ATTACHMENT 5
SGLA CHARACTERIZATION

(1) Characterization of
D.C. Cook Unit 1
Steam Generator Lower Assemblies

ER-03-006, Rev 0

Approvals Page

Characterization of D.C. Cook Unit 1 Steam Generator Lower Assemblies

Prepared by: _____ 27Oct 03
Mark Whittaker, Sr. Analyst — Date

Reviewed by: _____ 10/31/03
Charles Witt, Principal Engineer — Date

FOR INFORMATION ONLY

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LIST OF TABLES AND FIGURES

1. Summary

This report presents the analyses performed in support of the source characterization and classification of four D.C. Cook Unit 1 Steam Generator Lower Assemblies (SGLAs) for American Electric Power, the owner and operator of the D.C. Cook plant. The radionuclide content of the SGLAs was determined based on isotopic and dose rate information to demonstrate compliance with applicable criteria for transportation and disposal.

The activity in each SGLA will be re-evaluated after removal of the SGLAs from the storage facility and prior to shipment for disposal. If there is a significant change in the activity from that estimated in this report, a revised charaterization will be prepared.

2. Physical Description of Steam Generators

The steam generators at D.C. Cook Unit 1 are Westinghouse Model 51, identical to those previously transported for disposal. The basic physical dimensions and design criteria of the SGLAs are taken from the characterization report for the previously disposed SGLAs, ER-98-009 [11].

3. Radioactive Source Characteristics

A contamination sample (smear) was taken from the interior of one of the SGLAs on Feb. 5, 2000. The sample was analyzed for radionuclide content. The analysis report is included in Appendix A. The activity was decayed to the date of the radiation survey of the SGLAs, Sept. 12, 2003. The decayed radionuclide content was used as the isotopic distribution of radioactivity within the SGLAs. For two pair of radionuclides, Cm-243/244 and Pu-239/240, a single activity is reported. The distribution was normalized to Co-60 and applied to the Co-60 activity determined from the dose to curie conversion factor from the shielding model. The sample results and the normalized distribution are provided in Table 3-1.

Table 3.1 - Radionuclide Distribution

Radionuclide	Measured Activity (Ci)	Decayed Activity (Ci)	Normalized Distribution
Am-241	2.00E-05	1.99E-05	2.02E-04
Cm-243/244	1.80E-05	1.66E-05	1.69E-04
Co-60	1.51E-01	9.84E-02	1.00E+00
Fe-55	4.70E-02	2.06E-02	2.09E-01
Mn-54	2.78E-03	1.98E-04	2.02E-03
Ni-63	1.10E-02	1.08E-02	1.09E-01
Pu-239/240	1.30E-05	1.30E-05	1.32E-04
Pu-241	1.80E-03	1.54E-03	1.56E-02

Radionuclide	Measured Activity (Ci)	Decayed Activity (Ci)	Normalized Distribution
Tc-99	3.50E-04	3.50E-04	3.56E-03

External radiation surveys were taken on the SGLAs on Sept. 12, 2003. This survey information is included in Appendix A. The average value over the straight tube region of the SGLA was determined. These average values are used in calculating the surface area contamination on the straight tubes.

The characterization will be re-evaluated based on dose rate profiles taken on the SGLAs on removal from the storage facility. However, these dose rates are not expected to change significantly from those measured in September, 2003.

4. Characterization Assumptions

Several assumptions are made in the course of performing the characterization analyses of the steam generators. These assumptions are utilized to simplify the analysis, while maintaining accuracy in the overall result.

1. Secondary-side steam generator surfaces contain no activity.

   Since the secondary side of the steam generator is exposed only to secondary side water, it is assumed that the secondary side contains only negligible quantities of radioactive contamination. This assumption has been used for previous steam generator characterizations.

2. Residual water in plugged tubes contains no activity.

   The plugged tubes in the steam generator could contain relatively small amounts of water that seeps into the tubes during operation of the generators. It is assumed that this water contains negligible quantities of radioactive material, and is not considered in this characterization.

3. Uniformity in distribution of primary-side surface contaminates.

   Two EPRI reports [2, 3] address the issue of steam generator primary side surface contamination. These reports indicate that, while the straight tube sections with the SGLAs exhibit fairly uniform surface contamination, the U-tube and tube sheet sections of the heat exchanger tubes contain higher surface contamination values than that of the straight tube sections.

Additional uncertainty exists concerning the relative surface contamination levels between the tubes and the channel head surfaces, including the tube sheet, divider plate, and bowl itself. The studies indicate that the differing materials used for the tubes versus the channel head components, combined with other factors, could result in higher surface contamination values in the channel head region.

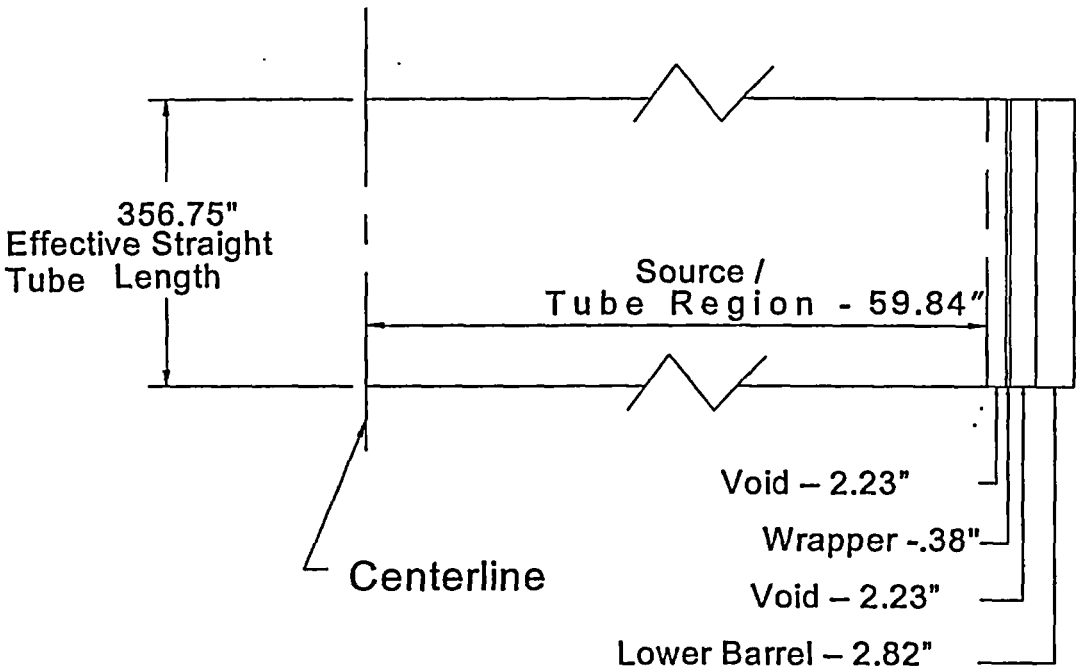
To address these issues, this analysis assumes that all surfaces other than the straight tube sections contain surface contamination levels per unit area twice that of the straight tube sections. This factor of two is addressed specifically in the reference [2] study for the various tube sections. It is reasonable to apply this assumption to the channel head sections as well, as they are of a similar geometry and represent only a minimal fraction of the total surface area, and thus only a small portion of the total activity in the SGLAs.

5. Source Characterization

Employing the information from the previous sections, the radionuclide content of the SGLAs can be determined from the measured external SGLA dose rates and the SGLA design parameters.

The straight tube section of the lower barrel of the SGLA is modeled with the Microshield [4] point kernel shielding code, using a 1 curie Co-60 source term. The shortest straight tube length is approximately 357 inches, not including the 21 inch length of tube in the tube sheet. The diameter and thickness of the radial source and shielding regions of the model are taken from ER-98-009 [11].

Figure 5-1 Microshield Model Representation of Steam Generator Source Region



The source region is modeled as nickel alloy, Alloy 600, at a density of 0.646 g/cc to represent the fraction of the source region cross-section occupied by the tubes. The void regions are modeled as air, and the wrapper and lower barrel are modeled as A 533 steel. The densities are taken from ER-98-009[11].

5.1 Microshield Calculations

Analyses are performed with Microshield using the model previously described with the 1 Ci Co-60 source term. The calculation produces an exposure rate, 1 foot from the surface, of 1.181 mR/hr; thus, the dose-to-curie factor is 1.181 mR/hr/Ci. The average exposure rates are then divided by the dose-to-curie factor to determine the number of curies of Co-60 in the straight tube section of the SGLA on the date of the survey, 9/12/03. This activity is then divided by the surface area of the straight tubes (3.80E+07 cm^2) to give the activity per unit area. The results of these calculations are presented in Table 5-1.

Table 5-1 Co-60 Content in Straight Tube Section

	SGLA 11	SGLA 12	SGLA 13	SGLA 14
Average 30 cm Exposure Rate (mR/hr)	20.4	26.9	24.2	24.3
Activity in Straight Tube Section (Ci Co-60)	17.31	22.81	20.48	20.53
Areal Activity ($\mu Ci/cm^2$ Co-60)	0.456	0.601	0.539	0.541

5.2 Source Distribution

The straight tube source contamination calculated in Section 5.1 is utilized to determine the contamination on the U-tube and tube sheet sections of the heat exchanger tubes, as well as the channel head components.

The straight tube contamination levels, shown in Table 5-1, are multiplied by the surface area of the other components and the factor of two discussed in Section 4. The resulting Co-60 surface contamination levels on the remaining primary side surfaces of the steam generator are 0.912, 1.201, 1.079, and 1.082 $\mu Ci/cm^2$, respectively. These surface contamination levels are used to calculate the Co-60 curies in each steam generator as shown in Table 5-2.

Table 5-2 SGLA Co-60 Content Results (as of 12 September 2003).

Contaminated Surface Areas	Surface Area (cm^2)	SGLA 11 Co-60 Activity (Ci)	SGLA 12 Co-60 Activity (Ci)	SGLA 13 Co-60 Activity (Ci)	SGLA 14 Co-60 Activity (Ci)
Straight Tube Surface Area	3.80E+07	17.31	22.81	20.48	20.53
Tubes in Tube Sheet	2.25E+06	2.04	2.69	2.41	2.42
U-Tube Section Surface Area	5.19E+06	4.73	6.23	5.59	5.61
Channel Head	1.60E+05	0.15	0.19	0.17	0.17
Tube Sheet	5.93E+04	0.05	0.07	0.06	0.06
Divider Plate	8.00E+04	0.07	0.10	0.09	0.09
Total		**24.34**	**32.08**	**28.81**	**28.88**

The normalized distribution presented in Table 3.1 is used to determine the full isotopic distribution of activity in each SGLA, i.e., each isotope distribution factor is multiplied by the Co-60 content from Table 5-2. The activity is decayed to the estimated date of shipment, May 15, 2004. The resulting activity is shown in Table 5-3.

Table 5-3 SGLA Activity.

	SGLA#11		SGLA#12		SGLA#13		SGLA#14	
	9/12/03	5/15/04	9/12/03	5/15/04	9/12/03	5/15/04	9/12/03	5/15/04
Isotopic	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)
Am-241	0.005	0.005	0.006	0.006	0.006	0.006	0.006	0.006
Cm-243	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.005
Co-60	24.341	22.277	32.083	29.362	28.808	26.364	28.882	26.433
Fe-55	5.085	4.285	6.703	5.648	6.018	5.072	6.034	5.085
Mn-54	0.049	0.028	0.065	0.037	0.058	0.034	0.058	0.034
Ni-63	2.661	2.648	3.507	3.491	3.149	3.134	3.157	3.142
Pu-239	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.004
Pu-241	0.381	0.369	0.502	0.486	0.451	0.436	0.452	0.437
Tc-99	0.087	0.087	0.114	0.114	0.102	0.102	0.103	0.103
Total	**32.616**	**29.706**	**42.989**	**39.154**	**38.601**	**35.157**	**38.700**	**35.248**

6. Waste Classification and DOT Subtyping

The shipping and disposal classifications can be performed for the SGLAs based on the calculated radionuclide content in accordance with regulatory requirements [5, 6, 7, and 8]. This information is important to demonstrate that the SGLAs meet applicable requirements for transportation and disposal.

The DOT subtyping for the highest activity SGLA, SGLA #12, is shown in Table 6-1. As shown, the SGLA #12 contains a greater-than-Type-A quantity of radioactive material, with a cumulative A_2 value of 7.3. The average Co-60 surface contamination levels, shown in Table 5-2, are much less than the SCO-II limit of 20 $\mu Ci/cm^2$. Since Co-60 is over 70% of the total activity, the overall average contamination levels are also much less than the limits. However, uncertainty in the distribution of activity over all surfaces in the SGLA results in an uncertainty that all areas are less than the SCO-II limit. As such, an exemption from SCO-II limits and packaging requirements will be requested from the DOT as suggested in Reference 9.

The total amount of fissile material in all four SGLAs is 0.26g which is less than 15g; therefore, the shipment qualifies as fissile excepted.

Table 6-1 DOT Subtyping of D.C. Cook SGLA 12

Isotope	Curies	A2 Value	A2 Fraction
Am-241	6.48E-03	0.00541	1.198
Cm-243	5.33E-03	0.00811	0.658
Co-60	2.94E+01	10.8	2.719
Fe-55	5.65E+00	1080	0.005
Mn-54	3.75E-02	27	0.001
Ni-63	3.49E+00	811	0.004
Pu-239	4.24E-03	0.00541	0.783
Pu-241	4.86E-01	0.27	1.799
Tc-99	1.14E-01	24.3	0.005
TOTAL	3.92E+01		7.173

The disposal classification of SGLA #12, which has the largest total activity, is shown in Table 6-2. The disposal volume is 104.52 m^3 and the mass is 1.266E+08g. This classification lists the required nuclides from 10 CFR 61, and demonstrates that the Table 1 and Table 2 isotopes meet the requirements for classification of the SGLAs as Class A waste.

Table 6-2 Disposal Classification of D.C. Cook SGLA 12

nuclides	Activity	SpA, nCi/g	SpA, Ci/m^3	Part 61 fraction
14C	0.00E+00		0.00E+00	0.00E+00
14C	0.00E+00		0.00E+00	0.00E+00
59 Ni	0.00E+00		0.00E+00	0.00E+00
94 Nb	0.00E+00		0.00E+00	0.00E+00
99Tc	1.14E-01		1.09E-03	3.64E-04
129 I	0.00E+00		0.00E+00	0.00E+00
TRU	1.61E-02	1.27E-01		1.27E-03
241Pu	4.86E-01	3.84E+00		1.10E-03
242 Cm	0.00E+00	0.00E+00		0.00E+00
			sum of fractions	2.73E-03
			Table 1 Eval:	Class A
Table 2				
All....	5.69E+00		5.44E-02	Class A
3H	0.00E+00		0.00E+00	Class A
60Co	2.94E+01		2.81E-01	Class A
63Ni	3.49E+00		3.34E-02	Class A
63Ni act	0.00E+00		0.00E+00	Class A
90Sr	0.00E+00		0.00E+00	Class A
137Cs	0.00E+00		0.00E+00	Class A
TOTAL:	3.92E+01		3.70E-01	

7. References

[1] CNS Procedure EN-AD-010, "Procedure for Waste Characterization of Non-Irradiated Components or Items."

[2] EPRI-NP-2968, "Primary-Side Deposits on PWR Steam Generator Tubes," Electric Power Research Institute, Palo Alto, CA, March 1983.

[3] EPRI-NP-3107, "Gamma-Ray Exposure Rate Distribution in a Steam Generator," Electric Power Research Institute, Palo Alto, CA, May 1983.

[4] Grove Engineering, Inc. "Microshield Computer Code," Version 5.01.

[5] NRC, "Low-Level Waste Licensing Branch Technical Position on Radioactive Waste Classification," (May 1983).

[6] Code of Federal Regulations, 10CFR Part 61 and 10CFR Part 71.

[7] Code of Federal Regulations, 49CFR Parts 100 to 177.

[8] DHEC License CNSI-SC-097, (Barnwell Site Criteria).

[9] NRC Generic Letter 96-07, "Interim Guidance on Transportation of Steam Generators," U.S. NRC Office of Nuclear Material Safety and Safeguards, December 5, 1996.

[10] NUREG-1608, "Categorizing and Transporting Low Specific Activity Materials and Surface Contaminated Objects," U.S. Nuclear Regulatory Commission, July 1998

[11] Duratek Engineering Report,ER-98-009, Rev.1, Preliminary Waste Characterization of D.C. Cook Steam Generator Lower Assemblies

APPENDIX A

AEP SUPPLIED INFORMATION

(7 PAGES)

RADIOLOGICAL AREA STATUS SHEET

AREA DESCRIPTION S/G MAUSOLEUM **MAP NO.** 271

AREA CLASSIFICATION

- [x] RADIATION
- [ ] HIGH RADIATION
- [ ] EXTREME HIGH RADIATION
- [ ] CONTAMINATION
- [ ] AIRBORNE RADIOACTIVITY

REMARKS

Dose Rate Surveying only

METER TYPE/N

EXT /2820

UNLESS NOTED: * DENOTES CONTACT / 30 CM.
DOSE RATES IN MR/HR AT WAIST LEVEL & CONTAMINATION IN DPM / 100CM²

REASON FOR SURVEY

characterization Survey

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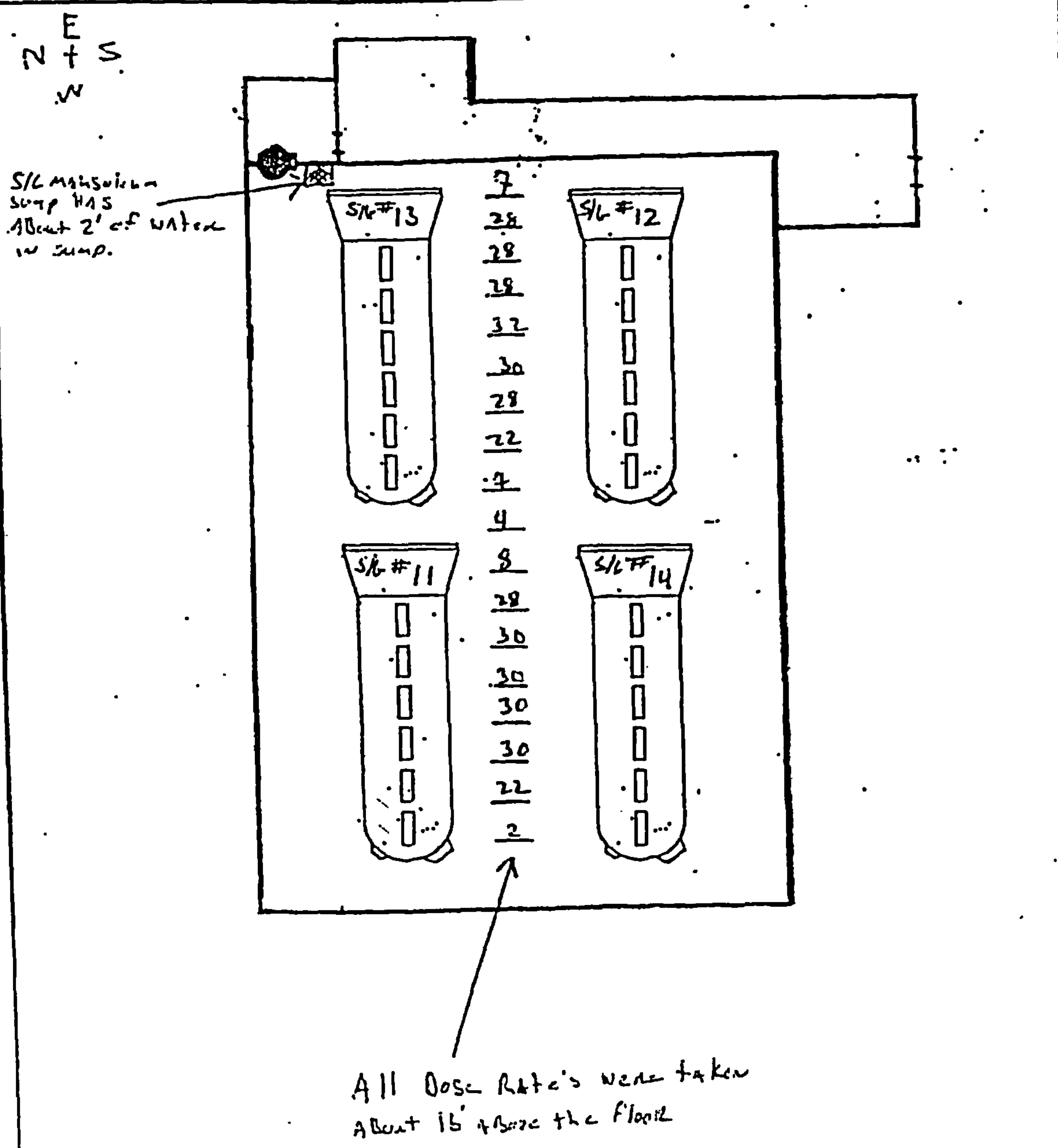
SURVEYED BY Miller/Harris TIME 1230 DATE 9/12/03

REVIEWED BY [signature] DATE 9-12-03



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RADIOLOGICAL AREA STATUS SHEET

AREA DESCRIPTION S/G MAUSOLEUM

MAP NO. 271

AREA CLASSIFICATION
- [x] RADIATION
- [ ] HIGH RADIATION
- [ ] EXTREME HIGH RADIATION
- [ ] CONTAMINATION
- [ ] AIRBORNE RADIOACTIVITY

REMARKS S/G # 12
* Denotes Contact Dose Rate
i Denotes 1ft reading from Contact.

METER TYPE/NO.
RSO /340
EXT /2820

UNLESS NOTED: ✳ DENOTES CONTACT / 30 CM.
DOSE RATES IN MR/HR AT WAIST LEVEL & CONTAMINATION IN DPM / 100CM^2

REASON FOR SURVEY
Characterization Survey

SURVEYED BY Harris, J. / McLean, M. **TIME** 1115 **DATE** 09-12-03

REVIEWED BY [signature] **DATE** 9-12-03

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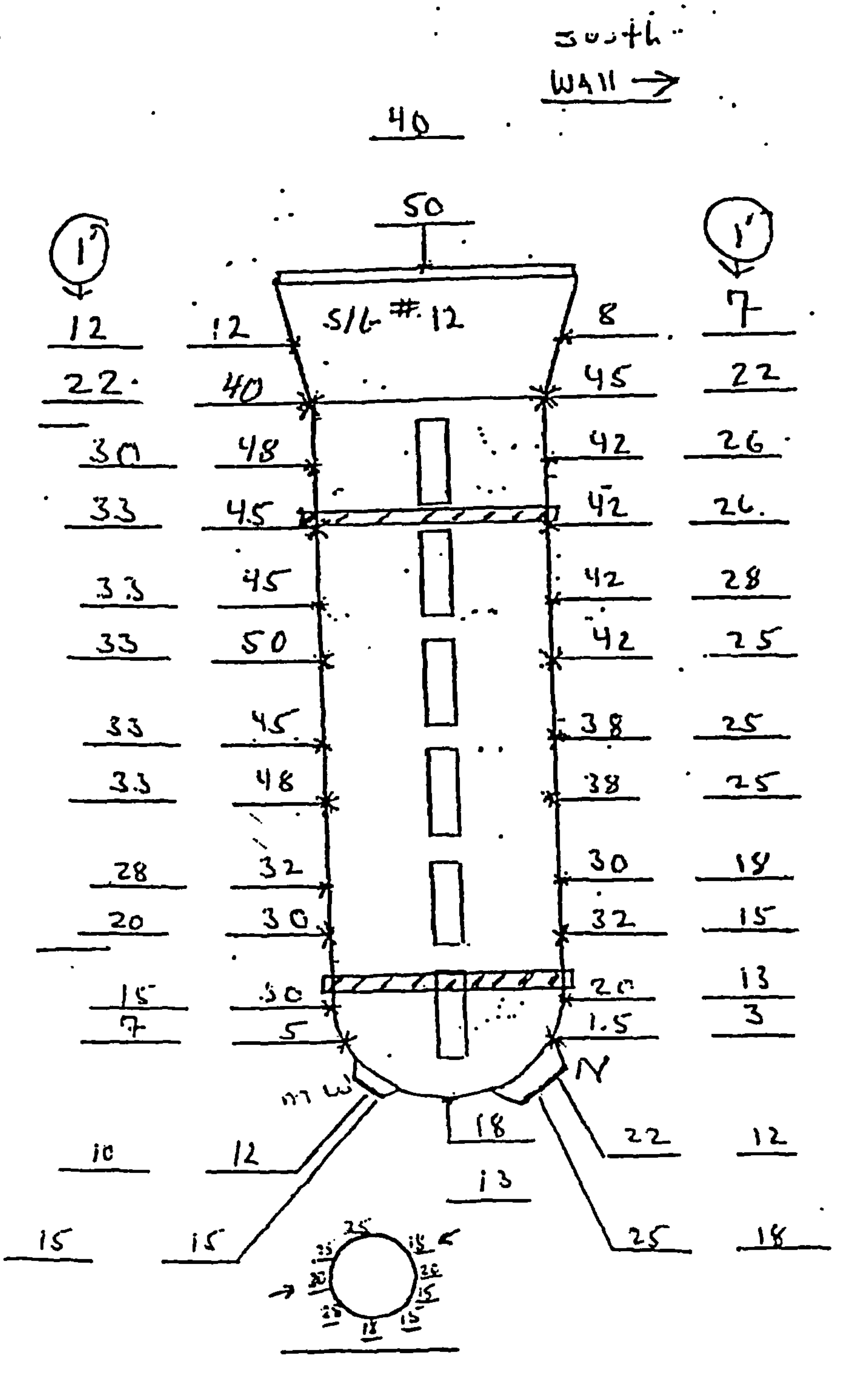

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RADIOLOGICAL AREA STATUS SHEET

AREA DESCRIPTION: S/G MAUSOLEUM

MAP NO. 271

AREA CLASSIFICATION
- [x] RADIATION
- [ ] HIGH RADIATION
- [ ] EXTREME HIGH RADIATION
- [ ] CONTAMINATION
- [ ] AIRBORNE RADIOACTIVITY

REMARKS #13 S/G

* Denotes contact dose rate

' Denotes 1 ft. read from contact

METER TYPE/N: ExT-2820, RSO-340

UNLESS NOTED: * DENOTES CONTACT / 30 CM. DOSE RATES IN MR/HR AT WAIST LEVEL & CONTAMINATION IN DPM/100CM²

REASON FOR SURVEY: Characterization Survey

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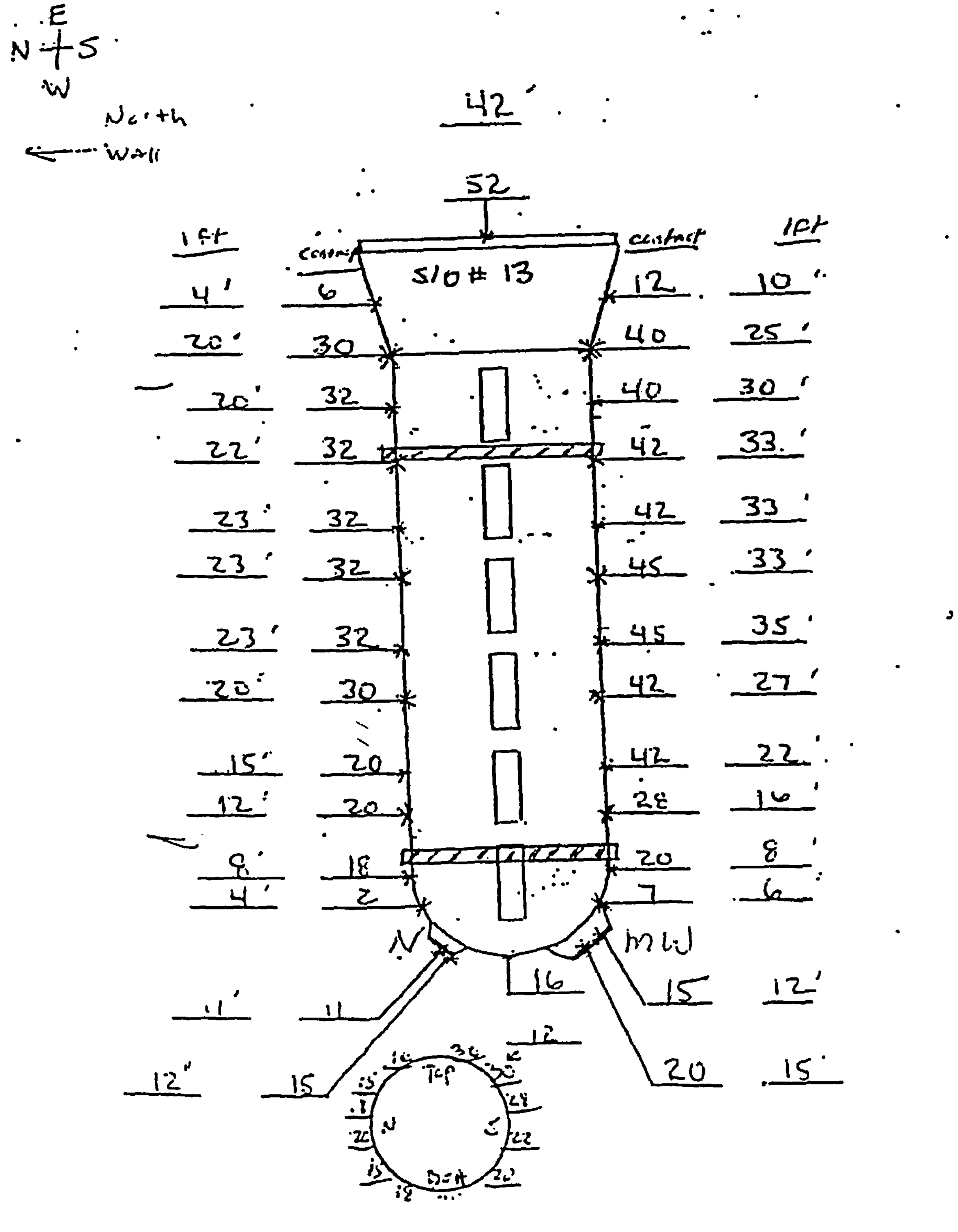
REVIEWED BY: [signature] | DATE 9-12-03



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RADIOLOGICAL AREA STATUS SHEET

AREA DESCRIPTION: S/G MAUSOLEUM

MAP NO. 271

AREA CLASSIFICATION
- ☐ RADIATION
- ☐ HIGH RADIATION
- ☐ EXTREME HIGH RADIATION
- ☐ CONTAMINATION
- ☐ AIRBORNE RADIOACTIVITY

REMARKS #14 S/G

* Denotes contact dose rate.

/ Denotes 1 ft reading from contact

METER TYPE/NO.
RSO / 390
EXT / 2820

UNLESS NOTED: ✻ DENOTES CONTACT / 30 CM.
DOSE RATES IN MR/HR AT WAIST LEVEL & CONTAMINATION IN DPM / 100CM²

REASON FOR SURVEY: Characterization Survey

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REVIEWED BY: [signature]   **DATE:** 9-12-03

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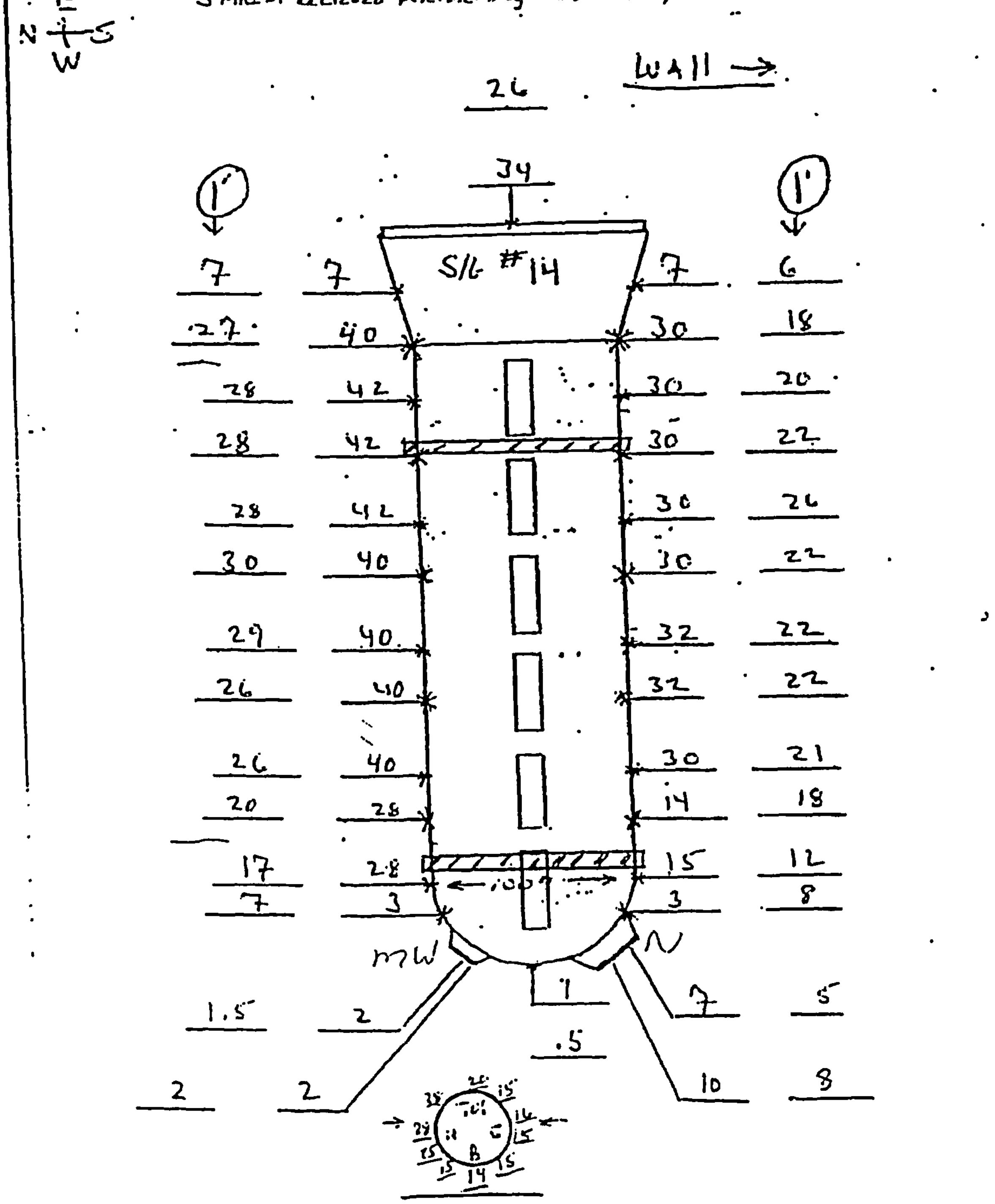

CONTAMINATION/ REMARKS

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RADIOLOGICAL AREA STATUS SHEET

AREA DESCRIPTION	S/G MAUSOLEUM	MAP NO. 271

AREA CLASSIFICATION	REMARKS SG # 11	METER TYPE/N
☒ RADIATION ☐ HIGH RADIATION ☐ EXTREME HIGH RADIATION ☐ CONTAMINATION ☐ AIRBORNE RADIOACTIVITY	* denotes contact dose rate ' denotes 1ft reading from contact.	EXT-2820 R50-340

UNLESS NOTED: * DENOTES CONTACT / 30 CM.
DOSE RATES IN MR/HR AT WAIST LEVEL & CONTAMINATION IN DPM/100CM²

REASON FOR SURVEY	SURVEYED BY McLean, M. Harris, J.	TIME 1020	DATE 09-12-03
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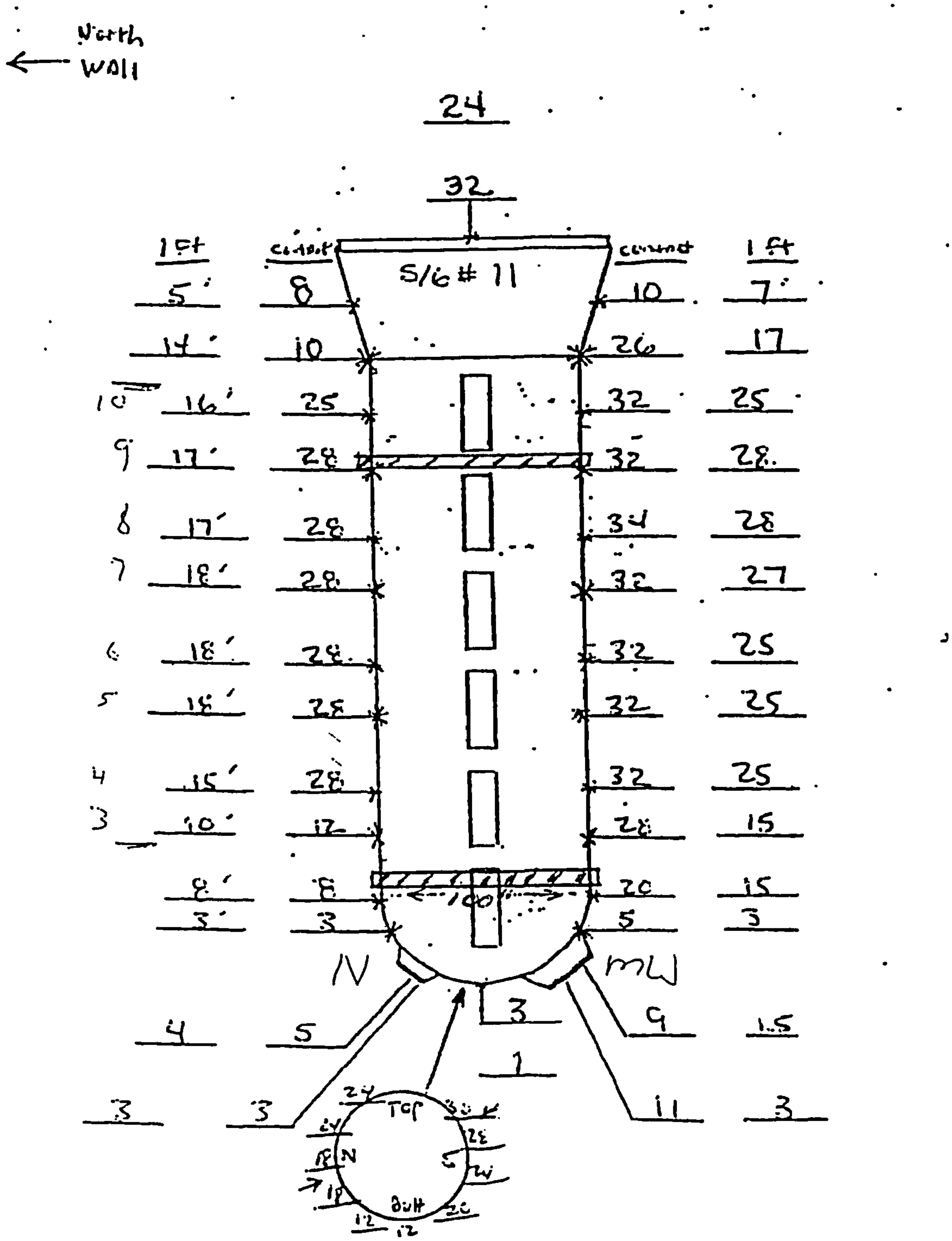

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Unit 1 Shutdown
Sept. 9, 1997

TELEDYNE BROWN ENGINEERING Environmental Services

REPORT OF ANALYSIS

Jul 19 2000, 03:18 pm

LOGIN # L11551

Address:	Work Order #:	Cust. P.O. #:	Date Received	Delivery Date	PAGE: 5
MR TIM LECHENET	L11551	B-1060 C#5	05/01/00	05/31/00	
INDIANA MICHIGAN POWER COMPANY		Release #:			Project Manager: A.CARMICHAEL
D C COOK NUCLEAR PLANT					
ONE COOK PLACE					
BRIDGMAN MI 49106					

Teledyne Sample #	Customer's Identification	Sta. #	Collection Dates Start Date/Time	Stop Date/Time	Matrix/ Nuclide	Activity	Units	Count Date	Volume Procedure #	Units	Lab Comment

Continued

Matrix: Swipes

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					I-129	L.T. 4.	E-05		06/05/00		32
					NI-63*	1.1 +-0.1	E-02		06/09/00		32
					SR-90	L.T. 1.	E-05		06/09/00		32
					TC-99*	3.5 +-0.7	E-04		06/10/00		32
					BE-7	L.T. 3.	E-02		05/31/00		42
					K-40	L.T. 5.	E-03		05/31/00		42
					CR-51	L.T. 8.	E-02		05/31/00		42
					MN-54*	2.78+-1.29	E-03		05/31/00		42
					CO-58	L.T. 3.	E-03		05/31/00		42
					FE-59	L.T. 2.	E-02		05/31/00		42
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					NB-94	L.T. 1.	E-03		05/31/00		42
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					SB-124	L.T. 3.	E-03		05/31/00		42
					SB-125	L.T. 3.	E-03		05/31/00		42
					I-131	L.T. 2.	E 01		05/31/00		42
					CS-134	L.T. 1.	E-03		05/31/00		42
					CS-137	L.T. 1.	E-03		05/31/00		42
					BA-140	L.T. 1.	E 00		05/31/00		42
					LA-140	L.T. 2.	E-01		05/31/00		42
					CE-141	L.T. 9.	E-03		05/31/00		42
					CE-144	L.T. 5.	E-03		05/31/00		42
					RA-226	L.T. 9.	E-03		05/31/00		42
					TH-228	L.T. 1.	E-03		05/31/00		42
					NP-237	L.T. 1.	E-03		05/31/00		42
					AM-241*	2.0 +-0.3	E-05		06/08/00		62

Lab Key: 22 - Gas Lab; 32 - Radiochemistry Lab; 42 - GE(Li) Gamma Spec Lab; 52 - Tritium Lab; 62 - Alpha Spec Lab; 12 - Environmental TLD; 72 - Consulting;

TELEDYNE BROWN ENGINEERING Environmental Services

REPORT OF ANALYSIS

Jul 19 2000, 03:18 pm

LOGIN # L11551

Address:	Work Order #:	Cust. P.O. #:	Date Received	Delivery Date	PAGE: 6
MR TIM LECHENET INDIANA MICHIGAN POWER COMPANY D C COOK NUCLEAR PLANT ONE COOK PLACE BRIDGMAN MI 49106	L11551	B-1060 C#5 Release #:	05/01/00	05/31/00	Project Manager: A.CARMICHAEL

Teledyne Sample #	Customer's Identification	Sta. #	Collection Dates Start Date/Time	Stop Date/Time	Matrix/ Nuclide	Activity	Units	Count Date	Volume Units Procedure #	Lab Comment
Continued										
					CM-242	L.T. 4. E-07	Total uCi	06/08/00	62	
					CM-243/244 *	1.8 +-0.3 E-05		06/08/00	62	
					PU-239/240 *	1.3 +-0.3 E-05		06/08/00	62	
					PU-241 *	1.8 +-0.3 E-03		06/10/00	62	
					U-238	L.T. 6. E-07		06/10/00	62	

(fax)

A. Latham Ph. D.
Laboratory Director

Last Page of Report

total of *

2.13981 E-01

=> Co^{60} - 70.5%

Lab Key: 22 - Gas Lab; 32 - Radiochemistry Lab; 42 - GE(Li) Gamma Spec Lab; 52 - Tritium Lab; 62 - Alpha Spec Lab; 12 - Environmental TLD; 72 - Consulting;

Copy: 1 of 1

APPENDIX B

MICROSHIELD MODELS AND OUTPUT

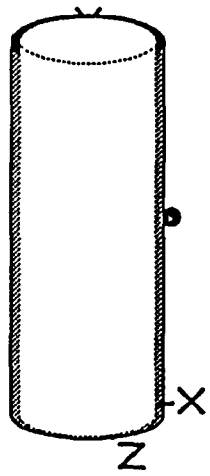
(1 PAGE)

MicroShield v6.00 (6.0-00005)

Page : 1
DOS File : dc cook.ms6
Run Date: October 22, 2003
Run Time: 11:06:25 AM
Duration : 00:00:01

File Ref: _____
Date: _____
By: [illegible]
Checked: _____

Case Title: DC Cook SGLA
Description: Characterization model, 1 Ci Co-60
Geometry: 7 - Cylinder Volume - Side Shields



Source Dimensions

Height	906.145 cm	29 ft 8.7 in
Radius	151.994 cm	4 ft 11.8 in

Dose Points

	X	Y	Z
# 1	201.93 cm	453.0725 cm	0 cm
	6 ft 7.5 in	14 ft 10.4 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	4.01e+06 in³	Alloy 600	0.646
Shield 1	2.23 in	Air	0.00122
Shield 2	.38 in	A 533	7.86
Shield 3	2.23 in	Air	0.00122
Shield 4	2.82 in	A 533	7.86
Transition		Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Co-60	1.0000e+000	3.7000e+010	1.5206e-002	5.6260e+002

Buildup
The material reference is : Shield 4

Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.6938	6.035e+06	9.497e-04	9.229e-03	1.834e-06	1.782e-05
1.1732	3.700e+10	4.195e+01	2.774e+02	7.497e-02	4.956e-01
1.3325	3.700e+10	6.576e+01	3.948e+02	1.141e-01	6.850e-01
TOTALS:	7.401e+10	1.077e+02	6.722e+02	1.891e-01	1.181e+00

ATTACHMENT 7
EVALUATION OF RESIDUAL WATER IN PLUGGED TUBES

ATTACHMENT 7
Evaluation of Residual Water in Plugged Tubes

The generators are each estimated to conservatively contain between 229 and 360 gallons of water. This estimate was made by a ratio between the number of plugged tubes in the calculations done for the unit 2 disposal project done in 1999 and the number in the unit 1 steam generators. The primary input to determine the amount of waste in each generator is the number of failed tubes that were then plugged. The plugs would prevent the draining on the water from the generator when it is taken out of service.

A summary of the estimation is provided in the table below.

Estimate of Gallons of Water in Steam Generator					
Unit 1 (Disposal in 2004)			Unit 2 (Disposal in 1999)		
Steam Generator Number	Plugged Tube Count	Volume of Entrapped water (gallons)	Steam Generator Number	Plugged Tube Count	Volume of Entrapped water (gallons)
SG 11	676	229.06	SG 21	173	58.62
SG 12	436	245.66	SG 22	261	147.06
SG 13	447	360.35	SG 23	265	213.63
SG 14	606	345.83	SG 24	252	143.81
	Total	**1180.90**		**Total**	**563.12**