U.S. NUCLEAR REGULATORY COMMISSION

OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS

ENVIRONMENTAL ASSESSMENT RELATED TO THE CONSTRUCTION AND OPERATION OF THE SURRY DRY CASK INDEPENDENT SPENT FUEL STORAGE INSTALLATION

DOCKET NO. 72-2

VIRGINIA POWER

MARCH 1985

ENVIRONMENTAL ASSESSMENT
FOR
SURRY DRY CASK ISFSI

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ENVIRONMENTAL ASSESSMENT
RELATED TO THE PROPOSED CONSTRUCTION AND OPERATION
OF THE SURRY DRY CASK INDEPENDENT
SPENT FUEL STORAGE INSTALLATION

1.0 INTRODUCTION

1.1 DESCRIPTION OF PROPOSED ACTION

By letter dated October 8, 1982, Virginia Power* (the Applicant) submitted an application[1] for a license to construct and operate a Dry Cask Independent Spent Fuel Storage Installation (ISFSI) to be located on the Surry Power Station site in Surry County, Virginia. The function of the Dry Cask ISFSI is to provide interim storage of spent fuel from Surry Units 1 and 2. Loading and initial preparations of the casks will take place within the Surry Power Station fuel handling building. The casks will be stored on concrete slabs constructed on site.

The Surry ISFSI is designed to operate through the operating life of Units 1 and 2, i.e. to the years 2007 and 2008, respectively. However, the duration of licenses issued under 10 CFR Part 72 is limited to 20 years; thus, the application is for 20 years from the date of issuance. The applicant expects to request renewal of the Dry Cask ISFSI license, if necessary, prior to its expiration.

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* At the date of application, the company's name was Virginia Electric and Power Company (VEPCO).

This Environmental Assessment addresses the potential environmental impacts associated with the proposed construction and operation of the Dry Cask ISFSI on the Surry Power Station Site.

1.2 BACKGROUND INFORMATION

The Surry Power Station Units 1 and 2 (Dockets 50-280 and 50-281) were licensed to operate in May 1972 and January 1973, respectively. Commercial operation began in December 1972 for Unit 1 and in May 1973 for Unit 2.

Until about 1975, it was planned in general that spent fuel from nuclear powered reactors would be stored in the spent fuel pool at the reactor site where generated for an interim period. After the interim storage, it was anticipated that spent fuel would be transported to a reprocessing plant for recovery and recycling of the fuel. Reactor facilities, including Surry, which were designed and constructed prior to 1975 provided less capacity for spent fuel storage on site than required for life-of-plant.

Commercial reprocessing of spent fuel has not developed as had been originally anticipated. In 1975 the Nuclear Regulatory Commission directed the staff to prepare a generic environmental impact statement on spent fuel storage. 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. The Statement was to consider 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.

A Final Generic Environmental Impact Statement on Handling and Storage of Spent Light Water Power Reactor Fuel (the FGEIS)[2] was issued by the NRC in August 1979. In the FGEIS, consistent with long range policy, the storage of spent fuel is considered to be interim storage to be used until the issue of permanent disposal is resolved and implemented.

Options for interim storage considered in detail in the FGEIS include (1) on-site spent fuel pool capacity expansion, (2) spent fuel storage capacity expansion at reprocessing plants, (3) independent spent fuel storage facilities, (4) transshipment of spent fuel between reactors and (5) reactor shut-downs to terminate or reduce the total amount of spent fuel generated. Of these options, 111 onsite spent fuel pool capacity expansions through reracking modifications have been reviewed and approved by the NRC since issuance of the FGEIS. As discussed in Section 3.0 of this Environmental Assessment, further increase in fuel pool capacity at Surry is not a viable alternative. The option of transshipment of a portion of the generated spent fuel from Surry to the applicant's North Anna Station is being considered in a separate licensing action.

The applicant is participating in a demonstration program with the Department of Energy (DOE) which involves shipment of spent fuel (up to 4 casks of capacity) to DOE's Idaho National Engineering Laboratory (INEL). The first demonstration cask, which is the CASTOR V/21 model, is at INEL awaiting the expected delivery of Surry spent fuel in the latter half of 1985. The second demonstration cask (a Westinghouse Model MC-10) is expected to be delivered to INEL in 1986 and the third and fourth casks have an uncertain delivery

schedule at this time. Spent fuel storage under this program is not considered as an alternative to the proposed action since the program is a demonstration only and involves limited storage of a small amount of spent fuel (about 60 metric tons). Participation in the demonstration does nothing to alter the applicant's need as detailed in Section 2.0.

The FGEIS concluded that the independent spent fuel storage installations represented the major means of away-from-reactor interim storage and that a standard design of an ISFSI to be situated at a reactor site had been submitted to and reviewed by the NRC. The FGEIS supports findings that (1) the storage of LWR spent fuels in water pools, whether at the reactor or away from reactor sites has an insignificant impact on the environment, and (2) the use of alternative dry passive storage techniques for aged fuel appears to be equally feasible and environmentally acceptable.[3] The environmental aspects of the dry storage option have not been addressed generically in the FGEIS and like the fuel pool expansion option would need to be considered on a site-specific basis. This assessment addresses the site-specific environmental aspects related to the Dry Cask ISFSI at the Surry site.

A comparison of the impact-costs of various alternatives reflects the advantage of continued generation of nuclear power versus its replacement by coal fired power generation. In the bounding case considered in the FGEIS, that of shutting down the reactor when the existing spent fuel storage capacity is filled, the cost of replacing nuclear stations before the end of their normal lifetime makes this alternative uneconomical.

1.3 PREVIOUS ENVIRONMENTAL ASSESSMENTS AND SUPPORTING DOCUMENTS

Several previous assessments have been conducted which are specific to the Surry site. A Final Environmental Statement (FES) was prepared for each of the Surry Units 1 and 2; the Unit 1 FES[4] was issued in May 1972 and the Unit 2 FES[5] in June 1972.

An application for a construction permit for two additional units to be located at the Surry site was filed in April 1973. An FES[6] related to this proposed construction of Surry Units 3 and 4 was issued in May 1974. Subsequent to the issuance of a construction permit in Feburary 1975, the applicant cancelled plans to construct the two additional units.

This environmental assessment is tiered on the previously issued FESs for the Surry reactor units and the Final Generic Environmental Impact Statement (NUREG-0575), noted in Section 1.2 above. Additional environmental information, used in this assessment, is provided in the applicant's Surry ISFSI Environmental Report (ER)[7] and Safety Analysis Report (SAR)[8] and supplemental responses (references 9 through 17) to the NRC staff's questions[18,19,20] on the Surry ISFSI ER and SAR.

1.4 STATUS OF ENVIRONMENTAL APPROVALS

The applicant will require a Conditional Use Permit from the Surry County Board of Supervisors to proceed with construction of the Surry ISFSI. All existing requirements of Federal (other than NRC requirements, specific to this applica-

tion), state and local permits, licenses or other forms of approval issued for Surry Units 1 and 2 will encompass operation of the Surry ISFSI since the installation is located on-site.

We have identified no other environmental approvals required for the proposed action and are unaware of any potential licensing difficulties related to environmental protection matters.

2.0 NEED FOR PROPOSED ACTION

Surry Units 1 and 2 are Westinghouse pressurized water reactors (PWRs) with 157 fuel assemblies per unit[8]. The spent fuel pool at Surry has a capacity of 1044 fuel assemblies[8]. After off-loading spent fuel in March 1985, space for 159 assemblies, or two more than full core reserve capability will remain in the spent fuel pool[21]. Although maintenance of full core reserve capacity is not a safety matter, many power plant owners consider maintenance of this capacity desirable for operational flexibility[2]. According to the FGEIS, experience has shown that the capacity for fully unloading a reactor has been useful in making modifications and repairs to reactor structural components and for periodic reactor vessel inspections[2]. The spent fuel storage capacity of the spent fuel pool at Surry has been expanded; additional expansion of the spent fuel pool is not viable as discussed, along with other alternatives, in Section 3.0. The applicant's need is to provide spent fuel storage to avoid shutdowns before the end of the useful life of the Surry Power Station. The Dry Cask ISFSI is one of four methods which could provide additional interim storage capacity. The applicant's preferred alternative is the proposed Dry Cask ISFSI[17].

Assuming all approvals are obtained and the installation is completed on a one year construction schedule, the movement of spent fuel from the pool to the Surry ISFSI can be initiated without the loss of full core reserve capability at the subsequent spent fuel off-loading. The proposed dry cask ISFSI is designed to store all of the anticipated spent fuel resulting from Surry Units 1 and 2 operation in excess of the present design capacity of the spent fuel pool.

3.0 ALTERNATIVES

The following sections present alternatives to the proposed action. The alternatives were considered against the need for the proposed action discussed in Section 2.0. For likely alternatives, impacts are addressed.

1. Ship spent fuel to a permanent federal repository.
2. Ship spent fuel to North Anna.
3. Increase the storage capacity of the existing spent fuel pool.
4. Construct a new independent spent fuel storage pool at the Surry site.
5. Ship spent fuel to a reprocessing facility.
6. Ship spent fuel to a Federal Interim Storage (FIS) facility.
7. Improve fuel usage.
8. Operate Surry Power Station at reduced power.
9. Ship spent fuel to other utility companies' reactors for storage.
10. Construct an ISFSI at a site away from the Surry Power Station.
11. No action.

3.1 SHIP SPENT FUEL TO A PERMANENT FEDERAL REPOSITORY

This alternative would be Virginia Power's preferred alternative. The Department of Energy (DOE) is developing a repository under the Nuclear Waste Policy Act of 1982, (NWPA), but is not likely to be ready to receive spent fuel before 1998. Therefore this alternative does not meet the near-term storage needs of Virginia Power.

3.2 SHIP SPENT FUEL TO NORTH ANNA

Virginia Power, under a separate licensing action, has applied for an amendment to the North Anna Power Station operating license to transship up to 500 spent fuel assemblies from its Surry Power Station to its North Anna Power Station for storage in the spent fuel pool there. This alternative is being reviewed in parallel with the Surry ISFSI application and, if approved, would provide additional storage of spent fuel from the Surry Power Station until the early 1990's.

The environmental impact of Virginia Power's application for increasing spent fuel storage at North Anna Units 1 and 2 and the transshipment and receipt of Surry 1 and 2 spent fuel at North Anna has been separately assessed by the NRC. The action was found to have no significant impacts.[22]

Subsequent to the application, Virginia Power entered into a agreement with Louisa County, Virginia, to limit the number of assemblies transshipped to 130.[23] This amount would only provide Virginia Power a few years additional storage, then more capacity would be required.

Presently, the North Anna licensing action is in litigation before an Atomic Safety and Licensing Board (ASLB). Because of this, there exists some uncertainty about the availability and timely implementation of this alternative. However, if approved, this alternative would only provide a short-term solution to the storage problem at the Surry Power Station and therefore does not meet Virginia Power's extended spent fuel storage needs.

3.3 INCREASE THE STORAGE CAPACITY OF THE EXISTING SPENT FUEL POOL

In order to provide increased spent fuel storage capability, many utilities are altering the racks that hold the spent fuel assemblies in the spent fuel storage pools. When using this procedure, the structural framework of the spent fuel storage pools must be able to withstand the additional stresses caused by the increase in weight of the spent fuel to be stored. The applicant has already increased the original capacity of the Surry spent fuel pool and has determined that if any significant additional increase in storage capacity were made to the Surry spent fuel pool the structural design safety criteria would be exceeded. The applicant has determined that it cannot store more spent fuel than the present licensed capacity at the Surry Power Station spent fuel storage pool.[7]

3.4 *CONSTRUCT A NEW INDEPENDENT SPENT FUEL STORAGE POOL AT THE SURRY SITE*

Additional storage capacity could be achieved by building a new spent fuel storage pool similar to that existing at the Surry Power Station. The NRC has generically assessed the impacts of this alternative and found that "the storage of LWR spent fuels in water pools has an insignificant impact on the environment."[2] However, it does not appear that a new storage pool and the equipment for transfer could be designed, licensed and constructed in time to meet Virginia Power's immediate need.

3.5 SHIP SPENT FUEL TO A REPROCESSING FACILITY

Reprocessing of the Surry Power Station spent fuel is not viable because there is no operating commercial reprocessing facility in the United States, nor is there the prospect for one in the foreseeable future.

3.6 SHIP SPENT FUEL TO A FEDERAL INTERIM STORAGE (FIS) FACILITY

Under the Nuclear Waste Policy Act of 1982 (NWPA) the federal government has the responsibility to provide not more than 1900 metric tons capacity for the interim storage of spent fuel. The impacts of storing spent fuel at a FIS facility fall within those already assessed by the NRC in NUREG-0575.[2] In passing the NWPA, Congress found that the owners and operators of nuclear power stations have the primary responsibility for providing interim storage of spent nuclear fuel. In accordance with the NWPA and 10 CFR Part 53, shipping spent fuel to a FIS facility is considered a last resort alternative. Therefore, while Virginia Power pursues its own licenseable alternatives that can be reasonably provided in a timely manner, this alternative is not considered pertinent.

3.7 IMPROVE FUEL USAGE

Under this alternative fuel assemblies would be used in the reactor longer thereby reducing the amount of spent fuel generated. Virgnia Power is presently participating in a DOE program to extend the burnup of fuel

assemblies at its North Anna and Surry Power Stations. While this alternative may reduce the ultimate amount stored and lengthen the time when increments of increased storage capacity will be needed, it does not eliminate the need for increased storage capacity and is therefore not viable.

3.8 OPERATE SURRY POWER STATION AT REDUCED POWER

Operating the Surry reactors at reduced power levels would extend the life of the fuel and thereby reduce the amount of spent fuel generated. This alternative, like improving fuel usage, merely postpones the time when additional capacity is required and the amount needed. Also, operating at reduced power would not make effective use of available resources, thus causing economic penalties. Therefore, this alternative is not considered viable.

3.9 SHIP SPENT FUEL TO OTHER UTILITY COMPANIES' REACTORS FOR STORAGE

In 1979, Virginia Power explored this alternative with several neighboring utilities with unfavorable results[7]. The NWPA and 10 CFR Part 53 clearly place the responsibility for the interim storage of spent nuclear fuel with each owner or operator of nuclear power plants. Thus, for utility companies faced with their own potential storage capacity limitations, accepting another utility's spent fuel for storage is not very attractive. Therefore, this is not considered a practical or reasonable alternative.

3.10 CONSTRUCT AN ISFSI AT A SITE AWAY FROM THE SURRY POWER STATION

The construction of an ISFSI at a location other than at the Surry site could provide additional storage capacity for Virginia Power. The ISFSI could be a dry type similar to the one proposed or a pool type similar to alternative four. The only difference between the proposed ISFSI and this alternative would be that an ISFSI away from the reactor site would require off site shipment of spent fuel and construction of a fuel handling facility. This alternative would be more costly than the proposed action and would have the additional environmental impacts associated with offsite transportation of spent fuel. However, the NRC has generically assessed the impacts for this alternative and found that LWR spent fuel storage in pools has an insignificant impact on the environment and that dry storage appears to be environmentally acceptable.[2] There is some doubt about the availability of alternative sites and the timeliness of implementing such an ISFSI (about five years).[2] Therefore this alternative would not fulfill Virginia Power's immediate need for additional storage capacity.

3.11 NO ACTION

If no action were taken, Virginia Power would be forced to shut down operations at its Surry Power Station. This would result in no more production of spent fuel thereby eliminating the need for increased spent fuel storage capacity. The impacts of curtailing the generation of spent fuel by ceasing the operation of existing nuclear power plants when their spent fuel pools become filled was

evaluated and found to be undesirable.[2] This alternative would be a waste of an available resource, the Surry Power Station itself, and is not considered viable.

3.12 SUMMARY OF ALTERNATIVES

In summary, only four of the alternatives could provide a solution to Virginia Power's spent fuel storage problem; ship spent fuel to North Anna, construct a new independent spent fuel storage pool at the Surry site, construct an ISFSI at a site away from the Surry Power Station, and ship spent fuel to a Federal Interim Storage facility. Transshipping spent fuel for storage at North Anna has been separately assessed by the NRC and found to have no significant impacts, but would only provide a temporary solution to Virginia Power's need for increased spent fuel storage capacity at the Surry Power Station. Construction of an additional spent fuel storage pool at the Surry site or an ISFSI away from the Surry site could provide long term increased storage capacity for Virginia Power with insignificant environmental impact. However, they cannot be implemented in a timely manner to meet Virginia Power's immediate need for additional capacity. The impacts for the alternative of shipping to a FIS facility would be similar to those for the offsite ISFSI alternative. However, this is only viable as a last resort.

4.0 ENVIRONMENTAL INTERFACES

The environment of the Surry site and region have been described in the previous Surry FESs.[4,5,6] The applicant has updated the environmental descriptions with information in Chapter 2 of the Surry ISFSI Environmental Report[7]. Those environmental features which the staff believes most likely to interface with the construction and operation of the Surry ISFSI are summarized in this section. Most of the environmental effects are expected to be limited to the Surry site. For some of the interfaces (e.g. socioeconomics and radiological dose to humans), the staff considered the region of interest to extend off-site out to an 80 km (50 mi) radius from the Surry site. The staff's assessments of the potential environmental effects of ISFSI construction and operation are presented in Section 6.

4.1 SITE LOCATION, LAND USE AND TERRESTRIAL RESOURCES

The Surry ISFSI is to be located on the Surry Power Station site approximately 1,000 m (3,300 ft) southeast of Units 1 and 2 reactor building within the site boundaries of the station (Figs. 4-1 and 4-2). The ISFSI façility will occupy approximately 6 ha (15 acres) (Reference 7, Section 2.1.1.1).

At present there is an existing low-level waste storage facility consisting of a concrete slab 30.5 m by 30.5 m (100 ft by 100 ft) covered by a Butler building and a gravel road leading to it from service road along the intake canal (Figs. 4-2 and 4-3).

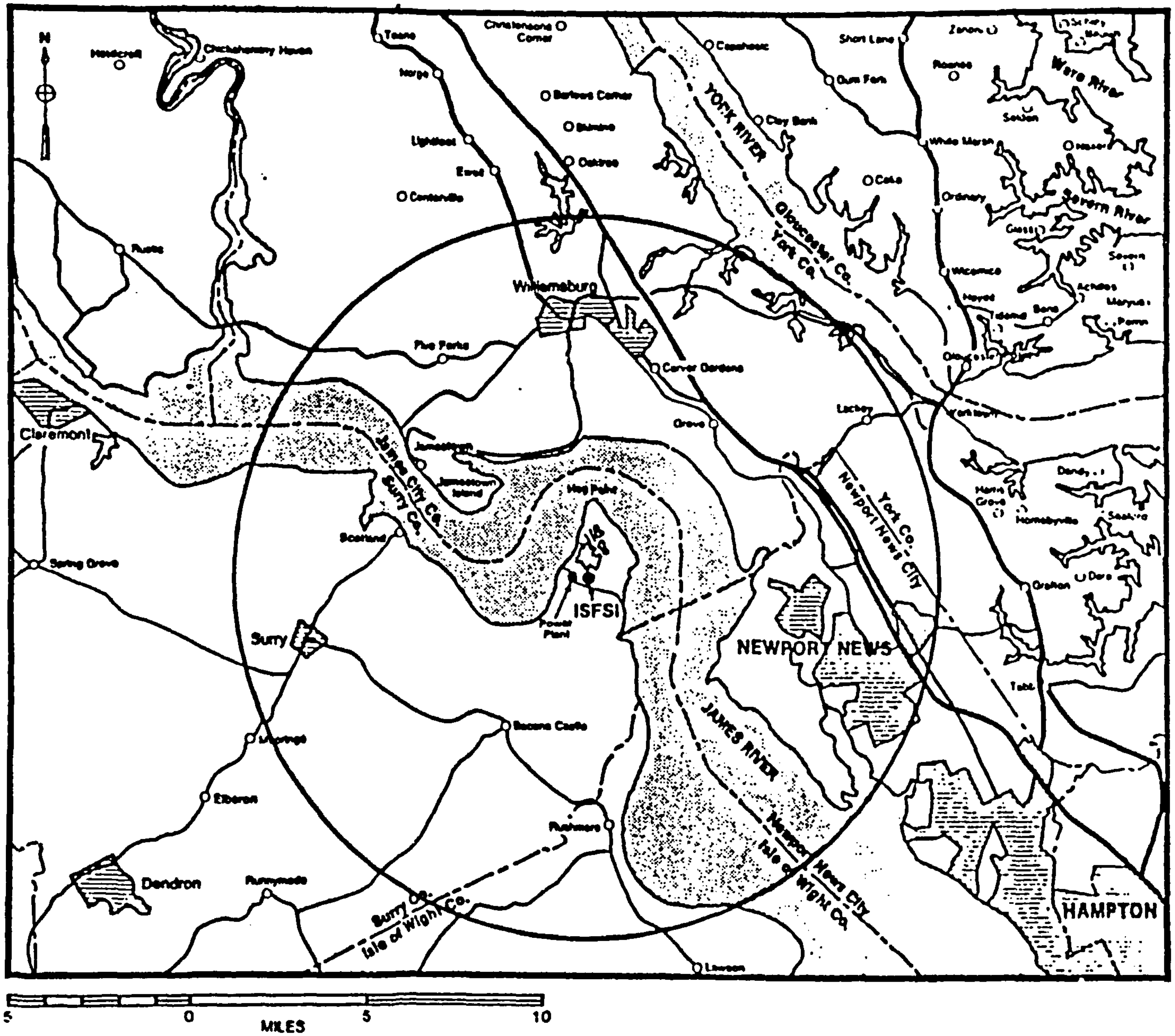

FIGURE 4-1 SURRY POWER STATION SITE VICINITY
(Source: Ref. 7, Figure 2.3-26)

Security-Related Information
Figure Withheld Under 10 CFR 2.390

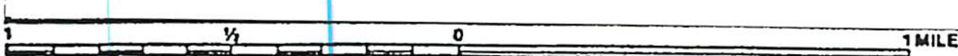

FIGURE 4-2 SURRY SITE PLAN
(Source: Ref. 7, Fig. 2.1-1 Modified)

The remainder of the ISFSI site consists of an open woods of mixed pines and hardwoods that was last logged in the late 1960's (Reference 24, Section 2.7.7). A discussion of the wildlife inhabiting the Surry site are provided in Reference 24, Section 2.7.2.

A breeding pair of Southern bald eagles, Haliaeetus leucocephalus, is nesting onsite (Reference 7, Section 4.1.6.3). This species is on the U.S. Fish and Wildlife Service's endangered list in Virginia. The nesting site is located approximately 823 m (2700 ft) from the ISFSI site (Reference 7, page 4.1-5).

The Surry nuclear power site is bounded on the north and approximately 2/3 on its south side by the Hog Island State Wildlife Management area (Fig. 4-2). The wildlife management area is used primarily for the protection of migratory waterfowl, mostly Canada geese, Anser canadensis, and pintails, Anas acuta, (Reference 6, Section 2.7.1). Peak water-fowl populations approach 25,000 birds (Ibid.).

4.2 WATER USE AND AQUATIC RESOURCES

The Surry site is located on Gravel Neck peninsula which is bordered on three sides by the James River (Fig. 4-1). Detailed descriptions of hydrology, water use and aquatic biota in the vicinity of the site are provided in Reference 4, Sections 2.1.3 and 2.7 and Reference 5, Sections 2.5 and 2.7.2. The site grade for the ISFSI concrete slabs will be 35 ft (msl). Surface drainage is from the ISFSI to the James River toward the north.

Security- Related Information
Figure Withheld Under 10 CFR 2.390

FIGURE 4-3 SURRY POWER STATION AND PROPOSED
ISFSI - SITE PLAN
(Source: Ref. 7, Fig. 3.1-2, Modified)

Since issuance of th FES[6] for Units 3 and 4, the discovery in 1975 of Kepone contamination at the James River has resulted in a total ban or partial closure of fisheries depending on species, river segment or type of fisheries; i.e. recreational or commercial (Reference 7, Section 2.1.3).

4.3 SOCIOECONOMICS AND HISTORICAL, ARCHAEOLOGICAL AND CULTURAL RESOURCES

The immediate region surrounding the Surry Power Station is rural. The site, however, is within commuting distance of several sizeable metropolitan areas. The closest cities are Williamsburg and Newport News. At further distances are Hampton, Portsmouth, Norfolk, Virginia Beach, Petersburg, Hopewell and Richmond.

While the Surry Station is located in a region rich in natural and man-made historical sites there does not appear to be anything of historical interest within the boundaries of the site.

The socioeconomic character of the region and cultural resources have previously been described in other reports by VEPCO[7,24] and by the AEC[6] and NRC[25].

4.4 DEMOGRAPHY

Residential population within 5 miles of the Surry site is small, estimated by NRC to be approximately 1,360 persons or 17 persons per square mile in

1980. Between 5 and 10 miles the residential population density increases with the inclusion of Newport News and Williamsburg. NRC estimates that the 1980 residential population within 10 miles of the Surry site was approximately 71,300 persons. Within 50 miles of the site the 1980 residential population was approximately 1,684,500 persons. The staff has compared its residential population estimates with the applicants and finds general consistency. Differences in estimates are attributable to difference in the estimating techniques used. Transient population within 10 miles is relatively large. Peak transient population estimates furnished by the applicant are taken from the "Virginia Radiological Emergency Response Plan" dated June 1983.[9] Total peak transient population within approximately 10 miles is 63,755 persons. Colonial Williamsburg and Busch Gardens account for 50,400 of this total. Institutional population within approximately 10 miles is 15,290 persons.

4.5 METEOROLOGY AND CLIMATOLOGY

This section summarizes the regional climatology and local meteorology including information on severe weather and atmospheric diffusion conditions. The effects of heat dissipation from the casks and the potential increase in fogging due to ISFSI operation are addressed in Section 6.2.2. Review of the applicant's assessment of atmospheric diffusion conditions for use in accident analyses is presented in Section 4.5.4. Causes of accidents postulated by the applicant include tornados which are addressed in Section 4.5.3. Also, see the staff's assessment of accidents in Section 6.2.1.3.

4.5.1 Regional Climatology

The Surry site is located in a zone of transition between continental and marine climates, exhibiting characteristics of each. The climate is generally moderate, influenced during much of the year by the anticyclonic circulation of the Azores-Bermuda high pressure system. Summers are warm and humid, resulting from the dominance of tropical maritime air masses over the area. Winters are generally mild, with continental and maritime air masses alternating over the area. Temperatures are moderated due to the proximity of the Atlantic Ocean. The Appalachian Mountains to the west act as a partial barrier to outbreaks of cold, continental air in the winter, usually delaying the advance of the cold air long enough to moderate the temperatures associated with it. The site is principally affected by storms originating along the southeast coast of the U.S. and tracking northeastward along the coast.

4.5.2 Local Meteorology

Data from Richmond and Norfolk (50 miles NW, and 35 miles SE of the site, respectively) have been used to characterize the local meteorology of the Surry site. Richmond data exhibit more continental characteristics, and Norfolk more maritime. Mean monthly temperatures at Richmond range from 3°C (38°F) in January to 26°C (78°F) in July, while mean monthly temperatures at Norfolk range from 5°C (41°F) in January to 26°C (78°F) in July. Record minimum temperatures have been -24°C (-12°F) at Richmond

(January 1940) and -17°C (2°F) at Norfolk (February 1895). Record maximum temperatures have been 42° (107°F) at Richmond (August 1918) and 41°C (105°F) at Norfolk (August 1918). Temperatures of 31°C (90°F) and above can be expected about 43 days per year at Richmond, and 31 days per year at Norfolk. Temperatures of 0°C (32°F) or below can be expected about 92 days per year at Richmond, and only 62 days per year at Norfolk.

Annual average precipitation in the area is about 1120 mm (44 inches), with the maximum monthly means occurring in June, July and August when about 130 mm (5 inches) can be expected. The maximum monthly precipitation recorded at Richmond was about 480 mm (19 inches) in July 1945. Snowfall varies greatly in the region, with Richmond expecting an annual snowfall of 370 mm (14.7 inches), and Norfolk expecting 190 mm (7.4 inches). The maximum 24 hour snowfall reported at Richmond was 550 mm (21.6 inches) in January 1940, while Norfolk has reported 450 mm (17.7 inches) in December 1892.

Wind data from the Surry site for the 45 m (147 ft) level, representing the period 1974-1981, indicates predominant wind directions from the southwest and south southwest, occurring 19.6% of the time. North northeast and northeast winds occurred least frequently, at a frequency of 8.2% of the time. The prevailing wind direction at Richmond is south, and at Norfolk the prevailing wind direction is southwest. During the time period 1949-1980, mean wind speeds were 3.3 m/s (7.5 mph) and 4.7 m/s (10.5 mph) at Richmond and Norfolk, respectively.

Data from Richmond and Norfolk indicate averages of 29 and 22 days per year of heavy fog (defined as visibility of ¼ mile or less), respectively.

4.5.3 Severe Weather

A variety of severe weather, from ice and snow storms to tornadoes and hurricanes, can affect the site area.

Spring and summer circulation patterns bring a strong flow of warm, moist unstable air into the area, and resulting thunderstorms are not uncommon. Thunderstorms can be expected on about 37 days per year, being most frequent in July with a monthly average of between 8 and 9 days with thunderstorms. About 75% of the annual number of thunderstorms days occur during the months of May through August. Thunderstorms are least frequent during the months of December, January and February, with monthly averages of less than one-half day with a thunderstorm.

During the period 1954-1981, 27 tornadoes were reported within the one-degree latitude-longitude square containing the site, giving a mean annual tornado frequency of about 1. The computed probability of a tornado strike at the plant site is 9×10^{-5} per year.

In the period 1871-1981, 52 tropical storms or hurricane centers passed within 35 km (100 nautical miles) of the site. The maximum "fastest mile" of winds, recorded at Richmond and Norfolk, were 30 m/s (68 mph) and 36 m/s (80 mph), respectively.

During the period 1955-1967, in the one-degree latitude-longitude square containing the site, there were 7 windstorms of 26 m/s (50 knots) or greater, and 9 reports of hail 19 mm (3/4 inch) or larger.

Ice storms of freezing rain or glaze are not uncommon in the winter, but they are seldom severe enough to do any considerable damage. The most notable glaze storm at Richmond was during January 27-28, 1943, when heavy damage was done to trees and overhead transmission lines of all kinds. No quantitative statistics are available to the staff at this time. Fifty-one atmospheric stagnation cases of 4 days or more were reported in the site region during the period 1936-1965. The highest monthly frequency of these cases was in October. Three cases of atmospheric stagnation lasting 7 days or more were reported for the area in the period 1936-1965.

4.5.4 Atmospheric Diffusion Conditions for Accidental Releases

In a letter[15] to the staff, the applicant has provided an assessment of atmospheric diffusion conditions for use in determining the effects of a loss of confinement barrier accident at the proposed Dry Cask Independent Spent Fuel Storage Facility (ISFSF). To determine relative concentrations (X/Q) for this accident, the direction-dependent atmospheric dispersion model described in Regulatory Guide 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants" was used. Seven years (1976-1982) of onsite meteorological data provided inputs to the evaluation. The input parameters included hourly average

values of wind speed and wind direction at the 10 m (33 ft) level, and atmospheric stability determined from temperature differences measured between the 10 m (33 ft) and 45.7 m (150 ft) levels of the onsite meteorological tower. From the array of X/Q values presented by the applicant, the staff selected for use in the accident assessment presented in Section 6.2.1, 6.7 X 10^{-4} sec/m^3 at the controlled area boundary 0.5 km (0.3 miles) northwest of the ISFSF and 3.8 x 10^{-5} sec/m^3 at the nearest residence 2.5 km (1.5 miles) south southwest of the ISFSF. According to the calculations, these values are expected to be exceeded 0.5% of the time. These assessments, as made by the applicant, are reasonable and provide an acceptably low probability of being exceeded.

4.6 GEOLOGY AND SEISMOLOGY

This section summarizes geological and seismological features in the vicinity of the site. One of the causes of a postulated accident of the Surry ISFSI considered by the applicant is an earthquake. (See the staff's assessment of accidents in Section 6.2.1.3.)

4.6.1 Geology

The ISFSI site is located in the Coastal Plain physiographic province. In Virginia this province has a stair-step character, composed of a series of plains that are successively lower from west to east. In the vicinity of the site the upper 6.1 to 10.7 m (20 to 35 ft) consists of layers of brown and mottled brown sand, silty sand, and organic and inorganic silts and clays.

In late-Pleistocene time the sea level rose to about +45 feet, accompanied by the deposition of clayey sands. From the end of this period to the present the sea has been receding and erosion has been occurring. Regional subsidence in the site area has been measured to be 1 to 5 mm (0.04 to 0.2 in) per year. A site survey conducted in May 1975, indicated that this was not a problem.

In the immediate site area there are no surface features indicative of actual or potential localized subsidence or landsliding. There is no history of surface mining or other activities by man, which would cause ground disturbance.

4.6.2 Seismology

No earthquake within the last 200 years has been large enough to cause structural damage at the site. There are no known earthquake epicentral locations within 48 km (30 miles) of the site.

Liquefaction is not likely to occur in local strata for an earthquake having a maximum ground acceleration of less than .07g.

5.0 DESCRIPTION OF SURRY DRY CASK ISFSI

5.1 ISFSI LOCATION

The Surry ISFSI will consist of sealed surface storage casks arranged on three concrete slabs which will be constructed on-site (see Figures 4-1, 4-2 and 4-3).

5.2 SITE PREPARATION

The 6 ha (15 ac) of approximate land area set aside for the ISFSI may be cleared of vegetation (see Section 6.1.1). The areas to be occupied by the concrete slabs will be excavated one at a time with about 3060 m^3 (4000 yd^3) of material removed per slab. This spoil material will be stored near the ISFSI excavation site. The excavations will be filled and compacted with suitable material to support the slabs. Each slab will be formed with ready-mixed concrete trucked into the site. The approximate area covered by each slab is 684 m^2 (7360 ft^2). The depth of the slab may be up to 0.68 m (2 ft 3 in); thus, the expected volume of concrete required for the three slabs is 465 m^3 (613 yd^3). Temporary construction buildings will be erected on the site and removed at the completion of construction of the ISFSI.

5.3 STORAGE SYSTEM

The Surry ISFSI is designed for the dry storage, in casks, of spent nuclear fuel, originating from the Surry Power Station. The initial cask design selected by the applicant for licensing and use at the Surry ISFSI is the

CASTOR V/21 cask.[26] The CASTOR V/21 cask was designed by Gesellschaft für Nuklear-Service mbH (GNS) to meet the International Atomic Energy Agency (IAEA) specifications for Type B(U) packaging, corresponding to Nuclear Safety Fissile Class I, "Regulations for the Safe Transport of Radioactive Materials." The cask is a thick wall nodular cast iron cylinder which weighs 106 metric tons, fully loaded. It is about 4.9 m (16 ft) high and 2.4 m (8 ft) in diameter (see Figures 5-1 and 5-2). The CASTOR V/21 is designed to safely store 21 PWR spent fuel assemblies by providing confinement, shielding, criticality control and heat removal.

5.3.1 Material to be Stored

The material to be stored at the Surry ISFSI is spent nuclear fuel used at the Surry Power Station. The fuel used during the first years of operation had an initial enrichment not exceeding 3.5 weight percent U-235 and a discharge burnup not exceeding 35,000 MWD/MTU. There are about 900 spent fuel assemblies meeting these criteria stored in the spent fuel pool at Surry and being considered for dry cask storage. This fuel is the design basis fuel considered for this assessment.

Although the Surry Power Station has been authorized to operate with fuel of higher initial enrichment and to higher burnups, it is not presently being considered for licensing in the Surry ISFSI. For the purpose of this environmental assessment, the radiological impacts, based on the design basis fuel in CASTOR V/21 casks, have been multiplied by a factor of three to

Security-Related Information
Figure Withheld Under 10 CFR 2.390

All Dimensions in mm

FIGURE 5-1 CASTOR V/21 CASK (SCHEMATIC)
(Source: Ref. 26, Fig. 1.1-2)

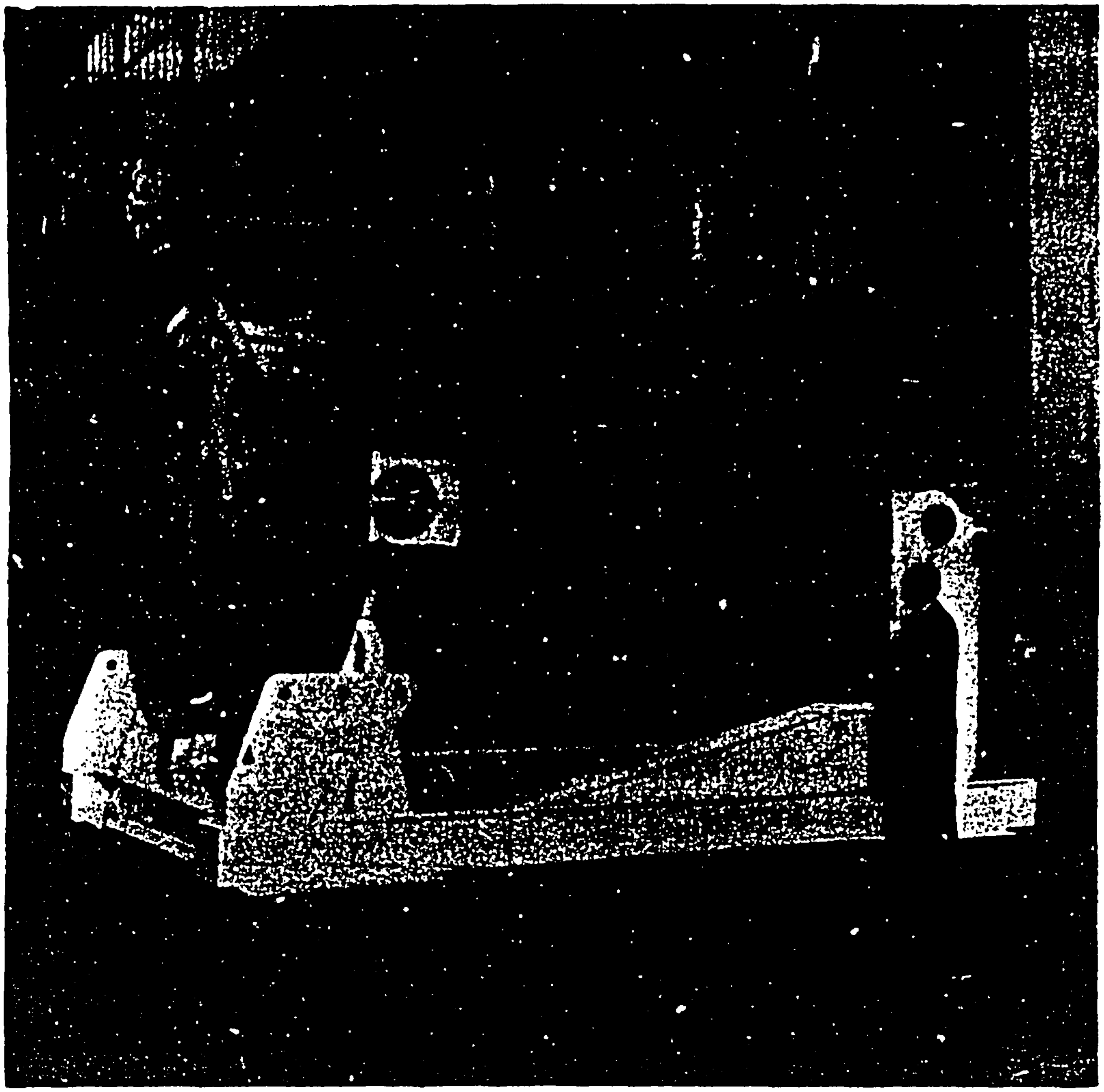

FIGURE 5-2 CASTOR V/21 CASK
(Source: Ref. 26, Fig. 1.2-5)

encompass potential impacts that may result from variations in future cask designs or vendors and from storing spent fuel with higher initial enrichment and burnup.

In order to meet certain cask design criteria, the PWR spent fuel to be stored in the CASTOR V/21 cask will not exceed the following design basis characteristics.

1. Initial enrichment of 3.5 weight percent U-235.
2. Maximum burnup of 35,000 MWD/MTU at a specific power of 35 MW/MTU.
3. Peak thermal power of 1 kw/assembly.
4. Out of the reactor not less than five (5) years.
5. 9.765 MTU/cask (.465 MTU/assembly).

5.3.2 Cask Design and Safety Features

The CASTOR V/21 cask design safety report[26] is reviewed and a safety evaluation issued in addition to a safety evaluation of the use of this cask at the Surry ISFSI before the issuance of the license. The safety evaluations review design adequacy, site parameters, and operations to ensure confinement, shielding, criticality control and heat removal of the spent fuel and to ensure safe storage.

CONFINEMENT

Confinement of the spent fuel is achieved by the cask and two stainless steel lids which are bolted to the cask body. Each lid is sealed shut using multiple metal and elastomer O-ring seals. The lid system integrity is ensured by monitoring the pressure between the two lids. The cask is designed to maintain its structural integrity and stability against external impacts, cask drops and severe environmental loads. Thus, because of the cask structural integrity and tightness, it is a safe confinement barrier against the release of radioactivity and loss of the helium cover gas.

SHIELDING

The 379 mm (15 in) thick nodular cast iron walls of the cask provide gamma shielding. For additional neutron shielding, two concentric rows of axial holes in the cask wall are filled with polyethylene. When the CASTOR V/21 is filled with the design basis fuel, the surface dose rate at the side of the cask wall is about 30 mrem/hr (7.8 mrem/hr neutron and 22.3 mrem/hr gamma).

CRITICALITY CONTROL

The basket (see Figure 5-3) used to hold the spent fuel assemblies inside the cask is made of stainless steel and boronated stainless steel. The boron in the stainless steel provides sufficient neutron absorption to maintain subcritical condition of the fuel in the cask. The basket is designed to

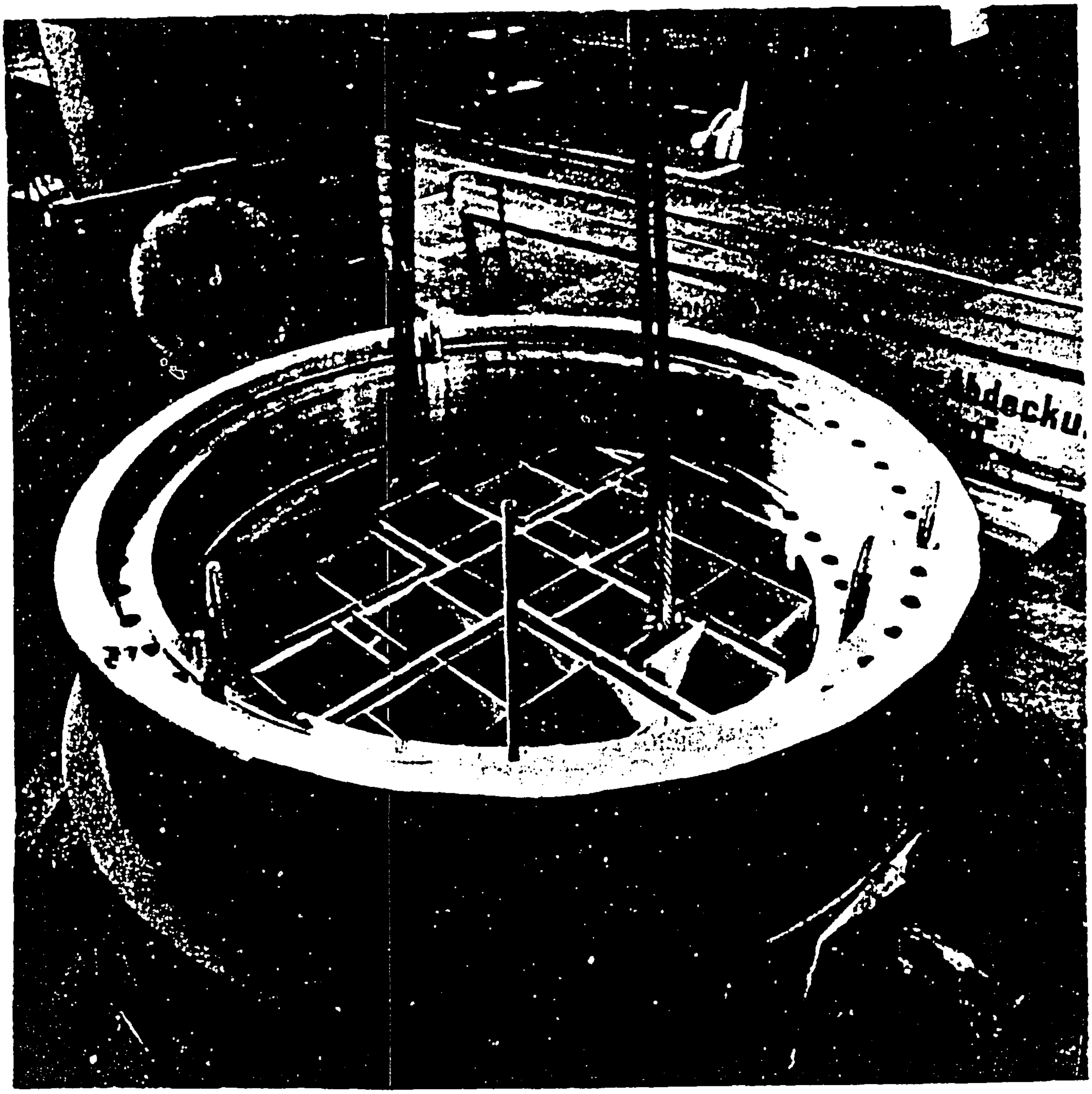

FIGURE 5-3 CASTOR V-21 FUEL BASKET
(Source: Ref. 26, Fig. 1.2-6)

maintain its structural integrity under the same accident conditions as the cask. Thus the spent fuel elements are ensured to remain subcritical under all storage conditions.

HEAT REMOVAL

In order to ensure fuel cladding integrity, the CASTOR V/21 cask is designed to keep cladding temperatures below a maximum specified temperature of 370°C (698°F). The cask is designed for a maximum thermal power load of 21 kw under extreme environmental conditions. The cask has an inert helium gas atmosphere which not only inhibits corrosion but acts as a heat transfer medium. The decay heat of the fuel assemblies is conducted through the cask body and transferred to the air surrounding the cask by natural convection and radiation from exterior surfaces. The cask has 73 cooling fins on the outside to assist heat transfer. The passive nature of heat removal is an additional safety feature of the cask. Heat is transferred directly to the air. No cooling water is required. The maximum design surface temperature of the cask is 82°C (180°F).[26]

5.4 ISFSI OPERATIONS

The Surry ISFSI, by the nature of its passive dry cask storage, has simple operations. All cask loading and preparations take place at the Surry Power Station spent fuel storage building under the reactor operating licenses. There, after fuel is placed in the cask, the primary lid is set in place and tightened. Water is drained from the cask and the cask cavity is vacuum

dried. A helium leak test is conducted to ensure tightness of the lid. The cavity is then filled with helium slightly below atmospheric pressure (0.8 bar). The second lid is placed on the cask and the seals tested. The space between the two lids is filled with helium to 7 bar-abs pressure and the seal monitoring system is then activated. The outside of the cask is decontaminated before the cask is moved out of the Surry fuel and decontamination buildings and transferred to the ISFSI. Once the cask is set inplace on the concrete pad, the seal monitoring system is connected. No maintenance is required other than periodic visual or functional checks of the seal monitoring system. The applicant anticipates that about four casks per year will be placed in the ISFSI. Existing operating plans, practices and procedures (i.e. health physics, environmental monitoring, security, and quality assurance) for the Surry Power Station will be adopted for use at the Surry ISFSI.

5.5 MONITORING PROGRAMS

5.5.1 Containment Seal Monitoring

Preparation of the cask seals is described in Section 5.4. Tne seal monitoring system is activated while the cask is in the spent fuel storage building. When the cask is set in place at the ISFSI site, the seal monitoring system is connected. The system uses a diaphragm-type pressure gage which monitors the pressure set up between the primary and secondary lids.[26] Pressure changes result in opening a contact of the pressure-actuated switch in the main gage, generating an electrical signal to the control room. The signal

is displayed visually or by an annuciator. A second gage of the same type is used to monitor the reference pressure of 4 bar established in the main gage. The second gage actuates a visual and acoustic signal if the reference pressure in the main gage falls below a preset level of 3.5 bar. No maintenance of the casks at the ISFSI is required other than periodic visual or functional checks of the seal monitoring system.

5.5.2 Radiological Monitoring

In addition to the existing radiological monitoring program for the Surry Power Station, the applicant plans to add thermoluminescent dosimeters to be located at appropriate intervals along the ISFSI perimeter fence. The contribution of the ISFSI to the offsite dose will be reported in the station Radiological Environmental Monitoring Annual Reports. The method for determining the ISFSI contribution will be documented in the offsite dose calculation manual.

5.5.3 Non-radiological Monitoring

The ongoing onsite meteorological measurements program for the Surry Power Station provides a data base for evaluation of the station and ISFSI operations. The primary meteorological tower measures wind speed, wind direction and horizontal component directional fluctuation at two levels [i.e. at 10 m (33 ft) and 45.7 m (150 ft)], ambient air and dewpoint temperature at the lower level, differential air temperature between levels and

rainfall at the tower base. A backup tower monitors wind speed, direction and horizontal component fluctuation in direction at 9.2 m (30.3 ft) el. No other non-radiological monitoring specific to the ISFSI is required.

6.0 ENVIRONMENTAL IMPACTS OF PROPOSED ACTION

6.1 CONSTRUCTION IMPACTS

6.1.1 Land Use and Terrestrial Resources

Approximately 6 ha (15 acres) of open woods and the wildlife habitat this area contains will be destroyed. This is a small area with no known rare, endangered or threatened species of plants or animals. The nesting pair of bald eagles were not disturbed by the construction of the low level waste facilities on the ISFSI site (Reference 7, page 4.1-5). Therefore, the impact of constructing the ISFSI site at the same distance from the nesting site is expected to have a negligible effect on land use and terrestrial resources, including the nesting bald eagles.

6.1.2 Water Use and Aquatic Resources

Construction of the Surry ISFSI is not expected to impact local water users, water quality or aquatic biota. Those activities which could potentially impact surface waters are the clearing and excavation operations conducted prior to pouring the concrete slabs. The applicant indicates that a temporary drainage system may be constructed to collect runoff into temporary settling ponds and that more permanent drainage will be provided as excavation and backfill operations proceed.

No dewatering during excavation is anticipated. Concrete for the slabs will be ready-mixed so no water use nor wastes from concrete batch operations will

result. Existing site facilities for barge off-loading may be used; no dredging or other construction activities on the James River will be required for the ISFSI.

6.1.3 Other Impacts of Construction

Because of the small size of the construction effort impacts to air quality and ambient noise levels and other potential impacts associated with construction are expected to be well within the bounds of impacts previously considered and found acceptable at the Surry site and unlikely to be discernible from other impacts associated with normal station maintenance activities. With good construction impact control practices (Ref. 7, Section 4.5), the potential for fugitive dust, erosion and noise impacts typical of the planned construction activities can be controlled to minimal levels.

The construction effort for the ISFSI is small relative to initial nuclear station construction. A peak construction force of about 20 people is anticipated (Ref. 7, p. 4.1-3)). Construction of Surry Unit 1 involved a peak work force in excess of 2000 people[4]. A typical scheduled refueling and maintenance outage brings several hundred workers to a nuclear station site. Construction of the ISFSI is also limited in scope, involving primarily clearing and grading, and pouring concrete pads. This type of construction is not unique and is an activity which the licensee could do without NRC approval were it not for the requirement of a Part 72 license for fuel storage.

6.1.4 Socioeconomics

The socioeconomic effects associated with operation of the facility will be essentially nil as no additional operating work force will be required.[7]

6.2 OPERATIONAL IMPACTS

6.2.1 Radiological Impacts from Routine Operations

There are three pathways by which workers and members of the public may be exposed as a result of the Surry Independent Spent Fuel storage installation (ISFSI) operation: to direct radiation; to radioactivity released in gaseous effluents; and to radioactivity released in liquid effluents. Because the proposed ISFSI involves only dry storage of spent nuclear fuel in selected casks, there will be essentially no liquid or gaseous effluents associated with storage activities. Although activities associated with cask loading and decontamination may result in some liquid and gaseous effluents, these operations will be conducted at the Surry Power Station under the 10 CFR Part 50 operating licenses. The radiological impacts from those effluents fall within the scope of impacts from reactor operations which were assessed in the Surry Power Station Unit 1 and Unit 2 Final Environmental Statements[4,5].

The primary exposure pathway associated with normal Surry ISFSI operations is direct irradiation of nearby residents and site workers . The radiological dose estimates presented were calculated using conservative and design basis

assumptions: Maximum cask surface dose rates of 7.8 mrem neutrons and 22.3 mrem/hr gammas, maximum fuel burnup of 35 GWD/MTU[26], fuel out of the reactor at least 5 years before storage, no self-shielding of casks in arrays, and emplacement of four casks per year. The resultant calculated doses were then multiplied by a factor of three (3) to provide an upper bound of the radiological impacts associated with the potential storage of higher burnup fuel and to accommodate other potential cask designs. These assumptions result in conservative dose estimates; actual doses are expected to be lower.

6.2.1.1 Offsite Dose Commitments

ISFSI operations will also result in additional dose to members of the public from direct radiation exposure. Section 72.67(a) of 10 CFR 72 requires that, from normal operations, dose equivalents to any real individual located beyond the ISFSI controlled area not exceed 25 mrem/yr to the whole body as a result of planned effluents releases, direct radiation and other radiation from uranium fuel cycle operations within the region.

Appendix I to 10 CFR 50 sets forth design objective dose commitment guides for liquid and gaseous effluents released from nuclear power reactors. For each reactor, the maximum annual dose commitment to an individual in an unrestricted area is 3 mrem due to liquid effluents and 5 mrem due to gaseous effluents. Thus, the maximum design guide dose commitment from effluents due to Surry Power Station operations would be 16 mrem/yr. Based on its usage, the Low Level Waste Storage Facility (LLWSF) would contribute an additional 4.4E-2 mrem/yr. Actual doses due to release of radioactivity in effluents are less

than design amount. The estimated radiological doses due to Surry Power Station operations are .36 mrem/yr from gaseous effluents and 2.52 mrem/yr from liquid effluents.[4]

The estimated maximum annual dose commitment to the nearest real individual [located 2.5 km (1.5 mi) away] due to direct radiation from the casks at the Surry ISFSI is about 6E-5* mrem/yr. This dose is only a very small fraction of the design guide dose commitment and those estimated in the FES for the Surry Power Station operations. When combined with the dose commitment from reactor and low-level waste storage operations, the total dose commitment is well within the 25 mrem/yr limit specified in 10 CFR 72.67 and 40 CFR 190.

Forty-eight permanent residents are located within 3.2 km (2 mi) of the Surry ISFSI. If all are assumed to be located as close as the nearest resident, then the collective dose commitment would be 3E-6 man-rem/yr due to Surry ISFSI operations. Based on ground-level air concentration dose rates in the Surry Unit 1 FES[4], the collective dose commitment to this same population within two miles would be about 4.3E-4 man-rem/yr due to Surry Power Station operations. Attenuation of the direct radiation dose rates from the ISFSI beyond two miles contributes little to the collective dose commitment for more distant populations. Compared to the estimated 92.4 man-rem/yr due to Surry Power Station operations,[4] the impact of the collective dose commitment in the region due to the Surry ISFSI is negligible.

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* 6E-5 = 6×10^{-5}

6.2.1.2 Collective Occupational Dose Commitment

Spent fuel storage at the Surry ISFSI will result in a small increase in the total occupational dose at the Surry Power Station. Engineered features of the casks and application of administrative controls ensure that all exposures are maintained at levels which are as low as reasonably achievable (ALARA).

Virginia Power has estimated the maximum annual collective occupational dose commitment from the operation of the Surry ISFSI. The estimates were based on emplacing four casks per year and the design basis use of the collocated LLWSF. The additional exposure to workers at the Surry Power Station assumes the ISFSI is full.

Occupational doses during construction assumes 2060 man-hours to complete one concrete slab on which casks will be placed. Because the slabs are to be constructed as needed, the exposures during construction include contributions from the LLWSF and 28 casks on previously filled slabs.

If all the concrete slabs were initially constructed at one time, a small reduction (18%) in the total occupational dose from construction could be realized. However, because the applicant may want to use casks with greater storage capacity, not all the slabs may be needed. Thus, by constructing the slabs at one time, the small reduction in occupational exposure must be weighed against higher initial capital outlay for something that eventually may not be needed.

Table 6.2-1 summarizes the maximum collective occupational dose commitments from annual operations and construction.[17] The 23 man-rem/yr dose from normal operations and an average of 64 man-rem per slab construction constitutes a small fraction of the total occupational dose commitment at the Surry Power Station. Actual doses are expected to be less. For example, in 1982 the collective occupational dose at the Surry Power Station was 2119 man-rem, with an annual average collective occupational dose over ten years, ending with 1982, of 2315 man-rem/yr.[27] Individual doses are controlled to be within the limits of 10 CFR Part 20.

6.2.1.3 Environmental Assessment of Accidents

Virginia Power, in its application, postulated accidents of the Surry ISFSI due to a variety of causes: earthquakes, tornados, floods, fires, natural gas pipeline explosions, and an accidently dropped cask. All are either not credible for the Surry site or the cask is designed to withstand the resultant forces without losing its mechanical integrity. The only cask components with a potential to malfunction are the lid seals, the pressure gauge or the pressure gauge monitoring system. For assessment purposes, Virginia Power postulated an accident scenario where a nonmechanistic simultaneous failure of both cask seals and all fuel cladding occurs, resulting in the loss of the helium cover gas and the radioactive noble gas inventory in the spent fuel for one cask. The assessment of accident impacts presented here is based on the inventory contained in the CASTOR V/21 cask which will be initially used by Virginia Power.

Table 6.2-1 COLLECTIVE ANNUAL OCCUPATIONAL AND CONSTRUCTION DOSE COMMITMENTS*

Annual Operations		Man-Rem/Year
Cask loading and decontamination at reactor (1)		5.5
Transfer of Cask to ISFSI (1)		.1
Cask Emplacement (1),(2)		4.0
Surveillance and Maintenance (2),(3)		.8
Additional exposure to workers at the Low-Level Waste Storage Facility (2)		8.1
Additional exposure to workers at the Surry Power Station		4.3
	Total	22.8

(1) Four cask per year
(2) Assumes the ISFSI and the LLWSF are completely filled
(3) Assumes 12 surveys, 2 instrument test/yr, 1 instrument/yr and recalibration

Construction		Man-Rem
Slab 1		53
Slab 2		62
Slab 3		78
	Total	193

*Source: Reference 17
Includes enveloping factor of three

The CASTOR V/21 cask was designed for storage and transportation of irradiated spent fuel assemblies and its design to fulfill the IAEA international specifications for type B(U) packaging. Although storage of spent fuel is the only use evaluated in this report, a hypothetical worst-case accident based on transportation accident scenarios is being evaluated to establish an upper bound accident impact for storage applications. The transportation accident scenario is not considered credible for storage situations. It has been chosen merely to determine estimates for release of radionuclides from the spent fuel to the cask cavity and then to the environment rather than arbitrarily assuming a non-mechanistic accident release.

The release fractions used in this analysis were based on Reference 28 for scenario 5 (a worst-case for air-cooled casks). This scenario considers all release mechanisms that are credible for air-cooled casks. The mechanism for release of radioactivity considered appropriate for this evaluation was an impact rupture which somehow causes mechanical disruption of the cladding and subsequent depressurization of 10 percent of the fuel rods. The fraction (20 percent) of the spent fuel inventory of noble gases generated in the reactor that are in the fuel pellet gap is released to the cask cavity. Because of the low temperatures, the remainder of fission products released are assumed to be particulates that are swept out of the rods as they depressurize after rupture. The spent fuel inventory fraction that is swept out as particulates is 2E-6.

Once radionuclides have been released from the fuel rods they must then find a path out of the cask. The result of accident damage is not expected to provide a pathway with a large cross-sectional area from the cask cavity to the environment. Only a small section of a failed cask seal would be the most likely release pathway. Before the radionuclides are released to the environment, they must pass many places that are relatively cool and through small passages. As a result, radionuclides can condense, plate out, or be filtered out before escaping the cask. For gas-cooled casks (in this case helium cooled) 60 percent of the noble gases in the cask cavity are assumed to be released and 5 percent of the particulates.

After the radioactive material escapes the cask, there are two factors important in determining whether the particles reach people; the fraction that becomes suspended in air and the fraction that is respirable (less than 10 microns aerodynamic diameter). Five percent of the particulates were assumed to be smaller than 10 microns and remain as an aerosol.

The radioactivity released to the cask cavity is based on the design fuel to be stored in the cask; PWR fuel, initial enrichment of 3.5 percent U-235, 35,000 MWD/MTU burnup, 5 years out of the reactor. The 0.5 percent ground level direction dependent atmospheric dispersion (X/Q) values were used to calculate doses at the nearest controlled area boundary (503m) and at the nearest resident (2414m).[15]

Tables 6.2-2 and 6.2-3 summarize the radiological impact of a CASTOR V/21 cask accident containing 5-year cooled spent fuel. The upper bound doses (with a

Table 6.2-2 Radiological Doses at the Controlled Area Boundary from Storage Due to a CASTOR V/21 Accident at the Surry Power Station

Nuclide	Cask Inventory(1)* (μCi)	Total Fraction Released Aerosolized + Respirable(2)	X/Q(3) (sec/m^3)	Breathing Rate(4) (m^3/sec)	Whole-body Inhalation Dose Conversion Factors(5) (Rem/μCi)	Dose at Controlled Area Boundary (Rem)
H-3	5.44E+9**	1E-2	6.73E-4	2.54E-4	1.25E-4	1.16E-3
Kr-85	7.93E+10	1E-2	6.73E-4	N/A	3.34E-4(6) $\frac{\text{Rem-m}^3}{\text{sec-Ci}}$	1.78E-4
I-129	4.05E+5	5E-10	6.73E-4	2.54E-4	5.0 (thyroid)	1.7E-10(thyroid)
Cs-134	3.45E+11	5E-10	6.73E-4	2.54E-4	4.55E-2	1.34E-6
Cs-137	9.77E+11	5E-10	6.73E-4	2.54E-4	3.26E-2	2.72E-6
Sr-90	6.89E+11	5E-10	6.73E-4	2.54E-4	2.4E-2	1.41E-6
Ru-106	1.76E+11	5E-10	6.73E-4	2.54E-4	6.18E-2	9.30E-7
					Total Whole Body Dose	1.35E-3

* Footnotes:

1. GNSI CASTOR V/21 Cask Topical SAR, 5-Year Cooled Fuel (Ref. 26).
2. SAND 80-2124 (Ref. 28).
3. At 503m (Ref. 15).
4. Regulatory Guide 1.109.
5. NUREG/CR-0150 Vol. 3. (Ref. 29)
6. NUREG/CR-1918 (Ref. 30)

** For example, 5.44E+9 means 5.44×10^9 .

Table 6.2-3 Radiological Doses to the Nearest Resident from Storage Due to a CASTOR V/21 Accident at the Surry Power Station

Nuclide	Cask Inventory(1)* (μCi)	Total Fraction Released Aerosolized + Respirable(2)	X/Q(3) (sec/m^3)	Breathing Rate(4) (m^3/sec)	Whole-body Inhalation Dose Conversion Factors(5) (Rem/μCi)	Dose to the Nearest Resident (Rem)
H-3	5.44E+9	1E-2	3.84E-5	2.54E-4	1.25E-4	6.63E-5
Kr-85	7.93E+10	1E-2	3.84E-5	N/A	3.34E-4(6) $\frac{\text{Rem-m}^3}{\text{sec-Ci}}$	1.02E-5
I-129	4.05E+5	5E-10	3.84E-5	2.54E-4	5.0 (thyroid)	9.88E-12(thyroid)
Cs-134	4.35E+11	5E-10	3.84E-5	2.54E-4	4.55E-2	9.65E-8
Cs-137	9.77E+11	5E-10	3.84E-5	2.54E-4	3.26E-2	1.55E-7
Sr-90	6.89E+11	5E-10	3.84E-5	2.54E-4	2.4E-2	8.06E-8
Ru-106	1.76E+11	5E-10	3.84E-5	2.54E-4	6.18E-2	5.30E-8
				Total Whole Body Dose		7.69E-5

* Footnotes:

1. GNSI CASTOR V/21 Cask Topical SAR, 5-year cooled fuel, (Ref. 26).
2. SAND 80-2124 (Ref. 28).
3. At 2414m (Ref. 15).
4. Regulatory Guide 1.109.
5. NUREG/CR-0150 Vol. 3 (Ref. 29)
6. NUREG/CR-1918 (Ref. 30)

bounding factor of 3) at the controlled area boundary, due to the postulated accident, would be about 4 mrem to the whole-body and thyroid. If all the noble gas (Kr-85) were released, as was assumed by the applicant, the dose at the nearest site boundary would only be 18 mrem to the whole body. The nearest resident would receive about .24 mrem dose to the whole-body and thyroid. The resultant whole-body dose to an individual at the controlled area boundary is a small fraction of the 5 rem criteria specified in 10 CFR 72.68(b). These doses are also much less than the protective action guidelines established by the Environmental Protection Agency (EPA) for individuals exposed to radiation as a result of accidents: 1 rem to the whole-body and 5 rem to the most severely effected organ. Thus the release of effluents due to accidents at the ISFSI have a negligible impact on the population in the region around the Surry Power Station.

Another accident associated with ISFSI operations that Virginia Power addressed is a fuel assembly dropped in the worst orientation while being loaded into the cask. However, cask loading is conducted at the Surry Power Station under the reactor operating licenses. The environmental impact from this type of accident has already been assessed by the staff in the FESs[4,5] for the Surry Power Station Unit 1 and Unit 2.

6.2.2 Non-Radiological Impacts

6.2.2.1 Land Use and Terrestrial Resources

Operation of this facility is not expected to detrimentally impact the terrestrial environment. The only potential terrestrial interaction identified is the heat radiating from the casks. This may limit the ability to maintain a grass cover close to the pads and with no vegetative cover, other erosion control measures may become necessary. Since erosion adjacent to the pads could interfere with use of the access road, the staff expects that the applicant would correct any erosional problem before erosion became a significant environmental impact.

During operation, the ISFSI site will present relatively poor habitat for use by wildlife species. Construction of the ISFSI will have reduced the cover types and, thus, the ecological niches on the 6 ha (15 ac) ISFSI site. The reduced cover, plus the inhibited access due to the ISFSI perimeter fence and other human interference due to various operational and maintenance activities in and around the ISFSI are expected to discourage wildlife use of the area, in general. It can be postulated that some species may demonstrate a preference in winter to the warmer temperatures experienced near the casks. However, birds and other species which might be attracted would be represented by few individuals and no population-level effects are expected to result.

6.2.2.2 Water Use and Aquatic Resources

The Surry Dry Cask ISFSI is a passive system cooled by air; there is no planned water use nor liquid releases to surface or groundwater bodies associated with operation of the ISFSI. Surface runoff from precipitation

events will be handled by the construction of swales, as necessary, to direct runoff from the ISFSI toward natural drainage patters.

6.2.2.3 Socioeconomics

The socioeconomic effects associated with construction of the ISFSI will be extremely small. The project is a small construction project and will involve a peak work force of 20 persons.[7]

6.2.2.4 Cask Heat Dissipation

At the request of the staff (Request for Additional Information Q-1.3.8E)[18], the applicant[10] has performed a conservative analysis of fog enhancement beyond the site boundary due to precipitation evaporation after impingement on cask surfaces, which may be heated to 127°C (260°F)*. The analysis was based on the maximum 24-hour precipitation rate measured at Norfolk, Virginia and atmospheric dispersion conditions which are typical of rainy periods. The results of the analysis showed that the relative humidity would be increased by a few percent.

The staff has reviewed the analysis and assumptions and concurs in the results. Since a change in relative humidity of a few percent in an atmosphere that is already near saturation would not appreciably increase fog formation, the staff agrees with the applicant's conclusion that any fog formation, due to evaporating water from the heated casks, would be negligible beyond the site boundary.

* The temperature of 82°C (180°F) is the maximum cask surface temperature expected for the CASTOR V/21 cask under extreme environmental conditions (Ref. 26, Section 5). The higher temperature was considered with regard to fog formation.

7.0 SAFEGUARDS FOR SPENT FUEL

Security-Related Information
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7.1 ON-SITE MOVEMENT

Security-Related Information
Text Withheld Under 10 CFR 2.390

Security-Related Information
Text Withheld Under 10 CFR 2.390

7.2 FIXED SITE SAFEGUARDS

Security-Related Information
Text Withheld Under 10 CFR 2.390

Security-Related Information
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Security-Related Information
Text Withheld Under 10 CFR 2.390

7.3 SUMMARY

Security-Related Information
Text Withheld Under 10 CFR 2.390

8.0 DECOMMISSIONING

A proposed decommissioning plan[1] was included as a part of the application in accordance with 10 CFR 72.18.* The only activities expected in decommissioning the Surry ISFSI are the removal of the spent fuel from the site and decontaminating the inside surface of the casks. The casks would then be released for re-use or disposal. No residual contamination is expected to be left behind on the concrete pads.

The costs of decommissioning the ISFSI are expected to represent a small and negligible fraction of the costs of decommissioning the Surry Power Station Units 1 and 2.

* Under Section 51.20(b)(10) of 10 CFR Part 51, an environmental impact statement must be prepared in connection with the issuance of a license amendment authorizing decommissioning of an ISFSI. However, the proposed action here is limited to construction and operation. A request for authority to decommission, contemplated by Section 72.38 of 10 CFR Part 72, will come at a later date. New regulations revising the requirements for such applications, as well as the requirements applicable to such authorization, have recently been proposed [50 Fed. Reg. 5600 (February 11, 1985)]. Among the proposed regulation changes is the deletion of the requirement in Section 51.20(b)(10) to prepare an environmental impact statement in connection with decommissioning of an ISFSI.

9.0 SUMMARY AND CONCLUSIONS

9.1 SUMMARY OF ENVIRONMENTAL IMPACTS

As discussed in Section 6.1, no significant construction impacts are anticipated. The activities will affect only about 2% of the land area on the Surry site. With good construction practices, the potentials for fugitive dust, erosion and noise impacts, typical of the planned construction activities, can be controlled to minimal levels. The applicant is committed to the implementation of "good construction practices" during ISFSI construction. The only resource committed irretrievably is the concrete used in the three ISFSI storage pads.

As discussed in Section 6.2.1, the radiological impacts from liquid and gaseous effluents during normal operation of the ISFSI fall within the scope of impacts from licensed reactor operations which were assessed in the Surry Units 1 and 2 FES's and are controlled by the existing Technical Specifications for the Surry units. The primary exposure pathway associated with the ISFSI operation is direct irradiation of site workers and nearby residents. The dose commitment to the nearest resident from the ISFSI operation is 6E-5 mrem/yr and when added to that of the Surry Power Station operations is less than 25 mrem/yr as required by 10 CFR 72.67. The collective dose commitment to residents within two miles of the ISFSI is 3E-6 man-rem/yr. Occupational dose of site workers during slab construction (64 man-rem per slab) and during ISFSI operation (23 man-rem/yr) is a

small fraction of the total occupational dose commitment at the Surry Power Station (i.e. 2315 man-rem/yr as the annual average dose over 10 years ending in 1982). Individual doses are controlled to be within the limits established by 10 CFR Part 20.

The radiological impacts due to accidents at the Surry ISFSI are 4 mrem to the whole-body and thyroid of an individual located at the controlled area boundary and .24 mrem to the nearest resident. These doses are only a small fraction of the criteria specified in 10 CFR 72.68(b) and by the EPA. An Emergency Planning Zone (EPZ) would coincide with the ISFSI controlled area and the Surry Power Station site boundaries. Therefore, there is no need for the applicant to have an offsite emergency response plan for the ISFSI.

As discussed in Section 6.2.2, no significant non-radiological impacts are expected during operation. The only environmental interface of the ISFSI is with the air surrounding the casks; the only discharge of waste to the environment is heat to the air via the passive heat dissipation system. Climatological effects which are anticipated in the immediate vicinity of the ISFSI are judged to be insignificant to public health and safety.

9.2 BASIS FOR FINDING OF NO SIGNIFICANT IMPACT

We have reviewed the proposed action relative to the requirements set forth in 10 CFR Part 51 and, based on this assessment, have determined that issuance of a materials license under 10 CFR Part 72 authorizing storage of spent fuel

at the Surry ISFSI will not significantly affect the quality of the human environment. Therefore, an environmental impact statement is not warranted and, pursuant to 10 CFR Part 51.31, a Finding of No Significant Impact (FONSI) is appropriate.

10.0 REFERENCES

1. Virginia Electric and Power Company (VEPCO), letter to the U.S. Nuclear Regulatory Commission, submitting Application for Surry Independent Spent Fuel Storage Installation, October 8, 1982.

2. U.S. Nuclear Regulatory Commission, "Final Generic Environmental Impact Statement on Handling and Storage of Spent Light Water Power Reactor Fuel," NUREG-0575, August 1979.

3. Ibid., p. ES-12.

4. U.S. Atomic Energy Commission, "Final Environmental Statement related to Operation of Surry Power Station Unit 1," Docket No. 50-280, May 1972.

5. U.S. Atomic Energy Commission, "Final Environmental Statement related to Operation of Surry Power Station Unit 2," Docket No. 50-281, June 1972.

6. U.S. Atomic Energy Commission, "Final Environmental Statement related to Construction of Surry Power Station Units 3 and 4," Docket Nos. 50-434 and 50-435, May 1974.

7. VEPCO, "Environmental Report - Surry Power Station Dry Cask Independent Spent Fuel Storage Installation," (undated), submitted with Application (see Reference 1).

8. VEPCO, "Safety Analysis Report - Surry Power Station Dry Cask Independent Spent Fuel Storage Installation," (undated), submitted with Application (see Reference 1).

9. VEPCO, Letter to NRC submitting Responses to NRC Staff's Requests for Additional Information, March 2, 1984.

10. Ibid., June 20, 1984.

11. Op. cit., June 25, 1984.

12. Op. cit., September 21, 1984.

13. Op. cit., October 24, 1984.

14. Op. cit., November 30, 1984.

15. Op. cit., December 4, 1984.

16. Op. cit., December 10, 1984.

17. Virginia Power, Letter to NRC submitting Responses to NRC Staff's Requests for Additional Information, February 8, 1985.

18. U.S. Nuclear Regulatory Commission, Letter to VEPCO transmitting Requests for Additional Information, September 9, 1983.

19. Ibid., October 1, 1984.

20. Op. cit., November 14, 1984.

21. NRC Memorandum from J. Roberts to L. Rouse, (Subject: Summary of Meeting with VEPCO on January 31, 1985), dated February 4, 1985.

22. NRC, "Finding of No Significant Impact" and "Environmental Assessment related to Increasing the Spent Fuel Storage Capacity and the Storage of Surry Spent Fuel at the North Anna Power Station Units", Docket Nos. 50-338 and 50-339, Enclosure 1 of memorandum from James R. Miller, NRC Office of Nuclear Reactor Regulation, to Joseph Rutberg, NRC Office of the Executive Legal Director, dated July 2, 1984.

23. Letter from Michael W. Maupin (Hunton & Williams) to Sheldon J. Wolfe, Atomic Safety and Licensing Board Panel, U.S. Nuclear Regulatory Commission, transmitting Settlement Agreement of April 26, 1984 between County of Louisa, Va., and VEPCO, dated May 1, 1984.

24. VEPCO, "Applicant's Environmental Report - Construction Permit Stage - Surry Power Station Units 3 and 4," Docket Nos. 50-434 and 50-435, April 1973.

25. U.S. Nuclear Regulatory Commission, "Socioeconomic Impacts of Nuclear Generating Stations: Surry Case Study," NUREG/CR-2749 Vol. 11, July 1982.

26. General Nuclear Systems, Inc., "Topical Safety Analysis Report for the CASTOR V/21 Cask Independent Spent Fuel Storage Installation (Dry Storage)," January 22, 1985.

27. U.S. NRC, "Occupational Radiation Exposure at Commercial Nuclear Power Reactors - 1982 Annual Report," NUREG-0713, Vol. 4, December 1983.

28. E.L. Wilmont, "Transportation Accident Scenarios for Commercial Spent Fuel," SAND-80-2124, Sandia National Laboratories, Albuquerque, NM, February 1981.

29. D. E. Dunning, Jr. et al., "Estimates of Internal Dose Equivalent to 22 Target Organs for Radionuclides Occurring in Routine Releases from Nuclear Fuel-Cycle Facilities, Vol. III", NUREG/CR-0150, Vol. 3, prepared for the NRC by Oak Ridge National Laboratory, Oak Ridge, Tennessee, October 1981.

30. D. C. Kocher, "Dose-Rate Conversion Factors for External Exposure to Photons and Electrons", NUREG/CR-1918, prepared for the NRC by Oak Ridge National Laboratory, Oak Ridge, Tennessee, August 1981.

11.0 LIST OF PREPARERS

Name and Title	Responsibility
C. Billups, Aquatic Scientist	Project Leader, Water Use and Aquatic Resources
W. Swick, Secretary	Word Processing, Coordination
D. Cleary, Section Leader	Socioeconomics, Demography
G. LaRoche, Sr. Land Use Analyst	Land Use and Terrestrial Resources
E. Markee, Sr. Meteorologist	Meteorology, Climatology
R. Samworth, Section Leader	Air Quality, Noise
O. Smith, Plant Protection Analyst	Safeguards for Spent Fuel
F. Sturz, Health Physicist	Radiological, Alternatives