REGULATORY FILE CY

70-687

UNION CARBIDE

UNION CARBIDE CORPORATION

P. O. BOX 324, TUXEDO, NEW YORK 10987

TELEPHONE: 914-351-2131

STERLING FOREST
RESEARCH CENTER

December 18, 1974

U. S. Atomic Energy Commission
Materials and Plant Protection Branch
Directorate of Licensing
Washington, D. C. 20545

Attn: Mr. C. N. Smith

Dear Sir:

I have enclosed a corrected copy of Appendix D to the Union Carbide SNM Measurements, Statistical Controls and Inventory Plan. This appendix has been corrected to incorporate the changes discussed during our meeting of 11/16/74.

Thank you again for your consideration.

Very truly yours,

J McGovern

James J. McGovern
Manager
Radiochemical Production

JJMcG:js
Enclosures (10)

(1)

2442

APPENDIX D

LEMUF MODEL

TYPICAL CHART OF MATERIALS FOR LEMUF DETERMINATION

Type of Material and Location	MUF Component	Typical Quantity U	Typical Quantity ^{235}U	Item Identity
Material from	BI	376.3	350 gms	(BI_{f_1})
Uranyl Nitrate		376.3	350 gms	(BI_{f_2})
Feed	R	376.3	350 gms	(R_{f_3})
		376.3	350 gms	(R_{f_4})
	EI	376.3	350 gms	(EI_{f_4})
Uranyl Nitrate	BI	53.8	50 gms	$(BI_{p_{1-1}})$
Plating		53.8	50 gms	$(BI_{p_{2-1}})$
		53.8	50 gms	$(BI_{p_{3-1}})$
		53.8	50 gms	$(BI_{p_{4-1}})$
	EI	48.4	45 gms	$(EI_{p_{1-8}})$
		48.4	45 gms	$(EI_{p_{2-8}})$
		48.4	45 gms	$(EI_{p_{3-8}})$
		48.4	45 gms	$(EI_{p_{4-8}})$
Uranyl Nitrate	BI	10.75	10 gms	(BI_{pw_1})
Plating Waste	S	75.3	70 gms	(S_{pw_1})
	EI	10.75	10 gms	(EI_{pw_2})
UO_2 Targets	BI	430.1	400 gms	$(BI_{t_{101 \rightarrow 140}})$
	EI	322.6	300 gms	$(EI_{t_{171 \rightarrow 210}})$
Uranyl Sulfate	BI	1032.3	960 gms	$(BI_{t_{1 \rightarrow 100}})$
Radioactive Waste	S	376.3	350 gms	$(S_{t_{1 \rightarrow 35}})$
		376.3	350 gms	$(S_{t_{36 \rightarrow 70}})$
	EI	1032.3	960 gms	$(EI_{t_{71 \rightarrow 170}})$

APPENDIX D, (Cont'd)

MEASUREMENT ERROR STANDARD DEVIATIONS

Location and Type of Material	Relative Systematic Standard Dev.	Relative Random Standard Dev.
Volume Determination Element & Isotope	$\sigma_{\delta i}$	$\sigma_{\delta i}$
1. UO_2 feed (Uranyl Nitrate Solution)	.001	.005
2. Plating solution (Uranyl Nitrate)	.02	.03
3. Plating waste batch (Uranyl Nitrate)	.001	.006
4. Radioactive waste batch (Uranyl Sulfate) shipped	.02	.03
5. Radioactive waste solution in cell (targets)	0*	0*
6. Targets (UO_2)	0	0
Element Sampling	$\sigma_{\Delta i}$	σ_{ni}
1. UO_2 feed solution	.02	.01
2. Plating solution	.006	.01
3. Plating waste solution	.006	.01
4. Radioactive waste solution shipped	.006	.07
5. RW solution in cell (targets)	0*	0*
6. Targets	0	0
Element Analysis	$\sigma_{\theta k}$	$\sigma_{\omega k}$
1. UO_2 feed solution	.004	.01
2. Plating solution	.004	.01
3. Plating waste solution	.004	.01
4. Radioactive waste solution shipped	.004	.07
5. RW solution in cell (targets)	.067	.04
6. Targets	.067	.04
Isotope Sampling	$\sigma_{\lambda l}$	$\sigma_{\mu l}$
1. UO_2 feed solution	.02	.01
2. Plating solution	.02	.01
3. Plating waste solution	.02	.01
4. Radioactive waste solution shipped	.02	.07
5. Radioactive waste solution in cell (targets)	0*	0*
6. Targets	0	0

*Previous measurements from plating solutions and targets.

APPENDIX D, (Cont'd)

MEASUREMENT ERROR STANDARD DEVIATIONS

Location and Type of Material	Relative Systematic Standard Dev.	Relative Random Standard Dev.
Isotope Analysis	σ_v	σ_v
1. Materials in solution (F, P, PW, RW shipped)	.009	.045
2. Radioactive waste solution in cell (targets)	.04*	.04*
3. Targets	.04	.04

*Previous measurements from targets.

APPENDIX D

Variance in Volume Measurements for Element Determinations

$$C_{\delta 1} = (BI_{f_1} + BI_{f_2} + R_{f_3})^2 \times (\sigma_{\delta 1})^2$$

$$C_{\delta 2} = (BI_{pw_1} - S_{pw_1} - EI_{pw_2})^2 \times (\sigma_{\delta 2})^2$$

$$C_{\delta 3} = (BI_{p_{1-1}} - EI_{p_{1-8}})^2 \times (\sigma_{\delta 3})^2$$

$$C_{\delta 4} = (BI_{p_{2-1}} - EI_{p_{2-8}})^2 \times (\sigma_{\delta 4})^2$$

$$C_{\delta 5} = (BI_{p_{3-1}} - EI_{p_{3-8}})^2 \times (\sigma_{\delta 5})^2$$

$$C_{\delta 6} = (BI_{p_{4-1}} - EI_{p_{4-8}})^2 \times (\sigma_{\delta 6})^2$$

$$C_{\delta 7} = (S_{rw_{1_{abc}}})^2 \times (\sigma_{\delta 7})^2$$

$$C_{\delta 8} = (S_{rw_{2_{abc}}})^2 \times (\sigma_{\delta 8})^2$$

$$C_{\epsilon 1} = (BI_{f_1})^2 + (BI_{f_2})^2 + (R_{f_3})^2 \times (\sigma_{\delta 1})^2$$

$$C_{\epsilon 2} = (BI_{p_{1-1}})^2 + (-EI_{p_{1-8}})^2 + (BI_{p_{2-1}})^2 + (-EI_{p_{2-8}})^2 +$$

$$(BI_{p_{3-1}})^2 + (-EI_{p_{3-8}})^2 + (BI_{p_{4-1}})^2 + (-EI_{P_{4-8}})^2 \times (\sigma_{\epsilon 2})^2$$

$$C_{\epsilon 3} = (BI_{pw_1})^2 + (-S_{pw_1})^2 + (-EI_{pw_2})^2 \times (\sigma_{\epsilon 3})^2$$

$$C_{\epsilon 4} = (-S_{rw_{1_a}})^2 + (-S_{rw_{1_b}})^2 + (-S_{rw_{1_c}})^2 \times (\sigma_{\epsilon 4})^2$$

$$C_{\epsilon 5} = (-S_{rw_{2_a}})^2 + (-S_{rw_{2_b}})^2 + (-S_{rw_{2_c}})^2 \times (\sigma_{\epsilon 4})^2$$

Variance in Sampling for Element Determinations

$$C_{\Delta 1} = (BI_{f_{1+2}} + R_{f_3})^2 \times (\sigma_{\Delta 1})^2$$

$$C_{\Delta 2} = (BI_{p_{1-1 \text{ thru } 4-1}} - EI_{p_{1-8 \text{ thru } 4-8}})^2 \times (\sigma_{\Delta 2})^2$$

$$C_{\Delta 3} = (BI_{pw_1} - S_{pw_1} - EI_{pw_2})^2 \times (\sigma_{\Delta 3})^2$$

$$C_{\Delta 4} = (-S_{rw_{1_{abc}}} - S_{rw_{2_{abc}}})^2 \times (\sigma_{\Delta 4})^2$$

$$C_{\kappa 1} = \frac{(BI_{f_{1+2}} + R_{f_3})^2}{\text{No. Samples}} \times (\sigma_{\kappa 1})^2$$

$$C_{\kappa 2} = \frac{(BI_{p_{1-1 \text{ thru } 4-1}} - EI_{p_{1-8 \text{ thru } 4-8}})^2}{\text{No. Samples}} \times (\sigma_{\kappa 2})^2$$

$$C_{\kappa 3} = \frac{(BI_{pw_1} - S_{pw_1} - EI_{pw_2})^2}{\text{No. Samples}} \times (\sigma_{\kappa 3})^2$$

$$C_{\kappa 4} = \frac{(-S_{rw_1} - S_{rw_2})^2}{\text{No. Samples}} \times (\sigma_{\kappa 4})^2$$

Variance in Element Analysis Determinations

$$C_{\theta 1} = (BI_{f_{1+2}} + R_{f_3} + BI_{p_{1-1 \text{ thru } 4-1}} - EI_{p_{1-8 \text{ thru } 4-8}} + BI_{pw_1} - S_{pw_1} - EI_{pw_2})^2 \times (\sigma_{\theta 1})^2$$

$$C_{\theta 2} = (BI_{t_{101 \rightarrow 140}} - EI_{t_{171 \rightarrow 210}} + BI_{rwt_{1 \rightarrow 100}} - EI_{rwt_{71 \rightarrow 170}})^2 \times (\sigma_{\theta 5})^2$$

$$C_{\theta 3} = (-S_{rw_{1_a}} - S_{rw_{1_b}} - S_{rw_{1_c}} - S_{rw_{2_a}} - S_{rw_{2_b}} - S_{rw_{2_c}})^2 \times (\sigma_{\theta 3})^2$$

Variance in Element Analysis Determinations (Cont'd)

$$C_{\omega 1} = \frac{(BI_{f_{1+2}} + R_{f_3})^2}{\text{No. Analyses}} + \frac{(BI_{p_{1-1 \text{ thru } 4-1}} - EI_{p_{1-8 \text{ thru } 4-8}})^2}{\text{No. Analyses}}$$

$$+ \frac{(BI_{pw_1} - S_{pw_1} - EI_{pw_2})^2}{\text{No. Analyses}} \times (\sigma_{\omega 1})^2$$

$$C_{\omega 2} = (BI_{t_1})^2 + \ldots + (BI_{t_{70}})^2 + (-EI_{t_{141}})^2 + \ldots + (-EI_{t_{210}})^2 +$$
$$(-S_{t_1})^2 + \ldots + (-S_{t_{70}})^2 \times (\sigma_{\omega 2})^2$$

$$C_{\omega 3} = \frac{(-S_{rw_1} - S_{rw_2})^2}{\text{No. Analyses}} \times (\sigma_{\omega 3})^2$$

Variance in Volume Measurements for Isotope Determinations

$$C_{\delta 1} = (BI_{f_{1+2}} + R_{f_3})^2 \times (\sigma_{\delta 1})^2$$

$$C_{\delta 2} = (BI_{p_{1-1}} - EI_{p_{1-8}})^2 + (BI_{p_{2-1}} - EI_{p_{2-8}})^2 + (BI_{p_{3-1}} - EI_{p_{3-8}})^2 + (BI_{p_{4-1}} - EI_{p_{4-8}})^2 \times (\sigma_{\delta 2})^2$$

$$C_{\delta 3} = (BI_{pw_1} - S_{pw_1} - EI_{pw_2})^2 \times (\sigma_{\delta 3})^2$$

$$C_{\delta 4} = (-S_{rw_{1_a}} - S_{rw_{1_b}} - S_{rw_{1_c}})^2 \times (\sigma_{\delta 4})^2$$

$$C_{\delta 5} = (-S_{rw_{2_{abc}}})^2 \times (\sigma_{\delta 5})^2$$

$$C_{\epsilon 1} = (BI_{f_1})^2 + (BI_{f_2})^2 + (R_{f_3})^2 \times (\sigma_{\epsilon 1})^2$$

$$C_{\epsilon 2} = (BI_{p_{1-1}})^2 + (-EI_{p_{1-8}})^2 + (BI_{p_{2-1}})^2 + (EI_{p_{2-8}})^2 + (BI_{p_{3-1}})^2 + (-EI_{p_{3-8}})^2 + (BI_{p_{4-1}})^2 + (EI_{p_{4-8}})^2 \times (\sigma_{\epsilon 2})^2$$

$$C_{\epsilon 3} = (BI_{pw_1})^2 + (-S_{pw_1})^2 + (-EI_{pw_2})^2 \times (\sigma_{\epsilon 3})^2$$

$$C_{\epsilon 4} = (-S_{rw_{1_a}})^2 + (-S_{rw_{1_b}})^2 + (-S_{rw_{1_c}})^2 \times (\sigma_{\epsilon 4})^2$$

$$C_{\epsilon 5} = (-S_{rw_{2_a}})^2 + (-S_{rw_{2_b}})^2 + (-S_{rw_{2_c}})^2 \times (\sigma_{\epsilon 5})^2$$

Variance in Sampling for Isotope Determinations

$$C_{\lambda 1} = (BI_{f_{1+2}} + R_{f_3})^2 \times (\sigma_{\lambda 1})^2$$

$$C_{\lambda 2} = (BI_{p_1 \text{ thru } 4-1} - EI_{p_1 \text{ thru } 4-8})^2 \times (\sigma_{\lambda 2})^2$$

$$C_{\lambda 3} = (BI_{pw_1} - S_{pw_1} - EI_{pw_2})^2 \times (\sigma_{\lambda 3})^2$$

$$C_{\lambda 4} = (-S_{rw_{1_{abc}}} - S_{rw_{2_{abc}}})^2 \times (\sigma_{\lambda 4})^2$$

Variance in Sampling for Isotope Determinations (Cont'd)

$$C_{\kappa 1} = \frac{(BI_{f_{1+2}} + R_{f_3})^2}{\text{No. Samples}} \times (\sigma_{\kappa 1})^2$$

$$C_{\kappa 2} = \frac{(BI_{p_1 \text{ thru } 4\text{-}1} - EI_{p_1 \text{ thru } 4\text{-}8})^2}{\text{No. Samples}} \times (\sigma_{\kappa 2})^2$$

$$C_{\kappa 3} = \frac{(BI_{pw_1} - S_{pw_1} - EI_{pw_2})^2}{\text{No. Samples}} \times (\sigma_{\kappa 3})^2$$

$$C_{\kappa 4} = \frac{(-S_{rw_1} - S_{rw_2})^2}{\text{No. Samples}} \times (\sigma_{\kappa 4})^2$$

Variance in Isotope Analysis Determinations

$$C_{\gamma 1} = (BI_{f_{1+2}} + R_{f_3} + BI_{p_{1\text{-}1} \text{ thru } 4\text{-}1} - EI_{p_{1\text{-}8} \text{ thru } 4\text{-}8} + BI_{pw_1} - S_{pw_1} - EI_{pw_2} - S_{pw_1})^2 \times (\sigma_{\gamma 1})^2$$

$$C_{\gamma 2} = (BI_{t_{101\text{-}140}} - EI_{t_{171 \rightarrow 210}} + BI_{rwt_{1 \rightarrow 100}} - EI_{rwt_{71 \rightarrow 170}})^2 \times (\sigma_{\gamma 2})^2$$

$$\begin{aligned} C_{\nu 1} = {} & (BI_{f_1})^2 + (BI_{f_2})^2 + (R_{f_3})^2 + (BI_{p_{1\text{-}1}})^2 \\ & + (BI_{p_{2\text{-}1}})^2 + (BI_{p_{3\text{-}1}})^2 + (BI_{p_{4\text{-}1}})^2 \\ & + (-EI_{p_{1\text{-}8}})^2 + (-EI_{p_{2\text{-}8}})^2 + (-EI_{p_{3\text{-}8}})^2 \\ & + (-EI_{p_{4\text{-}8}})^2 + (BI_{pw_1})^2 + (-EI_{pw_2})^2 + (-S_{pw_1})^2 \\ & + (-S_{rw_{1_a}})^2 + (-S_{rw_{1_b}})^2 + (-S_{rw_{1_c}})^2 \\ & + (-S_{rw_{2_a}})^2 + (-S_{rw_{2_b}})^2 + (-S_{rw_{2_c}})^2 \times (\sigma_{\nu 1})^2 \end{aligned}$$

$$C_{\nu 2} = (BI_{rwt_1})^2 + \ldots + (BI_{rwt_{70}})^2 + (-EI_{t_{141}})^2 + \ldots + (-EI_{t_{210}})^2 \times (\sigma_{\nu 2})^2$$