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April 24, 1991

U.S. Nuclear Regulatory Commission  
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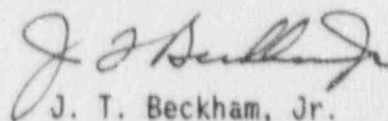
PLANT HATCH - UNITS 1, 2  
NRC DOCKETS 50-321, 50-366  
OPERATING LICENSES DPR-57, NPF-5  
ANNUAL RADIOLOGICAL ENVIRONMENTAL SURVEILLANCE REPORT

Gentlemen:

In accordance with Plant Hatch Units 1 and 2 Technical Specifications, sections 6.9.1.6 and 6.9.1.7, Georgia Power Company is submitting the enclosed Annual Radiological Environmental Surveillance Report for 1990.

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

Sincerely,



J. T. Beckham, Jr.

OCV/cr

Enclosure

cc: (See next page.)

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U.S. Nuclear Regulatory Commission

April 24, 1991

Page Two

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GEORGIA POWER COMPANY  
EDWIN I. HATCH NUCLEAR PLANT  
ANNUAL RADIOLOGICAL ENVIRONMENTAL SURVEILLANCE REPORT  
CALENDAR YEAR 1990

EDWIN I. HATCH NUCLEAR PLANT  
RADIOLOGICAL ENVIRONMENTAL SURVEILLANCE REPORT

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## ACRONYMS

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 Applicable
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 calendar year 1990.

The specifications for the REMP are provided in Section 3/4.16 of the Unit 1 Technical Specifications (TS) and in Section 3/4.12 of the Unit 2 TS. The Unit 2 TS simply reference the Unit 1 TS. A single program serves both units.

A summary description of the program is provided in Section 2. Maps showing the sampling locations are keyed to a table indicating the distance and direction of each sampling location 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 assessment of any radiological impacts upon the environment, 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 Table 3.16.1-1 of the TS 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 2-4. This description of the sample locations closely follows that found in the table and figures in Section 3.0 of the Offsite Dose Calculation Manual (ODCM).

It is stated in Section 3.16.1.a of the TS that deviations are permitted from the required sampling schedule, which is delineated in Table 2-1 herein, 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.

During 1990, all the laboratory analyses, except for the reading of the thermoluminescent dosimeters (TLDs), were performed by Georgia Power Company's (GPC's) Environmental Laboratory (EL) in Smyrna, Georgia. The reading of the TLDs was provided by Teledyne Isotopes Midwest Laboratory in Northbrook, Illinois.

TABLE 2-1 (SHEET 1 OF 3)

## SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

<u>Exposure Pathway and/or Sample</u>	<u>Approximate Number of Sample Locations</u>	<u>Sampling and Collection Frequency</u>	<u>Type of Analysis and Frequency</u>
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)	2	Biweekly	Gamma isotopic and I-131 analyses biweekly
Fish or Clams (b)	2	Semiannually	Gamma isotopic analysis 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

<u>Exposure Pathway and/or Sample</u>	<u>Approximate Number of Sample Locations</u>	<u>Sampling and Collection Frequency</u>	<u>Type of Analysis and Frequency</u>
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 the 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. Composite samples shall be collected by collecting an aliquot at intervals not exceeding a few hours.
- e. If it is found that river water downstream of HNP 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 HNP to identify those who use Altamaha River water for drinking.

TABLE 2-2 (SHEET 1 OF 2)

## RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS

<u>Station Number</u>	<u>Station Type (a)</u>	<u>Descriptive Location</u>	<u>Direction (b)</u>	<u>Distance (b) (miles)</u>	<u>Sample Type (c)</u>
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	Upriver	WNW	(d)	R
172	I	Downriver	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	C
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	10.8	M
309	C	Baxley Substation	S	10.0	AD
316	C	Thompson's Dairy	NNW	13.2	M
416	C	Emergency 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:

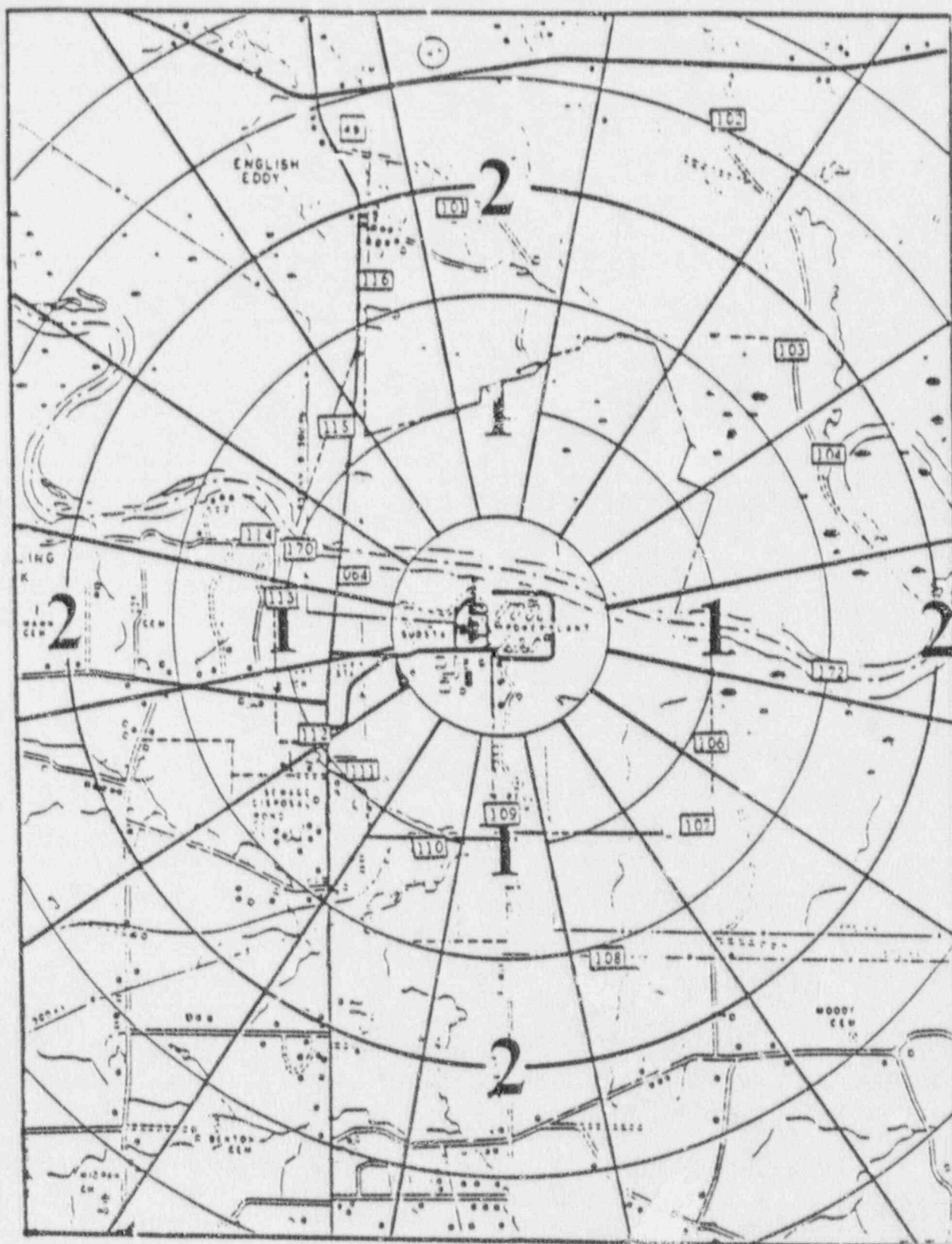
- A - Airborne Radioactivity
- D - Direct Radiation
- M - Milk
- R - River (fish or clams, shoreline sediment, and surface water)
- V - Vegetation

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 location from which river water and sediment may be taken can be sharply defined. Often, the sampling locations for clams 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 the samples are collected.

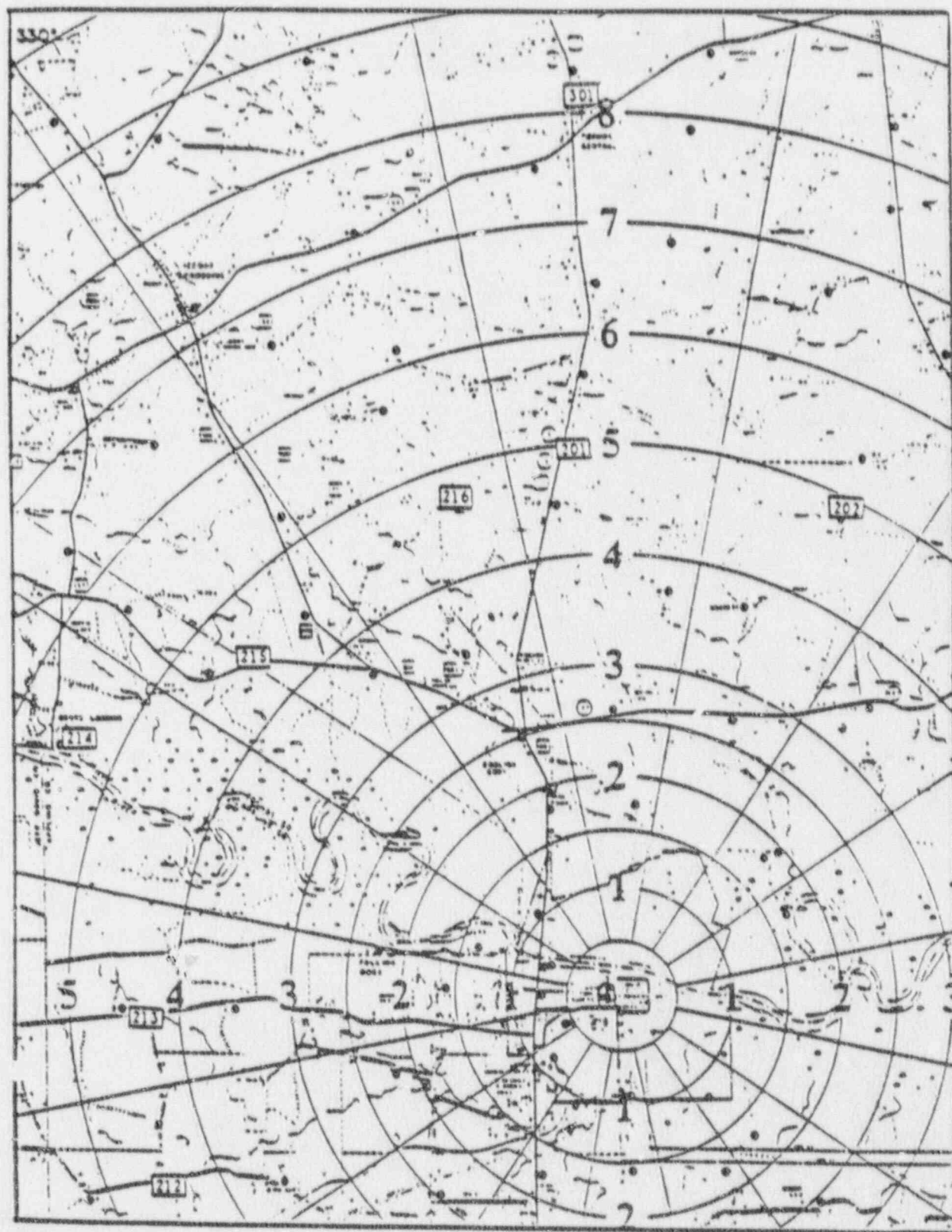




EDWIN I. HATCH NUCLEAR PLANT

RADIOLOGICAL ENVIRONMENTAL SAMPLING  
LOCATIONS ON SITE PERIPHERY

FIGURE 2-1

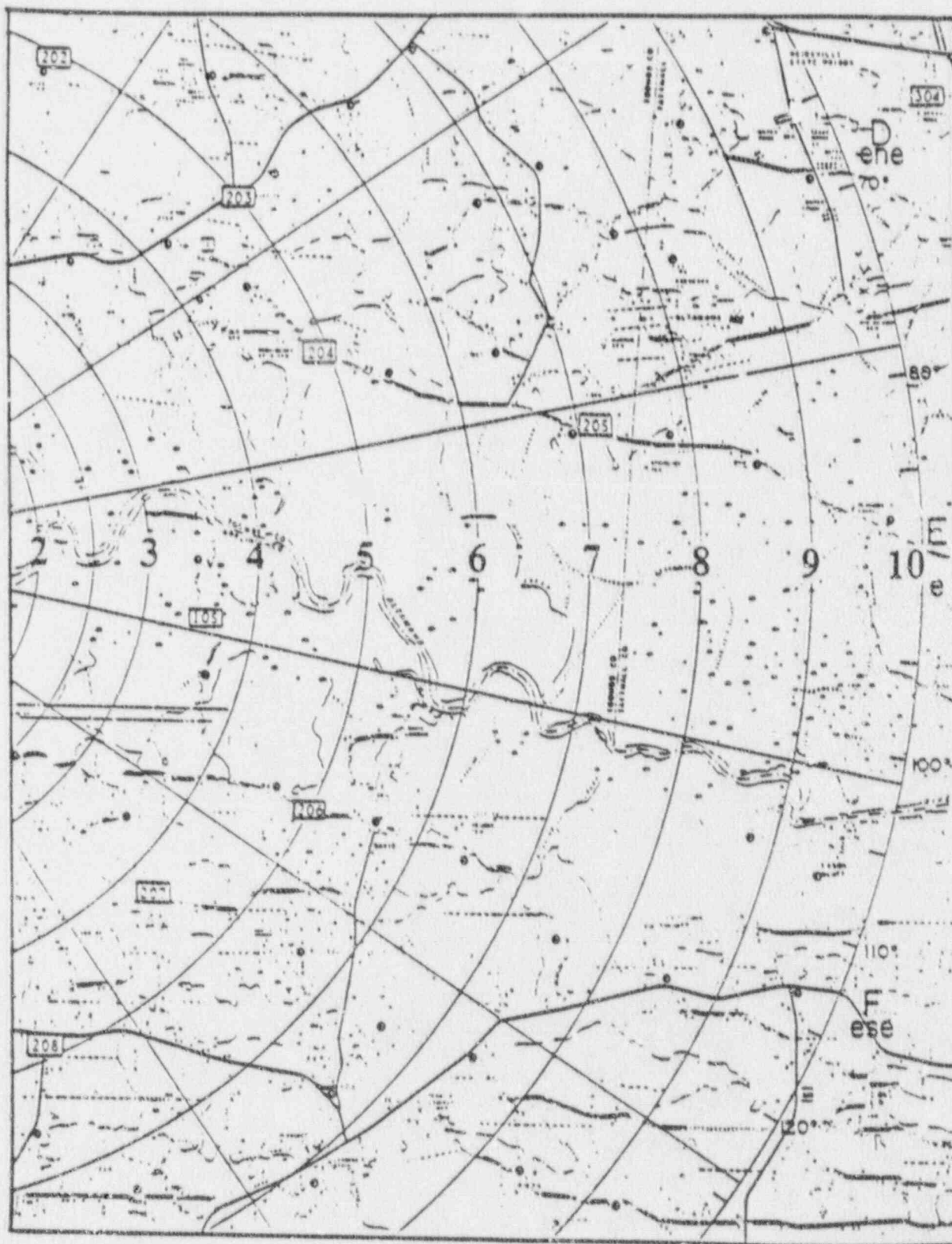


EDWIN I. HATCH NUCLEAR PLANT

RADIOLOGICAL ENVIRONMENTAL SAMPLING  
LOCATIONS BEYOND SITE PERIPHERY

FIGURE 2-2 (SHEET 1 of 3)

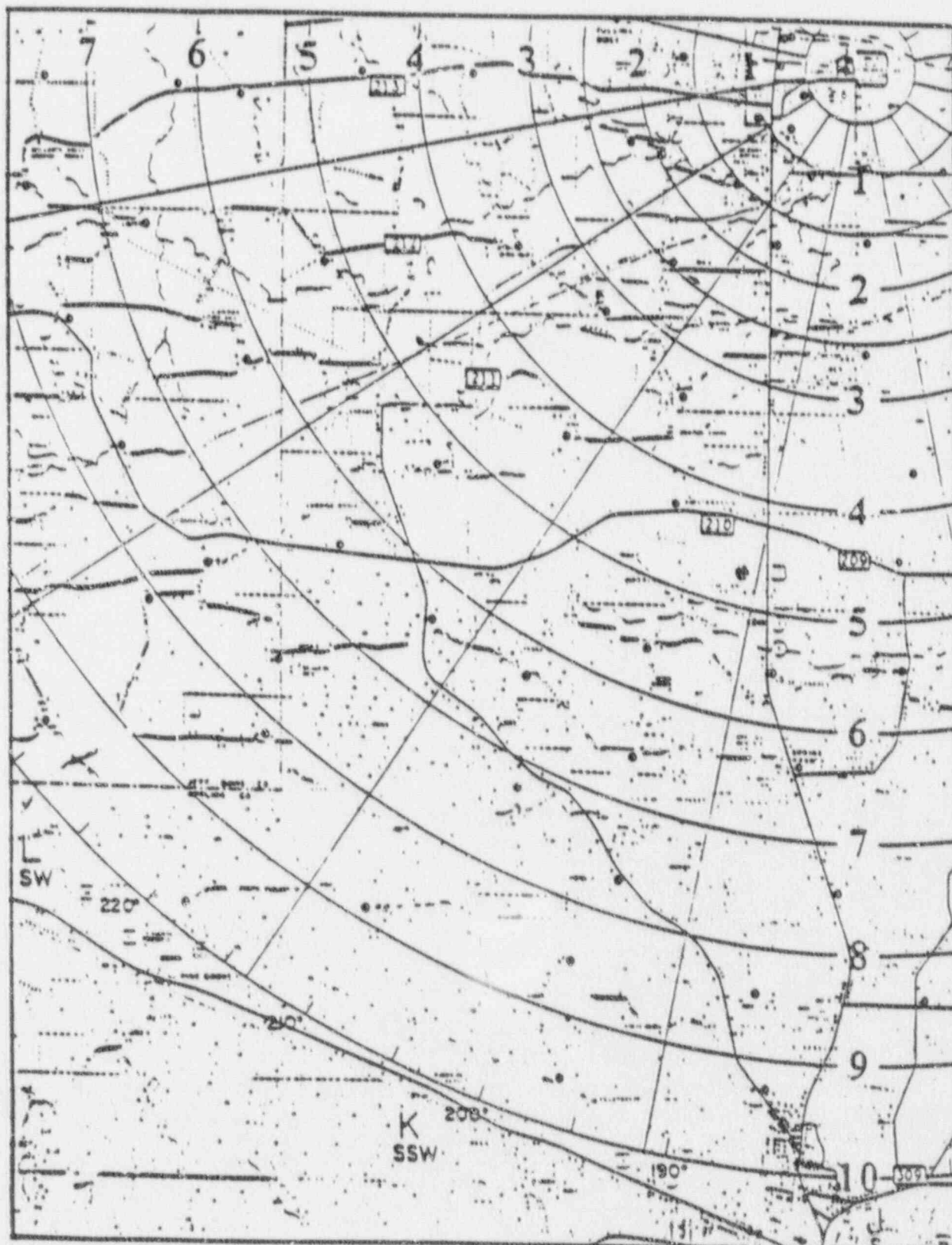




EDWIN I. HATCH NUCLEAR PLANT

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)

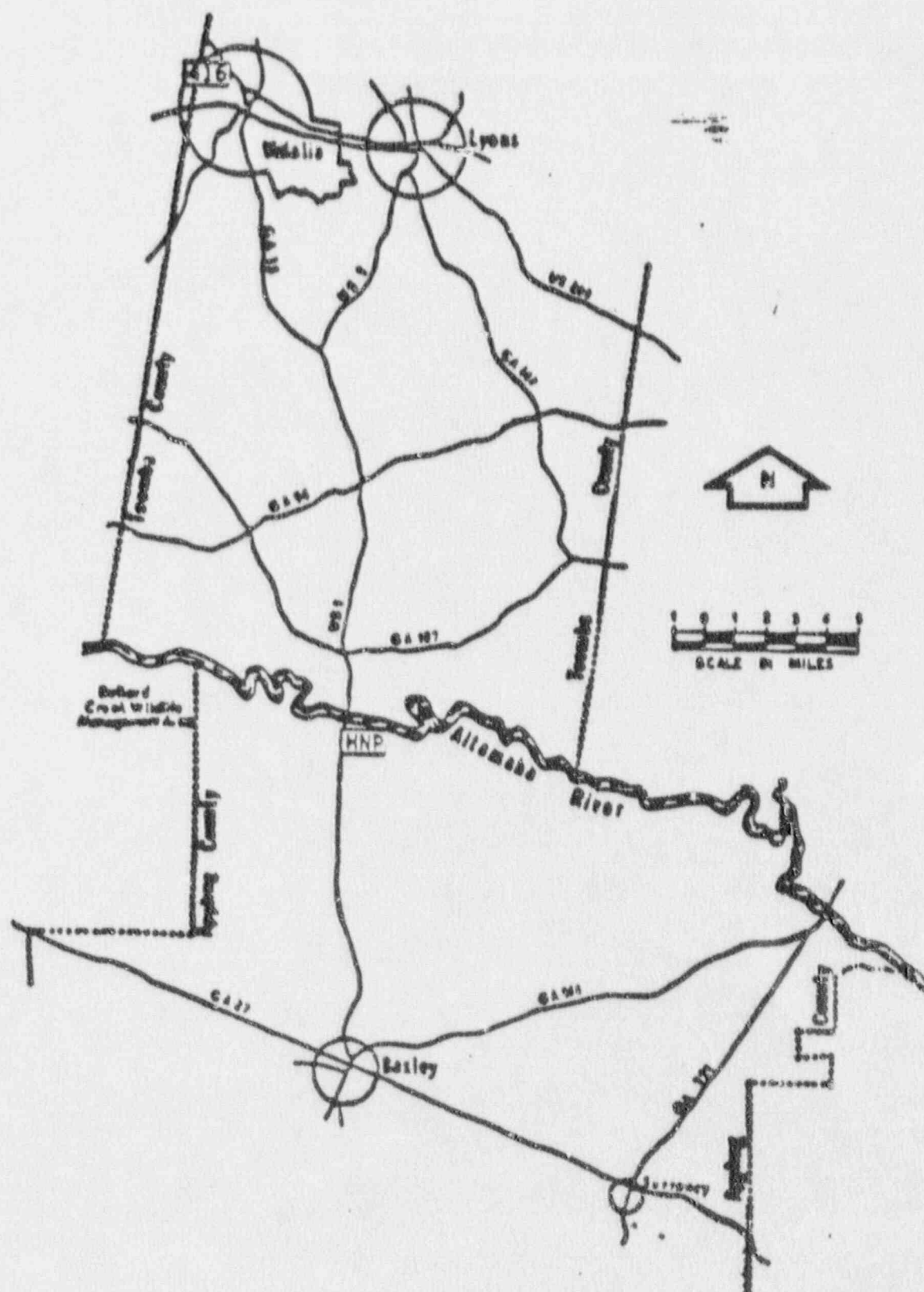




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LOCATION OF ADDITIONAL  
CONTROL STATION FOR MILK

FIGURE 2-3



EDWIN I. HATCH NUCLEAR PLANT

LOCATION OF ADDITIONAL CONTROL  
STATION FOR TLDs AND VEGETATION

FIGURE 2-4

### 3.0 RESULTS SUMMARY

In accordance with Section 6.9.1.7 of the TS, 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 Table 6.9.1.7-1 of the TS. Only manmade 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 included in Section 4, the discussion of results section, for the type sample.



TABLE 3-1 (SHEET 1 OF 5)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY  
 Edwin I. Hatch Nuclear Plant, Docket Nos. 50-321 and 50-366  
 Appling County, Georgia, Calendar Year 1990

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 <sup>3</sup> )	Gross Beta 316	10	19.3 7-37 (212/212)	No. 103 Inner Ring 1.8 miles NE	19.6 8-35 (53/53)	18.7 7-36 (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 <sup>3</sup> )	I-131 317	70	NDM		NDM	NDM	0
Direct Radiation (mR/91 days)	Gamma Dose 75	NA (d)	14.9 11-23 (64/64)	No. 104 Inner Ring 1.6 miles ENE	19.2 15-23 (4/4)	13.9 12-16 (11/11)	0
Milk (pCi/l)	Gamma Isotopic 40						
	Cs-134	20	NA		NDM	NDM	0
	Cs-137	20	NA		NDM	NDM	0



TABLE 3-1 (SHEET 2 OF 5)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY  
 Edwin I. Hatch Nuclear Plant, Docket Nos. 50-321 and 50-366  
 Appling County, Georgia, Calendar Year 1990

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
Grass (pCi/kg wet)	Ba-140	60	NA		NDM	NDM	0
	La-140	20	NA		NDM	NDM	0
	I-131 40	1	NA		NDM	NDM	0
	Gamma Isotopic 39						
	I-131	60	NDM		NDM	NDM	0
	Cs-134	60	NDM		NDM	NDM	0
	Cs-137	80	66.7 58-82 (3/26)	No. 112 Inner Ring 1.0 miles WSW	66.7 58-82 (3/26)	34.5 35-35 (1/13)	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

TABLE 3-1 (SHEET 3 OF 5)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY  
 Edwin I. Hatch Nuclear Plant, Docket Nos. 50-321 and 50-366  
 Appling County, Georgia, Calendar Year 1990

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
3-4	Zn-65	30	NDM		NDM	NDM	0
	Zr-95	30	NDM		NDM	NDM	0
	Nb 95	20	NDM		NDM	NDM	0
	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)	138.5 132-145 (2/4)	No. 172 Downriver 3.0 miles	138.5 132-145 (2/4)	NDM	0
	Gamma Isotopic 8						
Fish (pCi/kg wet)	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

TABLE 3-1 (SHEET 4 OF 5)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY  
 Edwin I. Hatch Nuclear Plant, Docket Nos. 50-321 and 50-366  
 Appling County, Georgia, Calendar Year 1990

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (a) (LID)	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 dry)	Zn-65	300	NDM		NDM	NDM	0
	Cs-134	100	NDM		NDM	NDM	0
	Cs-137	200	26.7 20-31 (3/3)	No. 172 Downriver 1.7 miles	26.7 20-31 (3/3)	24.2 9-39 (5/5)	0
	Gamma Isotopic 4						
	Co-60	40 (g)	33.0 33-33 (1/2)	No. 172 Downriver 1.7 miles	33.0 33-33 (1/2)	19.0 19-19 (1/2)	0
	Cs-134	200	31.0 31-31 (1/2)	No. 172 Downriver 1.7 miles	31.0 31-31 (1/2)	NDM	0
	Cs-137	200	130.5 61-200 (2/2)	No. 172 Downriver 1.7 miles	130.5 61-200 (2/2)	66.0 55-77 (2/2)	0



TABLE 3-1 (SHEET 5 OF 5)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY  
Edwin I. Hatch Nuclear Plant, Docket Nos. 50-321 and 50-366  
Appling County, Georgia, Calendar Year 1990

- a. The LLD is defined in table notation a of Table 4.16.1-1, of the TS. Except as noted otherwise, the values listed in the column are those found in that table. In practice, the LLDs attained are generally much lower than the values listed.
- b. Mean and range are based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses.
- 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 Table 4.16.1-1 of the TS). 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 Table 4.16.1-1 of the TS).
- g. The EL has determined that this value may be routinely attained. No value was provided in Table 4.16.1-1 of the TS.

#### 4.0 DISCUSSION OF RESULTS

An interpretation and evaluation, as appropriate, of the laboratory results for each type sample are included in this section. Relevant comparisons are 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 is determined using the standard Student's t-test. A difference in the average values which is less than the MDD is considered to be statistically indiscernible. Pertinent results were also compared with past results including preoperations. The results were examined to perceive any trends. To provide perspective, a result might also be compared with its LLD or Reporting Level (RL) which is provided by Table 3.16.1-2 of the TS. Attempts were made to explain any RLs or other high radiological levels found in the samples.

One sample was not counted for a sufficient time to attain the LLD required by Table 4.1.6.1-1 of the TS. This failure occurred for the I-131 analysis of the grass sample collected at Station 416 on December 3. The value attained and the maximum value permitted (the value of the LLD from the above mentioned table) were 65 and 60 pCi/kg wet, respectively.

The annual land use survey as required by Section 3.16.2 of the TS was conducted on October 22. The location of the nearest permanent residence in each of the 16 meteorological sectors within a distance of 5 miles as required by the survey is listed in Table 4-1. The results of the milk animal component of the survey are presented in Subsection 4.3. The results of the annual river survey required by Note f in Table 2-1 are presented in Subsection 4.5.

To flag any result which differed from the others in its set by a relatively large amount, the practice of testing all results for conformance to Chauvenet's Criterion<sup>1</sup> was introduced this year. Identified outliers were investigated to determine reasons for deviating from the norm. If an equipment malfunction or other valid physical reason was found, the anomalous result was deemed non-representative and excluded from the data set. No datum was excluded for failing Chauvenet's Criterion only.

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

TABLE 4-1

LOCATION OF THE NEAREST  
PERMANENT RESIDENCE IN EACH SECTOR

<u>SECTOR</u>	<u>DISTANCE</u> <u>(miles)</u>
N	2.0
NNE	2.9
NE	3.2
ENE	4.2
E	*
ESE	3.7
SE	1.8
SSE	2.0
S	1.0
SSW	1.3
SW	1.1
WSW	1.1
W	1.1
WNW	1.1
NW	3.6
NNW	1.8

---

\* None within 5 miles.



#### 4.1 Airborne

As indicated by Table 2-2, airborne particulates and airborne radioiodine are collected at 4 indicator stations (Nos. 103, 107, 112, and 116) which encircle the site boundary and at 2 control stations (Nos. 304 and 309) which are at least 10 miles from the plant. At these locations air is 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 are collected weekly.

As a consequence of equipment malfunctions, the gross beta results for two airborne particulate samples and the I-131 result for one airborne radioiodine sample were rejected. Each of the gross beta results had failed Chauvenet's criterion. Last year there were three failures in obtaining adequate airborne particulate samples and two failures in obtaining adequate airborne radioiodine samples.

The volume of air passing through the particulate filter and the charcoal canister collected on January 22 at Station 304, was only about 60 percent of that to be expected. This occurred because of a power failure due to a blown fuse. Both of these samples were therefore deemed to be inadequate; the analysis result for each was rejected.

The gross beta result for the sample collected on November 26 at Station 309, was also rejected because the particulate filter had a hole in it and the result was very low. Much of the particulate may not have been retained on the filter. There was no reason to reject the I-131 result for the charcoal canister.

As deposits build up on a particulate filter, the increased pressure drop across the filter may cause it to rupture. To lessen the probability of holes developing in the filters, the air flow rate has been reduced at each of the air stations.

Each of the air particulate filters is counted for gross beta activity. As seen in Table 3-1, the annual average weekly activity of  $19.3 \text{ fCi/m}^3$  for the indicator stations is  $0.6 \text{ fCi/m}^3$  greater than that for the control stations. However, this difference is not discernible, since it is less than the MDD, calculated as  $1.9 \text{ fCi/m}^3$ . During the 8 years prior to 1990, the absolute value of the difference between the average weekly activities for the indicator and control stations was never greater than about  $2 \text{ fCi/m}^3$ . The average activity for the control stations was greater than that for the indicator stations on three occasions. Although the differences fluctuated randomly, the average activity over the entire 8 year period for the control stations was about  $0.1 \text{ fCi/m}^3$  greater than that for the indicator stations.

The average weekly gross beta activity for all stations during 1990 was greater than that for 1989 by  $0.9 \text{ fCi/m}^3$  ( $19.1 \text{ fCi/m}^3$  versus  $18.2 \text{ fCi/m}^3$ ). In past years, it had been an order of magnitude higher. For example: the average weekly activity was  $140 \text{ fCi/m}^3$ .

during preoperations, 242 fCi/m<sup>3</sup> during 1977, and 195 fCi/m<sup>3</sup> during 1981. Those high values were 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 in recent years have become much lower. The annual average was 33 fCi/m<sup>3</sup> for 1982, and this steadily decreased to 22 fCi/m<sup>3</sup> for 1985. However, during 1986 as a consequence to the Chernobyl incident, the average activity increased to 37 fCi/m<sup>3</sup>. The annual averages for 1987 and 1988 were 23 and 22 fCi/m<sup>3</sup>, respectively.

During 1990, for the fourth consecutive year, no manmade radionuclides were detected in the gamma isotopic analyses of the quarterly composites of air particulate filters. During preoperations and each year of operations through 1986, numerous fission products (some at fairly significant levels) and some activation products were detected. These were generally attributed to the nuclear weapons tests. With the cessation of the tests, the number of radionuclides detected became scant and their levels low. The positive results found during 1986 were attributed to the Chernobyl incident.

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 of the samples during the year. The maximum allowed LLD is 70 fCi/m<sup>3</sup>; however, the activity usually attained was about a third 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 after 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<sup>3</sup>). In 1986 the same phenomenon occurred; only, the positive levels were attributed to the Chernobyl incident. The highest airborne I-131 level found to date was 217 fCi/m<sup>3</sup> in 1977. The RL called for in Table 3.16.1-2 of the TS is 900 fCi/m<sup>3</sup>.

## 4.2 Direct Radiation

Direct (external) radiation is measured by TLDs. Two TLD badges are placed at each station; each badge contains four calcium sulfate TLD cards.

Two TLD stations are established in each of the 16 meteorological sectors about the plant. The inner ring of stations (Nos. 101 through 116) is located near the site boundary, while the outer ring (Nos. 201 through 216) is located at a distance of about 4 to 5 miles. These rings were installed at the beginning of 1980 to meet the requirements of Revision 1 to the Technical Position of the Radiological Assessment Branch of the Nuclear Regulatory Commission (NRC), dated November 1979. However, each of the stations in the East Sector is at a radius which is a few miles greater than 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. The 16 stations forming the inner ring are designated as the indicator stations. The three 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 dose of 14.9 mR acquired at the indicator stations (inner ring) was 1.0 mR greater than that acquired at the control stations; this difference was not discernable, however, since it was less than the MDD of 1.6 mR. For the 10 year period, 1980 through 1989: 1) the absolute value of the difference between the annual average quarterly doses acquired at these two station groups varied from 0 to 1.6 mR, 2) the average dose was greater at the indicator stations five times, and 3) the average dose at the indicator stations during this entire period was 0.02 mR less than that at the control stations. No trends in the data for these station groups were recognized.

The quarterly doses acquired at outer ring stations ranged from 10.7 to 20.5 mR with an average of 14.7 mR for the year, which is 0.2 mR less than that found for the inner ring. There was no discernable difference between the averages of the inner and outer rings, since this difference was less than the MDD of 1.0 mR. From 1980 through 1986, the average quarterly dose for the inner ring stations was greater than that for the outer ring stations by amounts ranging from 0.2 to 1.0 mR; the average difference was 0.6 mR. From 1987 through 1989, the average quarterly dose for the outer ring was greater than that for the inner ring by amounts ranging from 0.1 to 0.4 mR; the average difference was 0.2 mR.



The quarterly doses in units of mR acquired at the special interest areas were:

<u>Location</u>	<u>Average</u>	<u>Minimum</u>	<u>Maximum</u>
Roadside Park	15.1	13.5	16.9
Toombs Central School	14.4	13.3	15.8

These doses are seen to be on the order of those acquired at the other stations.

The average quarterly dose for all of the TLDs placed in the field varied very little from 1986 through 1988, when it was 14.7, 15.0 and 15.1 mR, respectively. For 1989, this overall average was 16.6 mR or about 11 percent greater than that for the previous 3 year period. For 1990, the overall average quarterly dose of 14.7 mR returns to that of the 3 year period prior to 1989.

Not infrequently, TLDs are lost due to theft or vandalism. Near the middle of each quarter, the TLD stations are checked for missing or damaged badges; replacement badges are provided as needed. If both badges are missing at the end of the quarter, the dose for the quarter at that location cannot be assessed. Both badges were missing at Station 309 at the end of the third quarter. During the year, six badges from three different stations were lost. The previous year, eight badges from three different stations were lost.

#### 4.3 Milk

Milk samples from cows were obtained biweekly at Station 304 (the state prison dairy) throughout the year and at Station 316 (Thompson's dairy) for over 5 months. Both of these locations are control stations. Gamma isotopic and I-131 analyses were performed on each sample.

Since September 22, 1986, milk had been collected regularly at Thompson's Dairy. On June 4, the last sample was collected from this reliable station. Before the next sampling date, dairy operations were terminated; all milk animals were removed from the premises. This station is being deleted due to the permanent unavailability of milk. To locate a suitable replacement station, the county extension agents from five counties in the vicinity were contacted on June 29 and August 24. None was found.

Beginning in 1987, collections of goat milk were sometimes made at Clark's Farm, an indicator station which was designated as Station 216 and which was located 4.8 miles NNW of the plant. The availability of milk samples at this station had been unreliable from the start. Although 26 samples are nominally collected annually at each station, only 10 were collected at Clark's during 1987, 12 during 1988, 6 during 1989, and none during 1990. All efforts (land use surveys and inquiries to county agents and others) to locate another indicator station during the past few years have been unsuccessful. When the goats went dry in May 1989, the Clarks expected milking to resume in 5 or 6 months; in December 1989, they anticipated milking might begin again in the Spring; and in March 1990, their intention had become not to resume milking. This station is being deleted.

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 October 22. No milk animals were found. A milk animal is a cow or goat producing milk for human consumption.

During the year, no man-made radionuclide was detected from the gamma isotopic analyses of the milk samples. Each year since 1978, when gamma isotopic analysis of milk samples became a requirement, positive levels of Cs-137 were found in some of the samples, except for 1987. No other man-made radionuclide has been detected in the milk samples by this type analysis.

During preoperations, a chemical separation technique was employed to measure the Cs-137 levels in milk samples; the levels ranged from 2 to 60 pCi/l with an average value of 19.3 pCi/l. The frequency of occurrence, the range of values, and the average value in units of pCi/l in milk samples during each of the following periods indicate Cs-137 is being found less often and at lower levels.

<u>Period</u>	<u>Frequency</u>	<u>Minimum</u>	<u>Maximum</u>	<u>Average</u>
1978-1983	0.267	2.0	57.1	14.8
1984-1986	0.178	4.3	15.1	9.4
1988-1989	0.040	7.9	12.0	9.6

These positive values for Cs-137 are attributed to the nuclear weapons tests of the 1970s and before, and to the Chernobyl incident of 1986. The lower levels after 1986 are believed, at least partially, to be due to changes in the location of the milk stations. During the latter half of 1986, milk became permanently unavailable at two stations. At one of these stations, Johnson's Dairy (9.1 miles SW of the plant), Cs-137 was frequently found at relatively high levels.

During the year, I-131 was not detected in any of the milk samples. During preoperations, all readings for I-131 were less than 2 pCi/l, which was the allowed LLD at that time. Positive results were found during each year of the first 5 years of operations (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, while in 1986, positive results ranged 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 for I-131 are 1 and 2 pCi/l, respectively. All positive readings for I-131 have been generally attributed to fallout from the nuclear weapons tests and the Chernobyl incident.



#### 4.4 Grass

The TS call for the gamma isotopic analysis of grass samples collected monthly at three locations. Two indicator stations (Nos. 106 and 112) and one control station (No. 416) have been designated for these collections. Gamma isotopic analysis has been performed on grass samples since 1978.

The results presented in Table 3-1 show that Cs-137 is the only manmade radionuclide detected; this has been the case since 1986. The levels are typical of those generally found. Positive results were found in only about 10 percent of the samples collected. Since 1985, positive results were found in approximately 25 to 50 percent of the samples collected at the indicator stations. The present control station was established in 1989; the first positive result was found there this year. The LLD and RL for Cs-137 are 80 and 2000 pCi/kg wet, respectively. The presence of Cs-137 in grass samples is attributed to fallout from the nuclear weapons tests of years past and to a lesser extent from the Chernobyl incident of 1986.

#### 4.5 River Water

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

A gamma isotopic analysis is made on each monthly collection. As usual, no manmade radionuclides were detected. The occurrence of positive results for a manmade radionuclide has been infrequent. The only manmade radionuclides detected previously (by gamma isotopic analysis) were as follows:

<u>Year</u>	<u>Quarter</u>	<u>Station</u>	<u>Radionuclide</u>	<u>Level (pCi/l)</u>
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 were attributed to the Chernobyl incident.

Tritium analyses are performed on the quarterly composites. Positive results were found in only two of the composites from the indicator (downstream) station. Up until about five years ago, positive results were usually found for each composite; the levels were generally 50 to 100 percent greater.

On October 11, the annual survey of the Altamaha River was conducted downstream of the plant for at least 50 river miles to identify anyone who may use 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 analysis will be implemented.

#### 4.6 Fish

Gamma isotopic analyses were performed on the edible portion of the fish samples collected at the river stations on April 16 and October 15. The control station (No. 170) is located upstream of the plant, and the indicator station (No. 172) is located downstream of the plant. In April, large mouth bass, mullet, and red breast sunfish were collected at the control station while channel catfish was collected at the indicator station. In October, large mouth bass and bluegill bream were collected at the control station while large mouth bass and redear sunfish were collected at the indicator station.

As shown in Table 3-1, Cs-137 was the only manmade radionuclide detected. As usual, it was found in all of the samples. The average level for all samples with positive results was about 80 percent of that for last year and only 35 percent of that for the period of 1983 through 1988. The average level of 26.7 pCi/kg wet at the indicator station is seen to be 2.5 pCi/kg wet greater than that at the control station. However, this difference is not discernable since it is less than the MDD of 27.4 pCi/kg wet. The LLD and RL are 200 and 2000 pCi/kg wet, respectively.

In the past, the only other manmade radionuclide detected in fish samples by the gamma isotopic analysis were Co-60 and Cs-134. During preoperations, Co-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 the samples at levels on the order of those found for Cs-137.



#### 4.7 Sediment

The semiannual collections of sediment took place on April 30 and November 5 at the river stations. Although the TS require only an annual collection, a second collection was added last year to increase the statistical base.

A gamma isotopic analysis was performed on each sample. Positive results were obtained for Cs-137 in each sample. Positive results were also found for both Co-60 and Cs-134 in the sample collected at the downstream station (No. 172) in April, and for Co-60 only in the sample collected at the upstream station (No. 170) in November.

Positive readings for Cs-137 have been found in every sample since 1980 and in over 90% of all of the samples collected, including those during preoperations. As shown in Table 3-1, the average level of 130.5 pCi/kg dry found at the indicator (downstream) station was 64.5 pCi/kg dry greater than that at the control (upstream) station. This difference is not discernible, however, since it is less than the MDD of 490 pCi/kg dry. Typically, the Cs-137 levels have been several times greater than those found this year. The LLD for Cs-137 is 200 pCi/kg dry.

The activation product Co-60 was found in regular samples on four previous occasions - twice at each station. As shown in Table 3-1, the levels found at the indicator and control stations (33 and 19 pCi/kg dry, respectively) are much lower than those found in previous years (67.8 and 108 pCi/kg dry at the indicator station, and 31 and 33 pCi/kg dry at the control station). The assigned LLD for Co-60 is 40 pCi/kg dry.

During the past 9 years, Cs-134 was detected in 40 percent of the regular samples collected at the indicator station. The levels ranged from 132 to 505 pCi/kg dry, with an average of 284.3 pCi/kg dry. As shown in Table 3-1, the single positive result for this year which occurred at the indicator station was much lower - only 31 pCi/kg dry. Positive levels of 40 and 50 pCi/kg dry were found in samples collected at the control station during preoperations and 1984, respectively.

In past years, various fission products and activation products were found in sediment samples; the levels were significant in some of the samples. Their presence was generally attributed to the nuclear weapons tests or to the Chernobyl incident.

## 5.0 INTERLABORATORY COMPARISON PROGRAM

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

The Crosscheck Program was designed for laboratories involved with REMPs; it includes environmental media and a variety of radionuclides with activities at or near 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; REMP results can thereby be demonstrated to be reasonably valid.

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

The EL's participation in the program consists of the analyses on the radioactive materials supplied by the program that correspond with those required by Table 2-1. Analyses were performed in a normal manner. Each sample was analyzed in triplicate as required by the program. Results obtained from the gross beta and gamma isotopic analyses of air filters, the gamma isotopic and I-131 analyses 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 analysis performed, EPA's collection date, the known value and expected precision (one standard deviation) provided by the EPA, the average result obtained by the EL, the standard deviation of the EL's result, the normalized deviation (from the known result), and the normalized range. The normalized deviation and normalized range were also provided by the EPA.

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 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 are undertaken whenever any value exceeds the warning limit or whenever a plot of the values indicates a trend.

As may be seen from Table 5-1, the normalized deviation and the normalized range in each case were within control limits but the warning limit was exceeded for the I-131 analysis in milk on April 27 and for Ru-106 in water on February 9. In addition, a trend was recognized in plots of the values of the normalized deviation for Co-60, Ru-106, and Ba-133. Each of the above out of limit and trending cases prompted an investigation.

The investigation of the high value of the normalized deviation for the I-131 in milk revealed nothing unusual about sample preparation or about the calculations. The investigation of the high normalized deviation value for Ru-106 in water and the evaluations of the trends of the normalized deviation values recognized for three of the radionuclides have lead to some adjustments in the calculations, in the instrumentation and also in the preparation of samples - changes to peak background correction values, proper adjustments to a preamplifier pole zero on one of the detectors, and the implementation of a more homogeneous mixture of the samples.



TABLE 5-1 (SHEET 1 OF 2)  
CROSSCHECK PROGRAM RESULTS

<u>Analysis</u>	<u>Date Collected</u>	<u>Known Value</u>	<u>Expected Precision</u>	<u>Reported Average</u>	<u>Standard Deviation</u>	<u>Normalized Deviation</u>	<u>Normalized Range</u>
Air Filters (pCi/filter)							
Gross Beta	03/30/90	31.0	5.0	32.33	0.58	0.46	0.12
	08/31/90	62.0	5.0	63.33	1.15	0.46	0.24
Cs-137	03/30/90	10.0	5.0	12.33	2.31	0.81	0.47
	08/31/90	20.0	5.0	23.67	3.06	1.27	0.71
Milk (pCi/l)							
I-131	04/27/90	99.0	10.0	114.33	3.21	2.66	0.35
	09/28/90	58.0	6.0	52.00	1.00	-1.73	0.20
Cs-137	04/27/90	24.0	5.0	25.00	4.00	0.35	0.95
	09/28/90	20.0	5.0	18.67	0.58	-0.46	0.12
Water (pCi/l)							
H-3	02/23/90	4976.0	498.0	5067.00	136.67	0.32	0.31
	06/22/90	2933.0	358.0	2963.33	64.29	0.15	0.20
	10/19/90	7203.0	720.0	7147.00	130.13	-0.13	0.43
Co-60	02/09/90	15.0	5.0	14.67	2.52	-0.12	0.59
	06/08/90	24.0	5.0	20.67	0.58	-1.15	0.12
	10/05/90	20.0	5.0	19.33	0.58	-0.23	0.12
Zn-65	02/09/90	139.0	14.0	136.67	6.51	-0.29	0.55
	06/08/90	148.0	15.0	142.67	13.20	-0.62	1.04
	10/05/90	115.0	12.0	107.00	6.24	-1.15	0.59

TABLE 5-1 (SHEET 2 OF 2)

## CROSSCHECK PROGRAM RESULTS

<u>Analysis</u>	<u>Date Collected</u>	<u>Known Value</u>	<u>Expected Precision</u>	<u>Reported Average</u>	<u>Standard Deviation</u>	<u>Normalized Deviation</u>	<u>Normalized Range</u>
Ru-106	02/09/90	139.0	14.0	119.67	14.36	-2.39	1.26
	06/08/90	210.0	21.0	213.67	24.13	0.30	1.61
	10/05/90	151.0	15.0	138	6.51	-1.42	0.51
Cs-134	02/09/90	18.0	5.0	16.33	3.21	-0.58	0.71
	04/17/90	15.0	5.0	16.33	0.58	0.46	0.12
	06/08/90	24.0	5.0	25.00	5.20	0.35	1.12
	10/05/90	12.0	5.0	11.67	2.08	-0.12	0.47
Cs-137	02/09/90	18.0	5.0	17.67	0.58	-0.12	0.12
	04/17/90	15.0	5.0	16.67	1.53	0.58	0.35
	06/08/90	25.0	5.0	25.67	2.52	0.23	0.59
	10/05/90	12.0	5.0	12.00	1.73	0.00	0.35
Ba-133	02/09/90	74.0	7.0	71.33	1.53	-0.66	0.25
	06/08/90	99.0	10.0	109.00	2.65	1.73	0.30
	10/05/90	110.0	11.0	103.33	3.79	-1.05	0.38

## 6.0 CONCLUSIONS

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

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