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Docket Nos. 50-321
50-366

HL-4553

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Edwin I. Hatch Nuclear Plant
Annual Radiological Environmental Surveillance Report for 1993

Gentlemen:

In accordance with the Plant Hatch Units 1 and 2 Technical Specifications, Sections 6.9.1.6 and 6.9.1.7., which were in effect throughout 1993, Georgia Power Company is submitting the enclosed Environmental Surveillance Report for 1993.

If you have any questions in this regard, please contact this office at any time.

Sincerely,

J. T. Beckham, Jr.

WHO:sls
ENV-94-084

Enclosure: Annual Radiological Environmental Surveillance Report

cc: Georgia Power Company
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NORMS

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Mr. K. N. Jabbour, Licensing Project Manager - Hatch

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Enclosure
Edwin I. Hatch Nuclear Plant
Radiological Environmental Surveillance Report for 1993

EDWIN I. HATCH NUCLEAR PLANT
RADIOLOGICAL ENVIRONMENTAL SURVEILLANCE REPORT

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ACRONYMS

A2LA	American Association of Laboratory Accreditation
ASTM	American Society for Testing and Materials
CL	Confidence Level
EL	Environmental Laboratory
EPA	Environmental Protection Agency
GPC	Georgia Power Company
HNP	Edwin I. Hatch Nuclear Plant
LLD	Lower Limit of Detection
MDA	Minimum Detectable Activity
MDD	Minimum Detectable Difference
NA	Not Applicale
NDM	No Detectable Measurement(s)
NRC	Nuclear Regulatory Commission
ODCM	Offsite Dose Calculation Manual
REMP	Radiological Environmental Monitoring Program
RL	Reporting Level
TLD	Thermoluminescent Dosimeter
TS	Technical Specifications

EDWIN I. HATCH NUCLEAR PLANT
RADIOLOGICAL ENVIRONMENTAL SURVEILLANCE REPORT

1.0 INTRODUCTION

The objectives of the Radiological Environmental Monitoring Program (REMP) are to ascertain the levels of radiation and concentrations of radioactivity in the environs of the Edwin I. Hatch Nuclear Plant (HNP) and to evaluate any radiological impact upon the environment due to plant operations. Reported herein are the program's activities for 1993. All dates in this report are for 1993 unless otherwise indicated.

The REMP was conducted in accordance with Technical Specifications (TS) 3/4.16 for Unit 1 and TS 3/4.12 for Unit 2. A single program serves both units. All references to sections of the TS or the Offsite Dose Calculation Manual (ODCM) are to sections which were in effect during 1993. By implementation of Nuclear Regulatory Commission (NRC) Generic Letter 89-01 which occurred on January 1, 1994, the procedual details of the REMP have now been relocated from the TS to the ODCM.

A summary description of the program is provided in Section 2; maps showing the sampling locations (stations) are keyed to a table which indicates the direction and distance of each station from the main stack. An annual summary of the main laboratory analysis results obtained from the samples utilized for environmental monitoring is presented in Section 3. A discussion of the results, including assessments of any radiological impacts upon the environment and the results of the land use and river surveys, is provided in Section 4. The results of the Interlaboratory Comparison Program are presented in Section 5. Conclusions are stated in Section 6.

2.0 SUMMARY DESCRIPTION

A summary description of the REMP is provided in Table 2-1. This table portrays the program in the manner by which it is being regularly carried out. Table 2-1 is essentially a copy of TS Table 3.16.1-1 which delineates the program's requirements. Sampling locations required by Table 2-1 are described in Table 2-2 and are shown on maps in Figures 2-1 through 2-3. This description of the sample locations closely follows the table and figures in Section 3 of the ODCM.

TS 3.16.1.a states that deviations from the required sampling schedule which is delineated in Table 2-1 herein, are permitted if samples are unobtainable due to hazardous conditions, unavailability, inclement weather, malfunction of equipment, or other just reasons. Any deviations are accounted for in the discussions for each particular sample type in Section 4.

All laboratory analyses were performed by Georgia Power Company's (GPC) Environmental Laboratory (EL) in Smyrna, Georgia. Since 1987, the EL has been accredited by the American Association of Laboratory Accrediation (A2LA) for radiochemistry. The A2LA is a nonprofit, nongovernmental, public service, membership society dedicated to the formal recognition of competent laboratories and related activities. Accreditation is based upon internationally accepted criteria for laboratory competence.

TABLE 2-1 (SHEET 1 OF 3)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Approximate Number of Sample Locations	Sampling and Collection Frequency	Type of Analysis and Frequency
1. Airborne Radioiodine and Particulates	6	Continuous operation of sampler with sample collection weekly	Radioiodine canister: I-131 analysis, weekly. Particulate sampler: analyze for gross beta radioactivity not less than 24 hours following filter change, weekly; perform gamma isotopic analysis on affected sample when gross beta activity is 10 times the yearly mean of control samples; and composite (by location) for gamma isotopic analysis, quarterly.
2. Direct Radiation	37	Quarterly	Gamma dose, quarterly.
3. Ingestion Milk (a)	1	Biweekly	Gamma isotopic and I-131 analyses, biweekly.
Fish or Clams (b)	2	Semiannually	Gamma isotopic on edible portions, semiannually.
Grass or Leafy Vegetation	3	Monthly during growing season	Gamma isotopic analysis monthly (c).

TABLE 2-1 (SHEET 2 OF 3)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Approximate Number of Sample Locations	Sampling and Collection Frequency	Type of Analysis and Frequency
4. Waterborne			
Surface	2	Composite sample collected monthly (d)	Gamma isotopic analysis, monthly. Composite (by location) for tritium analysis, quarterly.
Sediment	2	Semiannually	Gamma isotopic analysis, semiannually.
Drinking Water (e & f)	One sample of river water near the intake and one sample of finished water from each of one to three of the nearest water supplies which could be affected by HNP discharges.	River water collected near the intake will be a composite sample; the finished water will be a grab sample. These samples will be collected monthly unless the calculated dose due to consumption of water is greater than 1 mrem/year; then the collection will be biweekly. The collections may revert to monthly should the calculated doses become less than 1 mrem/year.	I-131 analysis on each sample when biweekly collections are required. Gross beta and gamma isotopic analyses on each sample; composite (by location) for tritium analysis, quarterly.

TABLE 2-1 (SHEET 3 OF 3)

SUMMARY DESCRIPTION OF
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

NOTES

a. Up to three sampling locations within 5 miles and in different sectors will be used as available. In addition, one or more control locations beyond 10 miles will be used.

b. Commercially or recreationally important fish may be sampled. Clams may be sampled if difficulties are encountered in obtaining sufficient fish samples.

c. If gamma isotopic analysis is not sensitive enough to meet the Lower Limit of Detection (LLD), a separate analysis for I-131 may be performed.

d. The composite samples shall be composed of a series of aliquots collected at intervals not exceeding a few hours.

e. If river water downstream of the plant is used for drinking, water samples will be collected and analyzed as specified herein.

f. A survey shall be conducted annually at least 50 river miles downstream of the plant to identify who uses water from the Altamaha River for drinking.

TABLE 2-2 (SHEET 1 OF 2)

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS

Station Number	Station Type (a)	Descriptive Location	Direction (b)	Distance (miles) (b)	Sample Type (c)
064	O	Roadside Park	WNW	0.8	D
101	I	Inner Ring	N	1.9	D
102	I	Inner Ring	NNE	2.5	D
103	I	Inner Ring	NE	1.8	AD
104	I	Inner Ring	ENE	1.6	D
105	I	Inner Ring	E	3.7	D
106	I	Inner Ring	ESE	1.1	DV
107	I	Inner Ring	SE	1.2	AD
108	I	Inner Ring	SSE	1.6	D
109	I	Inner Ring	S	0.9	D
110	I	Inner Ring	SSW	1.0	D
111	I	Inner Ring	SW	0.9	D
112	I	Inner Ring	WSW	1.0	ADV
113	I	Inner Ring	W	1.1	D
114	I	Inner Ring	WNW	1.2	D
115	I	Inner Ring	NW	1.1	D
116	I	Inner Ring	NNW	1.6	AD
170	C	Upstream	WNW	(d)	R
172	I	Downstream	E	(d)	R
201	O	Outer Ring	N	5.0	D
202	O	Outer Ring	NNE	4.9	D
203	O	Outer Ring	NE	5.0	D
204	O	Outer Ring	ENE	5.0	D
205	O	Outer Ring	E	7.2	D
206	O	Outer Ring	ESE	4.8	D
207	O	Outer Ring	SE	4.3	D
208	O	Outer Ring	SSE	4.8	D
209	O	Outer Ring	S	4.4	D
210	O	Outer Ring	SSW	4.3	D
211	O	Outer Ring	SW	4.7	D
212	O	Outer Ring	WSW	4.4	D
213	O	Outer Ring	W	4.3	D
214	O	Outer Ring	WNW	5.4	D
215	O	Outer Ring	NW	4.4	D
216	O	Outer Ring	NNW	4.8	D
301	O	Toombs Central	N	8.0	D
304	C	State Prison	ENE	11.2	AD
304	C	State Prison	ENE	10.3	M
309	C	Baxley Substa	S	10.0	AD
416	C	Emer News Ctr	NNW	21.0	DV

TABLE 2-2 (SHEET 2 OF 2)

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS

NOTES

a. Station types

C - Control
I - Indicator
O - Other

b. Direction and distance are reckoned from the main stack.

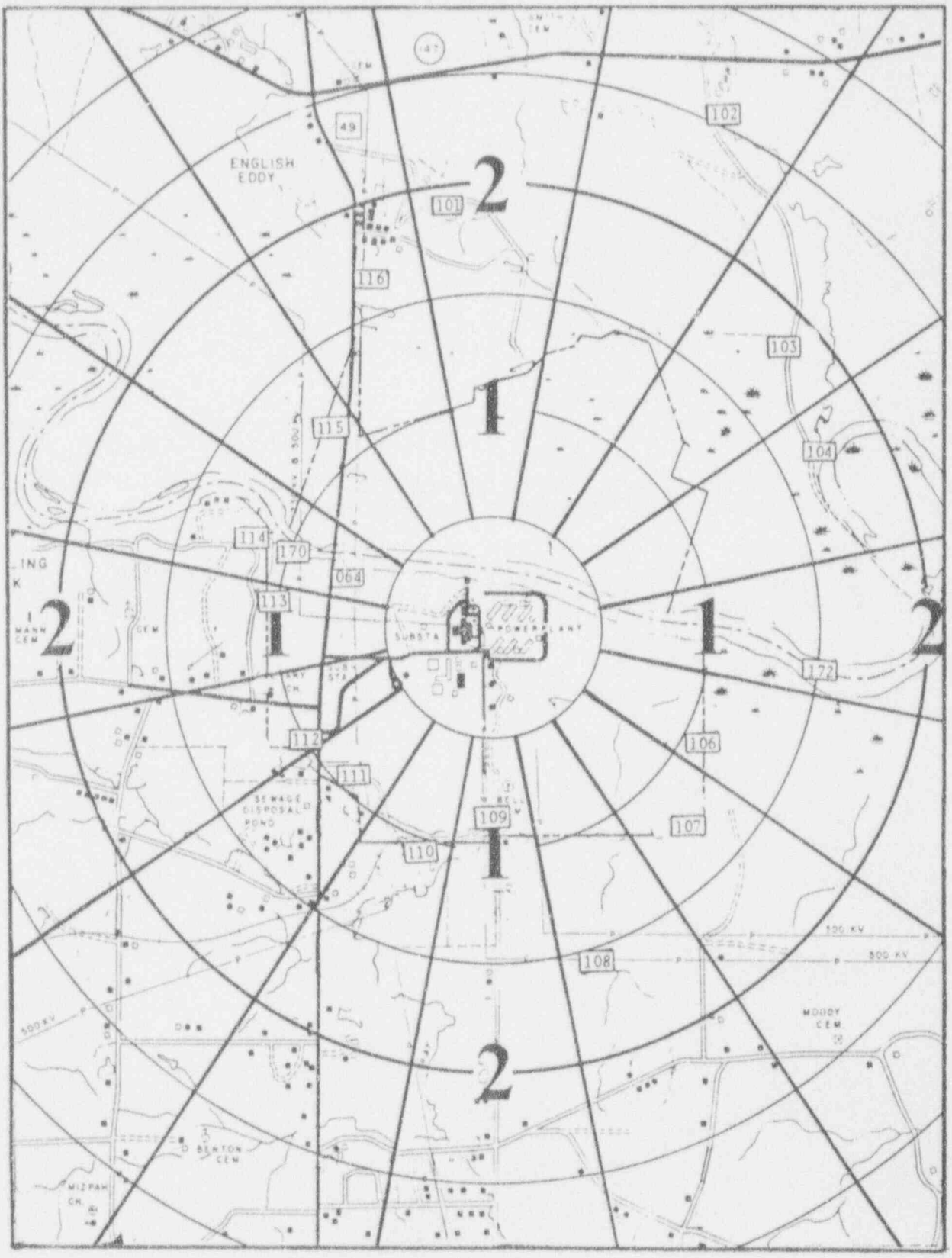
c. Sample types

A - Airborne Radioactivity
D - Direct Radiation
M - Milk
R - River (fish or clams, shoreline sediment, and surface water)
V - Vegetation

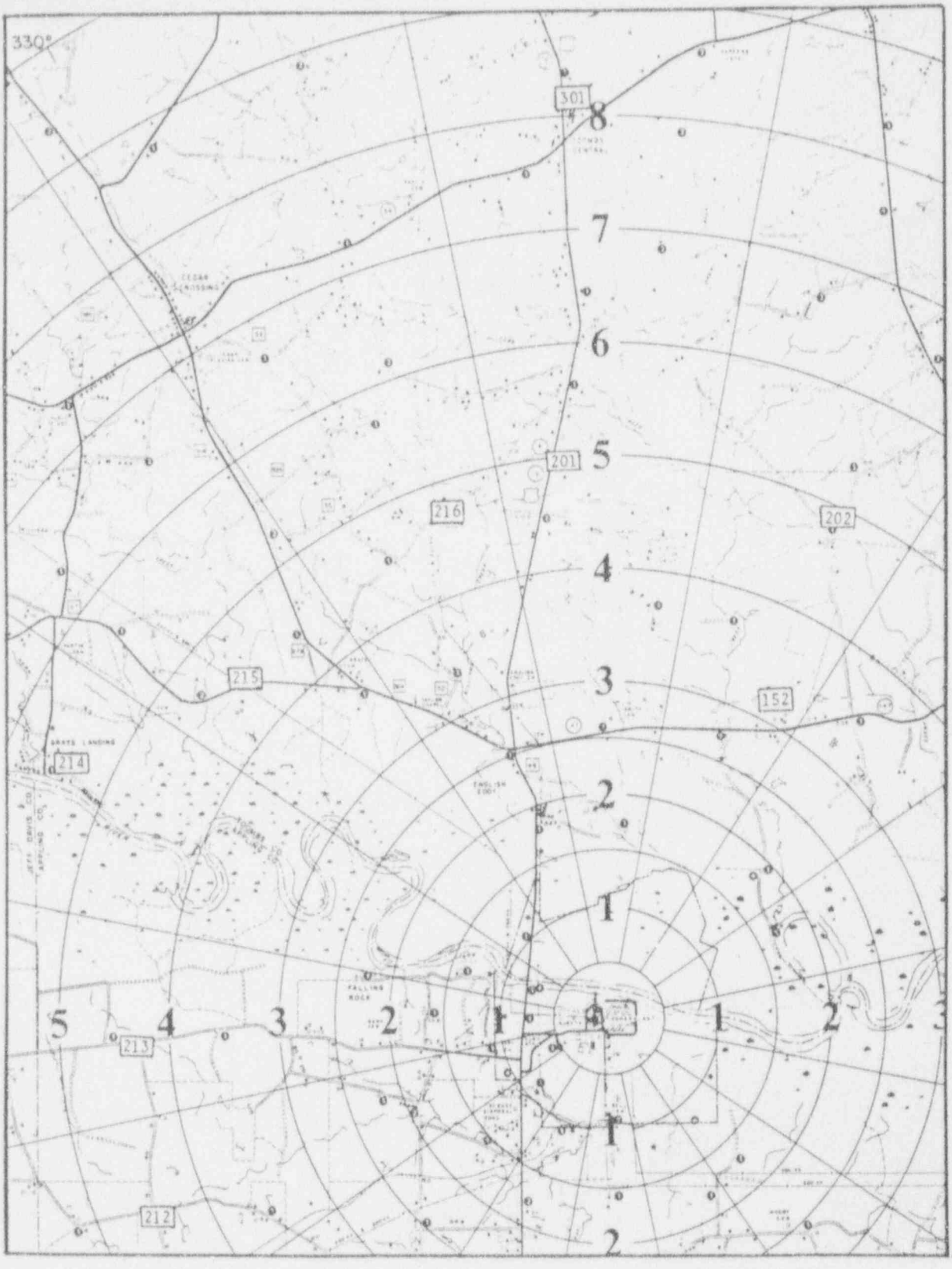
d. Station 170 is located approximately 0.6 river miles upstream of the intake structure for river water, 1.1 river miles for sediment and clams, and 1.5 river miles for fish.

Station 172 is located approximately 3.0 river miles downstream of the discharge structure for river water, sediment and clams, and 1.7 river miles for fish.

The locations from which river water and sediment may be taken can be sharply defined. However, the sampling locations for clams often have to be extended over a wide area to obtain a sufficient quantity. High water adds to the difficulty in obtaining clam samples and may also make an otherwise suitable location for sediment sampling unavailable. A stretch of the river of a few miles or so is generally needed to obtain adequate fish samples. The mile locations given above represent approximations of the locations where samples are collected.



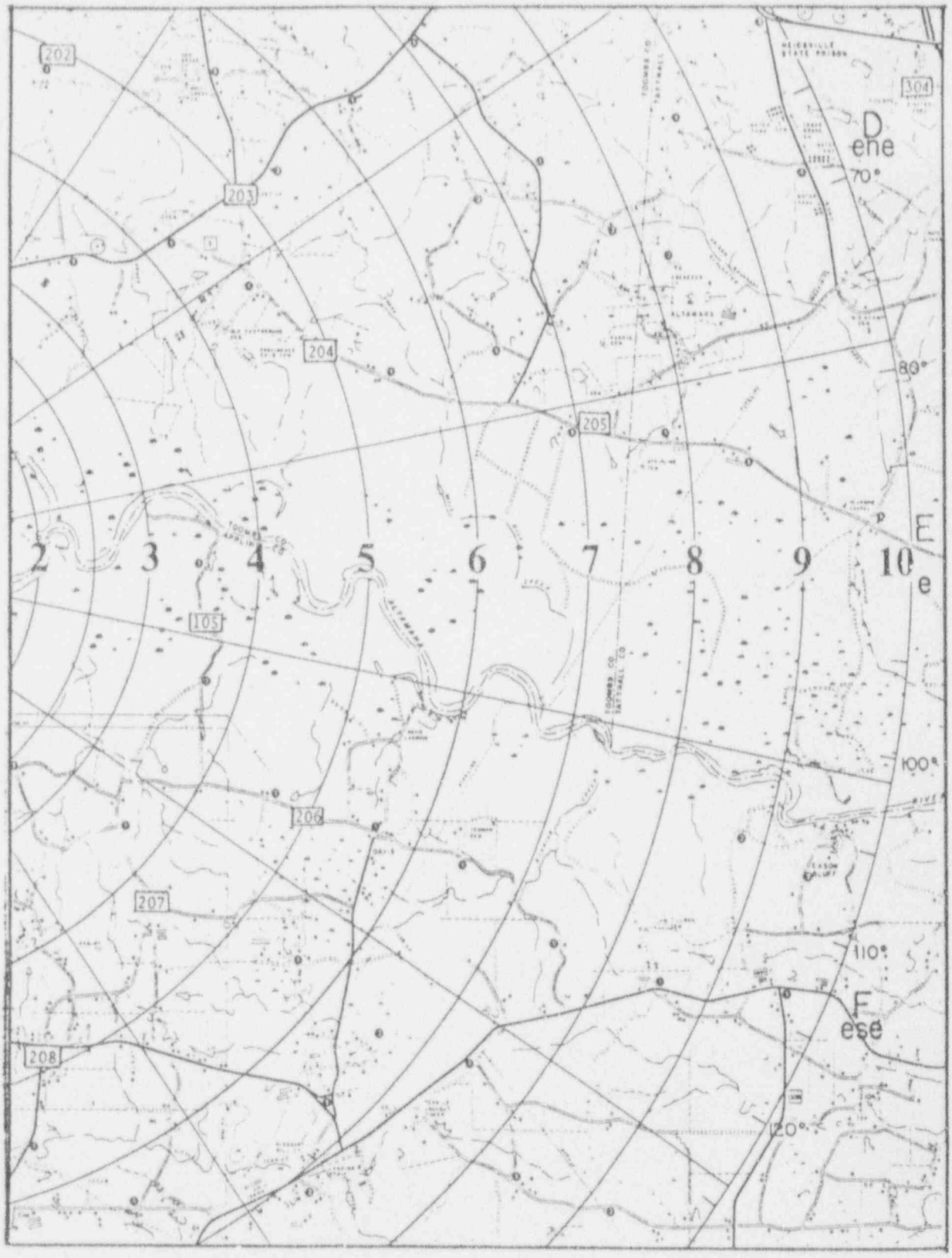
EDWIN I. HATCH NUCLEAR PLANT	RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS ON SITE PERIPHERY
	FIGURE 2-1



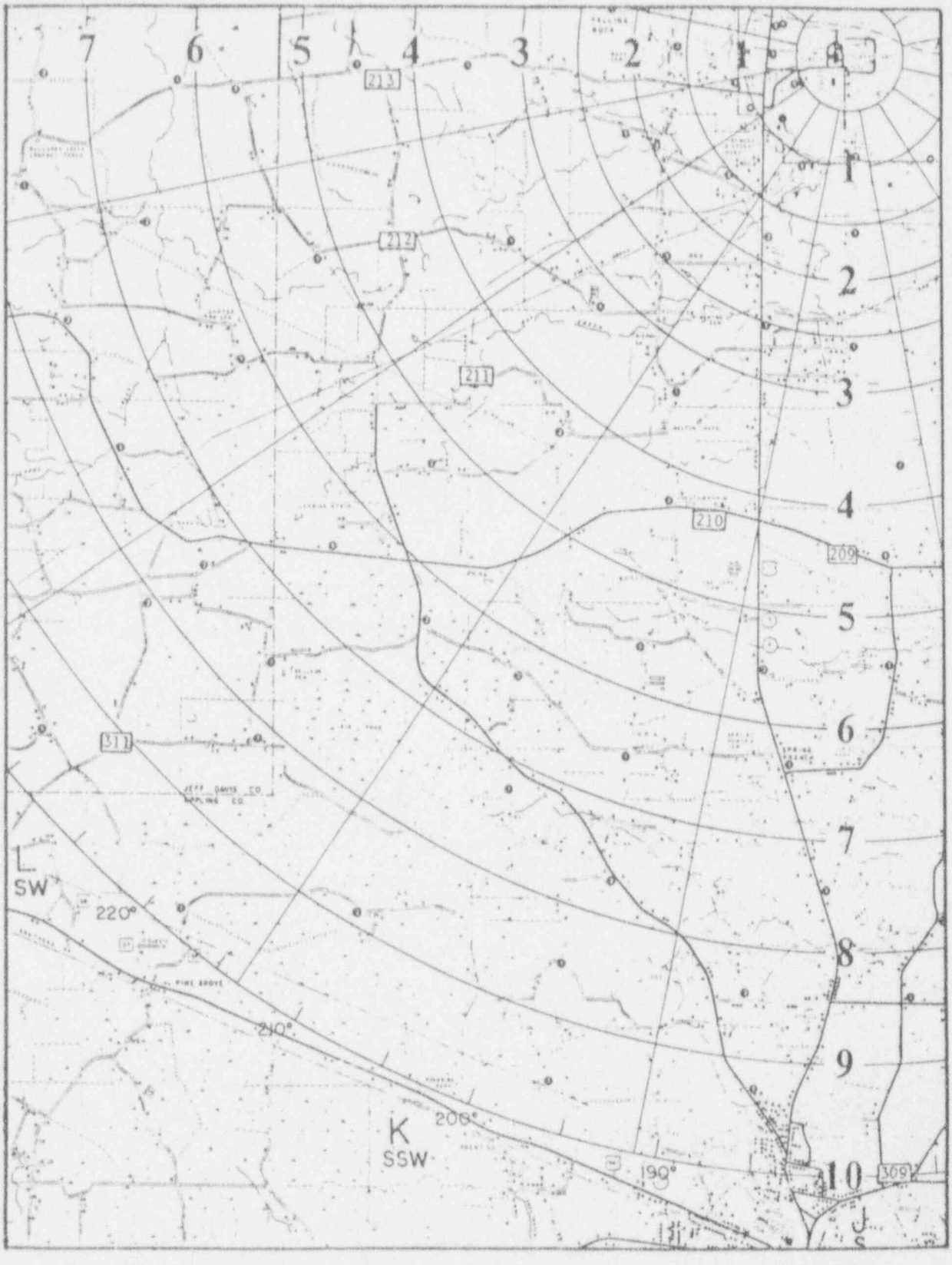
EDWIN I. HATCH NUCLEAR PLANT

RADIOLOGICAL ENVIRONMENTAL SAMPLING
LOCATIONS BEYOND SITE PERIPHERY

FIGURE 2-2 (SHEET 1 of 3)



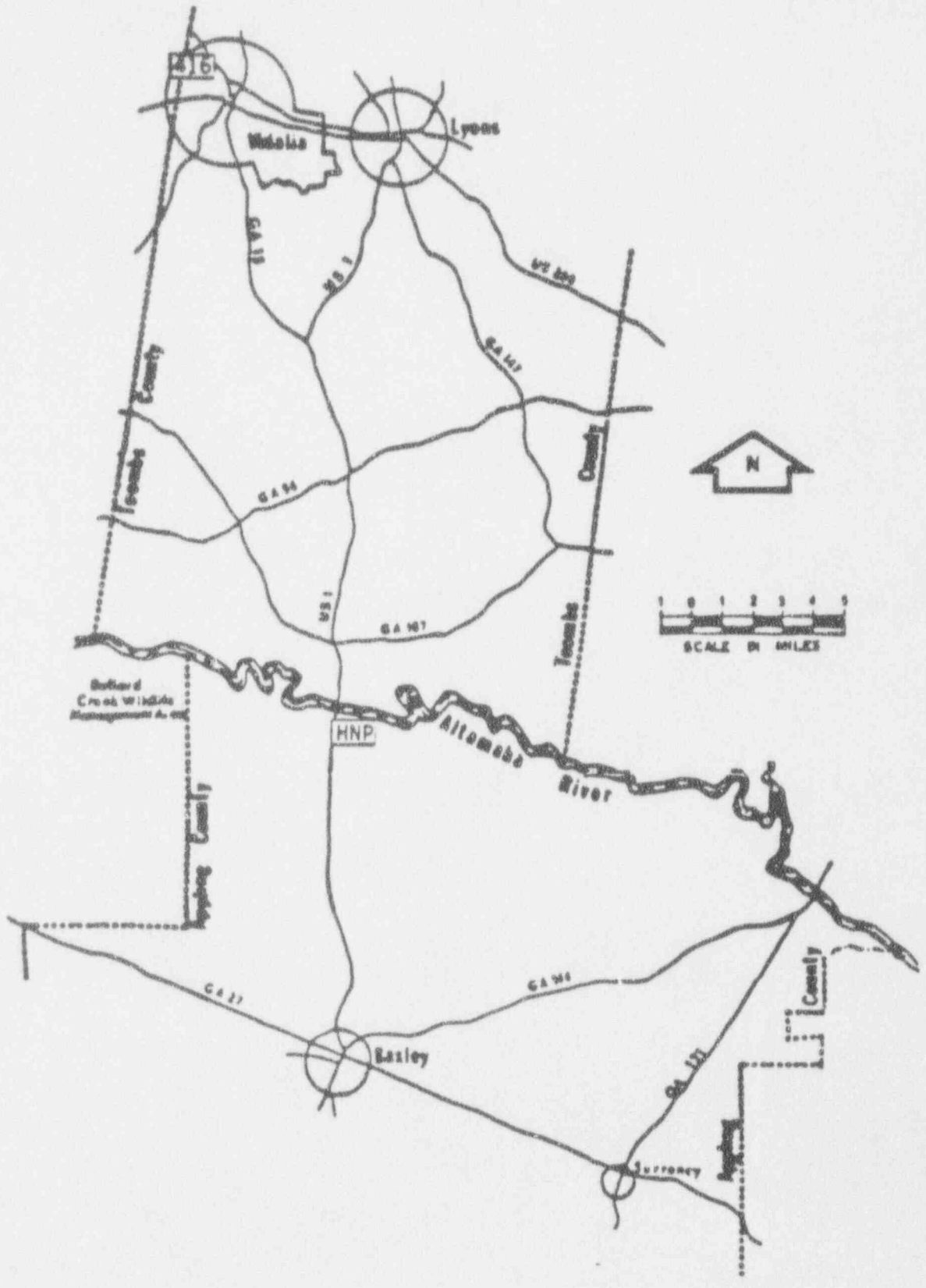
EDWIN I. HATCH NUCLEAR PLANT	RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS BEYOND SITE PERIPHERY
	FIGURE 2-2 (SHEET 2 of 3)



EDWIN I. HATCH NUCLEAR PLANT

RADIOLOGICAL ENVIRONMENTAL SAMPLING
LOCATIONS BEYOND SITE PERIPHERY

FIGURE 2-2 (SHEET 3 of 3)



Georgia Power

EDWIN I. HATCH NUCLEAR PLANT

LOCATION OF ADDITIONAL CONTROL STATION FOR TLDs AND VEGETATION

FIGURE 2-3

3.0 RESULTS SUMMARY

In accordance with TS 6.9.1.7, summarized and tabulated results for all of the regular samples collected for the year at the designated indicator and control stations are presented in Table 3-1 in the format of TS Table 6.9.1.7-1. Only man-made radionuclides are reported. Results for samples collected at locations other than indicator or control stations or in addition to those stipulated by Table 2-1 are discussed in Section 4.

TABLE 3-1 (SHEET 1 OF 5)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY FOR 1993
Edwin I. Hatch Nuclear Plant, Docket Nos. 50-321 and 50-366
Appling County, Georgia

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (a) (LLD)	All Indicator Locations Mean (b) Range (Fraction)	Location with Highest Annual Mean Name Distance & Direction	Mean (b) Range (Fraction)	Control Locations Mean (b) Range (Fraction)	Number of Reportable Occurrences
Airborne Particulates (fCi/m^3)	Gross Beta 312	10	20.4 4-33 (208/208)	No. 116 Inner Ring 1.6 miles NNW	21.2 5-33 (52/52)	20.7 5-32 (104/104)	0
	Gamma Isotopic 24						
	Cs-134	50	NDM (c)		NDM	NDM	0
	Cs-137	60	NDM		NDM	NDM	0
Airborne Radioiodine (fCi/m^3)	I-131 312	70	NDM		NDM	NDM	0
Direct Radiation (mR/91 days)	Gamma Dose 76	NA (d)	11.6 8-15 (64/64)	No. 104 Inner Ring 1.6 miles ENE	14.3 10-17 (4/4)	10.7 8-13 (12/12)	0
Milk (pCi/l)	Gamma Isotopic 27						
	Cs-134	20	NA		NDM	NDM	0
	Cs-137	20	NA		NDM	NDM	0
	Ba-140	60	NA		NDM	NDM	0
	La-140	20	NA		NDM	NDM	0

TABLE 3-1 (SHEET 2 OF 5)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY FOR 1993
Edwin I. Hatch Nuclear Plant, Docket Nos. 50-321 and 50-366
Appling County, Georgia

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (a) (LLD)	All Indicator Locations Mean (b) Range (Fraction)	Location with Highest Annual Mean Name Distance & Direction	Location with Highest Annual Mean Mean (b) Range (Fraction)	Control Locations Mean (b) Range (Fraction)	Number of Reportable Occurrences
	I-131 27	1	NA		NDM	NDM	0
Vegetation (pCi/kg wet)	Gamma Isotopic 36						
	I-131	60	NDM		NDM	NDM	0
	Cs-134	60	NDM		NDM	NDM	0
	Cs-137	80	24.7 25-25 (1/24)	No.416 Em News Ctr 21 miles NNW	45.8 32-56 (6/12)	45.8 32-56 (6/12)	0
River Water (pCi/l)	Gamma Isotopic 24						
	Mn-54	20	NDM		NDM	NDM	0
	Fe-59	30	NDM		NDM	NDM	0
	Co-58	20	NDM		NDM	NDM	0
	Co-60	20	NDM		NDM	NDM	0
	Zn-65	30	NDM		NDM	NDM	0
	Zr-95	30	NDM		NDM	NDM	0
	Nb-95	20	NDM		NDM	NDM	0

TABLE 3-1 (SHEET 3 OF 5)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY FOR 1993
Edwin I. Hatch Nuclear Plant, Docket Nos. 50-321 and 50-366
Appling County, Georgia

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (a) (LLD)	All Indicator Locations Mean (b) Range (Fraction)	Location with Highest Annual Mean Name Distance & Direction	Mean (b) Range (Fraction)	Control Locations Mean (b) Range (Fraction)	Number of Reportable Occurrences
	I-131	20 (e)	NDM		NDM	NDM	0
	Cs-134	20	NDM		NDM	NDM	0
	Cs-137	20	NDM		NDM	NDM	0
	Ba-140	60	NDM		NDM	NDM	0
	La-140	20	NDM		NDM	NDM	0
	Tritium 8	3000 (f)	NDM		NDM	NDM	0
Fish (pCi/kg wet)	Gamma Isotopic 8						
	Mn-54	100	NDM		NDM	NDM	0
	Fe-59	300	NDM		NDM	NDM	0
	Co-58	100	NDM		NDM	NDM	0
	Co-60	100	NDM		NDM	NDM	0
	Zn-65	300	NDM		NDM	NDM	0
	Cs-134	100	NDM		NDM	NDM	0
	Cs-137	200	38.0 32-49 (4/4)	No. 172 1.7 miles Downstream	38.0 32-49 (4/4)	25.9 18-34 (4/4)	0

TABLE 3-1 (SHEET 4 OF 5)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL FOR 1993
Edwin I. Hatch Nuclear Plant, Docket Nos. 50-321 and 50-366
Appling County, Georgia

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (a) (LLD)	All Indicator Locations Mean (b) Range (Fraction)	Location with Highest Annual Mean Name Distance & Direction	Mean (b) Range (Fraction)	Control Locations Mean (b) Range (Fraction)	Number of Reportable Occurrences
Sediment (pCi/kg)	Gamma Isotopic 4						
	Co-60	70 (g)	70.7 62-80 (2/2)	No. 172 3.0 miles Downstream	70.7 62-80 (2/2)	NDM	0
	Zn-65	129 (g)	39.9 40-40 (1/2)	No. 172 3.0 miles Downstream	39.9 40-40 (1/2)	NDM	0
	Cs-134	200	NDM		NDM	NDM	0
	Cs-137	200	113 95-131 (2/2)	No. 170 1.1 miles Upstream	115 35-196 (2/2)	115 35-196 (2/2)	0

TABLE 3-1 (SHEET 5 OF 5)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY FOR 1993
Edwin I. Hatch Nuclear Plant, Docket Nos. 50-321 and 50-366
Appling County, Georgia

NOTES

a. The LLD is defined by Notation a of TS Table 4.16.1-1. Except as noted otherwise, the values listed in this column are the detection capabilities required by that table. In practice, the LLDs attained were generally much lower than the values listed. Any attained LLDs greater than the values listed in TS Table 4.16.1-1 are discussed in Section 4.

b. Mean and range are based upon detectable measurements only. The fraction of all measurements at specified locations which was detectable is placed in parenthesis.

c. No Detectable Measurement(s).

d. Not Applicable.

e. Since no drinking water pathway exists, the LLD from the gamma isotopic analysis may be used (see Notation c of TS Table 4.16.1-1). The value listed is the objective LLD.

f. If a drinking water pathway existed, a LLD of 2000 pCi/l would have been used (see Notation d of TS Table 4.16.1-1).

g. The EL has determined that this value may be routinely attained under normal conditions. No value is provided in TS Table 4.16.1-1. Sample size, background count rate or chemical yield might make the Minimum Detectable Activity (MDA), an "a posteriori" or after the fact result, greater that the required LLD.

4.0 DISSCUSSION OF RESULTS

An interpretation and evaluation, as appropriate, of the laboratory results for each type sample are included in this section. Relevant comparisons were made between the difference in average values for indicator and control stations and the calculated Minimum Detectable Difference (MDD) between these two groups at the 99 percent Confidence Level (CL). The MDD was determined using the standard Student's t-test. A difference in the average values which was less than the MDD was considered to be statistically indiscernable.

Pertinent results were also compared with past results including preoperation. The results were examined to perceive any trends. To provide perspective, a result might also be compared with its Lower Limit of Detection (LLD) or Reporting Level (RL) which are nominally provided by TS Tables 4.16.1-1 and 3.16.1-2, respectively. Attempts were made to explain any RLs or other high radiological levels found in the samples. During the year there were no failures in the laboratory analyses of any of the samples in attaining the LLDs required by TS Table 4.16.1-1.

All results were tested for conformance to Chauvenet's Criterion[1] to flag any values which might differ from the others in its set by a relatively large amount. Identified outliers were investigated to determine reasons for deviation from the norm. If due to an equipment malfunction or other valid physical reason, the anomalous result was deemed non-representative and excluded from the data set. No datum was excluded for failing Chauvenet's Criterion only. Any exclusions are discussed in this section under the appropriate sample type.

The annual land use survey as required by TS 3.16.2 was conducted on November 8 to determine the locations of nearby permanent residences and milk animals. The locations of gardens greater than 500 square feet producing broad leaf vegetation were also included in the survey. The nearest locations found in each of the 16 meteorological sectors are presented in Table 4-1. Further information on the milk animal component of the survey is presented in Section 4.3.

1. G. D. Chase and J. L. Rabinowetz, Principles of Radioisotope Methodology, (Burgess Publishing Company, 1962), pp 87-90

TABLE 4-1

LAND USE SURVEY RESULTS

Distance in Miles to Nearest Location in Each Sector

SECTOR	RESIDENCE	MILK ANIMAL	GARDEN
N	2.0	*	3.6
NNE	2.9	*	2.9
NE	3.2	*	3.2
ENE	4.2	*	4.7
E	*	*	*
ESE	3.7	*	*
SE	1.8	*	3.5
SSE	2.0	*	2.1
S	1.0	*	1.5
SSW	1.3	*	2.3
SW	1.1	*	1.5
WSW	1.1	*	1.6
W	1.1	*	2.6
WNW	1.1	*	*
NW	3.6	*	*
NNW	1.8	*	3.4

* None within 5 miles.

TS 3.16.2.a requires a new controlling receptor for TS 4.15.2.3 if the land use survey identifies a location that yields a greater calculated thyroid dose or dose commitment. An analysis of the survey's results showed that there was none.

TS 3.16.2.b requires that whenever the land use survey identifies a location which would yield a thyroid dose (via the same ingestion pathway) 20 percent greater than that from a current indicator station, the new location must become a REMP station (if samples are available). No milk animals were found and none of the gardens yielded a thyroid dose 20 percent greater than that for the current indicator stations for vegetation.

The results of the annual river survey required by Note f of Table 2-1 to identify those who use water from the Altamaha River for drinking purposes are presented in Section 4.5.

4.1 Airborne

As indicated by Table 2-2, airborne particulates and airborne radioiodine were collected at 4 indicator stations (Nos. 103, 107, 112 and 116) which encircle the site and are on the site periphery, and at 2 control stations (Nos. 304 and 309) which are at least 10 miles from the plant. At these locations air was continuously drawn through a Gelman Type A/E glass fiber filter and a SAI CP-200 charcoal canister in sequence to retain airborne particulates and airborne radioiodine, respectively. The filters and canisters were collected weekly.

On March 15 at Station 103, the power was found to be off due to a blown fuse on the power pole as a consequence of severe weather. The power had been off approximately 2.3 days. The laboratory analysis results were not discarded as they were found to conform to Chauvenet's Criterion. Arrangements were made with Altamaha EMC to restore power.

Each of the air particulate filters was counted for gross beta activity. As seen in Table 3-1, the annual average weekly activity of 20.4 fCi/m^3 for the indicator stations was 0.3 fCi/m^3 less than that for the control stations. However, this difference was not discernable, since it was less than the MDD, calculated as 1.5 fCi/m^3. During the 5 year period from 1988 through 1992, the average weekly activity for the year at the indicator stations randomly varied from 0.9 fCi/m^3 greater than to 0.3 fCi/m^3 less than that for the control stations. The average weekly activity over the entire 5 year period for the indicator stations was nearly 0.3 fCi/m^3 greater than that for the control stations.

The average weekly gross beta activity for all stations during this 5 year period was 19.3 fCi/m^3. In past years, it had been an order of magnitude higher. For example: the average weekly activity was 140 fCi/m3 during preoperation, 242 fCi/m^3 during 1977, and 195 fCi/m^3 during 1981. Those high values have been shown to be the result of fallout from numerous nuclear weapons tests conducted on mainland China in the early 1970s and from 1976 through 1980. With the termination of the weapons tests, the gross beta levels became lower. The annual average was 33 fCi/m^3 for 1982, and this steadily decreased to 22 fCi/m^3 for 1985. Then, during 1986 as a consequence to the Chernobyl incident, the average activity increased to 37 fCi/m^3; it dropped to 23 fCi/m^3 in 1987.

During 1993, no man-made radionuclides were detected from the gamma isotopic analysis of the quarterly composites of air particulate filters. During preoperation and each year of operation through 1986, numerous fission products and some activation products were detected. As stated above, these were generally attributed to the nuclear weapons tests and to the Chernobyl incident. On only one occurrence since 1986, has a man-made radionuclide been detected in a quarterly composite; Cs-137 was found at a very low level for the first quarter of 1991 at Station 304.

The charcoal canisters used for adsorbing iodine from the atmosphere were analyzed for I-131 by gamma spectroscopy. I-131 was not detected in any samples during 1993. The maximum allowed LLD is 70 fCi/m^3; however, the average MDA (the result obtained) was about a fifth of this value.

Positive results for airborne radioiodine are not normally obtained. However, during 1976, 1977 and 1978, positive levels of I-131 were found in nearly all of the samples collected for a period of a few weeks following the arrival of the cloud from each of the Chinese nuclear weapons tests conducted at that time. Some of the levels were on the order of the maximum allowed LLD (that is, 70 fCi/m^3). In 1986, the same phenomenon occurred because of the Chernobyl incident. The highest airborne I-131 level found to date was 217 fCi/m^3 in 1977. The RL called for in TS Table 3.16.1-2 is 900 fCi/m^3.

4.2 Direct Radiation

Direct (external) radiation was measured with TLDs. Two Panasonic UD-814 TLD badges were placed at each station. The phosphor for the badges consists of calcium sulfate (with thulium impurity) crystals on a polymide substrate. Each badge has 3 phosphors with filters on each side of the phosphor to attenuate low energy photons. This filtration compensates for the overresponse of the calcium sulfate in this portion of the energy spectrum. The badges were nominally exposed for periods of a quarter of a year (91 days).

Two TLD stations were established in each of the 16 meteorological sectors about the plant forming two concentric rings. The stations comprising the inner ring (Nos. 101 through 116) are located near the site boundary, while those comprising the outer ring (Nos. 201 through 216) are generally located at distances of 4 to 5 miles. However, each of the stations in the East Sector is at a radius which is a few miles greater than those for the other stations in its ring. Flood plains in this sector prevent easy access on a year-round basis to the site boundary and to the 4 to 5 mile annulus. This two ring configuration of stations began with the first quarter of 1980.

The 16 stations forming the inner ring are designated as the indicator stations. The 3 control stations (Nos. 304, 309 and 416) are at least 10 miles from the plant. Stations 064 and 301 accommodate special interest areas. Station 064 is located in an onsite roadside park, while Station 301 is located adjacent to Toombs Central School. Station 210 in the outer ring is located adjacent to the Altamaha School, the only other nearby school.

As shown in Table 3-1, the average quarterly exposure of 11.6 mR acquired at the indicator stations (inner ring) was 0.9 mR greater than that acquired at the control stations. This difference was not discernable since it was less than the MDD of 1.1 mR. During the 13 year period from 1980 through 1992, the average quarterly exposure for the year at the indicator stations randomly varied from 1.4 mR greater than to 1.6 mR less than that for the control stations. The average quarterly exposure for the indicator stations over the entire 13 year period was 0.2 mR greater than that for the control stations.

The quarterly exposures acquired at outer ring stations ranged from 8.4 to 15.1 mR, with an average of 11.5 mR for the year, which was 0.1 mR less than that found for the inner ring. There was no discernable difference between the averages for the inner and the outer rings, since the difference was less than the MDD of 0.7 mR. For the 13 year period beginning in 1980, the average quarterly exposure for the year at the inner ring stations randomly varied from 1.0 mR greater than to 0.5 mR less than that at the outer ring stations. Overall, the average quarterly exposure for the inner ring was 0.3 mR greater than that for the outer ring.

The quarterly exposures in units of mR acquired during 1993 at the special interest areas which are listed below are seen to be within the range of those acquired at the other stations.

Station	Average	Minimum	Maximum
064	11.2	10.8	11.6
301	10.8	10.3	11.1

The average exposure for all of the TLDs during 1993 was approximately 2.5 percent less than that found in 1992. The average measured exposure in 1992 was about 23 percent less than that acquired in 1991; this anticipated reduction was due to the switch from Teledyne to Panasonic TLDs. The differences in exposures between the various station groups continue to be on the same order.

There were no badges lost in the field during 1993. However, the reading for TLD 115A for the second quarter was not used as it had a standard deviation of 1.6 which is greater than the self imposed limit of 1.4. The reading for TLD 115B was used to determine the exposure for Station 115 in the second quarter.

The standard deviation limit of 1.4 was calculated using a method[2] developed by the American Society for Testing and Materials (ASTM). The calculation was based upon the standard deviations obtained with the UD-814 badges during 1992. This limit serves as a flag to evoke an investigation. To be conservative, readings with a greater standard deviation are deleted since the high standard deviation may indicate a defective TLD.

2. ASTM Special Technical Publication 15D, ASTM Manual on Presentation of Data and Control Chart Analysis, Fourth Revision, Philadelphia, PA, October 1976.

4.3 Milk

Milk samples from cows were obtained biweekly at Station 304 (the state prison dairy) which is a control station. Gamma isotopic and I-131 analyses were performed on each sample.

The annual land use survey to identify the location of the nearest milk animal in each of the 16 meteorological sectors within a distance of 5 miles and the location of all milk animals within a distance of 3 miles was conducted on November 8. A milk animal is a cow or goat producing milk for human consumption. No milk animals were found. Also, the county extension agents from 5 counties in the vicinity were contacted on March 19 and August 2 in the search for suitably located milk animals; none were found.

Man-made radionuclides have not been detected from the gamma isotopic analysis of the milk samples for 4 years. Except for 1987, Cs-137 was found in some of the samples each year from 1978 (when this analysis became a requirement) through 1989. No other man-made radionuclides have been detected by this analysis of the samples. During preoperation a chemical separation technique was employed to measure the Cs-137 levels in the samples.

During preoperation the average positive level of Cs-137 was 19.3 pCi/l, while during operation the averages were 14.8 pCi/l during the period from 1978 through 1983, and 9.6 pCi/l from 1984 through 1989. The LLD and RL are 20 and 70 pCi/l, respectively.

For the past several years, I-131 has not been detected in any of the milk samples. During preoperation, all readings were less than 2 pCi/l which was the allowed LLD at that time. Positive results were found each year during the first 5 years of operation (1974 through 1978); these results ranged from 0.95 to 88 pCi/l. In 1980, positive results ranged from 0.7 to 1.8 pCi/l; then in 1986, from 0.6 to 20 pCi/l. In 1988, a single reading of 0.32 pCi/l which was believed to have resulted from a procedural deficiency, was reported. The LLD and RL are 1 and 3 pCi/l, respectively.

All the positive readings for Cs-137 and I-131 are generally attributed to fallout from the nuclear weapons tests and the Chernobyl incident.

4.4 Vegetation

Gamma isotopic analysis was performed on grass samples collected monthly from two indicator stations (Nos. 106 and 112) and one control station (No. 416). Gamma isotopic analysis on vegetation samples began during 1978 when it became a TS requirement.

The results presented in Table 3-1 show that Cs-137 was the only man-made radionuclide detected; this has been the case since 1986. The average value of 24.7 pCi/kg wet found at the indicator stations was 21.1 pCi/kg wet less than that found at the control station. A standard MDD calculation to compare results between the indicator and control stations was not possible as only one positive result was found at the indicator stations. A modified t-test which compared the single result for the indicator stations with the average result for the control station was performed; it showed that there was no statistical difference at the 99 percent CL between the results for the two station groups.

These results are within the range of those found in recent years; no trends were recognized. The LLD and RL for Cs-137 in vegetation samples are 80 and 2000 pCi/kg wet, respectively. The presence of Cs-137 in the vegetation samples is attributed to fallout from the nuclear weapons tests of years past and to the Chernobyl incident of 1986.

4.5 River Water

Surface water was composited from the Altamaha River at an upstream location (Station 170) and at a downstream location (Station 172) using ISCO automatic samplers. Small quantities were collected at intervals not exceeding a few hours. River water samples collected by these machines were picked up monthly; quarterly composites were made from the monthly collections.

A gamma isotopic analysis was conducted on each monthly collection. As usual, no man-made radionuclides were detected; positive results are seldom found. The only man-made radionuclides detected previously (by gamma isotopic analysis) are presented below; the levels are in units of pCi/l.

Year	Quarter	Station	Radionuclide	Level
1975	4th	172	Ce-141	78.2
1986	2nd	170	La-140	18.0
1986	2nd	172	Cs-137	12.0
1988	2nd	170	Cs-137	6.8

The positive results for 1986 are attributed to the Chernobyl incident.

Tritium analysis was performed on each quarterly composite. No positive results were found. Before 1986, positive results were usually found in each composite at levels typically between 200 and 400 pCi/l. Then from 1986 through 1988 only a few positive results were found each year at levels of about 200 pCi/l. In 1989, there were no positive results; in 1990 , there were two, each at levels of about 140 pCi/l. There have been no positive results since 1990.

On September 13, the annual survey of the Altamaha River was conducted downstream of the plant for at least 50 river miles to identify anyone who uses river water for drinking purposes. As in all previous surveys, no intakes for drinking water or irrigation were observed. This was corroborated by information obtained from the State of Georgia that no new surface water permits for drinking water or irrigation purposes on the Altamaha River had been issued. If river water should become used for drinking, the TS requirements for its sampling and analyses will be implemented.

4.6 Fish

Gamma isotopic analysis was performed on the edible portion of the fish samples collected at the river stations on May 5 and 25, and on October 18. The control station (No. 170) is located upstream of the plant while the indicator station (No. 172) is located downstream. In May, redear sunfish was collected at each station, and in addition, redbreast sunfish was collected at Station 170 and largemouth bass was collected at Station 172. In October, largemouth bass and redear sunfish were collected at each station.

As shown in Table 3-1, Cs-137 was the only man-made radionuclide detected. As usual, it was found in each sample. The average level of 38.0 pCi/kg wet at the indicator station is seen to be 12.1 pCi/kg wet greater than that at the control station. This difference, however is not discernable since it is less than the MDD of 17.0 pCi/kg wet. The LLD and RL for Cs-137 in fish are 200 and 2000 pCi/kg wet, respectively.

There seems to have been a reduction in the Cs-137 level after 1988. This is illustrated by comparing annual averages in units of pCi/kg wet at the indicator and control stations for the 1984-1988 period with the 1989-1992 period.

Item	84-88	89-92
Indicator Station		
Mean	84.0	33.9
Lowest	62.0	26.7
Highest	117.0	41.6
Control Station		
Mean	49.1	27.2
Lowest	33.3	24.2
Highest	63.3	28.9

In the past, the only other man-made radionuclides detected in fish samples by gamma isotopic analysis were Co-60 and Cs-134. During preoperations, Cc-60 was detected in one fish sample at a very low level. During the period of 1983 through 1988, Cs-134 was found in about half of the samples at levels on the order of those found for Cs-137.

4.7 Sediment

The semiannual collections of sediment took place on May 3 and November 1 at the river stations. Although the TS require only an annual collection, a second collection was added in 1989 to increase the statistical base.

A gamma isotopic analysis was performed on each sample as required by the TS. Positive results were obtained for Cs-137 in each sample. Positive results were also found for Co-60 in the samples for each of the collections at the downstream station (No. 172), and for Zn-65 in only the November collection at the downstream station.

Positive readings for Cs-137 have been found in every sediment sample since 1980 and in over 90 percent of the samples collected, including those during preoperation. As shown in Table 3-1, the average level of 113 pCi/kg dry found at the indicator (downstream) station was 2 pCi/kg dry less than that found at the control (upstream) station. This difference was not discernable as it is less than the MDD of 576 pCi/kg dry. The LLD for Cs-137 in sediment is 200 pCi/kg dry. The Cs-137 levels have varied widely and randomly through the years, during preoperation as well as during operation. The levels for 1993 are typical of and within the range of those found previously.

The activation product Co-60 was not detected in shoreline sediment until 1986. During the period, 1986 through 1992, it was found in over 60 percent of the regular samples from the indicator station but in less than 30 percent of those from the control station. The levels for 1993 are typical of those found previously.

The activation product Zn-65 has only been detected at the indicator station, starting in 1986. From 1986 through 1992, it was found in more than a third of the regular samples collected there. The level for 1992 was 44 percent of the average for the period, 1986 through 1991; the level for 1993 was 21 percent of that average.

In past years, various fission and activation products were occasionally found in sediment samples; in some of the samples, the levels were significant relative to the LLDs usually attained. Their presence was generally attributed to the nuclear weapons tests or to the Chernobyl incident, but plant releases were not ruled out. The levels measured were insignificant with respect to radiation dose and regulatory limits.

5.0 INTERLABORATORY COMPARISON PROGRAM

TS 3.16.3 requires that analyses be performed on radioactive materials supplied as part of an Interlaboratory Comparison Program approved by the NRC. The Intercomparison Studies (Crosscheck) Program conducted by the Environmental Protection Agency (EPA) at their Environmental Monitoring Systems Laboratory in Las Vegas, Nevada, provides such a program. Reported herein, as required by TS 4.16.3 is a summary of the results of the EL's participation in the EPA Crosscheck Program.

The Crosscheck Program was designed for laboratories involved with REMPs and includes environmental media and a variety of radionuclides with activities which might be as low as environmental levels. Participation in the program ensures that independent checks on the precision and accuracy of the measurements of radioactive materials in environmental sample matrices are performed.

Simulated environmental samples are distributed regularly to the participants who analyze the samples and return the results to the EPA for statistical analysis and comparison with known values and with results obtained from other participating laboratories. The EPA then provides each participant with documentation of its performance; this can be helpful in identifying any instrument or procedure problems.

The EL analyzed the EPA supplied crosscheck samples consistent with the requirements of Table 2-1. Analyses were performed in a normal manner. Each sample was analyzed in triplicate as required by the program. Results obtained for the gross beta and gamma isotopic analyses of air filters, the gamma isotopic analysis of milk samples, and the tritium and gamma isotopic analyses of water samples are summarized in Table 5-1.

Delineated in Table 5-1 for each of the environmental media are the type analyses performed, EPA's collection dates, the known values and expected precisions (one standard deviation) provided by the EPA, the average results obtained and reported by the EL along with the standard deviations of these results, and the normalized deviations and the normalized ranges from the known results. The normalized deviations and normalized ranges were also provided by the EPA.

TABLE 5-1 (SHEET 1 OF 2)

CROSSCHECK PROGRAM RESULTS

Radionuclide or Analysis	Date Collected	Known Value	Expected Precision	Reported Average	Standard Deviation	Normalized Deviation	Normalized Range
			Air Filters (pCi/filter)				
Gross Beta	08/27/93	47.0	5.0	48.33	0.58	0.46	0.12
Cs-137	08/27/93	9.0	5.0	10.67	0.58	0.58	0.12
			Milk (pCi/l)				
I-131	09/24/93	120.0	12.0	121.33	8.33	0.19	0.79
Cs-137	09/24/93	49.0	5.0	50.67	4.73	0.58	1.12
			Water (pCi/l)				
H-3	06/04/93	9844.0	984.0	9670.00	131.13	-0.31	0.16
	11/05/93	7398.0	740.0	7776.67	170.39	0.89	0.27
Co-60	04/20/93	39.0	5.0	39.00	3.61	0.00	0.83
	06/11/93	15.0	5.0	17.67	0.59	0.92	0.59
	10/19/93	10.0	5.0	14.33	1.15	1.50	0.24
	11/12/93	30.0	5.0	28.67	0.58	-0.46	0.12
Zn-65	06/11/93	103.0	10.0	101.33	5.03	-0.29	0.59
	11/12/93	150.0	15.0	141.33	2.52	-1.00	0.20

TABLE 5-1 (SHEET 2 OF 2)

CROSSCHECK PROGRAM RESULTS

Radionuclide or Analysis	Date Collected	Known Value	Expected Precision	Reported Average	Standard Deviation	Normalized Deviation	Normalized Range
Ru-106	06/11/93	119.0	12.0	132.00	7.94	1.88	0.74
	11/12/93	201.0	20.0	183.00	15.62	-1.56	0.20
Cs-134	04/20/93	27.0	5.0	24.33	1.15	-0.92	0.24
	06/11/93	5.0	5.0	8.00	1.73	1.04	0.35
	10/19/93	12.0	5.0	11.67	1.15	-0.12	0.24
	11/12/93	59.0	5.0	53.67	1.15	-1.84	0.24
Cs-137	04/20/93	32.0	5.0	33.00	1.00	0.35	0.24
	06/11/93	5.0	5.0	8.67	3.06	1.27	0.71
	10/19/93	12.0	5.0	13.33	0.58	0.46	0.12
	11/12/93	40.0	5.0	38.67	2.52	-0.46	0.59
Ba-133	06/11/93	99.0	10.0	98.33	2.52	-0.12	0.30
	11/12/93	79.0	8.0	75.33	1.53	-0.79	0.22

The normalized deviation from the known value provides a measure of the central tendency of the data (accuracy). The normalized range is a measure of the dispersion of the data (precision). An absolute value of 3 standard deviations for the normalized deviation and for the normalized range was established by the EPA as the control limit. An absolute value of 2 standard deviations was established as the warning limit. The EL considers any value greater than the control limit as unacceptable. Investigations were undertaken whenever any value exceeded the warning limit or whenever a plot of the values indicated a trend.

An examination of Table 5-1 showed that in each case the values for the normalized deviation and the normalized range were within the warning limit. However, plots of the values of the normalized deviation for Co-60, Ru-106 and Ba-133 found from the gamma isotopic analysis of water indicated an upward trend.

This higher activity trend began after the relocation of the germanium detectors (used in the detection of these radionuclides) in the latter part of 1990. In 1991, new computer software was purchased to convert from a DEC based system to a PC based system. However, the PC based software did not calculate absolute activities below the detection limits; these activities would have been used to correct small biases due to background contributions. A program was developed to make these calculations. Usage of the new peak background correction values began on January 22, 1994. The future EPA and QC samples will be monitored to evaluate the peak background correction values.

6.0 CONCLUSIONS

This report confirms the licensee's conformance with TS 3/4.16 during 1993. It shows that all data were carefully examined. A summary and discussion of the results of the laboratory analyses for each type sample were presented.

No measurable radiological impact upon the environment or the public as a consequence of plant discharges to the atmosphere or to the river was established.