Battelle

Columbus Laboratories

505 King Avenue

Columbus, Ohio 43201

Telephone (614) 424-6424

Telex 24-5454

March 2, 1982

Proposal Number 588-J-6854

Ms. Jane Monhart
 Director of Contracts
 U. S. DOE-Chicago Operations
 and Regional Office
 9800 South Cass Avenue
 Argonne, Illinois 60439

MASTER

Dear Ms. Monhart:

Contract W-7405-Eng. 92, TA34

On December 2, 1981, Messrs. George Kirsch and Richard Riester of the BCL staff visited the retired Piqua Nuclear Power Facility located in Piqua, Ohio, to perform the annual radiological survey.

SURVEY PARAMETERS

<u>Type</u>	<u>Location</u>	<u>Analyses Performed</u>
I. Smear Survey	Even numbered locations 22-78	Gross beta-gamma counting
Radiation Survey	Even numbered locations 22-78	Beta-gamma radiation survey
II. Water Sample "A"	Building Tap H ₂ O	Gross alpha and beta (dissolved and suspended)
Water Sample "B"	Lower level sump	Gross alpha and beta (dissolved and suspended)
Water Sample "B"	Lower level sump	Gamma isotopic for ¹³⁷ Cs, ⁶⁰ Co, ⁵⁵ Fe
Sludge Sample "B"	Lower level sump	Gamma isotopic for ¹³⁷ Cs, ⁶⁰ Co, ⁵⁵ Fe
Four Environmental Surface/Soil Samples Each of Four Quadrants	Immediately outside the facility	Gamma isotopic for ¹³⁷ Cs, ⁶⁰ Co, and ⁵⁵ Fe
III. Visual Inspection	Outer containment vessel	

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

MOW

DISCLAIMER

This book was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

SURVEY RESULTS

I. Surface Contamination

Reactor Building, 78-ft Level

	Beta-Gamma Contamination	
	Fixed (mrad/hr)	Removable (dpm/100 cm ²)
22 Floor	0.02	2.70
24 Floor	0.02	6.34
26 Wall	0.02	0.87
28 Floor	0.02	2.70
30 Floor	0.02	6.34
32 Metal grating catwalk	0.02	2.70
34 Metal grating catwalk	0.02	2.70
36 Metal grating catwalk	0.02	6.34
38 Stair	0.02	4.52
40 Floor drain	0.02	0.87
42 Floor	0.02	0.87
44 Floor	0.02	0.95
46 Floor drain	0.02	0.95
48 Wall	0.02	0.95
50 Metal grating	0.02	2.77
52 Wall	0.02	2.77
54 Exhaust air duct	0.02	0.95
56 Metal grating	0.02	0.95
58 Metal grating	0.02	0.95
60 Metal grating	0.02	2.70
62 Emergency personnel air lock	0.02	2.77

Reactor Building, 56-ft Level

64 Stairwell	0.02	2.70
66 Stairwell	0.02	0.87
68 Floor	0.02	0.95
70 Wall	0.02	2.70
72 Floor	0.02	2.70
74 Drain F4	0.20	0.87
76 Floor	0.02	2.77
78 Floor	0.02	0.95

II. Water Sludge and Soil Samples*

Identification and Location	Dissolved Alpha	Solids Alpha	Dissolved Beta	Solids Beta	^{137}Cs	^{60}Co	^{55}Fe
Sample A - Bldg Tap Water	6.70 ± 1.40 $\times 10^{-9}$	6.09 ± 4.57 $\times 10^{-10}$	4.21 ± 1.11 $\times 10^{-9}$	0.00 ± 6.93 $\times 10^{-10}$	-	-	-
Sample B Lower Level Sump Water	8.02 ± 3.00 $\times 10^{-9}$	3.20 ± 3.66 $\times 10^{-10}$	3.13 ± 0.25 $\times 10^{-8}$	0.00 ± 6.93 $\times 10^{-10}$	9.50 ± 2.40 $\times 10^{-8}$	5.50 ± 1.60 $\times 10^{-8}$	<2.0 $\times 10^{-7}$
Sample B Lower Level Sump Sludge	-	-	-	-	113.3 ± 2.23	115 ± 2.92	<50
North Quadrant Soil	-	-	-	-	0.91 ± 0.13	<0.08	<20
South Quadrant Soil	-	-	-	-	0.50 ± 0.11	<0.08	<20
East Quadrant Soil	-	-	-	-	0.60 ± 0.12	<0.08	<20
West Quadrant Soil	-	-	-	-	0.40 ± 0.09	0.08 ± 0.04	<20

* Concentrations are reported as $\mu\text{Ci/ml}$ for water samples and pCi/gram for sludge and soil samples.

III. Visual Inspection

The outer containment vessel was visually examined for indications of changes in the integrity of the structure and components. No evidence of structural changes were observed.

DISCUSSION

I. Surface Contamination

Removable surface contamination levels were appreciably less than the contract criteria of 1000 dpm/100 cm². The average level was approximately 2.40 d/m/100 cm². Previous annual surveys indicated approximately the same levels of contamination, an exception being in 1974, where several smears were reported in the range of 30 to 100 dpm/100 cm².

Fixed surface contamination levels were also within the contract specification of 0.4 mrad/hr at 1 cm for beta-gamma emitters. The maximum reading observed was 0.20 mrad/hr in a floor drain. All other readings were 0.02 mrad/hr. Previous annual surveys indicated essentially the same radiation levels.

II. Sump Water and Sludge Samples

Gross alpha and beta counting was performed on the water and sludge in the lower level sump (location B). For water the alpha concentrations were $8.02 \pm 3.00 \times 10^{-9}$ and $3.20 \pm 3.66 \times 10^{-10}$ $\mu\text{Ci/ml}$, respectively for dissolved and solid components. The combined dissolved and solids alpha activity was $8.34 \pm 3.37 \times 10^{-9}$ $\mu\text{Ci/ml}$. The combined alpha activity for 1980 was $0.00 \pm 1.00 \times 10^{-8}$ $\mu\text{Ci/ml}$. Previous combined alpha concentrations ranged from 1.0×10^{-9} to 4.0×10^{-8} $\mu\text{Ci/ml}$.

The beta concentrations were $3.13 \pm 0.25 \times 10^{-8}$ and $0.00 \pm 6.93 \times 10^{-10}$ $\mu\text{Ci/ml}$, respectively for dissolved and solid components. The combined dissolved and solids beta activity for 1981 was $3.13 \pm 0.32 \times 10^{-8}$ $\mu\text{Ci/ml}$. For 1980, the combined beta activity was $2.08 \pm 0.14 \times 10^{-7}$ $\mu\text{Ci/ml}$. Previous combined beta concentrations ranged from 1.50×10^{-8} to 1.50×10^{-7} $\mu\text{Ci/ml}$.

The total dissolved and solid alpha and beta gross activity in the sump water for 1981 was $3.96 \pm 0.66 \times 10^{-8}$ $\mu\text{Ci/ml}$.

Comparison of Concentrations of Activity of Water
in the Sump with the Concentration
Guides Listed in DOE Order 5480.1, Chapter XI

Where either the identity or the concentration of any radionuclide in the mixture is not known the concentration guide for an uncontrolled area is 3.0×10^{-8} $\mu\text{Ci/ml}$ and 4.0×10^{-7} $\mu\text{Ci/ml}$ for a controlled area. The total concentration of 3.96×10^{-8} $\mu\text{Ci/ml}$ for the sump water for 1981 is 132 percent of the uncontrolled area CG and 10 percent of the controlled area CG.

Of interest, the reactor basement sump pump was operated on two days during 1981, July 7 and August 4, to test the fire alarm system. To the best of facility's managements knowledge no water was discharged from the sump, however, a discharge of 390 gallons (1.476×10^6 ml) was recorded based on the operational time for the sump pump.

The reactor basement sump water is pumped to the auxiliary building sump and then discharged to an uncontrolled area outside the building. This auxiliary building sump collects water used for the most part for washing municipal electrical department vehicles.

For 1981 the auxiliary building sump was recorded as having pumped 5,190 gallons of water (1.964×10^7 ml). The possible pumping of 390 gallons of water from the reactor sump to the auxiliary building sump with a subsequent release from the building to an uncontrolled area is a dilution of 390 gallons into 5,190 gallons or 0.075 times 3.96×10^{-8} $\mu\text{Ci/ml}$ with a resultant concentration of 2.97×10^{-9} $\mu\text{Ci/ml}$, or 10 percent of the concentration guide of 3.0×10^{-8} $\mu\text{Ci/ml}$ for releases to a uncontrolled area of radioactive material where either the identity or the concentration of any radionuclide in the mixture is not known.

In 1975, extensive analyses were performed on both liquid and solid components in the sump. Three radionuclides: cesium-137, cobalt-60 and iron-55 were determined to be primary contributors and consequently indicators of future buildup of radioactive material in the sump.

The total concentration of cesium-137 in the sump water for 1981 was $9.50 \pm 2.40 \times 10^{-8}$ $\mu\text{Ci/ml}$. Of interest, the soluble and insoluble components were $\sim$ equal. The soluble cesium-137 concentration was $5.50 \pm 1.30 \times 10^{-8}$ $\mu\text{Ci/ml}$ and the insoluble component was $4.00 \pm 1.10 \times 10^{-8}$ $\mu\text{Ci/ml}$. The control guides are 4×10^{-4} $\mu\text{Ci/ml}$ for soluble and 1×10^{-3} $\mu\text{Ci/ml}$ for insoluble and 2×10^{-9} $\mu\text{Ci/ml}$ for soluble and 4×10^{-5} $\mu\text{Ci/ml}$ for insoluble releases respectively to controlled and uncontrolled areas.

The total concentration of cobalt-60 in water for 1981 was $5.50 \pm 1.60 \times 10^{-8}$ $\mu\text{Ci/ml}$. The soluble component was $3.50 \pm 1.00 \times 10^{-8}$ $\mu\text{Ci/ml}$ and the insoluble component was $2.00 \pm 0.60 \times 10^{-8}$ $\mu\text{Ci/ml}$. The concentration guides are 1×10^{-3} $\mu\text{Ci/ml}$ for both soluble and insoluble releases 5×10^{-5} $\mu\text{Ci/ml}$ for soluble releases and 3×10^{-5} $\mu\text{Ci/ml}$ for insoluble releases to controlled and uncontrolled areas, respectively.

Iron-55 was not analyzed for soluble and insoluble components since the concentration was at the minimum sensitivity level of $<2 \times 10^{-7}$ $\mu\text{Ci/ml}$. The concentration guides are 2×10^{-2} $\mu\text{Ci/ml}$ for soluble and 7×10^{-2} $\mu\text{Ci/ml}$ for insoluble releases to controlled areas. The uncontrolled area guides are 8×10^{-4} $\mu\text{Ci/ml}$ for soluble releases and 2×10^{-3} $\mu\text{Ci/ml}$ for insoluble releases.

Gamma analyses of sludge samples were performed for cesium-137, cobalt-60, and iron-55. The concentration of cesium-137 in sludge for 1981 was 113.3 ± 2.23 pci/grams and the concentration reported for 1980 was 130 ± 30 pci/gram. The concentration of cobalt-60 for 1981 was 115 ± 2.92 pci/gram and the concentration for 1980 was 84 ± 32 pci/gram. For iron-55 the concentration for 1981 was <50 pci/gram and the concentration reported for 1980 was <140 pci/gram.

Surface Soil Samples

This survey marks the inception of the collection of surface soil samples around the perimeter of the facility. Four quadrants were sampled, designated as north, south, east, and west quadrants. Each quadrant, consisting of a 10 meter by 10 meter square area was sampled. Five 1-inch deep by 4-inch diameter plugs of vegetation and soil were collected from each quadrant and analyzed for cesium-137, cobalt-60, and iron-55.

Both cobalt-60 and iron-55 were at or near their respective minimum detectable levels of <0.08 and <20 pci/gram. Concentrations of cesium-137 ranged from 0.40 ± 0.09 to 0.91 ± 0.13 pci/gram.

The concentrations of cesium-137 are similar to those found by Battelle in the vicinity of Columbus, Ohio and are also similar to concentrations reported by other DOE contractors for other geographical areas outside of Ohio.

CONCLUSIONS

Overall the survey did not reveal the existence of any significant changes within the facility. This survey marked the inception of a surface soil sampling program and analyses of the soil revealed concentrations of radioactivity are comparable to those found at other locations in Ohio as well as other geographical areas.

March 2, 1982

RECOMMENDATION

Analyses for iron-55 for the sump water, sludge and environmental surface/soil samples should be discontinued since the reported concentrations were at their respective minimum detectable levels. The cesium-137 and cobalt-60 will be sufficient indicators of any future buildup of radioactive material in these media.

Sincerely,

A handwritten signature in cursive script, appearing to read "John E. Davis for".

John E. Davis
Project Administrator

JED/sp