2.4 HYDROLOGY

Since the submission of the VEGP Construction Permit Stage Environmental Report (CPSER) and the publication of the Nuclear Regulatory Commission's Final Environmental Statement (FES), additional flow and water quality data for the Savannah River and groundwater have become available. The following is a brief description of these additional studies and factors which have changed since the CPSER and FES.

2.4.1 SURFACE WATER ENVIRONS

Since the completion of the FES, an additional upstream reservoir, Richard B. Russell, located between Clarke Hill and Hartwell reservoirs has been scheduled for completion in 1984. The construction of this reservoir is not expected to change the low or average flow characteristics at the VEGP site.

Based on data from the United States Geologic Survey gaging station at Augusta, Georgia (approximately 50 river miles upstream from the VEGP site), the annual average flow of the Savannah River is 10,300 ft^3/s. Due to upstream flow control by the U.S. Corp of Engineer dams, the minimum flow, guaranteed to preserve navigability, is 5,800 ft^3/s with 6,300 ft^3/s achieved 70 percent of the time.

There are four facility structures in the flood plain associated with VEGP: the intake structure with canal; the barge unloading facility; the site runoff flume; and site discharge pipe. These facilities have been permitted by the Corps of Engineers pursuant to section 10 of the River and Harbors Act and section 404 of the Clean Water Act. As part of that process (33 CFR 320.4 (1)), the Corps of Engineers considered Executive order 11988 relative to flood plain management and the effect that these facilities would have on upstream and downstream users.

Detailed information on surface water is found in section 2.4 of the Final Safety Analysis Report (FSAR). Section 2.5 of the CPSER and section 2.5 of the FES contain further information on surface water.

Additional surface water quality studies have been performed by Georgia Power Company, the U.S. Geological Survey, and others. Results of these studies have been analyzed and compared with information utilized to prepare the FES. These studies show no significant change in the characteristics of the surface water quality at the VEGP site from that used in the preparation of the FES. Georgia Power Company has conducted specific studies

regarding silt loading in the Savannah River in the vicinity of the intake structure. This information has been utilized in the design of the VEGP intake structure.

2.4.2 GROUNDWATER

Details of the regional and site groundwater characteristics are discussed in FSAR subsection 2.4.12. Readers are referred to that document for descriptions of aquifer characteristics, hydraulic properties, stratigraphic features which control groundwater migration, and details of past and projected future use of the ground water resource.

In the paragraphs which follow, the groundwater aquifers at the VEGP are briefly described with emphasis placed on the potential for contamination to migrate offsite and affect groundwater quality in adjacent areas.

2.4.2.1 Cretaceous and Tertiary Groundwater Systems

The Cretaceous groundwater system is represented in the VEGP area by the Tuscaloosa Formation. This unit is approximately 700 ft thick near the VEGP and appears to be of equal or greater thickness in South Carolina. It consists primarily of crossbedded sands and gravels with subordinate beds of silt, clay, and kaolin. It is a highly transmissive aquifer system. 4

Recharge to the Cretaceous aquifer is primarily from infiltration of rainfall where the formation is exposed several miles north of VEGP. In the same general area, the Teritiary groundwater system is also exposed and off-laps the Cretaceous system. In this area, the Cretaceous and Tertiary systems are in hydraulic contact and the groundwater is under water table conditions. After the water infiltrates the sediments, it migrates downdip in a south-by-southeast direction. Downdip from the recharge area, groundwater in the Cretaceous sediments becomes confined beneath the relatively impermeable clays and silts of the Huber and Ellenton Formations (Paleocene). At VEGP the Huber and Ellenton Formations are permeable and permit hydraulic contact between the Cretaceous aquifer and overlying Tertiary aquifer. As will be seen, these aquifers are both confined by the stratigraphically higher Blue Bluff member of the Lisbon Formation.

At the VEGP site, the Teritiary groundwater system is represented by two members of the Lisbon Formation. The lower member consists of fluvial sands and sandy clays for which formal stratigraphic nomenclatures has not yet been established.

These sediments are moderately permeable, as shown by field permeability tests for the river facilities and by the operation of the VEGP potable water supply well, which is completed in the upper 25 ft of this member. Total thickness at the site is approximately 100 ft. The sources of cooling system makeup water for the nuclear service cooling water system at VEGP are wells producing from these Cretaceous/ Tertiary aquifers.

The second member of the Lisbon Formation at the site is the Blue Bluff marl member, which consists of semiconsolidated glauconitic marl with subordinate lenses of dense, well-indurated, well-cemented limestone. The marl layer overlies the unnamed sands member and is approximately 70 ft thick. The permeability of the marl layer is extremely low, and it is classified as an aquiclude. It effectively confines the underlying unnamed sands to produce artesian conditions at the site.

To summarize, the Teritiary aquifer system overlies and offlaps 4
the Cretaceous system in its outcrop areas north of VEGP. Groundwater is under water table conditions in both aquifers in this area. At the VEGP site the two systems are separated stratigraphically (but not hydraulically) by the Huber and Ellenton Formations. The two systems are confined beneath the Blue Bluff marl member of the Lisbon Formation. These conditions prevail to an unidentified point to the southeast between VEGP and Girard.

2.4.2.2 Tertiary and Quaternary Water Table Aquifers

The marl aquiclude is overlain at VEGP and throughout much of the 25-mile study area by the Barnwell Group (late Eocene) which, in turn, is overlain by the Hawthorne Formation (early Miocene). Both formations are extensively exposed since erosion has removed much of the Hawthorne unit. Pleistocene alluvial and terrace deposits are also present as are Holocene flood plain deposits parallel to the Savannah River.

In the general vicinity of VEGP, the basal unit of the Barnwell Group is the Utley limestone member of the Clinchfield Formation. This is a fossiliferous and cavernous limestone unit which is capable of transmitting groundwater. However, the unit rarely exceeds a few tens of feet in thickness, and it is of limited areal extent. The remaining sedimentary units overlying the marl and the Utley limestone consist of unconsolidated clays, silts, and sands which contain groundwater under water table conditions. Laboratory and field permeability testing was performed on the materials overlying

the marl aquiclude at VEGP during early site investigations. The field tests indicated permeability values of 200 to 250 ft/year and laboratory tests indicated values of 10 to 20,000 ft/year.

Recharge to the water table aquifer is almost exclusively by infiltration of direct precipitation. Lateral recharge from adjacent areas is insignificant because the plant area is situated on an interfluvial high, i.e., it is isolated by drainage channels which have cut down to or near the marl aquiclude and act as interceptor drains to potential recharge sources moving laterally toward the interfluve. The isolation of the water table aquifer at the site effectively prevents offsite migration of groundwater contaminants through the aquifer. This very important point is discussed in a later section on potential for contaminant transport.

2.4.2.3 Effectiveness of the Marl Aquiclude

At the explorary hole 42 at VEGP, a series of observation wells located at various depths and designated 42A, B, C, D, and E 4
provide a measure of the effectiveness of the marl as an aquiclude. Head differential between two wells (42A and 42B) which are located just above and just below the marl is more than 50 ft. This difference is consistent throughout the areas covered by observation wells. Exploratory hole number 42 was abandoned during plant construction. This and all other holes not completed as observation wells and open to the confined aquifer were sealed with grout.

The marked difference in water levels indicates a large contrast in permeability between the aquifers and the marl. To bring about such a marked difference in piezometric levels, the barrier must be extensive and without significant through-going openings such as fractures or solution cavities. The continuity of the marl is verified over a large area by numerous exploratory holes drilled through it. None of the borings encountered highly fractured zones nor was there evidence of leaching and removal of calcareous material.

To further verify the effectiveness of the marl as an aquiclude, permeability tests wre conducted. These are discussed in detail in the VEGP FSAR paragraph 2.4.12.2.4. The results show that the permeability of the marl is effectively zero. It is concluded that the marl may be considered an effective barrier to groundwater movement. Any fluids that may infiltrate the overlying sands would be confined to the water table aquifer system.

2.4.2.4 Potential for Contamination of Aquifers

As previous sections have discussed, the water table aquifer is hydraulically separated from the underlying confined Tertiary and Cretaceous aquifers. Because the permeability of the marl aquiclude is essentially zero, there is effectively no possibility for contaminants to migrate downwards from the water table aquifer to these deeper aquifers. One possible means for contaminants to reach the confined aquifers would theoretically be for the contaminants to migrate through the water table aquifer to a stream which would discharge to the Savannah river. The Savannah River is in hydraulic contact with the deep aquifers; however, as described previously, the deep aquifers discharge to the river because their hydraulic heads are substantially higher in elevation than the river. Any contaminants still remaining after migrating to the river could not, therefore, enter the deeper aquifers.

Lateral migration of contaminants in the water table aquifer could not affect this aquifer offsite because the site is hydraulically isolated, as previously discussed. Any lateral transport would be intercepted by incised drainages and discharged to the river. 4

An analysis of a core melt is presented in Appendix 7A. This is assumed to be the worst case accident scenario from the standpoint of contaminating groundwater. An analysis of the critical tank rupture is presented in VEGP FSAR section 15.7.3. This analysis considers a release from the recycle holdup tank located at elevation 119 ft in the auxiliary building. The analysis takes no credit whatsoever for the presence of the auxiliary building and assumes that the contaminants are instantly transferred to the water table aquifer.

Other possible accident scenarios include surface spills and pipe breaks. All such scenarios are enveloped by the analysis for the recycle holdup tank because releases from this source have been assumed to instantly enter the water table aquifer, whereas surface spills would have to percolate downwards through the unsaturated zone before reaching the water table.

Within the nearby vicinity of the VEGP, water discharges from the Tuscaloosa Formation to the Savannah River. Piezometric maps published from various sources shows a groundwater sink along the Savannah River. All these maps indicate that groundwater in the Tuscaloosa Formation does not cross from South Carolina into Georgia or from Georgia into South Carolina (Reference 1).

2.4.2.5 Migration of Aquifer Contamination

A comprehensive groundwater monitoring program has been
implemented at the VEGP. This program was designed to monitor
groundwater levels and movement in both the confined and
unconfined aquifers for the life of the plant, and to monitor
levels of groundwater accumulating in the compacted backfill
inside the power block excavation throughout the construction.
The original program consisted of 9 observation wells set in
the confined aquifer, 16 observation wells set in the
unconfined aquifer, and 11 observation wells set in the
backfill. Some of the backfill wells were located at sites of
structures and were later abandoned. Those not abandoned will
be maintained for the permanent monitoring program. VEGP FSAR
table 2.4.12-7, sheet 1, summarizes water levels measured 4
during site exploration. FSAR table 2.4.12-7, sheet 2,
summarized piezometric levels that have been recorded since the
monitoring program was initiated.

As discussed above, the only possible aquifer which could be contaminated is the water table aquifer, and then only in the immediate vicinity of the site because it is hydraulically isolated. The onsite monitoring wells could be used to determine the presence and possible migration of contaminants. If an accident occurred, the analyses mentioned above show that there would be adequate time, on the order of years, to verify that contaminants in the water table aquifer would not migrate to other aquifers. Should the monitoring of a spill provide data to suggest that contaminants might, in fact, migrate offsite, then adequate time would be available to develop plans for the mitigation of contaminant migration. Such mitigation is well within present technological capabilities.

REFERENCE

1. Final Environmental Impact Statement, L-Reactor Operator Savannah River Plant, DOE/EIS - 0108, May 1984. 4

TABLE 5.2-1 (SHEET 1 OF 2)

DIFFUSION AND DEPOSITION ESTIMATES FOR ALL RECEPTOR LOCATIONS

Release Point: Plant Vent/Wake-Split   Season: Annual   Computer Run ID: VX-3

Direction	Distance to Near-est Milk Cow (m)[a]	X/Q (s/m)	Depleted X/Q (s/m)	D/Q (m^{-2})	Distance to Near-est Meat Animal (m)[a]	X/Q (s/m^3)	Depleted X/Q (s/m^3)	D/Q (m^{-2})	Distance to Near-est Milk Goat (m)[a]	Depleted X/Q (s/m^3)	X/Q (s/m^3)	D/Q (m^{-2})
N	-	2.5E-08	2.2E-08	8.2E-11	-	2.5E-08	2.2E-08	8.2E-11	-	2.5E-08	2.2E-08	8.2E-11
NNE	-	2.6E-08	2.3E-08	9.0E-11	-	2.6E-00	2.3E-08	9.0E-11	-	2.6E-08	2.3E-08	9.0E-11
NE	-	3.5E-08	3.2E-08	1.1E-10	-	3.5E-08	3.2E-08	1.1E-10	-	3.5E-08	3.2E-08	1.1E-10
ENE	-	2.9E-08	2.6E-08	1.3E-10	-	2.9E-08	2.6E-08	1.3E-10	-	2.9E-08	2.6E-08	1.3E-10
E	-	2.2E-08	2.0E-08	1.6E-10	-	2.2E-08	2.0E-08	1.6E-10	-	2.2E-08	2.0E-08	1.6E-10
ESE	-	2.2E-08	1.9E-08	1.4E-10	-	2.2E-08	1.9E-08	1.4E-10	-	2.2E-08	1.9E-08	1.4E-10
SE	7403	2.4E-08	2.2E-08	1.2E-10	6920	2.6E-08	2.3E-08	1.4E-10	-	2.3E-08	2.0E-08	1.1E-10
SSE	-	1.3E-08	1.2E-08	6.4E-11	-	1.3E-08	1.2E-08	6.4E-11	-	1.3E-08	1.2E-08	6.4E-11
S	-	2.0E-08	1.8E-08	8.1E-11	-	2.0E-08	1.8E-08	8.1E-11	-	2.0E-08	1.8E-08	8.1E-11
SSW	-	1.8E-08	1.6E-08	9.1E-11	7803	1.9E-08	1.7E-08	1.0E-10	-	1.8E-08	1.6E-08	9.1E-11
SW	-	3.6E-08	3.2E-08	1.4E-10	4889	5.6E-08	5.1E-08	3.0E-10	-	3.6E-08	3.2E-08	1.4E-10
WSW	-	2.8E-08	2.5E-08	1.2E-10	7724	3.0E-08	2.7E-08	1.3E-10	-	2.8E-08	2.5E-08	1.2E-10
W	-	2.5E-08	2.3E-08	1.1E-10	-	2.5E-08	2.3E-08	1.1E-10	-	2.5E-08	2.3E-08	1.1E-10
WNW	-	2.4E-08	2.2E-08	8.7E-11	-	2.4E-08	2.2E-08	8.8E-11	-	2.4E-08	2.2E-08	8.7E-11
NW	-	2.8E-08	2.6E-08	8.1E-11	6276	3.6E-08	3.4E-08	1.2E-10	-	2.8E-08	2.6E-08	8.1E-11
NNW	-	2.6E-08	2.4E-08	7.6E-11	-	2.6E-08	2.4E-08	7.6E-11	-	2.6E-08	2.4E-08	7.6E-11

1 4 2 4

TABLE 5.2-1 (SHEET 2 OF 2)

Direction	Distance to Nearest Residence (m)[a]	X/Q (s/m^3)	Depleted X/Q (s/m^3)	D/Q (m^{-2})	Distance to Nearest Veg. Garden (m)[a]	X/Q (s/m^3)	Depleted X/Q (s/m^3)	D/Q (m^{-2})	Nearest Site Boundary (m)	Depleted X/Q (s/m^3)	X/Q (s/m^3)	D/Q (m^{-2})
N	-	2.5E-08	2.2E-08	8.2E-11	-	2.5E-08	2.2E-08	8.2E-11	1344	1.4E-07	1.2E-07	1.3E-09
NNE	-	2.6E-08	2.3E-08	9.0E-11	-	2.6E-08	2.3E-08	9.0E-11	1097	1.9E-07	1.7E-07	1.8E-09
NE	-	3.5E-08	3.2E-08	1.1E-10	-	3.5E-08	3.2E-08	1.1E-10	1097	2.0E-07	1.8E-07	2.3E-09
ENE	-	2.9E-08	2.6E-08	1.3E-10	-	2.9E-08	2.6E-08	1.3E-10	1097	1.8E-07	1.7E-07	2.8E-09
E	-	2.2E-08	2.0E-08	1.6E-10	-	2.2E-08	2.0E-08	1.6E-10	1369	1.2E-07	1.1E-07	2.7E-09
ESE	-	2.2E-08	1.9E-08	1.4E-10	-	2.2E-08	1.9E-08	1.4E-10	1817	9.4E-08	8.4E-08	1.6E-09
SE	5310	3.4E-08	3.0E-08	2.2E-10	5310	3.4E-08	3.0E-08	2.2E-10	1866	8.3E-08	7.4E-08	1.2E-09
SSE	-	1.3E-08	1.2E-08	6.4E-11	-	1.3E-08	1.2E-08	6.4E-11	1773	4.8E-08	4.4E-08	7.0E-10
S	7240	1.9E-08	1.7E-08	9.4E-11	-	2.0E-08	1.8E-08	8.1E-11	1692	6.8E-08	6.1E-08	9.2E-10
SSW	7562	1.9E-08	1.7E-08	1.0E-10	-	1.8E-08	1.6E-08	9.1E-11	1680	7.7E-08	7.0E-08	1.1E-09
SW	4506	6.2E-08	5.6E-08	3.3E-10	4828	5.7E-08	5.2E-08	3.1E-10	1462	1.7E-07	1.6E-07	1.2E-09
WSW	1931	1.2E-07	1.1E-07	1.1E-09	2253	1.0E-07	9.5E-08	9.2E-10	1462	1.5E-07	1.4E-07	1.8E-09
W	2414	7.8E-08	7.1E-08	7.3E-10	2897	6.8E-08	6.1E-08	5.8E-10	1462	1.2E-07	1.1E-07	1.5E-09
WNW	3058	6.3E-08	5.9E-08	4.2E-10	5471	3.6E-08	3.3E-08	1.6E-10	1649	1.0E-07	9.4E-08	1.0E-09
NW	3379	6.5E-08	6.0E-08	3.4E-10	3862	5.8E-08	5.3E-08	2.7E-10	2240	8.5E-08	7.8E-08	6.3E-10
NNW	-	2.6E-08	2.4E-08	7.6E-11	-	2.6E-08	2.4E-08	7.6E-11	1840	9.4E-08	8.5E-08	7.7E-10

a. Receptor distance greater than 8000 m is indicated by (-); diffusion values given are for 8000 m; data collected in spring of 1983.

TABLE 5.2-2 (SHEET 1 OF 2)

DIFFUSION AND DEPOSTION ESTIMATES FOR ALL RECEPTOR LOCATIONS

Release Point: Assumed Ground Release in Building Wake   Season: Annual   Computer Run ID: VX-4

Direction	Distance to Nearest Milk Cow (m)[a]	X/Q (s/m³)	Depleted X/Q (s/m³)	D/Q (m⁻²)	Distance to Nearest Meat Animal (m)[a]	X/Q (s/m³)	Depleted X/Q (s/m³)	D/Q (m⁻²)	Distance to Nearest Milk Goat (m)[a]	X/Q (s/m³)	Depleted X/Q (s/m³)	D/Q (m⁻²)
N	-	1.1E-07	8.2E-08	2.4E-10	-	1.1E-07	8.2E-08	2.4E-10	-	1.1E-07	8.2E-08	2.4E-10
NNE	-	1.1E-07	8.4E-08	2.4E-10	-	1.1E-07	8.4E-08	2.4E-10	-	1.1E-07	8.4E-08	2.4E-10
NE	-	1.4E-07	1.0E-07	2.8E-10	-	1.4E-07	1.0E-07	2.8E-10	-	1.4E-07	1.0E-07	2.8E-10
ENE	-	1.2E-07	9.2E-08	2.8E-10	-	1.2E-07	9.2E-08	2.8E-10	-	1.2E-07	9.2E-08	2.8E-10
E	-	1.1E-07	8.2E-08	3.0E-10	-	1.1E-07	8.2E-08	3.0E-10	-	1.1E-07	8.2E-08	3.0E-10
ESE	-	1.1E-07	8.3E-08	2.8E-10	-	1.1E-07	8.3E-08	2.8E-10	-	1.1E-07	8.3E-08	2.8E-10
SE	7403	1.2E-07	8.7E-08	2.6E-10	6920	1.3E-07	9.8E-08	2.9E-10	-	1.1E-07	7.8E-08	2.4E-10
SSE	-	8.2E-08	6.1E-08	1.5E-10	-	8.2E-08	6.1E-08	1.5E-10	-	8.2E-08	6.1E-08	1.5E-10
S	-	1.2E-07	8.6E-08	1.9E-10	7242	1.2E-07	8.6E-07	1.9E-10	-	1.2E-08	8.6E-08	1.9E-10
SSW	-	1.0E-07	7.7E-08	2.0E-10	7803	1.2E-07	8.6E-08	2.2E-10	-	1.0E-07	7.7E-08	2.0E-10
SW	-	1.4E-07	1.0E-07	2.9E-10	4989	2.6E-07	2.0E-07	6.5E-10	-	1.4E-07	1.0E-07	2.9E-10
WSW	-	1.1E-07	8.0E-08	2.5E-10	7724	1.1E-07	8.4E-07	2.6E-10	-	1.1E-07	8.0E-08	2.5E-10
W	-	1.2E-07	9.1E-08	2.5E-10	-	1.1E-07	9.1E-08	2.5E-10	-	1.2E-07	9.1E-08	2.5E-10
WNW	-	1.0E-07	7.6E-08	2.1E-10	-	1.1E-07	7.6E-08	2.1E-10	-	1.0E-07	7.6E-08	2.1E-10
NW	-	1.1E-07	8.4E-08	2.2E-10	6276	1.6E-07	1.2E-07	3.3E-10	-	1.1E-07	8.4E-08	2.2E-10
NNW	-	1.1E-07	8.1E-08	2.2E-10	-	1.1E-07	8.1E-08	2.2E-10	-	1.1E-07	8.1E-08	2.2E-10

TABLE 5.2-2 (SHEET 2 OF 2)

Direction	Distance to Nearest Residence (m)[a]	X/Q (s/m^3)	Depleted X/Q (s/m^3)	D/Q (m^{-2})	Distance to Nearest Veg. Garden (m)[a]	X/Q (s/m^3)	Depleted X/Q (s/m^3)	D/Q (m^{-2})	Nearest Site Boundary (m)	Depleted X/Q (s/m^3)	X/Q (s/m^3)	D/Q (m^{-2})
N	-	1.1E-07	8.2E-08	2.4E-10	-	1.1E-07	8.2E-08	2.4E-10	1344	1.4E-06	1.2E-06	5.4E-09
NNE	-	1.1E-07	8.4E-08	2.4E-10	-	1.1E-07	8.4E-08	2.4E-10	1097	1.9E-06	1.7E-06	7.7E-09
NE	-	1.4E-07	1.0E-07	2.8E-10	-	1.4E-07	1.0E-07	2.8E-10	1097	2.2E-06	2.0E-06	8.8E-09
ENE	-	1.2E-07	9.2E-08	2.8E-10	-	1.2E-07	9.2E-08	2.8E-10	1097	2.0E-06	1.8E-06	8.8E-09
E	-	1.1E-07	8.2E-08	3.0E-10	-	1.1E-07	8.2E-08	3.0E-10	1369	1.3E.06	1.2E-06	6.8E-09
ESE	-	1.1E-07	8.3E-07	2.8E-10	-	1.1E-07	8.3E-08	2.8E-10	1817	8.8E-06	7.6E-07	3.8E-09
SE	5310	1.9E-07	1.5E-07	4.8E-10	5310	1.9E-07	1.5E-07	4.8E-10	1866	8.0E-07	6.9E-07	3.0E-08
SSE	-	8.2E-08	6.1E-08	1.5E-10	-	8.2E-08	6.1E-08	1.5E-10	1773	6.6E-07	5.8E-07	2.1E-09
S	7240	1.3E-07	1.0E-07	2.1E-10	-	1.2E-07	8.6E-08	1.9E-10	1692	9.9E-07	8.6E-07	2.9E-09
SSW	7562	1.1E-07	8.4E-08	2.2E-10	-	1.0E-07	7.7E-08	2.0E-10	1680	9.1E-07	7.9E-07	3.1E-09
SW	4506	3.0E-07	2.4E-07	7.7E-10	4828	2.8E-07	2.1E-07	6.7E-10	1462	1.5E-06	1.3E-06	5.7E-09
WSW	1931	8.1E-07	7.0E-07	2.9E-09	2253	6.7E-07	5.5E-07	2.2E-09	1462	1.2E-06	1.1E-06	5.0E-09
W	2414	6.6E-07	5.5E-07	2.0E-10	2897	5.1E-07	4.1E-07	1.5E-09	1462	1.3E-06	1.2E-06	4.9E-09
WNW	3701	3.9E-07	3.3E-07	1.2E-09	5471	1.07-07	1.3E-07	4.1E-09	1649	9.6E-07	8.4E-07	3.4E-09
NW	3701	3.8E-07	3.5E-07	1.0E-09	3862	3.1E-07	2.6E-07	8.1E-10	2240	6.9E-07	5.9E-07	2.0E-09
NNW	-	1.1E-07	8.1E-08	2.2E-10	-	1.1E-07	8.1E-08	2.2E-10	1804	9.2E-07	8.0E-07	2.9E-09

a. Receptor distance greater than 8000 m is indicated by (-); diffusion values given are for 8000 m; date collected in spring of 1983.

TABLE 5.2-3 1

CONCENTRATIONS OF GASEOUS (DEPOSITED) EFFLUENTS AT THE NEAREST RESIDENCE[a]

Isotope	On Ground (pCi/m²)	In Vegetation (pCi/m²)
H-3	0	1.60E-01
CR-51	4.93E-03	3.95E-10
MN-54	5.01E+01	7.12E-07
FE-55	2.32E-01	1.06E-09
FE-59	2.45E00	1.60E-07
CO-58	3.92E+01	1.90E-06
CO-60	4.45E+02	1.20E-06
SR-89	6.43E-01	3.94E-08
SR-90	8.81E00	1.23E-08
ZK-95	4.75E-04	2.40E-11
CE-141	2.35E-04	1.77E-11
CE-144	1.23E+02	2.01E-11
CS-134	1.12E-02	7.53E-07
CS-136	1.77E+05	9.45E-10
CS-137	1.60E-04	2.24E-04
BA-140	1.14E+02	1.34E-11
I-131	1.70E+01	3.71E-05
I-133	0	3.75E-10
C-14	0	2.08E-02

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a. Nearest residence - 1931 m WSW from the center of the VEGP.

TABLE 5.2-6 (SHEET 1 OF 7)

ESTIMATED ANNUAL DOSES TO AN INDIVIDUAL FORM GASEOUS AND PARTICULATE EFFLUENTS[a]

Gaseous Dose Rate[b]

Location	Pathway	Gamma Dose Rate in Air (mrad/year)	Beta Dose Rate in Air (mrad/year)	Total Body Dose Rate (mrem/year)	Skin Dose Rate (mrem/year)
Nearest Site Boundary (0.68 mile NE)	Plume	2.24E-02	3.94E-02	1.41E-02	3.34E-02
Nearest Residence (1.2 mile WSW)	Plume	1.20E-02	2.21E-02	7.63E-03	1.82E-02
Nearest Vegtable Garden (1.4 mile WSW)	Plume	1.01E-02	1.83E-02	6.35E-03	1.53E-02
Nearest Meat Animal (3.10 mile SW)	Plume	5.35E-03	9.91E-03	3.36E-03	8.21E-03
Nearest Milk Cow and Goat (4.60 mile SE)	Plume	2.31E-03	4.27E-03	1.46E-03	3.54E-03

Radioiodines and Particulates Dose Rate (mrem/year)[d]

Location	Pathway	Total Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Nearest Site Boundary (0.68 mile NE)	Ground Deposition	2.42E-01	2.42E-01	2.42E-01	2.42E-01	2.42E-01	2.42E-01	2.42E-01	2.83E-01
	Inhalation								
	Adult	2.70E-02	2.51E-02	2.09E-03	2.78E-02	3.22E-02	5.78E-02	2.77E-02	2.78E-02
	Teen	2.65E-02	2.54E-02	2.93E-03	2.90E-02	2.68E-02	6.62E-02	2.81E-02	2.79E-02
	Child	2.30E-02	2.24E-02	3.96E-03	2.59E-02	2.38E-02	6.97E-02	2.51E-02	2.50E-02
	Infant	1.31E-02	1.29E-02	2.42E-03	1.56E-02	1.38E-02	5.64E-02	1.54E-02	1.55E-02
	Total Dose to Receptor[e]								
	Adult	2.69E-01	2.67E-01	2.44E-01	2.70E-01	2.74E-01	3.00E-01	2.70E-01	3.11E-01
	Teen	2.69E-01	2.67E-01	2.45E-01	2.71E-01	2.69E-01	3.08E-01	2.70E-01	3.11E-01
	Child	2.65E-01	2.64E-01	2.46E-01	2.68E-01	2.66E-01	3.12E-01	2.67E-01	3.08E-01
	Infant	2.55E-01	2.55E-01	2.44E-01	2.58E-01	2.56E-01	2.98E-01	2.57E-01	2.99E-01

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TABLE 5.2-6 (SHEET 2 OF 7)

Dose Rate (mrem/year)

Location	Pathway	Total Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Nearest Site Boundary (0.68 Mile NE)	Ground	2.42E-01	2.42E-01	2.42E-01	2.42E-01	2.42E-01	2.42E-01	2.42E-01	2.83E-01
	Vegetables								
	Adult	1.43E-01	3.94E-02	1.62E-01	1.98E-01	9.18E-02	1.53E-02	1.98E-02	3.59E-02
	Teen	1.36E-01	5.04E-02	2.66E-01	3.04E-01	1.35E-01	1.45E-01	2.53E-02	4.65E-02
	Child	1.51E-01	8.80E-02	6.36E-01	5.25E-01	2.30E-01	2.37E-01	5.07E-02	8.50E-02
	Meat								
	Adult	1.72E-02	7.95E-03	2.78E-02	2.24E-02	1.27E-02	2.51E-02	9.50E-03	7.57E-03
	Teen	9.54E-03	5.59E-03	2.33E-02	1.73E-02	9.48E-03	1.81E-02	6.93E-03	5.36E-03
	Child	1.08E-02	8.54E-03	4.35E-01	2.42E-02	1.36E-02	2.76E-02	1.03E-02	8.41E-03
	Cow Milk								
	Adult	9.59E-02	1.64E-02	1.11E-01	1.40E-01	5.84E-02	5.04E-01	2.75E-02	1.35E-02
	Teen	9.75E-02	2.33E-02	2.01E-01	2.41E-01	9.89E-02	7.96E-01	4.86E-02	1.96E-02
	Child	9.59E-02	3.99E-02	4.86E-01	4.22E-01	1.68E-01	1.57E00	8.16E-02	3.70E-02
	Infant	1.23E-01	6.86E-02	8.09E-01	8.20E-01	2.79E-01	3.80E00	1.47E-01	6.58E-02
	Inhalation								
	Adult	2.70E-02	2.51E-02	2.09E-03	2.78E-02	3.22E-02	5.78E-02	2.77E-02	2.78E-02
	Teen	2.65E-02	2.54E-02	2.93E-03	2.90E-02	2.68E-02	6.62E-02	2.81E-02	2.79E-02
	Child	2.30E-02	2.24E-02	3.96E-03	2.59E-02	2.38E-02	5.97E-02	2.51E-02	2.50E-02
	Infant	1.31E-02	1.29E-02	2.42E-03	1.56E-02	1.38E-02	5.64E-02	1.54E-02	1.55E-02
	Total Dose to Receptor[c]								
	Adult	5.25E-01	3.31E-01	5.45E-01	6.30E-01	4.37E-01	9.82E-01	3.27E-01	3.68E-01
	Teen	5.12E-01	3.47E-01	7.35E-01	8.33E-01	5.12E-01	1.27E00	3.51E-01	3.82E-01
	Child	5.23E-01	4.01E-01	1.80E00	1.24E00	5.77E-01	2.15E00	4.10E-01	4.38E-01
	Infant	3.78E-01	3.24E-01	1.05E00	1.08E00	5.35E-01	4.10E00	4.04E-01	3.64E-01

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TABLE 5.2-6 (SHEET 3 OF 7)

Dose Rate (mrem/year)

Location	Pathway	Total Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Nearest Residence (1.2 mile WSW)	Ground	8.01E-02	8.01E-02	8.01E-02	8.01E-02	8.01E-02	8.01E-02	8.01E-02	9.35E-02
	Inhalation								
	Adult	1.12E-02	1.06E-02	7.35E-04	1.15E-02	1.10E-02	2.28E-02	1.07E-02	1.06E-02
	Teen	1.22E-02	1.07E-02	1.03E-03	1.19E-02	1.12E-02	2.59E-02	1.08E-02	1.06E-02
	Child	1.07E-02	9.41E-03	1.39E-03	1.07E-02	9.91E-03	2.71E-02	9.57E-03	9.39E-03
	Infant	6.57E-03	5.41E-03	8.53E-04	6.36E-03	5.72E-03	2.17E-02	5.52E-03	5.40E-03
	Total Dose to Receptor								
	Adult	9.13E-02	9.07E-02	8.08E-02	9.16E-02	9.11E-02	1.03E-01	9.08E-02	1.04E-01
	Teen	9.23E-02	9.08E-02	8.11E-02	9.20E-02	9.13E-02	1.06E-01	9.09E-02	1.04E-01
	Child	9.08E-02	8.95E-02	8.15E-02	9.08E-02	9.00E-02	1.07E-01	8.97E-02	1.03E-02
	Infant	8.67E-02	8.55E-02	8.10E-02	8.65E-02	8.58E-02	1.02E-01	8.56E-02	9.89E-02

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TABLE 5.2-6 (SHEET 4 OF 7)

Dose Rate (mrem/year)

Location	Pathway	Total Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Nearest Vegetable Garden (1.4 mile WSW)	Ground	6.08E-02	6.08E-02	6.08E-02	6.08E-02	6.08E-02	6.08E-02	6.08E-02	7.10E-02
	Vegetables								
	Adult	4.05E-02	1.48E-02	5.15E-02	5.45E-02	2.78E-02	1.53E-02	4.90E-02	1.38E-02
	Teen	4.10E-02	1.94E-02	8.46E-02	8.32E-02	4.05E-02	1.96E-02	5.27E-02	1.84E-02
	Child	5.15E-02	3.57E-02	2.04E-01	1.46E-01	7.13E-02	3.68E-02	8.77E-02	3.50E-02
	Inhalation								
	Adult	9.27E-03	8.78E-03	1.14E-03	9.50E-03	9.07E-03	9.31E-03	1.82E-02	8.75E-03
	Teen	9.19E-03	8.83E-03	1.60E-03	9.83E-03	9.25E-03	9.52E-03	2.07E-02	8.80E-03
	Child	7.95E-03	7.80E-03	2.17E-03	8.79E-03	8.20E-03	8.61E-03	2.16E-02	7.79E-03
	Infant	4.56E-03	4.48E-03	1.33E-03	5.23E-03	4.73E-03	5.23E-03	1.70E-02	4.48E-03
	Total Dose to Receptor								
	Adult	1.11E-01	8.43E-02	1.13E-01	1.25E-01	9.77E-02	8.54E-02	1.28E-01	9.35E-02
	Teen	1.11E-01	8.90E-02	1.47E-01	1.54E-01	1.11E-01	8.99E-02	1.34E-01	9.82E-02
	Child	1.20E-01	1.04E-01	2.67E-01	2.16E-01	1.40E-01	1.06E-01	1.70E-01	1.14E-01
	Infant	6.54E-02	6.53E-02	6.21E-02	6.60E-02	6.55E-02	6.61E-02	7.78E-02	7.55E-02

TABLE 5.2-6 (SHEET 5 OF 7)

Dose Rate (mrem/year)

Location	Pathway	Total Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Nearest Meat Animal (3.1 mile SW)	Ground	1.80E-02	1.80E-02	1.80E-02	1.80E-02	1.80E-02	1.80E-02	1.80E-02	2.10E-02
	Meat								
	Adult	2.32E-03	1.63E-03	5.57E-03	2.69E-03	1.98E-03	3.05E-03	1.72E-03	1.60E-03
	Teen	1.50E-03	1.21E-03	4.70E-03	2.08E-03	1.50E-03	2.25E-03	1.31E-03	1.19E-03
	Child	2.16E-03	1.99E-03	8.80E-03	3.45E-03	2.37E-03	3.57E-03	2.12E-03	1.98E-03
	Inhalation								
	Adult	4.08E-03	3.89E-03	2.12E-04	4.16E-03	4.01E-03	7.80E-03	3.92E-03	3.88E-03
	Teen	4.06E-03	3.91E-03	2.96E-04	4.29E-03	4.08E-03	8.81E-03	3.98E-03	3.90E-03
	Child	3.52E-03	3.46E-03	4.00E-04	3.83E-03	3.61E-03	9.12E-03	3.51E-03	3.46E-03
	Infant	2.01E-03	1.99E-03	2.45E-04	2.25E-03	2.09E-03	7.18E-03	2.02E-03	1.99E-03
	Total Dose to Receptor								
	Adult	2.44E-02	2.35E-02	2.38E-02	2.48E-02	2.39E-02	2.88E-02	2.36E-02	2.65E-02
	Teen	2.36E-02	2.31E-02	2.29E-02	2.44E-02	2.36E-02	2.90E-02	2.33E-02	2.61E-02
	Child	2.37E-02	2.34E-02	2.72E-02	2.53E-02	2.40E-02	3.07E-02	2.36E-02	2.65E-02
	Infant	2.00E-02	2.00E-02	1.82E-02	2.02E-02	2.01E-02	2.52E-02	2.00E-02	2.30E-02

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TABLE 5.2-6 (SHEET 6 OF 7)

Dose Rate (mrem/year)

Location	Pathway	Total Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Nearest Milk Cow (4.60 mile SE)	Ground	7.20E-03	7.20E-03	7.20E-03	7.20E-03	7.20E-03	7.20E-03	7.20E-03	8.40E-03
	Cow Milk								
	Adult	3.57E-03	1.21E-03	4.96E-03	4.86E-03	2.47E-03	1.73E-03	1.54E-03	1.12E-03
	Teen	4.03E-03	1.82E-03	9.07E-03	8.31E-03	4.08E-03	2.74E-02	2.57E-03	1.71E-03
	Child	5.17E-03	3.51E-03	2.20E-02	1.48E-02	7.36E-03	5.43E-02	4.74E-03	3.42E-03
	Infant	8.08E-03	6.44E-03	3.89E-02	2.87E-02	1.27E-02	1.29E-01	8.74E-03	6.35E-03
	Inhalation								
	Adult	1.83E-03	1.75E-03	9.22E-05	1.86E-03	1.79E-03	3.49E-03	1.76E-03	1.74E-03
	Teen	1.81E-03	1.76E-03	1.29E-04	1.92E-03	1.82E-03	3.95E-03	1.78E-03	1.75E-03
	Child	1.58E-03	1.55E-03	1.74E-04	1.71E-03	1.62E-03	4.08E-03	1.57E-03	1.55E-03
	Infant	9.03E-04	8.91E-04	1.07E-04	1.01E-03	9.32E-04	3.22E-03	9.07E-04	8.90E-04
	Total Dose to Receptor								
	Adult	1.26E-02	1.02E-02	1.23E-02	1.39E-02	1.15E-02	2.80E-02	1.05E-02	1.13E-02
	Teen	1.31E-02	1.08E-02	1.64E-02	1.74E-02	1.31E-02	3.86E-02	1.16E-02	1.18E-02
	Child	1.39E-02	1.23E-02	2.93E-02	2.38E-02	1.62E-02	6.55E-02	1.35E-02	1.34E-02
	Infant	1.62E-02	1.45E-02	4.62E-02	3.69E-02	2.08E-02	1.40E-01	1.69E-02	1.56E-02

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a. All data is on a per unit basis. Doses were calculated using the GASPAR code.

b. Evaluated at a location that could be occupied during the term of plant operation.

Appendix I design objectives - gaseous effluents (noble gases only):

Gamma dose in air - 10 mrad/year per unit
Beta dose in air - 20 mrad/year per unit
Dose to total body of individual - 5 mrem/year per unit
Dose to skin of individual - 15 mrem/year per unit

Annex to Appendix I, Docket RM-50-2. Design objectives are the same as Appendix I except on a per-site basis; therefore calculated doses should be multiplied by 2.

c. Provided for information only; a receptor is assumed present at the location of a potential pathway. This evaluation is based on the worst case X/Q at the site boundary. 1 4

d. Evaluated at a location where an exposure pathway and dose receptor actually exist at the time of licensing.

Appendix I design objectives - radioiodines and particulates:

Dose to any organ from all pathways - 15 mrem/year per unit

Annex to Appendix I Docket RM-05-2 design objectives:

Dose to any organ from all pathways - 15 mrem/year per site
I-131 releases - 1 Ci/year per unit (reference table 11.3.3-3)

e. Total dose due to realistic pathways. 4

TABLE 5.2-7

ANNUAL 50-MILE POPULATION - INTEGRATED DOSES (man-rem) 1

Pathway	Total Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Plume	1.29E-01	1.29E-01	1.29E-01	1.29E-01	1.29E-01	1.29E-01	1.34E-01	3.80E-01
Ground	1.87E-01	1.87E-01	1.87E-01	1.87E-01	1.87E-01	1.87E-01	1.87E-01	2.18E-01
Inhalation	1.63E-01	1.60E-01	5.99E-03	1.67E-01	1.63E-01	2.95E-01	1.61E-01	1.60E-01
Vegetables	7.86E-05	5.81E-05	1.85E-04	1.08E-04	7.46E-05	2.04E-04	6.30E-05	5.73E-05
Cow Milk	1.56E-04	9.67E-05	4.05E-04	2.56E-04	1.51E-04	7.08E-04	1.13E-04	9.44E-05
Meat	3.19E-04	2.78E-04	1.05E-03	3.57E-04	3.03E-04	3.90E-04	2.85E-04	2.75E-04
Total	4.80E-01	4.76E-01	3.24E-01	4.33E-01	4.79E-01	6.12E-01	4.82E-01	7.58E-01

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TABLE 5.2-8

ANNUAL U.S. POPULATION - INTEGRATED DOSES (man-rem) 1

Pathway	Total Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Plume	6.99E-01	6.99E-01	6.99E-01	6.99E-01	6.99E-01	6.99E-01	7.56E-01	3.25E00
Ground	1.87E-01	1.87E-01	1.87E-01	1.87E-01	1.87E-01	1.87E-01	1.87E-01	2.18E-01
Inhalation	1.20E00	1.19E00	5.99E-03	1.20E00	1.19E00	1.32E00	1.19E00	1.19E00
Vegetables	1.45E+01	1.45E+01	5.59E+01	1.45E+01	1.45E+01	1.45E+01	1.45E+01	1.45E+01
Cow Milk	5.75E00	5.75E00	1.90E+01	5.75E00	5.75E00	5.75E00	5.75E00	5.75E00
Meat	1.05E+01	1.05E+01	4.40E+01	1.05E+01	1.05E+01	1.05E+01	1.05E+01	1.05E+01
Total	3.27E+01	3.27E+01	1.20E+02	3.28E+01	3.27E+01	3.30E+01	3.28E+01	3.54E+01

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TABLE 6.1-1 (SHEET 1 OF 4)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Sample Medium and Location	Frequency	Analysis
Airborne particulates and radioiodine Indicator stations 7 - Simulator building (1.5 miles SE) 10 - Meteorogogical tower (1.1 miles SSW) 16 - Hancock Landing Road (1.4 miles NNW) Nearest community( ) 35 - Girard (6.6 miles SSE) Control station 36 - Waynesboro (15 miles WSW)	Continual sampler operation with sample collection weekly	Radioiodine cannister: I-131 Particulate sampler: gross beta activity following filter change;(a) composite (by location) for gamma isotopic quarterly
Direct radiation Thermoluminescent dosimeters (see table 6.1-2 for locations)	Quarterly	Gamma dose

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TABLE 6.1-1 (SHEET 3 OF 4)

Sample Medium and Location	Frequency	Analysis
Indicator station		
84 - River miles 148.5 to 150.5		
Milk	Biweekly	Gamma isotopic and I-131
98 - W. C. Dixon Dairy (9.8 miles SE)		
Grass	Monthly	Gamma isotopic
Indicator stations		
7 - Simulator building (1.5 miles SE)		
15 - Hancock Landing Road (1.5 miles NW)		
Control station		
36 - Waynesboro (15 miles WSW)		
Fish	Annually	Gamma isotopic on edible portions of composites of any commercial or recreationally important species, such as bream or catfish
Control station		
81 - River miles 153 to 158		
Indicator station		
85 - River miles 144 to 149.4		

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TABLE 6.1-2

THERMOLUMINESCENT DOSIMETER LOCATIONS

	Station	Distance (miles)	Direction (sector)	
1	Hancock Landing Road	1.1	N	
2	River bank	0.8	NNE	
3	River bank	0.7	NE	
4	River bank	0.8	ENE	
5	River bank	1.2	E	
6	Plant Wilson	1.1	ESE	
7	Simulator building	1.5	SE	
8	River road	1.1	SSE	
9	River Road	1.1	S	
10	River Road	1.1	SSW	
11	River Road	1.2	SW	
12	River Road	1.1	WSW	
13	River Road	1.3	W	
14	River Road	1.8	WNW	4
15	Hancock Landing Road	1.5	NW	
16	Hancock Landing Road	1.4	NNW	
17	Savannah River Plant - River Road	5.4	N	4
18	Savannah River Plant - D Area	5.0	NNE	
19	Savannah River Plant - Road A.13	4.6	NE	
20	Savannah River Plant - Road A.13.1	4.8	ENE	
21	Savannah River Plant - Road A.17	5.3	E	
22	River bank upstream of Buxton Landing	4.2	ESE	
23	River Road	4.7	SE	4
24	Chance Road	4.9	SSE	4
25	Chance Road and Highway 23	5.2	S	
26	Highway 23, mi 15.5	4.6	SSW	
27	Highway 23, mi 17	4.8	SW	
28	Hancock Landing Road	5.0	WSW	
29	Claxton-Lively Road	5.0	W	
30	Ben Hatcher Road	4.7	WNW	4
31	River Road at Allen's Church Fork	5.0	NW	4
32	River bank	4.8	NNW	3
33	Nearby residence	3.3	SE	3
34	Girard Elementary School	6.3	SSE	4
35	Girard	6.6	SSE	4
36	Waynesboro	15.0	WSW	

6.4 PREOPERATIONAL ENVIRONMENTAL RADIOLOGICAL MONITORING DATA

Radiological monitoring began August 1981 and is conducted as specified in subsection 6.1.5. The results of the radiological monitoring program for the period from August 1981 through December 1982 are summarized in this section. Although data on both manmade and naturally occurring radionuclides are presented in the tables, discussion is limited to manmade radionuclides.

All of the radiological analyses of the environmental samples were contracted to the Center for Applied Isotope Studies at the University of Georgia in Athens, Georgia. Thermoluminescent dosimeters were analyzed by Hazelton Environmental Sciences of Northbrook, Illinois.

Gross beta activity of airborne particulates and atmospheric radioiodine concentrations are monitored by five continuous air samplers. The date sampling began, number of samples collected, and estimated average activities are summarized in table 6.4-1. Average gross beta activity at the indicator stations ranged from 0.019 pCi/m^3 to 0.024 pCi/m^3. The average gross beta activity in the nearest community (Girard) and at the control station (Waynesboro) were 0.031 pCi/m^3 and 0.025 pCi/m^3, respectively. Airborne I-131 activity was below the minimum detectable concentration in all samples analyzed. A summary of specific radionuclides found in quarterly composites of air particulate samples is presented in table 6.4-2. Cs-137 was the only fission product detected and was present at the minimum detectable concentration in 4 of 30 composite samples from both indicator and control stations.

Water from the Savannah River is collected using composite samplers, two at control stations upstream of the plant site and three at indicator stations downstream of the plant site. Results of monthly gamma spectroscopic analysis and quarterly analysis of composites for tritium are summarized in table 6.4-3. The following fission products were detected in river water samples: Zr-95, Nb-95, and Cs-134 in one sample out of 39 collected at indicator stations; and Cs-137 in 4 of 39 samples collected at indicator stations and 3 of 32 samples collected at control stations. The average tritium concentrations at control stations and indicator stations were 487 pCi/l and 1392 pCi/l, respectively. 4

Drinking water samples are collected from one upstream location and two downstream locations. Drinking water samples have been collected from Cherokee Hill Water Treatment Plant since November 1981 and North Augusta Water Treatment Plant beginning December 1982. Results are summarized in table 6.4-4. Thirteen

water samples have been analyzed from Cherokee Hill Water Treatment Plant. Gross beta activity averaged 5.3 pCi/l. Gamma spectroscopic analysis identified. No gamma emitting nuclides were detected. Tritium concentrations averaged 3490 pCi/l in five composite samples. Only one drinking water sample is reported for the North Augusta Water Treatment Plant. Gross beta activity was 2.32 pCi/l, and the tritium concentration was 501 pCi/l.

Sediment samples are collected at two locations above the plant site and one location below the plant site. Four sediment samples were collected between September 1981 and December 1982. A single sample was collected from each of the two upstream control locations, and two samples were collected from the downstream indicator station (table 6.4-5). Samples from the control stations contained Zr-95, Nb-95, and Cs-134 (one sample) and Cs-137 (both samples). Samples from the indicator stations contained Nb-95 (one sample) and Cs-137 (both samples). The Cs-137 concentrations for the indicator and control sections were 98 and 235 pCi/kg, respectively.

The closest operating dairy (prior to March 1984), Dixon Dairy, is located 9.8 miles southeast of the plant site (see response to question 470.3). A summary of I-131 activity and gamma spectroscopic analysis of milk samples are presented in table 6.4-6. I-131 activity was below the minimum detectable concentration in all samples. Cs-137 was the only fission product detected in milk samples. Cs-137 was detected in 4 of 33 samples with an average detectable activity of 23 pCi/l. 3 4

Grass samples are collected from two locations on the plant site and from one control site. Results of gamma isotopic analysis of dried grass are summarized in table 6.4-7. Samples were collected beginning in December 1981. The following fission products were detected in grass samples: Nb-95, in 1 sample out of 14 collected at indicator stations; Cs-134, in 1 sample out of 10 collected at the control station; and Cs-137, in all 14 samples collected at indicator stations and 1 of 10 samples collected at the control station.

Fish samples are collected on the Savannah River above and below the plant site. Fish tissue was obtained from four species collected during six surveys. Cs-137 was found in all fish tissue samples (table 6.4-8). Concentrations ranged from 110 pCi/kg in catfish to 890 pCi/kg in largemouth bass at the indicator stations, and 116 to 370 pCi/kg at the control station for these same species.

TABLE 6.4-1

SUMMARY OF GROSS BETA ACTIVITY IN AIRBORNE DUST AND AIRBORNE I-131 ACTIVITY

		Date Sampling Began	Gross Beta (pCi/m^3)		I-131 (pCi/m^3)	
			Number of Samples	Avg ± Std (Range)	Number of Samples	Avg[(a)]
Indicator Stations						
Station No.	Location					
7	Simulator building (1.5 miles SE)	11-03-81	58	0.019 ± 0.006 (0.003-0.03)	58	0.039
10	Meteorological Tower (1.1 miles SSW)	08-31-81	67	0.022 ± 0.020 (0.006-0.134)	64	0.039
16	Hancock Landing (1.4 mi NNW)	09-09-81	67	0.024 ± 0.024 (0.001-0.182)	67	0.038
Nearest Community						
Station No.	Location					
35	Girard (6.6 miles SSE)	09-28-81	67	0.031 ± 0.065 (0.006-0.49)	66	0.038
Control Station						
Station No.	Location					
36	Waynesboro	08-31-81	67	0.025 ± 0.022 (0.007-0.189)	66	0.040

4

a. I-131 was less than minimum detectable concentration (MDC) for all samples. Therefore, only the average MDC is reported for the period.

TABLE 6.4-4

SUMMARY OF GROSS BETA ACTIVITY, TRITIUM CONCENTRATIONS, AND SPECIFIC RADIONUCLIDES DETECTED IN DRINKING WATER SAMPLES

Analysis	Indicator Station[a] (pCi/liter) Avg + Std (Fract)		Control Station[b] (pCi/liter) Avg + Std (Fract)	
Gross Beta	5.3 + 8.8	(13/13)	2.32	(1/1)
Tritium	3490 + 1212[d]	(5/5)	370[d]	(1/1)
Gamma Spectroscopy	(c)			(c)

4

a. Only Cherokee Hill Water Treatment Plant has been sampled at this time.

b. Samples taken beginning in December 1982.

c. Radionuclides not detected in samples.

d. First quarter 1981 data included in this average was not corrected for decay. 4

TABLE 6.4-9

SUMMARY OF TRITIUM CONCENTRATION AND OTHER RADIONUCLIDES DETECTED IN GROUNDWATER SAMPLES OBTAINED AUGUST 1982

Location			
Station No.	Location	Tritium[(a)] (pCi/l)	Gamma Spectroscopic Analysis Radionuclide Concentration (pCi/l)
51	Makeup Wells	240 + 21	None
61	Mallard's Pond	1280 + 40	None
62	Bluff at river mile 150	3810 + 70	None

a. Tritium activity was not corrected for decay. 4

Table 6.2.1 of the LPGS lists the transmitted fraction for a number of radionuclides, the more important of which are reproduced as follows:

Nuclide	T1/2 (yrs)	T.F.
H-3	12.1	0.97
SR-90	28	0.87
Ru-106	1	0.33
Cs-137	30	0.31

The values are based on the following data assumed in the LPGS for the generic river site:[11]

$$GWTT = \frac{1500\ ft}{6.7\ ft/day} = 224\ days = 0.61\ year$$

a (H-3) = 1 (equivalent values of K_d = 0)

a (Sr-90) = 9.2 (equivalent values of K_d = 2)

a (Ru-106) = 1 (equivalent values of K_d = 0)

a (Cs-137) = 83 (equivalent values of K_d = 20)

The equivalent values of K_d used in the LPGS are quite low in comparison to other estimates for Sr-90 and Cs-137. In the Sandia liquid pathway study, K_d values of 20 and 200 were used for Sr-90 Cs-137, respectively.[12] Duke Power Company estimated K_d values of 560 (Cs-137) and 6 (Sr-90) for the fractured bedrock underlying its Catawba Nuclear Station.[13] K_d values of 5 (Sr-90) and 50 (Cs-137) were estimated to represent the complex groundwater hydrology at the Seabrook Station site. At Seabrook, groundwater exists both in bedrock and in surface soils.[14] Values of K_d for the granular materials underlying the San Onofre Nuclear Station were estimated as 31 (Sr-90) and 2204 (Cs-137).[15] Regardless of this evidence for larger values and because no specific K_d estimates were available for the VEGP sites, the values used in the LPGS are adopted for convenience.

The groundwater transport time at the VEGP site is estimated to be 27.4 years. On the basis of this and the K_d (or "a") values

1

used in the LPGS the transmitted fractions for the principal radionuclides are as follows:

Nuclide	T (yr)	ln (T.F.)	T.F.	T.F. (VEGP)/T.F. (LPGS)
H_3	12.1	-1.57	0.21	0.22
Sr-90	28	-6.24	0.002	0.002
Ru-106	1	-19.0	0	0
Cs-137	30	-52.5	0	0

4

The effect of the much longer GWTT at the VEGP site (27.4 years compared to 0.51 years in the LPGS), even with the relatively small assumed values of k , is very significant. Virtually no Cs-137 or Ru-106 would be expected to reach the Savannah River. Only 2/1000 of the released Sr-90 would reach the river (compared to a transmitted fraction of 0.87 in the LPGS). Tritium is closer to the LPGS results with a transmitted fraction of 0.21 for VEGP compared to 0.97. 1

The source effect on liquid pathway consequences can be summarized as follows:

A. Pathway doses which are dominated by Cs-137 and/or Ru-106 will be nil in comparison to doses calculated in the LPGS.

B. Pathways doses which are dominated by Sr-90 will be about 3 orders of magnitude lower than those calculated in the LPGS, assuming equal pathways exposure.

C. Pathways doses from H will be lower but within the same order of magnitude, assuming equal pathways exposure. At the levels of population dose calculated in both NUREG-0440 and in the Sandia study [16], tritium is not a significant contributor. This is in part due to the smaller core inventory of tritium (two to three orders of magnitude less the curie content than Sr-90, Cs-137, or Ru-106)[17] and also in part to the relatively low total body dose factor (1×10^2 man-rem/curie compared to 1.9×10^6 man/rem/curie for Sr-90 and 8×10^4 man-rem/curie for Cs-137).[18]

7A.4.6 DRINKING WATER PATHWAY COMPARISON

The LPGS generic river system was assumed to supply drinking water to 620,000 people.[19] As shown in table 2.1-44 the current number of people that get their drinking water supply

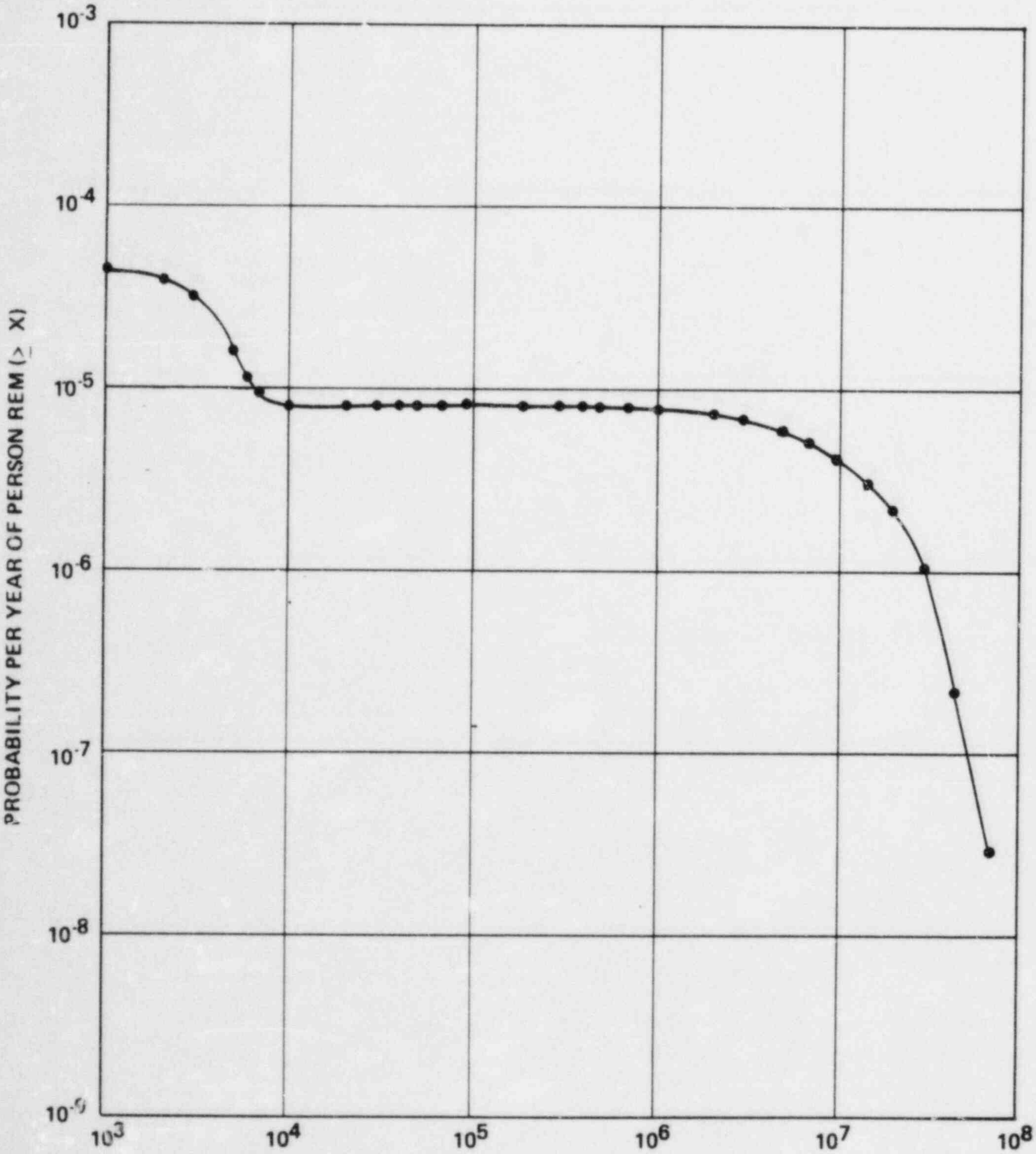
TABLE 7A-3

AVERAGE VALUES OF ENVIRONMENTAL RISKS DUE TO ACCIDENTS PER REACTOR-YEAR

Environmental Risk	Average Value
Population exposure (total man-rems)	121.0
Acute fatalities	0.00000586
Latent cancer fatalities (all organs excluding thyroid)	0.000575
Cost of protective actions and decontamination	$5084 [a]

1 4 1

a. 1980 dollars.



4

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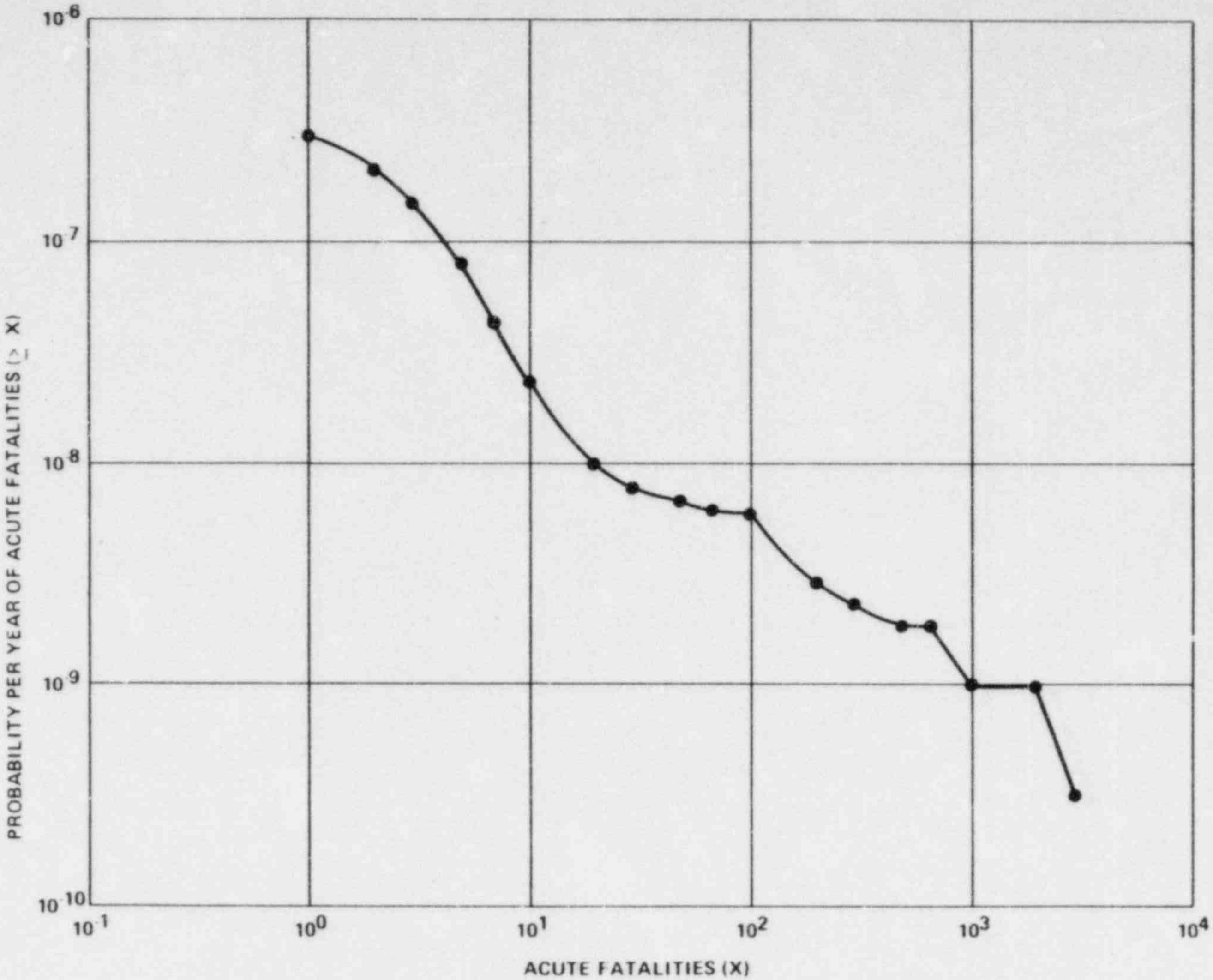
VOGTLE
ELECTRIC GENERATING PLANT
UNIT 1 AND UNIT 2

PROBABILITY DISTRIBUTION FOR TOTAL POPULATION EXPOSURE

FIGURE 7A-2

433-9



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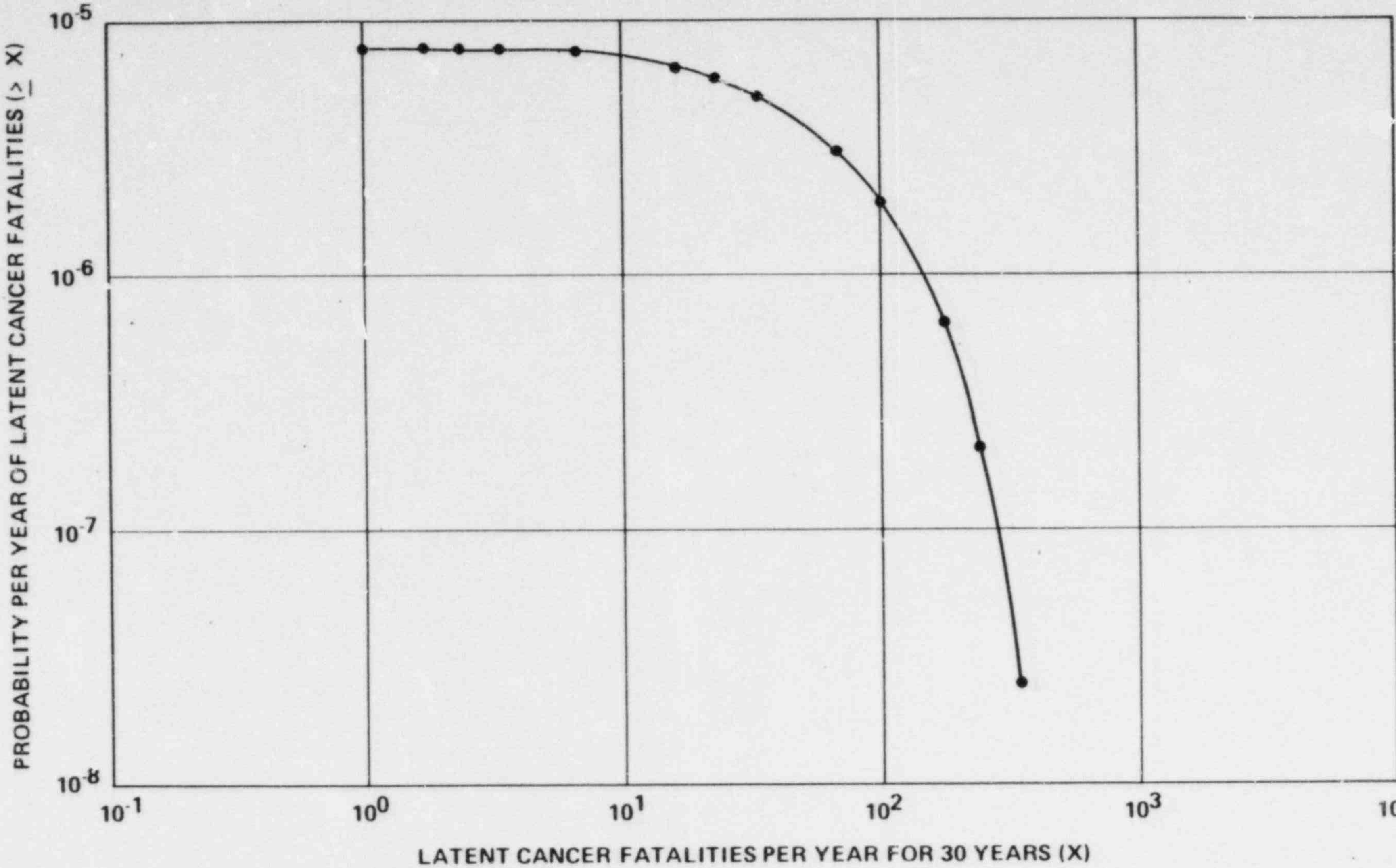
VOGTLE
ELECTRIC GENERATING PLANT
UNIT 1 AND UNIT 2

PROBABILITY DISTRIBUTION
FOR ACUTE FATALITIES

FIGURE 7A-3

433-9



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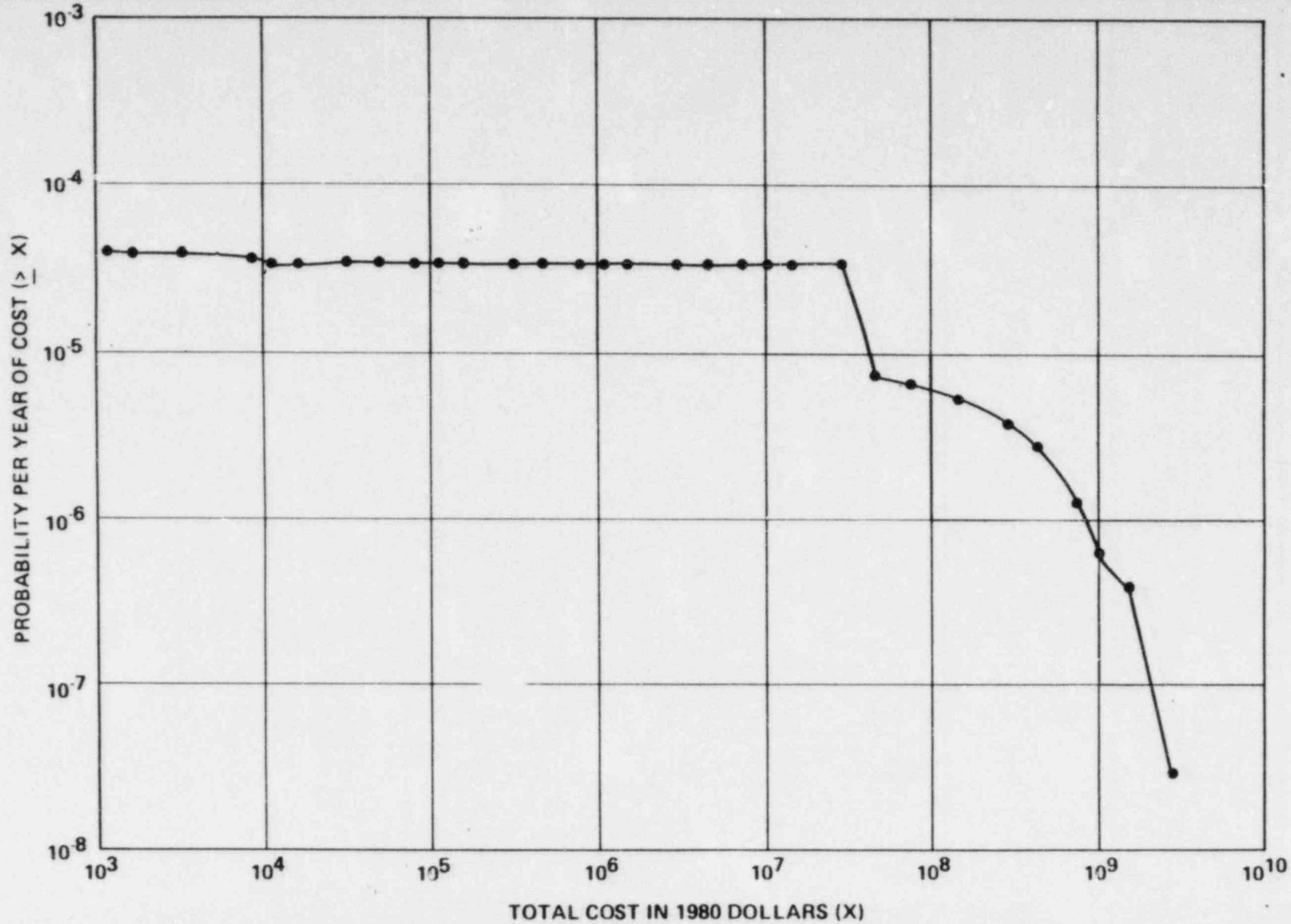
VOGTLE
ELECTRIC GENERATING PLANT
UNIT 1 AND UNIT 2

PROBABILITY DISTRIBUTION
FOR FATAL CANCERS

FIGURE 7A-4

4

433-9



Georgia Power

VOGTLE
ELECTRIC GENERATING PLANT
UNIT 1 AND UNIT 2

PROBABILITY DISTRIBUTION FOR
COST OF OFFSITE MITIGATING ACTIONS

FIGURE 7A-5

4

433-9

TABLE QE290.8-1 (SHEET 1 OF 2)

COOLING TOWER DRIFT PARAMETERS FOR VOGTLE AND FOUR OTHER PLANTS

Plant/ Type of Cooling Tower		Vogtle/ Natural Draft	Susquehenna/ Natural Draft	Beaver Valley/ Natural Draft Unit 1	Beaver Valley/ Natural Draft Unit 2	Shearon Harris/ Natural Draft	Grand Gulf/ Natural Draft
Number of cooling towers		2	2	1	1	4	2
Height of cooling tower		550 ft	540 ft	501 ft	501 ft	520 ft	522 ft
Drift Rate	Guaranteed	0.03%	0.02%	0.05%	0.013%	0.05%	0.008%
	Expected	0.008%	0.002%	0.005%	NA	0.002%	NA
Circulating water flow rate		484,600 gpm	478,000 gpm	480,400 gpm	507,400 gpm	482,000 gpm	572,000 gpm
Concentration in makeup		60 mg/ℓ (avg)	432 mg/ℓ [a] (max)	204 mg/ℓ (avg)	203 mg/ℓ (avg)	70 mg/ℓ (avg)	376 mg/ℓ (avg)
Concentration factor		4 (avg)	3.8 (avg)	1.8 (avg)	1.8 (avg)	7.7 (avg)	5 (max) [a]
Concentration in blowdown		240 mg/ℓ (avg)	1640 mg/ℓ [a] (max)	368 mg/ℓ (avg)	365 mg/ℓ (avg)	539 mg/ℓ (avg)	1880 mg/ℓ [a] (max)
Evaporation rate		3.0%	2.3%	1.5%	2.0%	1.5%	1.8%
Plant capacity		0.8	0.8	0.8	0.8	0.8	0.8
Droplet size distribution	<100 μm	45%	20%	NA [d]	35%	NA	45%
	100-300 μm	50%	70%	NA	65%	NA	55%
	>300 μm	5%	10%	NA	0%	NA	0%
Max onsite drift deposition	Rate	17 lb/acre/yr	3 lb/acre/yr	80 lb/acre/yr	3 lb/acre/yr	400 lb/acre/yr	NA
	Distance from CT	0.9 miles	0.6 miles	0.3 miles	0.75 miles	0.3 miles	NA
	Wind sector deposited in	SE	NE	SE	SW	SW	NA

TABLE QE290.8-1 (SHEET 2 OF 2)

Plant/ Type of Cooling Tower		Vogtle/ Natural Draft	Susquehenna/ Natural Draft	Beaver Valley/ Natural Draft Unit 1	Beaver Valley/ Natural Draft Unit 2	Shearon Harris/ Natural Draft	Grand Gulf/ Natural Draft
Max offsite drift deposition	Rate	15 lb/acre/yr	3 lb/acre/yr	NA	9.9 lb/acre/yr[g]	NA	5.02 lb/acre/yr 4
	Distance from cooling tower	1.0 miles	0.6 miles	NA	0.9 miles	NA	0.6 miles
	Wind sector deposited in	SE	SSW	NA	E	NA	E
Meteorological conditions, annual avg	Humidity	72%	70%	69%[e]	73.5%	71%	76%
	Temperature	63.4°F	49°F	50.3°F	49.1°F	60°F	65.5°F
	Wind speed in predominant direction	6.6 miles/hr[b]	8.7 miles/hr	5.6[b] miles/hr	6.6[b] miles/hr	8.7 miles/hr	6.4 miles/hr[c]
	Frequency of dominant wind	12%	14.5%	15.6%	10.5%	10.6%	9.0%
	Dominant Pasquil stability class	E	D	E	D	E-F	D-E

a. Design maximum values were used in salt drift modeling.

b. Average wind speed in the dominant wind direction is not available, local average wind speed is applied. The actual wind speed is expected to be higher.

c. Wind speed has been adjusted from 33 ft to 150 ft by the following equation: $V/V = (Z/Z_1)^P$, with V_1 = wind speed at a given level, Z_1 = reference height, and P = 0.45.

d. Although droplet size distribution for Unit 1 cooling tower was not provided in the environmental reports, it is expected to be similar to that for Unit 2.

e. Based on the data collected onsite between September 5, 1969 to September 5, 1970.

f. Based on the data collected onsite between January 1, 1976 to December 31, 1980.

g. Deposition rate represents the contribution from both units. 4

Question E290.10

Please specify what types of areas along power line corridors will be treated with herbicides and why herbicide treatment is necessary in these areas. Give the expected total acreage that might be treated with herbicides and describe the herbicide application procedure.

Response

Georgia Power Company uses herbicides to maintain its rights-of-way mainly in inaccessible areas. Inaccessible areas include mountainous terrain and low lying marsh or swampy areas. Both mowing and hand cutting are less efficient than aerial spraying in these areas. Also, cutting tools are more dangerous to use in difficult terrain. 4

Georgia Power Company has maintained less than 1 percent of its rights-of-way brush with herbicides over the last 3 years. For this period, the average number of brush acres maintained has been 40,069. An average of only 299 brush acres were aerially sprayed. This represents less than 1 percent of the total number of brush acres maintained. Spraying activities of the rights-of-way acreages associated with VEGP should not be more than one percent of the area.

Georgia Power Company aerial spraying is conducted according to the following procedures and specifications:

1. Only herbicides approved by the Environmental Protection Agency for rights-of-way use are applied.

2. Application is done by a licensed pesticide applicator.

3. Herbicide is applied only when wind velocity or other weather conditions will not be detrimental to the quality of work or the surrounding area.

4. A Georgia Power Company employee familiar with herbicide application and use will continually monitor the application when spraying is done within the system.

NUCLEAR REGULATORY COMMISSION
QUESTIONS AND RESPONSES INDEX
VOGTLE ELECTRIC GENERATING PLANT - UNITS 1 AND 2
OPERATING LICENSE STAGE ENVIRONMENTAL REPORT
NRC DOCKET NUMBERS 50-424 AND 50-425

NRC Question	OLSER Section/Subsection	Keywords
E240.14	7A.4	Groundwater velocity and travel time based on effective porosity.
E240.15	2.4.2	Possible groundwater contamination.

Question E240.14 (OLSER 7A.4)

The groundwater velocity and travel time should be based on effective porosity rather than total porosity. Revise your values and results accordingly. There is also an error in the table on page 7A-16. The half-life for Cs-137 should be 30 years rather than 3 years as shown.

Response

Effective porosity, as used in this question, is believed to be as described by Todd (Todd, D. K., "Groundwater Hydrology," J. Wiley and Sons, second edition, p. 27, 1980); "The term "effective porosity" refers to the amount of interconnected pore space available for fluid flow and is also (as is total porosity) expressed as a ratio of interstices to total volume. For unconsolidated porous media and for many consolidated rocks, the two porosites (effective and total) are identical."

Although they don't refer to "effective porosity," Freeze and Cherry (Freeze, R. A. and Cherry, J. A., "Groundwater," Prentice-Hall Inc., p. 71, 1979) address the concept in determining the "average linear velocity ($\bar{v}$), which they state as:

$$\bar{v} + Q/nA$$

where,

Q = volumetric flux (L^3/T).
n = porosity (ratio), and
A = cross-sectional area of the media (L^2).

Freeze and Cherry also describe an alternative form of the equation suggested by Nelson (Nelson, R. W., "In-place Determination of Permeability Distribution for Heterogeneous Porous Media Through Analysis of Energy Dissipation", Society of Petroleum Engineers Journal, No. 8, 1968);

$$\bar{v} + Q/enA$$

where, e is an empirical constant dependent on the characteristics of the porous medium (recognizing that more than just porosity will affect the velocity). They go on to point out that laboratory studies of relatively uniform sands indicate values of e range 0.98 - 1.18, and that it is commonly assumed in tracer and contamination studies that e = 1.

Based on these references, we believe that total porosity is the best estimate of "effective porosity." The value for the half-life of Cs-137 found on page 7A-16 has been corrected to 30 years.

Question E240.15

Groundwater is a very valuable natural resource and the local populace has expressed their concern regarding possible contamination of this resource. The subject thus warrants comprehensive consideration in the Environmental Report as well as in the FSAR.

Provide a general discussion in the Environmental Report addressing the portential for radioactive contamination of the several aquifers beneath and around the Vogtle site. Consider several potential scenarios other than the core melt, such as a surface spill and pipe leak. You could also cross reference the tank spill that is evaluated as the worst case design accident in the FSAR. Include a discussion of the possible methods of controlling and/or mitigating contamination of the aquifers.

Response

Subsection 2.4.2 has been amended to include a discussion of the potential for groundwater contamination at the VEGP.