4.0 EVALUATION OF DOSE

4.1 DOSE FROM ENVIRONMENTAL MEASUREMENTS

Annual doses to maximum exposed individuals were estimated based on measured concentrations of radionuclides in 2011 CNS REMP samples. Only those samples that were not affected by the Fukushima Daiichi fallout were used to calculate doses. The primary purpose of estimating doses based on sample results is to allow comparison to effluent program dose estimates.

Doses based on sample results were calculated using the methodology and data presented in NRC Regulatory Guide 1.109. Measured radionuclide concentrations, averaged over the entire year for a specific radionuclide, indicator location and sample type, were used to calculate REMP-based doses. Where applicable, average background concentration at the corresponding control location was subtracted. Regulatory Guide 1.109 consumption rates for the maximum exposed individual were used in the calculations. When the guide listed "NO DATA" as the dose factor for a given radionuclide and organ, a dose factor of zero was assumed.

Maximum dose estimates (Highest Annual Mean Concentration) based on broadleaf vegetation, drinking water, fish, and shoreline sediment sample results are reported in Table 4.1-A. The individual critical population and pathway dose calculations are reported in Table 4.1-B.

REMP-based dose estimates are not reported for airborne radioiodine, airborne particulate, milk, or ground water sample types because no radionuclides attributable to CNS operations were detected. Naturally occurring K-40 and Be-7 were detected in some samples but were not included in any REMP-based dose estimates. Dose estimates are not reported for surface water because sampled surface water is not considered to be a potable drinking water source although surface water tritium concentrations are used in calculating doses from fish. Exposure estimates based upon REMP TLD results are discussed in Section 3.10.

The maximum environmental organ dose estimate for any single sample type (excluding TLD results) collected during 2011 was 2.23E-1 mrem to the maximum exposed child bone from consuming broadleaf vegetation.

4.2 ESTIMATED DOSE FROM RELEASES

Throughout the year, dose estimates were calculated based on actual 2010 liquid and gaseous effluent release data. Effluent-based dose estimates were calculated using the RETDAS computer program which employs methodology and data presented in NRC Regulatory Guide 1.109. These doses are shown in Table 4.1-A along with the corresponding REMP-based dose estimates. Summaries of RETDAS dose calculations are reported in the Annual Radioactive Effluent Release Report (reference 6.6).

The effluent-based liquid release doses are summations of the dose contributions from the drinking water, fish, and shoreline pathways. For iodine, particulate, and tritium exposure the effluent-based gaseous release doses are summations of the dose contributors from ground/plane, inhalation, milk and vegetation pathways.

4.3 COMPARISON OF DOSES

The environmental and effluent dose estimates given in Table 4.1-A agree reasonably well. The similarity of the doses indicate that the radioactivity levels in the environment do not differ significantly from those expected based on effluent measurements and modeling of the environmental exposure pathways. This indicates that effluent program dose estimates are both valid and reasonably conservative.

There are some differences in how effluent and environmental doses are calculated that affect the comparison. Doses calculated from environmental data are conservative because they are based on a mean that includes only samples with a net positive activity versus a mean that includes all sample results (i.e. zero results are not included in the mean). Also, airborne tritium is not measured in environmental samples but is used to calculate effluent doses.

Additionally, in 2010 Catawba began reporting estimated dose from effluent Carbon 14 (C-14). This change came about with the issuing of Regulatory Guide 1.21, Revision 2, Measuring, Evaluating and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste. A description of this change is found in the 2010 Annual Radiological Effluent Release Report. C-14 is not measured in the environment and therefore, environmental and effluent doses from C-14 cannot be compared directly.

In calculations based on liquid release pathways, drinking water, fish, and shoreline sediment were the predominant dose pathways based on environmental and effluent data. The maximum total organ dose based on 2011 environmental sample results was 9.13E-2 mrem to the child liver. The maximum total organ dose of 1.90E-1 mrem for liquid effluent-based estimates was to the adult GI-LLI.

In calculations based on gaseous release pathways, vegetation was the predominant dose pathway for effluent samples. The maximum total organ dose for gaseous effluent estimates was 4.75E0 mrem to the child bone. Vegetation was the predominant dose pathway for environmental samples. The maximum total organ dose for gaseous environmental estimates was 2.23E-1 mrem to the child bone.

The doses calculated do not exceed 40CFR190 or 10CFR50 dose commitment limits for members of the public. Doses to members of the public attributable to the operation of CNS are being maintained well within regulatory limits.

TABLE 4.1-A

CATAWBA NUCLEAR STATION
2011 ENVIRONMENTAL AND EFFLUENT DOSE COMPARISON

LIQUID RELEASE PATHWAY

Organ	Environmental or Effluent Data	Critical Age (1)	Critical Pathway (2)	Location	Maximum Dose (3) (mrem)
Skin	Environmental	Teen	Shoreline Sediment	208 (0.45 mi S)	6.87E-04
Skin	Effluent	Teen	Shoreline Sediment	Discharge Pt.	1.64E-02
Bone	Environmental	Child	Fish	208 (0.45 mi S)	4.87E-02
Bone	Effluent	Teen	Shoreline Sediment	Discharge Pt.	1.78E-02
Liver	Environmental	Child	Fish	208 (0.45 mi S)	9.13E-02
Liver	Effluent	Child	Drinking Water	7.30 mi SSE	1.45E-01
T. Body	Environmental	Adult	Fish	208 (0.45 mi S)	7.41E-02
T. Body	Effluent	Child	Drinking Water	7.30 mi SSE	1.42E-01
Thyroid	Environmental	Child	Drinking Water	214 (7.30 mi SSE)	4.47E-02
Thyroid	Effluent	Child	Drinking Water	7.30 mi SSE	1.39E-01
Kidney	Environmental	Child	Drinking Water	214 (7.30 mi SSE)	5.99E-02
Kidney	Effluent	Child	Drinking Water	7.30 mi SSE	1.41E-01
Lung	Environmental	Child	Drinking Water	214 (7.30 mi SSE)	5.01E-02
Lung	Effluent	Child	Drinking Water	7.30 mi SSE	1.40E-01
GI-LLI	Environmental	Child	Drinking Water	214 (7.30 mi SSE)	4.50E-02
GI-LLI	Effluent	Adult	Fish	7.30 mi SSE	1.90E-01

(1) Critical Age is the highest total dose (all pathways) to an age group.

(2) Critial Pathway is the highest individual dose within the identified Critical Age group.

(3) Maximum dose is a summation of the fish, drinking water and shoreline sediment pathways.

GASEOUS RELEASE PATHWAY

IODINE, PARTICULATE, and TRITIUM

Organ	Environmental or Effluent Data	Critical Age (1)	Critical Pathway (2)	Location	Maximum Dose (3) (mrem)
Skin	Environmental	-	-	-	0.00E+00
Skin	Effluent	-	-	-	0.00E+00
Bone	Environmental	Child	Vegetation	201 (0.53 mi NE)	2.23E-01
Bone	Effluent	Child	Vegetation	0.5 mi NE	4.75E+00
Liver	Environmental	Child	Vegetation	201 (0.53 mi NE)	2.13E-01
Liver	Effluent	Child	Vegetation	0.5 mi NE	2.01E+00
T. Body	Environmental	Adult	Vegetation	201 (0.53 mi NE)	1.20E-01
T. Body	Effluent	Child	Vegetation	0.5 mi NE	2.01E+00
Thyroid	Environmental	-	-	-	0.00E+00
Thyroid	Effluent	Child	Vegetation	0.5 mi NE	2.01E+00
Kidney	Environmental	Child	Vegetation	201 (0.53 mi NE)	6.95E-02
Kidney	Effluent	Child	Vegetation	0.5 mi NE	2.01E+00
Lung	Environmental	Child	Vegetation	201 (0.53 mi NE)	2.50E-02
Lung	Effluent	Child	Vegetation	0.5 mi NE	2.01E+00
GI-LLI	Environmental	Adult	Vegetation	201 (0.53 mi NE)	3.54E-03
GI-LLI	Effluent	Child	Vegetation	0.5 mi NE	2.01E+00

(1) Critical Age is the highest total dose (all pathways) to an age group.

(2) Critial Pathway is the highest individual dose within the identified Critical Age group.

(3) Maximum dose is a summation of the ground/plane, inhalation, milk and vegetation pathways.

TABLE 4.1-B

Maximum Individual Dose for 2011 based on Environmental Measurements (mrem) for Catawba Nuclear Station

Age	Sample Medium	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Skin
Infant	Airborne	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Drinking Water	0.00E+00	3.43E-02	3.43E-02	3.43E-02	3.43E-02	3.43E-02	3.43E-02	0.00E+00
	Milk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	TOTAL	0.00E+00	3.43E-02	3.43E-02	3.43E-02	3.43E-02	3.43E-02	3.43E-02	0.00E+00
Child	Airborne	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Drinking Water	0.00E+00	3.49E-02	3.49E-02	3.49E-02	3.49E-02	3.49E-02	3.49E-02	0.00E+00
	Milk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Broadleaf Vegetation	2.23E-01	2.13E-01	3.15E-02	0.00E+00	6.95E-02	2.50E-02	1.34E-03	0.00E+00
	Fish	4.87E-02	5.64E-02	1.66E-02	9.76E-03	2.50E-02	1.52E-02	1.01E-02	0.00E+00
	Shoreline Sediment	0.00E+00	0.00E+00	5.85E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.87E-04
	TOTAL	2.72E-01	3.04E-01	8.36E-02	4.47E-02	1.29E-01	7.51E-02	4.63E-02	6.87E-04
Teen	Airborne	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Drinking Water	0.00E+00	1.82E-02	1.82E-02	1.82E-02	1.82E-02	1.82E-02	1.82E-02	0.00E+00
	Milk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Broadleaf Vegetation	1.23E-01	1.64E-01	5.71E-02	0.00E+00	5.58E-02	2.17E-02	2.33E-03	0.00E+00
	Fish	3.87E-02	6.33E-02	2.98E-02	1.18E-02	2.93E-02	1.86E-02	1.26E-02	0.00E+00
	Shoreline Sediment	0.00E+00	0.00E+00	2.80E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.29E-03
	TOTAL	1.62E-01	2.46E-01	1.08E-01	3.00E-02	1.03E-01	5.85E-02	3.31E-02	3.29E-03
Adult	Airborne	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Drinking Water	0.00E+00	2.58E-02	2.58E-02	2.58E-02	2.58E-02	2.58E-02	2.58E-02	0.00E+00
	Milk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Broadleaf Vegetation	1.34E-01	1.83E-01	1.20E-01	0.00E+00	6.20E-02	2.06E-02	3.54E-03	0.00E+00
	Fish	3.62E-02	6.48E-02	4.78E-02	1.54E-02	3.22E-02	2.09E-02	1.63E-02	0.00E+00
	Shoreline Sediment	0.00E+00	0.00E+00	5.01E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.89E-04
	TOTAL	1.70E-01	2.74E-01	1.94E-01	4.12E-02	1.20E-01	6.73E-02	4.56E-02	5.89E-04

Note: Dose tables are provided for sample media displaying positive nuclide occurrence.

Catawba Nuclear Station
Dose from Drinking Water Pathway for 2011 Data
Maximum Exposed Infant

Infant Dose from Drinking Water Pathway (mrem) = Usage (l) x Dose Factor (mrem/pCi ingested) x Concentration (pCi/l)

Usage (intake in one year) = 330 l

	Ingestion Dose Factor							Highest Annual Net Mean Concentration		Dose (mrem)						
Radionuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Indicator Location	Water (pCi/l)	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	1.99E-05	4.51E-06	NO DATA	4.41E-06	NO DATA	7.31E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	3.60E-06	8.98E-06	NO DATA	NO DATA	NO DATA	8.97E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	3.08E-05	5.38E-05	2.12E-05	NO DATA	NO DATA	1.59E-05	2.57E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	1.08E-05	2.55E-05	NO DATA	NO DATA	NO DATA	2.57E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	1.84E-05	6.31E-05	2.91E-05	NO DATA	3.06E-05	NO DATA	5.33E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	4.20E-08	1.73E-08	1.00E-08	NO DATA	1.24E-08	NO DATA	1.46E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	2.06E-07	5.02E-08	3.56E-08	NO DATA	5.41E-08	NO DATA	2.50E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	3.59E-05	4.23E-05	1.86E-05	1.39E-02	4.94E-05	NO DATA	1.51E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	3.77E-04	7.03E-04	7.10E-05	NO DATA	1.81E-04	7.42E-05	1.91E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	5.22E-04	6.11E-04	4.33E-05	NO DATA	1.64E-04	6.64E-05	1.91E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaLa-140	1.71E-04	1.71E-07	8.81E-06	NO DATA	4.06E-08	1.05E-07	4.20E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	NO DATA	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	214	337	0.00E+00	3.43E-02	3.43E-02	3.43E-02	3.43E-02	3.43E-02	3.43E-02
						Dose Commitment (mrem) =				0.00E+00	3.43E-02	3.43E-02	3.43E-02	3.43E-02	3.43E-02	3.43E-02

Catawba Nuclear Station
Dose from Drinking Water Pathway for 2011 Data
Maximum Exposed Child

Child Dose from Drinking Water Pathway (mrem) = Usage (l) x Dose Factor (mrem/pCi ingested) x Concentration (pCi/l)

Usage (intake in one year) = 510 l

	Ingestion Dose Factor							Highest Annual Net Mean Concentration		Dose (mrem)						
Radionuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Indicator Location	Water (pCi/l)	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	1.07E-05	2.85E-06	NO DATA	3.00E-06	NO DATA	8.98E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	1.80E-06	5.51E-06	NO DATA	NO DATA	NO DATA	1.05E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	1.65E-05	2.67E-05	1.33E-05	NO DATA	NO DATA	7.74E-06	2.78E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C0-60	NO DATA	5.29E-06	1.56E-05	NO DATA	NO DATA	NO DATA	2.93E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	1.37E-05	3.65E-05	2.27E-05	NO DATA	2.30E-05	NO DATA	6.41E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	2.25E-08	8.76E-09	6.26E-09	NO DATA	8.23E-09	NO DATA	1.62E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	1.16E-07	2.55E-08	2.27E-08	NO DATA	3.65E-08	NO DATA	2.66E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	NO DATA	1.54E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	2.34E-04	3.84E-04	8.10E-05	NO DATA	1.19E-04	4.27E-05	2.07E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	3.27E-04	3.13E-04	4.62E-05	NO DATA	1.02E-04	3.67E-05	1.96E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaLa-140	8.31E-05	7.28E-08	4.85E-06	NO DATA	2.37E-08	4.34E-08	4.21E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	NO DATA	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	214	337	0.00E+00	3.49E-02	3.49E-02	3.49E-02	3.49E-02	3.49E-02	3.49E-02
						Dose Commitment (mrem) =				0.00E+00	3.49E-02	3.49E-02	3.49E-02	3.49E-02	3.49E-02	3.49E-02

Catawba Nuclear Station
Dose from Broadleaf Vegetation Pathway for 2011 Data
Maximum Exposed Child

Child Dose from Vegetation Pathway (mrem) = Usage (kg) x Dose Factor (mrem/pCi ingested) x Concentration (pCi/kg)

Usage (intake in one year) = **26 kg**

	Ingestion Dose Factor							Highest Annual Net Mean Concentration		Dose (mrem)						
Radionuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Indicator Location	Food (pCi/kg)	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
I-131	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	NO DATA	1.54E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	2.34E-04	3.84E-04	8.10E-05	NO DATA	1.19E-04	4.27E-05	2.07E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	3.27E-04	3.13E-04	4.62E-05	NO DATA	1.02E-04	3.67E-05	1.96E-06	201	26.2	2.23E-01	2.13E-01	3.15E-02	0.00E+00	6.95E-02	2.50E-02	1.34E-03
						Dose Commitment (mrem) =				2.23E-01	2.13E-01	3.15E-02	0.00E+00	6.95E-02	2.50E-02	1.34E-03

Catawba Nuclear Station
Dose from Fish Pathway for 2011 Data
Maximum Exposed Child

Child Dose from Fish Pathway (mrem) = Usage (kg) x Dose Factor (mrem/pCi ingested) x Concentration (pCi/kg)

H-3 Concentration in Fish = Surface Water pCi/l x Bioaccumulation Factor 0.9 pCi/kg per pCi/l = 7744 pCi/l x 0.9 = 6970 pCi/kg

Usage (intake in one year) = **6.9 kg**

	Ingestion Dose Factor							Highest Annual Net Mean Concentration		Dose (mrem)						
Radionuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Indicator Location	Fish (pCi/kg)	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	1.07E-05	2.85E-06	NO DATA	3.00E-06	NO DATA	8.98E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	1.80E-06	5.51E-06	NO DATA	NO DATA	NO DATA	1.05E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	1.65E-05	2.67E-05	1.33E-05	NO DATA	NO DATA	7.74E-06	2.78E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C0-60	NO DATA	5.29E-06	1.56E-05	NO DATA	NO DATA	NO DATA	2.93E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	1.37E-05	3.65E-05	2.27E-05	NO DATA	2.30E-05	NO DATA	6.41E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	2.34E-04	3.84E-04	8.10E-05	NO DATA	1.19E-04	4.27E-05	2.07E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	3.27E-04	3.13E-04	4.62E-05	NO DATA	1.02E-04	3.67E-05	1.96E-06	208	21.6	4.87E-02	4.66E-02	6.89E-03	0.00E+00	1.52E-02	5.47E-03	2.92E-04
H-3	NO DATA	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	208	6970	0.00E+00	9.76E-03	9.76E-03	9.76E-03	9.76E-03	9.76E-03	9.76E-03
								Dose Commitment (mrem) =		4.87E-02	5.64E-02	1.66E-02	9.76E-03	2.50E-02	1.52E-02	1.01E-02

Catawba Nuclear Station
Dose from Shoreline Sediment Pathway for 2011 Data
Maximum Exposed Child

Shoreline Recreation =	**14**	**hr (in one year)**
Shore Width Factor =	**0.2**	
Sediment Surface Mass =	**40**	**kg/m^2**

Child Dose from Shoreline Sediment Pathway (mrem) = Shoreline Recreation (hr) x External Dose Factor (mrem/hr per pCi/m^2) x Shore Width Factor x Sediment Surface Mass (kg/m^2) x Sediment Concentration (pCi/kg)

	External Dose Factor Standing on Contaminated Ground		Highest Annual Net Mean Concentration		Dose	
	(mrem/hr per pCi/m^2)		Indicator	Sediment	(mrem)	
Radionuclide	**T. Body**	**Skin**	**Location**	**(pCi/kg)**	**T. Body**	**Skin**
Mn-54	**5.80E-09**	**6.80E-09**	**ALL**	**0.00**	**0.00E+00**	**0.00E+00**
*** Co-57**	**9.10E-10**	**1.00E-09**	**208**	**10.5**	**1.07E-06**	**1.18E-06**
Co-58	**7.00E-09**	**8.20E-09**	**208**	**83.6**	**6.55E-05**	**7.68E-05**
Co-60	**1.70E-08**	**2.00E-08**	**208**	**236**	**4.49E-04**	**5.29E-04**
Cs-134	**1.20E-08**	**1.40E-08**	**208**	**36.2**	**4.87E-05**	**5.68E-05**
Cs-137	**4.20E-09**	**4.90E-09**	**208**	**43.3**	**2.04E-05**	**2.38E-05**
		Dose Commitment (mrem) =			**5.85E-04**	**6.87E-04**

* Dose Factor from Reference 6.17

Catawba Nuclear Station
Dose from Drinking Water Pathway for 2011 Data
Maximum Exposed Teen

Teen Dose from Drinking Water Pathway (mrem) = Usage (l) x Dose Factor (mrem/pCi ingested) x Concentration (pCi/l)

Usage (intake in one year) = 510 l

	Ingestion Dose Factor							Highest Annual Net Mean Concentration		Dose (mrem)						
Radionuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Indicator Location	Water (pCi/l)	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	5.90E-06	1.17E-06	NO DATA	1.76E-06	NO DATA	1.21E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	9.72E-07	2.24E-06	NO DATA	NO DATA	NO DATA	1.34E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	5.87E-06	1.37E-05	5.29E-06	NO DATA	NO DATA	4.32E-06	3.24E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	2.81E-06	6.33E-06	NO DATA	NO DATA	NO DATA	3.66E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	5.76E-06	2.00E-05	9.33E-06	NO DATA	1.28E-05	NO DATA	8.47E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	8.22E-09	4.56E-09	2.51E-09	NO DATA	4.42E-09	NO DATA	1.95E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	4.12E-08	1.30E-08	8.94E-09	NO DATA	1.91E-08	NO DATA	3.00E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	NO DATA	1.62E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	8.37E-05	1.97E-04	9.14E-05	NO DATA	6.26E-05	2.39E-05	2.45E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	1.12E-04	1.49E-04	5.19E-05	NO DATA	5.07E-05	1.97E-05	2.12E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaLa-140	2.84E-05	3.48E-08	1.83E-06	NO DATA	1.18E-08	2.34E-08	4.38E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	NO DATA	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	214	337	0.00E+00	1.82E-02	1.82E-02	1.82E-02	1.82E-02	1.82E-02	1.82E-02
						Dose Commitment (mrem)=				0.00E+00	1.82E-02	1.82E-02	1.82E-02	1.82E-02	1.82E-02	1.82E-02

Catawba Nuclear Station
Dose from Broadleaf Vegetation Pathway for 2011 Data
Maximum Exposed Teen

Teen Dose from Vegetation Pathway (mrem) = Usage (kg) x Dose Factor (mrem/pCi ingested) x Concentration (pCi/kg)

Usage (intake in one year) = **42 kg**

	Ingestion Dose Factor							Highest Annual Net Mean Concentration		Dose (mrem)						
Radionuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Indicator Location	Food (pCi/kg)	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
I-131	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	NO DATA	1.62E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	8.37E-05	1.97E-04	9.14E-05	NO DATA	6.26E-05	2.39E-05	2.45E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	1.12E-04	1.49E-04	5.19E-05	NO DATA	5.07E-05	1.97E-05	2.12E-06	201	26.2	1.23E-01	1.64E-01	5.71E-02	0.00E+00	5.58E-02	2.17E-02	2.33E-03
							Dose Commitment (mrem) =			1.23E-01	1.64E-01	5.71E-02	0.00E+00	5.58E-02	2.17E-02	2.33E-03

Catawba Nuclear Station
Dose from Fish Pathway for 2011 Data
Maximum Exposed Teen

Teen Dose from Fish Pathway (mrem) = Usage (kg) x Dose Factor (mrem/pCi ingested) x Concentration (pCi/kg)

H-3 Concentration in Fish = Surface Water pCi/l x Bioaccumulation Factor 0.9 pCi/kg per pCi/l = 7744 pCi/l x 0.9 = 6970 pCi/kg

Usage (intake in one year) = **16 kg**

	Ingestion Dose Factor							Highest Annual Net Mean Concentration		Dose (mrem)						
Radionuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Location	(pCi/kg)	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	5.90E-06	1.17E-06	NO DATA	1.76E-06	NO DATA	1.21E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	9.72E-07	2.24E-06	NO DATA	NO DATA	NO DATA	1.34E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	5.87E-06	1.37E-05	5.29E-06	NO DATA	NO DATA	4.32E-06	3.24E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	2.81E-06	6.33E-06	NO DATA	NO DATA	NO DATA	3.66E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	5.76E-06	2.00E-05	9.33E-06	NO DATA	1.28E-05	NO DATA	8.47E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	8.37E-05	1.97E-04	9.14E-05	NO DATA	6.26E-05	2.39E-05	2.45E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	1.12E-04	1.49E-04	5.19E-05	NO DATA	5.07E-05	1.97E-05	2.12E-06	208	21.6	3.87E-02	5.15E-02	1.79E-02	0.00E+00	1.75E-02	6.81E-03	7.33E-04
H-3	NO DATA	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	208	6970	0.00E+00	1.18E-02	1.18E-02	1.18E-02	1.18E-02	1.18E-02	1.18E-02
							Dose Commitment (mrem) =			3.87E-02	6.33E-02	2.98E-02	1.18E-02	2.93E-02	1.86E-02	1.26E-02

Catawba Nuclear Station
Dose from Shoreline Sediment Pathway for 2011 Data
Maximum Exposed Teen

Shoreline Recreation = 67 **hr (in one year)**
Shore Width Factor = 0.2
Sediment Surface Mass = 40 **kg/m^2**

Teen Dose from Shoreline Sediment Pathway (mrem) = Shoreline Recreation (hr) x External Dose Factor (mrem/hr per pCi/m2) x Shore Width Factor x Sediment Surface Mass (kg/m^2) x Sediment Concentration (pCi/kg)

	External Dose Factor Standing on Contaminated Ground (mrem/hr per pCi/m^2)		Highest Annual Net Mean Concentration		Dose (mrem)	
Radionuclide	T. Body	Skin	Indicator Location	Sediment (pCi/kg)	T. Body	Skin
Mn-54	5.80E-09	6.80E-09	ALL	0.00	0.00E+00	0.00E+00
* Co-57	9.10E-10	1.00E-09	208	10:5	5.12E-06	5.63E-06
Co-58	7.00E-09	8.20E-09	208	83.6	3.14E-04	3.67E-04
Co-60	1.70E-08	2.00E-08	208	236	2.15E-03	2.53E-03
Cs-134	1.20E-08	1.40E-08	208	36.2	2.33E-04	2.72E-04
Cs-137	4.20E-09	4.90E-09	208	43.3	9.75E-05	1.14E-04
	Dose Commitment (mrem) =				2.80E-03	3.29E-03

* Dose Factor from Reference 6.17

Catawba Nuclear Station
Dose from Drinking Water Pathway for 2011 Data
Maximum Exposed Adult

Adult Dose from Drinking Water Pathway (mrem) = Usage (l) x Dose Factor (mrem/pCi ingested) x Concentration (pCi/l)

Usage (intake in one year) = 730 l

	Ingestion Dose Factor							Highest Annual Net Mean Concentration		Dose (mrem)						
Radionuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Indicator Location	Water (pCi/l)	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	4.57E-06	8.72E-07	NO DATA	1.36E-06	NO DATA	1.40E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	7.45E-07	1.67E-06	NO DATA	NO DATA	NO DATA	1.51E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	4.34E-06	1.02E-05	3.91E-06	NO DATA	NO DATA	2.85E-06	3.40E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	2.14E-06	4.72E-06	NO DATA	NO DATA	NO DATA	4.02E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	4.84E-06	1.54E-05	6.96E-06	NO DATA	1.03E-05	NO DATA	9.70E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	6.22E-09	3.46E-09	1.86E-09	NO DATA	3.42E-09	NO DATA	2.10E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	3.04E-08	9.75E-09	6.60E-09	NO DATA	1.53E-08	NO DATA	3.09E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	NO DATA	1.57E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaLa-140	2.03E-05	2.55E-08	1.33E-06	NO DATA	8.67E-09	1.46E-08	4.18E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	NO DATA	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	214	337	0.00E+00	2.58E-02	2.58E-02	2.58E-02	2.58E-02	2.58E-02	2.58E-02
						Dose Commitment (mrem) =				0.00E+00	2.58E-02	2.58E-02	2.58E-02	2.58E-02	2.58E-02	2.58E-02

Catawba Nuclear Station
Dose from Broadleaf Vegetation Pathway for 2011 Data
Maximum Exposed Adult

Adult Dose from Vegetation (mrem) = Usage (kg) x Dose Factor (mrem/pCi ingested) x Concentration (pCi/kg)

Usage (intake in one year) = **64 kg**

	Ingestion Dose Factor							Highest Annual Net Mean Concentration		Dose (mrem)						
Radionuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Indicator Location	Food (pCi/kg)	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
I-131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	NO DATA	1.57E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06	201	26.2	1.34E-01	1.83E-01	1.20E-01	0.00E+00	6.20E-02	2.06E-02	3.54E-03
							Dose Commitment (mrem) =			1.34E-01	1.83E-01	1.20E-01	0.00E+00	6.20E-02	2.06E-02	3.54E-03

Catawba Nuclear Station
Dose from Fish Pathway for 2011 Data
Maximum Exposed Adult

Adult Dose from Fish Pathway (mrem) = Usage (kg) x Dose Factor (mrem/pCi ingested) x Concentration (pCi/kg)

H-3 Concentration in Fish = Surface Water pCi/l x Bioaccumulation Factor 0.9 pCi/kg per pCi/l = 7744 pCi/l x 0.9 = 6970 pCi/kg

Usage (intake in one year) = **21 kg**

	Ingestion Dose Factor							Highest Annual Net Mean Concentration		Dose (mrem)						
Radionuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Location	(pCi/kg)	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	4.57E-06	8.72E-07	NO DATA	1.36E-06	NO DATA	1.40E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	7.45E-07	1.67E-06	NO DATA	NO DATA	NO DATA	1.51E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	4.34E-06	1.02E-05	3.91E-06	NO DATA	NO DATA	2.85E-06	3.40E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	2.14E-06	4.72E-06	NO DATA	NO DATA	NO DATA	4.02E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	4.84E-06	1.54E-05	6.96E-06	NO DATA	1.03E-05	NO DATA	9.70E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06	208	21.6	3.62E-02	4.94E-02	3.24E-02	0.00E+00	1.68E-02	5.58E-03	9.57E-04
H-3	NO DATA	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	208	6970	0.00E+00	1.54E-02	1.54E-02	1.54E-02	1.54E-02	1.54E-02	1.54E-02
								Dose Commitment (mrem) =		3.62E-02	6.48E-02	4.78E-02	1.54E-02	3.22E-02	2.09E-02	1.63E-02

Catawba Nuclear Station
Dose from Shoreline Sediment Pathway for 2011 Data
Maximum Exposed Adult

Shoreline Recreation = 12 hr (in one year)
Shore Width Factor = 0.2
Sediment Surface Mass = 40 kg/m^2

Adult Dose from Shoreline Sediment Pathway (mrem) = Shoreline Recreation (hr) x External Dose Factor (mrem/hr per pCi/m2) x Shore Width Factor x Sediment Surface Mass (kg/m^2) x Sediment Concentration (pCi/kg)

External Dose Factor Standing on Contaminated Ground (mrem/hr per pCi/m^2)			Highest Annual Net Mean Concentration		Dose (mrem)	
Radionuclide	T. Body	Skin	Indicator Location	Sediment (pCi/kg)	T. Body	Skin
Mn-54	5.80E-09	6.80E-09	ALL	0.00	0.00E+00	0.00E+00
* Co-57	9.10E-10	1.00E-09	208	10.5	9.17E-07	1.01E-06
Co-58	7.00E-09	8.20E-09	208	83.6	5.62E-05	6.58E-05
Co-60	1.70E-08	2.00E-08	208	236	3.85E-04	4.53E-04
Cs-134	1.20E-08	1.40E-08	208	36.2	4.17E-05	4.87E-05
Cs-137	4.20E-09	4.90E-09	208	43.3	1.75E-05	2.04E-05
	Dose Commitment (mrem) =				5.01E-04	5.89E-04

* Dose Factor from Reference 6.17

5.0 QUALITY ASSURANCE

5.1 SAMPLE COLLECTION

EnRad Laboratories, Fisheries, and Aquatic Ecology performed the environmental sample collections as specified by approved sample collection procedures.

5.2 SAMPLE ANALYSIS

EnRad Laboratories performed the environmental sample analyses as specified by approved analysis procedures. EnRad Laboratories is located in Huntersville, North Carolina, at Duke Energy Corporation's Environmental Center.

Duke Energy Corporation's Environmental Center

5.3 DOSIMETRY ANALYSIS

The Radiation Dosimetry and Records group performed environmental dosimetry measurements as specified by approved dosimetry analysis procedures.

5.4 LABORATORY EQUIPMENT QUALITY ASSURANCE

5.4.1 DAILY QUALITY CONTROL

EnRad Laboratories has an internal quality assurance program which monitors each type of instrumentation for reliability and accuracy. Daily quality control checks ensure that instruments are in proper working order and these checks are used to monitor instrument performance.

5.4.2 CALIBRATION VERIFICATION

National Institute of Standards and Technology (NIST) standards that represent counting geometries are analyzed as unknowns at various frequencies ranging from weekly to annually to verify that efficiency calibrations are valid. The frequency is dependent upon instrument use and performance. Investigations are performed and documented should calibration verification data fall out of limits.

5.4.3 BATCH PROCESSING

Method quality control samples are analyzed with sample analyses that are processed in batches. These include gross beta in drinking water and tritium analyses.

5.5 DUKE ENERGY INTERCOMPARISON PROGRAM

EnRad Laboratories participated in the Duke Energy Nuclear Generation Department Intercomparison Program during 2011. Interlaboratory cross-check standards, including Marinelli beakers, air filters, air cartridges, gross beta in water, and tritium in water samples were analyzed at various times of the year. A summary of the EnRad Laboratory program results for 2011 is documented in Table 5.0-A.

5.6 ECKERT & ZIEGLER ANALYTICS CROSS CHECK PROGRAM

EnRad Laboratories participated in the Eckert & Ziegler Analytics Cross Check Program during 2011. Cross-check standards including, Marinelli beakers, air filters, tritium in water, and Iodine in milk samples were analyzed at various times of the year. A summary of the EnRad Laboratory program results for 2011 is documented in Table 5.0-B.

5.7 ERA PROFICIENCY TESTING

EnRad Laboratories performed method proficiency testing through a program administered by Environmental Resource Associates (ERA) of Arvada, CO. ERA supplied requested method proficiency samples for analysis and nuclide concentration determination. ERA reported proficiency test results to the North Carolina Department of Health and Human Services, North Carolina Public Health Drinking Water Laboratory Certification Program. A summary of these proficiency test data for 2011 is documented in Table 5.0-C.

5.8 DUKE ENERGY AUDITS

The Catawba Radiation Protection Section was not audited by the Quality Assurance Group in 2011, but was audited in 2010. Procedure and sampling equipment enhancements were identified as part of this audit (reference 6.14).

5.9 U.S. NUCLEAR REGULATORY COMMISSION INSPECTIONS

The Catawba Nuclear Station Radiological Environmental Monitoring Program was audited by the NRC in 2011 (reference 6.12). No findings were noted in the report.

5.10 STATE OF SOUTH CAROLINA INTERCOMPARISON PROGRAM

Catawba Nuclear Station routinely participates with the Bureau of Radiological Health of the State's Department of Health and Environmental Control (DHEC) in an intercomparison program. The Memorandum of Agreement (MOA) between SC DHEC and Duke Energy describes the sampling frequency and analysis parameters for drinking water, surface water, milk, fish, vegetation, and shoreline sediment samples collected by EnRad Laboratories. Samples are routinely split with DHEC for intercomparison analysis. DHEC collects air samples near two of the locations sampled for air by CNS. Results of the analyses performed on split and duplicate samples are sent to DHEC.

5.11 TLD INTERCOMPARISON PROGRAM

5.11.1 NUCLEAR TECHNOLOGY SERVICES INTERCOMPARISON PROGRAM

Radiation Dosimetry and Records participates in a quarterly TLD intercomparison program administered by Nuclear Technology Services, Inc. of Roswell, GA. Nuclear Technology Services irradiates environmental dosimeters quarterly and sends them to the Radiation Dosimetry and Records group for analysis of the unknown estimated delivered exposure. A summary of the Nuclear Technology Services Intercomparison Report is documented in Table 5.0-D.

5.11.2 INTERNAL CROSSCHECK (DUKE ENERGY)

Radiation Dosimetry and Records participates in a quarterly TLD intracomparison program administered internally by the Dosimetry Lab. The Dosimetry Lab Staff irradiates environmental dosimeters quarterly and submits them for analysis of the unknown estimated delivered exposure. A summary of the Internal Cross Check (Duke Energy) Result is documented in Table 5.0-D.

TABLE 5.0-A
DUKE ENERGY
INTERLABORATORY COMPARISON PROGRAM

2011 CROSS-CHECK RESULTS FOR ENRAD LABORATORIES

Cross-Check samples are normally analyzed a minimum of three times. A status of "3 Pass" indicates that all three analyses yielded results within the designated acceptance range. A status of "1 Pass" indicates that one analysis of the cross check was performed

If applicable, footnote explanations are included following this table.

Gamma in Water 3.5 liters

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Mean Reported Value pCi/l	Cross Check Status
8/17/2011	Q113GWSL	Cr-51	1.85 - 3.28 E5	2.47 E5	2.47 E5	3 Pass
		Mn-54	6.36 - 11.28 E4	8.48 E4	8.62 E4	3 Pass
		Co-58	5.13 - 9.10 E4	6.84 E4	6.79 E4	3 Pass
		Fe-59	3.42 - 6.07 E4	4.56 E4	4.76 E4	3 Pass
		Co-60	6.28 - 11.13 E4	8.37 E4	8.26 E4	3 Pass
		Zn-65	0.78 - 1.38 E5	1.04 E5	1.06 E5	3 Pass
		Cs-134	5.22 - 9.25 E4	6.96 E4	6.30 E4	3 Pass
		Cs-137	4.51 - 8.00 E4	6.02 E4	5.59 E4	3 Pass
		Ce-141	4.89 - 8.68 E4	6.52 E4	6.51 E4	3 Pass
12/12/2011	Q114GWR	Mn-54	2.31 - 4.09 E4	3.08 E4	3.25 E4	1 Pass
		Co-57	3.05 - 5.40 E4	4.06 E4	4.34 E4	1 Pass
		Co-60	2.76 - 4.89 E4	3.67 E4	3.65 E4	1 Pass
		Y-88	1.49 - 2.65 E4	1.99 E4	2.03 E4	1 Pass
		Cd-109	0.00 - 0.00 E3	0.00E+00	6.46 E3	1/1 High [1]
		Sn-113	1.60 - 2.84 E4	2.14 E4	2.12 E4	1 Pass
		Cs-137	2.39 - 4.23 E4	3.18 E4	3.01 E4	1 Pass

Gamma in Water 1.0 liter

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Mean Reported Value pCi/l	Cross Check Status
8/17/2011	Q113GWSL	Cr-51	1.85 - 3.28 E5	2.47 E5	2.47 E5	3 Pass
		Mn-54	6.36 - 11.28 E4	8.48 E4	8.79 E4	3 Pass
		Co-58	5.13 - 9.10 E4	6.84 E4	6.87 E4	3 Pass
		Fe-59	3.42 - 6.07 E4	4.56 E4	4.90 E4	3 Pass
		Co-60	6.28 - 11.13 E4	8.37 E4	8.35 E4	3 Pass
		Zn-65	0.78 - 1.38 E5	1.04 E5	1.09 E5	3 Pass
		Cs-134	5.22 - 9.25 E4	6.96 E4	6.12 E4	3 Pass
		Cs-137	4.51 - 8.00 E4	6.02 E4	5.65 E4	3 Pass
		Ce-141	4.89 - 8.68 E4	6.52 E4	6.40 E4	3 Pass

Gamma in Water 1.0 liter, continued

12/12/2011	Q114GWR	Mn-54	2.31 - 4.09 E4	3.08 E4	3.18 E4	1 Pass
		Co-57	3.05 - 5.40 E4	4.06 E4	4.22 E4	1 Pass
		Co-60	2.76 - 4.89 E4	3.67 E4	3.63 E4	1 Pass
		Y-88	1.49 - 2.65 E4	1.99 E4	1.97 E4	1 Pass
		Cd-109	0.00 - 0.00 E3	0.00E+00	7.68 E3	1/1 High [1]
		Sn-113	1.60 - 2.84 E4	2.14 E4	2.09 E4	1 Pass
		Cs-137	2.39 - 4.23 E4	3.18 E4	2.94 E4	1 Pass

Gamma in Water 0.5 liter

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Mean Reported Value pCi/l	Cross Check Status
8/17/2011	Q113GWSL	Cr-51	1.85 - 3.28 E5	2.47 E5	2.46 E5	3 Pass
		Mn-54	6.36 - 11.28 E4	8.48 E4	8.60 E4	3 Pass
		Co-58	5.13 - 9.10 E4	6.84 E4	6.69 E4	3 Pass
		Fe-59	3.42 - 6.07 E4	4.56 E4	4.82 E4	3 Pass
		Co-60	6.28 - 11.13 E4	8.37 E4	8.17 E4	3 Pass
		Zn-65	0.78 - 1.38 E5	1.04 E5	1.08 E5	3 Pass
		Cs-134	5.22 - 9.25 E4	6.96 E4	5.90 E4	3 Pass
		Cs-137	4.51 - 8.00 E4	6.02 E4	5.56 E4	3 Pass
		Ce-141	4.89 - 8.68 E4	6.52 E4	6.34 E4	3 Pass

Gamma in Water 0.25 liter

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Mean Reported Value pCi/l	Cross Check Status
8/17/2011	Q113GWSL	Cr-51	1.85 - 3.28 E5	2.47 E5	2.51 E5	3 Pass
		Mn-54	6.36 - 11.28 E4	8.48 E4	8.76 E4	3 Pass
		Co-58	5.13 - 9.10 E4	6.84 E4	6.85 E4	3 Pass
		Fe-59	3.42 - 6.07 E4	4.56 E4	4.93 E4	3 Pass
		Co-60	6.28 - 11.13 E4	8.37 E4	8.25 E4	3 Pass
		Zn-65	0.78 - 1.38 E5	1.04 E5	1.09 E5	3 Pass
		Cs-134	5.22 - 9.25 E4	6.96 E4	6.11 E4	3 Pass
		Cs-137	4.51 - 8.00 E4	6.02 E4	5.65 E4	3 Pass
		Ce-141	4.89 - 8.68 E4	6.52 E4	6.38 E4	3 Pass

Gamma in Filter

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi	Reference Value pCi	Mean Reported Value pCi	Cross Check Status
6/16/2011	E7882-37	Cr-51	0.96 - 2.59 E2	1.58 E2	1.39 E2	2 Pass
		Mn-54	0.80 - 1.41 E2	1.06 E2	0.93 E2	2 Pass
		Co-58	0.88 - 1.56 E2	1.17 E2	0.96 E2	2 Pass
		Fe-59	7.10 - 12.60 E1	9.47 E1	8.62 E1	2 Pass
		Co-60	1.12 - 1.98 E2	1.49 E2	1.32 E2	2 Pass
		Zn-65	1.50 - 2.66 E2	2.00 E2	1.73 E2	2 Pass
		Cs-134	1.10 - 1.94 E2	1.46 E2	1.21 E2	2 Pass
		Cs-137	0.80 - 1.41 E2	1.06 E2	0.92 E2	2 Pass
		Ce-141	4.61 - 8.17 E1	6.14 E1	4.90 E1	2 Pass

Iodine in Water

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Mean Reported Value pCi/l	Cross Check Status
3/23/2011	Q111LIW1	I-131	2.63 - 4.66 E3	3.51 E3	3.62 E3	3 Pass
3/23/2011	Q111LIW2	I-131	5.26 - 9.33 E2	7.01 E2	7.04 E2	3 Pass
3/23/2011	Q111LIW3	I-131	1.15 - 2.03 E2	1.53 E2	1.54 E2	3 Pass

Iodine in Milk

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Mean Reported Value pCi/l	Cross Check Status
8/2/2011	Q113LIM1	I-131	1.84 - 3.26 E3	2.45 E3	2.60 E3	4 Pass
8/2/2011	Q113LIM2	I-131	1.58 - 2.80 E2	2.10 E2	2.19 E2	4 Pass
8/2/2011	Q113LIM3	I-131	2.63 - 4.66 E1	3.50 E1	3.67 E1	4 Pass

Iodine on Cartridge

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi	Reference Value pCi	Mean Reported Value pCi	Cross Check Status
6/16/2011	E7883-37	I-131	6.50 - 11.52 E1	8.66 E1	8.12 E1	2 Pass

Tritium in Water

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Mean Reported Value pCi/l	Cross Check Status
6/22/2011	Q112TWR1	H-3	2.82 - 5.00 E6	3.76 E6	3.57 E6	3 Pass
6/22/2011	Q112TWR2	H-3	4.57 - 8.11 E5	6.10 E5	5.77 E5	3 Pass
6/22/2011	Q112TWR3	H-3	3.73 - 7.63 E2	5.33 E2	5.10 E2	3 Pass
12/12/2011	Q114TWR3	H-3	6.11 - 10.84 E3	8.15 E3	7.65 E3	3 Pass
12/14/2011	Q114TWR1	H-3	0.93 - 1.66 E3	1.24 E3	1.23 E3	3 Pass
12/14/2011	Q114TWR2	H-3	3.18 - 5.64 E5	4.24 E5	4.03 E5	3 Pass

Gross Beta in Water

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Mean Reported Value pCi/l	Cross Check Status
5/23/2011	Q112ABW1	Cs-137	5.05 - 8.95 E1	6.73 E1	6.84 E1	3 Pass
5/23/2011	Q112ABW2	Cs-137	6.60 - 11.71 E1	8.80 E1	8.47 E1	3 Pass
5/23/2011	Q112ABW3	Cs-137	4.96 - 8.79 E2	6.61 E2	6.41 E2	3 Pass

Table 5.0-A Footnote Explanations

(1) Gamma in Water, Sample ID Q114GWR, Reference Date 12/12/2011

Cd-109 was identified in the cross-check sample and reported. The cross check supplier does not include this radionuclide on the certificate of analysis for this cross-check sample. The radionuclide Cd-109 was determined to be a misidentification by the software and was determined not to be present in the cross-check sample (reference 6.18).

TABLE 5.0-B
ECKERT & ZIEGLER ANALYTICS CROSS CHECK PROGRAM

2011 CROSS-CHECK RESULTS FOR ENRAD LABORATORIES

Cross-Check samples are received, prepared, and analyzed. Results are report directly to Eckert & Ziegler Analytics.

If applicable, footnote explanations are included following this table.

Gamma in Water 3.5 liters

Reference Date	Sample I.D.	Nuclide	Acceptance Range Ratio	Reference Value pCi/l	Reported Value pCi/l	Ratio	Cross Check Staus
9/15/2011	E8068-37	I-131	0.80 - 1.20	8.01E+01	7.96E+01	0.99	Pass
		Ce-141	0.80 - 1.20	9.15E+01	8.80E+01	0.96	Pass
		Cr-51	0.80 - 1.20	3.10E+02	3.18E+02	1.02	Pass
		Cs-134	0.80 - 1.20	1.76E+02	1.70E+02	0.97	Pass
		Cs-137	0.80 - 1.20	1.56E+02	1.57E+02	1.01	Pass
		Co-58	0.80 - 1.20	1.34E+02	1.37E+02	1.02	Pass
		Mn-54	0.80 - 1.20	2.07E+02	2.17E+02	1.05	Pass
		Fe-59	0.80 - 1.20	7.52E+01	8.34E+01	1.11	Pass
		Zn-65	0.80 - 1.20	2.47E+02	Not Reported	Not Reported	Failed (1)
		Co-60	0.80 - 1.20	2.15E+02	2.02E+02	0.94	Pass
12/8/2011	E8184-37	I-131	0.80 - 1.20	8.87E+01	9.46E+01	1.07	Pass
		Cr-51	0.80 - 1.20	5.66E+02	5.57E+02	0.98	Pass
		Cs-134	0.80 - 1.20	1.71E+02	1.76E+02	1.03	Pass
		Cs-137	0.80 - 1.20	2.10E+02	2.03E+02	0.97	Pass
		Co-58	0.80 - 1.20	2.21E+02	2.15E+02	0.97	Pass
		Mn-54	0.80 - 1.20	2.41E+02	2.52E+02	1.05	Pass
		Fe-59	0.80 - 1.20	1.83E+02	1.88E+02	1.03	Pass
		Zn-65	0.80 - 1.20	2.91E+02	2.97E+02	1.02	Pass
		Co-60	0.80 - 1.20	2.70E+02	2.87E+02	1.06	Pass

Gamma in Milk

Reference Date	Sample I.D.	Nuclide	Acceptance Range Ratio	Reference Value pCi/l	Reported Value pCi/l	Ratio	Cross Check Staus
12/8/2011	E8186-37	I-131	0.80 - 1.20	9.02E+01	9.84E+01	1.09	Pass
		Cr-51	0.80 - 1.20	5.66E+02	5.36E+02	0.95	Pass
		Cs-134	0.80 - 1.20	1.71E+02	1.59E+02	0.93	Pass
		Cs-137	0.80 - 1.20	2.10E+02	2.01E+02	0.96	Pass
		Co-58	0.80 - 1.20	2.21E+02	2.13E+02	0.96	Pass
		Mn-54	0.80 - 1.20	2.41E+02	2.45E+02	1.02	Pass
		Fe-59	0.80 - 1.20	1.83E+02	1.89E+02	1.03	Pass
		Zn-65	0.80 - 1.20	2.91E+02	2.95E+02	1.01	Pass
		Co-60	0.80 - 1.20	2.70E+02	2.74E+02	1.02	Pass

Iodine in Milk

Reference Date	Sample I.D.	Nuclide	Acceptance Range Ratio	Reference Value pCi/l	Reported Value pCi/l	Ratio	Cross Check Staus
9/15/2011	E8065-37	I-131	0.80 - 1.20	1.01E+02	9.88E+01	0.98	Pass

Tritium in Water

Reference Date	Sample I.D.	Nuclide	Acceptance Range Ratio	Reference Value pCi/l	Reported Value pCi/l	Ratio	Cross Check Staus
9/15/2011	E8069-37	H-3	0.80 - 1.20	9.01E+03	9.16E+03	1.02	Pass
12/8/2011	E8185-37	H-3	0.80 - 1.20	1.09E+04	1.04E+04	0.95	Pass

Gross Beta in Air Filter

Reference Date	Sample I.D.	Nuclide	Acceptance Range Ratio	Reference Value pCi/l	Reported Value pCi/l	Ratio	Cross Check Staus
9/15/2011	E8067-37	Cs-137	0.80 - 1.20	7.73E+01	7.60E+01	0.98	Pass
9/15/2011	E8066-37	Cs-137	0.80 - 1.20	1.94E+02	1.80E+02	0.93	Pass

Table 5.0-B Footnote Explanations

(1) Gamma in Water, Sample ID. E8068-37, Reference Date 9/15/2011

Zn-65 was identified in the cross-check sample but was not reported due to a summary report error (reference 6.19).

TABLE 5.0-C

ENVIRONMENTAL RESOURCE ASSOCIATES (ERA) QUIK™ RESPONSE PROGRAM

2011 PROFICIENCY TEST RESULTS FOR ENRAD LABORATORIES

ERA LABORATORY CODE: D242401

Proficiency test samples are received, prepared, analyzed, and reported to Environmental Resource Associates as described in the "Quik" Response instruction package within the study period. Proficiency test data are reported to ERA for evaluation. ERA reports proficiency test results to the North Carolina Department of Health and Human Services, North Carolina Public Drinking Water Laboratory Certification Program.

If applicable, footnote explanations are included following this data table.

Gamma Emitters in Water

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Reported Value pCi/l	Proficiency Check Status
4/4/2011	RAD-85*	Ba-133	6.30 - 8.28 E1	7.53 E1	7.70 E1	Pass
		Cs-134	5.95 - 8.02 E1	7.29 E1	7.28 E1	Pass
		Cs-137	6.93 - 8.74 E1	7.70 E1	7.66 E1	Pass
		Co-60	0.799 - 1.00 E2	8.88 E1	9.41 E1	Pass
		Zn-65	0.89 - 1.18 E2	9.89 E1	1.02 E2	Pass
10/7/2011	RAD-87**	Ba-133	0.818 - 1.06 E2	9.69 E1	8.92 E1	Pass
		Cs-134	2.63 - 3.67 E1	3.34 E1	3.33 E1	Pass
		Cs-137	3.94 - 5.17 E1	4.43 E1	3.79 E1	Low (1)
		Co-60	1.07 - 1.33 E2	1.19 E2	1.11 E2	Pass
		Zn-65	6.89 - 9.25 E1	7.68 E1	7.95 E1	Pass
10/4/2010	Quik 122111A***	Ba-133	5.75 - 7.58 E1	6.89 E1	7.14 E1	Pass
		Cs-134	3.45 - 4.75 E1	4.32 E1	4.41 E1	Pass
		Cs-137	1.11 - 1.38 E2	1.23 E2	1.23 E2	Pass
		Co-60	4.81 - 6.13 E1	5.34 E1	6.00 E1	Pass
		Zn-65	0.918 - 1.22 E2	1.02 E2	1.24 E2	High (2)

Tritium in Water

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Reported Value pCi/l	Proficiency Check Status
4/4/2011	RAD-85*	H-3	0.887 - 1.12 E4	1.02 E4	9.76 E3	Pass
10/7/2011	RAD-87**	H-3	1.52 - 1.91 E4	1.74 E4	1.68 E4	Pass

** ERA study period 4/4/2011 - 5/19/2011, ERA data report issue date 5/26/2011*

*** ERA study period 10/7/2011 - 11/21/2011, ERA data report issue date 11/29/2011*

**** ERA study period 12/21/2011 - 2/23/2012, ERA data report issue date 2/23/2012*

Table 5.0-C Footnote Explanations

(1) Gamma Emitters in Water, Sample ID RAD-87, Reference Date 10/7/2011

Reported result for Cs-137 was below the acceptance range limit (reference 6.20).

(2) Gamma Emitters in Water, Sample ID QUIK 122111A, Reference Date 10/4/2010

Sample ID QUIK 122111A originated as an evaluation sample for Sample ID RAD-87's low Cs-137 result. The reported Zn-65 result for QUIK 122111A was above the acceptance range limit (reference 6.20)

TABLE 5.0-D

2011 ENVIRONMENTAL DOSIMETER CROSS-CHECK RESULTS

Nuclear Technology Services

1st Quarter 2011

TLD Number	Reported (mR)	Delivered (mR)	Bias (% diff)	Pass/Fail Criteria	Pass/Fail
102178	96.3	95.1	1.26	<+/-15%	Pass
102194	99.4	95.1	4.50	<+/-15%	Pass
102234	101.4	95.1	6.65	<+/-15%	Pass
102162	99.7	95.1	4.88	<+/-15%	Pass
102099	97.5	95.1	2.52	<+/-15%	Pass
		Average Bias (B)	3.96		
		Standard Deviation (S)	2.10		
		Measure Performance |B|+S	6.07	<15%	Pass

2nd Quarter 2011

TLD Number	Reported (mR)	Delivered (mR)	Bias (% diff)	Pass/Fail Criteria	Pass/Fail
102021	15.7	14.6	7.81	<+/-15%	Pass
102026	15.6	14.6	6.85	<+/-15%	Pass
102038	16.3	14.6	11.92	<+/-15%	Pass
102057	14.4	14.6	-1.44	<+/-15%	Pass
102213	15.1	14.6	3.15	<+/-15%	Pass
		Average Bias (B)	5.66		
		Standard Deviation (S)	5.05		
		Measure Performance |B|+S	10.70	<15%	Pass

3rd Quarter 2011

TLD Number	Reported (mR)	Delivered (mR)	Bias (% diff)	Pass/Fail Criteria	Pass/Fail
102442	91.6	91.4	0.25	<+/-15%	Pass
102257	94.9	91.4	3.85	<+/-15%	Pass
102337	91.9	91.4	0.53	<+/-15%	Pass
102221	95.1	91.4	4.00	<+/-15%	Pass
102483	94.7	91.4	3.64	<+/-15%	Pass
		Average Bias (B)	2.46		
		Standard Deviation (S)	1.89		
		Measure Performance |B|+S	4.35	<15%	Pass

4th Quarter 2011

TLD Number	Reported (mR)	Delivered (mR)	Bias (% diff)	Pass/Fail Criteria	Pass/Fail
101285	72.0	70.0	2.84	<+/-15%	Pass
100746	71.2	70.0	1.71	<+/-15%	Pass
100087	70.7	70.0	0.97	<+/-15%	Pass
101131	71.7	70.0	2.46	<+/-15%	Pass
101356	72.5	70.0	3.59	<+/-15%	Pass
		Average Bias (B)	2.31		
		Standard Deviation (S)	1.01		
		Measure Performance |B|+S	3.32	<15%	Pass

Internal Crosscheck (Duke Energy)

1st Quarter 2011

TLD Number	Reported (mR)	Delivered (mR)	Bias (% diff)	Pass/Fail Criteria	Pass/Fail
102104	33.3	34.0	-2.15	<+/-15%	Pass
102316	32.7	34.0	-3.85	<+/-15%	Pass
102325	32.3	34.0	-5.12	<+/-15%	Pass
102434	32.8	34.0	-3.44	<+/-15%	Pass
102009	33.6	34.0	-1.26	<+/-15%	Pass
102149	32.3	34.0	-4.97	<+/-15%	Pass
102419	31.8	34.0	-6.44	<+/-15%	Pass
102160	34.8	34.0	2.47	<+/-15%	Pass
102502	32.5	34.0	-4.38	<+/-15%	Pass
102496	31.3	34.0	-7.88	<+/-15%	Pass
		Average Bias (B)	-3.70		
		Standard Deviation (S)	2.90		
		Measure Performance |B|+S	6.60	<15%	Pass

2nd Quarter 2011

TLD Number	Reported (mR)	Delivered (mR)	Bias (% diff)	Pass/Fail Criteria	Pass/Fail
100104	35.6	35.0	1.71	<+/-15%	Pass
100054	34.3	35.0	-2.00	<+/-15%	Pass
102410	34.4	35.0	-1.71	<+/-15%	Pass
102363	34.6	35.0	-1.09	<+/-15%	Pass
100816	34.2	35.0	-2.20	<+/-15%	Pass
101311	32.6	35.0	-6.86	<+/-15%	Pass
100432	36.1	35.0	3.03	<+/-15%	Pass
100065	33.2	35.0	-5.29	<+/-15%	Pass
100103	33.4	35.0	-4.54	<+/-15%	Pass
100097	35.1	35.0	0.23	<+/-15%	Pass
		Average Bias (B)	-1.87		
		Standard Deviation (S)	3.09		
		Measure Performance |B|+S	4.96	<15%	Pass

3rd Quarter 2011

TLD Number	Reported (mR)	Delivered (mR)	Bias (% diff)	Pass/Fail Criteria	Pass/Fail
102015	34.1	34.0	0.35	<+/-15%	Pass
102468	33.4	34.0	-1.91	<+/-15%	Pass
102008	33.0	34.0	-3.03	<+/-15%	Pass
102496	31.2	34.0	-8.21	<+/-15%	Pass
102160	33.2	34.0	-2.32	<+/-15%	Pass
102156	33.6	34.0	-1.26	<+/-15%	Pass
102064	32.9	34.0	-3.32	<+/-15%	Pass
102419	32.4	34.0	-4.79	<+/-15%	Pass
102498	33.0	34.0	-3.06	<+/-15%	Pass
102340	32.9	34.0	-3.29	<+/-15%	Pass
		Average Bias (B)	-3.09		
		Standard Deviation (S)	2.27		
		Measure Performance |B|+S	5.35	<15%	Pass

4th Quarter 2011

TLD Number	Reported (mR)	Delivered (mR)	Bias (% diff)	Pass/Fail Criteria	Pass/Fail
102005	38.8	40.0	-3.03	<+/-15%	Pass
101364	39.2	40.0	-1.98	<+/-15%	Pass
102164	37.5	40.0	-6.15	<+/-15%	Pass
102163	38.2	40.0	-4.43	<+/-15%	Pass
101252	37.6	40.0	-6.05	<+/-15%	Pass
102104	38.5	40.0	-3.83	<+/-15%	Pass
101297	38.0	40.0	-4.98	<+/-15%	Pass
102178	39.0	40.0	-2.50	<+/-15%	Pass
101305	38.3	40.0	-4.18	<+/-15%	Pass
102243	37.9	40.0	-5.38	<+/-15%	Pass
		Average Bias (B)	-4.25		
		Standard Deviation (S)	1.44		
		Measure Performance |B|+S	5.68	<15%	Pass

6.0 REFERENCES

6.1 Catawba Selected License Commitment Report

6.2 Catawba Technical Specifications

6.3 Catawba Updated Final Safety Analysis Review

6.4 Catawba Offsite Dose Calculation Manual

6.5 Catawba Annual Environmental Operating Report 1985 - 2010

6.6 Catawba Annual Effluent Report 1985 - 2011

6.7 Probability and Statistics in Engineering and Management Science, Hines and Montgomery, 1969, pages 287-293.

6.8 Practical Statistics for the Physical Sciences, Havilcek and Crain, 1988, pages 83-93.

6.9 Nuclear Regulatory Commission Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purposes of Evaluating Compliance with 10CFR50, Appendix I.

6.10 EnRad Laboratories Operating Procedures

6.11 RETDAS, Radiological Effluent Tracking and Dose Assessment Software, Canberra Version 3.5.1, DPC Revision #4.0

6.12 NRC Integrated Inspection Report 05000413/2011004 and 05000414/2011004

6.13 Duke Energy Corporation EnRad Laboratory Charcoal Cartridge Study, performed 2001

6.14 Radiological Effluents Controls INOS Audit 10-13(INOS)(REC)(CNS)

6.15 Nuclear System Directive (NSD) 701, Records Management

6.16 Problem Investigation Program Database, V 3.4.3, Duke Energy Company, G-11-01190

6.17 NUREG/CR-1276, User's Manual for LADTAP II – A Computer Program for Calculating Radiation Exposure to Man from Routine release of Nuclear Reactor Liquid Effluents

6.18 Problem Investigation Program Database, V 3.4.3, Duke Energy Company, G-12-00354

6.19 Problem Investigation Program Database, V 3.4.3, Duke Energy Company, G-12-0015

6.20 Problem Investigation Program Database, V 3.4.3, Duke Energy Company, G-11-001830

6.21 Problem Investigation Program Database, V 3.4.3, Duke Energy Company, G-11-00452

APPENDIX A

ENVIRONMENTAL SAMPLING
&
ANALYSIS PROCEDURES

APPENDIX A

ENVIRONMENTAL SAMPLING AND ANALYSIS PROCEDURES

Adherence to established procedures for sampling and analysis of all environmental media at Catawba Nuclear Station was required to ensure compliance with Station Selected Licensee Commitments. Analytical procedures were employed to ensure that Selected Licensee Commitments detection capabilities were achieved.

Environmental sampling and analyses were performed by EnRad Laboratories, Dosimetry and Records, Fisheries and Aquatic Ecology.

This appendix describes the environmental sampling frequencies and analysis procedures by media type.

I. CHANGE OF SAMPLING PROCEDURES

Indicator location 252 (Ground Water) removed from the program (reference 6.21).

Indicator location 260 (Crops) added as a replacement for indicator location 253 (Crops), which was removed from the program (reference 6.16).

II. DESCRIPTION OF ANALYSIS PROCEDURES

Gamma spectroscopy analyses are performed using high purity germanium gamma detectors and Canberra analytical software. Designated sample volumes are transferred to appropriate counting geometries and analyzed by gamma spectroscopy. Perishable samples such as fish and broadleaf vegetation are ground to achieve a homogeneous mixture. Soils and sediments are dried, sifted to remove foreign objects (rocks, clams, glass, etc.) then transferred to appropriate counting geometry.

Low-level iodine analyses are performed by passing a designated sample aliquot through a pre-weighed amount of ion exchange resin to remove and concentrate any iodine in the aqueous sample (milk). The resin is then dried, mixed thoroughly, and a net resin weight determined before being transferred to appropriate counting geometry and analyzed by gamma spectroscopy.

Tritium analyses are performed quarterly by using low-level environmental liquid scintillation analysis technique on a Packard 2550 liquid scintillation system or Perkin-Elmer 2900TR liquid scintillation system. Tritium samples are distilled and batch processed with a tritium spike and blank to verify instrument performance and sample preparation technique are acceptable.

Gross beta analysis is performed by concentrating a designated aliquot of sample precipitate and analyzing by Tennelec XLB Series 5 gas-flow proportional counters. Samples are batch processed with a blank to ensure sample contamination has not occurred.

III. CHANGE OF ANALYSIS PROCEDURES

No analysis procedures were changed during 2011.

IV. SAMPLING AND ANALYSIS PROCEDURES

A.1 AIRBORNE PARTICULATE AND RADIOIODINE

Airborne particulate and radioiodine samples at each of five locations were composited continuously by means of continuous air samplers. Air particulates were collected on a particulate filter and radioiodines were collected in a charcoal cartridge positioned behind the filter in the sampler. The samplers are designed to operate at a constant flow rate (in order to compensate for any filter loading) and are set to sample approximately 2 cubic feet per minute. Filters and cartridges were collected weekly. A separate weekly gamma analysis was performed on each charcoal cartridge and air particulate. A weekly gross beta analysis was performed on each filter. The continuous composite samples were collected from the locations listed below.

Location 200	=	Site Boundary (0.63 mi. NNE)
Location 201	=	Site Boundary (0.53 mi. NE)
Location 205	=	Site Boundary (0.25 mi. SW)
Location 212	=	Tega Cay (3.32 mi. E)
Location 258	=	Fairhope Road (9.84 mi. W)

A.2 DRINKING WATER

Monthly composite drinking water samples were collected at each of two locations. A gross beta and gamma analysis was performed on monthly composites. Tritium analysis was performed on the quarterly composites. The composites were collected monthly from the locations listed below.

Location 214	=	Rock Hill Water Supply (7.30 mi. SSE)
Location 218	=	Belmont Water Supply (13.5 mi. NNE)

A.3 SURFACE WATER

Monthly composite samples were collected at each of three locations. A gamma analysis was performed on the monthly composites. Tritium analysis was

performed on the quarterly composites. The composites were collected monthly from the locations listed below.

Location 208	=	Discharge Canal (0.45 mi. S)
Location 211	=	Wylie Dam (4.06 mi. ESE)
Location 215	=	River Pointe - Hwy 49 (4.21 mi. NNE)

A.4 GROUND WATER

Grab samples were collected quarterly from a residential well at one location. A gamma analysis and tritium analysis were performed on each sample. The samples were collected from the location listed below.

Location 252 = Residence (0.64 mi. SW)
Programmatic sampling terminated 5/11/2011, reference 6.21
Location 254 = Residence (0.82 mi. N)

A.5 MILK

Biweekly grab samples were collected at one location. A gamma and low-level Iodine-131 analysis was performed on each sample. The biweekly grab samples were collected from the location listed below.

Location 221 = Dairy (14.5 mi. NW)

A.6 BROADLEAF VEGETATION

Monthly samples were collected at each of five locations. A gamma analysis was performed on each sample. The samples were collected from the locations listed below.

Location 200	=	Site Boundary (0.63 mi. NNE)
Location 201	=	Site Boundary (0.53 mi. NE)
Location 222	=	Site Boundary (0.70 mi. N)
Location 226	=	Site Boundary (0.48 mi. S)
Location 258	=	Fairhope Road (9.84 mi. W)

A.7 FOOD PRODUCTS

Monthly samples were collected when available during the harvest season at one location. A gamma analysis was performed on each sample. The samples were collected from the location listed below.

Location 253 = Irrigated Gardens (1.90 mi SSE)
Programmatic sampling terminated 8/2/2011, reference 6.16
Location 260 = Irrigated Gardens (2.00 mi. SSE)
Programmatic sampling initiated 8/2/2011, reference 6.16

A.8 FISH

Semiannual samples were collected at each of two locations. A gamma analysis was performed on the edible portions of each sample. Boney fish (i.e. Sunfish) were prepared whole minus the head and tail portions. The samples were collected from the locations listed below.

Location 208	=	Discharge Canal (0.45 mi. S)
Location 216	=	Hwy 49 Bridge (4.19 mi. NNE)

A.9 SHORELINE SEDIMENT

Semiannual samples were collected at each of three locations. A gamma analysis was performed on each sample following the drying and removal of rocks and clams. The samples were collected from the locations listed below.

Location 208	=	Discharge Canal (0.45 mi. S)
Location 210	=	Ebenezer Access (2.31 mi. SE)
Location 215	=	River Pointe - Hwy 49 (4.21 mi. NNE)

A.10 DIRECT GAMMA RADIATION (TLD)

Thermoluminescent dosimeters (TLD) were collected quarterly at forty-one locations. A gamma exposure rate was determined for each TLD. TLD locations are listed in Table 2.1-B. The TLDs were placed as indicated below.

* An inner ring of 16 TLDs, one in each meteorological sector in the general area of the site boundary.

* An outer ring of 16 TLDs, one in each meteorological sector in the 6 to 8 kilometer range.

* The remaining TLDs were placed in special interest areas such as population centers, residential areas, schools, and at three control locations.

A.11 ANNUAL LAND USE CENSUS

An Annual Land Use Census was conducted to identify within a distance of 8 kilometers (5.0 miles) from the station, the nearest location from the site boundary in each of the sixteen meteorological sectors, the following:

* The Nearest Residence

* The Nearest Garden greater than 50 square meters or 500 square feet

* The Nearest Milk-giving Animal (cow, goat, etc.)

The census was conducted during the growing season from 7/13 to 7/14/2011. Results are shown in Table 3.11. No changes were made to the sampling procedures during 2011 as a result of the 2011 census.

V. GLOBAL POSITIONING SYSTEM (GPS) ANALYSIS

The Catawba site centerline used for GPS measurements was referenced from the Catawba Nuclear Station Updated Final Safety Analysis Report (UFSAR), section 2.1.1.1, Specification of Location. Waypoint coordinates used for CNS GPS measurements were latitude 35°-3'-5"N and longitude 81°-4'-10"W. Maps and tables were generated using North American Datum (NAD) 27. Data normally reflect accuracy to within 2 to 5 meters from point of measurement. All GPS field measurements were taken as close as possible to the item of interest. Distances for the locations are displayed using three significant figures.

APPENDIX B

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

SUMMARY OF RESULTS

2011

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station **Docket No. 50-413,414**

Location: York County, South Carolina **Report Period: 01-JAN-2011 to 31-DEC-2011**

Medium or Pathway Sampled	Type and Total Number of		Lower Limit of Detection	All Indicator Locations	Location with Highest Annual Mean Name, Distance, Direction		Control Location	No. of Non-Routine Report Meas.
Unit of Measurement	Analyses Performed		(LLD)	Mean (Fraction) Range	Location Code	Mean (Fraction) Range	Mean (Fraction) Range	
Air Particulate (pCi/m3)							258 (9.84 mi W)	
	BETA	260	1.00E-02	1.84E-2 (208/208)	201	1.98E-2 (52/52)	1.92E-2 (52/52)	0
				3.95E-3 - 3.43E-2	(0.53 mi NE)	7.42E-3 - 2.92E-2	6.09E-3 - 3.14E-2	
	CS-134	260	5.00E-02	0.00 (0/208)		0.00 (0/52)	0.00 (0/52)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137	260	6.00E-02	3.21E-3 (2/208)	201	3.92E-3 (1/52)	0.00 (0/52)	0
				2.50E-3 - 3.92E-3	(0.53 mi NE)	3.92E-3 - 3.92E-3	0.00 - 0.00	
	I-131	260	7.00E-02	1.19E-2 (10/208)	201	1.39E-2 (3/52)	1.04E-2 (2/52)	0
				4.89E-3 - 2.00E-2	(0.53 mi NE)	4.89E-3 - 2.00E-02	1.04E-2 - 1.05E-02	

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station **Docket No. 50-413,414**

Location: York County, South Carolina **Report Period: 01-JAN-2011 to 31-DEC-2011**

Medium or Pathway Sampled	Type and Total Number of	Lower Limit of Detection	All Indicator Locations	Location with Highest Annual Mean Name, Distance, Direction		Control Location	No. of Non-Routine Report Meas.
Unit of Measurement	Analyses Performed	(LLD)	Mean (Fraction) Range	Location Code	Mean (Fraction) Range	Mean (Fraction) Range	
Air Radioiodine (pCi/m3)						258 (9.84 mi W)	
	CS-134 260	5.00E-02	0.00 (0/208)		0.00 (0/52)	0.00 (0/52)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137 260	6.00E-02	0.00 (0/208)		0.00 (0/52)	0.00 (0/52)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	I-131 260	7.00E-02	4.21E-2 (17/208)	200	5.53E-2 (4/52)	5.65E-2 (4/52)	0
			7.06E-3 - 9.32E-2	(0.63 mi NNE)	2.74E-2 - 8.19E-2	2.51E-2 - 9.24E-2	

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station **Docket No. 50-413,414**

Location: York County, South Carolina **Report Period: 01-JAN-2011 to 31-DEC-2011**

Medium or Pathway Sampled Unit of Measurement	Type and Total Number of Analyses Performed		Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Drinking Water (pCi/liter)							218 (13.5 mi NNE)	
	BALA-140	26	15	0.00 (0/13)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	BETA	26	4	2.01 (13/13)	214	2.01 (13/13)	1.71 (13/13)	0
				1.15 - 2.64	(7.30 mi SSE)	1.15 - 2.64	0.68 - 2.73	
	CO-58	26	15	0.00 (0/13)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CO-60	26	15	0.00 (0/13)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-134	26	15	0.00 (0/13)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137	26	18	0.00 (0/13)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	FE-59	26	30	0.00 (0/13)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	H-3	8	2000	973 (4/4)	214	973 (4/4)	636 (4/4)	0
				783 - 1150	(7.30 mi SSE)	783 - 1150	519 - 779	
	I-131	26	15	0.00 (0/13)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	MN-54	26	15	0.00 (0/13)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	NB-95	26	15	0.00 (0/13)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	ZN-65	26	30	0.00 (0/13)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	ZR-95	26	15	0.00 (0/13)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station **Docket No. 50-413,414**

Location: York County, South Carolina **Report Period: 01-JAN-2011 to 31-DEC-2011**

Medium or Pathway Sampled Unit of Measurement	Type and Total Number of Analyses Performed		Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Surface Water (pCi/liter)							215 (4.21 mi NNE)	
	BALA-140	39	15	0.00 (0/26)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CO-58	39	15	8.75 (1/26)	208	8.75 (1/13)	0.00 (0/13)	0
				8.75 - 8.75	(0.45 mi S)	8.75 - 8.75	0.00 - 0.00	
	CO-60	39	15	19.6 (1/26)	208	19.6 (1/13)	0.00 (0/13)	0
				19.6 - 19.6	(0.45 mi S)	19.6 - 19.6	0.00 - 0.00	
	CS-134	39	15	0.00 (0/26)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137	39	18	0.00 (0/26)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	FE-59	39	30	0.00 (0/26)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	H-3	12	2000	4631 (8/8)	208	8285 (4/4)	541 (4/4)	0
				792 - 11300	(0.45 mi S)	4770 - 11300	433 - 629	
	I-131	39	15	0.00 (0/26)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	MN-54	39	15	0.00 (0/26)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	NB-95	39	15	0.00 (0/26)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	ZN-65	39	30	0.00 (0/26)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	ZR-95	39	15	0.00 (0/26)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station **Docket No. 50-413,414**

Location: York County, South Carolina **Report Period: 01-JAN-2011 to 31-DEC-2011**

Medium or Pathway Sampled Unit of Measurement	Type and Total Number of Analyses Performed		Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction Location Code	Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Ground Water (pCi/liter)							NO CONTROL LOCATION	
	BALA-140	4	15	0.00 (0/4)		0.00 (0/4)	0.00 (0/0)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CO-58	4	15	0.00 (0/4)		0.00 (0/4)	0.00 (0/0)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CO-60	4	15	0.00 (0/4)		0.00 (0/4)	0.00 (0/0)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-134	4	15	0.00 (0/4)		0.00 (0/4)	0.00 (0/0)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137	4	18	0.00 (0/4)		0.00 (0/4)	0.00 (0/0)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	FE-59	4	30	0.00 (0/4)		0.00 (0/4)	0.00 (0/0)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	H-3	4	2000	0.00 (0/4)		0.00 (0/4)	0.00 (0/0)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	I-131	4	15	0.00 (0/4)		0.00 (0/4)	0.00 (0/0)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	MN-54	4	15	0.00 (0/4)		0.00 (0/4)	0.00 (0/0)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	NB-95	4	15	0.00 (0/4)		0.00 (0/4)	0.00 (0/0)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	ZN-65	4	30	0.00 (0/4)		0.00 (0/4)	0.00 (0/0)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	ZR-95	4	15	0.00 (0/4)		0.00 (0/4)	0.00 (0/0)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station **Docket No. 50-413,414**

Location: York County, South Carolina **Report Period: 01-JAN-2011 to 31-DEC-2011**

Medium or Pathway Sampled	Type and Total Number of		Lower Limit of Detection	All Indicator Locations	Location with Highest Annual Mean Name, Distance, Direction		Control Location	No. of Non-Routine Report Meas.
Unit of Measurement	Analyses Performed		(LLD)	Mean (Fraction) Range	Location Code	Mean (Fraction) Range	Mean (Fraction) Range	
Milk (pCi/liter)				NO INDICATOR LOCATION			221 (14.5 mi NW)	
	BALA-140	26	15	0.00 (0/0)		0.00 (0/0)	0.00 (0/26)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-134	26	15	0.00 (0/0)		0.00 (0/0)	0.00 (0/26)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137	26	18	0.00 (0/0)		0.00 (0/0)	0.00 (0/26)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	I-131	26	15	0.00 (0/0)		0.00 (0/0)	10.5 (2/26)	0
				0.00 - 0.00		0.00 - 0.00	7.13 - 13.8	
	LLI-131	26	1	0.00 (0/0)		0.00 (0/0)	6.86 (3/26)	0
				0.00 - 0.00		0.00 - 0.00	1.09 - 14.7	

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station **Docket No. 50-413,414**

Location: York County, South Carolina **Report Period: 01-JAN-2011 to 31-DEC-2011**

Medium or Pathway Sampled Unit of Measurement	Type and Total Number of Analyses Performed		Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Broadleaf Vegetation (pCi/kg-wet)							258 (9.84 mi W)	
	CS-134	60	60	12.8 (1/48)	200	12.8 (1/12)	0.00 (0/12)	0
				12.8 - 12.8	(0.63 mi NNE)	12.8 - 12.8	0.00 - 0.00	
	CS-137	60	80	22.1 (5/48)	201	26.2 (3/12)	0.00 (0/12)	0
				11.6 - 38.8	(0.53 mi NE)	19.2 - 38.8	0.00 - 0.00	
	I-131	60	60	117 (4/48)	200	132 (1/12)	156 (1/12)	0
				96.3 - 132	(0.63 mi NNE)	132 - 132	156 - 156	

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station **Docket No. 50-413,414**

Location: York County, South Carolina **Report Period: 01-JAN-2011 to 31-DEC-2011**

Medium or Pathway Sampled Unit of Measurement	Type and Total Number of Analyses Performed		Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Food Products (pCi/kg-wet)							NO CONTROL LOCATION	
	CS-134	5	60	0.00 (0/5)		0.00 (0/5)	0.00 (0/0)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137	5	80	0.00 (0/5)		0.00 (0/5)	0.00 (0/0)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	I-131	5	60	0.00 (0/5)		0.00 (0/5)	0.00 (0/0)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station **Docket No. 50-413,414**

Location: York County, South Carolina **Report Period: 01-JAN-2011 to 31-DEC-2011**

Medium or Pathway Sampled Unit of Measurement	Type and Total Number of Analyses Performed		Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction Location Code	Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Fish (pCi/kg-wet)							216 (4.19 mi NNE)	
	CO-58	12	130	0.00 (0/6)		0.00 (0/6)	0.00 (0/6)	0
				0.00 - 0.00		0.00 (0/6)	0.00 - 0.00	
	CO-60	12	130	0.00 (0/6)		0.00 - 0.00	0.00 (0/6)	0
				0.00 - 0.00		0.00 (0/6)	0.00 - 0.00	
	CS-134	12	130	0.00 (0/6)		0.00 (0/6)	0.00 (0/6)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137	12	150	21.6 (1/6)	208	21.6 (1/6)	0.00 (0/6)	0
				21.6 - 21.6	(0.45 mi S)	21.6 - 21.6	0.00 - 0.00	
	FE-59	12	260	0.00 (0/6)		0.00 (0/6)	0.00 (0/6)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	MN-54	12	130	0.00 (0/6)		0.00 (0/6)	0.00 (0/6)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	ZN-65	12	260	0.00 (0/6)		0.00 (0/6)	0.00 (0/6)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station **Docket No. 50-413,414**

Location: York County, South Carolina **Report Period: 01-JAN-2011 to 31-DEC-2011**

Medium or Pathway Sampled Unit of Measurement	Type and Total Number of Analyses Performed		Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Shoreline Sediment (pCi/kg-dry)							215 (4.21 mi NNE)	
	MN-54	6	0	0.00 (0/4)		0.00 (0/2)	0.00 (0/2)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CO-57	6	0	10.5 (1/4)	208	10.5 (1/2)	0.00 (0/2)	0
				10.5 - 10.5	(0.45 mi S)	10.5 - 10.5	0.00 - 0.00	
	CO-58	6	0	83.6 (2/4)	208	83.6 (2/2)	0.00 (0/2)	0
				75.9 - 91.2	(0.45 mi S)	75.9 - 91.2	0.00 - 0.00	
	CO-60	6	0	236 (2/4)	208	236 (2/2)	0.00 (0/2)	0
				152 - 320	(0.45 mi S)	152 - 320	0.00 - 0.00	
	CS-134	6	150	36.2 (1/4)	208	36.2 (1/2)	0.00 (0/2)	0
				36.2 - 36.2	(0.45 mi S)	36.2 - 36.2	0.00 - 0.00	
	CS-137	6	180	43.3 (2/4)	208	43.3 (2/2)	0.00 (0/2)	0
				27.8 - 58.8	(0.45 mi S)	27.8 - 58.8	0.00 - 0.00	

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements
If LLD is equal to 0.00, then the LLD is not required by Selected Licensee Commitments

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station **Docket No. 50-413,414**

Location: York County, South Carolina **Report Period: 01-JAN-2011 to 31-DEC-2011**

Medium or Pathway Sampled Unit of Measurement	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction: Location Code	Location with Highest Annual Mean Name, Distance, Direction: Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Direct Radiation TLD (mR/standard quarter)						217 (10.3 mi SSE) 247 (7.33 mi ESE) 251 (9.72 mi WNW)	
	164	0.00E+00	18.3 (152/152)	237	23.3 (4/4)	14.6 (12/12)	0
			11.0 - 26.0	(4.75 mi SSE)	20.0 - 25.0	11.0 - 19.0	

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements

CATAWBA RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

SUMMARY OF 2011 RESULTS EXCLUDING RADIOACTIVITY ATTRIBUTABLE TO FUKUSHIMA DAIICHI

Environmental Radiological Monitoring Program Summary *

Facility: Catawba Nuclear Station **Docket No. 50-413,414**

Location: York County, South Carolina **Report Period: 01-JAN-2011 to 31-DEC-2011**

Medium or Pathway Sampled	Type and Total Number of		Lower Limit of Detection	All Indicator Locations	Location with Highest Annual Mean Name, Distance, Direction		Control Location	No. of Non-Routine Report Meas.
Unit of Measurement	Analyses Performed		(LLD)	Mean (Fraction) Range	Location Code	Mean (Fraction) Range	Mean (Fraction) Range	
Air Particulate (pCi/m3)							258 (9.84 mi W)	
	BETA	235	1.00E-02	1.84E-2 (188/188)	201	1.95E-2 (47/47)	1.90E-2 (47/47)	0
				3.95E-3 - 3.43E-2	(0.53 mi NE)	7.42E-3 - 2.92E-2	6.09E-3 - 3.14E-2	
	CS-134	235	5.00E-02	0.00 (0/188)		0.00 (0/47)	0.00 (0/47)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137	235	6.00E-02	0.00 (0/188)		0.00 (0/47)	0.00 (0/47)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	I-131	235	7.00E-02	0.00 (0/188)		0.00 (0/47)	0.00 (0/47)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements
* Summary does not include samples collected during Fukushima Daiichi fallout period 3/15/2011 - 4/19/2011

Environmental Radiological Monitoring Program Summary *

Facility: Catawba Nuclear Station **Docket No. 50-413,414**

Location: York County, South Carolina **Report Period: 01-JAN-2011 to 31-DEC-2011**

Medium or Pathway Sampled	Type and Total Number of	Lower Limit of Detection	All Indicator Locations	Location with Highest Annual Mean Name, Distance, Direction		Control Location	No. of Non-Routine Report Meas.
Unit of Measurement	Analyses Performed	(LLD)	Mean (Fraction) Range	Location Code	Mean (Fraction) Range	Mean (Fraction) Range	
Air Radioiodine (pCi/m3)						258 (9.84 mi W)	
	CS-134 235	5.00E-02	0.00 (0/188)		0.00 (0/47)	0.00 (0/47)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137 235	6.00E-02	0.00 (0/188)		0.00 (0/47)	0.00 (0/47)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	I-131 235	7.00E-02	0.00 (0/188)		0.00 (0/47)	0.00 (0/47)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements
* Summary does not include samples collected during Fukushima Daiichi fallout period 3/15/2011 - 4/19/2011

Environmental Radiological Monitoring Program Summary *

Facility: Catawba Nuclear Station **Docket No. 50-413,414**

Location: York County, South Carolina **Report Period: 01-JAN-2011 to 31-DEC-2011**

Medium or Pathway Sampled Unit of Measurement	Type and Total Number of Analyses Performed		Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction Location Code	Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Milk (pCi/liter)				NO INDICATOR LOCATION			221 (14.5 mi NW)	
	BALA-140	23	15	0.00 (0/0)		0.00 (0/0)	0.00 (0/23)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-134	23	15	0.00 (0/0)		0.00 (0/0)	0.00 (0/23)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137	23	18	0.00 (0/0)		0.00 (0/0)	0.00 (0/23)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	I-131	23	15	0.00 (0/0)		0.00 (0/0)	0.00 (0/23)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	LLI-131	23	1	0.00 (0/0)		0.00 (0/0)	0.00 (0/23)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements
* Summary does not include samples collected during Fukushima Daiichi fallout period 3/29/2011 - 4/26/2011

Environmental Radiological Monitoring Program Summary *

Facility: Catawba Nuclear Station **Docket No. 50-413,414**

Location: York County, South Carolina **Report Period: 01-JAN-2011 to 31-DEC-2011**

Medium or Pathway Sampled Unit of Measurement	Type and Total Number of Analyses Performed		Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Broadleaf Vegetation (pCi/kg-wet)							258 (9.84 mi W)	
	CS-134	55	60	0.00 (0/44)		0.00 (0/11)	0.00 (0/11)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137	56	80	26.2 (3/45)	201	26.2 (3/12)	0.00 (0/11)	0
				19.2 - 38.8	(0.53 mi NE)	19.2 - 38.8	0.00 - 0.00	
	I-131	55	60	0.00 (0/44)		0.00 (0/11)	0.00 (0/11)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements
* Summary does not include samples collected during Fukushima Daiichi fallout period 4/5/2011 but does include Cs-137 results for location 201 (Bluebird Lane) during this period.

SUMMARY OF RADIOACTIVITY ATTRIBUTABLE TO FUKUSHIMA DAIICHI DETECTED IN ENVIRONMENTAL MEDIA AT DUKE ENERGY FACILITIES

Fukushima Daiichi Radioactivity Detected in Environmental Media (2011)

Airborne Particulate

Station	Analysis	Annual Concentration with Fukushima Daiichi (pCi/m^3)		Annual Concentration without Fukushima Daiichi (pCi/m^3)	
		Indicator	Control	Indicator	Control
Catawba	I-131	1.39E-2	1.04E-2	0.00	0.00
Catawba	Cs-137	3.92E-3	0.00	0.00	0.00
McGuire	I-131	2.08E-2	1.54E-2	0.00	0.00
McGuire	Cs-137	7.06E-3	0.00	0.00	0.00
Oconee	I-131	1.46E-2	2.01E-2	0.00	0.00
Oconee	Cs-134	1.44E-2	0.00	0.00	0.00
Oconee	Cs-137	8.08E-3	0.00	0.00	0.00

Airborne Radioiodine

Station	Analysis	Annual Concentration with Fukushima Daiichi (pCi/m^3)		Annual Concentration without Fukushima Daiichi (pCi/m^3)	
		Indicator	Control	Indicator	Control
Catawba	I-131	5.53E-2	5.65E-2	0.00	0.00
McGuire	I-131	6.00E-2	5.46E-2	0.00	0.00
Oconee	I-131	5.05E-2	4.13E-2	0.00	0.00

Milk

Station	Analysis	Annual Concentration with Fukushima Daiichi (pCi/l)		Annual Concentration without Fukushima Daiichi (pCi/l)	
		Indicator	Control	Indicator	Control
Catawba	LLI-131	NA	6.86	NA	0.00
McGuire	LLI-131	NA	4.80	NA	0.00
Oconee	LLI-131	NA	0.81	NA	0.00

Broadleaf Vegetation

Station	Analysis	Annual Concentration with Fukushima Daiichi (pCi/kg)		Annual Concentration without Fukushima Daiichi (pCi/kg)	
		Indicator	Control	Indicator	Control
Catawba	I-131	132	156	0.00	0.00
Catawba	Cs-134	12.8	0.00	0.00	0.00
Catawba	Cs-137	26.2	0.00	26.2	0.00
McGuire	I-131	316	168	0.00	0.00
McGuire	Cs-137	22.9	0.00	0.00	0.00
Oconee	I-131	398	150	0.00	0.00
Oconee	Cs-134	42.9	0.00	0.00	0.00
Oconee	Cs-137	66.8	33.5	0.00	0.00

Food Products (Crops)

Station	Analysis	Annual Concentration with Fukushima Daiichi (pCi/kg)		Annual Concentration without Fukushima Daiichi (pCi/kg)	
		Indicator	Control	Indicator	Control
McGuire	I-131	142	NA	0.00	0.00
McGuire	Cs-137	30.6	NA	0.00	0.00

APPENDIX C

SAMPLING DEVIATIONS
&
UNAVAILABLE ANALYSES

APPENDIX C

CATAWBA NUCLEAR STATION
SAMPLING DEVIATIONS & UNAVAILABLE ANALYSES

DEVIATION & UNAVAILABLE REASON CODES			
BF	Blown Fuse	PO	Power Outage
FZ	Sample Frozen	PS	Pump out of service / Undergoing Repair
IW	Inclement Weather	SL	Sample Loss/Lost due to Lab Accident
LC	Line Clog to Sampler	SM	Motor / Rotor Seized
OT	Other	TF	Torn Filter
PI	Power Interrupt	VN	Vandalism
PM	Preventive Maintenance	CN	Construction
WO	Well Unavailable/Out of Service		

C.1 SAMPLING DEVIATIONS

Air Particulate and Air Radioiodines

Location	Scheduled Collection Dates	Actual Collection Dates	Code	Description	Corrective Action Identity
200 201 212 258	1/5 – 1/11/2011	1/5 – 1/14/2011	IW	Collection rescheduled due to inclement weather creating potentially unsafe site access conditions.	G-11-00047
201	4/26 – 5/3/2011	4/26 – 5/3/2011	PO	Power outage to sampling equipment likely attributable to severe weather.	G-11-00809
200	5/10 – 5/17/2011	5/10 – 5/15/2011	PO	Power outage to sampling equipment likely attributable to severe weather.	G-11-00810
201	5/10 – 5/17/2011	5/10 – 5/11/2011	PO	Power outage to sampling equipment likely attributable to severe weather.	G-11-00811
200	5/24 – 6/1/2011	5/24 – 5/26/2011	PO	Power outage to sampling equipment likely attributable to severe weather.	G-11-00883
201	6/21 – 6/28/2011	6/21 – 6/28/2011	PI	Power interruption to sampling equipment likely attributable to severe weather.	G-11-01038

Drinking Water

Location	Scheduled Collection Dates	Actual Collection Dates	Code	Description	Corrective Action Identity
214 218	12/14 – 1/11/2011	12/14 – 1/13/2011	IW	Collection rescheduled due to inclement weather creating potentially unsafe site access conditions.	G-11-00047

Surface Water

Location	Scheduled Collection Dates	Actual Collection Dates	Code	Description	Corrective Action Identity
208 211 215	12/14 – 1/11/2011	12/14 – 1/13/2011	IW	Collection rescheduled due to inclement weather creating potentially unsafe site access conditions.	G-11-00047

C.2 UNAVAILABLE ANALYSES

Ground Water

Location	Scheduled Collection Dates	Code	Description	Corrective Action Identity
252	3/8/2011	WO	Well at this location (residence) out of service. Residence vacant, sample unattainable due to absence of power to operate well pump.	G-11-00393

APPENDIX D

ANALYTICAL DEVIATIONS

No Analytical deviations were incurred for the
2011 Radiological Environmental Monitoring Program

APPENDIX E

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM RESULTS

This appendix includes sample analysis reports and supportive data generated from each sample medium. Appendix E is located separately from this report and is permanently archived in the Nuclear Electronic Document Library (NEDL) as described in reference 6.15.

APPENDIX F

ERRATA TO PREVIOUS REPORTS

APPENDIX F

ERRATA TO THE 2011 AREOR

1. Section 3.9, Shoreline Sediment, Table 3.9 (Mean Concentrations of Radionuclides in Shoreline Sediment (pCi/kg)) located on page 23

   Row for year 2005 Cs-137 concentration originally reported as 0.00E0. The corrected year 2005 Cs-137 concentration is 3.04E1 pCi/kg.