EXECUTIVE SUMMARY

ENVIRONMENTAL RADIATION SURVEILLANCE IN GEORGIA: 2000 – 2002

Georgia recognizes that nuclear facilities may affect environmental radiation levels by the introduction of man-made radioactive materials into the environment. In 1976 the Georgia General Assembly amended the Georgia Radiation Control Act, O.C.G.A. §31-13, to charge the Environmental Protection Division (EPD) of the Georgia Department of Natural Resources with responsibility for monitoring of radiation and radioactive materials in the environment. The Environmental Radiation Program in EPD measures and determines if radioactive materials are being released into the environment in quantities sufficient to adversely affect the health and safety of the citizens of Georgia. This report provides results from the environmental radiation monitoring performed by the Environmental Radiation Program during calendar years 2000, 2001 and 2002. Since 1976, EPD has operated extensive radiation monitoring networks at nine facilities in or bordering Georgia. These facilities are:

(1) U.S. Department of Energy, Savannah River Site (Jackson, South Carolina);
(2) Georgia Power Company, Vogtle Electric Generating Plant (Waynesboro, Burke Co.);
(3) Georgia Power Company, Edwin I. Hatch Nuclear Plant (Baxley, Appling Co.);
(4) Alabama Power Company, Joseph M. Farley Nuclear Plant (Dothan, Alabama);
(5) U.S. Navy, Naval Submarine Base, Kings Bay (St. Marys, Camden Co.);
(6) Georgia Tech Research Reactor – Now Decommissioned (Atlanta, Fulton Co.);
(7) Dawson Forest Wildlife Management Area (Dawsonville, Dawson Co.);
(8) Tennessee Valley Authority, Sequoyah Nuclear Plant (Chattanooga, Tennessee);
(9) Duke Power Company, Oconee Nuclear Plant (Seneca, South Carolina).

Georgia's environmental radiation monitoring networks cover more than 3000 square miles of land area and more than 300 miles of waterways in Georgia. Environmental samples are analyzed for radioactive materials at the Environmental Radiation Laboratory at Georgia Tech. EPD's Environmental Radiation Program associates, operating from Atlanta and the EPD East Central District Office in Augusta, regularly perform both instantaneous and time-averaged direct radiation measurements and collect samples of environmental media including air, surface water, groundwater, rain, stream sediment, fish, soil, vegetation, milk, game animals and crops near these facilities and at background locations around the state. Sample collection methods and laboratory analysis protocols are discussed in greater detail in Sections B and C of this report.

The vast majority of results from EPD environmental monitoring indicate that radiation levels and concentrations of man-made radionuclides remained consistent with background radiation levels. However, several areas or categories that were tested had elevated concentrations of man-made radionuclides or elevated radiation levels attributable to operations at the facility monitored, as depicted on the front cover of this report. Of these locations or categories, none regularly exceeded U.S. Nuclear Regulatory Commission reporting levels. However, five (5) exceptions were noted during the period covered by this report:

Reporting-Level Exceptions:

(1) Panfish in the Beaver Dam Creek area of the Savannah River, adjacent to the Savannah River Site, exceeded the aquatic pathway reporting level of 10 mrem/yr to bone: 122% of the reporting level with a projected dose of 12.2 mrem/yr to bone.

(2) Catfish from the Beaver Dam Creek area of the Savannah River, adjacent to the Savannah River Site, exceeded the reporting level of 10 millirem (mrem) per year (mrem/yr) to bone: 236 % of the reporting level with a projected dose of 23.6 mrem.

(3) Catfish from the Four Mile Creek area of the Savannah River, adjacent to the Savannah River Site, exceeded the aquatic pathway reporting level of 10 mrem/yr to bone: 245 % of the reporting level with a projected dose of 24.5 mrem.

(4) Leafy vegetation (forage) from two locations in southern Richmond County exceeded the airborne-pathway reporting level of 15 mrem/yr to bone: 370 % of the reporting level with a projected dose of 56 mrem at Bush Field; 170% of the reporting level with a projected dose of 26 mrem at McBean.

(5) Direct radiation, along the south and west fence-lines of the Georgia Tech Research Reactor, exceeded the reporting level (with doses up to 81 mRem in a year during D&D) but not the annual dose-limit (100 mRem).

The reporting level is used as a guideline by the Nuclear Regulatory Commission to monitor or to flag the impact of a facility. It is equivalent to a committed effective dose of 10 mrem per year (or 15 mrem per year to any critical organs of the body) for the air-pathway, which includes inhalation and any associated fallout-related doses from ground-shine and from consumption of food products. The reporting level for the aquatic pathway is lower: equivalent 3 mRem committed effective and 10 mrem to any organ, including doses from drinking water, consumption of fish and seafood, swimming, and ground-shine along river banks. By comparison, the National Council of Radiation Protection estimates the average U.S. citizen receives around 40 mrem per year from medical X-rays and 10 mrem per year from consumer products such as tobacco, smoke detectors, and luminous dials and signs. In comparison with normal statewide exposure to background radiation in the environment, which averaged 65 mrem per year for 2000-2002, the potential impact from eating fish is not significant. The estimated lifetime risk due to eating the edible portions of fish taken from the Savannah River is extremely small (on the order of 4 in a million, on the average).

A summary of all detectable results possibly attributed to nuclear facility operations, is presented in the table below:

Table A-1 (Summary of Positive Results)

Facility	Sample Type	Radionuclides Detected	Conclusions
Savannah River Site (SRS)	Air	Tritium (H-3)	Elevated levels of tritium (≥ **5X Bkg**) were periodically detected at 8 out of 10 locations within 30 miles of SRS, with highest concentrations detected within SRS' predominant down-wind footprint. H-3 concentrations ranged from 2000 - 24,000 fCi/m^3. All results were equivalent to less than 0.01 mrem per year or 0.1 % of the air-pathway reporting level (15 mrem/yr), and therefore, did not pose a significant risk. Based on periodic effluent reports, SRS is assumed to be the primary source of airborne H-3 (99.8%), with Vogtle contributing approximately 0.2%.
Savannah River Site (SRS)	Rain / Fallout	Tritium (H-3)	Elevated levels of tritium (up to **5X** Bkg) were observed in precipitation at several locations within 30 miles of SRS, with highest concentrations within SRS's predominant down-wind footprint. Detectable deposition (fallout) values for H-3 ranged from 4,000 pCi/m^2 to 92,000 pCi/m^2 per year. Even though a significant amount of H-3 was deposited in the rain, H-3 concentrations in the rainwater did not exceed the Safe Drinking Water Standard: 400 pCi/L average (2% MCL) and 1,000 pCi/L maximum (5% MCL). Thus, the H-3 did not pose a significant risk.
Savannah River Site (SRS)	Milk	Tritium (H-3)	Slightly elevated levels of tritium (up to **3X** Bkg) were detected in milk from 2 locations within 50 miles of SRS. Detectable H-3 values ranged from 200 to 700 pCi/l., with average results less than 0.05 % of the air-pathway reporting level (15 mrem/yr).
Savannah River Site (SRS)	Crops: Pears	Tritium (H-3)	Slightly elevated levels of H-3 (**2X** Bkg) were detected in pears from the Waynesboro area, about 25 miles from the center of SRS. H-3 concentrations were below any level of concern, with a projected dose less than 0.002 mrem per year (<0.02% of the reporting level).
Savannah River Site (SRS)	Groundwater	Tritium (H-3)	Elevated concentrations of tritium (up to **5X** Bkg) were detected in relatively shallow (< 100') groundwater within 15 miles of the center of SRS. Concentrations were not significant (equivalent to 5% of the Drinking Water MCL). All of the elevated readings are within the predominant down-wind footprint of SRS, where elevated H-3 fallout in rain was also detected. H-3 fallout from SRS is primary mechanism suspected for the contamination, but other potential pathways, such as underground migration, are still under investigation by USGS.

Facility	Sample Type	Radionuclides Detected	Conclusions
Savannah River Site (SRS)	Leafy Vegetation (Forage)	Tritium (H-3)	Elevated levels of tritium (up to **13X** Bkg) were detected in leafy vegetation or forage from several locations within 50 miles of SRS. Detectable H-3 concentrations averaged approximately 500 pCi/kg of fresh weight, with a maximum of 2,600 pCi/kg. H-3 concentrations averaged less than 0.02% of the air-pathway reporting level. Highest H-3 concentrations were observed within SRS's predominant downwind footprint.
Savannah River Site (SRS)	" "	Sr-90 **(Exceeds Reporting Level)**	Elevated Sr-90 (up to **4X** Bkg) concentrations were detected in leafy-vegetation (forage) samples southeast of Augusta near Bush Field and McBean (~ 20 miles from the center of SRS). SRS estimates off-site population doses of approximately 66,000 person-mRem from SRS-related strontium fallout in vegetation (WSRC-TR-970152- Sr-89/90 p4), so some of this Sr-90 may be SRS-related. Since Sr-90 is also present in global fallout, as well as SRS fallout, it is difficult to positively distinguish the two, however. Leafy vegetation from both locations in southeastern Richmond County **exceeded** the air-pathway reporting level of 15 mrem/yr (**370%** near Bush Field and **170%** near McBean).
Savannah River Site (SRS	Deer	Tritium (H-3)	Slightly elevated levels of H-3 (**3X** Bkg) were detected in deer samples collected near the Savannah River (within 5 miles of SRS). H-3 concentrations were below any level of concern, with a projected dose less than 0.002 mrem per year (~0.01% or the air-pathway reporting level).
		Cs-137	Elevated concentrations of Cs-137 (up to **4X** Bkg) were detected in deer samples collected within 2-5 miles of SRS. Since Cs-137 is known to be present both in global fallout as well as in SRS effluents, it is difficult to distinguish which source (SRS or global fallout) is the primary contributor in this situation. Further study will be necessary to positively determine the source.
		Dose	The projected 2002 deer-consumption dose (near SRS) to an average offsite-hunter in Georgia, averaged 3.5 mrem (or 22% of the reporting level), due primarily to Cs-137. This compares favorably with recent SRS offsite-hunter dose estimates (2.9 mrem adjusted to average consumption - WSRC-TR-2000-00328, p.121). SRS assumes that deer migration from the Site is the primary mechanism contributing to offsite doses from SRS.
		Cancer Risk	Preliminary 30-year cancer-morbidity risk estimates near SRS averaged 7.8E-05 or 78 out of 1,000,000 for consumption of deer meat. Several years' worth of data are needed to provide a more accurate risk assessment, however, since the current risk assessment is based only on a single year (2002).

Facility	Sample Type	Radionuclides Detected	Conclusions
Savannah River Site (SRS)	Soil	Pu-239	One soil sample taken in the Shell Bluff area adjacent to SRS had a higher percentage of Pu-239 (per unit of Cs-137) than all of the other samples tested (**15% higher**), suggesting that the excess Pu-239 may be from SRS. Shell Bluff is located within SRS's predominant down-wind footprint, approximately 10 miles from plutonium-processing facilities, where much higher Pu-239/Cs-137 percentages have been detected in soil (WSRC-RP-92-879-Rev-1). Since Cs-137 and Pu-239 are known to be present, both in global fallout as well as in SRS effluents, it is difficult to positively distinguish which source (SRS or global fallout) contributed the excess Pu-239. More study will be necessary to determine whether the excess Pu-239 near Shell Bluff is SRS-related. (SRS estimates a population dose of 121,000 person-mrem, through 1995, due to SRS-related fallout of Pu-239 onto vegetation … WSRC-TR-970152, Pu-239-p.4).
Savannah River Site (SRS)	River Water Effluent (Outfalls)	Tritium (H-3) General Information	Elevated concentrations of tritium (up to **300X** Bkg) were detected in river water adjacent to SRS effluent creeks (outfalls), with concentrations ranging up to 60,000 pCi/l (equivalent to 300% of the MCL for a one-week period at Four-Mile Creek). Annual average concentrations were less than the Safe Drinking Water MCL, however, at all locations monitored. Uptake of H-3 from river water near these outfalls is mainly expected to be mainly from fish consumption rather than from drinking water.
		Tritium (H-3) Averages by Effluent Creek	**Average H-3 Concentration and Percent of MCL** Upper Three Runs Creek 13,000 pCi/l - 66% MCL Beaver Dam Creek 2,500 pCi/l - 13% MCL Four Mile Creek 13,000 pCi/l - 66% MCL Steel Creek 1,200 pCi/l - 6% MCL Lower Three Runs Creek 1,000 pCi/l - 5% MCL
		I-129	Elevated I-129 (up to **6X** Bkg) in river water was detected at one SRS outfall (Four-Mile Creek). Concentrations ranged from 0.2 pCi/l to 0.7 pCi/l, averaging 0.4 pCi/l, which is equivalent to 40% of the MCL or reporting level, based on use as a drinking water supply (unlikely). Instead, most uptake of I-129 from this outfall is expected to be through consumption of nearby aquatic plants, fish, or deer.

Facility	Sample Type	Radionuclides Detected	Conclusions
Plant Vogtle	River Water Outfall	Tritium (H-3)	Elevated tritium (up to **50X** Bkg) in river water was detected below the Vogtle outfall. H-3 concentrations averaged 2,200 pCi/l (11% of MCL), with the highest concentration (11,000 pCi/l) associated with a chemistry problem in one of the reactors. This required a temporary shutdown and system cleanup near the end of 2002.
Savannah River Site - -- and --- Vogtle	River Water Downstream of SRS and VEGP at US301	Tritium (H-3)	Elevated tritium (up to **16X** Bkg) was detected in river water downstream of SRS and VEGP at the US-301 Bridge. H-3 concentrations averaged 1000 pCi/l (5% MCL), with a maximum of 3,300 pCi/l (16% MCL). Approximately 90% of the H-3 is from SRS, with around 10% from Vogtle, based on available effluent reports. H-3 did not pose a significant risk based on measured concentrations.
Savannah River Site - -- and --- Vogtle	Drinking Water	Tritium (H-3)	Elevated concentrations of tritium (up to **11X** Bkg) were detected in downstream drinking water from the Savannah I&D Water Plant. Concentrations averaged 800 pCi/l (4% MCL), with a maximum of 2,300 pCi/l (11% MCL). As noted above, most (~ 90%) of this H-3 is from SRS. H-3 did not pose a significant risk based on measured concentrations.
Savannah River Site (SRS)	Sediment	Cs-137	Elevated concentrations of Cs-137 in sediment (up to **540X** Bkg) were detected adjacent to and up to 100 miles downstream of SRS. Based on isotopic-ratios' analysis of the data, over 80% of the Cs-137 in Savannah River sediment is probably Site-related. Elevated Cs-137 in sediment (from SRS creeks) is responsible for most of the Cs-137-problem found in fish from this area, and, therefore potentially poses a long-term risk to the human population.
VEGP	Sediment	Cs-137	Elevated Cs-137 (approximately **2X** Bkg) was detected at Vogtle one time, but the average concentration was statistically indistinguishable from the control concentration.
SRS and VEGP	Sediment	Co-60	Elevated concentrations of Co-60 in sediment were measured at SRS - Steel Creek (up to **14X** Bkg) and below Plant Vogtle (up to **15X** Bkg), suggesting that Co-60 originated from both SRS and Vogtle. Co-60 was also detected up to 100 miles downstream (up to **22X** Bkg). Co-60 was not detected in drinking water or fish samples, indicating negligible impact to human populations.
Savannah River Site (SRS)	Sediment	Pu-238 and Pu-239	Elevated Pu-238 (up to **3X** Bkg) and Pu-239 (up to **6X** Bkg) were detected in sediment samples adjacent to and up-to 100 miles downstream of SRS. Based on isotopic-ratios' analysis, up to 80% of the plutonium detected appears to be Site-related and probably entered the Savannah River from Four-Mile Creek (SRS). Global fallout-related Pu-239, not related to SRS, was also detected at a saltwater control location in the Richmond Hill / Savannah area on the Ogeechee River. Neither Pu-238 nor Pu-239 were detected in drinking water or fish samples, indicating negligible impact to human populations.

Facility	Sample Type	Radionuclides Detected	Conclusions
Savannah River Site (SRS)	Fish	Cs-137	Elevated concentrations of Cs-137 (up to **220X** Bkg) were detected in fish filets from the Savannah River adjacent to SRS, with the highest concentration detected in largemouth bass from Steel Creek (SRS). Average concentrations by location ranged from less-than 10 to 1,100 pCi/kg fresh-weight (filet portion), for all species tested.
Savannah River Site (SRS)	Fish	Sr-90	Elevated concentrations of Sr-90 in fish (up to **10X** Bkg) were detected adjacent to SRS, with the highest concentrations detected in catfish from Beaver Dam Creek (SRS). Most of the Sr-90 is located in the bones of the fish. Average concentrations by location ranged from less-than 10 to 190 pCi/kg fresh-weight (whole fish), for all species tested.
Savannah River Site (SRS)	Fish	Tritium (H-3)	Elevated concentrations of H-3 in fish filets (up to **290X** Bkg) were detected adjacent to SRS, with the highest concentration detected in largemouth bass from Upper Three Runs Creek (SRS). Average concentrations by location ranged from 100 to 9,700 pCi/kg fresh-weight (filet portion), for all species tested.
Savannah River Site (SRS)	Fish	Radiological Risk Assessment	The 30-year radiological cancer-morbidity risk from eating fish adjacent to SRS averaged 4-in-1,000,000 for all species collected, with largemouth bass from Steel Creek (SRS) posing the highest risk (14 out of 1,000,000). Current DNR fish consumption advice, which recommends limiting consumption of largemouth from this area to one meal per week, based on mercury, is sufficient to cover radiological risk, as well. Downstream risk levels, measured in fish between US301 and Savannah, were essentially the same as background, which was measured upstream near Augusta, indicating that the radiological problem area is limited to the area adjacent to SRS.
Savannah River Site (SRS)	Fish	**Reporting Level Exceeded**	The aquatic-pathway reporting level (3 mrem/yr effective or 10 mrem/yr organ dose) was exceeded at two locations, and was significantly elevated at one other location, as follows: Beaver Dam Creek (SRS): Panfish – **122%** Beaver Dam Creek (SRS): Catfish – **236 %** Four Mile Creek (SRS): Catfish – **245%** Steel Creek (SRS): LM Bass – 51%

Facility	Sample Type	Radionuclides Detected	Conclusions
Plant Vogtle	Fish	H-3 and Cs-137	Elevated concentrations of Cs-137 and H-3 were also detected in fish samples near Plant Vogtle, which is located adjacent to SRS and Four-Mile Creek. The majority of Cs-137 activity detected in Vogtle fish is likely to be SRS-related, based on the upstream control samples. Vogtle-related activity was equivalent to less than 3% of the aquatic-pathway reporting level. The 30-year radiological cancer morbidity risk for fish consumed from this area was estimated to be between 1 and 2 out-of 1,000,000.
Plant Farley	River Water	Tritium (H-3)	Elevated tritium (up to **23X** Bkg) in Chattahoochee River water was detected approximately 3 miles downstream of Farley in three-out-of-twelve grab water samples. All other samples were non-detectable for H-3. The average detected concentration (1,100 pCi/l) was equivalent to less than 6% of the Drinking Water MCL.
Plant Farley	River Sediment	Co-60	Slightly elevated concentrations (up to **2X** Bkg) of Co-60 (attributed to Site operations) were detected in sediment samples approximately 3 miles downstream of Plant Farley. Activity levels were insignificant and did not pose a detectable risk for drinking water or fish.
Plant Hatch	River Sediment	Mn-54, Co-60	Slightly elevated concentrations (up to **6X** Bkg) of Mn-54 and Co-60 (attributed to Site operations) were detected in the Altamaha River up to 50 miles downstream of Plant Hatch. Neither of these radionuclides was detected in water or fish samples, and thus, did not result in a measurable risk to the human population. Elevated Cs-137 was also detected in sediment approximately 90 miles downstream in the coastal area, but the concentrations were comparable to Cs-137 at the coastal-control location (Ogeechee River). Given the comparability of results from both coastal locations and given the absence of Co-60 at the Plant Hatch coastal location, the Cs-137 was attributed to global fallout.
Plant Oconee	Surface Water in Lake Hartwell	H-3	Slightly elevated concentrations (up to **2X** Bkg) of H-3 were detected in Lake Hartwell near the Hartwell Dam. Detectable H-3 averaged 250 pCi/l (less than 2% of MCL).

Facility	Sample Type	Radionuclides Detected	Conclusions
Dawson Forest WMA (GNAL)	Soil	Co-60 Eu-152	Detectable concentrations of Co-60 (up to **11X** Bkg) and Eu-152 (up to **26X** Bkg) were measured in soil next to the decommissioned Georgia Nuclear Aircraft Laboratory (GNAL) reactor site at Dawson Forest Wildlife Management Area. Co-60 and Eu-152 are neutron activation products that were created in soil when the reactor was operating (outdoor operation). This activity has been previously documented as having no measurable or significant impact to other environmental pathways, except for minimal direct exposure. Direct radiation from this activity, which was measured via in-situ gamma spectroscopy, was found to be acceptable: less than 10 mrem per year for continuous exposure.
Georgia Tech Research Reactor (GTRR)	TLDs	Direct Radiation	Georgia Tech Research Reactor (GTRR) was demolished and decommissioned (D&D) during the 2000-2002 period. This involved the cutting and removing of a number of activated reactor components, including the reactor vessel, graphite, concrete, and lead shield, which were subsequently shipped offsite for disposal as radioactive waste. During this period, external gamma radiation levels were slightly elevated at the fence-line, due to gamma-shine from inside of GTRR and from radioactive-waste shipments. A network of monthly-serviced TLDs (Thermo-Luminescent Dosimeters) was deployed around the perimeter fence-line, prior to D&D, to provide a high-resolution, sensitive monitoring capability. This supplemented an existing quarterly TLD network. Elevated direct radiation dose-rates (up to **4X** Bkg or 275 mRem/yr above background) were detected at the fence-line on several monthly-TLDs, which surrounded GTRR. Although the reporting level was **exceeded** along the west and south fence-lines, the highest annual off-site dose (81 mrem) measured at the west fence-line, did not exceed the 10CFR20.1301-1302 annual dose limit (100 mrem).
Georgia Tech Research Reactor (GTRR)	Real-Time Gamma Monitor	Direct Radiation	Gamma radiation was also detected and monitored in real-time with a remotely controlled gamma-radiation detector. Dose rates up to **4X** Bkg were also detected during D&D by this instrument.

Facility	Sample Type	Radionuclides Detected	Conclusions
Georgia Tech Research Reactor (GTRR)	Air	H-3	Slightly elevated concentrations (up to **10X** Bkg) of H-3 were briefly detected in several air samples during D&D operations, after pipe cutting and removal operations, and during removal of the reactor vessel. The calculated dose for measured airborne H-3 was 0.002 mrem (or less than 0.02% of the air-pathway reporting level).
Georgia Tech Research Reactor (GTRR)	Surface Run-Off Water	H-3	Slightly elevated concentrations (up to **2X** Bkg) of H-3 in surface run-off water were also periodically detected during the same pipe-cutting operations noted above. Results averaged 300 pCi/l (2% of the Drinking Water MCL).
Georgia Tech Research Reactor (GTRR)	Vegetation	H-3	Slightly elevated concentrations (up to **3X** Bkg) of H-3 in vegetation samples were also detected during the same pipe-cutting operations noted above. Results averaged less than 2% of MCL, based on the H-3 content of the vegetation moisture.
	Vegetation And Soil	Co-60	Slightly elevated concentrations of Co-60 were also detected in one vegetation sample (**9X** Bkg), and in one soil (**4X** Bkg) soil sample, separated by a five-month interval, starting during graphite-removal phase. It was assumed that the Co-60 had been deposited as a result of a very localized release, either as an airborne release or as a surface run-off water release. Assuming an airborne release, the dose was estimated to have been no more than 0.01 mrem (effective) and 0.07 mrem (lungs), which would have been equivalent to no more than 0.5% of the air-pathway reporting level.
Georgia Tech Research Reactor	Waste Water	H-3	Elevated concentrations of H-3 were measured in wastewater samples during the pipe-cutting operations. All measured concentrations were less than the maximum permissible concentration (MPC) limit for liquid effluent.

A detailed discussion of the findings related to each of the monitored nuclear facilities may be found in Sections D-K of this report. The following is a brief summary of the major findings for each facility.

Savannah River Site (SRS) / Vogtle Electric Generating Plant

Georgia DNR's most extensive environmental radiation monitoring network is focused on an area in Georgia adjacent to and downstream of the U.S. Department of Energy's Savannah River Site (SRS) in South Carolina and Georgia Power Company's Vogtle Electric Generating Plant (VEGP) in Georgia. A commercial radioactive waste burial ground facility, operated by Chem-Nuclear, is also located near the monitored area (adjacent to SRS and Lower Three Runs Creek). Because of the relatively close proximity of the Savannah River Site to the Vogtle Electric Generating Plant, a single combined monitoring network has been utilized by DNR since approximately 1978.

Georgia Power Company's Vogtle Electric Generating Plant (VEGP) is a two-unit Pressurized Water Reactor (PWR) facility located on a 5-square-mile tract of land adjacent to the Savannah River in Burke County, Georgia approximately 20 miles southeast of Augusta. This facility, which was supplied by the Westinghouse Corporation, and which is operated by Southern Nuclear Operating Company, has been in operation since 1985.

The U.S. Department of Energy's Savannah River Site (SRS) is a large, U.S. Government complex that has been operated since the early 1950's, primarily for the production of special nuclear materials, including tritium (H-3) and plutonium, used in nuclear weapons. SRS also provides nuclear materials for other purposes, such as plutonium-238 (Pu-238) for radioisotope thermal generators and radioisotope heaters in support of NASA interplanetary space missions.
The SRS area includes numerous airborne emission points distributed over a 300-square-mile area, as well as numerous waterborne emission points, which feed into a 30-mile stretch of the Savannah River. Westinghouse Savannah River Company (WSRC) currently operates SRS under contract to DOE. Facilities at SRS include five (5) mothballed reactors, two (2) large radiochemical separations plants, a large high-level waste processing plant, a radioactive-waste incinerator plant, two (2) high-level-radioactive-waste tank farms, several radioactive waste burial grounds, fuel & target plants, etc. Many of these facilities are being actively decommissioned.

Although the reactors at SRS are no longer operating, millions of gallons of highly radioactive liquid waste and thousands of spent fuel elements still pose a significant, long-term environmental risk, requiring continued monitoring. Future missions at SRS, including the disassembly and reprocessing of plutonium pits and the recovery and recycling of excess plutonium and uranium for mixed-oxide (MOX) commercial reactor fuel, will also require continued vigilance for many years, due to the long-lived nature of the processed material. SRS also is the nation's sole site for the tritium recycle mission, in which tritium is removed from weapons reservoirs, purified, and then loaded back into reservoirs for reuse. SRS is also slated to be the site for recovery of tritium produced in commercial nuclear reactors.

During the period that DNR has monitored SRS, several site-related radionuclides have been detected periodically by DNR, including tritium (H-3), cobalt-60 (Co-60), strontium-90 (Sr-90),

iodine-129 (I-129), cesium-134 (Cs-134), cesium-137 (Cs-137), plutonium-238 (Pu-238), and plutonium-239 (Pu-239). During the current (2000-2002) period, all of the above SRS-related radionuclides (except for Cs-134) were detected:

1) H-3 was detected in many samples from a 400 square-mile area of land in Georgia adjacent to SRS, including air (up to **5x** background), rain (up to **5x** background), groundwater (up to **5x** background), vegetation (up to **13x** background), and crop samples. Airborne emissions from SRS are believed to be responsible for the majority of these results.
2) H-3 was also detected in river water samples over a 130-mile stretch of the Savannah River and its tributaries (up to **240x** background adjacent to SRS and up to **16x** background downstream of SRS). H-3 was also detected in fish samples over the same area of the river (up to **230x** background near SRS and up to **9x** background downstream of SRS).
3) Long-lived I-129 was detected in water from Four-Mile Creek, a tributary of the Savannah River. This radionuclide, which is attributed to SRS, is attributed primarily to seepage from closed radioactive-waste treatment basins and burial grounds located at SRS.
4) Elevated Co-60 (up to **22x** background), Sr-90, (up to **3x** background), Cs-137 (up to **540x** background), Pu-238 (up to **3x** background or MDC) and Pu-239 (up to **6x** background or MDC) were detected in sediment samples adjacent to and up to 100 miles downstream of SRS. Based on observed isotopic ratios, it appears that discharges from SRS may be responsible for at least 80% of the Cs-137 and up to 50% of the Pu-238 and Pu-239 in the Savannah River downstream of SRS. A portion of the off-site Co-60 is may be attributed to VEGP as well as to SRS.
5) Cs-137 and Pu-239 were detected in several soil samples. Most of the activity in these samples appears to be related to global fallout, with the possible exception of a sample from Shell Bluff Landing, which is in the most predominant downwind direction from SRS.
6) Elevated Sr-90 (up to **5x** background) and Cs-137 (up to **220x** background) were detected in fish samples adjacent to the SRS area.
7) Elevated Cs-137 (up to **4x** background) and H-3 (up to **3x** background) were detected in deer samples collected in Georgia adjacent to SRS.
8) Somewhat elevated Sr-90 (up to **4x** background) was detected in vegetation samples from two locations northwest of SRS near Augusta.

During the period that DNR has monitored Plant Vogtle (VEGP), three Site-related radionuclides have periodically been detected in the aquatic environment, including H-3 in river water, Co-58 in river sediment, and Co-60 in river sediment. During the current 2000-2002 period, H-3 and Co-60 were the only man-made radionuclides detected that may be attributed to Site operations:

1) H-3 was detected in river water (up to **50x** background) downstream of Vogtle in one sample after a chemistry problem in one reactor (near the end of 2002), which required system shutdown and cleanup.
2) Co-60 was detected in river sediment (up to **7x** background) downstream of Vogtle.

Edwin I. Hatch Nuclear Plant

Georgia Power Company's Plant Edwin I. Hatch is a two-unit Boiling Water Reactor (BWR) facility located on the Altamaha River in Appling County, Georgia, adjacent to Toombs County.

This facility, which was supplied by the General Electric Company and which is operated by Southern Nuclear Operating Company, has been in operation since 1975.

The Georgia Department of Natural Resources has monitored Plant Hatch since 1978, during which period site-related radionuclides were generally non-detectable in most off-site samples, with the exception of downstream river sediment. Site-related, low-level Co-60 and Mn-54 have been routinely detected in sediment. Site-related Cs-134 and Cs-137 were also detected in sediment following a 1986 spill of water from the spent fuel pool. Global fallout-related radionuclides (Nb-95, Zr-95, Ru-103, Ru-106, Ce-141, Ce-144, and Cs-137) were also detected one year (1981) during the Chinese weapons testing period. Chernobyl-related fallout radionuclides (I-131, Cs-134, Cs-137, Ru-103, and Ru-106) were detected another year (1986).

During 2000-2002, Co-60 and Mn-54 in river sediment (up to **6x** background) were the only site-related radionuclides detected above background levels.

Joseph M. Farley Nuclear Plant

Alabama Power Company Plant Joseph M. Farley is a two-unit Pressurized Water Reactor (PWR) facility located on the Chathoochee River in Houston County, Alabama, adjacent to Early County, Georgia. This facility, which was supplied by the Westinghouse Corporation, and which is operated by Southern Nuclear Operating Company, has been in operation since 1977.

The Georgia Department of Natural Resources (DNR) has monitored Plant Farley since approximately 1978. Historically, low levels of Co-60 in river sediment and low level of tritium (H-3) in river water are the only site-related radionuclides detected. However, several global fallout-related radionuclides (including Nb-95, Zr-95, Ru-103, Ru-106, Ce-141, Ce-144, and Cs-137) were also detected one year (1981) during the Chinese weapons testing period. Cs-137 is the only one of these nuclides that is still detectable.

During the current 2000-2002 period, H-3 in river water (up to **23x** background) and Co-60 in river sediment (up to **2x** background) were the only site-related radionuclides detected.

Naval Submarine Base, Kings Bay

Naval Submarine Base, Kings Bay supports the Trident Nuclear Submarines and their associated ballistic missile systems, as a part of the U.S. Navy's Fleet Ballistic Missile Submarine facilities. Kings Bay also supports other classes of submarines. It is situated between St. Mary's, Georgia on the west and Cumberland Sound on the east, in Camden County. Submarine wharves, dry-docks, and other support facilities are located on the waterfronts of Kings Bay and Cumberland Sound.

The Georgia Department of Natural Resources (DNR) has monitored Kings Bay since it began operations in 1978. During this period, no measurable radioactivity that could be attributed to operations at the facility has been detected by DNR. Only naturally occurring radionuclides and global fall-out-related Cs-137 have been detected in the environment around King's Bay.

Georgia Tech Research Reactor (decommissioned)

The decommissioned Georgia Tech Research Reactor (GTRR), located at the Frank H. Neely Nuclear Research Center on the Georgia Tech Campus in Atlanta, Georgia, was a 5-megawatt, highly enriched, heavy water moderated research reactor. Prior to the 1996 Olympics, it was permanently shut down and de-fueled in preparation for its decommissioning, which is now complete (**Figure A-1**). DNR has monitored GTRR since 1978, when it was first given that responsibility. Historically, the only routinely detectable radionuclides that could be attributed to GTRR operations were H-3, Co-60, Cs-137, and gross beta in liquid effluents. Once sampled and determined to be within regulatory limits, liquid effluents were discharged to the sanitary sewer. Global fallout-related radionuclides (including Nb-95, Zr-95, and Cs-137) were also historically detected, with fresh deposits detected during 1981 after a series of Chinese weapons tests. Of these radionuclides, Cs-137 is the only global fallout-related radionuclide still detectable

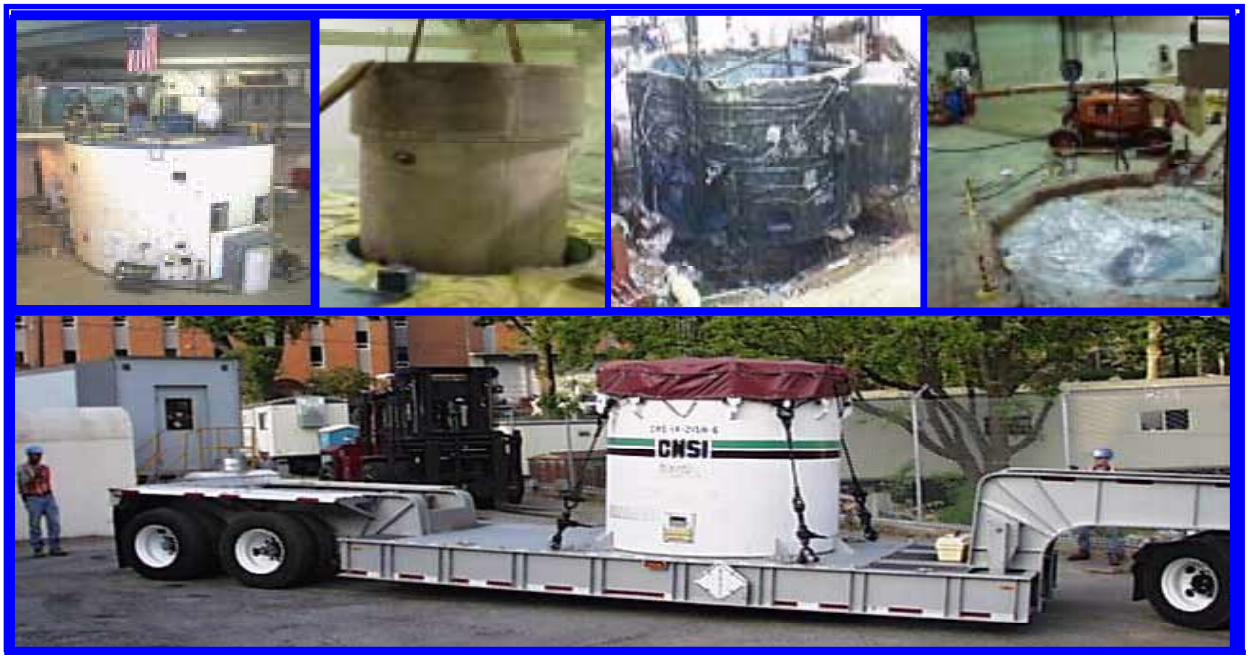

Figure A-1: **Top View**: Georgia Tech Research Reactor Before, During, and After It's Removal.
Bottom View: Truck Hauling GTRR Reactor Vessel Away in a Shielded Cask for Burial.

During the current 2000-2002 period, which involved demolition and decommissioning (D&D) of GTRR, elevated direct gamma radiation and slightly-elevated levels of radionuclides (H-3 and Co-60, at levels up to **10x** background) were periodically detected off-site (near the fence-line). Measurable direct radiation and environmental radioactivity from D&D appeared to have been confined to the immediate area (within approximately 100 feet) of the facility boundary, with no offsite impact in excess of regulatory limits. Although reporting levels were **exceeded** along the south and west fence-lines, offsite doses from all monitored pathways (which approached 81 mrem in a one year period between April-2000 and April-2001 at one location) did not exceed the annual dose limit (100 mrem) found in U.S. Nuclear Regulatory Commission regulations.

Dawson Forest Wildlife Management Area

Dawson Forest Wildlife Management Area (DFWMA) is a 10,000-acre tract of land located in Dawson County, approximately 5 miles southwest of Dawsonville, Georgia. It is the decommissioned site of the former Georgia Nuclear Aircraft Laboratory (GNAL), which was operated by Lockheed Aircraft Corporation, under contract for the U.S. Air Force, until it was decommissioned around the end of 1971. Facilities containing radioactive materials at GNAL included a test reactor, hot cell building seepage basins, and cooling-off area (for temporary outdoor storage of "hot" items after irradiation at the reactor site). The land, which is now owned by the City of Atlanta as a possible future airport site, is currently managed by the Georgia Forestry Commission for the purpose of forestry management and by the Georgia Department of Natural Resources for the purpose of game management.

DNR first initiated environmental monitoring of DFWMA shortly after their Environmental Radiation Program was formed at the end of 1977. At that time, a portion of the site was found to contain residual activity of possible concern, and two of these areas were fenced to prevent public access. Site structures, including the hot cell building, were also sealed to prevent access.

DNR has conducted quarterly or semi-annual direct (external) gamma radiation measurements in public-accessible locations at DFWMA for the past 25 years. A variety of instruments have been used for this task, including hand-held dose-rate monitors, a gamma spectrometer, and thermoluminescent dosimeters (TLDs). TLDs were the primary means used by DNR for continuous long-term dose monitoring. Gamma spectrometry was used primarily to determine the relative contribution of each radionuclide (including naturally occurring nuclides) to gamma doses. Hand-held instruments were used primarily to survey the perimeter to insure that hotspots remained confined.

Direct radiation dose rates, as recorded by the TLDs, have declined noticeably, during the past 25 years, in the restricted areas. Doses at all TLD locations currently appear to be nearing background levels. EPD environmental measurements have confirmed that the radioactive materials present on the site, primarily Co-60 and Eu-152 (up to **25x** Bkg), are not mobile in the environment.

Sequoyah Nuclear Plant

Tennessee Valley Authority's Sequoyah Nuclear Plant is a two-unit Pressurized Water Reactor (PWR) facility located in Hamilton County, Tennessee approximately 20 miles northeast of Rossvile, Georgia. Westinghouse Electric Corporation supplied this facility, which has been in operation since 1980.

Several TLD and sample locations are included in DNR's network, with most of the monitoring focused on the northwest corner of Georgia, including Rock City, Rossville, Ringold, and Cohutta. DNR has monitored Plant Sequoyah since approximately 1980, with no detectable Site-related activity. However, several man-made global-fallout-related radionuclides (including Nb-95, Zr-95, Ru-103, Ru-106, Ce-141, Ce-144, and Cs-137) were detected many years ago (1981)

during the Chinese weapons testing period. Global fallout-related Cs-137 is the only man-made radionuclide that is still detectable.

Oconee Nuclear Plant

Duke Power Company Oconee Nuclear Plant is a three-unit Pressurized Water Reactor (PWR) facility located adjacent to Lake Keowee, near Senaca, South Carolina, approximately 20 miles northeast of Toccoa, Georgia. It discharges into the headwaters of the Savannah River upstream of Lake Hartwell. Babcock and Wilcox Company supplied this facility, which has been in operation since 1974.

Several land and aquatic sample are included in DNR's network, which includes the northeast corner of Georgia, around and including Lake Hartwell. DNR has monitored Plant Oconee since approximately 1978, with no detectable site-related activity except for periodic low-level H-3 in surface water collected from Lake Hartwell (near the Hartwell Dam). However, several global fallout-related radionuclides (Nb-95, Zr-95, Ru-103, Ru-106, Ce-141, Ce-144, and Cs-137) were detected many years ago (1981) during the Chinese weapons testing period. Cs-137 is the only one of these fallout-related gamma-emitting radionuclides that is still detectable.

Radiological Emergency Response

By Executive Order of the Governor, the Department of Natural Resources is the lead state agency for response to and technical assessment of peacetime radiological incidents and emergencies. This responsibility, assigned to the Environmental Protection Division, is implemented by the Environmental Radiation Program, with assistance from the Radioactive Materials Program. The Program also plays a major role in radiological emergency planning and preparedness efforts for the state, including participation in radiological emergency exercises at Plant Hatch, Plant Vogtle, Plant Farley, and the Savannah River Site. Program associates are also involved in emergency preparedness and response activities related to the transportation of radioactive materials.

Figure A-2. Florida, Georgia and DOE contractor staff consult on a field monitoring issue during the 2002 Joint Venture Exercise.

The Federal Emergency Management Agency (FEMA) evaluates radiological emergency preparedness exercises at commercial nuclear power facilities. EPD participates in three evaluated radiological emergency preparedness exercises (**Figure A-2**) every two years. FEMA consistently has reported that the EPD emergency response capability for protecting the health and safety of Georgia's citizens in the event of a radiological incident as "adequate", and in many instances as "superior".

During 2000-2002, EPD participated in five evaluated radiological emergency preparedness exercises. In addition to these, in April 2002, Georgia had the unprecedented opportunity to participate in an exercise alongside the bulk of the federal resources that, together, represent the Federal Radiological Monitoring and Assessment Center (FRMAC), the Advisory Team for Environment, Food and Health (A-Team), and the Aerial Measurement System (AMS) – all national radiological emergency response assets. The Joint Venture ingestion pathway exercise (IPX) extended over 3 days, and included participation by state radiological health personnel from Alabama, Florida, Georgia, North Carolina and South Carolina, as well as federal agency and contractor participants. The exercise simulated a major release of radioactive materials affecting both Georgia and South Carolina. Staff of both the EPD Environmental Radiation Program and the Radioactive Materials Program were fully involved in the exercise, as were contract laboratory personnel from Georgia Tech. Georgia, accompanied by Florida and North Carolina, deployed its Mobile Radiological Laboratory (MRL) to co-locate with the FRMAC at the National Guard Armory in Graniteville, SC (**Figure A-3**).

Figure A-3. Florida, North Carolina and Georgia Mobile Radiation Laboratories at the 2002 Joint Venture Exercise in Graniteville, SC.

In addition to participation in periodic radiological emergency preparedness exercises, the Environmental Radiation Program, in conjunction with the Radioactive Materials Program, has responded to more than 80 incidents (roughly one every two weeks) involving radioactive materials during this report period. In one incident the Federal Bureau of Investigation requested identification of a mailed package that was radioactive. The FBI, fearing a radiological dispersion device, wanted EPD to characterize the package, which turned out to be a strong beta-emitter (later determined to be Sr-90). EPD took possession of the package for later safe disposal. Other incidents (nearly 43%) involved contaminated scrap metal, including the buildup of naturally occurring radioactive materials (NORM) in manufacturing process equipment.

Although none of the incidents during this reporting period resulted in significant releases of radioactive materials to the environment, several incidents required decontamination of facilities and equipment. Contaminated scrap metal poses a special problem for EPD radiation specialists, in that the material involved needs to be quickly identified without undue risk to the investigator. In most cases, the source of radiation is NORM deposited on the surface equipment. However, during one response, EPD personnel determined the source of radiation to be a radioactive gage that had been improperly disposed.

EPD routinely uses a field-portable gamma spectrometer to help in the field identification of radionuclides. Roughly a third of the incidents involved Georgia radioactive materials licensees or companies with radioactive materials licenses from the U.S. Nuclear Regulatory Commission or other states doing business in Georgia under reciprocity. 11 incidents involved the detection of radioactive materials, primarily short-lived medical radionuclides, at municipal or commercial landfills.