APPENDIX A

CAROLINA POWER & LIGHT COMPANY
BRUNSWICK STEAM ELECTRIC PLANT

UNITS 1 & 2

RADIATION CONTROL AND TEST PROCEDURE: 3280

RADIOACTIVE MATERIAL RECOVERY PROCEDURE

Revision 0

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Date: 5/1/80

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Date: 5-1-80

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1.0 Purpose

The purpose is to provide guidance for the identification and removal of radioactive and/or contaminated materials which originated at BSEP from the Brunswick County Landfill.

2.0 Limits and Frequency

2.1 Items that can be identified as having originated at BSEP and having radiation levels in excess of two times background (10-15 μR/hr) will be removed from the landfill, packaged, and taken to the plant for disposal as radioactive material.

2.2 Limits for airborne radioactive material will be those listed in 10CFR20 for occupational exposure for 40 hours per week. Use the MPC for "unknown" isotopes if the specific nuclides are not known.

2.3 Other limits will be those found in the Radiation Protection Manual, Health Physics procedures, or other mutually agreeable limits between those agencies involved at the site at the time.

3.0 Summary of Method

Using a comprehensive survey of the landfill area in which all locations exhibiting unique radiation patterns at or above twice those of background have been identified. Each identified location will be excavated by a backhoe, other mechanical means, or suitable hand tools. Material removed will be surveyed in detail, and items presenting radiation levels twice background will be removed, packaged, and disposed as low-level radioactive waste. The excavation will be surveyed periodically as it progresses to direct efforts towards higher radiation levels. Excavation will cease when surveys fail to demonstrate levels greater than twice background and concurrence with the NC Radiological Health representatives.

4.0 Equipment

4.1 Backhoe or other suitable mechanical equipment.

4.2 Radiation Survey Instruments

4.2.1 μR meter.

4.2.2 Eberline RASCAL PRS-2 with 2" NAI detector.

4.2.3 GM survey meter having a range up to 2000 mR/hr.

4.2.4 Ruether-Stokes pressurized ion chamber.

4.2.5 Instrumentation provided on the NC Radiological Health van.

4.0 Equipment (Cont'd)

4.2.6 RM-14 frisker.

4.3 Portable high-volume air sampler.

4.4 Shovels, rakes, hoes.

4.5 Plastic bags (clear) and other suitable containers such as 55-gallon drums.

4.6 Radioactive labels and tags.

4.7 Protective clothing (probably coveralls but not anti-C clothing).

4.8 Gloves (cotton and/or cotton work gloves and rubber gloves).

4.9 Portable counting equipment for air samples and smears.

4.10 Log book.

4.11 TLD badges and dosimeters.

4.12 Portable generator.

5.0 Reagent List

Not applicable.

6.0 Limitations, Precautions, and Interferences

6.1 Qualified health physics personnel will be present during all excavation work who will be responsible for making all decisions regarding radiological safety. He should consult with other state and federal agencies present prior to making major decisions which depart from this procedure.

6.2 NC Radiological Health personnel, if on-site, should be consulted when making a determination that all required radioactive materials have been removed from each area prior to refilling and covering the hole.

6.3 Care should be taken to prevent the spread of contamination during the digging process.

6.4 All air samples and smears will be retained for complete laboratory analysis and evaluation.

6.0 Limitations, Precautions, and Interferences (Cont'd)

6.5 A detailed log of all activities will be maintained by the person in charge at the site.

6.6 Protective clothing will be provided to those personnel involved in digging. Additionally, anti-C clothing will be available for all personnel as necessary.

6.7 Painter's dust masks will be available for all involved personnel, should they be necessary or desirable (not suitable for protection against airborne radioactive materials).

6.8 Gloves will be worn by all personnel handling contaminated or potentially contaminated materials.

6.9 Survey all equipment and personnel that could possibly be contaminated prior to release from the area.

6.10 Do not open any containers at the landfill. Immediately place them in containers for return to the plant.

6.11 No individual under 19 years of age should be involved in the recovery operation.

7.0 Sampling Instructions

7.1 High volume air samples will be collected downwind when digging is in progress.

7.2 Environmental sampling will be described in a separate procedure.

7.3 Other sampling, such as smear surveys, may be required as determined to be necessary by health physics personnel on-site.

8.0 Procedure

8.1 Personnel will dress out in suitable protective clothing.

8.2 Determine the site to be excavated. Establish access boundary to control personnel.

8.3 Position the backhoe upwind of the spot.

8.4 Start the portable high volume air sampler downwind of the area.

8.0 Procedure (Cont'd)

8.5 Begin digging by taking the first scoop of material from the area. Take a preliminary survey of the material while still in the scoop. If no radiation levels in excess of background are detected, direct the operator to deposit the material in a selected location. Then resurvey the material using a rake or shovel to spread the material if necessary. If no radioactive material is detected, confirm by radiation readings that the radioactive material is still in the hole.

8.6 If radiation readings in excess of background are detected in a scoop, direct the operator to place the material in a segregated area or container. The segregated area should be a plastic sheet. All items identified as being from BSEP and having readings in excess of two x background (10-15 μR/hr) will be separated. Package all radioactive items in appropriate containers or other packaging material.

8.7 Repeat Steps 8.5 and 8.6 until all radioactive material has been identified and removed from the area.

8.8 After the air sampler has sampled approximately 300 ft^3, remove the filter and determine airborne radioactive material levels by counting the filter on the portable equipment. Save the filter for laboratory analysis. Continue to run the air sampler, and remove and count the filter.

8.9 If, after excavating the area and no specific item in excess of two x background can be detected, consult with NC Radiological Health personnel, if on-site, prior to refilling the area; move on to the next location.

8.10 Package all radioactive materials removed in appropriate containers (plastic bags or other strong containers) for return to the plant site. Identify all packages with appropriate radioactive material identification.

8.11 When all items in excess of limits have been removed from an area, make a complete radiation survey of the area using a μR meter. Collect soil samples as directed by the health physicist on-site for later analysis at the Harris laboratory. Review with NC Radiological Health personnel, if on-site, that all radioactive materials have been removed.

8.12 Refill the hole and identify the area with a suitable permanent marker such as a wooden, numbered stake.

8.0 Procedure (Cont'd)

8.13 Because of the varied nature of the buried material, alternate handling plans may have to incorporate minor changes in this procedure. Any significant changes will be reviewed with NC Radiological Health personnel and other agencies who may be on-site.

8.14 Smear surveys may be made as directed by health physics personnel on-site to monitor and ensure control of radioactive material. Any smears taken will be counted on field counting equipment and retained for later laboratory analysis.

8.15 Log, in detail, all activities including dates and times.

9.0 Counting and Calibration

9.1 Initially all air filters and smear samples will be counted on field counting equipment.

9.2 All samples will be retained for laboratory analysis and evaluation.

10.0 Results

Not applicable.

APPENDIX B

Estimated Radioactivity Removed From the Landfill

Item	Radiation Intensity @ 2" mP/hr	Estimated Activity ^{54}Mn mCi
Powder Bucket 1	100	.53
Powder Bucket 2	30	.16
34 Pipe pieces	1	.18
Screen 1	14	.07
Screen 2	25	.13
Spring 1	25	.13
Spring 2	35	.19
	Subtotal	1.39 mCi
	Soil Activity*	2.36 mCi
	TOTAL	3.8 mCi

Soil Activity = $13.5X10^{-9}$mCi/gm x 1.4 gm/Cm^3 x $\frac{1\ Cm^3}{3.53x10^{-5}ft^3}$ x $4410ft^3$ = 2.36 mCi

TABLE 3 (Cont'd)

SAMPLE NUMBER	LOCATION	DATE/TIME	RESULTS (pCi/m^3)	
BLAP-42	'N'	05-14-80/1351	^{54}Mn	0.983 ± .241
			^{60}Co	0.814 ± .259
BLAP-43	'O'	05-14-80/1437	^{54}Mn	1.12 ± .15
			^{60}Co	1.55 ± .20
BLAP-44	'R'	05-14-80/1804	^{54}Mn	2.7 ± .34
			^{60}Co	2.22 ± .22

TABLE 4

ANALYSES OF SOIL SAMPLES FROM BRUNSWICK COUNTY LANDFILL

SAMPLE NUMBER	LOCATION	DATE	RESULTS (pCi/Kg)	
BLSS-1	'H'	05-02-80	^{54}Mn	432 ± 24
			^{60}Co	688 ± 30
			^{134}Cs	56.2 ± 13.4
			^{137}Cs	178 ± 21
BLSS-2	General Area	05-02-80	^{60}Co	23.8 ± 8.5
			^{137}Cs	32.4 ± 9.1
BLSS-3	'G'	05-02-80	^{54}Mn	145 ± 28
			^{60}Co	2470 ± 50
			^{137}Cs	80.1 ± 26.5
BLSS-4	'H'	05-02-80	^{60}Co	32 ± 8.8
			^{137}Cs	41 ± 12.3
*BLSS-5	'G'	05-02-80	^{54}Mn	425 ± 133
			^{60}Co	10,900 ± 20
			^{65}Zn	1050 ± 160
			^{125}Sb	1110 ± 160
			^{137}Cs	158 ± 80
BLSS-6	'F'	05-03-80	^{54}Mn	150 ± 22
			^{60}Co	266 ± 23
			^{137}Cs	33.2 ± 15.3
BLSS-7	Overfill for 'F'	05-03-80	^{137}Cs	28.3 ± 12.2

*This sample was a sample of soil being removed and packaged as contaminated material.

TABLE 4 (Cont'd)

SAMPLE NUMBER	LOCATION	DATE	RESULTS (pCi/Kg)	
BLSS-8	'D'	05-03-80	^{54}Mn	309 ± 24
			^{60}Co	673 ± 28
			^{134}Cs	96.3 ± 15
			^{137}Cs	206 ± 23
BLSS-9	'E'	05-03-80	^{54}Mn	278 ± 20
			^{60}Co	478 ± 25
			^{134}Cs	150 ± 19
			^{137}Cs	383 ± 22
BLSS-10	'I'	05-04-80	^{54}Mn	114 ± 13
			^{60}Co	146 ± 15
			^{134}Cs	317 ± 218
			^{137}Cs	123 ± 16
BLSS-11	'I'	05-04-80	^{54}Mn	1450 ± 40
			^{60}Co	1090 ± 40
			^{134}Cs	94 ± 24
			^{137}Cs	183 ± 23
BLSS-12	'I'	05-04-80	^{54}Mn	2200 ± 50
			^{60}Co	1480 ± 40
			^{134}Cs	61.1 ± 20.5
			^{137}Cs	124 ± 24
BLSS-13	'L'	05-04-80	^{54}Mn	804 ± 42
			^{60}Co	1340 ± 60
			^{134}Cs	454 ± 41
			^{137}Cs	855 ± 49

TABLE 4 (Cont'd)

SAMPLE NUMBER	LOCATION	DATE	RESULTS (pCi/Kg)	
BLSS-14	'J'	05-04-80	^{51}Cr	11200 ± 500
			^{54}Mn	1530 ± 80
			^{58}Co	488 ± 57
			^{59}Fe	357 ± 57
			^{60}Co	2920 ± 100
			^{134}Cs	406 ± 56
			^{137}Cs	450 ± 54
BLSS-15	'E'	05-05-80	^{54}Mn	468 ± 46
			^{60}Co	977 ± 69
			^{134}Cs	258 ± 47
			^{137}Cs	680 ± 51
BLSS-16	'M'	05-05-80	^{60}Co	95.1 ± 13.9
			^{137}Cs	34 ± 16.5
BLSS-17	'B'	05-05-80	^{54}Mn	892 ± 37
			^{60}Co	1560 ± 50
			^{134}Cs	160 ± 31
			^{137}Cs	431 ± 27
BLSS-18	'J2'	05-05-80	^{54}Mn	37.1 ± 17.1
			^{60}Co	106 ± 22
			^{134}Cs	46 ± 18.5
			^{137}Cs	108 ± 17
BLSS-19	'C'	05-06-80	^{54}Mn	217 ± 18
			^{60}Co	221 ± 2[illegible]
			^{137}Cs	99.8 ± 14.7

TABLE 4 (Cont'd)

SAMPLE NUMBER	LOCATION	DATE	RESULTS (pCi/Kg)	
BLSS-20	'A'	05-06-80	^{54}Mn	77.1 ± 17.0
			^{60}Co	273 ± 23
			^{137}Cs	65.4 ± 14.9
BLSS-21	'J4'	05-07-80	^{54}Mn	514 ± 30
			^{60}Co	652 ± 37
			^{134}Cs	583 ± 36
			^{137}Cs	930 ± 40
BLSS-22	'G1'	05-08-80	^{54}Mn	476 ± 27
			^{60}Co	1260 ± 40
			^{137}Cs	138 ± 19
BLSS-23	'H1; H2'	05-08-80	^{54}Mn	72.1 ± 16.7
			^{60}Co	161 ± 17
			^{137}Cs	71.5 ± 13.3
BLSS-24	'J-K'	05-09-80	^{54}Mn	66.3 ± 21.4
			^{60}Co	119 ± 19
			^{134}Cs	70.9 ± 14.3
			^{137}Cs	123 ± 16
BLSS-25	'J-5'	05-10-80	^{54}Mn	347 ± 23
			^{60}Co	291 ± 23
			^{134}Cs	24.1 ± 16.3
			^{137}Cs	80.2 ± 19.4

TABLE 4 (Cont'd)

SAMPLE NUMBER	LOCATION	DATE	RESULTS (pCi/Kg)	
BLSS-26	'K-1'	05-10-80	^{54}Mn	1,570 ± 40
			^{58}Co	102 ± 20
			^{60}Co	1910 ± 50
			^{134}Cs	136 ± 25
			^{137}Cs	251 ± 23
BLSS-27	'K-2'	05-10-80	^{54}Mn	342 ± 26
			^{60}Co	737 ± 35
			^{134}Cs	58.3 ± 21.6
			^{137}Cs	155 ± 20
BLSS-28	'L-1'	05-10-80	^{54}Mn	142 ± 21
			^{60}Co	229 ± 21
			^{134}Cs	80.9 ± 10.5
			^{137}Cs	173 ± 16
BLSS-29	'N'	05-10-80	^{60}Co	15.3 ± 14
			^{137}Cs	70.1 ± 17.9
BLSS-30	'0'	05-11-80	^{54}Mn	195 ± 20
			^{60}Co	377 ± 23
			^{134}Cs	236 ± 22
			^{137}Cs	528 ± 25
BLSS-31	'P'	05-11-80	^{54}Mn	52.3 ± 8.9
			^{60}Co	41.5 ± 14.0
			^{137}Cs	86.9 ± 12.9

TABLE 4 (Cont'd)

SAMPLE NUMBER	LOCATION	DATE	RESULTS (pCi/Kg)	
BLSS-32	'R'	05-11-80	^{60}Co	38.2 ± 11.3
			^{137}Cs	85.9 ± 13.3
BLSS-33	'M-1'	05-13-80	^{54}Mn	53.3 ± 10.8
			^{60}Co	111 ± 22
			^{137}Cs	85.1 ± 15.0
BLSS-34	'D-1'	05-13-80	^{54}Mn	246 ± 18
			^{60}Co	324 ± 24
			^{134}Cs	111 ± 18
			^{137}Cs	164 ± 22
BLSS-35	'S'	05-13-80	^{54}Mn	419 ± 30
			^{60}Co	931 ± 35
			^{137}Cs	172 ± 21
BLSS-36	'K-1'	05-13-80	^{54}Mn	66.8 ± 15.1
			^{60}Co	170 ± 22
BLSS-37	'K-2'	05-13-80	^{54}Mn	510 ± 26
			^{60}Co	645 ± 32
			^{134}Cs	65.8 ± 23.3
			^{137}Cs	196 ± 21
BLSS-38	'L-3'	05-13-80	^{54}Mn	184 ± 22
			^{60}Co	163 ± 24
			^{134}Cs	150 ± 22
			^{137}Cs	187 ± 23

TABLE 4 (Cont'd)

SAMPLE NUMBER	LOCATION	DATE	RESULTS (pCi/Kg)	
BLSS-39	'J-5'	05-13-80	^{54}Mn	258 ± 25
			^{60}Co	350 ± 27
			^{134}Cs	241 ± 25
			^{137}Cs	326 ± 26
BLSS-40	'L'	05-14-80	^{54}Mn	95.4 ± 19.8
			^{60}Co	142 ± 17
			^{134}Cs	49.7 ± 16.2
			^{137}Cs	112 ± 19
BLSS-41	'B-1'	05-14-80	^{54}Mn	99.7 ± 15.3
			^{60}Co	246 ± 22
			^{137}Cs	57 ± 24

ENVIRONMENTAL ASSESSMENT SURVEY

Upon completion of the landfill survey, environmental sampling was initiated to determine if any significant radionuclide pathway to man existed. The pathway of major interest appeared to be a water transport pathway. The landfill soil is sandy and does not retain elements such as the radionuclides deposited there; therefore, the contaminants might be leached from the soil by rain and other ground water sources. The area is drained by Beaver Dam Creek which flows south to the Intracoastal Waterway. The surface drainage flows eastward to the creek through a swampy area of thick vegetation. The drainage that flows westward is collected by a drainage ditch that channels it into Beaver Dam Creek.

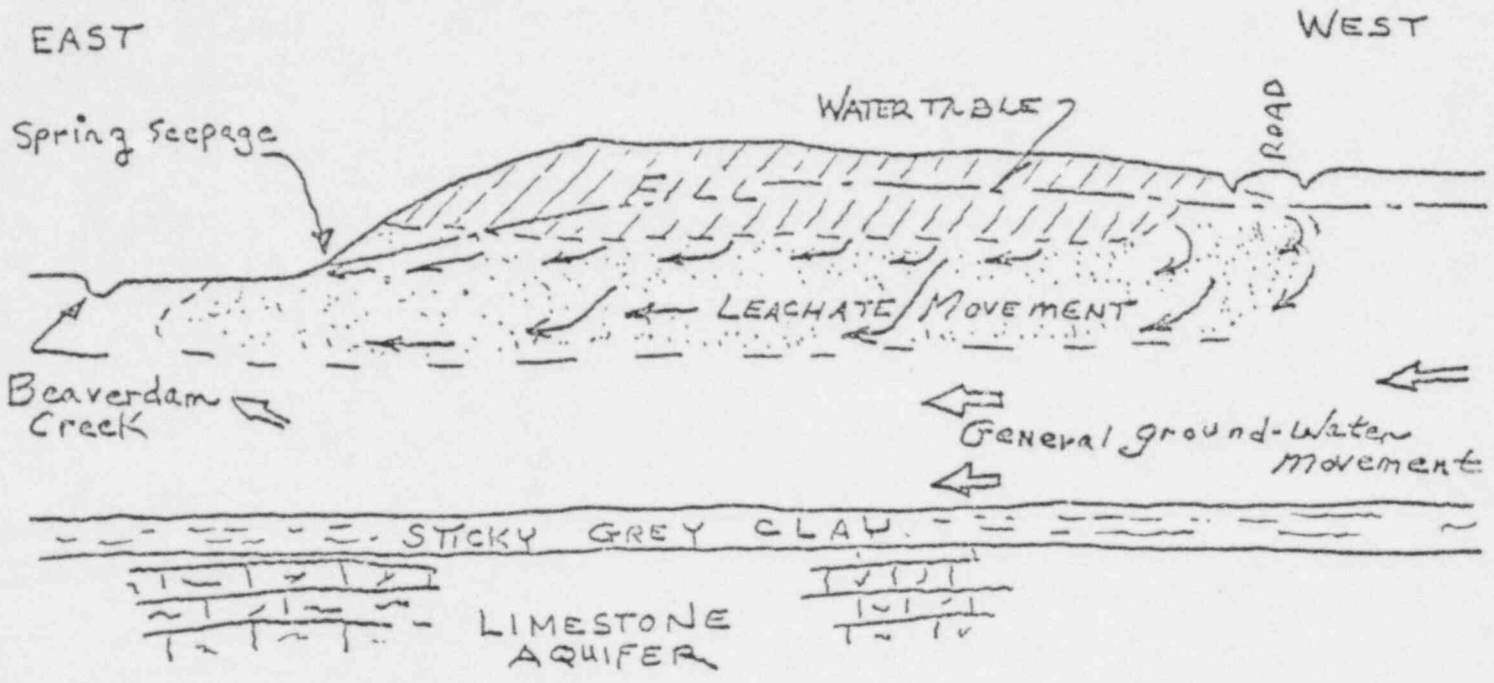
Underlying the area at a depth of approximately 30 feet is a stratum of sticky grey clay that has a thickness of four-to-five feet. This stratum of clay is highly impermeable, and it prevents the downward movement of shallow ground water into the underlying aquifers. This is significant inasmuch as the Brunswick County well field is within 0.5 miles. The stratum of grey clay effectively protects the limestone aquifer from any leachate from the landfill. Ground water flow from the landfill is believed to be as shown in Figure 3.

Figure 4 depicts the proximity of the landfill to the environmental sampling locations. To evaluate a water-fish-man pathway, samples of sediments and water were taken along the pathway to the Intracoastal Waterway. There, marine life, as might be consumed by man, was also sampled and assayed. These results are presented in Table 5.

Approximately one-half mile east of the landfill, there is a water treatment plant which supplies drinking water to Southport and the nearby beach area. The source of water for the plant is supplied by a series of wells scattered over approximately a two-square-mile area north and south of the landfill. The wells extend down from 140 to 170 feet which is into the Castle Hayne Aquifer. Surface water of the area cannot enter this aquifer because of the stratum of clay mentioned above, and because of the artesian pressure in the aquifer. To demonstrate the lack of transport in this pathway, the water from well No. 5, the closest well to the landfill, and composited raw water supply to the treatment plant were sampled. Results of these analyses also appear in Table 5. The processed water is currently sampled as a part of the plant's ongoing environmental program.

During the excavation operation, an environmental sample of air was taken at the north end of the landfill with prevailing winds from the south. Analysis of the sample demonstrated no detectable radionuclides indicative of plant operations.

FIGURE 3 TYPICAL SECTION THROUGH BRUNSWICK COUNTY LANDFILL SHOWING GROUNDWATER FLOW DIRECTIONS



NOT TO SCALE

TABLE 5

ANALYSES OF ENVIRONMENTAL SAMPLES FROM THE AREAS AT AND NEAR THE SOUTHPORT LANDFILL

LOCATION	MEDIA	DATE COLLECTED	ANALYSES
Each Ditch at Landfill	Water	May 1, 1980	54Mn 4.46 ± 1.28 pCi/l
Each Ditch at Landfill	Soil	May 1, 1980	137 Cs 16.5 ± 14.4 pCi/Kg (Dry)
West Ditch at Landfill	Water	May 1, 1980	≤ MDA [20,000 Sec. Count 1 Liter Sample GeLi Detector]
West Ditch at Landfill	Soil	May 1, 1980	54Mn 96 ± 23.1 pCi/Kg 60Co 103 ± 29 pCi/Kg 137Cs 551 ± 33 pCi/Kg [Kg is Dry Weight]
Hwy 211 at Beaver Dam Creek	Water	May 1, 1980	≤ MDA
Hwy 211 at Beaver Dam Creek	Soil	May 1, 1980	137Cs 714 ± 37 pCi/Kg [Dry Weight]
Downstream at Beaver Dam Creek	Water	May 1, 1980	≤ MDA [20,000 Sec. Count 1 Liter]
Downstream at Beaver Dam Creek	Sediment	May 1, 1980	137Cs 341 ± 35 pCi/Kg [Kg Dry Weight]
Brunswick County Well No. 5	Water	May 1, 1980	≤ MDA [20,000 Sec. Count 1 Liter]
Brunswick County Raw Water	Water	May 1, 1980	≤ MDA [20,000 Count 1 Liter]