 PENNSYLVANIA POWER & LIGHT DER=1052MW FLD=1980 CORE WT=153MT FUEL STR= 0MT REM CAP=581MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED		0	0	0	31	31	31	31	31	38	38	38	38	38	38	38	38	38	38	38	38	38
REM STR W/O FCR		581	581	1162	1131	1100	1039	978	917	868	779	703	626	550	474	397	321	244	168	92	15	-61
REM STR W FCR		428	423	1009	978	948	886	825	764	695	626	550	474	397	321	244	168	92	15	-61	-138	-214

B SUSQUEHANNA 2 PENNSYLVANIA POWER & LIGHT DER=1052MW FLD=1982 CORE WT=153MT FUEL STR= 0MT REM CAP=581MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED				0	0	0	31	31	31	31	31	38	38	38	38	38	38	38	38	38	38	38

P THREE MILE ISLAND 1 METROPOLITAN EDISON DER= 819MW FLD=1973 CORE WT= 80MT FUEL STR= 72MT REM CAP=266MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	20	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
REM STR W/O FCR	247	220	194	167	140	114	87	61	34	8	-19	-45	-72	-99	-125	-152	-178	-205	-231	-258	-284	-311
REM STR W FCR	167	140	114	87	61	34	8	-19	-45	-72	-99	-125	-152	-178	-205	-231	-258	-284	-311	-338	-364	-391

P THREE MILE ISLAND 2 METROPOLITAN EDISON DER= 906MW FLD=1978 CORE WT= 80MT FUEL STR= 0MT REM CAP=199MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	0	0	20	20	20	20	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
REM STR W/O FCR	199	199	179	159	140	120	93	67	40	14	-13	-40	-66	-93	-119	-146	-172	-199	-225	-252	-279	-305
REM STR W FCR	119	119	99	80	60	40	14	-13	-40	-66	-93	-119	-146	-172	-199	-225	-252	-279	-305	-332	-358	-385

P TROJAN PORTLAND GENERAL ELECTRIC DER=1130MW FLD=1975 CORE WT= 87MT FUEL STR= 29MT REM CAP=264MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR	243	221	199	171	142	113	84	55	27	-2	-31	-60	-89	-118	-146	-175	-204	-233	-261	-290	-319	-348
REM STR W FCR	156	134	113	84	55	26	-3	-32	-60	-89	-118	-147	-176	-204	-233	-262	-291	-320	-348	-377	-406	-435

P TURKEY POINT 3 FLORIDA POWER & LIGHT DER= 693MW FLD=1971 CORE WT= 71MT FUEL STR=156MT REM CAP=124MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
REM STR W/O FCR	77	30	-17	-63	-110	-157	-204	-251	-297	-344	-391	-438	-485	-531	-578	-625	-672	-719	-765	-812	-859	-906
REM STR W FCR	6	-41	-87	-134	-181	-228	-275	-321	-368	-415	-462	-509	-555	-602	-649	-696	-743	-789	-836	-883	-930	-977

P TURKEY POINT 4 FLORIDA POWER & LIGHT DER= 693MW FLD=1972 CORE WT= 71MT FUEL STR= 0MT REM CAP= 0MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23

P TYRONE NORTHERN STATES POWER DER=1150MW FLD=1988 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED										0	0	0	22	22	22	22	29	29	29	29	29	29
REM STR W/O FCR										347	347	347	326	304	283	261	232	203	175	146	117	88
REM STR W FCR										261	261	261	239	217	196	174	145	117	88	59	30	1

B VERMONT YANKEE VERMONT YANKEE NUCLEAR POWER DER= 514MW FLD=1971 CORE WT= 74MT FUEL STR=179MT REM CAP=221MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
REM STR W/O FCR	203	184	166	148	129	111	92	74	56	37	19	0	-18	-36	-55	-73	-92	-110	-128	-147	-165	-184
REM STR W FCR	129	111	92	74	56	37	19	0	-18	-36	-55	-73	-92	-110	-128	-147	-165	-184	-202	-220	-239	-257

P VOGTLE 1 GEORGIA POWER DER=1100MW FLD=1986 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED								0	0	0	22	22	22	22	29	29	29	29	29	29	29	29
REM STR W/O FCR								347	695	695	673	630	587	544	493	436	378	320	263	205	148	90
REM STR W FCR								261	608	608	536	543	500	457	406	349	291	234	176	118	61	3

P VOGTLE 2 GEORGIA POWER DER=1100MW FLD=1987 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED									0	0	0	22	22	22	22	29	29	29	29	29	29	29

P WASHINGTON NUCLEAR 1 WASHINGTON PPSS DER=1251MW FLD=1983 CORE WT= 92MT FUEL STR= 0MT REM CAP=369MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED					0	0	0	23	23	23	23	31	31	31	31	31	31	31	31	31	31	31
REM STR W/O FCR					369	369	359	715	692	669	623	570	516	463	401	340	279	218	157	95	34	-27
REM STR W FCR					277	277	277	623	600	577	531	477	424	370	309	248	187	126	64	3	-58	-119

B WASHINGTON NUCLEAR 2 WASHINGTON PPSS DER=1103MW FLD=1980 CORE WT=153MT FUEL STR= 0MT REM CAP=581MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED		0	0	0	31	31	31	31	31	38	38	38	38	38	38	38	38	38	38	38	38	38
REM STR W/O FCR		581	581	581	550	520	489	458	428	390	351	313	275	237	199	160	122	84	46	8	-31	-69
REM STR W FCR		428	428	428	397	367	336	306	275	237	199	160	122	84	46	8	-31	-69	-107	-145	-183	-222

P WASHINGTON NUCLEAR 3 WASHINGTON PPSS DER=1242MW FLD=1985 CORE WT=108MT FUEL STR= 0MT REM CAP=434MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED							0	0	0	27	27	27	27	36	36	36	36	36	36	36	36	36
REM STR W/O FCR							434	434	868	841	814	760	706	643	580	508	436	364	292	220	148	76
REM STR W FCR							325	325	759	732	705	651	597	534	471	399	327	255	183	111	39	-33

P WASHINGTON NUCLEAR 4 WASHINGTON PPSS DER=1267MW FLD=1986 CORE WT= 92MT FUEL STR= 0MT REM CAP=369MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED								0	0	0	23	23	23	23	31	31	31	31	31	31	31	31

P WASHINGTON NUCLEAR 5 WASHINGTON PPSS DER=1242MW FLD=1987 CORE WT=108MT FUEL STR= 0MT REM CAP=434MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED									0	0	0	27	27	27	27	36	36	36	36	36	36	36

P WATERFORD 3 LOUISIANA POWER & LIGHT DER=1267MW FLD=1981 CORE WT= 92MT FUEL STR= 0MT REM CAP=369MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED			0	0	0	23	23	23	23	31	31	31	31	31	31	31	31	31	31	31	31	31
REM STR W/O FCR			369	369	369	346	323	300	277	247	216	185	155	124	94	63	32	2	-29	-59	-90	-121
REM STR W FCR			277	277	277	254	231	208	185	154	124	93	63	32	1	-29	-60	-90	-121	-152	-182	-213

P WATTS BAR 1 TENNESSEE VALLEY AUTHORITY DER=1165MW FLD=1980 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED		0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29	29	29
REM STR W/O FCR		347	695	695	673	630	587	544	493	436	378	320	263	205	148	90	32	-25	-83	-140	-198	-256
REM STR W FCR		261	608	608	536	543	500	457	406	349	291	234	176	118	61	3	-54	-112	-170	-227	-285	-342

P WATTS BAR 2 TENNESSEE VALLEY AUTHORITY DER=1165MW FLD=1981 CORE WT= 87MT FUEL STR= 0MT REM CAP=347MT

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED			0	0	0	22	22	22	22	29	29	29	29	29	29	29	29	29	29	29	29	29

Table F.7. Continued

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P WOLF CREEK 1        KANSAS GAS & ELECTRIC                    DER=1150MW  FLD=1984  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                 0    0    0   22   22   22   22   29   29   29   29   29   29   29   29   29   29
REM STR W/O FCR                             347  347  347  326  304  283  261  232  203  175  146  117   88   59   31    2  -27
REM STR W FCR                               261  261  261  239  217  196  174  145  117   88   59   30    1  -27  -56  -85 -114

P YANKEE ROWE         YANKEE ATOMIC ELECTRIC                   DER= 175MW  FLD=1960  CORE WT= 34MT  FUEL STR= 67MT  REM CAP=109MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        11   11   11   11   11   11   11   11   11   11   11   11   34    0    0    0    0    0    0    0    0    0
REM STR W/O FCR     246  235  224  212  201  190  179  167  156  145  134  122   88   88   88   88   88   88   88   88   88   88
REM STR W FCR       212  201  189  178  167  156  144  133  122  111   99   88   88   88   88   88   88   88   88   88   88   88

P YELLOW CREEK 1      TENNESSEE VALLEY AUTHORITY               DER=1285MW  FLD=1986  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                           0    0    0   22   22   22   22   29   29   29   29   29   29   29   29
REM STR W/O FCR                                       347  695  695  673  630  587  544  493  436  378  320  263  205  148   90
REM STR W FCR                                         261  608  608  584  543  500  457  406  349  291  234  176  118   61    3

P YELLOW CREEK 2      TENNESSEE VALLEY AUTHORITY               DER=1285MW  FLD=1987  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=347MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                0    0    0   22   22   22   22   29   29   29   29   29   29   29

P ZIMMER 1            CINCINNATI GAS & ELECTRIC                DER= 810MW  FLD=1979  CORE WT=252MT  FUEL STR=  0MT  REM CAP=008MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED         0    0    0   63   63   63   63   84   84   84   84   84   84   84   84   84   84   84   84   84   84   84
REM STR W/O FCR    1008 1008 1008  945  882  819  756  672  588  504  419  335  251  167   83   -1  -86 -170 -254 -338 -422 -506
REM STR W FCR       756  756  756  693  630  567  504  420  336  252  167   83   -1  -85 -169 -253 -338 -422 -506 -590 -674 -758

P ZION 1              COMMONWEALTH EDISON                      DER=1040MW  FLD=1972  CORE WT= 87MT  FUEL STR=139MT  REM CAP=252MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29
REM STR W/O FCR     761  704  646  589  531  473  416  358  301  243  185  128   70   13  -45 -103 -160 -218 -275 -333 -391 -448
REM STR W FCR       675  617  559  502  444  387  329  271  214  156   99   41  -17  -74 -132 -189 -247 -305 -362 -420 -477 -535

P ZION 2              COMMONWEALTH EDISON                      DER=1040MW  FLD=1973  CORE WT= 87MT  FUEL STR=  0MT  REM CAP=  0MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED        22   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29   29

B 230 B                                                        DER=1180MW  FLD=1997  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                            0    0    0   29
REM STR W/O FCR                                                                                        556  556  556  527
REM STR W FCR                                                                                          410  410  410  381

B 230 B                                                        DER=1180MW  FLD=1997  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                            0    0    0   29
REM STR W/O FCR                                                                                        556  556  556  527
REM STR W FCR                                                                                          410  410  410  381

P 230 P                                                        DER=1250MW  FLD=1997  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                            0    0    0   24
REM STR W/O FCR                                                                                        391  391  391  366
REM STR W FCR                                                                                          293  293  293  269

P 230 P                                                        DER=1250MW  FLD=1997  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                            0    0    0   24
REM STR W/O FCR                                                                                        391  391  391  366
REM STR W FCR                                                                                          293  293  293  269

P 230 P                                                        DER=1250MW  FLD=1997  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                            0    0    0   24
REM STR W/O FCR                                                                                        391  391  391  366
REM STR W FCR                                                                                          293  293  293  269

P 230 P                                                        DER=1250MW  FLD=1997  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                            0    0    0   24
REM STR W/O FCR                                                                                        391  391  391  366
REM STR W FCR                                                                                          293  293  293  269

B 280 B                                                        DER=1180MW  FLD=1996  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                       0    0    0   29   29
REM STR W/O FCR                                                                                   556  556  556  527  498
REM STR W FCR                                                                                     410  410  410  381  352

B 280 B                                                        DER=1180MW  FLD=1996  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                       0    0    0   29   29
REM STR W/O FCR                                                                                   556  556  556  527  498
REM STR W FCR                                                                                     410  410  410  381  352

B 280 B                                                        DER=1180MW  FLD=1993  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                         0    0    0   29   29   29   29   29
REM STR W/O FCR                                                                     556  556  556  527  498  469  440  410
REM STR W FCR                                                                       410  410  410  381  352  322  293  264

B 280 B                                                        DER=1180MW  FLD=1996  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR               1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                       0    0    0   29   29
REM STR W/O FCR                                                                                   556  556  556  527  498
REM STR W FCR                                                                                     410  410  410  381  352
```

Table F.7. Continued

```
B 280 B                                                          DER=1180MW  FLD=1993  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                            0    0    0   29   29   29   29   29
REM STR W/O FCR                                                                        556  556  556  527  498  469  440  410
REM STR W FCR                                                                          410  410  410  381  352  322  293  264

B 280 B                                                          DER=1180MW  FLD=1993  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                            0    0    0   29   29   29   29   29
REM STR W/O FCR                                                                        556  556  556  527  498  469  440  410
REM STR W FCR                                                                          410  410  410  381  352  322  293  264

B 280 B                                                          DER=1180MW  FLD=1995  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                      0    0    0   29   29   29
REM STR W/O FCR                                                                                  556  556  556  527  498  469
REM STR W FCR                                                                                    410  410  410  381  352  322

B 280 B                                                          DER=1180MW  FLD=1995  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                      0    0    0   29   29   29
REM STR W/O FCR                                                                                  556  556  556  527  498  469
REM STR W FCR                                                                                    410  410  410  381  352  322

B 280 B                                                          DER=1180MW  FLD=1995  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                      0    0    0   29   29   29
REM STR W/O FCR                                                                                  556  556  556  527  498  469
REM STR W FCR                                                                                    410  410  410  381  352  322

B 280 B                                                          DER=1180MW  FLD=1994  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1.36 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                 0    0    0   29   29   29   29
REM STR W/O FCR                                                                             556  556  556  527  498  469  440
REM STR W FCR                                                                               410  410  410  381  352  322  293

B 280 B                                                          DER=1180MW  FLD=1994  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                 0    0    0   29   29   29   29
REM STR W/O FCR                                                                             556  556  556  527  498  469  440
REM STR W FCR                                                                               410  410  410  381  352  322  293

B 280 B                                                          DER=1180MW  FLD=1994  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                 0    0    0   29   29   29   29
REM STR W/O FCR                                                                             556  556  556  527  498  469  440
REM STR W FCR                                                                               410  410  410  381  352  322  293

B 280 B                                                          DER=1180MW  FLD=1997  CORE WT=146MT  FUEL STR=  0MT  REM CAP=556MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                                0    0    0   29
REM STR W/O FCR                                                                                            556  556  556  527
REM STR W FCR                                                                                              410  410  410  381

P 280 P                                                          DER=1250MW  FLD=1993  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                            0    0    0   24   24   24   24   32
REM STR W/O FCR                                                                        391  391  391  366  342  318  293  261
REM STR W FCR                                                                          293  293  293  269  244  220  196  163

P 280 P                                                          DER=1250MW  FLD=1993  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                            0    0    0   24   24   24   24   32
REM STR W/O FCR                                                                        391  391  391  366  342  318  293  261
REM STR W FCR                                                                          293  293  293  269  244  220  196  163

P 280 P                                                          DER=1250MW  FLD=1993  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                            0    0    0   24   24   24   24   32
REM STR W/O FCR                                                                        391  391  391  366  342  318  293  261
REM STR W FCR                                                                          293  293  293  269  244  220  196  163

P 280 P                                                          DER=1250MW  FLD=1994  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                 0    0    0   24   24   24   24
REM STR W/O FCR                                                                             391  391  391  366  342  318  293
REM STR W FCR                                                                               293  293  293  269  244  220  196

P 280 P                                                          DER=1250MW  FLD=1994  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                 0    0    0   24   24   24   24
REM STR W/O FCR                                                                             391  391  391  366  342  318  293
REM STR W FCR                                                                               293  293  293  269  244  220  196

P 280 P                                                          DER=1250MW  FLD=1994  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                 0    0    0   24   24   24   24
REM STR W/O FCR                                                                             391  391  391  366  342  318  293
REM STR W FCR                                                                               293  293  293  269  244  220  196

P 280 P                                                          DER=1250MW  FLD=1995  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                      0    0    0   24   24   24
REM STR W/O FCR                                                                                  391  391  391  366  342  318
REM STR W FCR                                                                                    293  293  293  269  244  220

P 280 P                                                          DER=1250MW  FLD=1997  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
MT DISCHARGED                                                                                                0    0    0   24
REM STR W/O FCR                                                                                            391  391  391  366
REM STR W FCR                                                                                              293  293  293  269
```

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Table F.7. Continued

```
P 280 P                                                                         DER=1250MW  FLD=1997  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979  1980  1981  1982  1983  1984  1985  1986  1987  1988  1989  1990  1991  1992  1993  1994  1995  1996  1997  1998  1999  2000
MT DISCHARGED                                                                                                                          0     0     0    24
REM STR W/O FCR                                                                                                                      391   391   391   366
REM STR W FCR                                                                                                                        293   293   293   269

P 280 P                                                                         DER=1250MW  FLD=1996  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979  1980  1981  1982  1983  1984  1985  1986  1987  1988  1989  1990  1991  1992  1993  1994  1995  1996  1997  1998  1999  2000
MT DISCHARGED                                                                                                                    0     0     0    24    24
REM STR W/O FCR                                                                                                                391   391   391   366   342
REM STR W FCR                                                                                                                  293   293   293   269   244

P 280 P                                                                         DER=1250MW  FLD=1996  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979  1980  1981  1982  1983  1984  1985  1986  1987  1988  1989  1990  1991  1992  1993  1994  1995  1996  1997  1998  1999  2000
MT DISCHARGED                                                                                                                    0     0     0    24    24
REM STR W/O FCR                                                                                                                391   391   391   366   342
REM STR W FCR                                                                                                                  293   293   293   269   244

P 280 P                                                                         DER=1250MW  FLD=1996  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979  1980  1981  1982  1983  1984  1985  1986  1987  1988  1989  1990  1991  1992  1993  1994  1995  1996  1997  1998  1999  2000
MT DISCHARGED                                                                                                                    0     0     0    24    24
REM STR W/O FCR                                                                                                                391   391   391   366   342
REM STR W FCR                                                                                                                  293   293   293   269   244

P 280 P                                                                         DER=1250MW  FLD=1996  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979  1980  1981  1982  1983  1984  1985  1986  1987  1988  1989  1990  1991  1992  1993  1994  1995  1996  1997  1998  1999  2000
MT DISCHARGED                                                                                                                    0     0     0    24    24
REM STR W/O FCR                                                                                                                391   391   391   366   342
REM STR W FCR                                                                                                                  293   293   293   269   244

P 280 P                                                                         DER=1250MW  FLD=1996  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979  1980  1981  1982  1983  1984  1985  1986  1987  1988  1989  1990  1991  1992  1993  1994  1995  1996  1997  1998  1999  2000
MT DISCHARGED                                                                                                                    0     0     0    24    24
REM STR W/O FCR                                                                                                                391   391   391   366   342
REM STR W FCR                                                                                                                  293   293   293   269   244

P 280 P                                                                         DER=1250MW  FLD=1995  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979  1980  1981  1982  1983  1984  1985  1986  1987  1988  1989  1990  1991  1992  1993  1994  1995  1996  1997  1998  1999  2000
MT DISCHARGED                                                                                                              0     0     0    24    24    24
REM STR W/O FCR                                                                                                          391   391   391   366   342   318
REM STR W FCR                                                                                                            293   293   293   269   244   220

P 280 P                                                                         DER=1250MW  FLD=1995  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979  1980  1981  1982  1983  1984  1985  1986  1987  1988  1989  1990  1991  1992  1993  1994  1995  1996  1997  1998  1999  2000
MT DISCHARGED                                                                                                              0     0     0    24    24    24
REM STR W/O FCR                                                                                                          391   391   391   366   342   318
REM STR W FCR                                                                                                            293   293   293   269   244   220

P 280 P                                                                         DER=1250MW  FLD=1995  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979  1980  1981  1982  1983  1984  1985  1986  1987  1988  1989  1990  1991  1992  1993  1994  1995  1996  1997  1998  1999  2000
MT DISCHARGED                                                                                                              0     0     0    24    24    24
REM STR W/O FCR                                                                                                          391   391   391   366   342   318
REM STR W FCR                                                                                                            293   293   293   269   244   220

P 280 P                                                                         DER=1250MW  FLD=1995  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979  1980  1981  1982  1983  1984  1985  1986  1987  1988  1989  1990  1991  1992  1993  1994  1995  1996  1997  1998  1999  2000
MT DISCHARGED                                                                                                              0     0     0    24    24    24
REM STR W/O FCR                                                                                                          391   391   391   366   342   318
REM STR W FCR                                                                                                            293   293   293   269   244   220

P 280 P                                                                         DER=1250MW  FLD=1996  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979  1980  1981  1982  1983  1984  1985  1986  1987  1988  1989  1990  1991  1992  1993  1994  1995  1996  1997  1998  1999  2000
MT DISCHARGED                                                                                                                    0     0     0    24    24
REM STR W/O FCR                                                                                                                391   391   391   366   342
REM STR W FCR                                                                                                                  293   293   293   269   244

P 280 P                                                                         DER=1250MW  FLD=1995  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979  1980  1981  1982  1983  1984  1985  1986  1987  1988  1989  1990  1991  1992  1993  1994  1995  1996  1997  1998  1999  2000
MT DISCHARGED                                                                                                              0     0     0    24    24    24
REM STR W/O FCR                                                                                                          391   391   391   366   342   318
REM STR W FCR                                                                                                            293   293   293   269   244   220

P 280 P                                                                         DER=1250MW  FLD=1994  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979  1980  1981  1982  1983  1984  1985  1986  1987  1988  1989  1990  1991  1992  1993  1994  1995  1996  1997  1998  1999  2000
MT DISCHARGED                                                                                                        0     0     0    24    24    24    24
REM STR W/O FCR                                                                                                    391   391   391   366   342   318   293
REM STR W FCR                                                                                                      293   293   293   269   244   220   196

P 280 P                                                                         DER=1250MW  FLD=1994  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979  1980  1981  1982  1983  1984  1985  1986  1987  1988  1989  1990  1991  1992  1993  1994  1995  1996  1997  1998  1999  2000
MT DISCHARGED                                                                                                        0     0     0    24    24    24    24
REM STR W/O FCR                                                                                                    391   391   391   366   342   318   293
REM STR W FCR                                                                                                      293   293   293   269   244   220   196

P 280 P                                                                         DER=1250MW  FLD=1994  CORE WT= 98MT  FUEL STR=  0MT  REM CAP=391MT
YEAR                1979  1980  1981  1982  1983  1984  1985  1986  1987  1988  1989  1990  1991  1992  1993  1994  1995  1996  1997  1998  1999  2000
MT DISCHARGED                                                                                                        0     0     0    24    24    24    24
REM STR W/O FCR                                                                                                    391   391   391   366   342   318   293
REM STR W FCR                                                                                                      293   293   293   269   244   220   196
```

Table F.7-A. Summary for Alternative 3 (Unlimited Transshipment) Showing Discharges and Remaining Storage for Each Year, with and without FCR (280 GWe Installed in Year 2000)

SUMMARY TOTALS

YEAR	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
MT DISCHARGED	1427	1524	1642	1937	2220	2452	2620	2962	3232	3550	3837
REM STR W/O FCR	1047	1112	1181	1379	1581	1742	1859	2007	2168	2320	2484
REM STR W FCR	17079	19116	19927	21418	22255	23317	24210	24606	25309	24849	24094

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MT DISCHARGED	4204	4375	4535	4944	5191	5494	5777	6070	6477	6311	6546
REM STR W/O FCR	2577	2577	2741	2989	3023	3061	3276	3555	3930	4200	4303
REM STR W FCR	22700	21927	21053	19348	17147	14636	11344	8755	2341	-4356	-11263

Table F.8. Away-from-Reactor Spent Fuel Storage Requirements (in MTHM) by Reactor Site for 230 GWe Capacity in the Year 2000.

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1979				
Oconee 1	P22	27	-19	887
Oconee 2	P23	20		887
Oconee 3	P24	20		887
San Onofre 1	P33	23	-23	436
Total		90	-42	3,097
1980				
Humboldt Bay	B15	9	-4	65
Oconee 1	P22	27	-99	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Turkey Point 3	P40	23	-41	693
Turkey Point 4	P41	23		693
Total		135	-143	4,112
1981				
Big Rock Point	B 1	4	-3	72
Humboldt Bay	B15	9	-13	65
Indian Point 2	P15	29	-16	873
Robinson 2	P31	23	-16	700
Oconee 1	P22	27	-178	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Turkey Point 3	P40	23	-87	693
Turkey Point 4	P41	23		693
Total		191	-314	5,757
1982				
Big Rock Point	B 1	4	-7	72
Humboldt Bay	B15	9	-22	65
Indian Point 2	P15	29	-45	873
Robinson 2	P31	23	-40	700
Oconee 1	P22	27	-258	887

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1979				
Total		-	-	-
1980				
Oconee 1	P22	27	-19	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Total		80	-19	2,661
1981				
Oconee 1	P22	27	-99	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Turkey Point 3	P40	23	-17	693
Turkey Point 4	P41	23		693
Total		126	-115	4,047
1982				
Oconee 1	P22	27	-178	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Turkey Point 3	P40	23	-63	693
Turkey Point 4	P41	23		693

Table F.8. Continued

With Full Core Reserve					Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe	Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1982 (Continued)					1982 (Continued)				
Oconee 2	P23	27		887					
Oconee 3	P24	27		887					
Quad Cities 1	B24	36	-15	789					
Quad Cities 2	B25	36		789					
Turkey Point 3	P40	23	-134	693					
Turkey Point 4	P41	23		693					
Total		264	-520	7,335	Total		126	-242	4,047
1983					1983				
Big Rock Point	B 1	4	-12	72	Oconee 1	P22	27	-258	887
Ft. Calhoun	P11	20	-12	457	Oconee 2	P23	27		887
Humboldt Bay	B15	9	-30	65	Oconee 3	P24	27		887
Indian Point 2	P15	29	-73	873	Turkey Point 3	P40	23	-110	693
Maine Yankee	P18	32	-26	790	Turkey Point 4	P41	23		693
Oyster Creek	B20	28	-16	650					
Palisades	P25	31	-9	805					
Robinson 2	P31	23	-63	700					
Calvert Cliffs 1	P 4	32	-1	845					
Calvert Cliffs 2	P 5	32		845					
Oconee 1	P22	27	-336	887					
Oconee 2	P23	27		887					
Oconee 3	P24	27		887					
Prairie Island 1	P28	18	-11	530					
Prairie Island 2	P29	18		530					
Quad Cities 1	B24	36	-88	789					
Quad Cities 2	B25	36		789					
Surry 1	P35	23	-31	822					
Surry 2	P36	23		822					
Turkey Point 3	P40	23	-181	693					
Turkey Point 4	P41	23		693					
Total		522	-889	14,431	Total		126	-368	4,047
1984					1984				
Big Rock Point	B 1	4	-16	72	Humboldt Bay	B15	9	-4	65
Ft. Calhoun	P11	20	-32	457	Indian Point 2	P15	29	-15	873
Humboldt Bay	B15	9	-39	65	Robinson 2	P31	23	-16	700

Table F.8. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1984 (Continued)				
Indian Point 2	P15	29	-102	873
Maine Yankee	P18	32	-58	790
Oyster Creek	B20	28	-44	650
Palisades	P25	31	-39	805
Rancho Seco	P30	27	-15	918
Robinson 2	P31	23	-86	700
Brunswick 1	B 5	26	-14	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-65	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-13	717
Hatch 2	B14	22		822
Millstone 2	P19	32	-8	830
Oconee 1	P22	27	-417	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Prairie Island 1	P28	18	-47	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-160	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-78	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-228	693
Turkey Point 4	P41	23		693
Total		688	-1,462	19,360
1985				
Big Rock Point	B 1	4	-20	72
Ft. Calhoun	P11	20	-52	457
Humboldt Bay	B15	9	-47	65
Indian Point 2	P15	29	-131	873
Maine Yankee	P18	32	-90	790
Millstone 1	B17	29	-8	660
Oyster Creek	B20	28	-72	650
Palisades	P25	31	-70	805
Rancho Seco	P30	27	-42	918

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1984 (Continued)				
Oconee 1	P22	27	-338	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Quad Cities 1	B24	36	-15	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-7	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-157	693
Turkey Point 4	P41	23		693
Total		306	-552	8,907
1985				
Big Rock Point	B 1	4	-3	72
Humboldt Bay	B15	9	-13	65
Indian Point 2	P15	29	-44	873
Robinson 2	P31	23	-39	700
Calvert Cliffs 1	P 4	32	-32	845
Calvert Cliffs 2	P 5	32		845
Oconee 1	P22	27	-417	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887

Table F.8. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1985 (Continued)				
Robinson 2	P31	23	-110	700
Trojan	P39	29	-3	1,130
Brunswick 1	B 5	28	-70	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-130	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-63	717
Hatch 2	B14	22		822
Millstone 2	P19	32	-41	830
Oconee 1	P22	27	-497	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Prairie Island 1	P28	18	-83	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-232	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-125	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-275	693
Turkey Point 4	P41	23		693
Total		745	-2,160	21,150
1986				
Big Rock Point	B 1	4	-24	72
Ft. Calhoun	P11	20	-72	457
Ginna	P12	18	-1	490
Humboldt Bay	B15	9	-56	65
Indian Point 2	P15	29	-160	790
Maine Yankee	P18	32	-123	790
Millstone 1	B17	29	-37	660
Oyster Creek	B20	28	-100	650
Palisades	P25	31	-100	805
Pilgrim 1	B23	29	-1	655
Rancho Seco	P30	27	-68	918
Robinson 2	P31	23	-133	700
Three Mile Island 1	P37	27	-19	819
Three Mile Island 2	P38	27	-13	906

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1985 (Continued)				
Prairie Island 1	P28	18	-28	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-88	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-54	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-204	693
Turkey Point 4	P41	23		693
Total		411	-923	11,729
1986				
Big Rock Point	B 1	4	-7	72
Ft. Calhoun	P11	20	-12	457
Humboldt Bay	B15	9	-22	65
Indian Point 2	P15	29	-73	873
Maine Yankee	P18	32	-25	790
Palisades	P25	31	-9	805
Robinson 2	P31	23	-63	700
Brunswick 1	B 5	28	-14	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-97	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-7	717
Hatch 2	B14	28		822
Oconee 1	P22	27	-497	887

Table F.8. Continued

With Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1986 (Continued)				
Trojan	P39	29	-32	1,130
Brunswick 1	B 5	28	-126	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-195	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-119	717
Hatch 2	B14	28		822
Millstone 2	P19	32	-73	830
Oconee 1	P22	27	-576	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Prairie Island 1	P28	18	-119	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-305	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-171	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-321	693
Turkey Point 4	P41	23		693
Total		851	-2,944	24,020
1987				
Big Rock Point	B 1	4	-28	72
Ft. Calhoun	P11	20	-91	457
Ginna	P12	18	-19	490
Humboldt Bay	B15	9	-65	65
Indian Point 2	P15	29	-189	873
Maine Yankee	P18	32	-155	790
Millstone 1	B17	29	-66	660
Oyster Creek	B20	28	-128	650
Palisades	P25	31	-131	805
Pilgrim 1	B23	29	-29	655
Rancho Seco	P30	27	-95	918
Robinson 2	P31	23	-157	700
Three Mile Island 1	P37	27	-45	819
Three Mile Island 2	P38	27	-40	906

Without Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1986 (Continued)				
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Prairie Island 1	P28	18	-64	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-160	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-101	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-251	693
Turkey Point 4	P41	23		693
Total		606	-1,401	16,962
1987				
Big Rock Point	B 1	4	-12	72
Ft. Calhoun	P11	20	-32	457
Humboldt Bay	B15	9	-30	65
Indian Point 2	P15	29	-102	873
Maine Yankee	P18	32	-58	790
Oyster Creek	B20	28	-16	650
Palisades	P25	31	-39	805
Rancho Seco	P30	27	-15	918
Robinson 2	P31	23	-86	700
Brunswick 1	B 5	28	-70	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-162	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-63	717

Table F.8. Continued

With Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1987 (Continued)				
Trojan	P39	29	-60	1,130
Vermont Yankee	B26	18	-18	514
Arkansas 1	P 1	27	-37	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-182	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-260	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-175	717
Hatch 2	B14	28		822
Millstone 2	P19	32	-105	830
Oconee 1	P22	27	-656	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Prairie Island 1	P28	18	-155	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-377	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-218	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-368	693
Turkey Point 4	P41	23		693
Total		923	-3,850	26,334
1988				
Big Rock Point	B 1	4	-33	72
Fitzpatrick	B12	28	-25	821
Ft. Calhoun	P11	20	-111	457
Ginna	P12	18	-37	490
Humboldt Bay	B15	9	-73	65
Indian Point 2	P15	29	-217	873
Indian Point 3	P16	29	-5	873
Maine Yankee	P18	32	-188	790
Millstone 1	B17	29	-95	660
Monticello	B18	24	-15	545
Oyster Creek	B20	28	-156	650

Without Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1987 (Continued)				
Hatch 2	B14	28		822
Millstone 2	P19	32	-8	830
Oconee 1	P22	27	-576	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Prairie Island 1	P28	18	-100	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-232	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-148	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-297	693
Turkey Point 4	P41	23		693
Total		693	-2,047	19,360
1988				
Big Rock Point	B 1	4	-16	72
Ft. Calhoun	P11	20	-51	457
Humboldt Bay	B15	9	-39	65
Indian Point 2	P15	29	-131	873
Maine Yankee	P18	32	-90	790
Oyster Creek	B20	28	-44	650
Palisades	P25	31	-70	805
Rancho Seco	P30	27	-42	918
Robinson 2	P31	23	-109	700
Trojan	P39	29	-2	1,130
Arkansas 1	P 1	27	-10	850

Table F.8. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1988 (Continued)				
Palisades	P25	31	-162	805
Pilgrim 1	B23	29	-58	655
Rancho Seco	P30	27	-122	918
Robinson 2	P31	23	-180	700
Three Mile Island 1	P37	27	-72	819
Three Mile Island 2	P38	27	-66	906
Trojan	P39	29	-89	1,130
Vermont Yankee	B26	18	-36	514
Arkansas 1	P 1	27	-90	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-238	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-324	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-231	717
Hatch 2	B14	28		822
Millstone 2	P19	32	-138	830
Oconee 1	P22	27	-736	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Prairie Island 1	P28	18	-191	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-450	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-265	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-415	693
Turkey Point 4	P41	23		693
Total		1,004	-4,817	28,573
1989				
Big Rock Point	B 1	4	-37	72
Fitzpatrick	B12	28	-53	821
Ft. Calhoun	P11	20	-131	457
Ginna	P12	18	-55	490
Humboldt Bay	B15	9	-82	65
Indian Point 2	P15	29	-246	873

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1988 (Continued)				
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-126	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-227	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-119	717
Hatch 2	B14	28		822
Millstone 2	P19	32	-40	830
Oconee 1	P22	27	-656	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Prairie Island 1	P28	18	-136	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-305	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-194	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-344	693
Turkey Point 4	P41	23		693
Total		775	-2,752	22,290
1989				
Big Rock Point	B 1	4	-20	72
Ft. Calhoun	P11	20	-71	457
Ginna	P12	18	-1	490
Humboldt Bay	B15	9	-47	65
Indian Point 2	P15	29	-159	873
Maine Yankee	P18	32	-122	790

Table F.8. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available^{a,b}	MWe
1989 (Continued)				
Indian Point 3	P16	29	-34	873
Maine Yankee	P18	32	-220	790
Millstone 1	B17	29	-124	660
Monticello	B18	24	-39	545
Oyster Creek	B20	28	-184	650
Palisades	P25	31	-192	805
Pilgrim 1	B23	29	-87	655
Rancho Seco	P30	27	-148	918
Robinson 2	P31	23	-203	700
Three Mile Island 1	P37	27	-99	819
Three Mile Island 2	P38	27	-93	906
Trojan	P39	29	-118	1,130
Vermont Yankee	B26	18	-55	514
Arkansas 1	P 1	27	-143	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-294	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-389	845
Calvert Cliffs 2	P 5	32		845
Davis Besse 1	P 9	27	-14	906
Hatch 1	B13	28	-287	717
Hatch 2	B14	28		822
Millstone 2	P19	32	-170	830
Oconee 1	P22	27	-815	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom	B21	38	-48	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-227	530
Prairie Island 2	P29	18		530
Quad Cities	B24	36	-522	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-312	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-462	693
Turkey Point 4	P41	23		693
Total		1,107	-5,883	31,609

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available^{b,c}	MWe
1989 (Continued)				
Millstone 1	B17	29	-8	660
Oyster Creek	B20	28	-72	650
Palisades	P25	31	-100	805
Rancho Seco	P30	27	-68	918
Robinson 2	P31	23	-133	700
Three Mile Island 1	P37	27	-19	819
Three Mile Island 2	P28	27	-13	906
Trojan	P39	29	-31	1,130
Arkansas 1	P 1	27	-63	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-182	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-292	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-175	717
Hatch 2	B14	28		822
Millstone 2	P19	32	-72	830
Oconee 1	P22	27	-736	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Prairie Island 1	P28	18	-172	530
Prairie Island 2	P29	18		530
Quad Cities 2	B24	36	-377	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-241	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-391	693
Turkey Point 4	P41	23		693
Total		875	-3,568	25,165

Table F.8. Continued

With Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1990				
Big Rock Point	B 1	4	-41	72
Cook 2	P 7	29	-27	1,100
Cooper	B 7	27	-11	778
Fitzpatrick	B12	28	-81	821
Ft. Calhoun	P11	20	-151	457
Ginna	P12	18	-73	490
Humboldt Bay	B15	9	-90	65
Indian Point 2	P15	29	-275	873
Indian Point 3	P16	29	-63	873
Maine Yankee	P18	32	-252	790
Millstone 1	B17	29	-153	660
Monticello	B18	24	-63	545
Oyster Creek	B20	28	-212	650
Palisades	P25	31	-223	805
Pilgrim 1	B23	29	-116	655
Rancho Seco	P30	27	-175	918
Robinson 2	P31	23	-227	700
Three Mile Island 1	P37	27	-125	819
Three Mile Island 2	P38	27	-119	906
Trojan	P39	29	-147	1,130
Vermont Yankee	B26	18	-73	514
Arkansas 1	P 1	27	-196	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-350	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-454	845
Calvert Cliffs 2	P 5	32		845
Davis Besse 1	P 9	27	-41	906
Hatch 1	B13	28	-343	717
Hatch 2	B14	28		822
Oconee 1	P22	27	-895	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-124	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-263	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-594	789
Quad Cities 2	B25	36		789

Without Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1990				
Big Rock Point	B 1	4	-24	72
Ft. Calhoun	P11	20	-91	457
Ginna	P12	18	-18	490
Humboldt Bay	B15	9	-56	65
Indian Point 2	P15	29	-188	873
Maine Yankee	P18	32	-155	790
Millstone 1	B17	29	-37	660
Oyster Creek	B20	28	-100	650
Palisades	P25	31	-131	805
Pilgrim 1	B23	29	-1	655
Rancho Seco	P30	27	-95	918
Robinson 2	P31	23	-156	700
Three Mile Island 1	P37	27	-45	819
Three Mile Island 2	P38	27	-40	906
Trojan	P39	29	-60	1,130
Arkansas 1	P 1	27	-117	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-238	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-356	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-231	717
Hatch 2	B14	28		822
Oconee 1	P22	27	-815	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Prairie Island 1	P28	18	-208	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-450	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-288	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-438	693
Turkey Point 4	P41	23		693

Table F.8. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1990 (Continued)				
Surry 1	P35	23	-359	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-509	693
Turkey Point 4	P41	23		693
Total		1,130	-6,825	32,657
1991				
Big Rock Point	B 1	4	-45	72
Cook 2	P 7	29	-56	1,100
Cooper	B 7	27	-39	778
Fitzpatrick	B12	28	-109	821
Ft. Calhoun	P11	20	-171	457
Ginna	P12	18	-91	490
Humboldt Bay	B15	9	-99	65
Indian Point 2	P15	29	-304	873
Indian Point 3	P16	29	-92	873
Maine Yankee	P18	32	-285	790
Millstone 1	B17	29	-182	660
Monticello	B18	24	-87	545
Oyster Creek	B20	28	-240	650
Palisades	P25	31	-253	805
Pilgrim 1	B23	29	-145	655
Rancho Seco	P30	27	-201	918
Robinson 2	P31	23	-250	700
Three Mile Island 1	P37	27	-152	819
Three Mile Island 2	P38	27	-146	906
Trojan	P39	29	-176	1,130
Vermont Yankee	B26	18	-92	514
Arkansas 1	P 1	27	-249	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-406	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-519	845
Calvert Cliffs 2	P 5	32		845
Davis Besse 1	P 9	27	-67	906
Dresden 1	B 8	0[d]	-46	200
Dresden 2	B 9	36		794

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1990 (Continued)				
Total		872	-4,338	24,990
1991				
Big Rock Point	B 1	4	-28	72
Ft. Calhoun	P11	20	-111	457
Ginna	P12	18	-36	490
Humboldt Bay	B15	9	-65	65
Indian Point 2	P15	29	-217	873
Indian Point 3	P16	29	-5	873
Maine Yankee	P18	32	-187	790
Millstone 1	B17	29	-66	660
Oyster Creek	B20	28	-128	650
Palisades	P25	31	-162	805
Pilgrim 1	B23	29	-29	655
Rancho Seco	P30	27	-122	918
Robinson 2	P31	23	-180	700
Three Mile Island 1	P37	27	-72	819
Three Mile Island 2	P38	27	-66	906
Trojan	P39	29	-89	1,130
Vermont Yankee	B26	18	-18	514
Arkansas 1	P 1	27	-170	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-294	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-421	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-287	717
Hatch 2	B14	28		822
Oconee 1	P22	27	-895	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-48	1,065
Peach Bottom 3	B22	38		1,065

Table F.8. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1991 (Continued)				
Dresden 3	B10	36		794
Hatch 1	B13	28	-399	717
Hatch 2	B14	28		822
Oconee 1	P22	27	-975	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-201	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-299	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-667	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-405	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-555	693
Turkey Point 4	P41	23		693
Zion 1	P43	29	-17	1,040
Zion 2	P44	29		1,040
Total		1,260	-8,018	36,325
1992				
Big Rock Point	B 1	4	-49	72
Cook 2	P 7	29	-85	1,100
Cooper	B 7	27	-66	778
Fitzpatrick	B12	28	-137	821
Ft. Calhoun	P11	20	-190	457
Ginna	P12	18	-109	490
Haddam Neck	P13	23	-2	575
Humboldt Bay	B15	9	-108	65
Indian Point 2	P15	29	-333	873
Indian Point 3	P16	29	-121	873
Maine Yankee	P18	32	-317	790
Millstone 1	B17	29	-211	660
Monticello	B18	24	-111	545
Oyster Creek	B20	28	-268	650
Palisades	P25	31	-284	805
Pilgrim 1	B23	29	-174	655
Rancho Seco	P30	27	-228	918

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1991 (Continued)				
Prairie Island 1	P28	18	-244	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-522	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-335	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-485	693
Turkey Point 4	P41	23		693
Total		995	-5,281	28,507
1992				
Big Rock Point	B 1	4	-33	72
Fitzpatrick	B12	28	-25	821
Ft. Calhoun	P11	20	-131	457
Ginna	P12	18	-54	490
Humboldt Bay	B15	9	-73	65
Indian Point 2	P15	29	-246	873
Indian Point 3	P16	29	-34	873
Maine Yankee	P18	32	-220	790
Millstone 1	B17	29	-95	660
Monticello	B18	24	-15	545
Oyster Creek	B20	28	-156	650
Palisades	P25	31	-192	805
Pilgrim 1	B23	29	-58	655
Rancho Seco	P30	27	-148	918
Robinson 2	P31	23	-203	700
Three Mile Island 1	P37	27	-99	819
Three Mile Island 2	P38	27	-93	906

Table F.8. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1992 (Continued)				
Robinson 2	P31	23	-274	700
Three Mile Island 1	P37	27	-178	819
Three Mile Island 2	P38	27	-172	906
Trojan	P39	29	-204	1,130
Vermont Yankee	B26	18	-110	514
Zimmer 1	CP65	84	-1	810
Arkansas 1	P 1	27	-302	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-462	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-584	845
Calvert Cliffs 2	P 5	32		845
Dresden 1	B 8	0	-118	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Hatch 1	B13	28	-455	717
Hatch 2	B14	28		822
Oconee 1	P22	27	-1,054	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-277	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-335	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-739	789
Quad Cities 2	B25	36		789
San Onofre 1	P33	23	-59	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Surry 1	P35	23	-452	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-602	693
Turkey Point 4	P41	23		693
Zion 1	P43	29	-74	1,040
Zion 2	P44	29		1,040
Total		1,430	-9,247	39,520

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1992 (Continued)				
Trojan	P39	29	-117	1,130
Vermont Yankee	B26	18	-36	514
Arkansas 1	P 1	27	-223	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-350	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-486	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-343	717
Hatch.2	B14	28		822
Oconee 1	P22	27	-975	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-124	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-280	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-594	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-382	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-531	693
Turkey Point 4	P41	23		693
Total		1,048	-6,316	29,873

Table F.8. Continued

With Full Core Reserve					Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe	Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1993					1993				
Big Rock Point	B 1	17	-49	72	Big Rock Point	B 1	17	-49	72
Cook 2	P 7	29	-114	1,100	Cook 2	P 7	29	-27	1,100
Cooper	B 7	27	-93	778	Fitzpatrick	B12	28	-53	821
Fitzpatrick	B12	28	-165	821	Ft. Calhoun	P11	20	-150	457
Ft. Calhoun	P11	20	-210	457	Ginna	P12	18	-72	490
Ginna	P12	18	-127	490	Humboldt Bay	B15	34	-108	65
Haddam Neck	P13	23	-26	575	Indian Point 2	P15	29	-275	873
Humboldt Bay	B15	34	-108	65	Indian Point 3	P16	29	-63	873
Indian Point 2	P15	29	-361	873	Maine Yankee	P18	32	-252	790
Indian Point 3	P16	29	-149	873	Millstone 1	B17	29	-124	660
Lacrosse	B16	4	-3	50	Monticello	B18	24	-39	545
Maine Yankee	P18	32	-350	790	Oyster Creek	B20	28	-184	650
Millstone 1	B17	29	-240	660	Palisades	P25	31	-223	805
Monticello	B18	24	-136	545	Pilgrim 1	B23	29	-87	655
Oyster Creek	B20	28	-296	650	Rancho Seco	P30	27	-175	918
Palisades	P25	31	-315	805	Robinson 2	P31	23	-225	700
Pilgrim 1	B23	29	-203	655	Three Mile Island 1	P37	27	-125	819
Rancho Seco	P30	27	-254	918	Three Mile Island 2	P38	27	-119	906
Robinson 2	P31	23	-297	700	Trojan	P39	29	-146	1,130
Three Mile Island 1	P37	27	-205	819	Vermont Yankee	B26	18	-55	514
Three Mile Island 2	P38	27	-199	906	Arkansas 1	P 1	27	-276	850
Trojan	P39	29	-233	1,130	Arkansas 2	P 2	27		950
Vermont Yankee	B26	18	-128	514	Brunswick 1	B 5	28	-406	821
Zimmer 1	CP65	84	-85	810	Brunswick 2	B 6	28		821
Arkansas 1	P 1	27	-356	850	Calvert Cliffs 1	P 4	32	-551	845
Arkansas 2	P 2	27		950	Calvert Cliffs 2	P 5	32		845
Brunswick 1	B 5	28	-518	821	Dresden 1	B 8	0[d]	-46	200
Brunswick 2	B 6	28		821	Dresden 2	B 9	36		794
Calvert Cliffs 1	P 4	32	-648	845	Dresden 3	B10	36		794
Calvert Cliffs 2	P 5	32		845	Hatch 1	B13	28	-399	717
Diablo Canyon 1	CP19	29	-26	1,084	Hatch 2	B14	28		822
Diablo Canyon 2	CP20	29		1,106	Oconee 1	P22	27	-1,054	887
Dresden 1	B 8	0	-190	200	Oconee 2	P23	27		887
Dresden 2	B 9	36		794	Oconee 3	P24	27		887
Dresden 3	B10	36		794	Peach Bottom 2	B21	38	-201	1,065
Farley 1	P10	23	-46	829	Peach Bottom 3	B22	38		1,065
Farley 2	CP21	23		829	Prairie Island 1	P28	18	-316	530
Hatch 1	B13	28	-511	717	Prairie Island 2	P29	18		530

Table F.8. Continued

With Full Core Reserve					Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe	Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1993 (Continued)					1993 (Continued)				
Hatch 2	B14	28		822	Quad Cities 1	B24	36	-667	789
Oconee 1	P22	27	-1,134	887	Quad Cities 2	B25	36		789
Oconee 2	P23	27		887	San Onofre 1	P33	23	-50	436
Oconee 3	P24	27		887	San Onofre 2	CP41	32		1,140
Peach Bottom 2	B21	38	-354	1,065	San Onofre 3	CP42	32		1,140
Peach Bottom 3	B22	38		1,065	Surry 1	P35	23	-428	822
Prairie Island 1	P26	18	-371	530	Surry 2	P36	23		822
Prairie Island 2	P29	18		530	Turkey Point 3	P40	23	-578	693
Quad Cities 1	B24	36	-812	789	Turkey Point 4	P41	23		693
Quad Cities 2	B25	36		789	Zion 1	P43	29	-45	1,040
San Onofre 1	P33	23	-147	436	Zion 2	P44	29		1,040
San Onofre 2	CP41	32		1,140					
San Onofre 3	CP42	32		1,140					
St. Lucie 1	P34	32	-30	802					
Surry 1	P35	23	-499	822					
Surry 2	P36	23		822					
Turkey Point 3	P40	23	-649	693					
Turkey Point 4	P41	23		693					
Zion 1	P43	29	-132	1,040					
Zion 2	P44	29		1,040					
Total		1,641	-10,768	45,062	Total		1,333	-7,569	37,357
1994					1994				
Big Rock Point	B 1	0	-49	72	Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-143	1,100	Cook 2	P 7	29	-56	1,100
Cooper	B 7	27	-121	778	Cooper	B 7	27	-11	778
Duane Arnold	B11	18	-2	538	Fitzpatrick	B12	28	-81	821
Fitzpatrick	B12	28	-193	821	Ft. Calhoun	P11	20	-170	457
Ft. Calhoun	P11	20	-230	457	Ginna	P12	18	-90	490
Ginna	P12	18	-145	490	Humboldt Bay	B15	0	-108	65
Haddam Neck	P13	23	-49	575	Indian Point 2	P15	29	-303	873
Humboldt Bay	B15	0	-108	65	Indian Point 3	P16	29	-91	873
Indian Point 2	P15	29	-390	873	Maine Yankee	P18	32	-284	790
Indian Point 3	P16	29	-178	873	Millstone 1	B17	29	-153	660
Lacrosse	B16	4	-7	50	Monticello	B18	24	-63	545
Maine Yankee	P18	32	-382	790	Oyster Creek	B20	28	-212	650
Millstone 1	B17	29	-269	660	Palisades	P25	31	-253	805

Table F.8. Continued

With Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1994 (Continued)				
Monticello	B18	24	-160	545
Oyster Creek	B20	28	-324	650
Palisades	P25	31	-345	805
Pilgrim 1	B23	29	-232	655
Rancho Seco	P30	27	-281	918
Robinson 2	P31	23	-320	700
Summer 1	CP51	23	-22	900
Three Mile Island 1	P37	27	-231	819
Three Mile Island 2	P38	27	-225	906
Trojan	P39	29	-262	1,130
Vermont Yankee	B26	18	-147	514
Zimmer 1	CP65	84	-169	810
Arkansas 1	P 1	27	-409	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-574	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-713	845
Calvert Cliffs 2	P 5	32		845
Diablo Canyon 1	CP19	29	-83	1,084
Diablo Canyon 2	CP20	29		1,106
Dresden 1	B 8	0	-263	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Farley 1	P10	23	-93	829
Farley 2	CP21	23		829
Hatch 1	B13	28	-567	717
Hatch 2	B14	28		822
Millstone 2	P19	32	-17	830
Millstone 3	CP33	22		1,159
Oconee 1	P22	27	-1,214	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-430	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-407	530
Prairie Island 2	P29	18		530
Pt. Beach 1	P26	18	-36	497
Pt. Beach 2	P27	18		497

Without Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1994 (Continued)				
Pilgrim 1	B23	29	-116	655
Rancho Seco	P30	27	-201	918
Robinson 2	P31	23	-250	700
Three Mile Island 1	P37	27	-152	819
Three Mile Island 2	P38	27	-146	906
Trojan	P39	29	-175	1,130
Vermont Yankee	B26	18	-73	514
Arkansas 1	P 1	27	-329	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-462	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-616	845
Calvert Cliffs 2	P 5	32		845
Dresden 1	B 8	0	-118	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Farley 1	P10	23	-22	829
Farley 2	CP21	23		829
Hatch 1	B13	28	-455	717
Hatch 2	B14	28		822
Oconee 1	P22	27	-1,134	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-277	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-352	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-739	789
Quad Cities 2	B25	36		789
San Onofre 1	P33	23	-138	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Surry 1	P35	23	-475	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-625	693
Turkey Point 4	P41	23		693
Zion 1	P43	29	-103	1,040
Zion 2	P44	29		1,040

Table F.8. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1994 (Continued)				
Quad Cities 2	B25	36		789
San Onofre 1	P33	23	-235	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Sequoyah 1	CP46	29	-54	1,140
Sequoyah 2	CP45	29		1,140
St. Lucie 1	P34	32	-95	802
St. Lucie 2	CP49	32		842
Surry 1	P35	23	-546	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-696	693
Turkey Point 4	P41	23		693
Zion 1	P43	29	-189	1,040
Zion 2	P44	29		1,040
Total		1,779	-12,489	51,626
1995				
Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-171	1,100
Cooper	B 7	27	-148	778
Duane Arnold	B11	18	-21	538
Fitzpatrick	B12	28	-221	821
Ft. Calhoun	P11	20	-250	457
Ginna	P12	18	-163	490
Haddam Neck	P13	23	-72	575
Humboldt Bay	B15	0	-108	65
Indian Point 2	P15	29	-419	873
Indian Point 3	P16	29	-207	873
Lacrosse	B16	4	-10	50
Maine Yankee	P18	32	-414	790
Millstone 1	B17	29	-298	660
Monticello	B18	24	-184	545
Oyster Creek	B20	28	-352	650
Palisades	P25	31	-376	805
Pilgrim 1	B23	29	-261	655
Rancho Seco	P30	27	-307	918

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1994 (Continued)				
Total		1,356	-8,884	39,656
1995				
Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-85	1,100
Cooper	B 7	27	-39	778
Fitzpatrick	B12	28	-109	821
Ft. Calhoun	P11	20	-190	457
Ginna	P12	18	-108	490
Haddam Neck	P13	23	-2	575
Humboldt Bay	B15	0	-108	65
Indian Point 2	P15	29	-332	873
Indian Point 3	P16	29	-120	873
Maine Yankee	P18	32	-317	790
Millstone 1	B17	29	-182	660
Monticello	B18	24	-87	545
Oyster Creek	B20	28	-240	650
Palisades	P25	31	-284	805
Pilgrim 1	B23	29	-145	655
Rancho Seco	P30	27	-228	918
Robinson 2	P31	23	-273	700
Three Mile Island 1	P37	27	-178	819

Table F.8. Continued

With Full Core Reserve					Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available^{a,b}	MWe	Reactor	Code	Annual Discharges	Storage Available^{b,c}	MWe
1995 (Continued)					1995 (Continued)				
Robinson 2	P31	23	-344	700	Three Mile Island 2	P38	27	-172	906
Summer 1	CP51	23	-45	900	Trojan	P39	29	-204	1,130
Three Mile Island 1	P37	27	-258	819	Vermont Yankee	B26	18	-92	514
Three Mile Island 2	P38	27	-252	906	Zimmer 1	CP65	84	-1	810
Trojan	P39	29	-291	1,130	Arkansas 1	P 1	27	-382	850
Vermont Yankee	B26	18	-165	514	Arkansas 2	P 2	27		950
Washington Nuclear 2	CB29	38	-31	1,103	Brunswick 1	B 5	28	-518	821
Zimmer 1	CP65	84	-253	810	Brunswick 2	B 6	28		821
Arkansas 1	P 1	27	-462	850	Calvert Cliffs 1	P 4	32	-680	845
Arkansas 2	P 2	27		950	Calvert Cliffs 2	P 5	32		845
Browns Ferry 1	B 2	38	-75	1,065	Diablo Canyon 1	CP19	29	-54	1,084
Browns Ferry 2	B 3	38		1,065	Diablo Canyon 2	CP20	29		1,106
Browns Ferry 3	B 4	38		1,065	Dresden 1	B 8	0	-190	200
Brunswick 1	B 5	28	-630	821	Dresden 2	B 9	36		794
Brunswick 2	B 6	28		821	Dresden 3	B10	36		794
Calvert Cliffs 1	P 4	32	-778	845	Farley 1	P10	23	-69	829
Calvert Cliffs 2	P 5	32		845	Farley 2	CP21	23		829
Diablo Canyon 1	CP19	29	-141	1,084	Hatch 1	B13	28	-511	717
Diablo Canyon 2	CP20	29		1,106	Hatch 2	B14	28		822
Dresden 1	B 8	0	-335	200	Oconee 1	P22	27	-1,214	887
Dresden 2	B 9	36		794	Oconee 2	P23	27		887
Dresden 3	B10	36		794	Oconee 3	P24	27		887
Farley 1	P10	23	-140	829	Peach Bottom 2	B21	38	-354	1,065
Farley 2	CP21	23		829	Peach Bottom 3	B22	38		1,065
Hatch 1	B13	28	-623	717	Prairie Island 1	P28	18	-388	530
Hatch 2	B14	28		822	Prairie Island 2	P29	18		530
McGuire 1	CP29	23	-49	1,180	Pt. Beach 1	P26	18	-17	497
McGuire 2	CP30	29		1,180	Pt. Beach 2	P27	18		497
Millstone 2	P19	32	-71	830	Quad Cities 1	B24	36	-812	789
Millstone 3	CP33	22		1,159	Quad Cities 2	B25	36		789
Oconee 1	P22	27	-1,293	887	San Onofre 1	P33	23	-226	436
Oconee 2	P23	27		887	San Onofre 2	CP41	32		1,140
Oconee 3	P24	27		887	San Onofre 3	CP42	32		1,140
Peach Bottom 3	B22	38		1,065	Sequoyah 2	CP45	29		1,140
Prairie Island 1	P28	18	-443	530	St. Lucie 1	P34	32	-62	802
Prairie Island 2	P29	18		530	St. Lucie 2	CP49	32		842
Pt. Beach 1	P26	18	-72	497	Surry 1	P35	23	-522	822

Table F.8. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1995 (Continued)				
Pt. Beach 2	P27	18		497
Quad Cities 1	B24	36	-956	789
Quad Cities 2	B25	36		789
Salem 1	P32	29	-48	1,090
Salem 2	CP40	29		1,115
San Onofre 1	P33	23	-324	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Sequoyah 1	CP46	29	-112	1,140
Sequoyah 2	CP45	29		1,140
St. Lucie 1	P34	32	-160	802
St. Lucie 2	CP49	32		842
Surry 1	P35	23	-593	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-743	693
Turkey Point 4	P41	23		693
Watts Bar 1	CP60	29	-54	1,165
Watts Bar 2	CP61	29		1,165
Zion 1	P43	29	-247	1,040
Zion 2	P44	29		1,040
Total		2,099	-14,526	62,819
1996				
Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-200	1,100
Cooper	B 7	27	-176	778
Crystal River 3	P 8	27	-9	825
Duane Arnold	B11	18	-39	538
Enrico Fermi 2	CB 6	38	-31	1,123
Fitzpatrick	B12	28	-249	821
Ft. Calhoun	P11	20	-270	457
Ginna	P12	18	-181	490
Haddam Neck	P13	23	-96	575
Humboldt Bay	B15	0	-108	65
Indian Point 2	P15	29	-448	873
Indian Point 3	P16	29	-236	873
LaCrosse	B16	4	-14	50

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1995 (Continued)				
Surry 2	P36	23		822
Turkey Point 3	P40	23	-672	693
Turkey Point 4	P41	23		693
Zion 1	P43	29	-160	1,040
Zion 2	P44	29		1,040
Total		1,680	-10,401	48,149
1996				
Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-113	1,100
Cooper	B 7	27	-66	778
Fitzpatrick	B12	28	-137	821
Ft. Calhoun	P11	20	-210	457
Ginna	P12	18	-126	490
Haddam Neck	P13	23	-25	575
Humboldt Bay	B15	0	-108	65
Indian Point 2	P15	29	-361	873
Indian Point 3	P16	29	-149	873
Maine Yankee	P18	32	-349	790
Millstone 1	B17	29	-211	660
Monticello	B18	24	-111	545
Oyster Creek	B20	28	-268	650

Table F.8. Continued

With Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1996 (Contined)				
Maine Yankee	P18	32	-447	790
Millstone 1	B17	29	-327	660
Monticello	B18	24	-208	545
Oyster Creek	B20	28	-380	650
Palisades	P25	31	-406	805
Pilgrim 1	B23	29	-290	655
Rancho Seco	P30	27	-334	918
Robinson 2	P31	23	-367	700
Shoreham	CB26	28	-22	854
Summer 1	CP51	23	-69	900
Three Mile Island 1	P37	27	-284	819
Three Mile Island 2	P38	27	-279	906
Trojan	P39	29	-320	1,130
Vermont Yankee	B26	18	-184	514
Washington Nuclear 2	CB29	38	-69	1,103
Waterford 3	CP59	31	-29	1,267
Zimmer 1	CP65	84	-338	810
Arkansas 1	P 1	27	-515	850
Arkansas 2	P 2	27		950
Browns Ferry 1	B 2	38	-190	1,065
Browns Ferry 2	B 3	38		1,065
Browns Ferry 3	B 4	38		1,065
Brunswick 1	B 5	28	-686	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-843	845
Calvert Cliffs 2	P 5	32		845
Diablo Canyon 1	CP19	29	-198	1,084
Diablo Canyon 2	CP20	29		1,106
Dresden 1	B 8	0	-408	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Farley 1	P10	23	-186	829
Farley 2	CP21	23		829
Hatch 1	B13	28	-679	717
Hatch 2	B14	28		822
LaSalle 1	CB15	38	-23	1,078
LaSalle 2	CB16	38		1,078
McGuire 1	CP29	23	-101	1,180

Without Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1996 (Continued)				
Palisades	P25	31	-315	805
Pilgrim 1	B23	29	-174	655
Rancho Seco	P30	27	-254	918
Robinson 2	P31	23	-297	700
Three Mile Island 1	P37	27	-205	819
Three Mile Island 2	P38	27	-199	906
Trojan	P39	29	-233	1,130
Vermont Yankee	B26	18	-110	514
Zimmer 1	CP65	84	-86	810
Arkansas 1	P 1	27	-435	850
Arkansas 2	P 2	27		950
Browns Ferry 1	B 2	38	-37	1,065
Browns Ferry 2	B 3	38		1,065
Browns Ferry 3	B 4	38		1,065
Brunswick 1	B 5	28	-574	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-745	845
Calvert Cliffs 2	P 5	32		845
Diablo Canyon 1	CP19	29	-112	1,084
Diablo Canyon 2	CP20	29		1,106
Dresden 1	B 8	0	-263	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Farley 1	P10	23	-116	829
Farley 2	CP21	23		829
Hatch 1	B13	28	-567	717
Hatch 2	B14	28		822
McGuire 1	CP29	23	-14	1,180
McGuire 2	CP30	29		1,180
Millstone 2	P19	32	-38	830
Millstone 3	CP33	22		1,159
Oconee 1	P22	27	-1,293	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-430	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-424	530
Prairie Island 2	P29	18		530

Table F.8. Continued

With Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available^{a,b}	MWe
1996 (Continued)				
Millstone 2	P19	32	-125	830
Millstone 3	CP33	22		1,159
Oconee 1	P22	27	-1,373	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-583	1,065
Peach Bottom 3	B22	36		1,065
Prairie Island 1	P28	18	-479	530
Prairie Island 2	P29	18		530
Pt. Beach 1	P26	18	-108	497
Pt. Beach 2	P27	18		497
Quad Cities 1	B24	36	-1,029	789
Quad Cities 2	B25	36		789
Salem 1	P32	29	-106	1,090
Salem 2	CP40	29		1,115
San Onofre 1	P33	23	-412	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Sequoyah 1	CP46	29	-170	1,140
Sequoyah 2	CP45	29		1,140
St. Lucie 1	P34	32	-225	802
St. Lucie 2	CP49	32		842
Surry 1	P35	23	-639	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-789	693
Turkey Point 4	P41	23		693
Watts Bar 1	CP60	29	-112	1,165
Watts Bar 2	CP61	29		1,165
Zion 1	P43	29	-305	1,040
Zion 2	P44	29		1,040
Total		2,299	-16,739	69,044
1997				
Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-229	1,100
Cooper	B 7	27	-203	778

Without Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available^{b,c}	MWe
1996 (Continued)				
Pt. Beach 2	P27	18		497
Quad Cities 1	B24	36	-884	789
Quad Cities 2	B25	36		789
Salem 1	P32	29	-19	1,090
Salem 2	CP40	29		1,115
San Onofre 1	P33	23	-314	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Sequoyah 1	CP46	29	-83	1,140
Sequoyah 2	CP45	29		1,140
St. Lucie 1	P34	32	-127	802
St. Lucie 2	CP49	32		842
Surry 1	P35	23	-569	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-719	693
Turkey Point 4	P41	23		693
Watts Bar 1	CP60	29	-25	1,165
Watts Bar 2	CP61	29		1,165
Zion 1	P43	29	-218	1,040
Zion 2	P44	29		1,040
Total		2,016	-12,215	60,228
1997				
Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-142	1,100
Cooper	B 7	27	-93	778

Table F.8. Continued

With Full Core Reserve					Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available^{a,b}	MWe	Reactor	Code	Annual Discharges	Storage Available^{b,c}	MWe
1997 (Continued)					1997 (Continued)				
Crystal River 3	P 8	27	-36	825	Fitzpatrick	B12	28	-165	821
Duane Arnold	B11	18	-58	538	Ft. Calhoun	P11	20	-230	457
Enrico Fermi 2	CB 6	38	-69	1,123	Ginna	P12	18	-144	490
Fitzpatrick	B12	28	-277	821	Haddam Neck	P13	23	-49	575
Ft. Calhoun	P11	20	-289	457	Humboldt Bay	B15	0	-108	65
Ginna	P12	18	-199	490	Indian Point 2	P15	29	-390	873
Haddam Neck	P13	23	-119	575	Indian Point 3	P16	29	-178	873
Humboldt Bay	B15	0	-108	65	LaCrosse	B16	4	-3	50
Indian Point 2	P15	29	-477	873	Maine Yankee	P18	32	-382	790
Indian Point 3	P16	29	-265	873	Millstone 1	B17	29	-240	660
Kewaunee	P17	18	-1	535	Monticello	B18	24	-136	545
LaCrosse	B16	4	-17	50	Oyster Creek	B20	28	-296	650
Maine Yankee	P18	32	-479	790	Palisades	P25	31	-245	805
Millstone 1	B17	29	-356	660	Pilgrim 1	B23	29	-203	655
Monticello	B18	24	-232	545	Rancho Seco	P30	27	-281	918
Oyster Creek	B20	28	-408	650	Robinson 2	P31	23	-320	700
Palisades	P25	31	-437	805	Summer 1	CP51	23	-22	900
Pilgrim 1	B23	29	-319	655	Three Mile Island 1	P37	27	-231	819
Rancho Seco	P30	27	-360	918	Three Mile Island 2	P38	27	-225	906
Robinson 2	P31	23	-391	700	Trojan	P39	29	-261	1,130
Shoreham	CB26	28	-50	854	Vermont Yankee	B26	18	-128	514
Summer 1	CP51	23	-92	900	Zimmer 1	CP65	84	-170	810
Three Mile Island 1	P37	27	-311	819	Arkansas 1	P 1	27	-488	850
Three Mile Island 2	P38	27	-305	906	Arkansas 2	P 2	27		950
Trojan	P39	29	-348	1,130	Browns Ferry 1	B 2	38	-152	1,065
Vermont Yankee	B26	18	-202	514	Browns Ferry 2	B 3	38		1,065
Washington Nuclear 2	CB29	38	-107	1,103	Browns Ferry 3	B 4	38		1,065
Waterford 3	CP59	31	-60	1,267	Brunswick 1	B 5	28	-630	821
Zimmer 1	CP65	84	-422	810	Brunswick 2	B 6	28		821
Arkansas 1	P 1	27	-568	850	Calvert Cliffs 1	P 4	32	-810	845
Arkansas 2	P 2	27		950	Calvert Cliffs 2	P 5	32		845
Bellefonte 1	CP 2	31	-27	1,235	Diablo Canyon 1	CP19	29	-169	1,084
Bellefonte 2	CP 3	31		1,235	Diablo Canyon 2	CP20	29		1,106
Braidwood 1	CP 4	29	-26	1,120	Dresden 1	B 8	0	-335	200
Braidwood 2	CP 5	29		1,120	Dresden 2	B 9	36		794
Browns Ferry 1	B 2	38	-304	1,065	Dresden 3	B10	36		794
Browns Ferry 2	B 3	38		1,065	Farley 1	P10	23	-162	829
Browns Ferry 3	B 4	38		1,065	Farley 2	CP21	23		829

Table F.8. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1997 (Continued)				
Brunswick 1	B 5	28	-742	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-908	845
Calvert Cliffs 2	P 5	32		845
Comanche Peak 1	CP15	29	-26	1,150
Comanche Peak 2	CP16	29		1,150
Diablo Canyon 1	CP19	29	-256	1,084
Diablo Canyon 2	CP20	29		1,106
Dresden 1	B 8	0	-480	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Farley 2	CP21	23		829
Hatch 1	B13	28	-735	717
Hatch 2	B14	28		822
LaSalle 1	CB15	38	-99	1,078
LaSalle 2	CB16	38		1,078
McGuire 1	CP29	23	-153	1,180
McGuire 2	CP30	29		1,180
Midland 1	CP31	27	-52	492
Midland 2	CP32	27		887
Millstone 2	P19	32	-186	830
Millstone 3	CP33	29		1,159
Oconee 1	P22	27	-1,453	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-659	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-515	530
Prairie Island 2	P29	18		530
Pt. Beach 1	P26	18	-144	497
Pt. Beach 2	P27	18		497
Quad Cities 1	B24	36	-1,101	789
Quad Cities 2	B25	36		789
Salem 1	P32	29	-163	1,090
Salem 2	CP40	29		1,115
San Onofre 1	P33	23	-500	436
San Onofre 2	CP41	32		1,140

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1997 (Continued)				
Hatch 1	B13	28	-623	717
Hatch 2	B14	28		822
McGuire 1	CP29	23	-67	1,180
McGuire 2	CP30	29		1,180
Millstone 2	P19	32	-99	830
Millstone 3	CP33	29		1,159
Oconee 1	P22	27	-1,373	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-506	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 2	P29	18		530
Pt. Beach 1	P26	18	-89	497
Pt. Beach 2	P27	18		497
Quad Cities 1	B24	36	-956	789
Quad Cities 2	B25	36		789
Salem 1	P32	29	-77	1,090
Salem 2	CP40	29		1,115
San Onofre 1	P33	23	-402	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Sequoyah 1	CP46	29	-140	1,140
Sequoyah 2	CP45	29		1,140
St. Lucie 1	P34	32	-192	802
St. Lucie 2	CP49	32		842
Surry 1	P35	23	-616	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-765	693
Turkey Point 4	P41	23		693
Watts Bar 1	CP60	29	-83	1,165
Watts Bar 2	CP61	29		1,165
Zion 1	P43	29	-275	1,040
Zion 2	P44	29		1,040

Table F.8. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1997 (Continued)				
San Onofre 3	CP42	32		1,140
Sequoyah 1	CP46	29	-227	1,140
Sequoyah 2	CP45	29		1,140
St. Lucie 1	P34	32	-289	802
St. Lucie 2	CP49	32		842
Surry 1	P35	23	-686	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-836	693
Turkey Point 4	P41	23		693
Watts Bar 1	CP60	29	-170	1,165
Watts Bar 2	CP61	29		1,165
Zion 1	P43	29	-362	1,040
Zion 2	P44	29		1,040
Total		2,554	-19,177	77,968
1998				
Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-258	1,100
Cooper	B 7	27	-230	778
Crystal River 3	P 8	27	-62	825
Duane Arnold	B11	18	-76	538
Enrico Fermi 2	CB 6	38	-107	1,123
Fitzpatrick	B12	28	-305	821
Ft. Calhoun	P11	20	-309	457
Ginna	P12	18	-217	490
Haddam Neck	P13	71	-119	575
Humboldt Bay	B15	0	-108	65
Indian Point 2	P15	29	-515	873
Indian Point 3	P16	29	-293	873
Kewaunee	P17	18	-18	535
Lacrosse	B16	4	-21	50
Maine Yankee	P18	32	-512	790
Millstone 1	B17	29	-385	660
Monticello	B18	24	-257	545
Oyster Creek	B20	28	-436	650
Palisades	P25	31	-468	805

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1997 (Continued)				
Total		2,050	-14,262	61,178
1998				
Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-171	1,100
Cooper	B 7	27	-121	778
Duane Arnold	B11	18	-2	538
Fitzpatrick	B12	28	-193	821
Ft. Calhoun	P11	20	-249	457
Ginna	P12	18	-162	490
Haddam Neck	P13	71	-119	575
Humboldt Bay	B15	0	-108	65
Indian Point 2	P15	29	-419	873
Indian Point 3	P16	29	-207	873
Lacrosse	B16	4	-7	50
Maine Yankee	P18	32	-414	790
Millstone 1	B17	29	-269	660
Monticello	B18	24	-160	545
Oyster Creek	B20	28	-324	650
Palisades	P25	31	-376	805
Pilgrim 1	B23	29	-232	655
Rancho Seco	P30	27	-308	918
Robinson 2	P31	23	-343	700

Table F.8. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1998 (Continued)				
Pilgrim 1	B23	29	-348	655
Rancho Seco	P30	27	-387	918
Robinson 2	P31	23	-515	700
Shoreham	CB26	28	-78	854
Summer 1	CP51	23	-116	900
Three Mile Island 1	P37	27	-338	819
Three Mile Island 2	P38	27	-332	906
Trojan	P39	29	-377	1,130
Vermont Yankee	B26	18	-220	514
Washington Nuclear 2	CB29	38	-145	1,103
Waterford 3	CP59	31	-90	1,2[illegible]
Zimmer 1	CP65	84	-506	810
Arkansas 1	P 1	27	-621	850
Arkansas 2	P 2	27		950
Beaver Valley 1	P 3	23	-27	852
Beaver Valley 2	CP 1	23		852
Bellefonte 1	CP 2	31	-89	1,235
Bellefonte 2	CP 3	31		1,235
Braidwood 1	CP 4	29	-83	1,120
Braidwood 2	CP 5	29		1,120
Browns Ferry 1	B 2	38	-419	1,065
Browns Ferry 2	B 3	38		1,065
Browns Ferry 3	B 4	38		1,065
Brunswick 1	B 5	28	-798	821
Brunswick 2	B 6	28		821
Byron 1	CP 6	29	-54	1,120
Byron 2	CP 7	29		1,120
Calvert Cliffs 1	P 4	32	-972	845
Calvert Cliffs 2	P 5	32		845
Catawba 1	CP10	29	-54	1,145
Catawba 2	CP11	29		1,145
Comanche Peak 1	CP15	29	-83	1,150
Diablo Canyon 1	CP19	29	-314	1,084
Diablo Canyon 2	CP20	29		1,106
Dresden 1	B 8	0	-552	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Farley 1	P10	23	-280	829

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1998 (Continued)				
Summer 1	CP51	23	-45	900
Three Mile Island 1	P37	27	-258	819
Three Mile Island 2	P38	27	-252	906
Trojan	P39	29	-290	1,130
Vermont Yankee	B26	18	-147	514
Zimmer 1	CP65	84	-254	810
Arkansas 1	P 1	27	-541	850
Arkansas 2	P 2	27		950
Browns Ferry 1	B 2	38	-266	1,065
Browns Ferry 2	B 3	38		1,065
Browns Ferry 3	B 4	38		1,065
Brunswick 1	B 5	28	-686	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-875	845
Calvert Cliffs 2	P 5	32		845
Diablo Canyon 1	CP19	29	-227	1,084
Diablo Canyon 2	CP20	29		1,106
Dresden 1	B 8	0	-408	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Farley 1	P10	23	-209	829
Farley 2	CP21	23		829
Hatch 1	B13	28	-679	717
Hatch 2	B14	28		822
LaSalle 1	CB15	38	-23	1,078
LaSalle 2	CB16	38		1,078
McGuire 1	CP29	23	-119	1,180
McGuire 2	CP30	29		1,180
Midland 1	CP31	27	-26	492
Midland 2	CP32	27		887
Millstone 2	P19	32	-161	830
Millstone 3	CP33	29		1,159
North Anna 2	CP34	23		943
North Anna 3	CP35	22		907
North Anna 4	CP36	22		907
Oconee 1	P22	27	-1,453	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887

Table F.8. Continued

With Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1998 (Continued)				
Farley 2	CP21	23		829
Hatch 1	B13	28	-791	717
Hatch 2	B14	28		822
LaSalle 1	CB15	38	-176	1,078
LaSalle 2	CB16	38		1,078
McGuire 1	CP29	23	-206	1,180
McGuire 2	CP30	29		1,180
Midland 1	CP31	27	-105	492
Midland 2	CP32	27		887
Millstone 2	P19	32	-248	830
Millstone 3	CP33	29		1,159
North Anna 1	P20	23	-81	907
North Anna 2	CP34	23		943
North Anna 3	CP35	22		907
North Anna 4	CP36	22		907
Oconee 1	P22	27	-1,532	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-736	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-551	530
Prairie Island 2	P29	18		530
Pt. Beach 1	P26	18	-180	497
Pt. Beach 2	P27	18		497
Quad Cities 1	B24	36	-1,174	789
Quad Cities 2	B25	36		789
Salem 1	P32	29	-221	1,090
Salem 2	CP40	29		1,115
San Onofre 1	P33	71	-635	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Sequoyah 1	CP46	29	-285	1,140
Sequoyah 2	CP45	29		1,140
St. Lucie 1	P34	32	-354	802
St. Lucie 2	CP49	32		842
Surry 1	P35	23	-733	822
Surry 2	P36	23		822

Without Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1998 (Continued)				
Peach Bottom 2	B21	38	-583	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-496	530
Prairie Island 2	P29	18		530
Pt. Beach 1	P26	18	-125	497
Pt. Beach 2	P27	18		497
Quad Cities 1	B24	36	-1,029	789
Quad Cities 2	B25	36		789
Salem 1	P32	29	-134	1,090
Salem 2	CP40	29		1,115
San Onofre 1	P33	71	-538	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Sequoyah 1	CP46	29	-198	1,140
Sequoyah 2	CP45	29		1,140
St. Lucie 1	P34	32	-257	802
St. Lucie 2	CP49	32		842
Surry 1	P35	23	-662	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-812	693
Turkey Point 4	P41	23		693
Watts Bar 1	CP6[illegible]	29	-140	1,165
Watts Bar 2	CP6[illegible]	29		1,165
Zion 1	P43	29	-333	1,040
Zion 2	P44	29		1,040

Table F.8. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1998 (Continued)				
Turkey Point 3	P40	23	-883	693
Turkey Point 4	P41	23		693
Watts Bar 1	CP60	29	-227	1,165
Watts Bar 2	CP61	29		1,165
Zion 1	P43	29	-420	1,040
Zion 2	P44	29		1,040
Total		2,900	-21,971	87,866
1999				
Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-287	1,100
Cooper	B 7	27	-258	778
Crystal River 3	P 8	27	-89	825
Duane Arnold	B11	18	-94	538
Enrico Fermi 2	CB 6	38	-145	1,123
Fitzpatrick	B12	28	-333	821
Ft. Calhoun	P11	20	-329	457
Ginna	P12	18	-235	490
Haddam Neck	P13	0	-119	575
Humboldt Bay	B15	0	-108	65
Indian Point 2	P15	29	-534	873
Indian Point 3	P16	29	-322	873
Kewaunee	P17	18	-36	535
Lacrosse	B16	14	-21	50
Maine Yankee	P18	32	-544	790
Millstone 1	B17	29	-414	660
Monticello	B18	24	-281	545
Oyster Creek	B20	112	-436	650
Palisades	P25	31	-498	805
Pilgrim 1	B23	29	-377	655
Rancho Seco	P30	27	-414	918
Robinson 2	P31	23	-437	700
Shoreham	CB26	28	-106	854
Summer 1	CP51	23	-139	900
Three Mile Island 1	P37	27	-364	819
Three Mile Island 2	P38	27	-358	906
Trojan	P39	29	-406	1,130

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1998 (Continued)				
Total		2,382	-16,467	68,915
1999				
Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-200	1,100
Cooper	B 7	27	-148	778
Crystal River 3	P 8	27	-9	825
Duane Arnold	B11	18	-21	538
Fitzpatrick	B12	28	-221	821
Ft. Calhoun	P11	20	-269	457
Ginna	P12	18	-180	490
Haddam Neck	P13	0	-119	575
Humboldt Bay	B15	0	-108	65
Indian Point 2	P15	29	-447	873
Indian Point 3	P16	29	-235	873
Lacrosse	B16	14	-21	50
Maine Yankee	P18	32	-446	790
Millstone 1	B17	29	-298	660
Monticello	B18	24	-184	545
Oyster Creek	B20	112	-436	650
Palisades	P25	31	-406	805
Pilgrim 1	B23	29	-261	655
Rancho Seco	P30	27	-334	918
Robinson 2	P31	23	-367	700
Summer 1	CP51	23	-68	900
Three Mile Island 1	P37	27	-284	819
Three Mile Island 2	P38	27	-279	906
Trojan	P39	29	-319	1,130
Vermont Yankee	B26	18	-165	514
Washington Nuclear 2	CB29	38	-31	1,103
Waterford 3	CP59	31	-29	1,267

Table F.8. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1999 (Continued)				
Vermont Yankee	B26	18	-239	514
Washington Nuclear 2	CB29	38	-183	1,103
Waterford 3	CP59	31	-121	1,267
Wolf Creek 1	CP62	29	-27	1,150
Zimmer 1	CP65	84	-590	810
Arkansas 1	P 1	27	-674	850
Arkansas 2	P 2	27		950
Beaver Valley 1	P 3	23	-74	852
Beaver Valley 2	CP 1	23		852
Bellefonte 1	CP 2	31	-150	1,235
Bellefonte 2	CP 3	31		1,235
Braidwood 1	CP 4	29	-141	1,120
Braidwood 2	CP 5	29		1,120
Browns Ferry 1	B 2	38	-534	1,065
Browns Ferry 2	B 3	38		1,065
Browns Ferry 3	B 4	38		1,065
Brunswick 1	B 5	28	-854	821
Brunswick 2	B 6	28		821
Byron 1	CP 6	29	-112	1,120
Byron 2	CP 7	29		1,120
Calvert Cliffs 1	P 4	32	-1,037	845
Calvert Cliffs 2	P 5	32		845
Catawba 1	CP10	29	-112	1,145
Catawba 2	CP11	29		1,145
Comanche Peak 2	CP16	29		1,150
Diablo Canyon 1	CP19	29	-371	1,084
Diablo Canyon 2	CP20	29		1,106
Dresden 1	B 8	0	-625	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Farley 1	P10	23	-327	829
Farley 2	CP21	23		829
Hatch 1	B13	28	-847	717
Hatch 2	B14	28		822
LaSalle 1	CB15	38	-252	1,078
LaSalle 2	CB16	38		1,078
McGuire 1	CP29	23	-258	1,180
McGuire 2	CP30	29		1,180

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1999 (Continued)				
Zimmer 1	CP65	84	-338	810
Arkansas 1	P 1	27	-594	850
Arkansas 2	P 2	27		950
Beaver Valley 1	P 3	23	-4	852
Beaver Valley 2	CP 1	23		852
Bellefonte 1	CP 2	31	-58	1,235
Bellefonte 2	CP 3	31		1,235
Braidwood 1	CP 4	29	-54	1,120
Braidwood 2	CP 5	29		1,120
Browns Ferry 1	B 2	38	-381	1,065
Browns Ferry 2	B 3	38		1,065
Browns Ferry 3	B 4	38		1,065
Brunswick 1	B 5	28	-742	821
Brunswick 2	B 6	28		821
Byron 1	CP 6	29	-25	1,120
Byron 2	CP 7	29		1,120
Calvert Cliffs 1	P 4	32	-940	845
Calvert Cliffs 2	P 5	32		845
Catawba 1	CP10	29	-25	1,145
Catawba 2	CP11	29		1,145
Comanche Peak 1	CP15	29	-54	1,150
Comanche Peak 2	CP16	29		1,150
Diablo Canyon 1	CP19	29	-284	1,084
Diablo Canyon 2	CP20	29		1,106
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Farley 1	P10	23	-256	829
Farley 2	CP21	23		829
Hatch 1	B13	28	-735	717
Hatch 2	B14	28		822
LaSalle 1	CB15	38	-99	1,078
LaSalle 2	CB16	38		1,078
McGuire 1	CP29	23	-171	1,180
McGuire 2	CP30	29		1,180
Midland 1	CP31	27	-79	492
Midland 2	CP32	27		887
Millstone 2	P19	32	-222	830
Millstone 3	CP33	29		1,159

Table F.8. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1999 (Continued)				
Midland 1	CP31	27	-158	492
Midland 2	CP32	27		887
Millstone 2	P19	32	-309	830
Millstone 3	CP33	29		1,159
Nine Mile Point 1	B19	106	-8	610
Nine Mile Point 2	CB19	38		1,080
North Anna 1	P20	23	-165	907
North Anna 2	CP34	23		943
North Anna 3	CP35	22		907
North Anna 4	CP36	22		907
Oconee 1	P22	27	-1,612	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-812	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-587	530
Prairie Island 2	P29	18		530
Pt. Beach 1	P26	18	-216	497
Pt. Beach 2	P27	18		497
Quad Cities 1	B24	36	-1,246	789
Quad Cities 2	B25	36		789
Salem 1	P32	29	-279	1,090
Salem 2	CP40	29		1,115
San Onofre 1	P33	0	-673	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Sequoyah 1	CP46	29	-342	1,140
Sequoyah 2	CP45	29		1,140
South Texas 1	CP47	29	-54	1,250
South Texas 2	CP48	29		1,250
St. Lucie 1	P34	32	-419	802
St. Lucie 2	CP49	32		842
Surry 1	P35	23	-780	822
Surry 2	P36	23		822
Susquehanna 1	CB27	38	-61	1,052
Susquehanna 2	CB28	38		1,052
Turkey Point 3	P40	23	-930	693

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1999 (Continued)				
North Anna 1	P20	23	-100	907
North Anna 2	CP34	23		943
North Anna 3	CP35	22		907
North Anna 4	CP36	22		907
Oconee 1	P22	27	-1,532	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-659	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-532	530
Prairie Island 2	P29	18		530
Pt. Beach 1	P26	18	-161	497
Pt. Beach 2	P27	18		497
Quad Cities 1	B24	36	-1,101	789
Quad Cities 2	B25	36		789
Salem 1	P32	29	-192	1,090
Salem 2	CP40	29		1,115
San Onofre 1	P33	0	-603	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Sequoyah 1	CP46	29	-256	1,140
Sequoyah 2	CP45	29		1,140
St. Lucie 1	P34	32	-321	802
St. Lucie 2	CP49	32		842
Surry 1	P35	23	-709	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-859	693
Turkey Point 4	P41	23		693
Watts Bar 1	CP60	29	-198	1,165
Watts Bar 2	CP61	29		1,165
Zion 1	P43	29	-391	1,040
Zion 2	P44	29		1,040

Table F.8. Continued

With Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1999 (Continued)				
Turkey Point 4	P41	23		693
Watts Bar 1	CP60	29	-284	1,165
Watts Bar 2	CP61	29		1,165
Zion 1	P43	29	-477	1,040
Zion 2	P44	29		1,040
Total		3,161	-24,817	94,299
2000				
Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-315	1,100
Cooper	B 7	27	-285	778
Crystal River 3	P 8	27	-115	825
Duane Arnold	B11	18	-113	538
Enrico Fermi 2	CB 6	38	-184	1,123
Fitzpatrick	B12	28	-361	821
Forked River	CP22	32	-31	1,070
Ft. Calhoun	P11	20	-349	457
Ginna	P12	54	-235	490
Haddam Neck	P13	0	-119	575
Humboldt Bay	B15	0	-108	65
Indian Point 2	P15	29	-563	873
Indian Point 3	P16	29	-351	873
Kewaunee	P17	18	-54	535
Lacrosse	B16	0	-21	50
Maine Yankee	P18	32	-576	790
Millstone 1	B17	29	-443	660
Monticello	B18	24	-305	545
Oyster Creek	B20	0	-436	650
Palisades	P25	31	-529	805
Pilgrim 1	B23	29	-406	655
Rancho Seco	P30	27	-440	918
Robinson 2	P31	23	-461	700
Shoreham	CB26	28	-134	854
Summer 1	CP51	23	-162	900
Three Mile Island 1	P37	27	-391	819
Three Mile Island 2	P38	27	-385	906

Without Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1999 (Continued)				
Total		2,769	-19,091	84,343
2000				
Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-229	1,100
Cooper	B 7	27	-176	778
Crystal River 3	P 8	27	-36	825
Duane Arnold	B11	18	-39	538
Enrico Fermi 2	CB 6	38	-31	1,123
Fitzpatrick	B12	28	-249	821
Ft. Calhoun	P11	20	-289	457
Ginna	P12	54	-235	490
Haddam Neck	P13	0	-119	575
Humboldt Bay	B15	0	-108	65
Indian Point 2	P15	29	-476	873
Indian Point 3	P16	29	-264	873
Kewaunee	P17	18	0	535
Lacrosse	B16	0	-21	50
Maine Yankee	P18	32	-479	790
Millstone 1	B17	29	-327	660
Monticello	B18	24	-308	545
Oyster Creek	B20	0	-436	650
Palisades	P25	31	-437	805
Pilgrim 1	B23	29	-290	655
Rancho Seco	P30	27	-360	918
Robinson 2	P31	23	-390	700
Shoreham	CB26	28	-22	854
Summer 1	CP51	23	-92	900
Three Mile Island 1	P37	27	-312	819
Three Mile Island 2	P38	27	-305	906
Trojan	P39	29	-348	1,130

Table F.8. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
2000 (Continued)				
Trojan	P39	29	-435	1,130
Vermont Yankee	B26	18	-257	514
Washington Nuclear 2	CB29	33	-222	1,103
Waterford 3	CP59	31	-152	1,267
Wolf Creek 1	CP62	29	-56	1,150
Zimmer 1	CP65	84	-674	810
Arkansas 1	P 1	27	-727	850
Arkansas 2	P 2	27		950
Beaver Valley 1	P 3	23	-121	852
Beaver Valley 2	CP 1	23		852
Bellefonte 1	CP 2	31	-211	1,235
Bellefonte 2	CP 3	31		1,235
Braidwood 1	CP 4	29	-198	1,120
Braidwood 2	CP 5	29		1,120
Browns Ferry 1	B 2	38	-648	1,065
Browns Ferry 2	B 3	38		1,065
Browns Ferry 3	B 4	38		1,065
Brunswick 1	B 5	28	-910	821
Brunswick 2	B 6	28		821
Byron 1	CP 6	29	-170	1,120
Byron 2	CP 7	29		1,120
Calvert Cliffs 1	P 4	32	-1,102	845
Calvert Cliffs 2	P 5	32		845
Catawba 1	CP10	29	-170	1,145
Catawba 2	CP11	29		1,145
Comanche Peak 1	CP15	29	-198	1,150
Comanche Peak 2	CP16	29		1,150
Diablo Canyon 1	CP19	29	-429	1,084
Diablo Canyon 2	CP20	29		1,106
Dresden 1	B 8	0	-697	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Farley 1	P10	23	-374	829
Farley 2	CP21	23		829
Hatch 1	B13	28	-903	717
Hatch 2	B14	28		822
LaSalle 1	CB15	38	-329	1,078
LaSalle 2	CB16	38		1,078

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
2000 (Continued)				
Vermont Yankee	B26	18	-184	514
Washington Nuclear 2	CB29	38	-69	1,103
Waterford 3	CP59	31	-59	1,267
Zimmer 1	CP65	84	-422	810
Arkansas 1	P 1	27	-648	850
Arkansas 2	P 2	27		950
Beaver Valley 1	P 3	23	-50	852
Beaver Valley 2	CP 1	23		852
Bellefonte 1	CP 2	31	-119	1,235
Bellefonte 2	CP 3	31		1,235
Braidwood 1	CP 4	29	-112	1,120
Braidwood 2	CP 5	29		1,120
Browns Ferry 1	B 2	38	-495	1,065
Browns Ferry 2	B 3	38		1,065
Browns Ferry 3	B 4	38		1,065
Brunswick 1	B 5	28	-798	821
Brunswick 2	B 6	28		821
Byron 1	CP 6	29	-83	1,120
Byron 2	CP 7	29		1,120
Calvert Cliffs 1	P 4	32	-1,004	845
Calvert Cliffs 2	P 5	32		845
Catawba 1	CP10	29	-83	1,145
Catawba 2	CP11	29		1,145
Comanche Peak 1	CP15	29	-112	1,150
Diablo Canyon 1	CP19	29	-342	1,034
Diablo Canyon 2	CP20	29		1,106
Dresden 1	B 8	0	-552	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Farley 1	P10	23	-303	829
Farley 2	CP21	23		829
Hatch 1	B13	28	-791	717
Hatch 2	B14	28		822
LaSalle 1	CB15	38	-176	1,078
LaSalle 2	CB16	38		1,078
McGuire 1	CP29	23	-223	1,180
McGuire 2	CP30	29		1,180
Midland 1	CP31	27	-132	492

Table F.8. Continued

With Full Core Reserve					Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe	Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
2000 (Continued)					2000 (Continued)				
Marble Hill 1	CP27	29	-54	1,130	Midland 2	CP32	27		887
Marble Hill 2	CP28	29		1,130	Millstone 2	P19	32	-283	830
McGuire 1	CP29	23	-310	1,180	Millstone 3	CP33	29		1,159
McGuire 2	CP30	29		1,180	North Anna 1	P20	23	-190	907
Midland 1	CP31	27	-212	492	North Anna 2	CP34	23		943
Midland 2	CP32	27		887	North Anna 3	CP35	22		907
Millstone 2	P19	32	-370	830	North Anna 4	CP36	22		907
Millstone 3	CP33	29		1,159	Oconee 1	P22	27	-1,612	887
Nine Mile Point 1	B19	0	-46	610	Oconee 2	P23	27		887
Nine Mile Point 2	CB19	38		1,080	Oconee 3	P24	27		887
North Anna 1	P20	23	-255	907	Peach Bottom 2	B21	38	-736	1,065
North Anna 2	CP34	23		943	Peach Bottom 3	B22	38		1,065
North Anna 3	CP35	22		907	Prairie Island 1	P28	18	-568	530
North Anna 4	CP36	22		907	Prairie Island 2	P29	18		530
Oconee 1	P22	27	-1,692	887	Pt. Beach 1	P26	54	-234	497
Oconee 2	P23	27		887	Pt. Beach 2	P27	18		497
Oconee 3	P24	27		887	Quad Cities 1	B24	36	-1,174	789
Peach Bottom 2	B21	38	-888	1,065	Quad Cities 2	B25	36		789
Peach Bottom 3	B22	38		1,065	Salem 1	P32	29	-249	1,090
Prairie Island 1	P28	18	-623	530	Salem 2	CP40	29		1,115
Prairie Island 2	P29	18		530	San Onofre 1	P33	0	-667	436
Pt. Beach 1	P26	54	-288	497	San Onofre 2	CP41	32		1,140
Pt. Beach 2	P27	18		497	San Onofre 3	CP42	32		1,140
Quad Cities 1	B24	36	-1,318	789	Sequoyah 1	CP46	29	-313	1,140
Quad Cities 2	B25	36		789	Sequoyah 2	CP45	29		1,140
Salem 1	P32	29	-336	1,090	South Texas 1	CP47	29	-25	1,250
Salem 2	CP40	29		1,115	South Texas 2	CP48	29		1,250
San Onofre 1	P33	0	-738	436	St. Lucie 1	P34	32	-386	802
San Onofre 2	CP41	32		1,140	St. Lucie 2	CP49	32		842
San Onofre 3	CP42	32		1,140	Surry 1	P35	23	-756	822
Sequoyah 1	CP46	29	-400	1,140	Surry 2	P36	23		822
Sequoyah 2	CP45	29		1,140	Turkey Point 3	P40	23	-906	693
South Texas 1	CP47	29	-112	1,250	Turkey Point 4	P41	23		693
South Texas 2	CP48	29		1,250	Watts Bar 1	CP60	29	-256	1,165
St. Lucie 1	P34	32	-484	802	Watts Bar 2	CP61	29		1,165
St. Lucie 2	CP49	32		842	Zion 1	P43	29	-448	1,040
Surry 1	P35	23	-827	822	Zion 2	P44	29		1,040

Table F.8. Continued

With Full Core Reserve					Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe	Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
2000 (Continued)					2000 (Continued)				
Surry 2	P36	23		822					
Susquehanna 1	CB27	38	-138	1,052					
Susquehanna 2	CB28	38		1,052					
Turkey Point 3	P40	23	-977	693					
Turkey Point 4	P41	23		693					
Watts Bar 1	CP60	29	-342	1,165					
Watts Bar 2	CP61	29		1,165					
Zion 1	P43	29	-535	1,040					
Zion 2	P44	29		1,040					
Total		3,091	-27,850	96,319	Total		2,858	-21,886	88,655

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[a] The negative numbers in this column indicate that away-from-reactor storage in the amount shown will be required if full-core reserve is to be maintained.

[b] In February 1979 application was filed requesting storage capacity expansion of the Oconee Units 1 and 2 reactor basin by 186 MTHM. Authorization was granted in June 1979. In April 1979 application was filed requesting capacity expansion of the Big Rock Point reactor basin by 50 MTHM. In July 1979 application was filed requesting capacity expansions of Hatch 1 and Hatch 2 reactor basins by a total of 813 MTHM. The shortfalls of storage capacity shown in this table do not reflect the additional capacity that would result from those expansions.

[c] The negative numbers in this column indicate that all at-reactor spent fuel storage capacity has been used, and away-from-reactor storage in the amount shown will be required for continuation of operation of the reactors at the site.

[d] 0 discharge means that all of the reactors for that utility are shut down due to age.

Table F.9. Away-from-Reactor Spent Fuel Storage Requirements (in MTHM) by Reactor Site for 280 GWe Capacity in the Year 2000

With Full Core Reserve					Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available^{a,b}	MWe	Reactor	Code	Annual Discharges	Storage Available^{b,c}	MWe
1979					1979				
Oconee 1	P22	27	-19	887					
Oconee 2	P23	20		887					
Oconee 3	P24	20		887					
San Onofre 1	P33	23	-23	436					
Total		90	-42	3,097	Total		-	-	-
1980					1980				
Humboldt Bay	B15	9	-4	65	Oconee 1	P22	27	-19	887
Oconee 1	P22	27	-99	887	Oconee 2	P23	27		887
Oconee 2	P23	27		887	Oconee 3	P24	27		887
Turkey Point 3	P40	23	-41	693					
Turkey Point 4	P41	23		693					
Total		135	-143	4,112	Total		80	-19	2,661
1981					1981				
Big Rock Point	B 1	4	-3	72	Oconee 1	P22	27	-99	887
Humboldt Bay	B15	9	-13	65	Oconee 2	P23	27		887
Indian Point 2	P15	29	-16	873	Oconee 3	P24	27		887
Robinson 2	P31	23	-16	700	Turkey Point 3	P40	23	-17	693
Oconee 1	P22	27	-178	887	Turkey Point 4	P41	23		693
Oconee 2	P23	27		887					
Oconee 3	P24	27		887					
Turkey Point 3	P40	23	-87	693					
Turkey Point 4	P41	23		693					
Total		191	-314	5,757	Total		126	-115	4,047
1982					1982				
Big Rock Point	B 1	4	-7	72	Oconee 1	P22	27	-178	887
Humboldt Bay	B15	9	-21	65	Oconee 2	P23	27		887
Indian Point 2	P15	29	-45	873	Oconee 3	P24	27		887
Robinson 2	P31	23	-40	700	Turkey Point 3	P40	23	-63	693
Oconee 1	P22	27	-258	887	Turkey Point 4	P41	23		693
Oconee 2	P23	27		887					

Table F.9. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1982 (Continued)				
Oconee 3	P24	27		887
Quad Cities 1	B24	36	-15	789
Quad Cities 2	B25	36		789
Turkey Point 3	P40	23	-134	693
Turkey Point 4	P41	23		693
Total		264	-520	7,335
1983				
Big Rock Point	B 1	4	-12	72
Ft. Calhoun	P11	20	-12	457
Humboldt Bay	B15	9	-30	65
Indian Point 2	P15	29	-73	873
Maine Yankee	P18	32	-26	790
Oyster Creek	B20	28	-16	650
Palisades	P25	31	-9	805
Robinson 2	P31	23	-63	700
Calvert Cliffs 1	P 4	32	-1	845
Calvert Cliffs 2	P 5	32		845
Oconee 1	P22	27	-338	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Prairie Island 1	P28	18	-11	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-88	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-31	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-181	693
Turkey Point 4	P41	23		693
Total		522	-889	14,431
1984				
Big Rock Point	B 1	4	-16	72
Ft. Calhoun	P11	20	-32	457
Humboldt Bay	B15	9	-35	65
Indian Point 2	P15	29	-102	873
Maine Yankee	P18	32	-58	790
Oyster Creek	B20	28	-44	650

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1982 (Continued)				
Total		126	-242	4,047
1983				
Oconee 1	P22	27	-258	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Turkey Point 3	P40	23	-110	693
Turkey Point 4	P41	23		693
Total		126	-368	4,047
1984				
Humboldt Bay	B15	9	-4	65
Indian Point 2	P15	29	-15	873
Robinson 2	P31	23	-16	700
Oconee 1	P22	27	-338	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887

Table F.9. Continued

With Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1984 (Continued)				
Palisades	P25	31	-39	805
Rancho Seco	P30	27	-15	918
Robinson 2	P31	23	-86	700
Brunswick 1	B 5	28	-14	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-65	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-13	717
Hatch 2	B14	22		822
Millstone 2	P19	32	-8	830
Oconee 1	P22	27	-417	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Prairie Island 1	P28	18	-47	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-160	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-78	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-228	693
Turkey Point 4	P41	23		693
Total		688	-1,462	19,360
1985				
Big Rock Point	B 1	4	-20	72
Ft. Calhoun	P11	20	-52	457
Humboldt Bay	B15	9	-47	65
Indian Point 2	P15	29	-131	873
Maine Yankee	P18	32	-90	790
Millstone 1	B17	29	-8	660
Oyster Creek	B20	28	-72	650
Palisades	P25	31	-70	805
Rancho Seco	P30	27	-42	918
Robinson 2	P31	23	-110	700
Trojan	P39	29	-3	1,130
Brunswick 1	B 5	28	-70	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-130	845
Calvert Cliffs 2	P 5	32		845

Without Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1984 (Continued)				
Quad Cities 1	B24	36	-15	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-7	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-157	693
Turkey Point 4	P41	23		693
Total		306	-552	8,907
1985				
Big Rock Point	B 1	4	-3	72
Humboldt Bay	B15	9	-13	65
Indian Point 2	P15	29	-44	873
Robinson 2	P31	23	-39	700
Calvert Cliffs 1	P 4	32	-32	845
Calvert Cliffs 2	P 5	32		845
Oconee 1	P22	27	-417	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Prairie Island 1	P28	18	-28	530
Prairie Island 2	P29	18		530
Quad Cliffs 1	B24	36	-88	789
Quad Cliffs 2	B25	36		789
Surry 1	P35	23	-54	822
Surry 2	P36	23		822

Table F.9. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1985 (Continued)				
Hatch 1	B13	28	-63	717
Hatch 2	B14	22		822
Millstone 2	P19	32	-41	830
Oconee 1	P22	27	-497	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Prairie Island 1	P28	18	-83	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-232	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-125	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-275	693
Turkey Point 4	P41	23		693
Total		745	-2,160	21,150
1986				
Big Rock Point	B 1	4	-24	72
Ft. Calhoun	P11	20	-72	457
Ginna	P12	18	-1	490
Humboldt Bay	B15	9	-56	65
Indian Point 2	P15	29	-160	873
Maine Yankee	P18	32	-123	790
Millstone 1	B17	29	-37	660
Oyster Creek	B23	28	-100	650
Palisades	P25	31	-100	805
Pilgrim 1	B23	29	-1	655
Rancho Seco	P34	27	-66	918
Robinson 2	P31	23	-133	700
Three Mile Island 1	P37	27	-19	819
Three Mile Island 2	P38	27	-13	906
Trojan	P39	29	-32	1,130
Brunswick 1	B 5	28	-126	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-195	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-119	717
Hatch 2	B14	28		822
Millstone 2	P19	32	-73	830

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1985 (Continued)				
Turkey Point 3	P40	23	-204	693
Turkey Point 4	P41	23		693
Total		411	-923	11,729
1986				
Big Rock Point	B 1	4	-7	72
Ft. Calhoun	P11	20	-12	457
Humboldt Bay	B15	9	-22	65
Indian Point 2	P15	29	-73	873
Maine Yankee	P18	32	-25	790
Palisades	P25	31	-9	805
Robinson 2	P31	23	-63	700
Brunswick 1	B 5	28	-14	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-97	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-7	717
Hatch 2	B14	28		822
Oconee 1	P22	27	-497	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Prairie Island 1	P28	18	-64	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-160	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-10[illegible]	822
Surry 2	P36	23		822

Table F.9. Continued

With Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1986 (Continued)				
Oconee 1	P22	27	-576	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Prairie Island 1	P28	18	-119	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-305	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-171	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-321	693
Turkey Point 4	P41	23		693
Total		851	-2,944	23,020
1987				
Big Rock Point	B 1	4	-28	72
Ft. Calhoun	P11	20	-91	457
Ginna	P12	18	-19	490
Humboldt Bay	B15	9	-65	65
Indian Point 2	P15	29	-189	873
Maine Yankee	P18	32	-155	790
Millstone 1	B17	29	-66	660
Oyster Creek	B20	38	-128	650
Palisades	P25	31	-137	805
Pilgrim 1	B23	29	-29	655
Rancho Seco	P30	27	-95	918
Robinson 2	P31	23	-157	700
Three Mile Island 1	P37	27	-45	819
Three Mile Island 2	P38	27	-40	906
Trojan	P39	29	-60	1,130
Vermont Yankee	B26	18	-18	514
Arkansas 1	P 1	27	-37	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-182	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-260	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-175	717
Hatch 2	B14	28		822
Millstone 2	P19	32	-105	830

Without Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1986 (Continued)				
Turkey Point 3	P40	23	-251	693
Turkey Point 4	P41	23		693
Total		606	-1,401	16,962
1987				
Big Rock Point	B 1	4	-12	72
Ft. Calhoun	P11	20	-32	457
Humboldt Bay	B15	9	-30	65
Indian Point 2	P15	29	-102	873
Maine Yankee	P18	32	-58	790
Oyster Creek	B20	28	-16	650
Palisades	P25	31	-39	805
Rancho Seco	P30	27	-15	918
Robinson 2	P31	23	-86	700
Brunswick 1	B 5	28	-70	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-162	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-63	717
Hatch 2	B14	28		822
Millstone 2	P19	32	-8	830
Oconee 1	P22	27	-576	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Prairie Island 1	P28	18	-100	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-232	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-148	822
Surry 2	P36	23		822

Table F.9. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available^{a,b}	MWe
1987 (Continued)				
Oconee 1	P22	27	-656	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Prairie Island 1	P28	18	-155	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-377	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-218	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-368	693
Turkey Point 4	P41	23		693
Total		923	-3,850	26,334
1988				
Big Rock Point	B 1	4	-33	72
Fitzpatrick	B12	28	-25	821
Ft. Calhoun	P11	20	-111	457
Ginna	P12	18	-37	490
Humboldt Bay	B15	9	-73	65
Indian Point 2	P15	29	-217	873
Indian Point 3	P16	29	-5	873
Maine Yankee	P18	32	-188	790
Millstone 1	B17	29	-95	660
Monticello	B18	24	-15	545
Oyster Creek	B20	28	-156	650
Palisades	P25	31	-162	805
Pilgrim 1	B23	29	-58	655
Rancho Seco	P30	27	-122	918
Robinson 2	P31	23	-180	700
Three Mile Island 1	P37	27	-72	819
Three Mile Island 2	P38	27	-66	906
Trojan	P39	29	-89	1,130
Vermont Yankee	B26	18	-36	514
Arkansas 1	P 1	27	-90	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-238	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-324	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-231	717

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available^{b,c}	MWe
1987 (Continued)				
Turkey Point 3	P40	23	-297	693
Turkey Point 4	P41	23		693
Total		693	-2,047	19,360
1988				
Big Rock Point	B 1	4	-16	72
Ft. Calhoun	P11	20	-51	457
Humboldt Bay	B15	9	-39	65
Indian Point 2	P15	29	-131	873
Maine Yankee	P14	32	-90	790
Oyster Creek	B20	28	-44	650
Palisades	P25	31	-70	805
Rancho Seco	P30	27	-42	918
Robinson 2	P31	23	-109	700
Trojan	P39	29	-2	1,130
Arkansas 1	P 1	27	-10	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-126	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-227	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-119	717
Hatch 2	B14	28		822
Oconee 1	P22	27	-656	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Prairie Island 1	P28	18	-136	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-305	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-194	822

Table F.9. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1989 (Continued)				
Hatch 1	B13	28	-287	717
Hatch 2	B14	28		822
Oconee 1	P22	27	-815	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-48	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-227	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-522	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-312	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-462	693
Turkey Point 4	P41	23		693
Total		1,048	-5,699	29,873
1990				
Big Rock Point	B 1	4	-41	72
Cook 2	P 7	29	-27	1,100
Cooper	B 7	27	-11	778
Fitzpatrick	B12	28	-81	821
Ft. Calhoun	P11	20	-151	457
Ginna	P12	18	-73	490
Humboldt Bay	B15	9	-90	65
Indian Point 2	P15	29	-275	873
Indian Point 3	P16	29	-63	873
Maine Yankee	P18	32	-252	790
Millstone 1	B17	29	-153	660
Monticello	B18	24	-63	545
Oyster Creek	B20	28	-212	650
Palisades	P25	31	-223	805
Pilgrim 1	B23	29	-116	655
Rancho Seco	P30	27	-175	918
Robinson 2	P31	23	-227	700
Three Mile Island 1	P37	27	-125	819
Three Mile Island 2	P38	27	-119	906
Trojan	P39	29	-147	1,130
Vermont Yankee	B26	18	-73	514
Arkansas 1	P 1	27	-196	850

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1989 (Continued)				
Prairie Island 1	P28	18	-172	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-377	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-241	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-391	693
Turkey Point 4	P41	23		693
Total		843	-3,495	24,335
1990				
Big Rock Point	B 1	4	-24	72
Ft. Calhoun	P11	20	-91	457
Ginna	P12	18	-18	490
Humboldt Bay	B15	9	-56	65
Indian Point 2	P15	29	-188	873
Maine Yankee	P18	32	-155	790
Millstone 1	B17	29	-37	660
Oyster Creek	B20	28	-100	650
Palisades	P25	31	-131	805
Pilgrim 1	B23	29	-1	655
Rancho Seco	P30	27	-95	918
Robinson 2	P31	23	-156	700
Three Mile Island 1	P37	27	-45	819
Three Mile Island 2	P38	27	-40	906
Trojan	P39	29	-60	1,130
Arkansas 1	P 1	27	-117	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-238	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-356	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-231	717

Table F.9. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1988 (Continued)				
Hatch 2	B14	28		822
Oconee 1	P22	27	-736	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Prairie Island 1	P28	18	-191	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-450	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-265	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-415	693
Turkey Point 4	P41	23		693
Total		971	-4,680	27,743
1989				
Big Rock Point	B 1	4	-37	72
Fitzpatrick	B12	28	-53	821
Ft. Calhoun	P11	20	-131	457
Ginna	P12	18	-55	490
Humboldt Bay	B15	9	-82	65
Indian Point 2	P15	29	-246	873
Indian Point 3	P16	29	-34	873
Maine Yankee	P18	32	-221	790
Millstone 1	B17	29	-124	660
Monticello	B18	24	-39	545
Oyster Creek	B20	28	-184	650
Palisades	P25	31	-192	805
Pilgrim 1	B23	29	-87	655
Rancho Seco	P30	27	-148	918
Robinson 2	P31	23	-203	700
Three Mile Island 1	P37	27	-99	819
Three Mile Island 2	P38	27	-93	906
Trojan	P39	29	-118	1,130
Vermont Yankee	B26	18	-55	514
Arkansas 1	P 1	27	-143	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-294	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-389	845
Calvert Cliffs 2	P 5	32		845

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1988 (Continued)				
Surry 2	P36	23		822
Turkey Point 3	P40	23	-344	693
Turkey Point 4	P41	23		693
Total		743	-2,712	21,460
1989				
Big Rock Point	B 1	4	-20	72
Ft. Calhoun	P11	20	-71	457
Ginna	P12	18	-1	490
Humboldt Bay	B15	9	-47	65
Indian Point 2	P15	29	-159	873
Maine Yankee	P18	32	-122	790
Millstone 1	B17	29	-8	660
Oyster Creek	B20	28	-72	650
Palisades	P25	31	-100	805
Rancho Seco	P30	27	-68	918
Robinson 2	P31	23	-133	700
Three Mile Island 1	P37	27	-19	819
Three Mile Island 2	P38	27	-13	906
Trojan	P39	29	-31	1,130
Arkansas 1	P 1	27	-63	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-182	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-292	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-175	717
Hatch 2	B14	28		822
Oconee 1	P22	27	-736	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887

Table F.9. Continued

With Full Core Reserve					Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available^{a,b}	MWe	Reactor	Code	Annual Discharges	Storage Available^{b,c}	MWe
1990 (Continued)					1990 (Continued)				
Arkansas 2	P 2	27		950	Hatch 2	B14	28		822
Brunswick 1	B 5	28	-350	821	Oconee 1	P22	27	-815	887
Brunswick 2	B 6	28		821	Oconee 2	P24	27		887
Calvert Cliffs 1	P 4	32	-454	845	Oconee 3	P24	27		887
Calvert Cliffs 2	P 5	32		845	Prairie Island 1	P28	18	-208	530
Hatch 1	B13	28	-343	717	Prairie Island 2	P29	18		530
Hatch 2	B14	28		822	Quad Cities 1	B24	36	-450	789
Oconee 1	P22	27	-895	887	Quad Cities 2	B25	36		789
Oconee 2	P23	27		887	Surry 1	P35	23	-288	822
Oconee 3	P24	27		887	Surry 2	P36	23		822
Peach Bottom 2	B21	38	-124	1,065	Turkey Point 3	P40	23	-438	693
Peach Bottom 3	B22	38		1,065	Turkey Point 4	P41	23		693
Prairie Island 1	P28	18	-263	530					
Prairie Island 2	P29	18		530					
Quad Cities 1	B24	36	-594	789					
Quad Cities 2	B25	36		789					
Surry 1	P35	23	-359	822					
Surry 2	P36	23		822					
Turkey Point 3	P40	23	-509	693					
Turkey Point 4	P41	23		693					
Total		1,104	-6,785	31,751	Total		872	-4,338	24,990
1991					1991				
Big Rock Point	B 1	4	-45	72	Big Rock Point	B 1	4	-28	72
Cook 2	P 7	29	-56	1,100	Ft. Calhoun	P11	20	-111	457
Cooper	B 7	27	-39	778	Ginna	P12	18	-36	490
Fitzpatrick	B12	28	-109	821	Humboldt Bay	B15	9	-65	65
Ft. Calhoun	P11	20	-171	457	Indian Point 2	P15	29	-217	873
Ginna	P12	18	-91	490	Indian Point 3	P16	29	-5	873
Humboldt	B15	9	-99	65	Maine Yankee	P18	32	-187	790
Indian Point 2	P15	29	-304	873	Millstone 1	B17	29	-66	660
Indian Point 3	P16	29	-92	873	Oyster Creek	B23	28	-128	650
Maine Yankee	P18	32	-285	790	Palisades	P25	31	-162	805
Millstone 1	B17	29	-182	660	Pilgrim 1	B23	29	-29	655
Monticello	B18	24	-87	545	Rancho Seco	P30	27	-122	918
Oyster Creek	B20	28	-240	650	Robinson 2	P31	23	-180	700
Palisades	P25	31	-253	805	Three Mile Island 1	P37	27	-72	819
Pilgrim 1	B23	29	-145	655	Three Mile Island 2	P38	27	-66	906

Table F.9. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1991 (Continued)				
Rancho Seco	P30	27	-201	918
Robinson 2	P31	23	-250	700
Three Mile Island 1	P37	27	-152	819
Three Mile Island 2	P38	27	-146	906
Trojan	P39	29	-176	1,130
Vermont Yankee	B26	18	-92	514
Zimmer 1	CP65	84	-1	810
Arkansas 1	P 1	27	-249	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-406	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-519	845
Calvert Cliffs 2	P 5	32		845
Dresden 1	B 8	0[d]	-46	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Hatch 1	B13	28	-399	717
Hatch 2	B14	28		822
Oconee 1	P22	27	-975	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-201	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-299	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-667	789
Quad Cities 2	B25	36		789
San Onofre 1	P33	23	-3	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Surry 1	P35	23	-405	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-555	693
Turkey Point 4	P41	23		693
Zion 1	P43	29	-17	1,040
Zion 2	P44	29		1,040
Total		1,406	-7,955	38,945

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1991 (Continued)				
Trojan	P39	29	-89	1,130
Vermont Yankee	B26	18	-18	514
Arkansas 1	P 1	27	-170	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-294	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-421	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-287	717
Hatch 2	B14	28		822
Oconee 1	P22	27	-895	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-48	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-244	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-522	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-335	322
Surry 2	P36	23		822
Turkey Point 3	P40	23	-485	693
Turkey Point 4	P41	23		693
Total		995	-5,281	28,507

Table F.9. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available^{a,b}	MWe
1992				
Big Rock Point	B 1	4	-49	72
Cook 2	P 7	29	-85	1,100
Cooper	B 7	27	-66	778
Fitzpatrick	B12	28	-137	821
Ft. Calhoun	P11	20	-190	457
Ginna	P12	18	-109	490
Haddam Neck	P13	23	-2	575
Humboldt Bay	B15	9	-108	65
Indian Point 2	P15	29	-333	873
Indian Point 3	P16	29	-121	873
Maine Yankee	P18	32	-317	790
Millstone 1	B17	29	-211	660
Monticello	B18	24	-111	545
Oyster Creek	B20	28	-268	650
Palisades	P25	31	-284	805
Pilgrim 1	B23	29	-174	655
Rancho Seco	P32	27	-228	918
Robinson 2	P31	23	-274	700
Three Mile Island 1	P37	27	-178	819
Three Mile Island 2	P38	27	-172	906
Trojan	P39	29	-204	1,130
Vermont Yankee	B26	18	-110	514
Zimmer 1	CP65	84	-85	810
Arkansas 1	P 1	27	-302	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-462	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-584	845
Calvert Cliffs 2	P 5	32		845
Dresden 1	B 8	0	-118	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Hatch 1	B13	28	-455	717
Hatch 2	B14	28		822
Oconee 1	P22	27	-1,054	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-277	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-335	530
Prairie Island 2	P29	18		530

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available^{b,c}	MWe
1992				
Big Rock Point	B 1	4	-33	72
Fitzpatrick	B12	28	-25	821
Ft. Calhoun	P11	20	-131	457
Ginna	P12	18	-54	490
Humboldt Bay	B15	9	-73	65
Indian Point 2	P15	29	-246	873
Indian Point 3	P16	29	-34	873
Maine Yankee	P18	32	-220	790
Millstone 1	B17	29	-95	660
Monticello	B18	24	-15	545
Oyster Creek	B20	28	-156	650
Palisades	P25	31	-192	805
Pilgrim 1	B23	29	-58	655
Rancho Seco	P30	27	-148	918
Robinson 2	P31	23	-203	700
Three Mile Island 1	P37	27	-99	819
Three Mile Island 2	P38	27	-93	906
Trojan	P39	29	-117	1,130
Vermont Yankee	B26	18	-36	514
Arkansas 1	P 1	27	-223	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-350	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-486	845
Calvert Cliffs 2	P 5	32		845
Hatch 1	B13	28	-343	717
Hatch 2	B14	28		822
Oconee 1	P22	27	-975	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-124	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-280	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-594	789
Quad Cities 2	B25	36		789
Surry 1	P35	23	-382	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-531	693
Turkey Point 4	P41	23		693

Table F.9. Continued

With Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1992 (Continued)				
Quad Cities 1	B24	36	-739	789
Quad Cities 2	B25	36		789
San Onofre 1	P33	23	-91	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
St Lucie 1	P34	32	-30	802
St Lucie 2	CP49	32		842
Surry 1	P35	23	-452	822
Surry 2	P36	23		822
Turkey Point 1	P40	23	-602	693
Turkey Point 2	P41	23		693
Zion 1	P43	29	-74	1,040
Zion 2	P44	29		1,040
Total		1,494	-9,394	41,164
1993				
Big Rock Point	B 1	17	-49	72
Cook 2	P 7	29	-114	1,100
Cooper	B 7	27	-93	778
Fitzpatrick	B12	28	-165	821
Ft. Calhoun	P11	20	-210	457
Ginna	P12	18	-127	490
Haddam Neck	P13	23	-26	575
Humboldt Bay	B15	34	-108	65
Indian Point 2	P15	29	-361	873
Indian Point 3	P16	29	-149	873
LaCrosse	B16	4	-3	50
Maine Yankee	P18	32	-350	790
Millstone 1	B17	29	-240	660
Monticello	B18	24	-136	545
Oyster Creek	B20	28	-296	650
Palisades	P25	31	-315	805
Pilgrim 1	B23	29	-203	655
Rancho Seco	P30	27	-254	918
Robinson 2	P31	23	-297	700
Summer 1	CP51	23	-22	900
Three Mile Island 1	P37	27	-205	819
Three Mile Island 2	P38	27	-199	906

Without Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1992 (Continued)				
Total		1,048	-6,316	29,873
1993				
Big Rock Point	B 1	17	-49	72
Cook 2	P 7	29	-27	1,100
Fitzpatrick	B12	28	-53	821
Ft. Calhoun	P11	20	-150	457
Ginna	P12	18	-72	490
Humboldt Bay	B15	34	-108	65
Indian Point 2	P15	29	-275	873
Indian Point 3	P16	29	-63	873
Maine Yankee	P18	32	-252	790
Millstone 1	B17	29	-124	660
Monticello	B18	24	-39	545
Oyster Creek	B20	28	-184	650
Palisades	P25	31	-223	805
Pilgrim 1	B23	29	-87	655
Rancho Seco	P30	27	-175	918
Robinson 2	P31	23	-226	700
Three Mile Island 1	P37	27	-125	819
Three Mile Island 2	P38	27	-119	906
Trojan	P39	29	-146	1,130
Vermont Yankee	B26	18	-55	514
Arkansas 1	P 1	27	-276	850
Arkansas 2	P 2	27		958

Table F.9. Continued

With Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1993 (Continued)				
Trojan	P39	29	-233	1,130
Vermont Yankee	B26	18	-128	514
Zimmer 1	CP65	84	-169	810
Arkansas 1	P 1	27	-356	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-518	821
Brunswick 2	B 6	28		821
Calvert Cliffs	P 4	32	-648	845
Calvert Cliffs	P 5	32		845
Diablo Canyon 1	CP19	29	-26	1,084
Diablo Canyon 2	CP20	29		1,106
Dresden 1	B 8	0	-190	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Farley 1	P10	23	-46	829
Farley 2	CP21	23		829
Hatch 1	B13	28	-511	717
Hatch 2	B14	28		822
Millstone 2	P19	32	-6	830
Millstone 3	CP33	22		1,159
Oconee 1	P22	27	-1,134	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-354	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-371	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-812	789
Quad Cities 2	B25	36		789
San Onofre 1	P33	23	-180	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Sequoyah 1	CP46	29	-26	1,140
Sequoyah 2	CP45	29		1,140
St Lucie 1	P34	32	-95	802
St Lucie 2	CP49	32		842
Surry 1	P35	23	-499	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-649	693
Turkey Point 4	P41	23		693

Without Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1993 (Continued)				
Brunswick 1	B 5	28	-406	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-551	845
Calvert Cliffs 2	P 5	32		845
Dresden 1	B 8	0[d]	-46	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Match 1	B13	28	-399	717
Match 2	B14	28		822
Oconee 1	P22	27	-1,054	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-201	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-316	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-667	789
Quad Cities 2	B25	36		789
San Onofre 1	P33	23	-82	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Surry 1	P35	23	-428	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-578	693
Turkey Point 4	P41	23		693
Zion 1	P43	29	-45	1,040
Zion 2	P44	29		1,040

Table F.9. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1993 (Continued)				
Zion 1	P43	29	-132	1,040
Zion 2	P44	29		1,040
Total		1,776	-11,004	50,231
1994				
Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-143	1,100
Cooper	B 7	27	-121	778
Duane Arnold	B11	18	-2	538
Fitzpatrick	B12	28	-193	821
Ft. Calhoun	P11	20	-230	457
Ginna	P12	18	-145	490
Haddam Neck	P13	23	-49	575
Humboldt Bay	B15	0	-108	65
Indian Point 2	P15	29	-390	873
Indian Point 3	P16	29	-178	873
LaCrosse	B16	4	-7	50
Maine Yankee	P18	32	-382	790
Millstone 1	B17	29	-269	660
Monticello	B18	24	-160	545
Oyster Creek	B20	28	-324	650
Palisades	P25	31	-345	805
Pilgrim 1	B23	29	-232	655
Rancho Seco	P30	27	-281	918
Robinson 2	P31	23	-320	700
Summer 1	CP51	23	-45	900
Three Mile Island 1	P37	27	-231	819
Three Mile Island 2	P38	27	-225	906
Trojan	P39	29	-262	1,130
Vermont Yankee	B26	18	-147	514
Waterford 3	CP59	31	-29	1,267
Zimmer 1	CP65	84	-253	810
Arkansas 1	P 1	27	-409	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-574	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-713	845
Calvert Cliffs 2	P 5	32		845

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1993 (Continued)				
Total		1,333	-7,601	37,357
1994				
Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-56	1,100
Cooper	B 7	27	-11	778
Fitzpatrick	B12	28	-81	821
Ft. Calhoun	P11	20	-170	457
Ginna	P12	18	-90	490
Humboldt Bay	B15	0	-108	65
Indian Point 2	P15	29	-303	873
Indian Point 3	P16	29	-91	873
Maine Yankee	P18	32	-284	790
Millstone 1	B17	29	-153	660
Monticello	B18	24	-63	545
Oyster Creek	B20	28	-212	650
Palisades	P25	31	-253	805
Pilgrim 1	B23	29	-116	655
Rancho Seco	P30	27	-201	918
Robinson 2	P31	23	-250	700
Three Mile Island 1	P37	27	-152	819
Three Mile Island 2	P38	27	-146	906
Trojan	P39	29	-175	1,130
Vermont Yankee	B26	18	-73	514
Zimmer 1	CP65	84	-1	810
Arkansas 1	P 1	27	-329	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-462	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-616	845
Calvert Cliffs 2	P 5	32		845
Dresden 1	B 8	0	-118	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Farley 1	P10	23	-22	829
Farley 2	CP21	23		829

Table F.9. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1994 (Continued)				
Diablo Canyon 1	CP19	29	-83	1,084
Diablo Canyon 2	CP20	29		1,106
Dresden 1	B 8	0	-263	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Farley 1	P10	23	-93	829
Farley 2	CP21	23		829
Hatch 1	B13	28	-567	717
Hatch 2	B14	28		822
McGuire 1	CP29	23	-26	1,180
McGuire 2	CP30	29		1,180
Millstone 2	P19	32	-60	830
Millstone 3	CP33	22		1,159
Oconee 1	P22	27	-1,214	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-430	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-407	530
Prairie Island 2	P29	18		530
Pt. Beach 1	P26	18	-36	497
Pt. Beach 2	P27	18		497
Quad Cities 1	B24	36	-884	789
Quad Cities 2	B25	36		789
San Onofre 1	P33	23	-268	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Sequoyah 1	CP46	29	-83	1,140
Sequoyah 2	CP45	29		1,140
St Lucie 1	P34	32	-160	802
St Lucie 2	CP49	32		842
Surry 1	P35	23	-546	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-696	693
Turkey Point 4	P41	23		693
Zion 1	P43	29	-189	1,040
Zion 2	P44	29		1,040
Total		1,862	-12,821	55,253

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1994 (Continued)				
Hatch 1	B13	28	-455	717
Hatch 2	B14	28		822
Oconee 1	P22	27	-1,134	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-277	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-352	530
Prairie Island 2	P29	18		530
Quad Cities 1	B24	36	-739	789
Quad Cities 2	B25	36		789
San Onofre 1	P33	23	-170	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
St Lucie 1	P34	32	-62	802
St Lucie 2	CP49	32		842
Surry 1	P35	23	-475	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-625	693
Turkey Point 4	P41	23		693
Zion 1	P43	29	-103	1,040
Zion 2	P44	29		1,040
Total		1,505	-8,980	42,110

Table F.9. Continued

With Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1995				
Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-171	1,100
Cooper	B 7	27	-148	778
Duane Arnold	B11	18	-21	538
Enrico Fermi 2	CB 6	38	-31	1,123
Fitzpatrick	B12	28	-221	821
Ft. Calhoun	P11	20	-250	457
Ginna	P12	18	-163	490
Haddam Neck	P13	23	-72	575
Humboldt Bay	B15	0	-108	65
Indian Point 2	P15	29	-419	873
Indian Point 3	P16	29	-207	873
LaCrosse	B16	4	-10	50
Maine Yankee	P18	32	-414	790
Millstone 1	B17	29	-298	660
Monticello	B18	24	-184	545
Oyster Creek	B20	28	-352	650
Palisades	P25	31	-376	805
Pilgrim 1	B23	29	-261	655
Rancho Seco	P30	27	-307	918
Robinson 2	P31	23	-344	700
Shoreham	CB26	28	-22	854
Summer 1	CP51	23	-69	900
Three Mile Island 1	P37	27	-258	819
Three Mile Island 2	P38	27	-252	906
Trojan	P39	29	-291	1,130
Vermont Yankee	B26	18	-165	514
Washington Nuclear 2	CB29	38	-31	1,103
Waterford 3	CP59	31	-60	1,267
Zimmer 1	CP65	84	-338	810
Arkansas 1	P 1	27	-462	850
Arkansas 2	P 2	27		950
Browns Ferry 1	B 2	38	-75	1,065
Browns Ferry 2	B 3	38		1,065
Browns Ferry 3	B 4	38		1,065
Brunswick 1	B 5	28	-630	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-778	845
Calvert Cliffs 2	P 5	32		845

Without Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1995				
Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-85	1,100
Cooper	B 7	27	-39	778
Fitzpatrick	B12	28	-109	821
Ft. Calhoun	P11	20	-190	457
Ginna	P12	18	-108	490
Haddam Neck	P13	23	-2	575
Humboldt Bay	B15	0	-108	65
Indian Point 2	P15	29	-332	873
Indian Point 3	P16	29	-120	873
Maine Yankee	P18	32	-317	790
Millstone 1	B17	29	-182	660
Monticello	B18	24	-87	545
Oyster Creek	B20	28	-240	650
Palisades	P25	31	-284	805
Pilgrim 1	B23	29	-145	655
Rancho Seco	P30	27	-228	918
Robinson 2	P31	23	-273	700
Three Mile Island 1	P37	27	-178	819
Three Mile Island 2	P38	27	-172	906
Trojan	P39	29	-204	1,130
Vermont Yankee	B26	18	-92	514
Zimmer 1	CP65	84	-86	810
Arkansas 1	P 1	27	-382	850
Arkansas 2	P 2	27		950
Brunswick 1	B 5	28	-518	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-680	845
Calvert Cliffs 2	P 5	32		845
Diablo Canyon 1	CP19	29	-54	1,084
Diablo Canyon 2	CP20	29		1,106
Dresden 1	B 8	0	-190	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Farley 1	P10	23	-69	829
Farley 2	CP21	23		829
Hatch 1	B13	28	-511	717
Hatch 2	B14	28		822
Millstone 2	P19	32	-35	830

Table F.9. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1995 (Continued)				
Diablo Canyon 1	CP19	29	-141	1,084
Diablo Canyon 2	CP20	29		1,106
Dresden 1	B 8	0	-335	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Farley 1	P10	23	-140	829
Farley 2	CP21	23		829
Hatch 1	B13	28	-623	717
Hatch 2	B14	28		822
McGuire 1	CP29	23	-78	1,180
McGuire 2	CP30	29		1,180
Millstone 2	P19	32	-122	830
Millstone 3	CP33	29		1,159
Oconee 1	P22	27	-1,293	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-506	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-443	530
Prairie Island 2	P29	18		530
Pt. Beach 1	P26	18	-72	497
Pt. Beach 2	P27	18		497
Quad Cities 1	B24	36	-956	789
Quad Cities 2	B25	36		789
Salem 1	P32	29	-48	1,090
Salem 2	CP40	29		1,115
San Onofre 1	P33	23	-356	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Sequoyah 1	CP46	29	-141	1,140
Sequoyah 2	CP45	29		1,140
St Lucie 1	P34	32	-225	802
St Lucie 2	CP49	32		842
Surry 1	P35	23	-593	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-743	693
Turkey Point 4	P41	23		693
Watts Bar 1	CP60	29	-54	1,165
Watts Bar 2	CP61	29		1,165

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1995 (Continued)				
Millstone 3	CP33	29		1,159
Oconee 1	P22	27	-1,214	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-354	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-388	530
Prairie Island 2	P29	18		530
Pt. Beach 1	P26	18	-17	497
Pt. Beach 2	P27	18		497
Quad Cities 1	B24	36	-812	789
Quad Cities 2	B25	36		789
San Onofre 1	P33	23	-258	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Sequoyah 1	CP46	29	-54	1,140
Sequoyah 2	CP45	29		1,140
St Lucie 1	P34	32	-127	802
St Lucie 2	CP49	32		842
Surry 1	P35	23	-522	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-672	693
Turkey Point 4	P41	23		693
Zion 1	P43	29	-160	1,040
Zion 2	P44	29		1,040

Table F.9. Continued

With Full Core Reserve					Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe	Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1995 (Continued)					1995 (Continued)				
Zion 1	P43	29	-247	1,040					
Zion 2	P44	29		1,040					
Total		2,203	-14,952	66,063	Total		1,741	-10,646	50,138
1996					1996				
Big Rock Point	B 1	0	-49	72	Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-200	1,100	Cook 2	P 7	29	-113	1,100
Cooper	B 7	27	-176	778	Cooper	B 7	27	-66	778
Crystal River 3	P 8	27	-9	825	Fitzpatrick	B12	28	-137	821
Duane Arnold	B11	18	-39	538	Ft. Calhoun	P11	20	-210	457
Enrico Fermi 2	CB 6	38	-69	1,123	Ginna	P12	18	-126	490
Fitzpatrick	B12	28	-249	821	Haddam Neck	P13	23	-25	575
Ft. Calhoun	P11	20	-270	457	Humboldt Bay	B15	0	-108	65
Ginna	P12	18	-181	490	Indian Point 2	P15	29	-361	873
Haddam Neck	P13	23	-96	575	Indian Point 3	P16	29	-149	873
Humboldt Bay	B15	0	-108	65	Maine Yankee	P18	32	-349	790
Indian Point 2	P15	29	-448	873	Millstone 1	B17	29	-211	660
Indian Point 3	P16	29	-236	873	Monticello	B18	24	-111	545
LaCrosse	B16	4	-14	50	Oyster Creek	B20	28	-268	650
Maine Yankee	P18	32	-447	790	Palisades	P25	31	-315	805
Millstone 1	B17	29	-327	660	Pilgrim 1	B23	29	-174	655
Monticello	B16	24	-208	545	Rancho Seco	P30	27	-254	918
Oyster Creek	B20	28	-380	650	Robinson 2	P31	23	-297	700
Palisades	P25	31	-406	805	Summer 1	CP51	23	-22	900
Pilgrim 1	B23	29	-290	655	Three Mile Island 1	P37	27	-205	819
Rancho Seco	P30	27	-334	918	Three Mile Island 2	P38	27	-199	906
Robinson 2	P31	23	-367	700	Trojan	P39	29	-233	1,130
Shoreham	CB26	28	-50	854	Vermont Yankee	B26	18	-110	514
Summer 1	CP51	23	-92	900	Zimmer 1	CP65	84	-170	810
Three Mile Island 1	P37	27	-284	819	Arkansas 1	P 1	27	-435	850
Three Mile Island 2	P38	27	-279	906	Arkansas 2	P 2	27		950
Trojan	P39	29	-320	1,130	Browns Ferry 1	B 2	38	-37	1,065
Vermont Yankee	B26	18	-184	514	Browns Ferry 2	B 3	38		1,065
Washington Nuclear 2	CB29	38	-69	1,103	Browns Ferry 3	B 4	38		1,065
Waterford 3	CP59	31	-90	1,267	Brunswick 1	B 5	28	-574	821
Zimmer 1	CP65	84	-422	810	Brunswick 2	B 6	28		821
Arkansas 1	P 1	27	-515	850	Calvert Cliffs 1	P 4	32	-745	845
Arkansas 2	P 2	27		950	Calvert Cliffs 2	P 5	32		845
Bellefonte 1	CP 2	31	-58	1,235	Diablo Canyon 1	CP19	29	-112	1,084

Table F.9. Continued

With Full Core Reserve					Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe	Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1996 (Continued)					1996 (Continued)				
Bellefonte 2	CP 3	31		1,235	Diablo Canyon 2	CP20	29		1,106
Braidwood 1	CP 4	29	-26	1,120	Dresden 1	B 8	0	-263	200
Braidwood 2	CP 5	29		1,120	Dresden 2	B 9	36		794
Browns Ferry 1	B 2	38	-190	1,065	Dresden 3	B10	36		794
Browns Ferry 2	B 3	38		1,065	Farley 1	P10	23	-116	829
Browns Ferry 3	B 4	38		1,065	Farley 2	CP21	23		829
Brunswick 1	B 5	28	-686	821	Hatch 1	B13	28	-567	717
Brunswick 2	B 6	28		821	Hatch 2	B14	28		822
Byron 1	CP 6	29	-26	1,120	McGuire 1	CP29	23	-43	1,180
Byron 2	CP 7	29		1,120	McGuire 2	CP30	29		1,180
Calvert Cliffs 1	P 4	32	-843	845	Millstone 2	P19	32	-96	830
Calvert Cliffs 2	P 5	32		845	Millstone 3	CP33	29		1,159
Catawba 1	CP10	29	-26	1,145	Oconee 1	P22	27	-1,293	887
Catawba 2	CP11	29		1,145	Oconee 2	P23	27		887
Comanche Peak 1	CP15	29	-54	1,150	Oconee 3	P24	27		887
Comanche Peak 2	CP16	29		1,150	Peach Bottom 2	B21	38	-430	1,065
Diablo Canyon 1	CP19	29	-198	1,084	Peach Bottom 3	B22	38		1,065
Diablo Canyon 2	CP20	29		1,106	Prairie Island 1	P28	18	-424	530
Dresden 1	B 8	0	-408	200	Prairie Island 2	P29	18		530
Dresden 2	B 9	36		794	Pt. Beach 1	P26	18	-53	497
Dresden 3	B10	36		794	Pt. Beach 2	P27	18		497
Farley 1	P10	23	-186	829	Quad Cities 1	B24	36	-884	789
Farley 2	CP21	23		829	Quad Cities 2	B25	36		789
Hatch 1	B13	28	-679	717	Salem 1	P32	29	-19	1,090
Hatch 2	B14	28		822	Salem 2	CP40	29		1,115
LaSalle 1	CB15	38	-23	1,078	San Onofre 1	P33	23	-347	436
LaSalle 2	CB16	38		1,078	San Onofre 2	CP41	32		1,140
McGuire 1	CP29	23	-130	1,180	San Onofre 3	CP42	32		1,140
McGuire 2	CP30	29		1,180	Sequoyah 1	CP46	29	-112	1,140
Midland 1	CP31	27	-52	492	Sequoyah 2	CP45	29		1,140
Midland 2	CP32	27		887	St Lucie 1	P34	32	-192	802
Millstone 2	P19	32	-183	830	St Lucie 2	CP49	32		842
Millstone 3	CP33	29		1,159	Surry 1	P35	23	-569	822
Oconee 1	P22	27	-1,373	887	Surry 2	P36	23		822
Oconee 2	P23	27		887	Turkey Point 3	P40	23	-719	693
Oconee 3	P24	27		887	Turkey Point 4	P41	23		693
Peach Bottom 2	B21	38	-583	1,065	Watts Bar 1	CP60	29	-25	1,165
Peach Bottom 3	B22	38		1,065	Watts Bar 2	CP61	29		1,165
Prairie Island 1	P28	18	-479	530	Zion 1	P43	29	-218	1,040
Prairie Island 2	P29	18		530	Zion 2	P44	29		1,040

Table F.9. Continued

With Full Core Reserve					Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe	Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1996 (Continued)					1996 (Continued)				
Pt. Beach 1	P26	18	-108	497					
Pt. Beach 2	P27	18		497					
Quad Cities 1	B24	36	-1,029	789					
Quad Cities 2	B25	36		789					
Salem 1	P32	29	-106	1,090					
Salem 2	CP40	29		1,115					
San Onofre 1	P33	23	-444	436					
San Onofre 2	CP41	32		1,140					
San Onofre 3	CP42	32		1,140					
Sequoyah 1	CP46	29	-198	1,140					
Sequoyah 2	CP45	29		1,140					
St Lucie 1	P34	32	-289	802					
St Lucie 2	CP49	32		842					
Surry 1	P35	23	-639	822					
Surry 2	P36	23		822					
Turkey Point 3	P40	23	-789	693					
Turkey Point 4	P41	23		693					
Watts Bar 1	CP60	29	-112	1,165					
Watts Bar 2	CP61	29		1,165					
Zion 1	P43	29	-305	1,040					
Zion 2	P44	29		1,040					
Total		2,651	-17,428	82,000	Total		2,046	-12,533	61,128
1997					1997				
Big Rock Point	B 1	0	-49	72	Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-229	1,100	Cook 2	P 7	29	-142	1,100
Cooper	B 7	27	-203	778	Cooper	B 7	27	-93	778
Crystal River 3	P 8	27	-36	825	Fitzpatrick	B12	28	-165	821
Duane Arnold	B11	18	-58	538	Ft. Calhoun	P11	20	-230	457
Enrico Fermi 2	CB 6	38	-107	1,123	Ginna	P12	18	-144	490
Fitzpatrick	B12	28	-277	821	Haddam Neck	P13	23	-49	575
Ft. Calhoun	P11	20	-289	457	Humboldt Bay	B15	0	-108	65
Ginna	P12	18	-199	490	Indian Point 2	P15	29	-390	873
Haddam Neck	P13	23	-119	575	Indian Point 3	P16	29	-178	873
Humboldt Bay	B15	0	-108	65	LaCrosse	B16	4	-3	50
Indian Point 2	P15	29	-477	873	Maine Yankee	P18	32	-382	790
Indian Point 3	P16	29	-265	873	Millstone 1	B17	29	-240	660
Kewaunee	P17	18	-1	535	Monticello	B18	24	-136	545
LaCrosse	B16	4	-17	50	Oyster Creek	B20	28	-296	650
Maine Yankee	P18	32	-479	790	Palisades	P25	31	-345	805

Table F.9. Continued

With Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1997 (Continued)				
Millstone 1	B17	29	-356	660
Monticello	B18	24	-232	545
Oyster Creek	B20	28	-408	650
Palisades	P25	31	-437	805
Pilgrim 1	B23	29	-319	655
Rancho Seco	P30	27	-360	918
Robinson 2	P31	23	-391	700
Shoreham	CB26	28	-78	854
Summer 1	CP51	23	-116	900
Three Mile Island 1	P37	27	-311	819
Three Mile Island 2	P38	27	-305	906
Trojan	P39	29	-348	1,130
Vermont Yankee	B26	18	-202	514
Washington Nuclear 2	CB29	38	-107	1,103
Waterford 3	CP59	31	-121	1,267
Wolf Creek 1	CP62	29	-27	1,150
Zimmer 1	CP65	84	-506	810
Arkansas 1	P 1	27	-568	850
Arkansas 2	P 2	27		950
Beaver Valley 1	P 3	23	-27	852
Beaver Valley 2	CP 1	23		852
Bellefonte 1	CP 2	31	-119	1,235
Bellefonte 2	CP 3	31		1,235
Braidwood 1	CP 4	29	-83	1,120
Braidwood 2	CP 5	29		1,120
Browns Ferry 1	B 2	38	-304	1,065
Browns Ferry 2	B 3	38		1,065
Browns Ferry 3	B 4	38		1,065
Brunswick 1	B 5	28	-742	821
Brunswick 2	B 6	28		821
Byron 1	CP 6	29	-83	1,120
Byron 2	CP 7	29		1,120
Calvert Cliffs 1	P 4	32	-908	845
Calvert Cliffs 2	P 5	32		845
Catawba 1	CP10	29	-83	1,145
Catawba 2	CP11	29		1,145
Comanche Peak 1	CP15	29	-112	1,150

Without Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1997 (Continued)				
Pilgrim 1	B23	29	-203	655
Rancho Seco	P30	27	-281	918
Robinson 2	P31	23	-320	700
Summer 1	CP51	23	-45	900
Three Mile Island 1	P37	27	-231	819
Three Mile Island 2	P38	27	-225	906
Trojan	P39	29	-261	1,130
Vermont Yankee	B26	18	-128	514
Waterford 3	CP59	31	-29	1,267
Zimmer 1	CP65	84	-254	810
Arkansas 1	P 1	27	-488	850
Arkansas 2	P 2	27		950
Bellefonte 1	CP 2	31	-27	1,235
Bellefonte 2	CP 3	31		1,235
Browns Ferry 1	B 2	38	-152	1,065
Browns Ferry 2	B 3	38		1,065
Browns Ferry 3	B 4	38		1,065
Brunswick 1	B 5	28	-630	821
Brunswick 2	B 6	28		821
Calvert Cliffs 1	P 4	32	-810	845
Calvert Cliffs 2	P 5	32		845
Comanche Peak 1	CP15	29	-25	1,150
Comanche Peak 2	CP16	29		1,150
Diablo Canyon 1	CP19	29	-169	1,084
Diablo Canyon 2	CP20	29		1,106
Dresden 1	B 8	0	-335	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Farley 1	P10	23	-162	829
Farley 2	CP21	23		829
Hatch 1	B13	28	-623	717
Hatch 2	B14	28		82
McGuire 1	CP29	23	-95	1,18
McGuire 2	CP30	29		1,18
Midland 1	CP31	27	-26	49
Midland 2	CP32	27		887
Millstone 2	P18	32	-157	830

Table F.9. Continued

With Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1997 (Continued)				
Comanche Peak 2	CP16	29		1,150
Diablo Canyon 1	CP19	29	-256	1,084
Diablo Canyon 2	CP20	29		1,106
Dresden 1	B 8	0	-480	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Farley 1	P10	23	-233	829
Farley 2	CP21	23		829
Hatch 1	B13	28	-735	717
Hatch 2	B14	28		822
LaSalle 1	CB15	38	-99	1,078
LaSalle 2	CB16	38		1,078
McGuire 1	CP29	23	-182	1,180
McGuire 2	CP30	29		1,180
Midland 1	CP31	27	-105	492
Midland 2	CP32	27		887
Millstone 2	P19	32	-244	830
Millstone 3	CP33	29		1,159
North Anna 1	P20	23	-50	907
North Anna 2	CP34	23		943
North Anna 3	CP35	22		907
North Anna 4	CP36	22		907
Oconee 1	P22	27	-1,453	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-659	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-515	530
Prairie Island 2	P29	18		530
Pt. Beach 1	P26	18	-144	497
Pt. Beach 2	P27	18		497
Quad Cities 1	B24	36	-1,101	789
Quad Cities 2	B25	36		789
Salem 1	P32	29	-163	1,090
Salem 2	CP40	29		1,115
San Onofre 1	P33	23	-532	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Sequoyah 1	CP46	29	-256	1,140
Sequoyah 2	CP45	29		1,140
South Texas 1	CP47	29	-26	1,250

Without Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1997 (Continued)				
Millstone 3	CP33	29		1,159
Oconee 1	P22	27	-1,373	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-506	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-460	530
Prairie Island 2	P29	18		530
Pt. Beach 1	P26	18	-89	497
Pt. Beach 2	P27	18		497
Quad Cities 1	B24	36	-956	789
Quad Cities 2	B25	36		789
Salem 1	P32	29	-77	1,090
Salem 2	CP40	29		1,115
San Onofre 1	P33	23	-435	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Sequoyah 1	CP46	29	-169	1,140
Sequoyah 2	CP45	29		1,140
St. Lucie 1	P34	32	-257	802
St. Lucie 2	CP49	32		842
Surry 1	P35	23	-616	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-765	693
Turkey Point 4	P41	23		693
Watts Bar 1	CP60	29	-83	1,165
Watts Bar 2	CP61	29		1,165
Zion 1	P43	29	-275	1,040
Zion 2	P44	29		1,040

Table F.9. Continued

With Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available^{a,b}	MWe
1997 (Continued)				
South Texas 2	CP48	29		1,250
St. Lucie 1	P34	32	-354	802
St. Lucie 2	CP49	32		842
Surry 1	P35	23	-686	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-836	693
Turkey Point 4	P41	23		693
Watts Bar 1	CP60	29	-170	1,165
Watts Bar 2	CP61	29		1,165
Zion 1	P43	29	-362	1,040
Zion 2	P44	29		1,040
Total		2,892	-20,210	91,500
1998				
Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-258	1,100
Cooper	B 7	27	-230	778
Crystal River 3	P 8	27	-62	825
Duane Arnold	B11	18	-76	538
Enrico Fermi 2	CB 6	38	-145	1,123
Fitzpatrick	B12	28	-305	821
Forked River	CP22	32	-31	1,070
Ft. Calhoun	P11	20	-309	457
Ginna	P12	18	-217	490
Haddam Neck	P13	71	-119	575
Humboldt Bay	B15	0	-108	65
Indian Point 2	P15	29	-505	873
Indian Point 3	P16	29	-293	873
Kewaunee	P17	18	-18	535
LaCrosse	B16	4	-21	50
Maine Yankee	P18	32	-512	790
Millstone 1	B17	29	-385	660
Monticello	B18	24	-257	545
Oyster Creek	B20	28	-436	650
Palisades	P25	31	-468	805
Pilgrim 1	B23	29	-348	655
Rancho Seco	P30	27	-387	918

Without Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available^{b,c}	MWe
1997 (Continued)				
Total		2,252	-14,689	68,594
1998				
Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-171	1,100
Cooper	B 7	27	-121	778
Duane Arnold	B11	18	-2	538
Fitzpatrick	B12	28	-193	821
Ft. Calhoun	P11	20	-249	457
Ginna	P12	18	-162	490
Haddam Neck	P13	71	-119	575
Humboldt Bay	B15	0	-108	65
Indian Point 2	P15	29	-419	873
Indian Point 3	P16	29	-207	873
LaCrosse	B16	4	-7	50
Maine Yankee	P18	32	-414	790
Millstone 1	B17	29	-269	660
Monticello	B18	24	-160	545
Oyster Creek	B20	28	-324	650
Palisades	P25	31	-376	805
Pilgrim 1	B23	29	-232	655
Rancho Seco	P30	27	-307	918
Robinson 2	P31	23	-343	700
Summer 1	CP51	23	-68	900
Three Mile Island 1	P37	27	-258	819
Three Mile Island 2	P38	27	-252	906

Table F.9. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1998 (Continued)				
Robinson 2	P31	23	-414	700
Shoreham	CB26	28	-106	854
Summer 1	CP51	23	-139	900
Three Mile Island 1	P37	27	-338	819
Three Mile Island 2	P38	27	-332	906
Trojan	P39	29	-377	1,130
Vermont Yankee	B26	18	-220	514
Washington Nuclear 2	CB29	38	-145	1,103
Waterford 3	CP59	31	-152	1,267
Wolf Creek 1	CP62	29	-56	1,150
Zimmer 1	CP65	84	-590	810
Arkansas 1	P 1	27	-621	850
Arkansas 2	P 2	27		950
Beaver Valley 1	P 3	23	-74	852
Beaver Valley 2	CP 1	23		852
Bellefonte 1	CP 2	31	-180	1,235
Bellefonte 2	CP 3	31		1,235
Braidwood 1	CP 4	29	-141	1,120
Braidwood 2	CP 5	29		1,120
Browns Ferry 1	B 2	38	-419	1,065
Browns Ferry 2	B 3	38		1,065
Browns Ferry 3	B 4	38		1,065
Brunswick 1	B 5	28	-798	821
Brunswick 2	B 6	28		821
Byron 1	CP 6	29	-141	1,120
Byron 2	CP 7	29		1,120
Calvert Cliffs 1	P 4	32	-972	845
Calvert Cliffs 2	P 5	32		845
Catawba 1	CP10	29	-141	1,145
Catawba 2	CP11	29		1,145
Comanche Peak 1	CP15	29	-170	1,150
Comanche Peak 2	CP16	29		1,150
Diablo Canyon 1	CP19	29	-314	1,084
Diablo Canyon 2	CP20	29		1,106
Dresden 1	B 8	0	-552	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1998 (Continued)				
Trojan	P39	29	-290	1,130
Vermont Yankee	B25	18	-147	514
Waterford 3	CP59	31	-59	1,267
Zimmer 1	CP65	84	-338	810
Arkansas 1	P 1	27	-541	850
Arkansas 2	P 2	27		950
Beaver Valley 1	P 3	23	-4	852
Beaver Valley 2	CP 1	23		852
Bellefonte 1	CP 2	31	-88	1,235
Bellefonte 2	CP 3	31		1,235
Braidwood 1	CP 4	29	-54	1,120
Braidwood 2	CP 5	29		1,120
Browns Ferry 1	B 2	38	-266	1,065
Browns Ferry 2	B 3	38		1,065
Browns Ferry 3	B 4	38		1,065
Brunswick 1	B 5	28	-686	821
Brunswick 2	B 6	28		821
Byron 1	CP 6	29	-54	1,120
Byron 2	CP 7	29		1,120
Calvert Cliffs 1	P 4	32	-875	845
Calvert Cliffs 2	P 5	32		845
Catawba 1	CP10	29	-54	1,145
Catawba 2	CP11	29		1,145
Comanche Peak 1	CP15	29	-83	1,150
Comanche Peak 2	CP16	29		1,150
Diablo Canyon 1	CP19	29	-227	1,084
Diablo Canyon 2	CP20	29		1,106
Dresden 1	B 8	0	-408	200
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Farley 1	P10	23	-209	829
Farley 2	CP21	23		829
Hatch 1	B13	28	-679	717
Hatch 2	B14	28		822
LaSalle 1	CB15	38	-23	1,078
LaSalle 2	CB16	38		1,078
McGuire 1	CP29	23	-148	1,180

Table F.9. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1998 (Continued)				
Farley 1	P10	23	-280	829
Farley 2	CP21	23		829
Hatch 1	B13	28	-791	717
Hatch 2	B14	28		822
LaSalle 1	CB15	38	-176	1,078
LaSalle 2	CB16	36		1,078
Marble Hill 1	CP27	29	-54	1,130
Marble Hill 2	CP28	29		1,130
McGuire 1	CP29	23	-234	1,180
McGuire 2	CP30	29		1,180
Midland 1	CP31	27	-158	492
Midland 2	CP32	27		887
Millstone 2	P19	32	-305	830
Millstone 3	CP33	29		1,159
North Anna 1	P20	23	-140	907
North Anna 2	CP34	23		943
North Anna 3	CP35	22		907
North Anna 4	CP36	22		907
Oconee 1	P22	27	-1,532	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-736	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-551	530
Prairie Island 2	P29	18		530
Pt. Beach 1	P26	18	-180	497
Pt. Beach	P27	18		497
Quad Cities 1	B24	36	-1,174	789
Quad Cities 2	B25	36		789
Salem 1	P32	29	-221	1,090
Salem 2	CP40	29		1,115
San Onofre 1	P33	71	-668	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Sequoyah 1	CP46	29	-314	1,140
Sequoyah 2	CP45	29		1,140
South Texas 1	CP47	29	-83	1,250
South Texas 2	CP48	29		1,250

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1998 (Continued)				
McGuire 2	CP30	29		1,180
Midland 1	CP31	27	-79	492
Midland 2	CP32	27		887
Millstone 2	P19	32	-218	830
Millstone 3	CP33	29		1,159
North Anna 1	P20	23	-75	907
North Anna 2	CP34	23		943
North Anna 3	CP35	22		907
North Anna 4	CP36	22		907
Oconee 1	P22	27	-1,453	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-583	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-496	530
Prairie Island 2	P29	18		530
Pt. Beach 1	P26	18	-125	497
Pt. Beach 2	P27	18		497
Quad Cities 1	B24	36	-1,029	789
Quad Cities 2	B25	36		789
Salem 1	P32	29	-134	1,090
Salem 2	CP40	29		1,115
San Onofre 1	P33	71	-570	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Sequoyah 1	CP46	29	-227	1,140
Sequoyah 2	CP45	29		1,140
St Lucie 1	P34	32	-321	802
St Lucie 2	CP49	32		842
Surry 1	P35	23	-662	822
Surry 2	P36	23		822
Turkey Point 3	P40	23	-812	693
Turkey Point 4	P41	23		693
Watts Bar 1	CP60	29	-140	1,165
Watts Bar 2	CP61	29		1,165
Zion 1	P43	29	-333	1,040
Zion 2	P44	29		1,040

Table F.9. Continued

With Full Core Reserve					✓ Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe	Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1998 (Continued)					1998 (Continued)				
St. Lucie 1	P34	32	-419	802					
St. Lucie 2	CP49	32		842					
Surry 1	P35	23	-733	822					
Surry 2	P36	23		822					
Susquehanna 1	CB27	38	-61	1,052					
Susquehanna 2	CB28	38		1,052					
Turkey Point 3	P40	23	-883	693					
Turkey Point 4	P41	23		693					
Watts Bar 1	CP60	29	-227	1,165					
Watts Bar 2	CP61	29		1,165					
Zion 1	P43	29	-420	1,040					
Zion 2	P44	29		1,040					
Total		3,153	-23,273	97,000	Total		2,751	-17,301	83,426
1999					1999				
Big Rock Point	B 1	0	-49	72	Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-287	1,100	Cook 2	P 7	29	-200	1,100
Cooper	B 7	27	-258	778	Cooper	B 7	27	-148	778
Crystal River 3	P 8	27	-89	825	Crystal River 3	P 8	27	-9	825
Duane Arnold	B11	18	-94	538	Duane Arnold	B11	18	-21	538
Enrico Fermi 2	CB 6	38	-184	1,123	Enrico Fermi 2	CB 6	38	-31	1,123
Fitzpatrick	B12	28	-333	821	Fitzpatrick	B12	28	-221	821
Forked River	CP22	32	-63	1,070	Ft. Calhoun	P11	20	-269	457
Ft. Calhoun	P11	20	-329	457	Ginna	P12	18	-180	490
Ginna	P12	18	-235	490	Haddam Neck	P13	0	-119	575
Haddam Neck	P13	0	-119	575	Humboldt Bay	B15	0	-108	65
Humboldt Bay	B15	0	-108	65	Indian Point 2	P15	29	-447	873
Indian Point 2	P15	29	-534	873	Indian Point 3	P16	29	-235	873
Indian Point 3	P16	29	-322	873	LaCrosse	B16	14	-21	50
Kewaunee	P17	18	-36	535	Maine Yankee	P18	32	-446	790
LaCrosse	B16	14	-21	50	Millstone 1	B17	29	-298	660
Maine Yankee	P18	32	-544	790	Monticello	B18	24	-184	545
Millstone 1	B17	29	-414	660	Oyster Creek	B20	112	-436	650
Monticello	B18	24	-281	545	Palisades	P25	31	-406	805
Oyster Creek	B20	112	-436	650	Pilgrim 1	B23	29	-261	655
Palisades	P25	31	-498	805	Rancho Seco	P30	27	-334	918
Pilgrim 1	B23	29	-377	655	Robinson 2	P31	23	-367	700

Table F.9. Continued

With Full Core Reserve					Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe	Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1999 (Continued)					1999 (Continued)				
Rancho Seco	P30	27	-414	918	Shoreham	CB26	28	-22	854
Robinson 2	P31	23	-437	700	Summer 1	CP51	23	-92	900
Shoreham	CB26	28	-134	854	Three Mile Island 1	P37	27	-284	819
Summer 1	CP51	23	-162	900	Three Mile Island 2	P38	27	-279	906
Three Mile Island 1	P37	27	-364	819	Trojan	P39	29	-319	1,130
Three Mile Island 2	P38	27	-358	906	Vermont Yankee	B26	18	-165	514
Trojan	P39	29	-406	1,130	Washington Nuclear 2	CB29	39	-31	1,103
Vermont Yankee	B26	18	-239	514	Waterford 3	CP59	31	-90	1,267
Washington Nuclear 2	CB29	38	-183	1,103	Zimmer 1	CP65	84	-422	810
Waterford 3	CP59	31	-182	1,267	Arkansas 1	P 1	27	-594	850
Wolf Creek 1	CP62	29	-85	1,150	Arkansas 2	P 2	27		950
Zimmer 1	CP65	84	-674	810	Beaver Valley 1	P 3	23	-50	852
Arkansas 1	P 1	27	-674	850	Beaver Valley 2	CP 1	23		852
Arkansas 2	P 2	27		950	Bellefonte 1	CP 2	31	-149	1,235
Beaver Valley 1	P 3	23	-121	852	Bellefonte 2	CP 3	31		1,235
Beaver Valley 2	CP 1	23		852	Braidwood 1	CP 4	29	-112	1,120
Bellefonte 1	CP 2	31	-242	1,235	Braidwood 2	CP 5	29		1,120
Bellefonte 2	CP 3	31		1,235	Browns Ferry 1	B 2	38	-381	1,065
Braidwood 1	CP 4	29	-198	1,120	Browns Ferry 2	B 3	38		1,065
Braidwood 2	CP 5	29		1,120	Browns Ferry 3	B 4	38		1,065
Browns Ferry 1	B 2	38	-534	1,065	Brunswick 1	B 5	28	-742	821
Browns Ferry 2	B 3	38		1,065	Brunswick 2	B 6	28		821
Browns Ferry 3	B 4	38		1,065	Byron 1	CP 6	29	-112	1,120
Brunswick 1	B 5	28	-854	821	Byron 2	CP 7	29		1,120
Brunswick 2	B 6	28		821	Calvert Cliffs 1	P 4	32	-940	845
Byron 1	CP 6	29	-198	1,120	Calvert Cliffs 2	P 5	32		845
Byron 2	CP 7	29		1,120	Catawba 1	CP10	29	-112	1,145
Calvert Cliffs 1	P 4	32	-1,037	845	Catawba 2	CP11	29		1,145
Calvert Cliffs 2	P 5	32		845	Comanche Peak 1	CP15	29	-140	1,150
Catawba 1	CP10	29	-198	1,145	Comanche Peak 2	CP16	29		1,150
Catawba 2	CP11	29		1,145	Diablo Canyon 1	CP19	29	-285	1,184
Comanche Peak 1	CP15	29	-228	1,150	Diablo Canyon 2	CP20	29		1,106
Comanche Peak 2	CP16	29		1,150	Dresden 1	B 8	0	-480	200
Davis Besse 1	P 9	27	-13	906	Dresden 2	B 9	36		794
Davis Besse 2	CP17	27		906	Dresden 3	B10	36		794
Davis Besse 3	CP18	27		906	Farley 1	P10	23	-256	829
Diablo Canyon 1	CP19	29	-371	1,084	Farley 2	CP21	23		829
Diablo Canyon 2	CP20	29		1,106	Hatch 1	B13	28	-735	717
Dresden 1	B 8	0	-625	200	Hatch 2	B14	28		822

Table F.9. Continued

With Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1999 (Continued)				
Dresden 2	B 9	36		794
Dresden 3	B10	36		794
Farley 1	P10	23	-327	829
Farley 2	CP21	23		829
Hatch 1	B13	28	-847	717
Hatch 2	B14	28		822
LaSalle 1	CB15	38	-252	1,078
LaSalle 2	CB16	38		1,078
Marble Hill 1	CP27	29	-112	1,130
Marble Hill 2	CP28	29		1,130
McGuire 1	CP29	23	-287	1,180
McGuire 2	CP30	29		1,180
Midland 1	CP31	27	-212	492
Midland 2	CP32	27		887
Millstone 2	P19	32	-366	830
Millstone 3	CP33	29		1,159
Nine Mile Point 1	B19	106	-123	610
Nine Mile Point 2	CB19	38		1,080
North Anna 1	P20	23	-230	907
North Anna 2	CP34	23		943
North Anna 3	CP35	22		907
North Anna 4	CP36	22		907
Oconee 1	P22	27	-1,612	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-812	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-587	530
Prairie Island 2	P29	18		530
Pt. Beach 1	P26	18	-216	497
Pt. Beach 2	P27	18		497
Quad Cities 1	B24	36	-1,246	789
Quad Cities 2	B25	36		789
Salem 2	CP40	29		1,115
San Onofre 1	P33	0	-733	436
San Onofre 2	CP41	32		1,140

Without Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1999 (Continued)				
LaSalle 1	CB15	38	-99	1,078
LaSalle 2	CB16	38		1,078
Marble Hill 1	CP27	29	-25	1,130
Marble Hill 2	CP28	29		1,130
McGuire 1	CP29	23	-200	1,180
McGuire 2	CP30	29		1,180
Midland 1	CP31	27	-132	492
Midland 2	CP32	27		887
Millstone 2	P19	32	-279	830
Millstone 3	CP33	29		1,159
North Anna 1	P20	23	-165	907
North Anna 2	CP34	23		943
North Anna 3	CP35	22		907
North Anna 4	CP36	22		907
Oconee 1	P22	27	-1,532	887
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-659	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-532	530
Prairie Island 2	P29	18		530
Pt. Beach 1	P26	18	-161	497
Pt. Beach 2	P27	18		497
Quad Cities 1	B24	36	-1,101	789
Quad Cities 2	B25	36		789
Salem 1	P32	29	-192	1,090
Salem 2	CP40	29		1,115
San Onofre 1	P33	0	-635	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Sequoyah 1	CP46	29	-284	1,140
Sequoyah 2	CP45	29		1,140
South Texas 1	CP47	29	-54	1,250
St. Lucie 1	P34	32	-386	802
St. Lucie 2	CP49	32		842
Surry 1	P35	23	-709	822

Table F.9. Continued

With Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
1999 (Continued)				
San Onofre 3	CP42	32		1,140
Sequoyah 1	CP46	29	-371	1,140
Sequoyah 2	CP45	29		1,140
South Texas 1	CP47	29	-141	1,250
South Texas 2	CP48	29		1,250
St. Lucie 1	P34	32	-484	802
St. Lucie 2	CP49	32		842
Surry 1	P35	23	-780	822
Surry 2	P36	23		822
Susquehanna 1	CB27	38	-138	1,052
Susquehanna 2	CB28	38		1,052
Turkey Point 3	P40	23	-930	693
Turkey Point 4	P41	23		693
Washington Nuclear 1	CP55	31	-58	1,251
Washington Nuclear 4	CP57	31		1,267
Watts Bar 1	CP60	29	-285	1,165
Watts Bar 2	CP61	29		1,165
Zion 1	P43	29	-477	1,040
Zion 2	P44	29		1,040
Total		3,392	-26,447	102,900
2000				
Bailly 1	CB 1	22	-18	660
Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-315	1,100
Cooper	B 7	27	-285	778
Crystal River 3	P 8	27	-115	825
Duane Arnold	B11	18	-113	538
Enrico Fermi 2	CB 6	38	-222	1,123
Fitzpatrick	B12	28	-361	821
Forked River	CP22	32	-96	1,070
Ft. Calhoun	P11	20	-349	457
Ginna	P12	54	-235	490
Haddam Neck	P13	0	-119	575
Humboldt Bay	B15	0	-108	65
Indian Point 2	P15	29	-563	873

Without Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
1999 (Continued)				
Surry 2	P36	23		822
Turkey Point 3	P40	23	-859	693
Turkey Point 4	P41	23		693
Watts Bar 1	CP60	29	-198	1,165
Watts Bar 2	CP61	29		1,165
Zion 1	P43	29	-391	1,040
Total		2,951	-20,178	91,080
2000				
Big Rock Point	B 1	0	-49	72
Cook 2	P 7	29	-229	1,100
Cooper	B 7	27	-176	778
Crystal River 3	P 8	27	-36	825
Duane Arnold	B11	18	-39	538
Enrico Fermi 2	CB 6	38	-69	1,123
Fitzpatrick	B12	28	-249	821
Ft. Calhoun	P11	20	-289	457
Ginna	P12	54	-235	490
Haddam Neck	P13	0	-119	575
Humboldt Bay	B15	0	-108	65
Indian Point 2	P15	29	-476	873
Indian Point 3	P16	29	-264	873
Kewaunee	P17	18	0	535

Table F.9. Continued

With Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe
2000 (Continued)				
Indian Point 3	P16	29	-351	873
Kewaunee	P17	18	-54	535
LaCrosse	B16	0	-21	50
Maine Yankee	P18	32	-576	790
Millstone 1	B17	29	-443	660
Monticello	B18	24	-305	545
Oyster Creek	B20	0	-436	650
Palisades	P25	31	-529	805
Pilgrim 1	B23	29	-406	655
Rancho Seco	P30	27	-440	918
Robinson 2	P31	23	-461	700
Shoreham	CB26	28	-162	854
Summer 1	CP51	23	-186	900
Three Mile Island 1	P37	27	-391	819
Three Mile Island 2	P38	27	-385	906
Trojan	P39	29	-435	1,130
Vermont Yankee	B26	18	-257	514
Washington Nuclear 2	CB29	38	-222	1,103
Waterford 3	CP59	31	-213	1,267
Wolf Creek 1	CP62	29	-114	1,150
Zimmer 1	CP65	84	-758	810
Arkansas 1	P 1	27	-727	850
Arkansas 2	P 2	27		950
Beaver Valley 1	P 3	23	-168	852
Beaver Valley 2	CP 1	23		852
Bellefonte 1	CP 2	31	-303	1,235
Bellefonte 2	CP 3	31		1,235
Braidwood 1	CP 4	29	-256	1,120
Braidwood 2	CP 5	29		1,120
Browns Ferry 1	B 2	38	-648	1,065
Browns Ferry 2	B 3	38		1,065
Browns Ferry 3	B 4	38		1,065
Brunswick 1	B 5	28	-910	821
Brunswick 2	B 6	28		821
Byron 1	CP 6	29	-256	1,120
Byron 2	CP 7	29		1,120
Callaway 1	CP 8	29	-54	1,150
Callaway 2	CP 9	29		1,150

Without Full Core Reserve

Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
2000 (Continued)				
LaCrosse	B16	0	-21	50
Maine Yankee	P18	32	-479	790
Millstone 1	B17	29	-327	660
Monticello	B18	24	-208	545
Oyster Creek	B20	0	-436	650
Palisades	P25	31	-437	805
Pilgrim 1	B23	29	-290	655
Rancho Seco	P30	27	-360	918
Robinson 2	P31	23	-390	700
Shoreham	CB26	28	-50	854
Summer 1	CP51	23	-115	900
Three Mile Island 1	P37	27	-311	819
Three Mile Island 2	P38	27	-305	906
Trojan	P39	29	-348	1,130
Vermont Yankee	B26	18	-184	514
Washington Nuclear 2	CB29	38	-69	1,103
Waterford 3	CP59	31	-121	1,267
Wolf Creek 1	CP62	29	-27	1,150
Zimmer 1	CP65	84	-506	810
Arkansas 1	P 1	27	-648	850
Arkansas 2	P 2	27		950
Beaver Valley 1	P 3	23	-97	852
Beaver Valley 2	CP 1	23		852
Bellefonte 1	CP 2	31	-211	1,235
Bellefonte 2	CP 3	31		1,235
Braidwood 1	CP 4	29	-169	1,120
Braidwood 2	CP 5	29		1,120
Browns Ferry 1	B 2	38	-495	1,065
Browns Ferry 2	B 3	38		1,065
Browns Ferry 3	B 4	38		1,065
Brunswick 1	B 5	28	-798	821
Brunswick 2	B 6	28		821
Byron 1	CP 6	29	-169	1,120
Byron 2	CP 7	29		1,120
Calvert Cliffs 1	P 4	32	-1,004	845
Calvert Cliffs 2	P 5	32		845
Catawba 1	CP10	29	-169	1,145
Catawba 2	CP11	29		1,145

Table F.9. Continued

With Full Core Reserve					Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe	Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
2000 (Continued)					2000 (Continued)				
Calvert Cliffs 1	P 4	32	-1,102	845	Comanche Peak 1	CP15	29	-198	1,150
Calvert Cliffs 2	P 5	32		845	Comanche Peak 2	CP16	29		1,150
Catawba 1	CP10	29	-256	1,145	Davis Besse 1	P 9	27	-13	906
Catawba 2	CP11	29		1,145	Davis Besse 2	CP17	27		906
Comanche Peak 1	CP15	29	-285	1,150	Davis Besse 3	CP18	27		906
Comanche Peak 2	CP16	29		1,150	Diablo Canyon 1	CP19	29	-342	1,084
Davis Besse 1	P 9	27	-93	906	Diablo Canyon 2	CP20	29		1,106
Davis Besse 2	CP17	27		906	Dresden 1	B 8	0	-552	200
Davis Besse 3	CP18	27		906	Dresden 2	B 9	36		794
Diablo Canyon 1	CP19	29	-429	1,084	Dresden 3	B10	36		794
Diablo Canyon 2	CP20	29		1,106	Farley 1	P10	23	-303	829
Dresden 1	B 8	0	-697	200	Farley 2	CP21	23		829
Dresden 2	B 9	36		794	Hatch 1	B13	28	-791	717
Dresden 3	B10	36		794	Hatch 2	B14	28		822
Farley 1	P10	23	-374	829	LaSalle 1	CB15	38	-176	1,078
Farley 2	CP21	23		829	LaSalle 2	CB16	38		1,078
Grand Gulf 1	CB 7	39	-63	1,250	Marble Hill 1	CP27	29	-83	1,130
Grand Gulf 2	CB 8	39		1,250	Marble Hill 2	CP29	29		1,130
Hatch 1	B13	28	-903	717	McGuire 1	CP29	23	-252	1,180
Hatch 2	B14	28		822	McGuire 2	CP30	29		1,180
LaSalle 1	CB15	38	-329	1,078	Midland 1	CP31	27	-185	492
LaSalle 2	CB16	38		1,078	Midland 2	CP32	27		887
Marble Hill 1	CP27	29	-170	1,130	Millstone 2	P19	32	-341	830
Marble Hill 2	CP28	29		1,130	Millstone 3	CP33	29		1,159
McGuire 1	CP29	23	-339	1,180	Nine Mile Point 1	B19	0	-8	610
McGuire 2	CP30	29		1,180	Nine Mile Point 2	CB19	38		1,080
Midland 1	CP31	27	-265	492	North Anna 1	P20	23	-255	907
Midland 2	CP32	27		887	North Anna 2	CP34	23		943
Millstone 2	P19	32	-428	830	North Anna 3	CP35	22		907
Millstone 3	CP33	29		1,159	North Anna 4	CP36	22		907
Nine Mile Point 1	B19	0	-161	610	Oconee 1	P22	27	-1,612	887
Nine Mile Point 2	CB19	38		1,080	Oconee 2	P23	27		887
North Anna 1	P20	23	-320	907	Oconee 3	P24	27		887
North Anna 2	CP34	23		943	Peach Bottom 2	B21	38	-736	1,065
North Anna 3	CP35	22		907	Peach Bottom 3	B22	38		1,065
North Anna 4	CP36	22		907	Prairie Island 1	P28	18	-568	530
Oconee 1	P22	27	-1,692	887	Prairie Island 2	P29	18		530

Table F.9. Continued

With Full Core Reserve				
Reactor	Code	Annual Discharge	Storage Available[a,b]	MWe
2000 (Continued)				
Oconee 2	P23	27		887
Oconee 3	P24	27		887
Peach Bottom 2	B21	38	-888	1,065
Peach Bottom 3	B22	38		1,065
Prairie Island 1	P28	18	-623	530
Prairie Island 2	P29	18		530
Pt. Beach 1	P26	54	-288	497
Pt. Beach 2	P27	18		497
Quad Cities 1	B24	36	-1,318	789
Quad Cities 2	B25	36		789
Salem 1	P32	29	-336	1,090
Salem 2	CP40	29		1,115
San Onofre 1	P33	0	-797	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Seabrook 1	CP43	29	-54	1,194
Seabrook 2	CP44	29		1,194
Sequoyah 1	CP46	29	-429	1,140
Sequoyah 2	CP45	29		1,140
South Texas 1	CP47	29	-198	1,250
South Texas 2	CP48	29		1,250
St Lucie 1	P34	32	-549	802
St Lucie 2	CP49	32		842
Surry 1	P35	23	-827	822
Surry 2	P38	23		822
Susquehanna 1	CB27	38	-214	1,052
Susquehanna 2	CB28	38		1,052
Turkey Point 3	P40	23	-977	693
Turkey Point 4	P41	23		693
Washington Nuclear 1	CP55	31	-119	1,251
Washington Nuclear 4	CB57	31		1,267
Washington Nuclear 3	CP56	36	-33	1,242
Washington Nuclear 5	CP58	36		1,242
Watts Bar 1	CP60	29	-342	1,165
Watts Bar 2	CP61	29		1,165
Zion 1	P43	29	-535	1,040

Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
2000 (Continued)				
Pt. Beach 1	P26	54	-234	497
Pt. Beach 2	P27	18		497
Quad Cities 1	B24	36	-1,174	789
Quad Cities 2	B25	36		789
Salem 1	P32	29	-249	1,090
Salem 2	CP40	29		1,115
San Onofre 1	P33	0	-700	436
San Onofre 2	CP41	32		1,140
San Onofre 3	CP42	32		1,140
Sequoyah 1	CP46	29	-342	1,140
Sequoyah 2	CP45	29		1,140
South Texas 1	CP47	29	-112	1,250
South Texas 2	CP48	29		1,250
St Lucie 1	P34	32	-451	802
St Lucie 2	CP49	32		842
Surry 1	P35	23	-756	822
Surry 2	P36	23		822
Susquehanna 1	CB27	38	-61	1,052
Susquehanna 2	CB28	38		1,052
Turkey Point 3	P40	23	-906	693
Turkey Point 4	P41	23		693
Washington Nuclear 1	CP55	31	-27	1,251
Washington Nuclear 4	CP57	31		1,267
Watts Bar 1	CP60	29	-256	1,165
Watts Bar 2	CP61	29		1,165
Zion 1	P43	29	-448	1,040
Zion 2	P44	29		1,040

Table F.9. Continued

With Full Core Reserve					Without Full Core Reserve				
Reactor	Code	Annual Discharges	Storage Available[a,b]	MWe	Reactor	Code	Annual Discharges	Storage Available[b,c]	MWe
2000 (Continued)					2000 (Continued)				
Zion 2	P44	29		1,040					
Total		3,520	-29,847	111,900	Total		3,200	-23,212	100,485

[a] The negative numbers in this column indicate that away-from-reactor storage in the amount shown will be required if full-core reserve is to be maintained.

[b] In February 1979 application was filed requesting storage capacity expansion of the Oconee Units 1 and 2 reactor basin by 186 MTHM. Authorization was granted in June 1979. In April 1979 application was filed requesting capacity expansion of the Big Rock Point reactor basin by 50 MTHM. In July 1979 application was filed requesting capacity expansions of Hatch 1 and Hatch 2 reactor basins by a total of 813 MTHM. The shortfalls of storage capacity shown in this table do not reflect the additional capacity that would result from those expansions.

[c] The negative numbers in this column indicate that all at-reactor spent fuel storage capacity has been used, and away-from-reactor storage in the amount shown will be required for continuation of operation of the reactors at the site.

[d] 0 discharge means that all of the reactors for that utility are shut down due to age.

References

1. U.S. Nuclear Regulatory Commission, "Operating Units Status Reports--Licensed Operating Reactors" (Gray Book), NUREG-0020, Volume 3, Number 1, January 1979. Available from National Technical Information Service (NTIS), Springfield, Virginia 22161.

2. U.S. Nuclear Regulatory Commission, "Construction Status Report--Nuclear Power Plants" (Yellow Book), NUREG-0030, Volume 2, Number 1, February 1979. Available from National Technical Information Service (NTIS), Springfield, Virginia 22161.

3. U.S. Nuclear Regulatory Commission, "Program Summary Report" (Brown Book), NUREG-0380, Volume 3, Number 2, February 16, 1979. Available from National Technical Information Service (NTIS), Springfield, Virginia 22161.

APPENDIX G

CHARACTERISTICS OF NUCLEAR FUEL

1.0 INTRODUCTION

Section 2.1 of Volume 1 provides a general description of fuel used in light water nuclear reactors designed for commercial generation of electricity. As indicated in that section, this appendix contains more detailed information, including tabular material and illustrations dealing with the general description of the fuel (Tables G.1 through G.4 and Figures G.1 through G.3) and detailed information concerning the characteristics of spent nuclear fuel (Section 2.0 of this appendix, Tables G.5 through G.13 and Figure G.4).

The information presented herein is included to provide a more complete picture of nuclear fuel, but is not deemed essential to an understanding of the major issues addressed in this Statement.

2.0 CHARACTERISTICS OF SPENT FUEL

2.1 Composition

The characteristics of spent fuel, for this discussion, as listed in Tables G.5 through G.13 are based on operation of a typical large PWR with fuel exposed to 33,000 megawatt-days thermal per metric ton of uranium (MWD/MTU) at a specific power of 37.5 megawatts per metric ton (MW/MTU). Composition of BWR spent fuel would be similar, but its fresh-fuel ^{235}U content would be from 1 to 10% lower. The values shown in Tables G.5 through G.13 represent anticipated maximum burnup of 33,000 MWD/MTU at a plant capacity factor of 80% with operation over a period of three years.

The composition data were extracted from a 4 May 1978 output of the ORIGEN computer code at the Oak Ridge National Laboratory.*

2.1.1 Fission Products

During its service in a reactor, nuclear fuel undergoes fission. A portion of the initial uranium and some of the plutonium generated in situ is fragmented or fissioned, with a release of heat and the production of fragments, or fission products. These fission products consist of two groups of elements: one group has atomic weights somewhat less than half that of uranium; the other group has atomic weights somewhat more than half that of uranium. Some of these fission product elements are stable and indistinguishable from

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*ORIGEN-Oak Ridge National Laboratory model for spent fuel.

elements found in nature, while some are unstable (radioactive) and seek a stable state by radioactive decay. A measure of their instability is the half-life of each radionuclide. These half-lives vary from a small fraction of a second to millions of years. Specific activity, a function of decay time, and biological effects of the emitted radiation are the predominant factors in evaluating the human risk of exposure to the radioactive constituents in spent fuels.

Table G.5 lists the fission product radionuclides present in spent fuel in concentrations that produce more than 0.001 curie per metric ton of uranium contained in the spent fuel after a decay time of 120 days following reactor shutdown (the decay time normally stipulated as a minimum for storage prior to spent fuel reprocessing). This table characterizes each nuclide by its half-life, mode of decay, specific activity, energy (MEV) of the principal modes of decay, and the primary daughter element produced by radioactive decay. Table G.6 is a tabulation of the radioactivity generated by these nuclides as a function of decay time. The times were chosen to represent the conditions at reactor shutdown (discharge), short storage times (30 and 120 days), at one year, and after 10 and 20 years to show decay characteristics of individual nuclides over a relatively long time period in storage. Table G.7 shows the quantities of these same radionuclides in units of grams per metric ton of uranium in the fuels, again as a function of decay times over a range of 0 to 7300 days.

2.1.2 Transuranics

During its service in a reactor a portion of the uranium present also undergoes nuclear transmutation by the absorption of neutrons. Elements formed from uranium, or from further transmutation of uranium absorption products, constitute a group of heavy nuclides known as transuranics.

Table G.8 lists the transuranics and their characteristics present in spent fuels in concentrations which produce more than 0.001 curie per metric ton of uranium in the fuel after a decay time of 120 days following reactor shutdown. The nuclides are characterized in the same manner as shown in Table G.5. Similarly, Tables G.9 and G.10 show the radioactivity and grams of the transuranics per metric ton of uranium, respectively.

2.1.3 Light Elements and Materials of Construction

The metallic structural components of reactor fuels also undergo transmutation while in service in a reactor. Table G.11 identifies those radionuclides from this source present in concentrations which produce more than 0.001 curie per metric ton of uranium in the spent fuel after 120 days following reactor shutdown. The contribution to total radioactivity of the fuel assembly from this source is minor, being at least two orders of magnitude less than that of the fission products in the fuel.

2.2 Heat Generation

Radioactive decay is a mechanism by which an unstable nuclide reaches a more stable energy state by the ejection of alpha and beta or beta particles from its nucleus and the release of energy in the form of gamma rays. The ejection and absorption by matter of such particles and energy rays produce heat. The radionuclides present in spent fuel produce heat in the fuel by this mechanism. The rate of heat generation reflects the total radioactive decay processes going on at any specific time after reactor shutdown and is a complex function of the quantities of radionuclides present and their decay rates. Figure G.4 is a plot of heat generation for spent fuel that has been exposed to 33,000 MWD/MTU of reactor operation during three years of operation at a plant capacity factor of 80%. Heat decay rate declines from a thermal power of about 90 KW/MTU at 10 days to 12 KW/MTU at one year, about 1.3 KW/MTU at 10 years and less than 1 KW/MTU at 20 years.

Table G.1. Babcock & Wilcox Fuel Asembly Designs

Parameter	1	2
Overall assembly length (cm)	421	421
Active fuel length (cm)	366	363
Nominal envelope	$(21.7\ \mathrm{cm})^2$	$(21.7\ \mathrm{cm})^2$
Avg wt U per assembly (kg)	465	520
Total weight per assembly (kg)	700	-
Fuel rod array	15 x 15	17 x 17
Fuel rod O. D. (cm)	1.09	0.96
Fuel rod clad material	Zirc-4	Zirc-4

Table G.2. Combustion Engineering Fuel Assembly Designs

Parameter	1	2	3	4	5	6
Overall assembly length (cm)	378	425	399	464	464	449*
Active fuel length (cm)	335.3	344.7	347.2	348	381	381
Nominal envelope	$(20.6\ \text{cm})^2$	$(20.8\ \text{cm})^2$	$(20.8\ \text{cm})^2$	$(20.8\ \text{cm})^2$	$(20.8\ \text{cm})^2$	$(20.2\ \text{cm})^2$
Avg wt U per assembly (kg)	415	375	375	375	450	485
Total weight per assembly (kg)	615	590	570	570	650	652
Fuel rod array	15 × 15	14 × 14	14 × 14	14 × 14	14 × 14	16 × 16
Fuel rod O. D. (cm)	1.05	1.12	1.12	1.12	1.12	0.97
Fuel rod clad material	Zirc-4	Zirc-4	Zirc-4	Zirc-4	Zirc-4	Zirc-4
Burnable poison material	B_4C	B_4C	B_4C	B_4C	-	B_4C

*This value applies to the 16 × 16 core array used at Arkansas Nuclear 1. The later CE "System 80" plants are currently designed with a 16 × 16 array; of the parameters listed in this table, only the overall assembly length differs in the "System 80" design, and it is 453 cm. The weight may be greater by a small amount, of course, with the additional assembly length.

Table G.3. Westinghouse Electric Fuel Assembly Designs

Parameter	1	2	3	4	5	6	7	8	9
Overall assembly length (cm)	283	352	352	410	410	415	418	418	410
Active fuel length (cm)	231	309	305	366	366	366	366	366	366
Nominal envelope	(18.2 cm)^2	(21.4 cm)^2	(19.7 cm)^2	(21.4 cm)^2	(19.7 cm)^2	(21.4 cm)^2	(21.4 cm)^2	(21.4 cm)^2	(21.4 cm)^2
Avg wt U per assembly (kg)	255	410	340	445	390	445	450	445	521
Total weight per assembly (kg)	-	600	485	650	570	650	650	640	656
Fuel rod array	18 × 18	15 × 15	14 × 14	15 × 15	14 × 14	15 × 15	15 × 15	15 × 15	17 × 17
Fuel rod O. D. (cm)	0.86	1.07	1.07	1.07	1.07	1.07	1.07	1.07	0.95
Fuel rod clad material	SS	SS	SS	Zirc-4	Zirc-4	Zirc-4	Zirc-4	Zirc-4	Zirc-4
Burnable poison material	-	-	-	Borosilicate glass	Borated pyrex	Borosilicate glass	Borated pyrex	Borosilicate glass	Borosilicate glass

Table G.4. General Electric Fuel Assembly Designs

Parameter	1	2
Overall assembly length (cm)	435	435
Active fuel length (cm)	366	366
Nominal envelope	$(13.8\ \mathrm{cm})^2$	$(13.9\ \mathrm{cm})^2$
Avg wt U per assembly (kg)	195	210
Total weight per assembly (kg)	310	275
Fuel rod array	7 × 7	8 × 8
Fuel rod O. D. (cm)	1.45	1.25
Fuel rod clad material	Zirc-2	Zirc-2
Burnable poison material	Gd_2O_3	Gd_2O_3

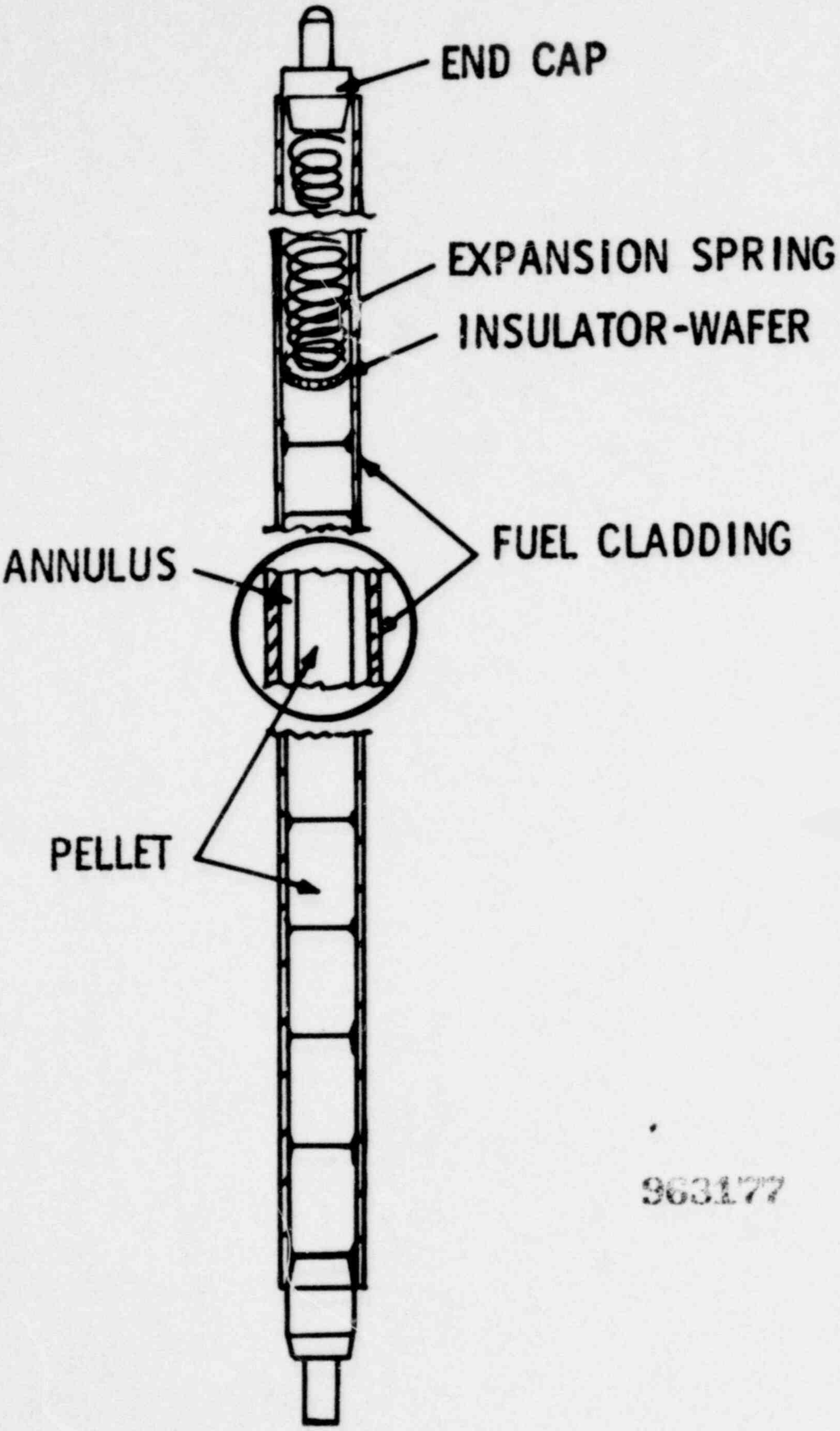

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Figure G.1. Cutaway of Oxide Fuel Rod for Commercial LWR Power Plant

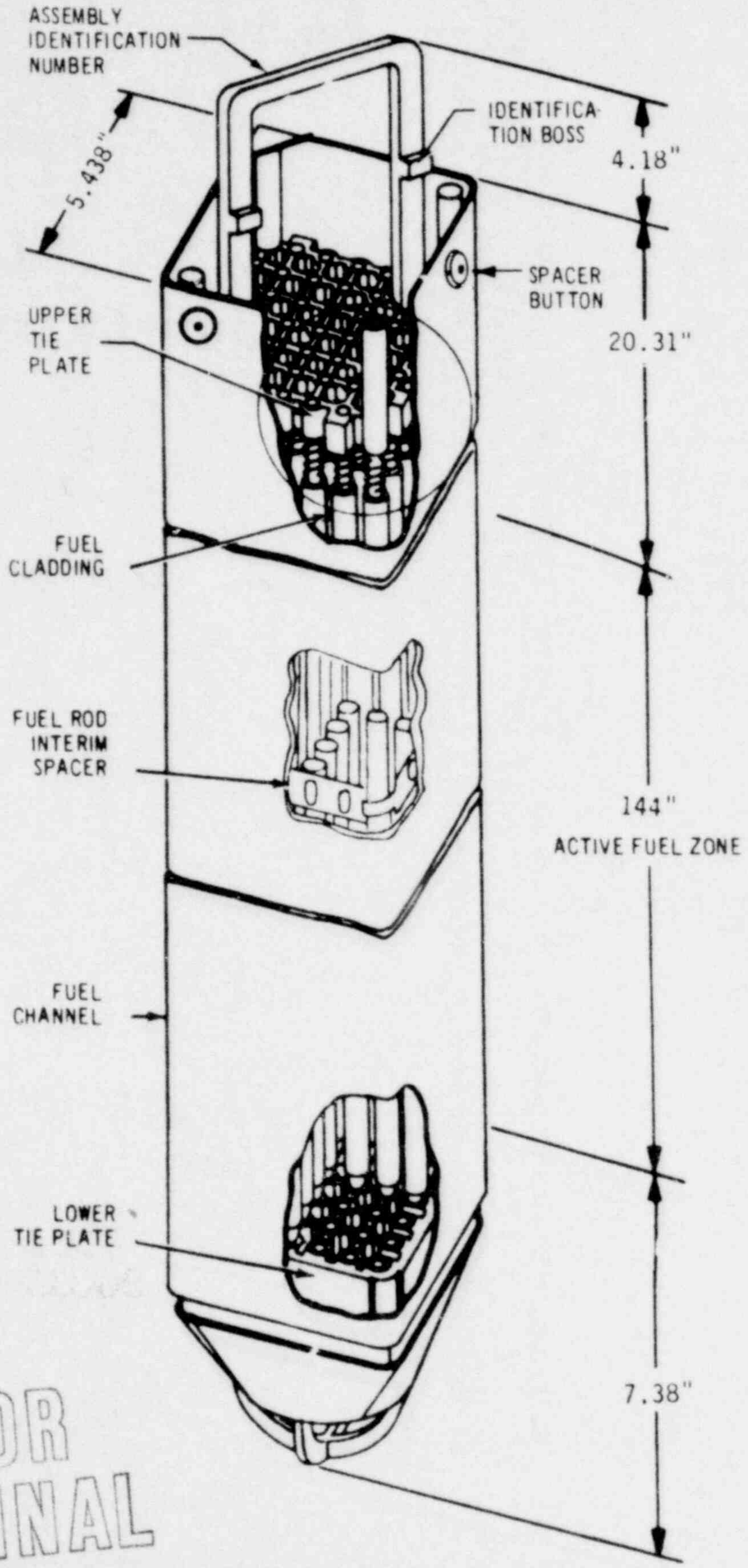

Figure G.2. BWR Fuel Assembly

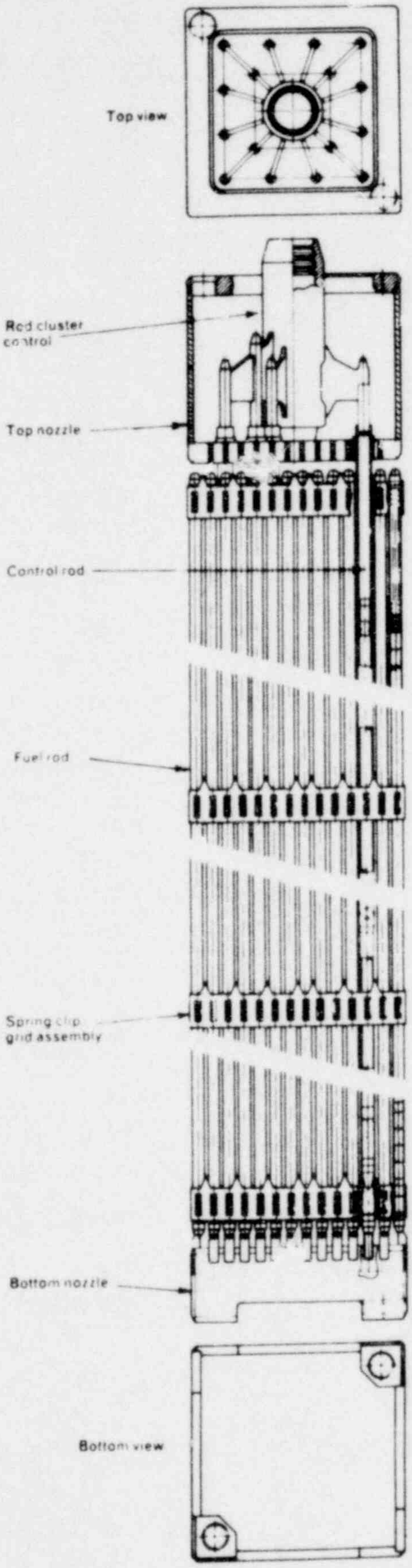

Figure G.3. PWR Fuel Assembly

Table G.5. Characteristics of the Fission Product Nuclides Present in Spent Fuel for Storage

Nuclide	Symbol	Half-Life	Mode of Decay	Specific Activity, Ci/gm	Mev - Major Mode of Decay β	Mev - Major Mode of Decay γ	Primary Daughter
Tritium	H-3	12.3Y	β	9.6×10^{3}	0.019	-	He-3
Selenium-79	Se-79	6.5×10^{4}Y	β	7×10^{-2}	0.15	-	Br-79
Krypton-85	Kr-85	10.7Y	β,γ	3.9×10^{2}	0.67	0.51	Rb-85
Rubidium-86	Rb-86	18.7D	β,γ	8.2×10^{4}	1.77	1.08	Sr-86
Strontium-89	Sr-89	50.5D	β,γ	2.8×10^{4}	1.49	0.91	Y-89
Strontium-90	Sr-90	29Y	β	1.4×10^{2}	0.55	-	Y-90
Yttrium-90	Y-90	64H	β,γ	5.4×10^{5}	2.29	1.76	Zr-90
Yttrium-91	Y-91	58.6D	β,γ	2.4×10^{5}	1.55	1.21	Zr-91
Zirconium-93	Zr-93	1.5×10^{6}Y	β,γ	2.6×10^{-3}	0.06	0.03	Nb-93
Niobium-93m	Nb-93m	13.6Y	e*,γ	2.8×10^{2}	-	0.03	Nb-93
Zirconium-95	Zr-95	65.5D	β,γ	2.1×10^{4}	0.366	0.76	Nb-95
Niobium-95m	Nb-95m	3.0D	γ	3.8×10^{5}	-	0.23	Nb-95
Niobium-95	Nb-95	35.1D	β,γ	3.8×10^{4}	0.16	0.77	Mo-95
Technicium-99	Tc-99	2.1×10^{5}Y	β,γ	1.7×10^{-2}	0.29	0.090	Ru-99
Ruthenium-103	Ru-103	39.6D	β,γ	3.2×10^{4}	0.225	0.50	Rh-103m
Rhodium-103m	Rh-103m	56M	e,γ	3.2×10^{7}	-	0.04	Rh-103
Ruthenium-106	Ru-106	369D	β	3.4×10^{3}	0.039	-	Rh-106
Rhodium-106	Rh-106	2.2H	β,γ	1.3×10^{7}	0.92	0.51	Pd-106
Palladium-107	Pd-107	6.5×10^{6}Y	β	5×10^{-4}	0.035	-	Ag-107
Silver-110m	Ag-110m	252D	β,γ	4.7×10^{3}	0.08	0.66	Cd-110
Silver-110	Ag-110	24S	β,γ	4.3×10^{9}	2.89	0.66	Cd-110
Silver-111	Ag-111	7.5D	β,γ	1.6×10^{5}	1.03	0.34	Cd-111
Cadmium-113m	Cd-113m	14.6Y	β,γ	2.2×10^{2}	0.59	0.26	In-113
Cadmium-115m	Cd-115m	44.6D	β,γ	2.5×10^{4}	1.63	0.93	In-115
Indium-114m	In-114m	50D	e,γ	2.3×10^{4}	-	0.56	In-114
Indium-114	In-114	72S	β,γ	1.4×10^{9}	2.0	1.3	Sn-114
Tin-117m	Sn-117m	14D	e,γ	8×10^{4}	-	0.16	Sn-117
Tin-119m	Sn-119m	245D	e,γ	4.5×10^{3}	-	0.024	Sn-119
Tin-121m	Sn-121m	50Y	β,γ	5.9×10^{1}	0.35	0.037	Sb-121
Tin-123	Sn-123	129D	β,γ	8.1×10^{3}	1.41	1.08	Sb-123
Tellurium-123m	Te-123m	120D	e,γ	9×10^{3}	-	0.16	Te-123
Antimony-124	Sb-124	60D	β,γ	1.7×10^{4}	0.61	1.69	Te-124
Tin-125	Sn-125	9.7D	β,γ	1.1×10^{5}	2.4	1.07	Sb-125
Antimony-125	Sb-125	2.73Y	β,γ	1×10^{3}	0.30	0.43	Te-125
Tellurium-125m	Te-125m	58D	e,γ	1.8×10^{4}	-	0.035	Te-125
Tin-126	Sn-126	10^{5}Y	β,γ	2.8×10^{-2}	0.25	0.088	Sb-126
Antimony-126m	Sb-126m	19M	β,γ	7.8×10^{7}	1.9	0.67	Te-126
Antimony-126	Sb-126	12.4D	β,γ	8.3×10^{4}	1.9	0.70	Te-126
Tellurium-127m	Te-127m	109D	e,γ	9.3×10^{3}	-	0.058	Te-127
Tellurium-127	Te-127	9.4H	β,γ	2.6×10^{6}	0.69	0.42	I-127
Tellurium-129m	Te-129m	33.4D	β,γ	3×10^{4}	1.6	0.70	Te-129
Tellurium-129	Te-129	70M	β,γ	2.1×10^{7}	1.47	0.028	I-129
Iodine-129	I-129	1.6×10^{7}Y	β,γ	1.7×10^{-4}	0.15	0.04	Xe-129
Xenon-131m	Xe-131m	12D	e,γ	8.3×10^{4}	-	0.16	Xe-131
Iodine-131	I-131	8D	β,γ	1.2×10^{5}	0.61	0.36	Xe-131
Xenon-133	Xe-133	5.3D	β,γ	1.9×10^{5}	0.35	0.081	Cs-133
Cesium-134	Cs-134	2Y	β,γ	1.3×10^{3}	0.66	0.80	Ba-134
Cesium-135	Cs-135	2.3×10^{6}Y	β	1×10^{-3}	0.21	-	Ba-135
Cesium-136	Cs-136	13D	β,γ	7.4×10^{4}	0.34	0.82	Ba-136
Barium-136m	Ba-136m	0.31S	γ	2.7×10^{11}	-	0.82	Ba-136
Cesium-137	Cs-137	30.1Y	β,γ	8.7×10^{1}	0.51	0.66	Ba-137
Barium-137m	Ba-137m	2.5M	γ	5.5×10^{8}	-	0.66	Ba-137
Barium-140	Ba-140	12.8D	β,γ	7.3×10^{4}	1.0	0.54	La-140
Lanthanum-140	La-140	40H	β,γ	5.6×10^{5}	1.36	1.60	Ce-140
Cerium-141	Ce-141	32.5D	β,γ	2.8×10^{4}	0.44	0.15	Pr-141
Praseodymium-143	Pr-143	13.6D	β,γ	6.6×10^{4}	0.931	0.74	Nd-143
Cerium-144	Ce-144	284D	β,γ	3.2×10^{3}	0.32	0.03	Pr-144
Praseodymium-144m	Pr-144m	7.2M	γ	1.8×10^{8}	-	0.70	Pr-144
Praseodymium-144	Pr-144	17.3M	β,γ	7.55×10^{7}	3.0	0.70	Nd-144
Neodymium-147	Nd-147	11D	β,γ	8×10^{3}	0.80	0.091	Pm-147
Promethium-147	Pm-147	2.6Y	β,γ	9.4×10^{2}	0.23	0.12	Sm-147

Table G.5. (Continued)

Nuclide	Symbol	Half-Life	Mode of Decay	Specific Activity, Ci/gm	Mev - Major Mode of Decay		Primary Daughter
					β	γ	
Promethium-148m	Pm-148m	41.3D	β,γ	2.1×10^{4}	0.40	0.55	Sm-148
Promethium-148	Pm-148	5.4D	β,γ	1.6×10^{5}	2.48	0.55	Sm-148
Samarium-151	Sm-151	93Y	β,γ	2.6×10^{1}	0.076	0.022	Eu-151
Europium-152	Eu-152	13Y	β,γ	1.8×10^{2}	0.69	0.34	Gd-152
Gadolinium-153	Gd-153	242D	EC*, γ	3.5×10^{3}	-	0.097	Eu-153
Europium-154	Eu-154	8.2Y	β,γ	2.8×10^{2}	0.58	0.12	Gd-154
Europium-155	Eu-155	4.8Y	β,γ	4.8×10^{2}	0.16	0.09	Gd-155
Europium-156	Eu-156	15.2D	β,γ	1.6×10^{5}	0.49	0.09	Gd-156
Terbium-160	Tb-160	72.3D	β,γ	1.1×10^{4}	0.57	0.88	Dy-160
Terbium-161	Tb-161	6.9M	β,γ	1.2×10^{5}	0.51	0.026	Dy-161

*EC designates electron capture; e designates electron conversion.

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Table G.6. Activities of Fission Products in Spent Fuel vs. Decay Times
(33 GWD/MTU, 80% capacity factor)

	Activities (Ci/MTU charged to reactor)					
		Decay Time				
Isotope	Discharge	30 Days	120 Days	1 Year	10 Years	20 Years
H-3	5.67E+02[a]	5.64E+02	5.56E+02	5.36E+02	3.23E+02	1.84E+02
Se-79	3.82E-01	3.82E-01	3.82E-01	3.82E-01	3.82E-01	3.82E-01
Kr-85	9.56E+03	9.51E+03	9.36E+03	8.97E+03	5.02E+03	2.63E+03
Rb-86	7.41E+02	2.43E+02	8.56E+00	9.49E-04	0.0	0.0
Sr-89	9.06E+05	6.07E+05	1.83E+05	6.99E+03	6.73E-16	5.00E-37
Sr-90	7.86E+04	7.85E+04	7.80E+04	7.67E+04	6.15E+04	4.80E+04
Y-90	8.23E+04	7.85E+04	7.80E+04	7.67E+04	6.15E+04	4.80E+04
Y-91	1.18E+06	8.37E+05	2.89E+05	1.59E+04	2.12E-13	3.77E-32
Zr-93	2.93E+00	2.93E+00	2.93E+00	2.93E+00	2.93E+00	2.93E+00
Zr-95	1.70E+06	1.24E+06	4.77E+05	3.57E+04	2.85E-11	4.77E-28
Nb-93m	2.20E-01	2.41E-01	2.77E-01	3.72E-01	1.35E+00	1.98E+00
Nb-95	1.66E+06	1.56E+06	8.41E+05	7.54E+04	6.14E-11	1.03E-27
Nb-95m	2.05E+04	1.57E+04	6.05E+03	4.53E+02	3.61E-13	6.06E-30
Tc-99	1.42E+01	1.43E+01	1.43E+01	1.43E+01	1.43E+01	1.43E+01
Ru-103	1.79E+06	1.06E+06	2.19E+05	3.01E+03	3.31E-22	0.0
Ru-106	5.41E+05	5.12E+05	4.32E+05	2.73E+05	5.70E+02	6.26E-01
Rh-103m	1.79E+06	1.06E+06	2.20E+05	3.01E+03	3.31E-22	0.0
Rh-106	8.71E+05	5.12E+05	4.32E+05	2.73E+05	5.70E+02	6.26E-01
Pd-107	1.08E-01	1.08E-01	1.08E-01	1.08E-01	1.08E-01	1.08E-01
Ag-110	2.16E+05	5.87E+01	4.59E+01	2.34E+01	2.78E-03	1.21E-07
Ag-110m	4.56E+03	4.20E+03	3.28E+03	1.67E+03	1.98E-01	8.65E-06
Ag-111	5.67E+04	3.51E+03	8.30E-01	1.11E-10	0.0	0.0
Cd-113m	3.53E+01	3.51E+01	3.47E+01	3.36E+01	2.19E+01	1.36E+01
Cd-115m	1.29E+03	8.07E+02	1.99E+02	4.42E+00	2.96E-22	0.0
In-114	1.34E+01	6.06E+00	1.72E+00	5.57E-02	5.93E-22	0.0
In-114m	9.56E+00	6.28E+00	1.78E+00	5.77E-02	6.15E-22	0.0
Sn-117m	9.56E+01	2.17E+01	2.52E-01	1.36E-06	0.0	0.0
Sn-119m	9.26E+01	8.51E+01	6.60E+01	3.30E+01	3.03E-03	9.95E-08
Sn-121m	1.66E-01	1.66E-01	1.65E-01	1.64E-01	1.45E-01	1.26E-01
Sn-123	4.86E+03	4.14E+03	2.55E+03	6.84E+02	1.49E-05	4.57E-14
Sn-125	1.14E+04	1.32E+03	2.06E+00	4.69E-08	0.0	0.0
Sn-126	5.67E-01	5.67E-01	5.67E-01	5.67E-01	5.67E-01	5.67E-01
Sb-124	4.19E+02	2.97E+02	1.05E+02	6.27E+00	2.34E-16	1.31E-34
Sb-125	9.81E+03	9.70E+03	9.13E+03	7.70E+03	7.85E+02	6.20E+01
Sb-126	7.50E+02	1.40E+02	9.93E-01	7.94E-02	7.93E-02	7.93E-02
Sb-126m	6.16E+02	5.67E-01	5.67E-01	5.67E-01	5.67E-01	5.67E-01
Te-123m	6.27E-01	5.27E-01	3.13E-01	7.58E-02	4.15E-10	2.73E-19
Te-125m	2.00E+03	2.03E+03	2.13E+03	1.87E+03	1.92E+02	1.51E+01
Te-127	1.06E+05	1.34E+04	7.31E+03	1.54E+03	1.30E-06	1.09E-16
Te-127m	1.54E+04	1.32E+04	7.47E+03	1.57E+03	1.33E-06	1.11E-16
Te-129	3.43E+05	3.20E+04	4.94E+03	3.06E+01	7.61E-29	0.0
Te-129m	9.34E+04	5.04E+04	7.78E+03	4.82E+01	1.20E-28	0.0
I-129	3.27E-02	3.30E-02	3.32E-02	3.33E-02	3.33E-02	3.33E-02
I-131	1.06E+06	8.27E+04	3.54E+01	2.38E-08	0.0	0.0
Xe-131m	7.50E+03	2.90E+03	2.20E+01	1.59E-05	0.0	0.0
Xe-133	2.05E+06	5.46E+04	4.14E-01	4.74E-15	0.0	0.0
Cs-134	3.15E+05	3.06E+05	2.82E+05	2.25E+05	1.09E+04	3.78E+02
Cs-135	3.68E-01	3.69E-01	3.69E-01	3.69E-01	3.69E-01	3.69E-01
Cs-136	8.26E+04	1.67E+04	1.37E+02	2.91E-04	0.0	0.0
Cs-137	1.09E+05	1.[illegible]E+05	1.08E+05	1.06E+05	8.66E+04	6.88E+04
Ba-136m	1.32E+04	2.[illegible]E+03	2.20E+01	4.65E-05	0.0	0.0
Ba-137m	1.03E+05	1.03E+05	1.02E+05	1.01E+05	8.19E+04	6.51E+04
Ba-140	1.83E+06	3.61E+05	2.75E+03	4.70E-03	0.0	0.0
La-140	1.95E+06	4.16E+05	3.16E+03	5.41E-03	0.0	0.0
Ce-141	1.74E+06	9.22E+05	1.35E+05	7.33E+02	2.95E-28	0.0
Ce-144	1.18E+06	1.10E+06	8.82E+05	4.85E+05	1.62E+02	2.21E-02
Pr-143	1.53E+06	3.69E+05	3.73E+03	1.38E-02	0.0	0.0
Pr-144	1.20E+06	1.10E+06	8.82E+05	4.85E+05	1.62E+02	2.21E-02
Pr-144m	1.42E+04	1.32E+04	1.06E+04	5.82E+03	1.94E+00	2.65E-04
Nd-147	7.43E+05	1.12E+05	3.84E+02	7.46E-05	0.0	0.0
Pm-147	8.75E+04	9.28E+04	8.82E+04	7.38E+04	6.86E+03	4.89E+02
Pm-148	2.20E+05	6.21E+03	3.76E+02	6.14E+00	7.00E-24	0.0
Pm-148m	4.08E+04	2.46E+04	5.44E+03	8.90E+01	1.01E-22	0.0

Table G.6. (Continued)

Isotope	Activities (Ci/MTU charged to reactor)					
		Decay Time				
	Discharge	30 Days	120 Days	1 Year	10 Years	20 Years
Sm-151	1.16E+03	1.16E+03	1.16E+03	1.15E+03	1.08E+03	1.00E+03
Eu-152	1.06E+01	1.06E+01	1.04E+01	1.01E+01	6.23E+00	3.66E+00
Eu-154	1.51E+04	1.50E+04	1.47E+04	1.40E+04	6.76E+03	3.02E+03
Eu-155	3.18E+03	3.14E+03	3.03E+03	2.75E+03	7.50E+02	1.77E+02
Eu-156	2.91E+05	7.42E+04	1.22E+03	1.72E-02	0.0	0.0
Gd-153	2.87E+01	2.63E+01	2.03E+01	1.00E+01	7.84E-04	2.14E-08
Tb-160	1.74E+03	1.31E+03	5.51E+02	5.26E+01	1.11E-12	7.04E-28
Tb-161	9.86E+02	4.88E+01	5.96E-03	1.31E-13	0.0	0.0
TOTAL	1.80E+08	1.30E+07	5.84E+06	2.37E+06	3.26E+05	2.38E+05

[a] Exponent Notation: 5.67E+02 = 5.67 × 10^{+2}

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Table G.7. Quantities of Fission Products in Spent Fuel vs. Decay Times
(33 GWD/MTU, 80% capacity factor)

Isotope	Quantities (g/MTU charged to reactor)					
	Discharge	Decay Time				
		30 Days	120 Days	1 Year	10 Years	20 Years
H-3	5.85E-02[a]	5.82E-02	5.74E-02	5.53E-02	3.33E-02	1.90E-02
Se-79	5.48E+00	5.48E+00	5.48E+00	5.48E+00	5.48E+00	5.48E+00
Kr-85	2.44E+01	2.43E+01	2.39E+01	2.29E+01	1.28E+01	6.71E+00
Rb-86	9.10E-03	2.98E-03	1.05E-04	1.16E-08	0.0	0.0
Sr-89	3.21E+01	2.15E+01	6.48E+00	2.48E-01	2.39E-20	1.77E-41
Sr-90	5.56E+02	5.55E+02	5.52E+02	5.42E+02	4.35E+02	3.40E+02
Y-90	1.51E-01	1.44E-01	1.44E-01	1.41E-01	1.13E-01	8.84E-02
Y-91	4.84E+01	3.42E+01	1.18E+01	6.49E-01	8.66E-18	1.54E-36
Zr-93	7.23E+02	7.23E+02	7.23E+02	7.23E+02	7.23E+02	7.23E+02
Zr-95	8.08E+01	5.89E+01	2.27E+01	1.70E+00	1.36E-15	2.27E-32
Nb-93m	7.13E-04	7.51E-04	8.63E-04	1.16E-03	4.21E-03	6.17E-03
Nb-95	4.25E+01	3.98E+01	2.15E+01	1.92E+00	1.57E-15	2.63E-32
Nb-95m	5.38E-02	4.12E-02	1.59E-02	1.19E-03	9.49E-19	1.59E-35
Tc-99	8.35E+02	8.39E+02	8.39E+02	8.39E+02	8.39E+02	8.39E+02
Pu-103	5.60E+01	3.31E+01	6.85E+00	9.40E-02	1.03E-26	0.0
Ru-106	1.62E+02	1.53E+02	1.29E+02	8.17E+01	1.71E-01	1.87E-04
Rh-103m	5.50E-02	3.26E-02	6.74E-03	9.24E-05	1.02E-29	0.0
Rh-106	2.45E-04	1.44E-04	1.21E-04	7.66E-05	1.60E-07	1.76E-10
Pd-107	2.10E+02	2.10E+02	2.10E+02	2.10E+02	2.10E+02	2.10E+02
Ag-110	5.18E-05	1.41E-08	1.10E-08	5.60E-09	6.66E-13	2.90E-17
Ag-110m	9.67E-01	8.90E-01	6.95E-01	3.54E-01	4.21E-05	1.83E-09
Ag-111	3.60E-01	2.23E-02	5.27E-06	7.05E-16	0.0	0.0
Cd-113m	1.63E-01	1.62E-01	1.60E-01	1.55E-01	1.01E-01	6.29E-02
Cd-115m	5.05E-02	3.17E-02	7.82E-03	1.74E-04	1.16E-26	0.0
In-114	9.73E-09	4.40E-09	1.25E-09	4.05E-11	4.31E-31	0.0
In-114m	4.13E-04	2.71E-04	7.70E-05	2.49E-06	2.66E-26	0.0
Sn-117m	1.20E-03	2.72E-04	3.16E-06	1.71E-11	0.0	0.0
Sn-119m	2.07E-02	1.90E-02	1.47E-02	7.36E-03	6.77E-07	2.22E-11
Sn-121m	2.81E-03	2.80E-03	2.79E-03	2.77E-03	2.44E-03	2.13E-02
Sn-123	5.90E-01	5.02E-01	3.10E-01	8.31E-02	1.81E-09	5.55E-18
Sn-125	1.05E-01	1.22E-02	1.90E-05	4.33E-13	0.0	0.0
Sn-126	2.00E+01	2.00E+01	2.00E+01	2.00E+01	2.00E+01	2.00E+01
Sb-124	2.39E-02	1.70E-02	6.01E-03	3.58E-04	1.84E-20	7.47E-39
Sb-125	9.36E+00	9.26E+00	8.71E+00	7.34E+00	7.49E-01	5.92E-02
Sb-126	8.97E-03	1.68E-03	1.19E-05	9.49E-07	9.49E-07	9.49E-07
Sb-126m	7.83E-06	7.21E-09	7.21E-09	7.21E-09	7.21E-09	7.21E-09
Te-123m	7.07E-05	5.94E-05	3.53E-05	8.54E-06	4.67E-14	3.08E-23
Te-125m	1.11E-01	1.15E-01	1.18E-01	1.04E-01	1.06E-02	8.41E-04
Te-127	4.03E-02	5.07E-03	2.77E-03	5.83E-04	4.94E-13	4.11E-23
Te-127m	1.63E+00	1.40E+00	7.91E-01	1.67E-01	1.41E-10	1.17E-20
Te-129	1.65E-02	1.53E-03	2.37E-04	1.47E-06	3.65E-36	0.0
Te-129m	3.08E+00	1.66E+00	2.57E-01	1.59E-03	3.95E-33	0.0
I-120	1.88E+02	1.89E+02	1.90E+02	1.91E+02	1.91E+02	1.91E+02
I-131	8.58E+00	6.67E-01	2.85E-04	1.92E-13	0.0	0.0
Xe-131m	9.02E-02	3.49E-02	2.64E-04	1.91E-10	0.0	0.0
Xe-133	1.10E+01	2.94E-01	2.23E-06	2.55E-20	0.0	0.0
Cs-134	2.43E+02	2.36E+02	2.18E+02	1.74E+02	8.42E+00	2.92E-01
Cs-135	3.20E+02	3.20E+02	3.20E+02	3.20E+02	3.20E+02	3.20E+02
Cs-136	1.12E+00	2.26E-01	1.86E-03	3.93E-09	0.0	0.0
Cs-137	1.26E+03	1.25E+03	1.25E+03	1.23E+03	9.98E+02	7.93E+02
Ba-136m	4.90E-08	9.90E-09	8.15E-11	1.73E-16	0.0	0.0
Ba-137m	1.92E-04	1.91E-04	1.90E-04	1.87E-04	1.52E-04	1.21E-04
Ba-140	2.52E+01	4.95E+00	3.77E-02	6.45E-08	0.0	0.0
La-140	3.51E+00	7.47E-01	5.68E-03	9.72E-09	0.0	0.0
Ce-141	6.10E+01	3.24E+01	4.76E+00	2.57E-02	1.04E-32	0.0
Ce-144	3.70E+02	3.44E+02	2.76E+02	1.52E+02	5.06E-02	6.93E-06
Pr-143	2.27E+01	5.48E+00	5.54E-02	2.05E-07	0.0	0.0
Pr-144	1.58E-02	1.45E-02	1.17E-02	6.42E-03	2.14E-06	2.93E-10
Pr-144m	7.82E-05	7.26E-05	5.83E-05	3.21E-05	1.07E-08	1.46E-12
Nd-147	9.18E+00	1.39E+00	4.75E-03	9.23E-10	0.0	0.0
Pm-147	9.44E+01	1.00E+02	9.51E+01	7.96E+01	7.39E+00	5.27E-01
Pm-148	1.34E+00	3.78E-02	2.29E-03	3.74E-05	4.26E-29	0.0
Pm-148m	1.91E+00	1.15E+00	2.55E-01	4.17E-03	4.75E-27	0.0

Table G.7. (Continued)

Isotope	Quantities (g/MTU charged to reactor)					
		Decay Time				
	Discharge	30 Days	120 Days	1 Year	10 Years	20 Years
Sm-151	4.53E+01	4.56E+01	4.55E+01	4.53E+01	4.23E+01	3.93E+01
Eu-152	5.86E-02	5.84E-02	5.76E-02	5.56E-02	3.44E-02	2.02E-02
Eu-154	5.60E+01	5.57E+01	5.46E+01	5.17E+01	2.50E+01	1.12E+01
Eu-155	6.60E+00	6.52E+00	6.30E+00	5.72E+00	1.56E+00	3.68E-01
Eu-156	5.28E+00	1.35E+00	2.22E-02	3.11E-07	0.0	0.0
Gd-153	8.10E-03	7.43E-03	5.73E-03	2.83E-03	2.21E-07	6.03E-12
Tb-160	1.54E-01	1.16E-01	4.88E-02	4.66E-03	9.81E-17	6.24E-32
Tb-161	8.41E-03	4.17E-04	5.08E-08	1.12E-18	0.0	0.0
TOTAL	3.49E+04	3.49E+04	3.49E+04	3.49E+04	3.49E+04	3.49E+04

[a] Exponent Notation: 5.85E-02 = 5.85 × 10^{-2}

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Table G.8. Characteristics of the Actinides and their Daughter Elements Present in Spent Fuel for Storage

Nuclide	Symbol	Half-Life	Mode of Decay	Specific Activity, Ci/gm	Mev - Major Mode of Decay			Primary Daughter
					α	β	γ	
Thallium-208	Tl-208	3M	β,γ	3×10^{8}	-	1.795	2.61	Pb-208
Lead-212	Pb-212	10.64H	β,γ	1.4×10^{6}	-	0.33	0.239	Bi-212
Bismuth-212	Bi-212	60M	β,γ	1.5×10^{7}	-	2.25	0.727	Po-212
Polonium-212	Po-212	45S	α,γ	1.2×10^{9}	11.7	-	2.61	Pb-208
Polonium-216	Po-216	0.15S	α	3.5×10^{11}	6.77	-	-	Pb-212
Radon-220	Rn-220	55S	α,γ	9.3×10^{8}	6.28	-	0.55	Po-216
Radium-224	Ra-224	3.6D	α,γ	1.6×10^{5}	5.69	-	0.24	Rn-220
Thorium-228	Th-228	1.9Y	α,γ	8.3×10^{2}	5.42	-	0.08	Ra-224
Thorium-231	Th-231	25H	β,γ	5.4×10^{5}	-	0.303	0.084	Pa-231
Thorium-234	Th-234	24D	β,γ	2.3×10^{4}	-	0.193	0.069	Pa-234
Protactinium-233	Pa-233	27D	β,γ	2.1×10^{4}	-	0.26	0.31	U-233
Protactinium-234m	Pa-234m	1.17M	β,γ	6.8×10^{8}	-	2.29	1.00	U-234
Protactinium-234	Pa-234	6.7H	β,γ	2.0×10^{6}	-	0.49	0.044	U-234
Uranium-232	U-232	72Y	α,γ	2.1×10^{1}	5.32	-	0.058	Th-228
Uranium-233	U-233	1.6×10^{5}Y	α,γ	9.6×10^{-3}	4.8	-	0.042	Th-229
Uranium-234	U-234	2.4×10^{5}Y	α,γ	6.4×10^{-3}	4.8	-	0.05	Th-230
Uranium-235	U-235	7.0×10^{8}Y	α,γ	2.2×10^{-6}	4.4	-	0.19	Th-231
Uranium-236	U-236	2.34×10^{7}Y	α,γ	6.5×10^{-5}	4.5	-	0.05	Th-232
Uranium-237	U-237	6.8D	β,γ	8.1×10^{4}	-	0.24	0.060	Np-237
Uranium-238	U-238	4.47×10^{9}Y	α,γ	3.3×10^{-7}	4.2	-	0.048	Th-234
Neptunium-237	Np-237	2.14×10^{6}Y	α,γ	7.1×10^{-4}	4.8	-	0.029	Pa-233
Neptunium-239	Np-239	2.35D	β,γ	2.3×10^{5}	-	0.33	0.28	Pa-239
Plutonium-236	Pu-236	2.85Y	α,γ	5.3×10^{2}	5.8	-	0.048	U-232
Plutonium-238	Pu-238	87.8Y	α,γ	1.7×10^{1}	5.5	-	0.043	U-234
Plutonium-239	Pu-239	2.4×10^{4}Y	α,γ	6.2×10^{-2}	5.2	-	0.052	U-235
Plutonium-240	Pu-240	6.54×10^{3}Y	α,γ	2.3×10^{-1}	5.2	-	0.045	U-236
Plutonium-241	Pu-241	15Y	α,β,γ	9.9×10^{1}	4.9	0.02	0.15	Am-241, U-237
Plutonium-242	Pu-242	3.76×10^{5}Y	α,γ	3.9×10^{-3}	4.9	-	0.045	U-238
Americium-241	Am-241	433Y	α,γ	3.4	5.5	-	0.06	Np-237
Americium-242m	Am-242m	152Y	α,γ	9.7	5.2	-	0.049	Np-238
Americium-242	Am-242	16H	β,γ	8.1×10^{5}	-	0.63	0.042	Cm-242
Americium-243	Am-243	7.37×10^{3}Y	α,γ	2.0×10^{-1}	5.3	-	0.075	Np-239
Curium-242	Cm-242	163D	α,γ	3.3×10^{3}	6.1	-	0.044	Pu-238
Curium-243	Cm-243	28Y	α,γ	5.3×10^{1}	5.8	-	0.28	Pu-239
Curium-244	Cm-244	17.9Y	α,γ	8.2×10^{1}	5.8	-	0.043	Pu-240
Curium-245	Cm-245	8.5×10^{3}Y	α,γ	1.7×10^{-1}	5.4	-	0.17	Pu-241
Curium-246	Cm-246	4.7×10^{3}Y	α	3.1×10^{-1}	5.4	-	-	Pu-242
Berkelium-249	Bk-249	320D	α,β,γ	1.6×10^{3}	5.4	0.12	0.33	Cf-249

Table G.9. Activities of Transuranic Nuclides in Spent Fuel vs. Decay Times (33 GWD/MTU, 80% capacity factor)

	Activities (Ci/MTU charged to reactor)					
		Decay Time				
Isotope	Discharge	30 Days	120 Days	1 Year	10 Years	20 Years
Tl-208	1.45E-03[a]	1.62E-03	2.28E-03	4.54E-03	3.48E-02	3.85E-02
Pb-212	4.02E-03	4.49E-03	6.34E-03	1.26E-02	9.66E-02	1.07E-01
Bi-212	4.02E-03	4.49E-03	6.34E-03	1.26E-02	9.66E-02	1.07E-01
Po-212	2.57E-03	2.88E-03	4.05E-03	8.07E-03	6.18E-02	6.84E-02
Po-216	4.02E-03	4.49E-03	6.34E-03	1.26E-02	9.66E-02	1.07E-01
Rn-220	4.02E-03	4.49E-03	6.34E-03	1.26E-02	9.66E-02	1.07E-01
Ra-224	4.02E-03	4.49E-03	6.34E-03	1.26E-02	9.66E-02	1.07E-01
Th-228	4.09E-03	4.58E-03	6.31E-03	1.26E-02	9.65E-02	1.07E-01
Th-231	1.14E+00	1.90E-02	1.90E-02	1.90E-02	1.90E-02	1.90E-02
Th-234	3.14E-01	3.14E-01	3.14E-01	3.14E-01	3.14E-01	3.14E-01
Pa-233	3.98E-01	4.14E-01	4.31E-01	4.33E-01	4.37E-01	4.45E-01
Pa-234m	3.26E-01	3.14E-01	3.14E-01	3.14E-01	3.14E-01	3.14E-01
U-232	1.97E-02	2.18E-02	2.77E-02	4.20E-02	1.07E-01	1.05E-01
U-234	9.58E-01	9.59E-01	9.61E-01	9.67E-01	1.05E+00	1.14E+00
U-235	1.90E-02	1.90E-02	1.90E-02	1.90E-02	1.90E-02	1.90E-02
U-236	2.48E-01	2.48E-01	2.48E-01	2.48E-01	2.48E-01	2.48E-01
U-237	1.24E+06	5.70E+04	9.23E+00	3.58E+00	2.33E+00	1.45E+00
U-238	3.14E-01	3.14E-01	3.14E-01	3.14E-01	3.14E-01	3.14E-01
Np-237	4.22E-01	4.32E-01	4.33E-01	4.33E-01	4.37E-01	4.45E-01
Np-239	2.35E+07	3.43E+03	2.03E+01	2.03E+01	2.03E+01	2.03E+01
Pu236	2.64E+00	2.60E+00	2.45E+00	2.08E+00	2.33E-01	2.05E-02
Pu-238	3.16E+03	3.22E+03	3.29E+03	3.37E+03	3.19E+03	2.96E+03
Pu-239	3.68E+02	3.75E+02	3.75E+02	3.75E+02	3.75E+02	3.75E+02
Pu-240	4.63E+02	4.63E+02	4.63E+02	4.63E+02	4.64E+02	4.65E+02
Pu-241	1.56E+05	1.56E+05	1.54E+05	1.49E+05	9.71E+04	6.04E+04
Pu-242	1.85E+00	1.85E+00	1.85E+00	1.85E+00	1.85E+00	1.85E+00
Am-241	1.38E+02	1.59E+02	2.20E+02	3.82E+02	2.11E+03	3.30E+03
Am-242m	1.37E+01	1.37E+01	1.36E+01	1.36E+01	1.31E+01	1.25E+01
Am-242	9.77E+04	1.37E+01	1.36E+01	1.36E+01	1.31E+01	1.25E+01
Am-243	2.03E+01	2.03E+01	2.03E+01	2.03E+01	2.03E+01	2.03E+01
Cm-242	5.13E+04	4.54E+04	3.10E+04	1.09E+04	1.07E+01	1.02E+01
Cm-243	4.87E+00	4.86E+00	4.83E+00	4.76E+00	3.92E+00	3.16E+00
Cm-244	2.27E+03	2.26E+03	2.24E+03	2.18E+03	1.55E+03	1.06E+03
Cm-245	2.17E-01	2.17E-01	2.17E-01	2.17E-01	2.17E-01	2.17E-01
Cm-246	4.26E-02	4.26E-02	4.26E-02	4.26E-02	4.25E-02	4.25E-02
Bk-249	4.80E-03	4.50E-03	3.69E-03	2.15E-03	1.52E-06	4.82E-10
TOTAL	2.51E+07	2.68E+05	1.91E+05	1.67E+05	1.05E+05	6.87E+04

[a] Exponent Notation: 1.45E-03 = 1.45 × 10^{-3}.

Table G.10. Quantities of Transuranic Nuclides in Spent Fuel vs. Decay Times, (33 GWD/MTU, 80% capacity factor)

	Quantities (g/MTU charged to reactor)					
		Decay Time				
Isotope	Discharge	30 Days	120 Days	1 Year	10 Years	20 Years
Tl-208	4.96E-12[a]	5.54E-12	7.82E-12	1.56E-11	1.19E-10	1.32E-10
Pb-212	2.88E-09	3.22E-09	4.54E-09	9.04E-09	6.92E-08	7.66E-08
Bi-212	2.74E-10	3.07E-10	4.33E-10	8.61E-10	6.60E-09	7.30E-09
Po-212	1.45E-20	1.62E-20	2.28E-20	4.55E-20	3.48E-19	3.85E-19
Po-216	1.15E-14	1.29E-14	1.82E-14	3.62E-14	2.77E-13	3.07E-13
Rn-220	4.38E-12	4.90E-12	6.92E-12	1.38E-11	1.05E-10	1.17E-10
Ra-224	2.51E-08	2.80E-08	3.95E-08	7.87E-08	6.03E-07	6.67E-07
Th-228	4.98E-06	5.58E-06	7.68E-06	1.53E-05	1.18E-04	1.30E-04
Th-231	2.14E-06	3.59E-08	3.59E-08	3.59E-08	3.59E-08	3.59E-08
Th-234	1.36E-05	1.35E-05	1.35E-05	1.35E-05	1.35E-05	1.35E-05
Pa-233	1.93E-05	2.02E-05	2.11E-05	2.11E-05	2.13E-05	2.18E-05
Pa-234m	4.75E-10	4.57E-10	4.56E-10	4.57E-10	4.56E-10	4.56E-10
Pa-234	6.05E-09	1.58E-10	1.58E-10	1.58E-10	1.58E-10	1.58E-10
U-232	9.19E-04	1.02E-03	1.29E-03	1.96E-03	5.02E-03	4.93E-03
U-234	1.55E+02	1.55E+02	1.55E+02	1.56E+02	1.70E+02	1.84E+02
U-235	8.88E+03	8.88E+03	8.88E+03	8.88E+03	8.88E+03	8.88E+03
U-236	3.91E+03	3.91E+03	3.91E+03	3.91E+03	3.91E+03	3.92E+03
U-237	1.52E+01	6.98E-01	1.13E-04	4.38E-05	2.86E-05	1.78E-05
U-238	9.41E+05	9.41E+05	9.41E+05	9.41E+05	9.41E+05	9.41E+05
Np-237	5.98E+02	6.13E+02	6.14E+02	6.14E+02	6.19E+02	6.32E+02
Np-239	1.01E+02	1.48E-02	8.72E-05	8.72E-05	8.72E-05	8.71E-05
Pu-236	4.96E-03	4.88E-03	4.60E-03	3.91E-03	4.38E-04	3.86E-05
Pu-238	1.87E+02	1.91E+02	1.95E+02	2.00E+02	1.89E+02	1.75E+02
Pu-239	6.01E+03	6.11E+03	6.11E+03	6.11E+03	6.11E+03	6.11E+03
Pu-240	2.10E+03	2.10E+03	2.10E+03	2.10E+03	2.11E+03	2.11E+03
Pu-241	1.54E+03	1.53E+03	1.51E+03	1.46E+03	9.56E+02	5.95E+02
Pu-242	4.75E+02	4.75E+02	4.75E+02	4.75E+02	4.75E+02	4.75E+02
Am-241	4.03E+01	4.63E+01	6.41E+01	1.11E+02	6.15E+02	9.63E+02
Am-242m	1.41E+00	1.40E+00	1.40E+00	1.40E+00	1.34E+00	1.28E+00
Am-242	1.21E-01	1.69E-05	1.69E-05	1.68E-05	1.61E-05	1.54E-05
Am-243	1.05E+02	1.05E+02	1.05E+02	1.05E+02	1.05E+02	1.05E+02
Cm-242	1.55E+01	1.37E+01	9.36E+00	3.30E+00	3.24E-03	3.09E-03
Cm-243	1.06E-01	1.06E-01	1.05E-01	1.04E-01	8.52E-02	6.86E-02
Cm-244	2.80E+01	2.79E+01	2.77E+01	2.70E+01	1.91E+01	1.30E+01
Cm-245	1.23E+00	1.23E+00	1.23E+00	1.23E+00	1.23E+00	1.23E+00
Cm-246	1.38E-01	1.38E-01	1.38E-01	1.38E-01	1.38E-01	1.38E-01
Bk-249	2.87E-06	2.69E-06	2.21E-06	1.28E-06	9.11E-10	2.89E-13
TOTAL	9.65E+05	9.65E+05	9.65E+05	9.65E+05	9.65E+05	9.65E+05

[a] Exponent Notation: $4.96E-12 = 4.96 \times 10^{-12}$

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Table G.11. Characteristics of Radioactive Light Elements and Materials of Construction Present in Spent Fuel for Storage

Nuclide	Symbol	Half-Life	Mode of Decay	Specific Activity, Ci/gm	Mev - Major Mode of Decay		Primary Daughter
					β	γ	
Calcium-45	Ca-45	163D	β,γ	1.8×10^{4}	0.257	0.012	Sc-45
Scandium-46	Sc-46	83.8D	β,γ	3.4×10^{4}	0.357	0.889	Ti-46
Chromium-51	Cr-51	27.7D	EC*,γ	9.2×10^{4}	-	0.32	V-51
Manganese-54	Mn-54	312D	EC,γ	7.7×10^{3}	-	0.835	Cr-54
Iron-55	Fe-55	2.7Y	EC	2.4×10^{3}	-	-	Mn-55
Iron-59	Fe-59	44.6D	β,γ	5.0×10^{4}	0.467	1.1	Co-59
Cobalt-58	Co-58	71.3D	EC,γ	3.1×10^{4}	-	0.81	Fe-58
Cobalt-60	Co-60	5.27Y	β,γ	1.1×10^{3}	0.318	1.33	Ni-60
Nickel-59	Ni-59	8×10^{4}Y	EC	7.6×10^{-2}	-	-	Co-59
Nickel-63	Ni-63	100Y	β	5.6×10^{1}	0.066	-	Cu-63
Strontium-89	Sr-89	50.5D	β,γ	2.9×10^{4}	1.49	0.909	Y-89
Strontium-90	Sr-90	29Y	β	1.4×10^{2}	0.55	-	Y-90
Yttrium-90	Y-90	64H	β,γ	5.4×10^{5}	2.28	1.76	Zr-90
Yttrium-91	Y-91	58.6D	β,γ	2.4×10^{4}	1.55	1.205	Zr-91
Zirconium-93	Zr-93	1.5×10^{6}Y	β,γ	3×10^{-3}	0.063	0.03	Nb-93
Zirconium-95	Zr-95	64D	β,γ	2.1×10^{4}	0.37	0.76	Nb-95
Niobium-92m	Nb-92m	10D	EC,γ	1.4×10^{5}	-	0.93	Zr-92
Niobium-93m	Nb-93m	13.6Y	e*,γ	2.8×10^{2}	-	0.03	Nb-93
Niobium-94	Nb-94	2.0×10^{4}Y	β,γ	1.9×10^{-1}	0.47	0.87	Mo-94
Niobium-95	Nb-95	35.1D	β,γ	3.9×10^{4}	0.159	0.766	Mo-95
Molybdenum-93	Mo-93	$\approx3\times10^{3}$Y	EC,γ	1.3	-	0.03	Nb-93
Technetium-99	Tc-99	2.1×10^{5}Y	β,γ	1.8×10^{-2}	0.292	0.09	Ru-99
Tin-117m	Sn-117m	≈14D	e,γ	7.9×10^{4}	-	0.159	Sn-117
Tin-119m	Sn-119m	≈245D	e,γ	4.4×10^{3}	-	0.024	Sn-119
Tin-121m	Sn-121m	≈50Y	β,γ	5.9×10^{1}	0.354	0.037	Sb-121
Tin-123	Sn-123	130D	β,γ	8.2×10^{3}	1.42	1.09	Sb-123
Antimony-124	Sb-124	60D	β,γ	1.7×10^{4}	0.61	0.60	Te-124
Antimony-125	Sb-125	2.7Y	β,γ	1.1×10^{3}	0.30	0.428	Te-125
Tellurium-125m	Te-125m	58D	e,γ	1.8×10^{4}	-	0.035	Te-125

*EC designates electron capture; e designates electron conversion.

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Table G.12. Activities of Light Elements and Materials of Construction in Spent Fuel vs. Decay Times (33 GWD/MTU, 80% capacity factor)

	Activities (Ci/MTU charged to reactor)					
		Decay Time				
Isotope	Discharge	30 Days	120 Days	1 Year	10 Years	20 Years
Ca-45	6.11E-02[a]	5.38E-02	3.69E-02	1.32E-02	1.34E-08	2.93E-15
Sc-46	8.65E+00	6.75E+00	3.21E+00	4.24E-01	6.93E-13	5.55E-26
Cr-51	3.12E+04	1.48E+04	1.57E+03	3.49E+00	9.37E-36	0.0
Mn-54	4.61E+02	4.30E+02	3.50E+02	2.00E+02	1.09E-01	2.58E-05
Fe-55	1.79E+03	1.75E+03	1.64E+03	1.37E+03	1.25E+02	8.69E+00
Fe-59	3.00E+02	1.89E+02	4.73E+01	1.09E+00	1.15E-22	0.0
Co-59	1.92E+04	1.43E+04	5.98E+03	5.52E+02	7.46E-12	2.90E-27
Co-60	7.11E+03	7.03E+03	6.80E+03	6.23E+03	1.90E+03	5.10E+02
Ni-59	3.36E+00	3.36E+00	3.36E+00	3.36E+00	3.36E+00	3.36E+00
Ni-63	4.94E+02	4.94E+02	4.93E+02	4.91E+02	4.58E+02	4.25E+02
Sr-89	7.96E+01	5.33E+01	1.61E-01	6.13E-01	5.90E-20	4.37E-41
Sr-90	1.74E-03	1.73E-03	1.72E-03	1.69E-03	1.36E-03	1.06E-03
Y-90	3.05E+03	1.25E+00	1.72E-03	1.69E-03	1.36E-03	1.06E-03
Y-91	2.09E+02	1.47E+02	5.08E+01	2.83E+00	4.30E-17	8.86E-36
Zr-93	1.14E-01	1.14E-01	1.14E-01	1.14E-01	1.14E-01	1.14E-01
Zr-95	3.82E+04	2.78E+04	1.06E+04	7.80E+02	4.77E-13	5.94E-30
Nb-92m	1.41E+01	1.84E+00	4.06E-03	2.39E-10	0.0	0.0
Nb-93m	8.40E-03	8.90E-03	1.04E-02	1.44E-02	5.63E-02	8.51E-02
Nb-94	3.06E-01	3.06E-01	3.06E-01	3.06E-01	3.06E-01	3.06E-01
Nb-95	3.60E+04	3.40E+04	1.84E+04	1.62E+03	1.01E-12	1.26E-29
Mo-93	1.75E-02	1.75E-02	1.75E-02	1.75E-02	1.75E-02	1.75E-02
Tc-99	1.77E-02	1.78E-02	1.78E-02	1.78E-02	1.78E-02	1.78E-02
Sn-117m	1.89E+04	4.29E+03	4.98E+01	2.69E-04	0.0	0.0
Sn-119m	2.25E+01	2.07E+01	1.61E+01	8.18E+00	9.06E-04	3.65E-08
Sn-121m	4.03E-01	4.03E-01	4.02E-01	3.99E-01	3.68E-01	3.36E-01
Sn-123	4.38E-01	3.71E-01	2.25E-01	5.79E-02	7.11E-10	1.15E-18
Sb-124	4.56E+00	3.22E+00	1.14E+00	6.72E-02	2.22E-18	1.08E-36
Sb-125	4.07E+01	3.99E+01	3.75E+01	3.15E+01	3.13E+00	2.41E-01
Te-125m	1.43E+01	1.47E+01	1.49E+01	1.30E+01	1.30E+00	9.98E-02
TOTAL	1.89E+05	1.05E+05	4.61E+04	1.13E+04	2.50E+03	9.49E+02

[a] Exponent Notation: 6.11E-02 = 6.11 × 10^{-2}

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Table G.13. Quantities of Light Elements and Materials of Construction in Spent Fuel vs. Decay Times (33 GWD/MTU, 80% capacity factor)

	Quantities (g/MTU charged to reactor)					
		Decay Time				
Isotope	Discharge	30 Days	120 Days	1 Year	10 Years	20 Years
Ca-45	3.47E-06[a]	3.06E-06	2.10E-06	7.49E-07	7.61E-13	1.67E-19
Sc-46	2.55E-04	1.99E-04	9.48E-05	1.25E-05	2.05E-17	1.64E-30
Cr-51	3.39E-01	1.60E-01	1.70E-02	3.79E-05	1.02E-40	0.0
Mn-54	5.77E-02	5.39E-02	4.39E-02	2.51E-02	1.37E-05	3.23E-09
Fe-55	7.16E-01	7.01E-01	6.56E-01	5.49E-01	4.99E-02	3.48E-03
Fe-59	6.11E-03	3.85E-03	9.62E-04	2.21E-05	2.35E-27	0.0
Co-58	6.08E-01	4.54E-01	1.89E-01	1.75E-02	2.36E-16	9.18E-32
Co-60	6.27E+00	6.20E+00	6.00E+00	5.50E+00	1.68E+00	4.50E-01
Ni-59	4.44E+01	4.44E+01	4.44E+01	4.44E+01	4.44E+01	4.44E+01
Ni-63	8.01E+00	8.01E+00	7.99E+00	7.95E+00	7.43E+00	6.89E+00
Sr-89	2.82E-03	1.89E-03	5.69E-04	2.17E-05	2.09E-24	1.55E-45
Sr-90	1.23E-05	1.22E-05	1.22E-05	1.20E-05	9.59E-06	7.49E-06
Y-90	5.61E-03	2.30E-06	3.16E-09	3.11E-09	2.49E-09	1.95E-09
Y-91	8.56E-03	6.01E-03	2.08E-03	1.16E-04	1.76E-21	3.63E-40
Zr-93	4.43E+01	4.43E+01	4.43E+01	4.43E+01	4.43E+01	4.43E+01
Zr-95	1.81E+00	1.31E+00	5.02E-01	3.69E-02	2.25E-17	2.81E-34
Nb-92m	1.01E-04	1.32E-05	2.91E-08	1.71E-15	0.0	0.0
Nb-93m	2.97E-05	3.15E-05	3.67E-05	5.08E-05	1.99E-04	3.01E-04
Nb-94	1.61E+00	1.61E+00	1.61E+00	1.61E+00	1.61E+00	1.61E+00
Nb-95	9.17E-01	8.66E-01	4.68E-01	4.13E-02	2.58E-17	3.21E-34
Mo-93	4.09E-02	4.09E-02	4.09E-02	4.09E-02	4.09E-02	4.09E-02
Tc-99	1.03E+00	1.03E+00	1.03E+00	1.03E+00	1.03E+00	1.03E+00
Sn-117m	2.38E-01	5.38E-02	6.24E-04	3.37E-09	0.0	0.0
Sn-119m	5.13E-03	4.72E-03	3.67E-03	1.86E-03	2.06E-07	8.31E-12
Sn-121m	1.04E-02	1.04E-02	1.03E-02	1.03E-02	9.46E-03	8.64E-03
Sn-123	5.16E-05	4.37E-05	2.65E-05	6.82E-06	8.37E-14	1.36E-22
Sb-124	2.60E-04	1.84E-04	6.49E-05	3.83E-06	1.26E-22	6.15E-41
Sb-125	3.84E-02	3.77E-02	3.54E-02	2.98E-02	2.96E-03	2.27E-04
Te-125m	7.95E-04	8.19E-04	8.28E-04	7.23E-04	7.21E-05	5.54E-06
TOTAL	2.71E+05	2.71E+05	2.71E+05	2.71E+05	2.71E+05	2.71E+05

[a] Exponent Notation: 3.47E-06 = 3.47 × 10^{-6}

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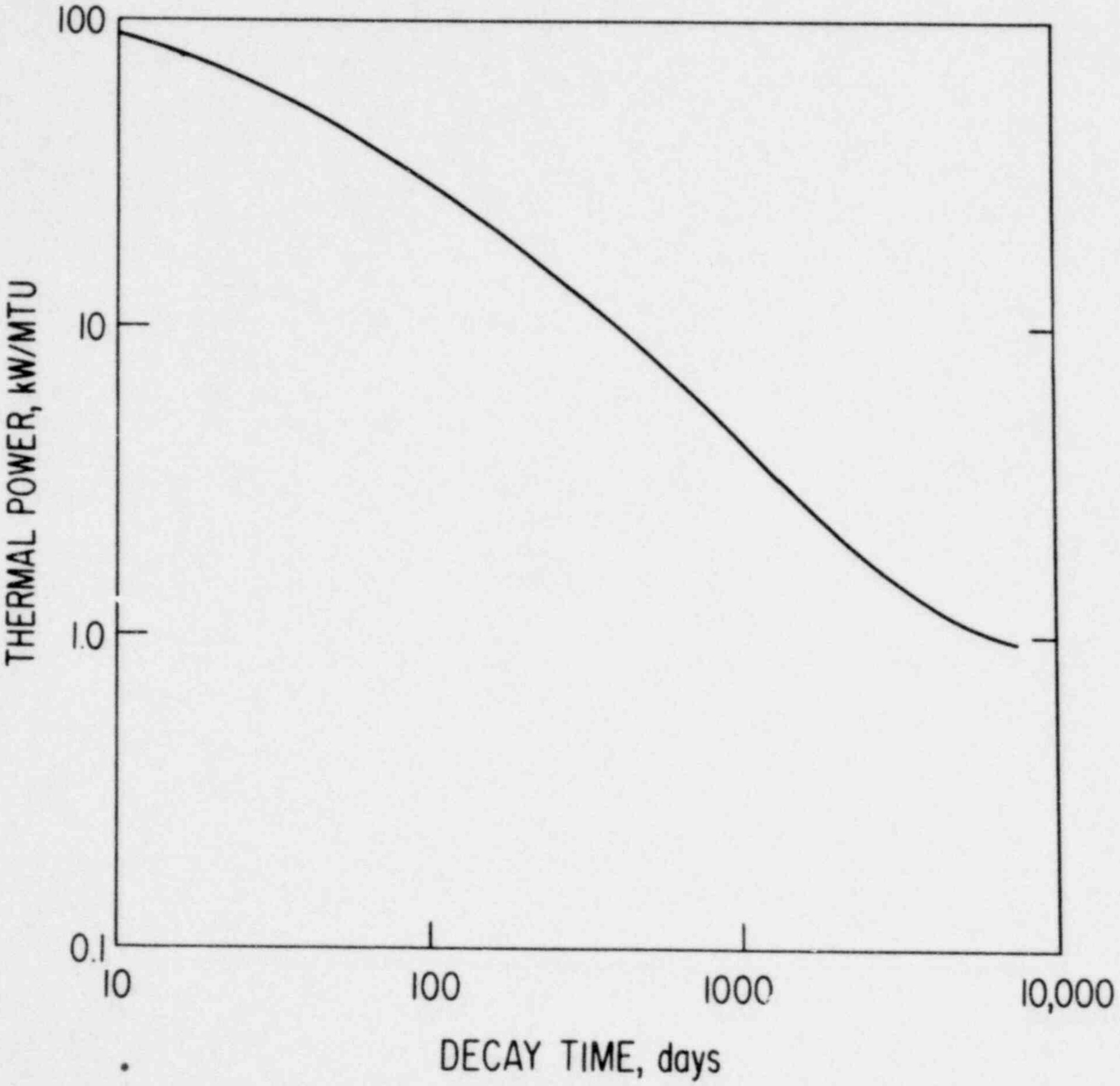

Figure G.4. Spent Fuel Heat Generation Rate

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APPENDIX H

"AWAY-FROM-REACTOR" (AFR) STORAGE CONCEPT

1.0 WET STORAGE FACILITIES

This section will treat a 1500-MTU pool as a model facility for discussion purposes only. The staff recognizes that a variety of designs are possible. Each will be specifically examined as they are proposed for licensing action. Such a facility will be designated as an AFR--an independent spent fuel storage installation (ISFSI), be it constructed away from the reactor site or on an existing reactor site but separated from existing structures.

1.1 SPENT FUEL CASK RECEIVING, HANDLING, AND UNLOADING

Irradiated fuel assemblies would be received at an ISFSI in heavily shielded fuel shipping casks transported by either rail or truck. The ISFSI would be designed for the receipt, cask preparation, cask unloading, and storage of irradiated fuel assemblies. Facilities would also be provided for the decontamination, repair (if required), and preparation of empty casks for return shipment.

The cask being received is first surveyed to determine if there is any external contamination; if none is detected, the cask and its carrier are flushed down with a high-pressure water spray to remove mud and road dirt. If low-level contamination is present, the cask is flushed down within the facility and the flush waste is routed to the liquid radwaste system.

As indicated in the text, spent nuclear fuel can be transported both by truck and rail spent fuel casks. The internal operating environment of rail or truck casks can be designed to be either wet or dry. As examples, the NFS-4 truck cask is designed to use water as the internal cavity heat transfer medium, while the NLI-1/2 truck cask uses helium as the internal medium. The GE IF-300 rail cask has a wet internal environment, while the NLI-10/24 rail cask has a dry internal environment. The latter cask is considered to most closely resemble current new or future designs.

The receipt, handling, and unloading of these two types of spent fuel casks present different operational problems. The internal temperatures of the dry cask are generally too high to permit the cask to be placed directly into the pool for unloading. The internal contamination of the wet cask may be too high to permit the cask internal water to mix with the storage pool water.

Because of these operational considerations, a cask cool-down and internal decontamination system is required by an ISFSI. The cool-down system would lower the internal temperature of a dry cask by first recirculating superheated steam or hot air through the cask internals. Then, by slowly lowering the temperature of the recirculating medium, the internal temperature of the cask is reduced until hot water can be recirculated through the cask. At this point the cask can be placed into the pool for unloading. Such a cask cool-down system continuously treats the cooling medium as it is discharged. The treatment process is one of combined filtration and ion exchange. Properly designed, the cool-down system can act as a cask internal decontamination system for wet casks. For this mode of operation, the wet cask would be connected to the cool-down system and water circulated through the cask to replace the primary coolant. This greatly reduces the amount of radioactive material that is introduced into the storage pool.

Following the cool down and decontamination, the cask is transferred into the cask unloading section of the pool. A 135-ton cask handling crane is used to transfer the cask. The design of the facility is such that at no time is a cask or any other heavy piece of equipment transferred over the top of stored spent fuel. Furthermore, areas over which the cask will be transferred will be protected with shock absorbing foundations.

After the spent fuel cask has been transferred to the unloading pool, the cask handling crane, along with its yoke, is moved aside, and a second, smaller cask unloading crane is positioned over the cask. The lid of the cask is removed while the cask is underwater, and the lid is placed beside the cask on the pool bottom. The individual fuel assemblies are then removed from the cask. After the operator compares the physical identity of each fuel assembly with the shipping records, the assemblies are transferred to a multiple assembly storage canister located in a rack in the cask unloading pool. Positive mechanical and electrical stops are employed to ensure that the spent fuel assemblies will not be lifted above the 3.6-m shielding depth of water.

When the last assembly has been removed from the cask, the cask interior is inspected visually to ensure that all fuel assemblies and nonfuel items have been removed. The cask lid is replaced on the cask and the cask is removed from the pool. As the cask is being removed, an operator rinses the cask exterior with demineralized water to wash off pool water. The cask is then placed in a decontamination and repair area. The head or lid bolts are tightened and the exterior of the cask is decontaminated as required. After a final radiation survey and visual inspection, the cask is moved to and mounted on the transport vehicle. Finally, the spent fuel in the cask unloading pool is transferred to the spent fuel storage pool.

1.2 SPENT FUEL POOL

A water-filled storage pool was chosen as the basic design concept for an independent spent fuel storage installation because of currently available experience of the nuclear industry. Water contained in the pool provides shielding and cooling of the spent fuel and is also a transparent medium to facilitate fuel handling and inspection. Figure H.1 is a plan view of a typical pool and its support areas.

The pools are massive, reinforced concrete structures lined with approximately 0.6-cm-thick stainless steel plate. The design considerations of the concrete structure and liner are dictated by the seismic history of the area. Regulatory Guide 3.24 calls for design to have a high degree of resistance to ground motion.

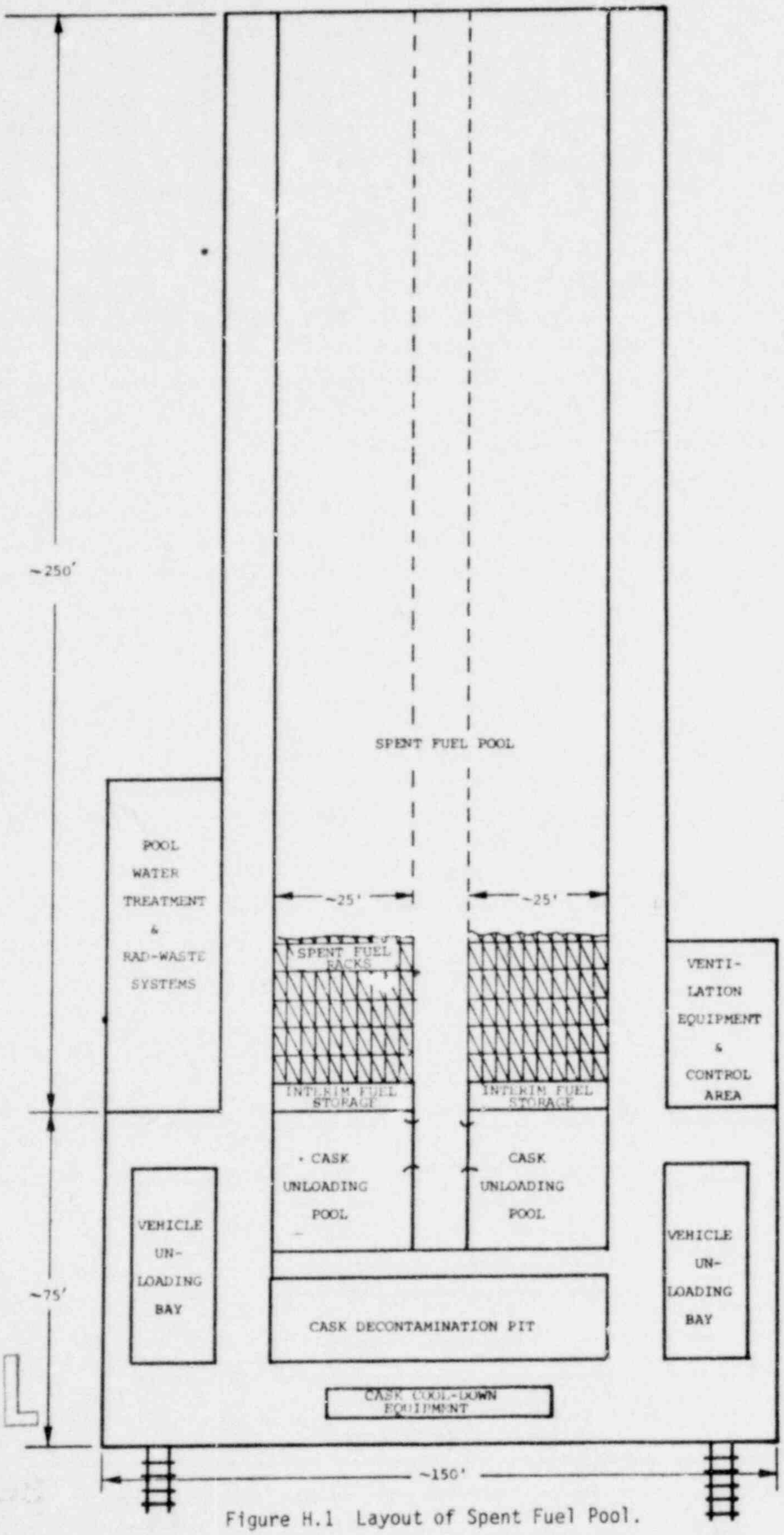

Figure H.1 Layout of Spent Fuel Pool.

The depth of the water within the pool is approximately 30 to 40 ft (9 to 12 m). This allows the 4.4-m-long fuel assemblies to be placed in storage racks from the top and still retain at least 3.6 m of water shielding during the fuel transfer operations.

The pool is divided into two main functional areas: the cask unloading pool and the fuel storage area. Two bridge cranes service the pool area. A 135-ton-capacity crane transfers the spent fuel cask from the transportation vehicle to the cask unloading position. A 15-ton-capacity crane unloads the cask and moves the fuel assemblies from point to point within the pool.

The pool liner is designed as a high reliability, leak-tight barrier. In addition, a leakage collection system is installed between the stainless steel liner and the concrete structure. The collection system is composed of a series of interconnecting channels or depressions in the concrete behind the liner. These channels guide and collect any leakage to a pool sump. Any leakage collected in the sump can be returned to the pool by pumps. The leakage collection system functions first as a leak detection system and secondly as a means of ensuring that major amounts of pool water do not escape containment.

Spent fuel storage racks maintain the spent fuel assemblies in their respective positions during storage. An extensive discussion of the design of these racks is provided in Appendix B. The purpose of these racks is to maintain the fuel assemblies in an upright position and to maintain spacing of the fuel assemblies such that the $k_{eff} < 0.95$, even during a seismic event or other disruption.

1.3 HEAT DISSIPATION

The heat rejection requirements of the facility are met with circulating cooling water systems and air systems (HVAC) that dissipate the heat to the environment. The water cooling complex is composed of closed loop primary systems, secondary loop and an emergency cooling water system.

The secondary cooling water system transports process and radioactive decay heat from the primary closed loop systems to cooling towers. Cooling water is pumped through heat exchangers, where the heat from the process system is returned to the cooling towers for dissipation to the atmosphere. The cooling tower is sited to meet the fuel receiving and storage facility cooling water requirements during normal operation. It would probably be of the mechanical forced-draft variety. The total dissolved solids content of the recirculating cooling water is limited by continuous blowdown. Calcium and magnesium are kept in solution by controlling the pH of the cooling water. Corrosion protection is provided by the addition of inorganic and organic inhibitors. Makeup water is introduced into the tower to compensate for blowdown, evaporation, and drift.

The primary cooling water and air systems consist of closed loops that are used to transfer heat from process equipment to the secondary cooling water system. The closed loop arrangements provide a positive barrier between potential leaks in the process equipment and the environment.

There are three primary cooling water and air system loops associated with:

1. The fuel storage pool

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2. HVAC air

3. The radwaste concentrator condenser.

The emergency cooling water system consists of a large pond with a capacity in the range of 10^7 liters and a special distribution system that supplies cooling water for emergency utilities and system operation. It is connected to the primary and secondary systems through fail-safe block valves. Such an emergency heat sink provides ample cooling in off-normal conditions.

Table H.1 shows the heat load on the secondary cooling system from the primary system. The secondary system must be able to remove about 5×10^7 Btu/hr, assuming 1500 MTU of spent fuel being stored and the fuel being out of the reactor for five years.

Table H.1. Heat Load on Secondary Cooling Water System and Corresponding Flow Rates through Heat Exchangers

Source	Heat Load (full pool) (Btu/hr)	Flow Rate through Secondary System Side of Heat Exchangers, liters per minute (reflects contingency)
1500 MTU spent fuel pool (normally fuel received 5 years out of reactor)	10^7 (2 kW/MTU)	6,000
HVAC heat rejection (compression, chillers, after cooler)	0.5×10^7	7,600
Radwaste concentrator	10^7	6,100
Subtotal + 100% contingency	2.5×10^7 2.5×10^7	19,700
Total	5×10^7 Btu/hr	

Table H.2 gives the water requirements for the secondary cooling water system. The water flow rate through the cooling tower (secondary cooling water system flow rate) is almost 20,000 liters per minute.

Heat exchangers in the three loops are of the plate type. Plates can be added to or removed from service to increase or decrease capacity.

The fuel storage pool heat exchanger has a primary side flow rate of 5,100 liters per minute, with an inlet temperature of 46°C and an outlet temperature of 29°C, when running at full capacity. The secondary side inlet temperature is 24°C and the outlet temperature is 38°C. The heat exchanger has a surface area of approximately 500 square meters.

The inlet temperature of the water to the HVAC heat exchanger is 24°C and the outlet temperature is 29°C, during full capacity conditions. The surface area is approximately 500 square meters. The inlet temperature of the radwaste concentrator condenser is 24°C and the outlet temperature is 38°C at full capacity with a heat exchanger surface area of approximately 95 square meters.

The inlet temperature of the water to the HVAC heat exchanger is 24°C and the outlet temperature is 29°C, during full capacity conditions. The surface area is approximately 500 square meters. The inlet temperature of the radwaste concentrator condenser is 24°C and the outlet temperature is 38°C at full capacity with a heat exchanger surface area of approximately 95 square meters.

Table H.2. Approximate Requirements of Secondary Cooling Water System

Component	Requirement, liters per minute
Cooling tower water flow	19,700
Evaporative losses	450
Drift losses	9
Blowdown	95
Makeup	570

Three cooling water pumps, two for normal operation and one standby, are provided for the secondary cooling water system. Each pump has an estimated capacity of approximately 9,800 liters per minute with a head of about 43 meters. The pumps are located in forebays in front of the cooling towers. Water intakes from the cooling tower to the forebay are equipped with two banks of filter screens in series. The heat dissipation system is shown in Figure H.2.

1.4 HEATING, VENTILATION, AND AIR CONDITIONING SYSTEM

The heating, ventilation, and air conditioning (HVAC) system for the fuel storage facility is designed to supply properly conditioned air to operational areas, ensure that air is restricted to prescribed flow paths for confinement, pass the airflow through final filters or treatment systems, and then discharge the air through a stack to the environment. The ventilation portion of the system is important for the control of contamination and must function continuously under normal, off-standard, and accident conditions. All operating facilities will not necessarily follow the arrangement discussed here. For example, Barnwell does not filter air through HEPA's.

The building structures and ventilation systems provide for confinement of radioactive materials and ensure that personnel exposure is maintained as low as reasonably achievable. In addition, the HVAC system, as a whole, maintains an environment conducive to work.

Air is supplied to the ventilation systems by conventional supply units with integral filters, heating coils, cooling coils, and fans. Air from these units is distributed to the operational areas of the facility through galvanized ductwork. Exhaust air from these areas is contained within coated carbon steel or stainless steel ducts as required by the specific system application.

Air exhausted from operating areas, where dry casks are air cooled, is cleaned and discharged to the outside. This air from areas that are contaminated or potentially contaminated passes through a roughing filter and two HEPA filters in series. The final filters consist of banks of filters in parallel and each filter bank has a mist eliminator.

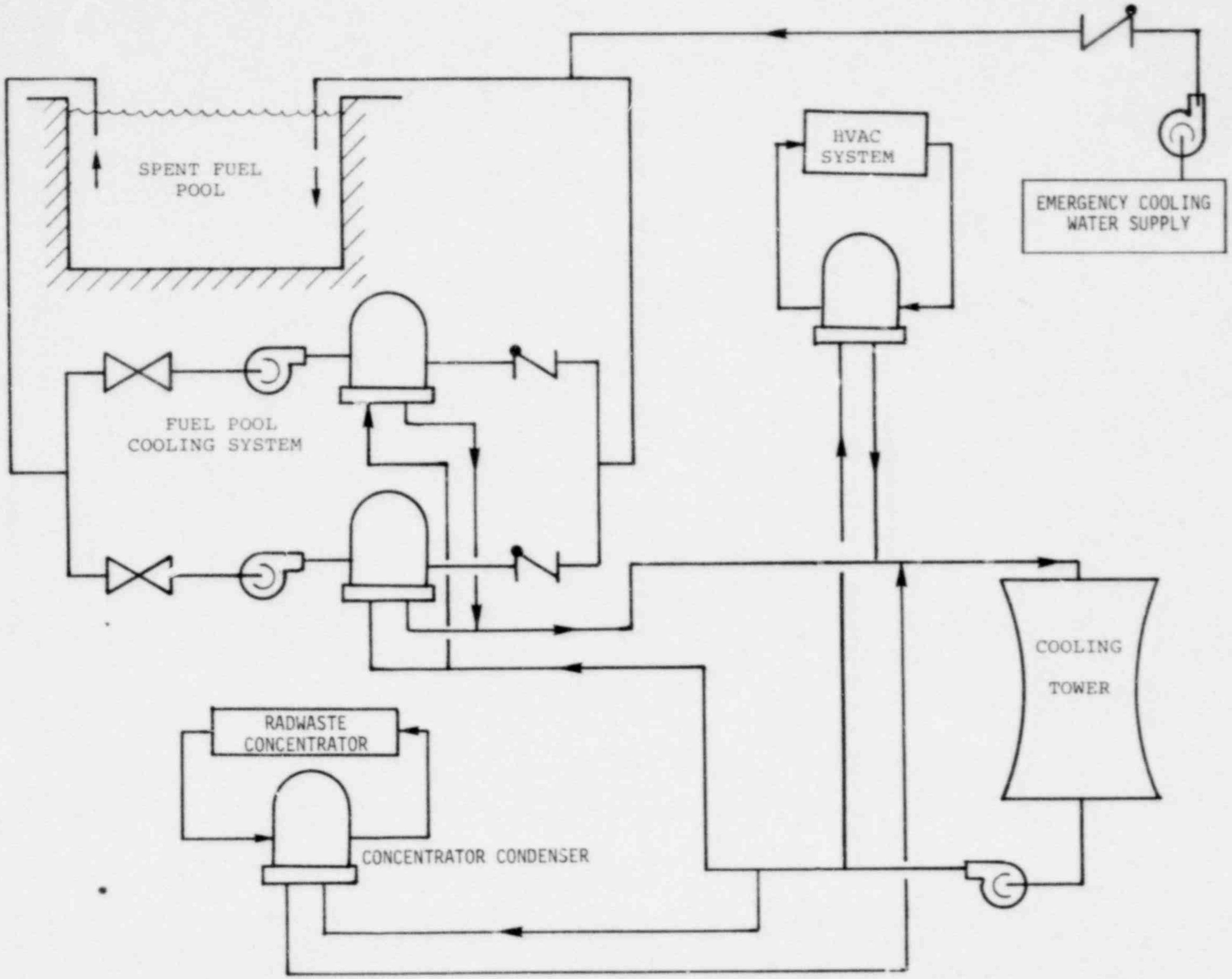

Figure H.2 Heat Dissipation System

The components are designed so they can be tested for operability, efficiency and functional performance under simulated design basis conditions.

The fuel receiving and storage facility ventilation system is divided into two subsystems with intake-supply units and exhaust-filtration units which discharge to a common stack. One subsystem serves the fuel storage pool and fuel pool water treatment buildings. The fuel receiving area, waste solidification and compaction station, cask unloading cell, and radwaste processing cell are served by the second subsystem.

Outdoor air is conditioned as required and supplied to the fuel storage pool and water treatment buildings. It is then discharged to the stack through HEPA filters. An air supply unit provides air to the fuel storage pool and water treatment buildings through galvanized steel ductwork. Airflow is from areas of lesser potential contamination to areas of higher potential contamination. Each unit consists of a fan, filters, steam heating coils, and chilled-water cooling coils to condition the air. During normal operation, more than one unit is on line and at least one spare is available.

Centrifugal blowers, including at least one standby unit, are used to exhaust the air from the fuel storage pool and water treatment buildings to the stack.

The fuel receiving area, waste solidification and compaction area, cask unloading cell, and radwaste processing cell receive air through several supply units. Each unit has a fan, filter, steam coils, and chilled-water coils to condition the air, with more than one unit on line during normal operation.

As in the first subsystem, air is distributed through galvanized ductwork from areas of lesser potential contamination to areas of greater potential contamination. Some of the air is recirculated by return air fans after filtration to the inlet supply units.

Outlet filters are installed at the air exits. These units include roughing filters, which collect the majority of particulate material exiting in the airstream, thus minimizing contamination to the exhaust ductwork and loading of the final filters. Banks of return air filters are provided to clean recirculated air prior to reuse. The filter banks have a mist eliminator, roughing filters and two HEPA filters in series. These return banks are removed from service during filter changeout operations.

The final filters consist of several banks of filter units in parallel, with each filter bank containing a mist eliminator and two HEPA filters in series.

Several blowers, including one standby blower, are used to exhaust air to the stack. Return air blowers, including one standby unit, return filtered air to the HVAC supply unit.

1.5 RADIOACTIVE WASTE GENERATION AND TREATMENT

The operation of spent nuclear fuel storage pools generates both liquid and solid radioactive wastes, which must be collected, treated, packaged, stored, and disposed of. The sources of radioactive contamination are fission and activation products from the fuel surface and defects in the fuel cladding.

The major sources of liquid and semi-liquid radioactive wastes are the water treatment system and the cask cool-down and decontamination system. The wastes that emerge from these systems include filters, ion-exchange media, ion-exchange regeneration solutions, filter sludges, and miscellaneous dry solids, including HEPA filters, charcoal, clothing, plastic, paper, wood, metal, and rubber. The next most important sources of contaminated waste are equipment and facility decontamination and flush solutions. About 300 cubic meters per year of wastes might be expected to be generated by a facility storing 1,500 MTU of spent fuel. Figure H.3 outlines the operational flow of a storage facility as it relates to the generation of radioactive waste.

The units used to filter the pool water and cask cool-down solutions can be either cartridges or backflushable. In the case of the cartridge filter, the used filter and filter cake require immobilization and packaging. In the case of backflushable filter units, the filter may be of either a precoat or non-precoat variety. If the backflushable filter is of the precoat variety, the precoat is a material such as diatomaceous earth. When the filter is backflushed, the precoat and the filter cake must be sent to the waste concentrator for volume reduction. The non-precoat backflushable filter cake is sent directly to the waste concentrator.

The filtered poolwater is demineralized in a mixed resin bed ion exchange column to remove any contaminated ionic species that cannot be filtered. When fully loaded these beds can be regenerated by running a regenerating chemical solution through the bed, which will release the ionic species. The regeneration waste solution is metered to the waste concentrator. The lifetime of the ion exchange resin varies, but can be as much as two years. When the resin has completed its useful lifetime, it is pumped to a dewatering tank and ultimately sluiced to the waste solidification system.

The waste concentrator is an evaporator providing a means of volume reduction of wastes. The liquid waste treatment system and the filter sludges (if backflushable filters are used) are sent to the evaporator, where they are concentrated in the bottoms. The evaporator bottoms slurry is sent to the waste solidification system for immobilization.

The waste solidification system immobilizes the spent resins, filter cartridges, and evaporator bottoms in a solid matrix. The solidification agent can be cement or urea formaldehyde.

The waste and solidification agent is mixed in either a continuous or batch mixing device and packaged in a container such as a 200-liter drum and capped. Once the solidification agent has had time to set up, the waste is immobilized. The container is then stored onsite to await final disposal.

Radioactive gases that are released from cask decontamination operations or fuel pool operations are collected through high efficiency particulate (HEPA) filters, condensers, or advanced systems.

The solid radioactive wastes include ventilation filters, rags, plastic, failed small equipment and similar items. Low-density solid waste, such as ventilation filters, are mechanically compacted so as to minimize the volume of waste that must be handled and disposed of.

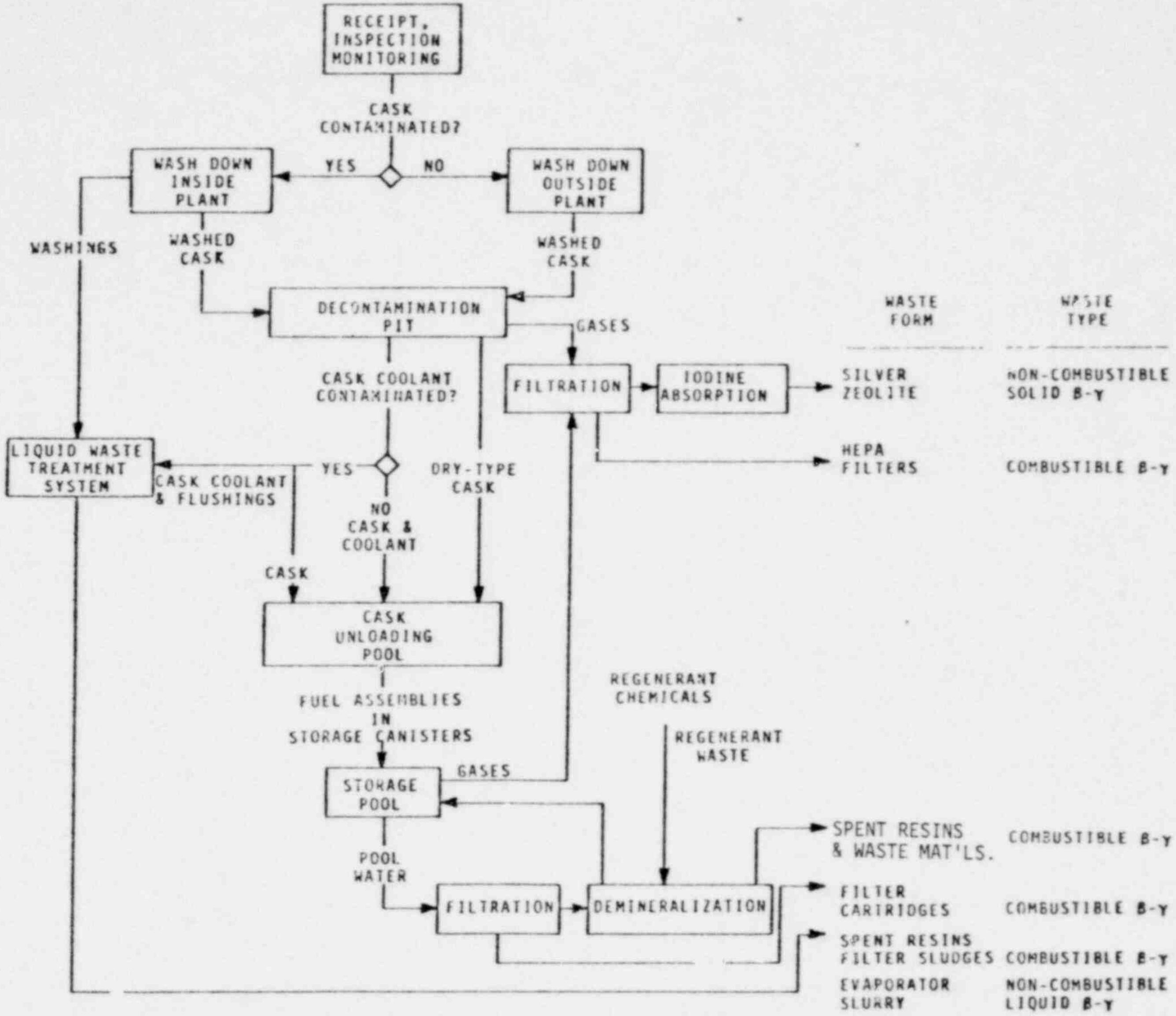

Figure H.3 Schematic Diagram of Spent Fuel Storage Pool Waste-Generation Flow.

1.6 FACILITY INTEGRITY

The fuel storage pool will be designed to Category I seismic requirements. Drains, permanently connected mechanical or hydraulic systems, and other features that by maloperation or failure could cause loss of coolant and uncover the fuel are not included in the design. Systems that maintain water quality and quantity are designed so that their maloperation or failure will not cause fuel to be uncovered. These systems do not otherwise meet Category I seismic requirements. A makeup system is provided to add coolant to the pool. As appropriate, a backup system for filling the pool is provided by a reservoir.

1.7 LICENSING AND CONSTRUCTION CONSIDERATIONS

As indicated by Regulatory Guide 3.24, a license application for an ISFSI would be reviewed under the requirements of 10 CFR Part 70 (or proposed 10 CFR Part 72 when adopted). As such, a review and evaluation of the engineering design and detailed safety analysis of the installation must be conducted prior to licensing. For this reason, a license application for an ISFSI should include a safety analysis report similar in scope and detail to the pertinent parts of a safety analysis report for a fuel reprocessing plant.

The licensing of an ISFSI would be a major federal action within the meaning of the National Environmental Policy Act of 1969. Therefore an applicant should prepare an environmental report that can serve as the technical basis for an evaluation by the Nuclear Regulatory Commission of the potential environmental impact of the installation. Preliminary engineering plans should be filed with the license application and its supporting environmental report at least nine months before the start of construction activities.

The activities that culminate in the operation of an ISFSI include:

- Site selection
- Project scoping
- Preliminary engineering
- Preparation and submittal of a license application and its supporting documents
- Detailed engineering
- Construction
- Cold checkout
- Startup

About five years will be required for project completion.

2.0 DRY STORAGE FACILITIES*

2.1 SPENT FUEL RECEIVING AND PACKAGING FACILITY

For the purpose of this study it was assumed that all of the dry storage options will require a spent fuel receiving and packaging facility. This receiving and packaging facility will vary

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*The facilities described in this section are presented as model facilities for discussion only.

slightly from option to option, but the basic design and operational mode will be essentially the same for all of the options except the dry rack storage.

A general operational flow diagram is shown in Figure H.4. The spent nuclear fuel is received at the facility in dry spent fuel casks transported to the facility by either rail or truck. The exterior of the shipping cask is first washed to remove any road dirt, then the cask is vented to the cask cool-down system. The internal temperature of the cask is reduced to an acceptable operational range by the cool-down system. The spent fuel is then removed remotely from the cask in a dry cell using cranes and manipulators and placed in racks for surge storage. The fuel is moved to a packaging area as operations permit. Single fuel elements are inserted into storage canisters. Canister lids are placed on the loaded canisters and the closure weld is made. The canister is checked for leaks and the external surface is decontaminated. The loaded canister is then placed in one of the dry storage modes.

The receiving and packaging building houses all of the process activities. The building is divided into general areas according to functions. These major functions include: receiving, packaging, personnel support, utility support, radwaste, and maintenance.

The receiving functions include the spent fuel shipping cask receiving area, the fuel handling and receiving cell, various galleries and service areas, and the control room. The shipping cask receiving area is contained within a steel-framed, high-bay building. The activities of the area are devoted to preparing the cask for unloading, including external decontamination of the cask, internal cask cool down, and mating the cask with the fuel receiving and handling cell. The various galleries and service areas used to support the receiving activities include an operating gallery, utility gallery, service gallery, laboratory and counting rooms, personnel change and shower rooms, and an HVAC area.

Operators control in-cell mechanical operations from the operating gallery while viewing these operations through shielding windows. The control room serves as the central control and monitoring area for the entire facility. The personnel support area provides space for the non-process-related functions within the building. These areas include access-controlled personnel entry and exit, a security office, personnel check and decontamination stations between potentially contaminated and clean areas, toilets and locker rooms, offices for supervisory personnel, meeting rooms, and a cafeteria.

The mechanical and electrical support area is a one-story standard concrete structure in which equipment that supplies the mechanical and electrical demands of the facility is housed. The mechanical room contains pumps, chillers, boilers, and other equipment in the utility systems. The electrical room contains motor and switch gear control centers. A battery room and standby generator room are included.

The waste treatment area will be constructed of reinforced concrete. The contents of this room are described in Section 2.3 of this appendix.

The receiving system can accept shipping casks, delivered either by truck or rail car. Trucks and rail cars are washed down to remove dirt and are checked for radioactive contamination. Facilities are provided for minor decontamination of trucks, rail cars, and casks in case the level of radioactivity is higher than that specified in the "Acceptance Criteria for Shipping Casks."

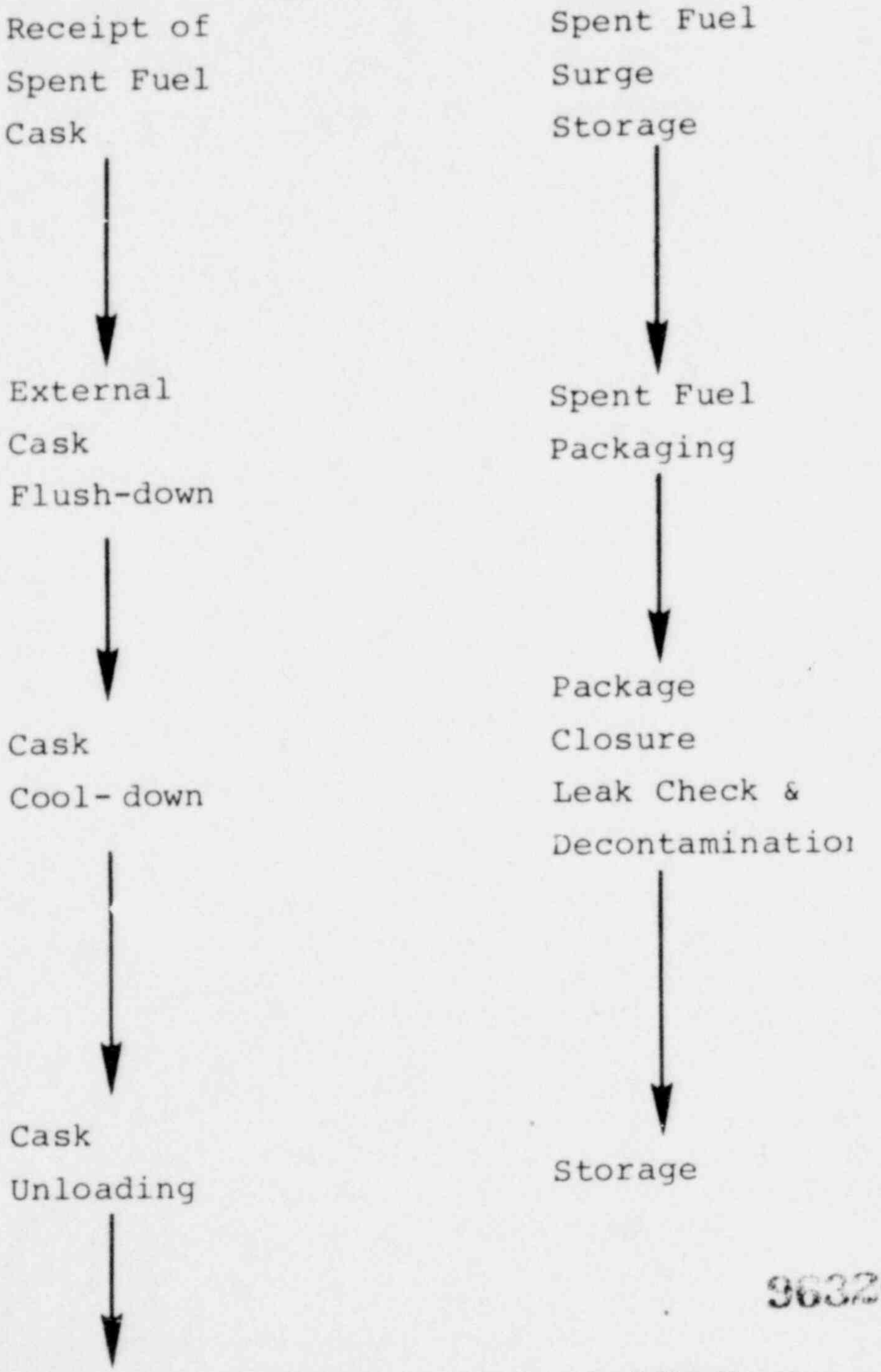

Figure H.4 Receiving and Packaging Facility Operational Flow Diagram.

Shipping casks are received in a horizontal position. The receiving area crane upends the cask and places it on the receiving area floor. Portable platforms are provided to allow personnel access to the top and sides of the cask. Hoses are connected to vents in the cask and any internal pressure is released to the cask cool-down system. The internal temperature of the cask is lowered by purging with the cooling media.

The shield plug retainer is removed and the cask is lifted by the receiving area crane and placed in a shipping cask carriage which is in a receiving pit. The cask is moved under the receiving cell and then is sealed to the underside of the shipping cask receiving port with an inflatable seal.

Operations are conducted remotely beyond this point in the receiving process. The shipping cask access port cover and shipping cask shield plug are removed and stored in a cell by the 15-ton hoist on the receiving cell crane. One assembly at a time is lifted from the shipping cask, using the receiving cell crane six-ton hoist equipped with an assembly lifting device. Each assembly is identified and visually inspected for damage. The assemblies are then placed in racks for surge storage.

As the operations permit, assemblies are transferred to the packaging area, where individual assemblies are inserted into single canisters. The lid is welded in place on the loaded canister as the final closure.

The canisters are inspected for contamination, and if required, placed in the spray chamber for decontamination by fog and water sprays. The canisters are checked for contamination after removal from the spray chamber. The cell manipulators are used to make swipe checks on the canisters. Swipes are then removed from the receiving cell through a swipe pass-through. They are given a preliminary check in the service gallery and may be taken to the counting room and laboratory for further analysis. The canister is decontaminated, if required, by washing with decontamination solutions in the decontamination chamber. Following packaging, decontamination, and final packaging, the canisters containing spent fuel assemblies are transferred to one of the dry storage modes.

Handling of the spent fuel assemblies and loaded canisters in the fuel receiving and packaging cells is controlled from the operating gallery by use of the remotely operated crane and master-slave manipulators. Operating personnel in the operating gallery are protected from radiation exposure by a two-meter-thick conventional concrete wall or equivalent shielding. Visual control is maintained by direct observation through a periscope and shielding windows and indirectly by the use of mirrors and closed-circuit television.

The receiving cell cooling and ventilation system is designed to remove heat released by waste canisters, cell lights, and mechanical equipment, and to maintain the cell exhaust temperature below 50°C. The cooling and ventilation system is described in Section 2.2 of this appendix. Receiving cell exhaust is on standby power but the normal cooling system is not. The receiving cell crane is on standby power, so it can be used to return canisters to the shipping cask; removal of the canister would permit cell access for repair.

The receiving cell is designed for contact maintenance after removal of high radiation sources. Hose connections and permanent spray piping are provided in the cell for use in decontamination.

The decontamination chemicals are fed to a high-pressure jet spray pump from mix tanks located in the aqueous makeup room.

A facility layout of the spent fuel receiving and packaging facility is shown in Figure H.5.

2.2 HEATING, VENTILATION AND AIR CONDITIONING SYSTEM

The HVAC system confines and limits the migration of radioactivity to specific areas within the storage facility and prevents the release of radioactivity to uncontrolled areas. Airflow is maintained toward areas of increasing contamination potential. Before being discharged to the atmosphere, the air is filtered by HEPA filters which maintain the release of potential radioactivity as far below guidelines established in 10 CFR Part 20 as is reasonably achievable.

The ventilation confinement requirements for the facility are provided by a primary and a secondary exhaust system. The primary exhaust system handles air from areas with significant contamination potential, while the secondary exhaust system handles air from areas with minor contamination potential.

The receiving and assembly building's HVAC system is divided into three ventilation zones. These zones are designated according to their potential for being contaminated. The primary zone consists of the areas with the highest contamination potential--receiving cell, canister transfer tunnel, weld and test cell, and waste concentration room. The secondary zone consists of the following low potential contamination areas: control room, operating galleries, service galleries, warm maintenance room, shipping cask receiving area, receiving pit, counting room and laboratory, personnel check and decontamination stations, storage unit assembly area, toilet, air-locks, cold maintenance room, aqueous makeup room, and exhaust filter-fan house. The unrestricted zone has minimum contamination potential and comprises the mechanical and electrical rooms and personnel support areas.

The differential pressure maintained between adjacent rooms assures that airflow will be from areas with least contamination potential to areas of successively higher contamination potential.

Automatic static pressure regulators and control dampers are used to control exhaust flows and maintain room pressure differentials. Automatic volume control dampers are provided to control the incoming ventilation airflow. Any inflow of air from adjacent areas to a room which is maintained at a lower pressure is compensated by automatic reduction in the amount of air supplied.

Supply air for the primary and secondary confinement zones, except for the shipping cask receiving area, storage unit assembly area, and personnel decontamination and change area, is filtered by prefilters and HEPA filters to reduce dust loading and changeout frequency for exhaust HEPA filters. Air exhausted from the primary and secondary confinement zones will be filtered by prefilters and two banks of HEPA filters in series prior to being released to the atmosphere.

The receiving cell, packaging cell, and the weld and test cell are maintained at the lowest pressure within the building so that air leakage is always inward. During normal operation, cooling units located adjacent to the cells recirculate cell air and remove heat released by canisters and equipment. A minimum quantity of air is normally exhausted through in-cell HEPA filters to maintain lower pressures.

1. Gaseous Waste Filter Vault(below)
2. Suspect Waste Tank (below)
3. Hot Waste Tank (below)
4. Cement Storage Room
5. Radwaste Feed Tank
6. Waste Concentration Room (below)
7. Casting Room
8. Control Area
9. Receiving Pit
10. Shipping Cask Receiving Area
11. Counting Room
12. Service Gallery
13. Receiving Cell
14. Cold Maintenance Room
15. Electrical Room
16. Stand-by Generator Room
17. Battery Room
18. HVAC Equipment Room
19. Warm & Cold Manipulator
20. Control Room
21. Cafeteria
22. Locker Room
23. Decontamination
24. Air Lock
25. Canister Storage Area
26. Access Door (sealed)
27. Load-Out Transfer Tunnel
28. Load-Out Area
29. Operating Gallery
30. Canister Loading Cell
31. Weld and Test Cell
32. Service Gallery
33. Mechanical Room
34. Air Lock
35. Welding Gas Storage
36. Exhaust Filter Fan House
37. Stack Monitor House
38. Stack

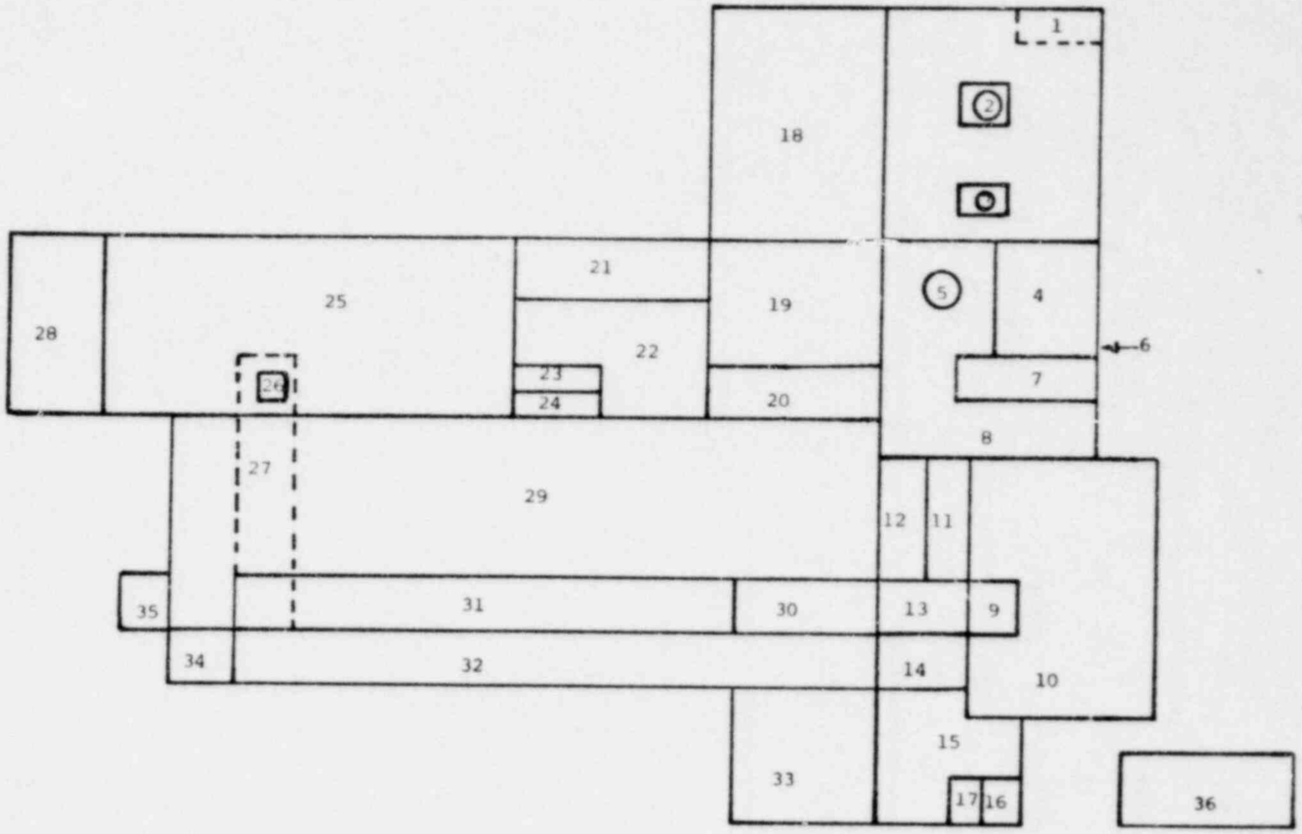

Figure H.5 Receiving and Assembly Building Layout.

Supply air to non-contaminated areas will be prefiltered and recirculated as feasible to minimize heating and cooling requirements. Heating and cooling of the receiving and assembly building are provided by steam and chilled-water circulating systems.

Two types of filters are used in the HVAC system. HEPA filters remove 99.97% of particulates 0.3 microns in diameter and larger. Each filter module has a face of 0.6 x 0. meter and can handle a flow rate of 28 cubic meters per minute of air. All HEPA filters a accessible for either remote or manual changeout.

Five centimeter-thick fiber glass pre-filters are provided upstream of the HEPA filters to extend the life of the HEPA filters.

The receiving and assembly building primary and secondary confinement zone exhaust fans are high-pressure industrial exhausters. Each fan is capable of exhausting air at approximately 425 cubic meters per minute and requires about a 60 hp motor. The secondary confinement fans exhaust approximately 1,100 cubic meters per minute each and require about 150 hp motors.

The heating and ventilating units are standard fan units with steam heating coils and insulated cabinets. The air conditioning units are standard cabinet fan units with steam heating coils, chilled-water cooling coils, and insulated cabinets.

2.3 RADIOACTIVE WASTES AND ASSOCIATED TREATMENT SYSTEMS

Each dry storage alternative will have the same radioactive waste treatment system for the portions of the facility that pertain to receiving and packaging operations.

The function of the waste treatment system is to collect, reduce as appropriate, and dispose of the radioactive waste resulting from the normal or abnormal operation of the dry storage facility in a manner such that all solid, liquid, and gaseous effluents meet the applicable Federal, NRC, DOE, state and local requirements.

It is expected that small quantities of low level radioactive waste will be accumulated during normal operations of the facility.

The waste treatment system converts contaminated solid and liquid waste to a form suitable for storage or disposal. Low-activity contamination could be encountered in the receiving area, receiving cell, weld and test cell, counting room and laboratory, warm maintenance areas, and other regulated zones of the facility. Chemical solutions used for decontamination in these areas are collected by sumps and floor drains and routed to the waste treatment system for processing. Shipping cask exteriors are washed in the receiving area and the interiors can be decontaminated once the fuel assemblies have been removed. Solid contaminated wastes such as smear test cloths, equipment parts, ion-exchange resin, tools, filters, trash, etc. are immobilized or compacted in the waste treatment system and removed to an existing waste storage facility outside the dry storage facility or to an approved commercial facility. An industrial standard hydraulically activated waste compacting system is provided to handle the low level solid waste materials. The contents are placed in 55-gallon drums (DOT-17C).

Figure H.6 is a schematic process flow diagram for the waste treatment system. All normal liquid process waste, including decontamination solutions, is collected in a 38,000-liter suspect waste tank. If mildly contaminated, the liquid is decontaminated by circulating it through an ion exchanger and then returned to the demineralized water storage tank, sent to cooling tower makeup, or sent to surface disposal.

If the suspect waste is highly contaminated, it is transferred by steam jet from the suspect waste tank to a 15,000-liter hot waste tank. Liquid wastes that are known to be highly contaminated can be sent directly to the waste tank. Highly contaminated liquid waste is solidified in the waste casting room.

Vessel vent systems are used to keep all tanks slightly below atmospheric pressure. The vented air passes through coolers and moisture eliminators and through HEPA filters before being discharged from the stack to the atmosphere.

The liquid wastes is concentrated to reduce volume through an evaporator at approximately 7.5 liters per minute. Distillate from the evaporator is discharged to surface disposal if uncontaminated. Any residual contamination is removed by means of a small ion-exchange unit. Concentrate is transferred to an underground 1,900-liter waste concentrate receiving tank near the waste casting room and held for processing in the waste casting system.

When processed, the highly contaminated liquid waste is mixed with cement in unshielded or shielded 55-gallon drums (DOT-17C), depending on radiation levels. The casting process can be achieved by any of the conventional packaging solidification systems commercially available. Major equipment items in the waste casting system, which handles approximately two drums per hour, include a cement hopper, cement fuel station, liquid waste fill station, a drum capper, a mixer, transfer and drum storage conveyors. The waste casting system is operated intermittently when sufficient liquid waste products accumulate to make a batch.

The waste treatment system is housed in an area of reinforced concrete construction approximately 150 square meters in size. Penetrations to the atmosphere are designed to resist the design basis tornado. The waste casting room will be located at ground level and will house the liquid waste casting equipment and the waste compactor. A basement area under the waste casting room houses the waste concentrator package, concentrator feed tank, and concentrate receiving tank.

Because of the high radiation levels possible and the potential for contamination, the area housing the waste casting system will be Category I. The remainder, including the storage areas for solidified wastes, will be Category II. Provisions will be made for remote operation of the system.

The suspect and waste tanks and gaseous waste system filters will be located in a Category I vault adjacent to the receiving and assembly building. The vault is shielded with a removable roof section for access.

The only source of radioactive wastes from the storing of the fuel assemblies comes from the air that is circulated through the storage media. All of the dry storage concepts except the caisson storage require the circulation of air as a cooling medium. The air for each of these options

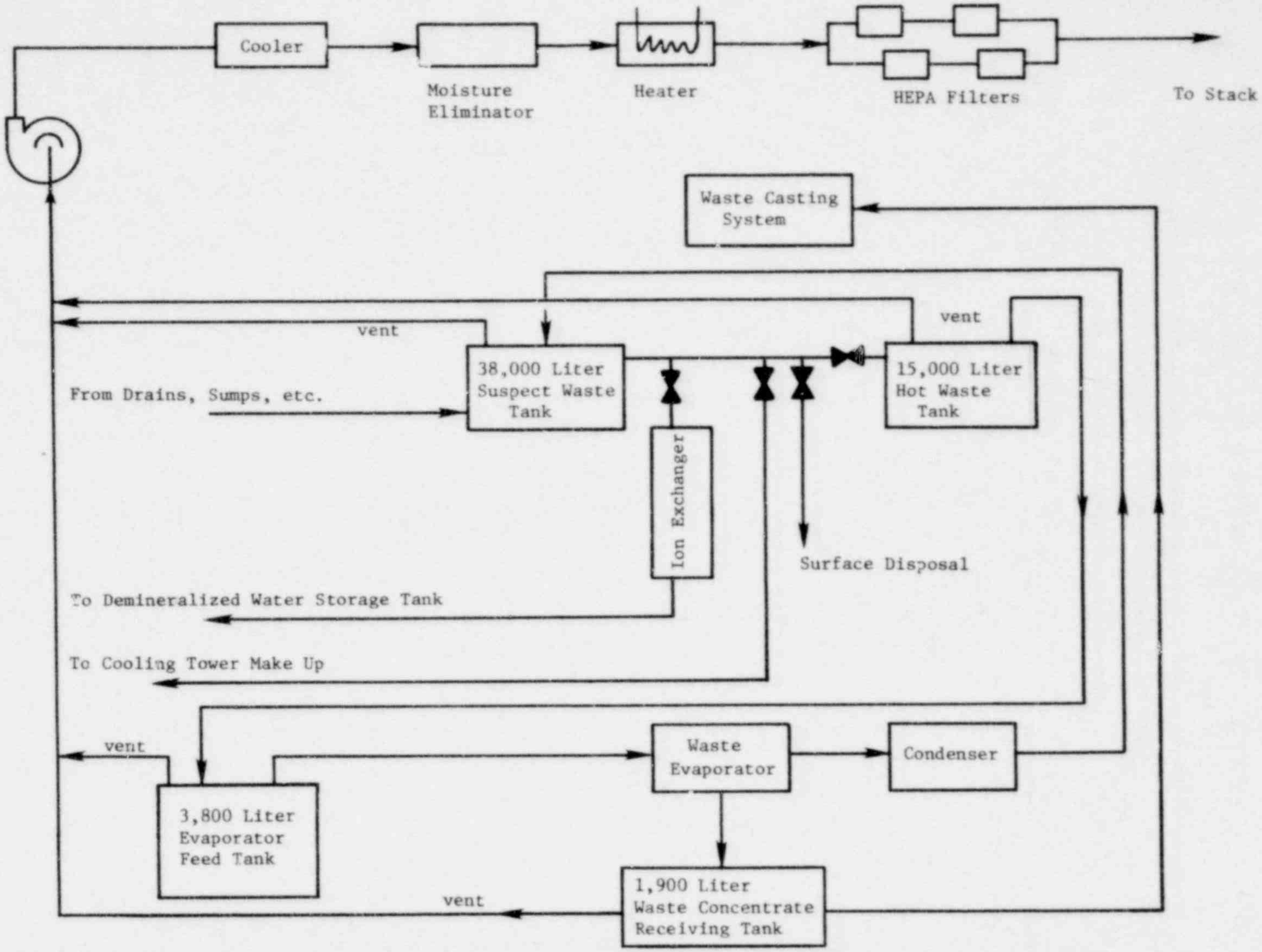

Fig. H.6. Radwaste Treatment System.

will be run through HEPA filters to remove any contamination which may occur during the natural circulation process.

The caisson storage mode generates no radioactive wastes.

3.0 CLADDING STABILITY DURING STORAGE OF SPENT FUEL

3.1 POOL STORAGE

Considerable data are available in the literature about the corrosive effects on Zircaloy and stainless steels when contacted with water.[1-6] The bulk of these data are reported for conditions occurring in operating light water reactors, that is, high temperature and high water pressure. However, extrapolation to spent fuel storage conditions of low temperature, low pressure, high purity water is considered reasonable.

Galvanic actions between Zircaloy and stainless steels and most other metals should be minimal. In addition, there is now a steadily accumulating body of favorable experience demonstrating the stability of spent fuel cladding.[7]

3.1.1 Corrosion

A small amount of the cladding that has been stored in pools is stainless steel and would be susceptible to attack by halide ions and caustic solutions if present in the water. These ions cause pitting, stress cracking, and intergranular corrosion. However, such attack is predominantly effective at temperatures well above those maintained in the pool water.

Most of the fuel that is currently being stored or will be stored in the future is clad with zirconium alloy. The corrosion resistance of zirconium is generally very good; however, the presence of halide ions in the water at high temperatures (above those maintained in the pool water) could cause stress corrosion cracking and accelerated uniform corrosion of zirconium alloy cladding. In the operation of a spent fuel storage pool, the water is cooled by circulation through a heat exchanger and maintained at high purity by circulation through ion-exchange columns. Purification is required to maintain water clarity for good visibility of the spent fuel, to remove any radioactive materials that may have been released from the fuel, as well as to prevent corrosion. Therefore, corrosion of spent fuel cladding due to water contaminents should not occur.

Water has been found to be corrosive at higher temperatures ($T > 260°C$). The rate constant for oxidation of zirconium at temperatures about 260°C appears to exhibit an Arrhenius type relationship.[1] The temperature of the water in the spent fuel pools, however, is controlled, usually to below 50°C and in any case below 65°C. However, temperatures may reach the boiling point for short times under postulated accident conditions. The extrapolation of the Arrhenius relationship down to normal operating temperature shows that the corrosive effects are negligible. This correlates with the experience observed in fuel stored for about 18 years. Zirconium shows excellent resistance to corrosion from strong acid solutions, so the presence of acid will cause no problem.

Based on the range of pool storage conditions, fuel-bundle materials and related corrosion mechanisms, an assessment was made of the anticipated corrosion of spent fuel cladding during 100 years of storage in a pool as follows:[8]

	Penetration	Percent of Clad
Zircaloy	0.3 to 0.5 µm	0.05 to 0.07
Stainless steel	< 1.5 µm	< 1
Aluminum	37 µm	---

This indicates that under pool storage conditions, the corrosion rate is expected to be very low. Corrosion is not expected to cause long term problems for storing spent fuel.

3.1.2 Electrolysis

Zirconium and stainless steel may be contacted in fuel pool storage when the assemblies are placed in racks. Also, aluminum may be present. The amount of information on the electrolysis of zirconium is limited, but since it usually assumes a noble potential, it should be relatively unaffected by galvanic coupling.[9-11] In other words, zirconium sits below both aluminum and stainless steel in the galvanic series, and if any long-term galvanic effects do take place, the zirconium would be cathodic or more noble and be protected.

The severity of galvanic corrosion depends not only on the difference in potential of the metals, but also upon the relative surface areas of each and the nature of the electrolyte. The exposed surface area of both zirconium and the stainless or aluminum will be relatively similar, with the stainless steel or aluminum (anodic) having the larger surface area. This arrangement would tend to minimize electrolysis. In addition, the electrolyte will be deionized water. This will help minimize any galvanic effects.

3.1.3 Experience

There has been a fair amount of experience gained from storage of irradiated LWR fuel in storage pools for times up to 18 years. Corrosion rates of both stainless steel and zirconium alloys have been extremely low during this time.

Pool storage of packaged fuel assemblies in 304L stainless steel has been practiced at the Receiving Basin for Offsite Fuels at the Savannah River Plant for over ten years. By maintaining the chloride concentration below 5 ppm, stress corrosion cracking has been avoided. Other corrosive effects have been found to be minimal.

The Navy currently stores spent fuel from naval reactors at the Idaho National Engineering Laboratory. Corrosion effects after five years of storage were found to be minimal, and no electrochemical effects were observed with chloride concentrations of up to 700 ppm in the water.

Fuel handling experience in the U.S., going back to 1959, has not revealed any instance where Zircaloy-clad uranium oxide fuel has undergone observable corrosion or other chemical degradation during pool storage. Stainless-clad experimental light-water reactor fuel has survived since about 1964 without visible degradation.[7,8] The favorable experience is corroborated by experience in other countries with the following maximum pool residence for Zircaloy-clad fuel as of late 1977: Canada--14 years; United Kingdom--11 years; Belgium (MOL)--10 years; Japan--9 years; Norway--9 years; Karlsruhe, Germany (WAK)--7 years; and Sweden--5 years.[8]

Data have been reported on the results of inspections of spent fuel that has been examined or returned to reactors after several years of pool residence for a number of different domestic and foreign nuclear plants. Times of spent fuel storage as high as 11 years and burnups as great as 33,000 MWD/MTU were experienced. (The highest burnup was not necessarily of fuel with the longest time of storage.) In no case was there any evidence of pool-induced corrosion or other degradation.[8]

Spent fuel with cladding defects has been stored, handled and reprocessed without substantial problems. Methods have been developed to deal with defective fuel, such as enclosure in canisters to isolate the fuel from the pool water or providing hoods over the fuel to conduct any released gases to the spent fuel pool building ventilation system. In the U.S. these measures are seldom needed, the large majority of fuel being stored on the same basis as intact cladding. An example is the GE Morris pool, where several hundred bundles having reactor-induced defects are stored uncanned. The pool purification system maintains radiation levels in the pool at about 4×10^{-4} Ci/ml, which is below the required limit for occupational usage.[8]

In an assessment made of the incidence of fuel damage during fuel handling accidents, nine fuel handling incidents were identified for the period 1974-1976. Of these, only two resulted in gas releases and only one registered any activity release.[7] An incomplete effort to update the survey failed to identify any additional accidents as of early 1978.[8]

3.1.4 Further Study

Corrosion effects that might occur after longer storage periods need to be examined in much greater detail so that effects such as accelerated corrosion, microstructural changes, or alterations in mechanical properties can be determined. Other areas of spent fuel storage that need further exploration are stress corrosion cracking, intergranular corrosion, and hydrogen absorption and precipitation by the zirconium alloys after long term storage. Both industry and NRC will continue to monitor storage experience. If unexpected long term material problems develop, there will be ample opportunity to take corrective action.

3.2 DRY STORAGE

Literature data are available about the corrosion effects on Zircaloy and stainless steels when in contact with an environment of air.[2-6] Experience has shown that stainless steel exhibits excellent resistance to corrosion. Zirconium will react somewhat with the constituents of air at higher temperatures; however, as the temperature in the air-cooled storage facility is controlled, no unusual corrosion is expected.

3.2.1 Corrosion

Several alternatives for the dry storage of spent LWR fuel require cooling by air. Air cooling of unpackaged spent fuel exposes stainless steel and Zircaloy-clad spent fuel elements to air temperatures in excess of 90°C but less than 315°C. Storage of austenitic stainless steel-clad fuel elements in air at these temperatures is no problem if the presence of contaminants such as halogens and heavy metals is minimized. This steel has been used for architectural purposes for over 30 years with no unusual corrosion. Type 304 stainless steel has sustained temperatures as high as 815°C with an oxidation rate of only 2×10^{-3} cm/yr.[2]

At room temperature, zirconium is extremely unreactive with the several gases present in air and will stay bright indefinitely. At elevated temperatures, zirconium reacts with oxygen and hydrogen, and at somewhat higher temperature it reacts with nitrogen.

Noticeable Zircaloy oxidation has been observed at temperatures above 50°C, but oxidation ceases when a thin layer of the reaction product covers the surface. Nevertheless, the stability of the surface oxide decreases with increasing temperature. The reaction of Zircaloy with oxygen at about 205°C has a rapid initial reaction; once a thin film is built up, it follows a parabolic growth rate. At 205°C the weight gain reaches an equilibrium value of 2 $\mu g/cm^2$ after two hours exposure to O_2. At 427°C the weight gain is 80 $\mu g/cm^2$ after two hours exposure.

Hydrogen reacts with Zircaloy at temperatures between 302°C and 399°C and is liberated at temperatures above 802°C.

Nitrogen reactions with Zircaloy occur at temperatures greater than 399°C, where 2 $\mu mg/cm^2$ additional weight has been measured after two hours of exposure to N_2.

At a temperature of 824°C, the weight gain due to a two-hour exposure to nitrogen is 80 $\mu g/cm^2$. Extrapolation of rates of oxidation of Zircaloy between 357°C and 499°C yields a wall thickness decay rate of 2.5×10^{-3} cm/yr at 100°C. A rate of 2.5×10^{-4} cm/yr was obtained on zirconium that was heated in air for 2800 hours at 205°C.[2]

Since the reaction products are soluble or partly soluble in the metal when zirconium is reacted with air, certain mechanical properties of the metal might conceivably change. There are, nonetheless, several factors which suggest that the zirconium does have good oxidation resistance during long term storage in an air environment. They are:

(1) High melting point (1,852°C)
(2) High melting point of oxide (2,677°C)
(3) Low volatility of oxide
(4) High degree of thermal stability of oxide
(5) Possible formation of continuous oxide film since the specific volume ratio of the oxide to metal is greater than one

Some of the unfavorable factors are:

(1) The metal reacts to form nitrides, hydrides, and carbides.
(2) The oxide is soluble at elevated temperatures in the metal.
(3) The oxide ZrO_2 undergoes crystal-structure transformations at high temperatures (above 1000°C)

3.2.2 Experience

Most air-cooled storage concepts are still in the planning stage; however, HTGR fuels are stored in closed but unsealed packages in below ground sealed canisters at the INEL facility near Idaho Falls.[12] Also, the Canadians have had some experience in air-storage of CANDU spent fuel.[13] Neither source has reported any significant corrosive effects on Zircaloy or stainless steels. Research on the development of dry storage for LWR spent fuel is also being conducted by the U.S. Department of Energy at its Nevada Test Site.[14]

Stainless steels have been a major constituent of the architectural and construction industry for over 30 years and are used in most building applications. They have proven to have excellent resistance to corrosion by air.

3.2.3 Further Study

Further study is needed to find if temperature control is necessary to prevent corrosion when long term air storage alternatives for spent LWR fuel are employed.

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APPENDIX I

SPENT FUEL STORAGE REQUIREMENTS FOR HIGHER PROJECTED NUCLEAR GENERATING CAPACITY

Appendix I addresses spent fuel storage requirements for a projected nuclear power generating capacity of 280 GWe in the year 2000. The staff believes that the lower projected capacity (230 GWe) used in Volume 1 is more reasonable, but the higher capacity projection provides a basis for analysis of the sensitivity of spent fuel generation and storage requirements to increases in projected nuclear power generating capacity.

Tables in this appendix are structured similar to those in Chapters 1, 2 and 3 of Volume 1 and are identified accordingly.*

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*The effects of recent reactor basin expansion applications for the Oconee Unit 1 & 2 basin, for the Big Rock Point basin, and for the Hatch 1 & 2 basins are not included in these tables. See Vol. 2, Appendix F, Table F.8, footnote b.

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Table I-1.1. Summary of Away-from-Reactor (AFR) Storage Requirements[a]

	Alternative 1		Alternative 2		Alternative 3	
	With FCR	Without FCR	With FCR	Without FCR	With FCR	Without FCR
Year requiring AFR storage	1979	1980	1982	1985	2000	> 2000
AFR requirements, 1985, MTHM	2,200	900	450	30	0	0
AFR requirements, 2000, MTHM	30,000	23,000	25,000	16,000	2,300	0

[a] 280 GWe, i.e., 280 GWe installed and 246 GWe discharging in year 2000.

Table I-1.2. Nuclear Generating Capacity Installed and Discharging Spent Fuel for Each Year, 1979-2000 (based on 280 GWe generating capacity installed in the year 2000)

Year	Capacity Installed, GWe	Capacity Discharging, GWe
1979	60	48
1980	71	48
1981	81	51
1982	91	60
1983	101	71
1984	111	81
1985	121	91
1986	131	101
1987	141	111
1988	151	121
1989	161	131
1990	171	141
1991	182	151
1992	193	161
1993	204	171
1994	215	182
1995	226	193
1996	236	204
1997	246	215
1998	258	226
1999	269	236
2000	280	246

Table I-2.1. Annual and Cumulated Schedules of Spent Fuel Discharge (based on 280 GWe generating capacity installed in the year 2000)

Year	GWe Capacity Discharging	Annual MTHM Spent Fuel Discharged[a]	Cumulated MTHM Spent Fuel Discharged[a]
1979	46	1420	
1980	48	1520	2,950
1981	51	1640	4,600
1982	60	1940	6,500
1983	71	2220	8,700
1984	81	2450	11,200
1985	91	2680	13,900
1986	101	2960	16,800
1987	111	3230	20,000
1988	121	3550	23,600
1989	131	3830	27,400
1990	141	4200	31,600
1991	151	4360	36,000
1992	161	4620	40,600
1993	171	4940	45,500
1994	182	5190	50,700
1995	193	5500	56,200
1996	204	5780	62,000
1997	215	6080	68,100
1998	226	6480	74,600
1999	236	6820	81,400
2000	246	6960	88,400

[a] Does not include ~ 4700 MTHM of spent fuel discharged prior to 1979 and stored AR and AFR at the end of 1978.

Table I-2.2. At-Reactor Storage Capacity, 280 GWe Installed in Year 2000, With and Without FCR

Year	Installed Capacity, GWe	Maximum Basin Storage Capacity, MTHM	
		Without FCR	With FCR
1979	60	27,720	22,740
1980	70	32,110	26,300
1981	80	35,180	28,750
1982	90	39,110	32,180
1983	100	42,610	35,230
1984	110	46,750	38,740
1985	120	50,690	42,310
1986	130	54,630	45,650
1987	140	58,560	49,590
1988	150	61,810	52,680
1989	160	65,570	55,760
1990	170	69,200	58,560
1991	181	73,040	62,150
1992	192	76,890	65,900
1993	203	80,900	69,130
1994	214	84,910	72,120
1995	225	88,930	75,110
1996	236	92,940	78,100
1997	247	96,950	81,090
1998	258	100,990	84,150
1999	269	104,890	87,200
2000	280	108,940	90,250

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Table I-3.1. Away-from-Reactor (AFR) Storage Requirements with No Transshipment, 280 GWe Installed in Year 2000, With and Without FCR

Year	Installed Generating Capacity,[a] GWe	Pool Capacity,[b] MTHM	Full Core Reserve, MTHM	Cumulated Discharges,[a] MTHM	AFR Capacity Required, MTHM	
					With FCR[b]	Without FCR[b]
1979	60	28,000	5,000	1,400	40	0
1980	70	32,000	5,800	2,900	140	10
1981	80	35,000	6,400	4,600	310	110
1982	90	39,000	6,900	6,500	520	240
1983	100	43,000	7,400	8,700	880	360
1984	110	47,000	8,000	11,000	460	550
1985	120	51,000	8,400	14,000	2,150	920
1986	130	55,000	9,000	17,000	2,940	1,400
1987	140	59,000	9,000	20,000	3,840	2,040
1988	150	62,000	9,100	24,000	4,670	2,710
1989	160	66,000	9,800	27,000	5,690	3,490
1990	170	69,000	10,600	32,000	6,780	4,330
1991	181	73,000	10,900	36,000	7,950	5,280
1992	192	77,000	11,000	41,000	9,390	6,310
1993	203	81,000	11,800	46,000	11,000	7,600
1994	214	85,000	12,800	51,000	12,800	8,970
1995	225	89,000	13,800	56,000	14,950	10,600
1996	236	93,000	14,800	62,000	17,400	12,500
1997	247	97,000	15,900	68,000	20,200	14,700
1998	258	101,000	16,800	75,000	23,300	17,300
1999	269	105,000	17,700	81,000	26,400	20,200
2000	280	109,000	18,700	88,000	29,800	23,200

[a] Does not include ~ 4700 MTHM in storage as of December 31, 1978, both AR and AFR.

[b] Includes ~ 4300 MTHM in AR storage as of December 31, 1978.

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Table I-3.2. Generating Capacity (GWe) Running out of Spent Fuel Storage Capacity Each Year, 1979 through 2000, with and without FCR
(based on 280 GWe generating capacity installed in the year 2000)

	GWe with FCR				GWe without FCR			
	Alternative 1		Alternative 2		Alternative 1		Alternative 2	
Year	Cumulated	Each Year	Cumulated	Each Year	Cumulated	Each Year	Cumulated	Each Year
1979	3	3	0		0	0	0	
1980	4	1	0		3	3	0	
1981	6	2	0		4	1	0	
1982	7	1	2	2	4	0	0	
1983	14	7	6	4	4	0	0	
1984	19	5	8	2	9	5	0	
1985	21	2	10	2	12	3	2	2
1986	24	3	13	3	17	5	3	1
1987	26	2	16	3	19	2	4	1
1988	28	2	14	-2[a]	21	2	10	6
1989	30	2	15	1	24	3	12	7
1990	32	2	17	2	25	1	11	-1[a]
1991	39	7	25	8	29	4	12	1
1992	41	2	30	5	30	1	12	0
1993	50	9	36	6	37	7	26	14
1994	55	5	53	17	42	5	34	12
1995	66	11	55	2	50	8	36	2
1996	82	16	74	19	61	11	51	15
1997	92	10	88	14	69	8	70	19
1998	97	5	126	38	83	14	82	12
1999	103	6	140	14	91	8	106	24
2000	112	9	160	20	100	9	131	25

[a] Because of additional storage space becoming available, reactors that had been out of storage space are able to resume operation, resulting in a negative number.

Table I-3.3. Cumulated Increase in Storage Capacity in Years 1993-2000 from Unnamed, Unsited Reactors
(based on 280 GWe generating capacity installed in year 2000)

	Number of Plants		Cumulated Increase in Storage Capacity (MTHM)	
Year	BWR	PWR	With FCR	Without FCR
1993	3	4	2,400	3,200
1994	3	6	5,300	7,200
1995	3	6	8,300	11,000
1996	3	6	11,000	15,000
1997	3	6	14,000	19,000
1998	3	6	17,000	23,000
1999	3	6	20,000	27,000
2000	3	6	23,000	31,000

Table I-3.4. Fuel Usage Summary Report for 280 GWe Capacity with Full Core Reserve (MTHM)

Year	Annual Discharges	Cumulated Discharges (3)	Alt. 1 AFR Req., No Transshipment (2,4,5,6,9)	Alt. 2 AFR Req., Intrautility Transshipment (4,5,6,7,8)	Alt. 3 Storage Reserve, Unlimited Transshipment (1,4,5,6)	Gigawatts Discharging (10)
1979	1420	1,420	-40		17,000	46
1980	1520	2,940	-140		19,000	48
1981	1640	4,580	-310		20,000	51
1982	1930	6,520	-520	-30	21,000	60
1983	2210	8,730	-880	-70	22,000	71
1984	2440	11,180	-1,500	-320	23,000	81
1985	2670	13,860	-2,200	-450	24,000	91
1986	2950	16,810	-2,900	-760	25,000	101
1987	3220	20,040	-3,800	-1,300	25,000	111
1988	3540	23,590	-4,700	-1,400	25,000	121
1989	3830	27,420	-5,700	-1,800	24,000	131
1990	4190	31,620	-6,800	-2,300	23,000	141
1991	4360	35,980	-8,000	-3,000	22,000	151
1992	4620	40,610	-9,400	-3,800	21,000	161
1993	4930	45,540	-11,000	-4,900	19,000	171
1994	5180	50,730	-13,000	-6,300	17,000	182
1995	5490	56,230	-15,000	-8,100	15,000	193
1996	5780	62,010	-17,000	-10,000	12,000	204
1997	6070	68,090	-20,000	-13,000	8,800	215
1998	6480	74,570	-23,000	-16,000	5,300(11)	226
1999	6820	81,400	-26,000	-20,000	1,600	236
2000	6950	88,360	-30,000	-25,000	-2,400	246

1 Assumes all spent fuel storage space would be available to any reactor requiring it.

2 Assumes reactors requiring storage could use only that space available at that reactor or at its site.

3 Does not include ∼ 4700 MT in storage, both AR and AFR at end of December 1978.

4 Includes ∼ 4700 MT in storage at end of December 1978.

5 Negative numbers mean AFR storage required. Positive or no number means no AFR storage required.

6 For sites with multiple reactors, spent fuel storage from installation of the second or additional reactors is not made available until fuel loading date has occurred.

7 Assumes all reactors within a given utility system can be used to store spent fuel from any reactor within that same utility system.

8 Includes only those reactors presently operating, planned, or under construction.

9 Reference case.

10 Corresponding installed GWe are 280 in year 2000.

11 Includes effect of additional storage from unnamed and unsited reactors.

Table I-3.5. Fuel Usage Summary Report for 280 GWe Capacity without Full Core Reserve (MTHM)

Year	Annual Discharges	Cumulated Discharges (3)	Alt. 1 AFR Req., No Transshipment (2,4,5,6,9)	Alt. 2 AFR Req., Intrautility Transshipment (4,5,6,7,8)	Alt. 3 Storage Reserve Unlimited Transshipment (1,4,5,6)	Gigawatts Discharging (10)
1979	1420	1,420			22,000	46
1980	1520	2,940	-10		25,000	48
1981	1640	4,580	-110		26,000	51
1982	1930	6,520	-240		28,000	60
1983	2210	8,730	-360		30,000	71
1984	2440	11,180	-550		31,000	81
1985	2670	13,860	-920	-30	33,000	91
1986	2950	16,810	-1,400	-130	34,000	101
1987	3220	20,040	-2,000	-260	34,000	111
1988	3540	23,590	-2,700	-440	34,000	121
1989	3830	27,420	-3,500	-800	34,000	131
1990	4190	31,620	-4,300	-1,100	33,000	141
1991	4360	35,980	-5,300	-1,500	33,000	151
1992	4620	40,610	-6,300	-2,000	32,000	161
1993	4930	45,540	-7,600	-2,600	31,000	171
1994	5180	50,730	-9,000	-3,500	30,000	182
1995	5490	56,230	-11,000	-4,700	28,000	193
1996	5780	62,010	-13,000	-6,200	27,000	204
1997	6070	68,090	-15,000	-8,000	25,000	215
1998	6480	74,570	-17,000	-10,000	22,000(11)	226
1999	6820	81,400	-20,000	-13,000	19,000	236
2000	6950	88,360	-23,000	-17,000	16,000	246

1 Assumes all spent fuel storage space would be available to any reactor requiring it.

2 Assumes reactors requiring storage could use only that space available at that reactor or at its site.

3 Does not include ~ 4700 MT in storage, both AR and AFR at end of December 1978.

4 Includes ~ 4700 MT in storage at end of December 1978.

5 Negative numbers mean AFR storage required. Positive or no number means no AFR storage required.

6 For sites with multiple reactors, spent fuel storage from installation of the second or additional reactors is not made available until fuel loading date has occurred.

7 Assumes all reactors within a given utility system can be used to store spent fuel from any reactor within that same utility system.

8 Includes only those reactors presently operating, planned, or under construction.

9 Reference case.

10 Corresponding installed GWe are 280 in year 2000.

11 Includes effect of additional storage from unnamed and unsited reactors.

APPENDIX J

PHYSICAL PROTECTION REQUIREMENTS AND HYPOTHETICAL SABOTAGE EVENTS IN A SPENT FUEL STORAGE FACILITY

1.0 PHYSICAL PROTECTION REQUIREMENTS

1.1 Legal Basis

NRC responsibility for nuclear security derives from the Atomic Energy Act of 1954, as amended and from the Energy Reorganization Act of 1974, which provides that "all licensing and related regulatory functions" of the Atomic Energy Commission be transferred to the NRC. The Atomic Energy Act explicitly authorized the AEC to set standards and impose regulatory controls over nuclear materials in order to "promote the common defense and security or to protect health or to minimize danger to life or property."

The essentials of the safeguards system formulated by the AEC and now implemented by the NRC are found in regulatory requirements. Supplementary information appears in various Regulatory Guides issued to assist applicants in complying with these regulations.

1.2 Summary of Safeguards Requirements for Irradiated Reactor Fuel at Fixed Sites

A physical protection plan must be submitted by each license applicant to the NRC for approval, based on compliance with the features listed below.

Physical Security Organization. The licensee must maintain a physical security organization, including armed guards, to protect his facility against industrial sabotage. At least one supervisor of the security organization must be onsite at all times. The licensee must establish, maintain, and follow written security procedures which document the structure of the security organization and which detail the duties of guards, watchmen, and other individuals responsible for security. All guards or watchmen must be properly trained, equipped, qualified, and requalified at least annually.

Physical Barriers. All "vital equipment", which is defined as any equipment, system, device, or material whose failure, destruction, or release could directly or indirectly endanger public health and safety, must be located within a separate structure or barrier designated as a "vital area". All vital areas must be located within a large protected area which is surrounded by a physical barrier. An isolation zone is required around the outer physical barrier and it must be kept clear of obstructions, illuminated, and monitored to detect the presence of individuals or vehicles attempting to gain entry to the protected area and to allow response by armed members of the facility security organization to suspicious activity or to the breaching of any physical barrier.

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Access Controls. Personnel and vehicle access into a protected or vital area must be controlled. A picture badge identification system must be used and visitors must be registered and escorted. Individuals and packages entering the protected area are required to be searched. Admittance to a vital area must be controlled and access limited to persons who require such access to perform their duties. Keys, locks, combinations, and related equipment are required to be controlled to minimize the possibility of compromise.

Intrusion Alarms. All emergency exits in the protected area and vital areas must be alarmed. Each unoccupied vital area must be locked and alarmed. All alarms must annunciate in a continuously manned central alarm station located within the protected area and in at least one other continuously manned station. All alarms must be self-checking and tamper-indicating and inspected and tested for operability and required functional performance at specified intervals not to exceed seven days.

Communications. Each guard or watchman on duty must be capable of maintaining continuous communications with an individual in a continuously manned central alarm station within the protected area and who must be capable of calling for assistance from other guards and from local law enforcement authorities. To provide the capability of continuous communication with local law enforcement authorities, two-way radio voice communication must be available in addition to conventional telephone service. All communications equipment must remain operable from independent power sources in the event of loss of primary power, and must be tested for operability and performance at least once at the beginning of each security personnel work shift.

Response Capability. Licensees must establish liaison with local law enforcement authorities and be prepared to take immediate action to neutralize threats to the facility. Such action may mean appropriate direct action on the part of the licensee, a call by the licensee for assistance from local law enforcement authorities, or both.

Records. Security records must be maintained of all individuals authorized access to vital and material access areas, including visitors, vendors, and others not employed by the licensee. Routine security tours, and all of the tests, inspections, and maintenance on security-related equipment and structures must be documented. A record must be maintained on each alarm, false alarm, alarm check, intrusion indication, or other security incident, to include the details of response by facility guards.

Reports to NRC. Attempts or acts of industrial sabotage must be reported immediately to NRC, followed by a written detailed report within 15 days.

2.0 HYPOTHETICAL SABOTAGE EVENTS IN A SPENT FUEL STORAGE FACILITY

2.1 Introduction

The NRC staff is unable to determine the quantitative likelihood of a hypothetical malevolent act being successfully performed by an adversary group. Instead, a group of selected reference events have been assumed to occur in order to establish a range of potential effects that might be caused by deliberate acts. The consequences corresponding to these reference events were calculated on a per-fuel-element basis, thus allowing the results to be extrapolated to possibly include massive destructive acts and thereby develop an upper bound on estimates of potential consequences, regardless of the plausability of the attempted acts. During the course of the analyses conducted to date,[1,2] calculations were made for single-assembly releases and for releases involving the maximum number of assemblies that may be accessible in any one area of the facility. When an intermediate number of assemblies is involved, estimates of the number of assemblies potentially affected were based upon feasibility arguments related to physical constraints imposed by the initiating event (e.g., the amount of explosives that can be inserted between adjacent assemblies).

The facility design used in the following event descriptions is based upon a fuel receiving and storage facility currently in the planning stage that encompasses a conventional basin storage pool, identical to those presently in use, but also involves an in-air cask unloading concept. Although existing ISFSI designs utilize underwater cask unloading schemes, the events postulated to occur in the cask-unloading cell (CUC) may be applicable to analogous sabotage events involving the removal and in-air damage of fuel assemblies during the cask receiving and washdown processes conducted prior to underwater unloading.

2.2 Damage to Fuel Assemblies in the Cask-Unloading Cell

Three scenarios postulated for this event are detailed below.

Mode 1. This mode assumes that between 1 and 20 fuel assemblies undergo extensive damage by mechanical means in the air space of the cask-unloading cell (CUC). Fuel rod claddings in up to 20 assemblies are broken. The ventilation air flow through the CUC remains at the normal air exchange rate of the postulated facility, namely six volumes per hour. The exhaust flow passes through the final filter system (four parallel banks of a roughing filter backed up by two HEPA filters in series) and is then discharged from the 50-meter-high facility stack.

While an adversary may use the crane in the low-level waste processing cell to remove one of the hatches to gain entry to the CUC in order to place explosive charges in such position as to damage several fuel assemblies, the high radiation levels in the CUC due to the spent fuel make it more plausible that the assemblies would be damaged from outside, using the remote crane and manipulators in the CUC from the adjacent CUC control room. In either case, however, it is postulated that the upper limit to the number of assemblies which may be damaged in the CUC is the contents of two casks (20 PWR assemblies) which may be open and partially unloaded at the time that the adversary action commences.

In order to maintain the ventilation flow, it is postulated that the adversaries commandeer the central control room and hold it for a period of approximately one-half hour in order to prevent the ventilation fans from being turned off.

Mode 2. This mode is identical to that of Mode 1 with the exception that the final filters are assumed to be damaged such that they are completely ineffective, the ventilation fans remaining operational. Thus, in addition to the sequence of events postulated under Mode 1, it is assumed that an adversary enters the ventilation building in order to remove or rupture the HEPA filters.

Mode 3. This mode is identical to that of Mode 1 with the exception that the air flow leaving the CUC is assumed to discharge directly to the atmosphere unfiltered at ground level. This may be accomplished by the breaching of the facility stack at its base along with the removal or rupture of the HEPA filters in the ventilation building; or by reversing the ventilation fans to create a positive pressure inside the CUC and penetrating an outside wall of the CUC to allow the escape of contaminants. The penetration of two opposing walls of the CUC is not considered a credible event within the design constraints of the postulated facility, thus making a natural ventilation release similar to that described for Mode 3 of the spent fuel storage pool event (see below) impossible.

2.3 Mechanical Damage to Fuel Assemblies in the Spent Fuel Storage Pool

Four scenarios postulated for this event are detailed below.

Mode 1. In this mode, between 1 and 1000 assemblies undergo extensive damage by high-explosive charges underwater in the spent fuel storage pool (SFSP). All fuel rod claddings in the assemblies are broken and contained gases are released to the pool water, whereupon they bubble to the surface and release to the building volume. The entire process occurs at ambient pool water temperature. The ventilation air flow through the building space above the pool is maintained at the normal exchange rate of six volumes per hour. The exhaust flow passes through the final filter system (four parallel banks of a roughing filter backed up by two HEPA filters in series) and is then discharged from the 50-meter-high facility stack. In order to maintain the ventilation flow, it is postulated that the adversaries commandeer the central control room and hold it for a period of approximately one-half hour in order to prevent the ventilation fans from being turned off.

It is postulated that all of the fuel rods of the affected assemblies suffer cladding rupture as a result of mechanical damage to the assemblies inflicted by high-explosive charges placed within the baskets. The number of assemblies which may be thus damaged depends upon the quantity of explosive which is introduced into the pool. It was determined analytically that only those assemblies directly adjacent to the explosive may be breached by a well-placed explosive charge. The minimum size of the explosive charge required to damage all four adjacent assemblies limits to three the number of such charges which may be carried by a single adversary. Thus, for example, if the adversary force has two persons carrying explosives into the SFSP area, the maximum number of assemblies which may be damaged is 24. The staff considers 1000 assemblies being extensively damaged as a worst-case bounding estimate used to ascertain the order of magnitude of potential consequences under extreme circumstances (affecting all assemblies of a 500-MTU-capacity pool).

Mode 2. This mode is identical to that of Mode 1 with the exception that the final filters are assumed to be damaged such that they are completely ineffective, the ventilation fans remaining operational. Thus, in addition to the sequence of events postulated under Mode 1 it is assumed that an adversary enters the ventilation building in order to remove or rupture the HEPA filters.

Mode 3. This mode is the same as for Mode 1 with respect to the events which take place within the SFSP area and the amount of radioactivity which is thus released to the building air. However, it is assumed that the normal ventilation system is completely disabled, and that openings are created in opposite walls of the SFSP building such that prevailing winds can effectively flush the contaminated air from the buildings at ground level without filtration. This assumes that the adversaries enter the central control room or ventilation building in order to turn off or otherwise disable the ventilation fans, and that they breach two opposite walls in the SFSP building using explosives or other means.

Mode 4. This scenario is identical to that of Mode 1 with respect to the air release of radionuclides. This scenario also assumes that the adversaries use an additional explosive charge or other mechanical means to breach the 3/16-in steel pool liner and 5-ft concrete floor so that contaminated pool water may leak into the ground. Leaching of radionuclides from the exposed fuel by the pool water, together with the portion of the gap activity that is dissolved in the water, forms a radionuclide source which is released to the underlying soil via the water leak.

References

1. "Adversary Actions in the Nuclear Power Fuel Cycle: Events at a Spent Fuel Receiving and Storage Facility (Interim Report)," Science Applications, Inc., Schaumburg, IL, May 1978. Available from National Technical Information Service (NTIS), Springfield, Virginia 22161.

2. "Generic Safeguards EIS Format (Part I: Independent Spent Fuel Storage Facility" (Draft), Argonne National Laboratory, Argonne, IL, August 1978. Available upon request from Director, Division of Technical Information and Document Control, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

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The Generic Environmental Impact Statement on spent fuel storage was prepared by the Nuclear Regulatory Commission staff in response to a directive from the Commissioners published in the Federal Register, September 16, 1975 (40 FR 42801). The Commission directed the staff to analyze alternatives for the handling and storage of spent light water power reactor fuel with particular emphasis on developing long range policy. Accordingly, the scope of this statement examines alternative methods of spent fuel storage as well as the possible restriction or termination of the generation of spent fuel through nuclear power plant shutdown.

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