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**Effluent and Environmental
Monitoring Report
for the Calendar Year 1992**

**Bettis Atomic Power Laboratory
West Mifflin, Pennsylvania 15122-0079**

**Prepared for the
U.S. Department of Energy
By Westinghouse Electric Corporation
Under Contract No. DE-AC11-93PN38195**

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1992 EFFLUENT AND ENVIRONMENTAL
MONITORING REPORT FOR THE
BETTIS ATOMIC POWER LABORATORY
PITTSBURGH SITE

PREPARED FOR THE U.S. DEPARTMENT OF ENERGY BY
WESTINGHOUSE ELECTRIC CORPORATION
WEST MIFFLIN, PENNSYLVANIA 15122-0079

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ABSTRACT

The results of the radiological and non-radiological environmental monitoring programs for 1992 at the Bettis-Pittsburgh Site are presented. The results obtained from the monitoring programs demonstrate that the existing procedures ensured that environmental releases during 1992 were in accordance with applicable Federal and State regulations. Evaluation of the environmental data indicates that operation of the Laboratory continues to have no adverse effect on the quality of the environment. A conservative assessment of radiation exposure to the general public as a result of Laboratory operations demonstrated that the dose received by any member of the public was well below the most restrictive dose limits established by the Environmental Protection Agency and the Department of Energy.

1992 EFFLUENT AND ENVIRONMENTAL MONITORING REPORT FOR THE BETTIS ATOMIC POWER LABORATORY

SUMMARY

The results of the radiological and non-radiological environmental monitoring programs for the Bettis Atomic Power Laboratory-Pittsburgh Site (Bettis) are summarized below. During 1992 Bettis was in compliance with applicable regulations governing use, emission and disposal of solid, liquid and gaseous materials. Current operations at the Bettis site did not result in any significant release of radioactivity or hazardous materials to the environment. Tables 1 and 2 summarize the environmental monitoring programs.

LIQUID EFFLUENTS

Liquid Release (Other than to Sanitary Sewer)

Approximately 8.8×10^7 gallons of water were released to the environment via the Northeast Area and Bull Run streams. No radioactivity attributable to operations at the Bettis site was detected in any of the environmental samples of these releases. Radioactivity concentrations were either below minimum detection levels or were typical of background levels in city water and precipitation.

Monitoring data for chemical constituents demonstrated no significant impact on the water quality from the effluents. These results continue to demonstrate compliance with U. S. Department of Energy (DOE) standards and the Laboratory's National Pollutant Discharge Elimination System (NPDES) permit.

SANITARY SEWER DISCHARGES

All sanitary effluents were discharged to the West Mifflin, Pennsylvania sewage treatment facility. No radioactivity attributable to operations of the Bettis site was detected in any of the environmental samples of sanitary effluent.

All wastes discharged to the sanitary system were in compliance with applicable regulations.

GROUND WATER EFFLUENTS

Analysis of water from natural springs, collected onsite and offsite, did not detect any radioactivity in excess of natural background levels.

The results from the majority of the groundwater analyses for a variety of chemicals were less than minimum detectable levels; some analyses, however, did indicate the presence of volatile halogenated organic compounds, such as tetrachloroethylene, associated with past degreasing operations. The presence of these chemicals is not due to current laboratory operations.

STREAM SEDIMENTS AND VEGETATION

Analyses of radioactivity in the Laboratory's effluent streambeds demonstrated that there was no measurable buildup of radioactivity in the streambeds during 1992.

Analysis of wild vegetation collected in and along the Bettis effluent streams on the Bettis site identified very low levels of Strontium-90 radioactivity in some of the samples. While historical deposits of radioactivity from past Laboratory operations could be responsible for the presence of this radioactivity in the vegetation, it is more likely due to atmospheric fallout since radioactivity in the Laboratory's liquid effluent streams would not have come in contact with these areas.

The levels of radioactivity are so low that a person could consume several hundred pounds of this vegetation each year with the highest concentration observed and never exceed the U.S. Nuclear Regulatory Commission (NRC) limits for individuals in unrestricted areas. Actual consumption is not considered as a possibility since this vegetation is not used as a human food source. The presence of this radioactivity does not present a risk to the environment or the public health.

RADIATION

Radiation surveys of the Bettis site indicated that radiation levels were typical of background radiation levels for Western Pennsylvania. Perimeter thermoluminescent dosimetry data show that Laboratory operations did not cause any measurable change in the natural radiation environment surrounding the Bettis site.

AIRBORNE EFFLUENTS

Airborne radioactivity in Laboratory effluents was controlled using high efficiency particulate filters, wet scrubbing systems and, in some cases, charcoal filters to maintain particulate and gaseous radioactivity releases to as low as reasonably achievable. The amount of long-lived (> 1 day half-life) alpha and beta particulate radioactivity released in airborne effluents from the Laboratory was less than 0.000005 Curie. Comparison of Laboratory airborne effluents with ambient air samples, collected at locations 1.5 to 5 miles from the Laboratory, shows that the Laboratory's airborne particulate effluent was up to 6 times lower than natural background airborne particulate radioactivity. The quantity of long-lived gaseous radioactivity released was less than 0.4 Curie of which Krypton-85 was the principal contributor.

Emissions of non-radiological air effluents were conservatively estimated and were well below applicable EPA and Allegheny County standards. Operation of the

Laboratory's fuel combustion and heating equipment was conducted in accordance with appropriate Allegheny County Air Pollution Source Operating Permits.

DOSE-TO-MAN

Radiation exposure to the general public from Bettis airborne releases was too low to measure and could only be estimated using conservative, EPA authorized calculational models. The resultant evaluation of all exposure pathways conservatively estimated a maximum annual hypothetical dose range of 0.5 to 2.8 millirem to an individual offsite. Realistically, the actual maximum annual dose would approach 0.5 millirem. However, using the larger value of 2.8 millirem, the dose is still less than one percent of the numerical guide for continuous exposure to any one member of the general public as established by the NRC and is only 2.8% of the more conservative numerical guide established by the DOE. The annual dose to the population from Bettis operations within a 50-mile radius of the site was conservatively estimated to be about 6.2 man-rem. This dose is negligible when compared to the approximately 960,000 man-rem received by this population from natural background radiation.

CHEMICALLY HAZARDOUS WASTE

Chemically hazardous materials are not manufactured nor disposed of at the Bettis site. Small quantities of chemically hazardous wastes were generated during site operations. These materials were handled, controlled and stored by trained personnel in accordance with applicable federal and state permits. Disposal was arranged with waste vendors operating under State and Federal permits.

SOLID RADIOACTIVE WASTE

The volume of solid, low-level radioactive waste was minimized by a program to limit the materials that could become contaminated and by waste compaction. Solid,

low-level radioactive wastes that were generated at the Laboratory were packaged in strong, tight containers approved by the U.S. Department of Transportation. Shipment of this waste to DOE-owned disposal facilities was controlled by written procedures to ensure compliance to state and federal regulations. Bettis has always shipped its radioactive waste out-of-state for disposal.

During 1992, 220 cubic meters of low-level radioactive waste were shipped from the Bettis site. This is less than 1 percent of the total low-level radioactive waste typically dispositioned annually by DOE-owned facilities.

ENVIRONMENTAL ASSESSMENTS

In 1988, a Preliminary Assessment and Site Inspection (PA/SI) Report was completed for Bettis to meet the requirements of Section 120 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). During 1989, the Environmental Protection Agency (EPA) completed their review of the Bettis PA/SI and concluded that no further action under CERCLA was required for the site.

During 1990 a Consent Order issued under Section 3008(h) of the Resource Conservation and Recovery Act (RCRA) was signed by the Pittsburgh Naval Reactors Office (PNR) and EPA, Region III.

The Consent Order requires that a Resource Conservation and Recovery Act Facility Investigation (RFI) and Corrective Measures Study (CMS) be conducted. The RFI is being conducted to characterize the site and the CMS is to determine site-specific remediation alternatives. The RFI workplans were approved by the EPA in 1991. Ground water well installation and the ground water, surface water, soil, sediment and air sampling specified in RFI workplans began in 1992.

COMPLIANCE SUMMARY

During 1992 Bettis operations were in compliance with existing permits and applicable regulations governing use, emission, transportation and disposal of solid, liquid, and gaseous materials and wastes. Operations during 1992 at the Bettis Site did not result in any significant release of radioactivity or hazardous materials to the environment.

Also during 1992, the EPA and the Commonwealth of Pennsylvania, Department of Environmental Resources (PA-DER) conducted on-site inspections of the hazardous waste program at Bettis. The Laboratory was found to be in compliance with all applicable regulations. No deficiencies were identified during these inspections.

CONCLUSION

Operations at the Bettis Atomic Power Laboratory during 1992 did not have any adverse effect on the quality of the environment at Bettis or in the surrounding communities.

TABLE 1
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM⁽¹⁾

<u>Sample</u>	<u>Sample Collection</u>	<u>Analysis Frequency⁽²⁾</u>	<u>Routine Analyses</u>
1. Liquid Effluents a. Bull Run b. NE Area	Continuous	Weekly Quarterly Composite of Weekly Samples Annual Composite of Weekly Samples	Gross alpha, beta Gross alpha, beta Sr-89, 90 Gamma Emitters
2. Influent Drinking Water	Daily Grab	Weekly Quarterly Composite of Weekly Samples Annual Composite of Weekly Samples	Gross alpha, beta Gross alpha, beta Sr-89, 90 Gamma Emitters
3. Precipitation	Continuous	Weekly Quarterly Composite of Weekly Samples Annual Composite of Weekly Samples	Gross alpha, beta Gross alpha, beta Sr-89, 90 Gamma Emitters
4. Ground water a. Springs Onsite b. Springs Offsite	Annual Grab	Annually	Gross alpha, beta Gamma Emitters Sr-89, 90
5. Sanitary Effluent	Weekly Grab	Weekly Quarterly Composite of Weekly Samples Annual Composite of Weekly Samples	Gross alpha, beta Sr-89, 90 Gamma Emitters
6. Stream Sediments and Vegetation a. Bull Run b. NE Area c. Thompson Run d. Streets Run	Semiannual Grab (Sediment) Annual Grab (Vegetation)	Semiannually (Sediment) Annually (Vegetation)	Gross alpha, beta Sr-89, 90 Gamma Emitters (Sediment) Sr-89, 90 Gamma Emitters (Vegetation)
7. Soil a. IWS Runoff Area	Biennial Grab	Biennially	Gross alpha, beta Sr-90, Gamma Emitters
8. Radiation a. Site Perimeter	Survey (PRM-7)	Annually	Gamma Exposure

TABLE 1
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM⁽¹⁾

<u>Sample</u>	<u>Sample Collection</u>	<u>Analysis Frequency⁽²⁾</u>	<u>Routine Analyses</u>
b. Bull Run/ Thompson Run	Survey (PRM-7)		
c. IWS Run-On/ Runoff	Survey (PRM-7)	Quarterly	Gamma Exposure
d. Onsite TLDs	Continuous		
e. Offsite TLDs	Continuous		
9. Environmental Air	Continuous	Weekly	Gross alpha, beta
a. Large, PA			
b. Duquesne Substation located in West Mifflin			
10. Airborne Effluent			
a. Particulate	Continuous	Semi-weekly, Weekly Quarterly	Gross alpha, beta
		Quarterly Composite of Semi-weekly and Weekly Samples	Gross alpha, beta Sr-89, 90* Gamma Emitters
b. Gaseous	Continuous	Weekly	Gross beta Gamma Emitters
1) Radon	Annual Grab	Annually	Radon 220, 222

⁽¹⁾These monitoring programs comply with DOE Order 5400.1.

⁽²⁾Minimum analysis frequencies

*On selected exhausts

TABLE 2
NON-RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM⁽¹⁾

<u>Sample</u>	<u>Sampling Method</u>	<u>Analysis Frequency⁽²⁾</u>	<u>Routine Analysis Performed</u>
1. Liquid Effluents	Grab	Semimonthly	pH, temperature, fecal coliform, dissolved oxygen, suspended solids, oil and grease
a. Bull Run			
b. NE Area	Grab	Quarterly	alkalinity, aluminum, ammonia, arsenic, chromium (hexavalent), copper, cyanide (free), fluoride, iron (dissolved), iron (total), lead, nickel, nitrate, nitrite, phenols, dissolved solids, threshold odor, organic carbon, zinc, osmotic pressure
	Grab	Annually	antimony, beryllium, cadmium, chloride, hardness, sodium, specific conductance, chemical oxygen demand, chromium (total), color, organic nitrogen, surfactants, herbicides, pesticides, polychlorinated biphenyls, manganese, mercury, silver, turbidity, sulfates, selenium, and thallium
c. Sanitary Sewer at Location SAN-2	Grab	Quarterly	pH, oil and grease, cyanide (free), phenols, chromium (hexavalent), dissolved oxygen, temperature, biochemical oxygen demand
d. Sanitary Sewer at Location SAN-10	Grab	Semi-annually	pH, oil and grease, cyanide (free), phenols, chromium (hexavalent), dissolved oxygen, temperature, biochemical oxygen demand
2. Influent Municipal Water Supply	Grab	Semimonthly	pH, fecal coliform, suspended solids, temperature, dissolved oxygen, oil and grease
	Grab	Quarterly	alkalinity, aluminum, ammonia, arsenic, chromium (hexavalent), copper, cyanide (free), fluoride, iron (dissolved), iron (total), lead, nickel, nitrate, nitrite, phenols, dissolved solids, threshold odor, organic carbon, zinc, osmotic pressure

TABLE 2
NON-RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM⁽¹⁾

<u>Sample</u>	<u>Sampling Method</u>	<u>Analysis Frequency⁽²⁾</u>	<u>Routine Analysis Performed</u>
	Grab	Annually	antimony, beryllium, cadmium, chemical oxygen demand, chloride, chromium (total), color, organic nitrogen, sodium, specific conductance, surfactants, herbicides, pesticides, polychlorinated biphenyls, manganese, mercury, silver, hardness, turbidity, sulfates, selenium, and thallium

⁽¹⁾ Of the various programs specified herein, only the monitoring programs for pH, oil and grease, and suspended solids are required by the Site's NPDES permit. Other programs are conducted as a matter of local policy.

⁽²⁾ Minimum analysis frequencies.

INTRODUCTION

PURPOSE

This document summarizes for calendar year 1992 the results of the radiological and non-radiological environmental monitoring programs at the Bettis Laboratory. This report also discusses the Laboratory programs for handling and off-site disposal of radioactive waste and chemically hazardous waste. The report is prepared in conformance with the Department of Energy (DOE) requirements.

BACKGROUND

The Bettis Laboratory is operated by the Westinghouse Electric Corporation for the Department of Energy and is engaged in the design and development of naval nuclear propulsion plants. Operations conducted at the Laboratory include development and examination of nuclear fuel materials and reactor materials including radiochemistry examinations.

The Laboratory is situated on a 202 acre tract of land in the Borough of West Mifflin, which is located approximately 8 miles southeast of the downtown section of Pittsburgh, Pa. The region surrounding the Bettis site is largely industrial and residential. The total population within a 50 mile radius of the site is approximately 3,200,000. The location of the Bettis site with respect to the surrounding communities is shown in Figure 1.

The Bettis facilities are situated on a plateau at an elevation which is approximately 1200 feet above sea level and 460 feet above the normal water level of the nearby Monongahela River. A geological survey of the area has disclosed that the surface soil depth ranges from 1 to 9 feet and consists principally of silt and clay with varying amounts of rock fragments. The bedrock underlying the soil is composed of nearly horizontal layers of consolidated sandstone, shale, limestone, clay, and coal.

None of the Laboratory land is utilized for agrarian purposes and there are no springs or wells onsite or in the local area which are known to be used for drinking water, industrial or irrigation purposes. Low groundwater yields from the bedrock formations are reported.

Data accumulated by the Bettis meteorological monitoring system during 1992 indicated that prevailing winds for the Bettis Site occurred about 33% of the time from the southwest quadrant and about 35% of the time from the northwest quadrant. Wind speeds of 5-12 mph occurred about 80% of the time and less than 5 mph about 20% of the time. Average daily temperatures during the year ranged from 30 to 71°F. The annual rain and snowfall amounted to 24 inches of water.

FIGURE 1 RELATIONSHIP OF THE BETTIS SITE TO THE SURROUNDING COMMUNITIES

ENVIRONMENTAL MONITORING

Descriptions of the Laboratory's radiological and non-radiological environmental programs are provided in References (1) and (2), respectively. These programs are outlined in the following sections and summarized in Tables 1 and 2.

A. LIQUID EFFLUENTS

The purpose of the liquid effluent monitoring programs is to determine the effectiveness of control methods and to measure concentrations in effluents for comparison with applicable standards and natural background levels. In addition to monitoring liquid effluents from the Laboratory, samples of precipitation and influent city water are monitored and used for background comparisons.

Sources and Treatment

The principal sources of non-sanitary, liquid effluents are once-through city water used for cooling purposes, surface runoff of precipitation, and process water.

The total liquid effluent released from the Laboratory through the storm sewer monitoring stations in 1992 was 8.8×10^7 gallons. Approximately 83% of this volume was released at the Bull Run monitoring station and the remaining 17% of the liquid was released at the Northeast Area monitoring station. Figure 2 shows the locations of these two monitoring stations. The discharged effluents comprise most of the flow of Bull Run, which empties into Thompson Run about one mile below the site. Thompson Run flows about 2.6 miles before emptying into the Monongahela River. There are no wells or springs onsite which are used for drinking or irrigation purposes. The Monongahela River is used as a raw water source for public water supply serving Bettis and some surrounding communities.

During 1992, as in previous years, a water reuse system was used whereby liquids containing radioactivity were collected, processed, and reused in select Laboratory operations.

Water used for sanitary purposes was discharged to the West Mifflin Borough, Thompson Run Sewage Treatment Plant which discharged treated effluent to Thompson Run.

Effluent Liquid Monitoring

The samples and analyses specified below constitute the minimum samples and analyses conducted at Bettis during 1992. Normally, additional samples and analyses are performed whenever radioactivity or chemical concentrations are detected in excess of normal or expected levels.

Radiological: Water samples of nonsanitary, effluent liquid were collected continuously at the Bull Run and Northeast Area discharge stations. Weekly, these samples were picked up and analyzed for gross alpha and gross beta radioactivity. Quarterly, composites of the weekly samples were analyzed for gross alpha and gross beta radioactivity and radiostrontium. Gamma spectrometry was performed annually on a composite of the weekly samples. Influent city water and precipitation samples were analyzed similarly to effluent liquid samples.

Grab samples of sanitary effluent were collected at the outfall of the main site area (location SAN-2), shown on Figure 2. These samples were analyzed weekly for gross alpha and gross beta radioactivity. Quarterly, a composite of the weekly samples from SAN-2 was analyzed for radiostrontium. Annually, a composite of the weekly samples from SAN-2 was analyzed for non-naturally occurring gamma emitters. Semiannual grab samples of sanitary effluent were collected at the outfall of the entire Bettis Site (location SAN-10). These samples were analyzed on both occasions for gross alpha and gross beta radioactivity.

FIGURE 2 LIQUID MONITORING STATIONS

Non-Radiological: Samples of effluents discharged through the Bull Run and Northeast Area discharge stations were collected on at least a monthly basis. Semimonthly, grab samples were collected and analyzed for pH, fecal coliforms, suspended solids, dissolved oxygen, temperature, and oil and grease. Quarterly, grab samples were collected and analyzed for alkalinity, aluminum, ammonia, arsenic, chromium (hexavalent), copper, cyanide (free), fluoride, iron (dissolved), iron (total), lead, nickel, nitrate, nitrite, osmotic pressure, phenols, dissolved solids, threshold odor, organic carbon and zinc. Annually, grab samples were collected and analyzed for antimony, beryllium, cadmium, chloride, hardness, sodium, specific conductance, chemical oxygen demand, chromium (total), color, organic nitrogen, herbicides, pesticides, polychlorinated biphenyls, manganese, mercury, silver, surfactants, turbidity, sulfates, selenium, and thallium.

Grab samples of the influent municipal water supply, which comprises a significant portion of the plant discharges, were collected at the same frequencies and analyzed for the same parameters described above for the Bull Run and Northeast Area effluents.

Quarterly grab samples of sanitary effluent were collected at the outfall of the main site area (location SAN-2) for pH, oil and grease, cyanide (free), phenols, chromium (hexavalent), temperature, dissolved oxygen and biochemical oxygen demand.

Semiannual grab samples of sanitary effluent were collected at the outfall of the entire Bettis Site (location SAN-10) for the same parameters noted for collection at location SAN-2.

Liquid Analyses

Radiological: Liquid samples (liquid effluent, city water, precipitation, sanitary, groundwater, etc.) were prepared for analysis by evaporation of at least 100 milliliter aliquots of liquid. The alpha and beta radioactivity of the samples were measured using a low background proportional counter. Typical minimum detection levels achieved for alpha and beta radioactivity for 100 ml samples were $2.0 \times 10^{-9} \mu\text{Ci/ml}$ and $3.0 \times 10^{-9} \mu\text{Ci/ml}$, respectively.

Gamma spectrometry was also performed to identify gamma-emitting radionuclides using a Germanium-Lithium (GeLi) or a Germanium detector and a multichannel analyzer. For samples collected weekly, a typical minimum detection level for Cesium-137 and Cobalt-60 in a 500 ml sample was $5.0 \times 10^{-9} \mu\text{Ci/ml}$. A typical minimum detection level for Cesium-137 and Cobalt-60 in the annual composite was $8.0 \times 10^{-11} \mu\text{Ci/ml}$.

Radiostromium analyses were performed on selected samples using a standard strontium radiochemical procedure. A typical minimum detection level achieved for Strontium-90 was $7.0 \times 10^{-10} \mu\text{Ci/ml}$.

Non-Radiological: Analyses of effluent and influent samples were performed using test methods described in Reference (3) or other EPA-approved methods. Detection limits and standards are listed in Tables 4 and 5.

Liquid Monitoring Results and Conclusions

Radiological: Due to utilization of a water reuse system and strict adherence to procedures governing control of radioactive liquids, no radioactive liquids were released to the environment at the Bull Run or Northeast Area discharge stations.

The results of the weekly analyses for alpha radioactivity in the site's effluents showed that the levels were very near or below the minimum detection level and were typical of the background alpha radioactivity levels measured in the city water influent and precipitation. None of 52 alpha radioactivity measurements of the effluents exceeded 1/200th of the limit of Reference (4) for alpha radioactivity, based on Thorium-232, in water in uncontrolled areas.

The results of the weekly analyses for beta radioactivity in the site's effluents showed that the beta radioactivity levels, although slightly higher because of the presence of natural radioactivity associated with dissolved solids contained in the effluent, were typical of the levels measured in the city water influent and precipitation. None of the 52 beta radioactivity measurements of the effluents exceeded 1/30th of the limit of Reference (4) for beta radioactivity, based on Strontium-90, in water in uncontrolled areas.

Table 3 presents the quarterly composite sample results of the alpha, beta, and Strontium-89 and -90 radioactivity analyses for the effluents from the Bull Run and Northeast Area discharge stations, as well as for precipitation and city water samples. The quarterly composite results show that the radioactivity in the site's effluents was similar, within measurement uncertainties, to radioactivity in city water and precipitation.

The results of the gamma analyses for the annual composited water samples are also shown in Table 3. The results indicate that the levels of non-naturally occurring, gamma-emitting radionuclides in the effluents from the Bull Run and Northeast Area discharge stations were below the minimum detection levels and indistinguishable from precipitation and influent city water.

The alpha and beta radioactivity levels in sanitary sewer samples were typical of background levels. The alpha levels in the sanitary effluent were generally near or below the minimum detection level. The beta levels were slightly higher than the alpha levels due primarily to the presence of Potassium-40 which occurs naturally in the body waste excretions.

During 1992 the gross alpha levels in the sanitary effluent never exceeded the local control level of 1.0×10^{-8} $\mu\text{Ci/ml}$. In two samples, the gross beta levels in the sanitary effluent exceeded the local control level of 70 pCi/l (7.0×10^{-8} $\mu\text{Ci/ml}$). The maximum level was 330 pCi/l. Specific analyses of these two samples did not identify the presence of any Bettis-generated radioactivity but did identify the medical diagnostic radioisotope Thallium-201. It was concluded that Bettis-generated radioactivity was not released to the environment.

Non-Radiological: A summary of the results of water quality (chemical constituents) measurements for influent city water and effluent water from the Bettis Site are presented in Tables 4 and 5. Since a significant portion of the effluent is non-contact cooling water, the quality of the effluent is influenced by the influent city water quality. Tables 4 and 5 also list the discharge standards established in the Site's NPDES permit and guidelines derived from the Pennsylvania Code, Title 25, Environmental Resources, Chapter 93, Water Quality Standards and Chapter 16, Water Quality Toxics Management Strategy.

The results in Tables 4 and 5 indicate that nearly all of the values of water quality parameters for the Laboratory effluents were within the discharge standards and the water quality guidelines promulgated by the Commonwealth of Pennsylvania with a few variances as explained below.

TABLE 3
LIQUID EFFLUENT QUARTERLY AND
ANNUAL RADIOACTIVITY ANALYSIS
CY 1992

RADIOACTIVITY ANALYSES OF QUARTERLY COMPOSITED SAMPLES^(1,2)

Units 10^{-9} μ Ci/ml

<u>Sample Location</u>	<u>Activity Analysis</u>	<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
Bull Run	Alpha	≤ 4.1	≤ 1.6	≤ 1.6	≤ 2.1
	Beta	4.1 ± 2.8	≤ 1.8	≤ 1.7	≤ 1.9
	Sr-90	≤ 0.71	≤ 0.81	≤ 0.43	≤ 0.36
	Sr-89	≤ 1.9	≤ 3.6	≤ 1.6	≤ 3.2
Northeast Area	Alpha	< 6.3	≤ 3.1	≤ 1.5	≤ 3.3
	Beta	3.5 ± 2.8	≤ 2.2	≤ 1.7	3.3 ± 2.8
	Sr-90	≤ 0.72	≤ 0.74	≤ 0.46	≤ 0.93
	Sr-89	≤ 1.9	≤ 3.2	≤ 1.8	≤ 3.5
Precipitation	Alpha	≤ 0.80	≤ 1.2	≤ 0.85	≤ 0.85
	Beta	4.4 ± 1.8	≤ 1.7	4.0 ± 2.0	≤ 1.5
	Sr-90	≤ 0.97	≤ 0.74	≤ 0.46	≤ 1.1
	Sr-89	≤ 2.8	≤ 3.2	≤ 1.8	≤ 4.0
City Water	Alpha	≤ 1.3	≤ 0.80	≤ 1.4	≤ 1.6
	Beta	≤ 1.6	≤ 1.3	≤ 1.7	≤ 1.8
	Sr-90	≤ 0.67	≤ 1.2	≤ 0.48	≤ 1.1
	Sr-89	≤ 1.8	≤ 5.7	≤ 1.9	≤ 4.2

GAMMA RADIOACTIVITY ANALYSES OF ANNUAL COMPOSITED SAMPLES^(1,2)

Units: 10^{-9} μ Ci/ml

<u>Composite Sample</u>	<u>Co-60</u>	<u>Cs-137</u>	<u>Cs-134</u>
Bull Run	≤ 0.07	≤ 0.08	≤ 0.06
Northeast Area	≤ 0.07	≤ 0.06	≤ 0.08
Precipitation	≤ 0.16	≤ 0.15	≤ 0.16
City Water	≤ 0.09	≤ 0.08	≤ 0.11

⁽¹⁾ Uncertainties are based on counting statistics and are expressed at the 95% confidence level.

⁽²⁾ $\leq$ signifies the data are at or below the minimum detection level (MDL). The MDL is a function of the sample size, the chemical recovery yield, count time, and the presence of other dissolved materials. While the MDLs vary slightly, the values are all well below the Reference (4) limits for water in uncontrolled areas.

TABLE 4

SUMMARY OF BIMONTHLY AND QUARTERLY INFLUENT AND EFFLUENT WATER QUALITY ANALYSES, CY 1992

PARAMETER (a)	UNITS	STANDARD/ GUIDELINE (b)	MINIMUM DETECTABLE LEVEL	MUNICIPAL INFLUENT WATER			BULL RUN EFFLUENT			NORTHEAST AREA EFFLUENT			SANITARY EFFLUENT SAN-2			SANITARY EFFLUENT SAN-10		
				MIN	MAX	MEAN ± S.G.	MIN	MAX	MEAN ± S.G.	MIN	MAX	MEAN ± S.G.	MIN	MAX	MEAN ± S.G.	MIN	MAX	MEAN ± S.G.
Alkalinity	mg/l as CaCO ₃	>20 (d)	1	22	36	31 ± 6	32	40	36 ± 3	30	60	43 ± 13						
Aluminum	mg/l	0.5 (d)	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1						
Ammonia	mg/l	0.2 (d)(e)(f)	0.1	<0.1	<0.1	<0.1	<0.1	0.30	0.2 ± 0.1	<0.1	0.21	0.1 ± 0.1						
Arsenic	µg/l	100 (d)	5	<5	<5	<5	<5	<5	<5	<5	<5	<5						
Biochemical Oxygen Demand	mg/l	(g)	1										61	139	101 ± 32	210	280	245 ± 49
Chromium, Hexavalent	µg/l	11 (d)	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Copper	µg/l	20 (d)(h)(i)	10	<10	30	10 ± 10	<10	20	10	<10	40	20 ± 10						
Cyanide, Free	µg/l	5 (d)	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Fecal Coliform	colonies/100 ml	(d) (k)	1	<1	<1 (l)	N/A	<1	63 (l)	N/A	<1	22 (l)	N/A						
Fluoride	mg/l	2.0 (d)	0.1	1.0	1.4	1.2 ± 0.2	1.0	1.4	1.2 ± 0.2	1.1	1.2	1.2 ± 0.1						
Iron, Dissolved	µg/l	300 (d)	1	10	60	50 ± 20	40	140	80 ± 50	70	260	130 ± 90						
Iron, Total	µg/l	1500 (d)	100	60	<100	80 ± 20	90	150	110 ± 30	80	500	200 ± 180						
Lead	µg/l	5 (d)	5	<5	<5	<5	<5	<5	<5	<5	<5	<5						
Nickel	µg/l	220 (d) (h)	100	<10	<20	<20	<10	<20	<20	10	<20	<20						
Nitrate and Nitrite	mg/l	10 (d)	0.01	0.83	0.99	0.94 ± 0.07	0.97	2.53	1.46 ± 0.73	0.90	2.63	1.44 ± 0.80						
Oil & Grease	mg/l	(m)	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	5.7	23.8	13 ± 8	14	20	17 ± 4
Osmotic Pressure	mOsm/kg	50 (d)	5	<5	21.9	9 ± 8	<5	10.0	7 ± 3	5.4	18.4	9.6 ± 6.0						
Oxygen, Dissolved	mg/l	>4.0 (d)	0.1	4.2	9.5	7.7 ± 1.1	5.9	10.0	7.8 ± 1.0	5.1	9.3	7.8 ± 1.0	4.4	5.9	5.7 ± 1.0	5.4	6.2	5.8 ± 0.6
pH	pH units	6.0 - 9.0 (n)	0.1	6.5	7.6	6.9	6.1	7.9	7.0	6.7	8.1	7.4	8.0	9.0	8.2	8.5	8.6	8.6
Phenol	µg/l	5 (d) (o)	5	<5	5	<5	<5	<5	<5	<5	<5	<5	<5	82	50 ± 33	37	47	42 ± 7
Solids, Dissolved	mg/l	1500 (d)	1	160	312	252 ± 66	320	366	342 ± 20	260	776	465 ± 222						
Solids, Suspended	mg/l	(n) (p)	1	<1	3	<1	<1	19.8	<3	<1	39.3	<3						

TABLE 4

SUMMARY OF BIMONTHLY AND QUARTERLY INFLUENT AND EFFLUENT WATER QUALITY ANALYSES, CY 1992

PARAMETER (a)	UNITS	STANDARD/ GUIDELINE (b)	MINIMUM DETECTABLE LEVEL			MUNICIPAL INFLUENT WATER			BULL RUN EFFLUENT			NORTHEAST AREA EFFLUENT			SANITARY EFFLUENT SAN-2			SANITARY EFFLUENT SAN-10				
			MIN	MAX	MEAN ± S.G.	MIN	MAX	MEAN ± S.G.	MIN	MAX	MEAN ± S.G.	MIN	MAX	MEAN ± S.G.	MIN	MAX	MEAN ± S.G.					
Temperature	°F	(d) (q)	0.1			41	82	62 ± 13	<1	<1	46	84	64 ± 11	43	86	63 ± 13	54	76	67 ± 9	68	72	70 ± 3
Threshold Odor #	#	24 (d)	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total Organic Carbon	mg/l	(r)	1.0			2.2	8.9	4.5 ± 3.1	3.3	8.0	5.4 ± 2.1	3.7	7.7	5.7 ± 1.8								
Zinc	µg/l	150 (d) (h)	50			150	250	200 ± 40	200	230	210 ± 10	140	200	170 ± 30								

(a) Additional samples of Municipal Influent and Bull Run and Northeast Area Effluent were collected as part of the RFI.

(b) The standards or guidelines noted are for the Bull Run and Northeast Area effluent and do not apply to sanitary effluent.

Applicable sanitary effluent standards or guidelines are pH: 5.5 to 9.0 and oil and grease: 100 mg/l per West Mifflin Ordinance 717.

(c) Average values preceded by < contain at least one less than minimum detection level value in the analysis results.

(d) Based on Pennsylvania Code, Title 25, Department of Environmental Resources, Chapter 93, Water Quality Standards or the fish and aquatic life criteria for continuous concentrations provided in Chapter 16, Water Quality Toxics Management Strategy.

(e) Guideline calculated using median pH and temperature measurements for July through September. Guideline represents the average total ammonia concentration over any 300 consecutive days.

(f) The maximum calculated concentration guideline for ammonia is 0.7 mg/l based on Pennsylvania Code, Title 25, Department of Environmental Resources, Chapter 93, Water Quality Standards.

(g) No specific guideline available; however, this parameter provides an indication of oxygen demanding substances present in the sanitary effluent.

(h) Guideline calculated using a hardness value of 150 mg/l to determine the fish and aquatic life criteria for continuous concentrations.

(i) The maximum calculated concentration guideline for copper is 26 µg/l based on Pennsylvania Code, Title 25, Department of Environmental Resources, Chapter 16, Water Quality Toxics Management Strategy.

(j) Detection limit changed due to change in analytical procedure used to analyze the sample.

(k) Guideline is 200 colonies/100 ml for May 1 to September 30 or 2000 colonies/100 ml for October 2 to April 30 for the geometric mean of five consecutive samples collected on different days.

(l) Value noted is the maximum geometric mean of five consecutive samples.

(m) Standard is 15 mg/l as a monthly average and 30 mg/l as an instantaneous maximum.

(n) Based on the National Pollutant Discharge Elimination System Permit for the Bettis Atomic Power Laboratory issued July 24, 1987 and revised December 15, 1987.

(o) Phenol concentrations generally are higher in sanitary effluents relative to storm effluents since phenolic compounds are typically found in disinfecting and cleaning solutions.

(p) Standard is 25 mg/l as a monthly average and 50 mg/l as a daily maximum.

(q) Temperature guideline varies with each month or part of month during the year.

(r) No specific guideline available; however, parameter provides an indication of the amount of organic material present in the effluent.

TABLE 5

**ANNUAL INFLUENT AND EFFLUENT
WATER QUALITY ANALYSES - CY 1992^(a)**

PARAMETER	UNITS	GUIDELINE	MUNICIPAL INFLUENT WATER	BULL RUN EFFLUENT	NORTHEAST AREA EFFLUENT
Antimony	µg/l	(b)(c)	<3	<3	<3
Beryllium	µg/l	(d)	<0.3	<0.3	<0.3
Cadmium	µg/l	(b)(e)	<0.1	<0.1	<0.1
Chemical Oxygen Demand	mg/l	(d)	2.0	4.4	8.4
Chloride	mg/l	250(b)	24	32	66
Chromium, Total	µg/l	(b)(f)	<5	<5	<5
Color	Pt-Co	50(b)	<10	<10	<10
Hardness, CaCO ₃	mg/l	(d)	150	150	184
Herbicide-2,4-D	µg/l	(d)	<0.980	<0.980	<0.980
Herbicide-Silvex	µg/l	(d)	<0.098	<0.098	<0.098
Manganese	µg/l	1000(b)	<15	<15	<15
Mercury	µg/l	(b)(g)(h)	<0.2	<0.2	<0.2
Organic Nitrogen	mg/l	(d)	<1.0	<1.0	<1.0
PCBs	µg/l	(b)(g)(i)	<1.00	<1.00	<1.00
Pesticides	µg/l	(b)(j)	<0.050	<0.050	<0.050
Pesticides	µg/l	(b)(g)(k)	<0.100	<0.100	<0.100
Pesticides	µg/l	(b)(g)(l)	<1.00	<1.00	<1.00
Selenium	µg/l	(b)(m)	<0.5	<0.5	<0.5
Silver	µg/l	(b)(n)	<0.2	<0.2	<0.2
Sodium	mg/l	(d)	<1.0	67	67
Specific Conductance	µmhos/cm	(d)	474	534	720

TABLE 5

**ANNUAL INFLUENT AND EFFLUENT
WATER QUALITY ANALYSES - CY 1992^(a)**

PARAMETER	UNITS	GUIDELINE	MUNICIPAL INFLUENT WATER	BULL RUN EFFLUENT	NORTHEAST AREA EFFLUENT
Sulfates	mg/l	250(b)	87	137	136
Surfactants	mg/l	(d)	<0.1	<0.1	<0.1
Thallium	µg/l	(b)(o)	<1	<1	<1
Turbidity	NTU	100(b)	<5	<5	<5

- (a) Additional samples of Municipal Influent and Bull Run and Northeast Area effluent were collected as part of the RFI.
- (b) Based on Pennsylvania Code, Title 25, Department of Environmental Resources, Chapter 93, Water Quality Standards or the fish and aquatic life criteria provided in Chapter 16, Water Quality Toxics Management Strategy.
- (c) The continuous and maximum concentration guidelines for antimony are 219 µg/l and 1095 µg/l respectively.
- (d) No specific guideline available.
- (e) Based on a hardness value of 150 mg/l, the calculated continuous and maximum concentration guidelines for cadmium are 1.6 µg/l and 6.2 µg/l respectively.
- (f) Based on a hardness value of 150 mg/l, the calculated continuous and maximum concentration guidelines for total chromium are 300 µg/l and 2400 µg/l respectively.
- (g) In some cases, a minimum detectable level which was higher than the guideline was encountered even though the minimum detection level recommended in Pennsylvania Code, Title 25, Department of Environmental Resources, Chapter 16, Water Quality Toxics Management Strategy was achieved. As a result, a direct comparison to the guideline cannot be made; however, these compounds are not believed to be present in the effluent.
- (h) The continuous and maximum concentration guidelines for mercury are 0.012 µg/l and 2.4 µg/l respectively.
- (i) The continuous and maximum concentration guidelines for PCBs are 0.014 µg/l and 2 µg/l respectively.
- (j) Pesticide compounds include aldrin, alpha-BHC, beta-BHC, delta-BHC, gamma-BHC, and heptachlor epoxide. The continuous and maximum concentration guidelines for these compounds range between 0.08 µg/l and 2 µg/l respectively.
- (k) Pesticide compounds include 4,4'-DDT, 4,4'-DDE, 4,4'-DDD, dieldrin, beta-endosulfan, endosulfan sulfate, endrin, and endrin aldehyde. The continuous and maximum concentration guidelines for these compounds range between 0.001 µg/l and 2.5 µg/l respectively.
- (l) Pesticide compound includes toxaphene. The continuous and maximum concentration guidelines for this compound are 0.0002 µg/l and 0.73 µg/l respectively.
- (m) The continuous and maximum concentration guidelines for selenium are 5 µg/l and 20 µg/l respectively.
- (n) Based on a hardness value of 150 mg/l, the continuous and calculated maximum concentration guidelines for silver are 0.2 µg/l and 8.2 µg/l respectively.
- (o) The continuous and maximum concentration guidelines for thallium are 18 µg/l and 90 µg/l respectively.

The influent city water zinc levels were above the water quality guideline promulgated by the Commonwealth of Pennsylvania in most of the samples collected. Zinc levels in the effluents were attributed to the zinc levels found in the influent water.

On a few occasions, the temperature of the Bull Run effluent and Northeast Area effluent exceeded the guideline. These elevated temperature levels were attributed primarily to the coincident high temperature of the influent municipal water supply which also exceeded the guideline on several occasions.

The average ammonia levels in the Bull Run and Northeast Area effluent did not exceed the calculated continuous concentration guideline. However, the maximum ammonia levels in the Bull Run effluent (0.30 mg/l) and Northeast Area effluent (0.21 mg/l) exceeded the calculated continuous concentration guideline (0.20 mg/l) but did not exceed the calculated maximum concentration guideline (0.7 mg/l). Therefore, the ammonia levels in the effluent were considered to be within the concentration guidelines.

The maximum copper level in the Northeast Area effluent (40 $\mu\text{g/l}$) exceeded the calculated continuous concentration guideline (20 $\mu\text{g/l}$) and calculated maximum concentration guideline (26 $\mu\text{g/l}$). An investigation was conducted and it was determined that the source of the high copper level was a cooling tower that discharged to the Northeast Area Outfall. The operation of the cooling tower was found to be concentrating the copper levels found in the municipal influent makeup water. Cooling tower operations were modified to minimize the concentrating effects and follow up sampling indicated that these efforts were successful with the resulting average concentration in the effluent equalling the calculated continuous concentration guideline (20 $\mu\text{g/l}$). In addition, on one occasion, the copper level in the municipal

influent (30 $\mu\text{g/l}$) was also found to exceed the calculated continuous (20 $\mu\text{g/l}$) and maximum (26 $\mu\text{g/l}$) concentration guidelines.

Based on the above, it was concluded that the water discharged from the Bettis Site was of sufficiently high quality that there was no adverse impact on the environment.

B. GROUND WATER

During 1992, the ground water monitoring program consisted of the collection of water samples from springs onsite and offsite and selected well locations. All of the non-radiological ground water samples from wells and springs were collected as part of the RFI.

The purpose of the ground water monitoring program is to determine the impact of operations on the groundwater so that the risk, if any, to human health and the environment can be assessed.

Sources and Treatment

The potential source of radioactivity and chemical constituents in the site's ground water is from operations conducted in the 1950s and 1960s. During that time small amounts of radioactivity were released from a few isolated locations onsite as a result of minor breaches in containers and underground pipes containing radioactive materials. In recent years, vigorous efforts to prevent recurrence of these problems have been successful, and much of the soil associated with these past releases has been removed. However, there remain some areas of soil within the Laboratory confines that might release very small amounts of radioactivity from time to time into surface water and groundwater. Monitoring is conducted to detect any influence of this activity on water quality.

The chemical contaminants originate from the past practice of discharging or disposing onsite of small amounts of spent solvents, typically degreasing agents such

as tetrachloroethylene. Since the early 1970s, these materials have been disposed of off-site.

As part of the 1990 Administrative Order on Consent (Consent Order) under RCRA section 3008(h), the EPA agreed that current conditions onsite do not require implementation of interim measures (i.e., immediate corrective actions) since site conditions do not present an imminent substantial endangerment to human health or the environment.

Ground Water Monitoring

The samples and analyses specified below constitute the minimum samples and analyses conducted at Bettis during 1992. The well locations and onsite springs are shown on Figure 3.

Radiological: Ground water samples, both filtered and non-filtered from springs (on and offsite) and selected well locations were collected at least annually and analyzed for gross alpha, gross beta, radiostrontium and gamma emitters.

Non-Radiological: Ground water samples from springs (on and offsite) and other ground seepage were collected as part of the RFI.

Ground Water Monitoring Results and Conclusions

Radiological: The results of the radioactivity analyses of the groundwater samples are summarized in Table 6 and Table 7. The radioactivity levels in onsite springs were consistent with radioactivity levels remote from the Bettis site.

Grab samples of several runoff locations from the Inactive Waste Site were analyzed for the parameters listed above. The results indicate the presence of natural uranium and Strontium-90. The maximum level of Strontium-90 was $9.5 \times 10^{-9} \mu\text{Ci/ml}$. This level is less than 4% of the limit of Reference (4) for Strontium-90 in water in unrestricted areas. These results are

consistent with sample results from past years.

Specific radionuclide analyses of all ground water samples showed that the levels of Cesium-134, Cesium-137, and Cobalt-60 were less than minimum detectable and were indistinguishable from background levels in ground water remote from the Bettis site.

The Strontium-90 analyses of ground water showed less than the minimum detectable levels with the exception of the Buono Spring samples which were near detection levels.

Eleven specifically selected ground water monitoring wells were sampled in 1992. Wells 44, 44A, 48, 56, 67, and 68 were recently installed as part of the RFI. The gross alpha, gross beta, and thorium radioactivity results for the above mentioned wells are consistent with background levels of natural radioactivity in ground water for this area. Results for Strontium-90 and gamma emitters were all less than minimum detection levels.

The results for Wells 1, 18, 26, 34, and 41 are consistent with data from previous years. The gross alpha, gross beta, and thorium radioactivity results are consistent with background levels of natural radioactivity in ground water for this area. Results for Strontium-90 and gamma emitters were all less than minimum detection levels.

The isotopic uranium results indicate the presence of natural uranium in wells 1, 18, 26, 34, 41, 56, 67, and 68. The maximum concentrations of Uranium 233/234 and Uranium-238 in these samples were $8.2 \times 10^{-9} \mu\text{Ci/ml}$ and $6.3 \times 10^{-9} \mu\text{Ci/ml}$, respectively. These values are less than 1% of NRC limits in Reference (4).

Non-Radiological: The validated results of samples collected during the RFI from the onsite Northeast, Buono, R-Q-20 and RH springs reveal the presence of tetrachloroethylene and its degradation

TABLE 6

Summary of Non-Filtered Ground Water Radioactivity Results, CY 1992⁽¹⁾

Sample Location	Sample Type	Alpha	Beta	Sr-90	Cs-137	Cs-134	Co-60
Buono Spring	Onsite Spring	<7.4	<4.7	0.85 ± 0.81	<5.0	<5.4	<5.4
Buono Farm Spring Stream	Onsite Spring	<5.9	<4.4	<0.86	<5.0	<5.4	<5.4
Bull Run Spring	Onsite Spring	<6.6	<4.6	<1.4	<5.1	<5.9	<5.7
Northeast Area Spring	Onsite Spring	<6.3	<4.3	<.84	<2.1	<5.4	<5.3
CY-Building Spring	Onsite Spring	<4.1	<3.9	<1.0	<5.2	<5.5	<5.7
Mine Drainage	Offsite Spring	<4.0	<3.9	<0.83	<5.1	<5.1	<5.4
Buono Spring prior to Bull Run Confluence	Onsite Spring + Runoff	<8.5	<4.8	1.6 ± 1.2	<5.2	<5.4	<5.2
Bull Run - Northeast ⁽²⁾ Confluence	Onsite Spring + Runoff + Effluent	<3.1	4.6 ± 2.8	<0.92	<4.8	<5.3	<5.1
Gasowski Farm (Control)	Offsite Spring	<3.4	7.2 ± 3.0	<0.79	<5.1	<5.2	<5.2
Victory Hill (Control)	Offsite Spring	<3.0	<2.1	<0.69	<4.8	<5.1	<5.2
Spring Near TLD #Q20	Onsite Spring	<5.3	<2.3	<0.94	<5.1	<5.8	<5.9

(1) Units are 10⁻⁹ µCi/ml.

(2) This sample includes surface water from the Bull Run and Northeast Area streams.

TABLE 7

Summary of Filtered Ground Water Radioactivity Results, CY 1992⁽¹⁾

Sample Location	Sample Type	Alpha	Beta	Sr-90	Cs-137	Cs-134	Co-60
Buono Spring	Onsite Spring	<7.3	<4.7	<0.90	<4.8	<5.8	<5.8
Buono Farm Spring Stream	Onsite Spring	<5.9	<4.4	<0.86	<5.1	<5.4	<5.3
Bull Run Spring	Onsite Spring	<6.9	<4.6	<2.9	<5.1	<6.0	<4.6
Northeast Area Spring	Onsite Spring	<6.7	<4.4	<0.68	<4.5	<5.6	<5.6
CY-Building Spring	Onsite Spring	<3.9	<3.8	<0.85	<4.9	<5.6	<4.8
Mine Drainage	Offsite Spring	<3.8	8.2 ± 5.0	<0.93	<5.0	<5.6	<5.8
Buono Spring prior to Bull Run Confluence	Onsite Spring + Runoff	<7.5	<4.7	1.3 ± 1.2	<4.8	<5.3	<5.1
Bull Run - Northeast ⁽²⁾ Confluence	Onsite Spring + Runoff + Effluent	<3.1	3.6 ± 2.7	<0.85	<4.7	<5.0	<5.6
Gasowski Farm (Control)	Offsite Spring	<3.4	4.9 ± 3.0	<0.66	<5.6	<6.0	<5.9
Victory Hill (Control)	Offsite Spring	<2.7	<2.0	<0.70	<4.8	<5.1	<5.2
Spring Near TLD #Q20	Onsite Spring	<5.3	3.6 ± 3.0	<0.66	<5.6	<6.0	<5.9

(1) Units are 10⁻⁹ µCi/ml.

(2) This sample includes surface water from the Bull Run and Northeast Area streams.

products. The levels found are consistent with the historical data from the springs with the exception of the tetrachloroethylene level in the RH spring which increased from a previous maximum of 0.280 mg/l to 0.520 mg/l. However, this concentration of tetrachloroethylene is consistent with the levels detected in other nearby springs such as Buono Spring. The other organic analyses results for parameters including base/neutrals and acids, pesticides and polychlorinated biphenyls were all less than their respective minimum detection limits. The results of the inorganic analyses performed on the spring samples were consistent with the previously detected values.

Summaries of the results of the RFI samples including the spring samples are reported to the EPA and PA-DER in the Bimonthly Progress Reports required by the Consent Order. The analytical results and an interpretation of their significance will be contained in the Draft RFI Report to be submitted to the regulatory agencies in December 1993.

C. AIRBORNE EFFLUENTS

The purpose of the airborne effluent monitoring program is to determine the effectiveness of control methods, measure concentrations in effluents for comparison with applicable standards and natural background levels, and to assess the effect of any inadvertent releases to the environment.

Sources and Treatment

All areas of the Laboratory wherein unencapsulated radioactive materials were handled were equipped with wet scrubbers or filtered exhaust systems. The high efficiency particulate air (HEPA) filters were preceded as necessary by prefilters to remove dust and large particulates. Charcoal filters were installed in select air handling systems to control gaseous radioactivity releases. HEPA filters were tested upon installation and at least annually thereafter to assure that high

removal efficiencies (99.95%) are maintained.

Sources of airborne effluents not related to radiological operations were heating systems, such as boilers and space heaters which use combustible gas and oil, and small scale operations involving chemicals. Fuel-burning and combustion equipment at the Laboratory were operated in compliance with their Allegheny County Air Pollution Operating Permits.

Airborne Monitoring

The samples and analyses specified below constitute the minimum samples and analyses conducted at Bettis during 1992.

All radioactive airborne effluents from the Laboratory were continuously monitored using fixed-filter air stations operated at a constant, metered flow rate under isokinetic sampling conditions. Particulate radioactivity in the effluents was collected on a 0.8 micron millipore filter. Gaseous radionuclides, primarily Iodine-131 and Antimony-125, were collected on a charcoal impregnated filter. Filters were collected and analyzed at least weekly for gross alpha and gross beta radioactivity with the exception of the filter from an inactive L-Building facility which is collected and analyzed quarterly. Additionally, the charcoal filters were analyzed for gamma emitters. Quarterly, the particulate filters from each exhaust were composited and analyzed for gross alpha and gross beta radioactivity. The composites were also analyzed for gamma emitters. Select filters were analyzed for Strontium-89, -90. In addition, sampling for the short half-life (55 seconds) Radon-220 from thorium handling areas was performed annually using a filter and charcoal cold-trap method. The Laboratory's radiological exhaust monitoring systems are in compliance with the EPA's requirement of Reference (6).

Air in the environment remote from Bettis site was monitored continuously using two

fixed-filter air samplers positioned offsite at Large, PA and West Mifflin, PA which are approximately 5 miles and 1.5 miles, respectively, from Bettis. The sampling station at Large is in a generally upwind location from Bettis and the West Mifflin station is in a generally downwind direction. Environmental air filters were collected and analyzed weekly for gross alpha and gross beta radioactivity.

There were no major chemical operations at the Laboratory during 1992 which might contribute significant quantities of non-radioactive airborne pollutants. Estimates of particulate and gaseous emissions for systems involving nonradioactive materials were used to ensure that applicable standards were met.

Airborne Analyses

The radioanalytical techniques employed were sufficiently sensitive to measure radioactivity below background radioactivity levels of the air in the Pittsburgh Metropolitan Area. It was conservatively assumed for airborne effluents which were below minimum detection levels that the exhaust air contained radioactivity at the minimum detection level. Although comparisons of the Laboratory's airborne effluent results were made to the background radioactivity levels measured at remote offsite locations no background corrections were made to the Laboratory's release results.

The sample particulate filters were analyzed for alpha and beta radioactivity at approximately 48 hours after collection to permit the decay of the natural airborne, short-lived radon-thoron daughter products accumulated on the filters. The alpha and beta radioactivities were measured using a lead-shielded, gas-flow proportional counter. If any weekly or semi-weekly sample result were to exceed half of the concentration guide for airborne radioactivity in uncontrolled regions (Reference (4)), the stack sample would be analyzed for specific radionuclides, the cause of the release of radioactivity would

be identified, and actions would be taken to reduce the amount of radioactivity released to as low as practicable.

The sample filters from each exhaust area were composited and analyzed quarterly for alpha and beta radioactivity as described above as well as analyzed for gamma emitters. The results of these analyses were used to provide a record of the long-lived particulate radioactivity releases from the Laboratory. Any sample composite result exceeding alpha or beta radioactivity levels of $2.0 \times 10^{-14} \mu\text{Ci/ml}$ was investigated. This level is the most restrictive concentration guide that exists for any single radionuclide in air which decays by alpha emission or spontaneous fission and it is also well below the most restrictive concentration guide for any beta and gamma-emitting radionuclide that is present in radiological operations or in the environment (Reference (4)). Gamma analyses were conducted using a high resolution Ge(Li) or germanium detector and a multichannel analyzer. A typical minimum detection level for Cesium-137 was $5.0 \times 10^{-16} \mu\text{Ci/ml}$. Alpha spectrometry was performed using a solid state silicon surface barrier detector and a multichannel analyzer after elemental separation and mount preparation. In addition, radiostrontium analyses were performed on selected quarterly filter composites from potential source areas. A typical minimum detection level for Strontium-90 was $0.8 \times 10^{-15} \mu\text{Ci/ml}$.

The charcoal impregnated air filters were analyzed weekly for alpha and beta radioactivity and for specific gamma emitting radionuclides. Gamma analyses were performed using a Ge(Li) gamma spectrometry system. A typical minimum detection level for gaseous Iodine-131 was $2.0 \times 10^{-14} \mu\text{Ci/ml}$.

The charcoal filters used for measuring Radon-220 releases were analyzed using the high resolution Ge(Li) detector. The Radon-220 concentrations were determined from the characteristic photo-peak of Lead-212 which is the principal

gamma emitting product of Radon-220 decay.

Airborne Monitoring **Results and Conclusions**

Radiological: The results of the releases of particulate and gaseous radioactivity from the Laboratory during 1992 are summarized in Table 8. Specific results from air effluent monitoring are discussed below.

The total airborne particulate and gaseous radioactivity released from the Laboratory during 1992, with radionuclide decay half-lives greater than one day, was less than 0.4 Curie. Of this total, almost all of the radioactivity was attributed to the release of Krypton-85, a gaseous material that does not concentrate in the environment. Less than 5×10^{-6} Ci was attributed to the release of particulate radioactivity.

The average concentration of airborne particulate gross alpha radioactivity released during 1992 was less than 8.73×10^{-16} $\mu\text{Ci/ml}$ and the average concentration of airborne particulate gross beta radioactivity was less than 3.87×10^{-15} $\mu\text{Ci/ml}$. These concentrations are well below 1% of the most restrictive concentration guide given in Reference (4) for Thorium-232 and Strontium-90 in air of uncontrolled areas.

By comparison, the average gross alpha and gross beta particulate airborne radioactivity measured for environmental air at the offsite locations was 1.5×10^{-15} $\mu\text{Ci/ml}$ and 2.2×10^{-14} $\mu\text{Ci/ml}$, respectively. Thus, on the average, the gross alpha and gross beta radioactivity concentrations in air emitted from the Laboratory were 1.7 and 6 times, respectively, less than background radioactivity levels in environmental air due to the Laboratory's filtration systems.

The primary contributor to the long-lived (greater than one day half-life) gaseous radioactivity released was Krypton-85 which has a half-life of 10.7 years.

Krypton-85 was released at an average concentration of 1.52×10^{-9} $\mu\text{Ci/ml}$ which is 0.51% of the limit for the maximum radioactivity concentration permitted for air in uncontrolled areas given in Reference (4). Release data for other gaseous radioactivity, as compared to their respective limits, are shown in Table 8. All gaseous radioactivity concentrations were small fractions of the applicable limits.

Based on the results of Radon-220 effluent measurements and pathway evaluations, the average concentration of the releases at the site boundary was estimated to be approximately 4.9×10^{-11} $\mu\text{Ci/ml}$. This level is well below the concentration guide of 1.0×10^{-8} $\mu\text{Ci/ml}$ for Radon-220 in the air of uncontrolled areas. The releases of the very short-lived (55 seconds) Radon-220 gaseous radioactivity from the Laboratory resulted in no adverse effect on the surrounding environment and did not result in radiation exposures above the EPA and DOE radiation dose standards, as shown in Table 13 of Section I.

The results of the Laboratory's airborne radiological effluent monitoring for 1992 have shown that the amount of airborne radioactivity released was too small to result in any measurable change in the background radioactivity levels in the environment. The concentrations of the particulate and gaseous radioactivity released from the Bettis site during 1992 were well below the applicable standards for radioactivity in environmental air. Furthermore, the estimated radiation dose to any member of the public from the airborne radioactivity released was too low to measure and was significantly below the radiation protection standards established by the EPA in Reference (6).

Non-radiological: The results of evaluations and calculations for the Laboratory's sources of airborne pollutants from areas where no radioactive materials were involved are summarized below:

TABLE 8
SUMMARY OF RADIOACTIVITY IN AIRBORNE EFFLUENTS
CY 1992

<u>Activity</u>	<u>Total Activity (μCi)</u>	<u>Average Concentration (μCi/ml)</u>	<u>Limit⁽¹⁾ (μCi/ml)</u>	<u>% of Limit</u>
Alpha	≤ 0.78	$\leq 8.73 \times 10^{-16}$	$1.0 \times 10^{-12(2)}$	0.087
Beta	≤ 3.46	$\leq 3.87 \times 10^{-15}$	$3.0 \times 10^{-11(3)}$	0.013
Sb-125	≤ 4.03	$\leq 2.40 \times 10^{-14}$	9.0×10^{-10}	0.003
I-131	≤ 3.44	$\leq 2.10 \times 10^{-14}$	1.0×10^{-10}	0.021
I-129 ⁽⁴⁾	0.80	3.48×10^{-15}	2.0×10^{-11}	0.017
Kr-85 ⁽⁴⁾	3.50×10^5	1.52×10^{-9}	3.0×10^{-7}	0.51
Pu-238	$\leq 4.33 \times 10^{-3}$	$\leq 1.44 \times 10^{-16}$	7.0×10^{-14}	0.21
Eu-152	≤ 0.238	$\leq 2.15 \times 10^{-15}$	4.0×10^{-10}	5.37×10^{-4}
U-233	≤ 0.016	$\leq 6.22 \times 10^{-17}$	4.0×10^{-12}	1.55×10^{-3}
Cs-137	≤ 0.14	$\leq 7.04 \times 10^{-16}$	5.0×10^{-10}	1.41×10^{-4}

Total Particulate Radioactivity: 4.6×10^{-6} Curies

Total Gaseous Radioactivity: ≤ 0.4 Curies⁽⁵⁾

⁽¹⁾ NRC limit as prescribed in Title 10, Code of Federal Regulations, Part 20 for air in uncontrolled regions.

⁽²⁾ Based on Th-232

⁽³⁾ Based on Sr-90

⁽⁴⁾ Discharges calculated

⁽⁵⁾ Gaseous radioactivity with radionuclide decay half-lives greater than one day.

(1) Heating System Exhaust

The boilers and space heating systems at the Laboratory were fueled with natural gas and No. 2 distillate fuel oil. The heating systems were operated in accordance with their Allegheny County Air Pollution Source Operating Permits. Conservative estimates of the pollutant releases, based on the rated capacity of the heating systems and fuel type, were made as part of the operating permit applications. These calculations show that the airborne emissions from the Laboratory's heating systems are well below the applicable local discharge limits identified in Reference (7).

(2) Exhausts from Laboratory Fume Hoods

Chemical vapors collected by the Laboratory's fume hoods are similar to those from other research labs engaged in analytical chemistry and development efforts. Air exhausted from the Laboratory's fume hoods was treated, as required, by filtration or wet scrubbers to minimize the release of such materials. On the basis of the small scale of the operations, the type of material handled, and the treatment provided, it was concluded that the Laboratory fume hood exhausts did not have any adverse effect on the environment.

(3) Asbestos Removal Work

All asbestos removal work was completed in compliance with the requirements of 40 CFR 61 Subpart M and Section 1001, Chapter X, Article XX, Air Pollution Control, Allegheny County Health Department to limit the discharge of asbestos fibers to the environment.

(4) Chemically Contaminated Areas

As part of the RFI, air samples were taken at the Inactive Waste Site and the Bettis Landfill for airborne asbestos and PCBs. Organic vapor monitoring was also conducted at the two locations. Summaries of the results of the RFI samples will be reported to the EPA and PA-DER in the Bimonthly Progress Reports required by the Consent Order. The analytical results and an interpretation of the significance will be contained in the Draft RFI Report to be submitted to the regulatory agencies in December 1993.

D. STREAM SEDIMENT, SOIL AND VEGETATION

The purpose of the stream sediment, soil and vegetation monitoring program is to determine if any long-term buildup of radioactivity or chemicals is occurring in the sediment and the vegetation in and along the site's effluent streambeds.

Soil sampling was conducted to monitor for potential migration of radioactivity from the Inactive Waste Site.

Sources

Surface or ground water flows containing residual radioactivity or chemicals from past operations could deposit these materials in the soil.

Sediment, Soil and Vegetation Monitoring

Radiological: Routine sediment samples were collected semiannually from the streambeds of the site's effluent streams and from an offsite control stream, as shown as Figure 4. Six sediment samples were collected along the length of Bull Run and Thompson Run. One sample each was collected from the Northeast Area effluent stream, Buono Spring and the control stream at Streets Run. The control stream at Streets Run is remote from the

FIGURE 4 SEDIMENT AND VEGETATION MONITORING LOCATIONS

Bettis site and there are no known nuclear or radiological facilities in operation which release radioactive waste effluents to the control stream.

Vegetation growing in and along the site's effluent streams, Buono Spring and from an offsite control stream was collected at the same locations as the routine sediment collection locations. Vegetation samples were also collected at locations outside of streams and flood plains.

In addition, two onsite manholes and the catch basins at the Bull Run and Northeast Area monitoring stations were sampled for sediment at least annually if sediment was available.

Soil samples were collected from six locations down gradient of the Inactive Waste Site on Valley Welding Supply Company Property. The Inactive Waste Site and the Valley Welding Supply Company property are shown in Figure 5. A background soil sample was also collected.

Duplicate aliquots of sediment samples were analyzed for gross alpha and gross beta radioactivity. Single aliquots were analyzed for Strontium-89 and -90, and gamma emitters. The vegetation samples were analyzed for Strontium-89 and -90 activity and gamma emitters.

Non-Radiological: Some soil samples were collected prior to proposed excavation and construction activities. However, most of the soil and sediment samples were collected in 1992 as part of the RFI.

Sediment, Soil and Vegetation Analyses

Radiological: The sediment samples were oven-dried, milled, homogenized, and screened to remove large stones and extraneous materials. The vegetation samples were air dried, chipped, and blended. The homogenized samples were uniformly distributed on a planchet for alpha and beta counting. The alpha and

beta radioactivities were measured by counting the dried samples using a lead shielded, gas-flow proportional counter.

Gamma analyses were performed on the sediment and vegetation by counting the dried samples with a gamma spectrometry system. Typical minimum detectable concentrations for the gamma analyses ranged from 0.03×10^{-6} to $0.09 \times 10^{-6} \mu\text{Ci/gm}$ for sediment and 0.09×10^{-6} to $0.36 \times 10^{-6} \mu\text{Ci/gm}$ for vegetation samples depending on sample size, counting time, and gamma ray energy.

Radiostrontium analyses of the samples were performed utilizing a standard strontium radiochemical procedure. The strontium was chemically separated and the sample was counted for beta radioactivity using the low background proportional counter described above. Typical minimum detectable concentrations for Strontium-90 ranged from 0.1×10^{-6} to $0.6 \times 10^{-6} \mu\text{Ci/gm}$ depending on sample size and chemical yield.

Non-Radiological: The sediments and soils were analyzed by an offsite vendor using EPA approved methods.

Sediment, Soil, and Vegetation Monitoring Results and Conclusions

Radiological: The results of environmental radioactivity analyses of sediments and vegetation collected during 1992 from the site effluent streams and offsite control stream are summarized in Tables 9, 10, and 11, respectively.

The alpha radioactivity levels in the Bull Run/Thompson Run streams, the Northeast Area stream and the Buono Spring sediment samples were consistent with the alpha radioactivity levels in the control stream sediment.

The beta radioactivity levels in the Northeast Area stream and the Buono Spring sediment samples were consistent

FIGURE 5
INACTIVE WASTE SITE AND ADJACENT AREA

TABLE 9
STREAM SEDIMENT RADIOACTIVITY ANALYSES, CY 1992
Range of Concentrations^(1,2), x 10⁻⁶ μ Ci/gm dry weight

Sediment Analyses	Bull Run/Thompson Run⁽³⁾	Buono Spring⁽⁴⁾	Northeast Area⁽⁵⁾	Control Stream⁽⁶⁾
Alpha Radioactivity	≤ 2.8 to 15 ± 5.7	≤ 3.6 to 12 ± 5.2	8.0 ± 5.3 to 15 ± 6.1	≤ 3.1 to 12 ± 5.7
Beta Radioactivity	6.9 ± 3.2 to 34 ± 3.8	14.0 ± 3.3 to 32 ± 3.5	28 ± 4.4 to 30 ± 3.8	20 ± 2.6 to 29 ± 3.8
Cesium-137	0.39 ± 0.10 to 4.6 ± 2.2	< 0.092 to 0.11 ± 0.08	≤ 0.078	≤ 0.076
Cesium-134	≤ 0.083	≤ 0.095	≤ 0.088	≤ 0.075
Cobalt-60	≤ 0.080	≤ 0.088	≤ 0.079	≤ 0.073
Strontium-90	≤ 0.33	≤ 0.10	≤ 0.14	≤ 0.091
Strontium-89	≤ 0.89	≤ 0.18	≤ 0.19	≤ 0.19

- (1) Uncertainties are based on counting statistics at the 95% confidence level.
(2) $\leq$ signifies at or below the minimum detection level (MDL).
(3) Ranges are for 16 samples. Single MDL values indicate maximum results for 16 samples.
(4) Ranges are for 2 samples. Single MDL values indicate maximum results for 2 samples.
(5) Ranges are for 4 samples. Single MDL values indicate maximum results for 4 samples.
(6) Ranges are for 2 samples. Single MDL values indicate maximum results for 2 samples.

TABLE 10

STREAM VEGETATION RADIOACTIVITY ANALYSES, CY 1992
Range of Concentrations^(1,2), x 10⁻⁶ μ Ci/gm dry weight

<u>Vegetation Analyses</u>	<u>Bull Run/Thompson Run⁽³⁾</u>	<u>Buono Spring⁽⁴⁾</u>	<u>Northeast Area⁽⁴⁾</u>	<u>Control Stream⁽⁴⁾</u>
Strontium-89	≤3.3	≤0.67	≤0.34	≤0.56
Strontium-90	<0.11 to 0.28 ± 0.11	≤0.13	0.34 ± 0.11	≤0.077
Cesium-137	≤0.21	≤0.12	≤0.20	≤0.13
Cesium-134	≤0.24	≤0.15	≤0.23	≤0.15
Cobalt-60	≤0.23	≤0.16	≤0.26	≤0.15

-
- (1) Uncertainties are based on counting statistics at the 95% confidence level.
(2) ≤ signifies at or below the minimum detection level (MDL).
(3) Ranges are for 6 stream samples. Single MDL values indicate maximum results for 6 stream samples.
(4) Single samples of stream vegetation were collected for these.

TABLE 11

VEGETATION RADIOACTIVITY ANALYSES, CY 1992⁽¹⁾

Range of Concentrations^(2,3), x 10⁻⁶ μ Ci/gm dry weight

Vegetation Analyses	Bull Run/Thompson Run⁽⁴⁾	Buono Spring⁽⁵⁾	Northeast Area⁽⁵⁾	Control Stream⁽⁵⁾
Strontium-89	≤0.64	≤0.11	≤0.069	≤0.47
Strontium-90	≤0.055 to 0.46 ± 0.11	≤0.058	0.38 ± 0.071	≤0.19
Cesium-137	≤0.23	≤0.13	≤0.17	≤0.24
Cesium-134	≤0.29	≤0.17	≤0.19	≤0.30
Cobalt-60	≤0.31	≤0.18	≤0.18	≤0.27

-
- (1) These locations are adjacent to the routine sample points, but they are situated outside of the stream beds and the flood plains of the stream beds.
 - (2) Uncertainties are based on counting statistics at the 95% confidence level.
 - (3) ≤ signifies at or below the minimum detection level (MDL).
 - (4) Ranges are for 6 stream samples. Single MDL values indicate maximum results for 6 stream samples.
 - (5) Single samples of stream vegetation were collected for these.

with the beta radioactivity levels in the control stream sediment.

The low levels of Cesium-137 radioactivity, $0.39 \times 10^{-6} \mu\text{Ci/g}$ to $4.6 \times 10^{-6} \mu\text{Ci/g}$, detected in the sediment of the routine samples from the Bull Run and Thompson Run streams are due to residual radioactivity from effluent releases which occurred more than 25 years ago. The levels identified in 1992 are consistent with levels detected in past years and compare with gamma radioactivity concentrations typically found in soil of approximately $20 \times 10^{-6} \mu\text{Ci/g}$.

The radioactivity levels for Cesium-134, Cobalt-60, and Strontium-90 in the sediment from the Bull Run, Thompson Run, and the Northeast Area streams and the Buono Spring were below minimum detection levels and were consistent with the levels in the control stream sediment.

Very low levels of Strontium-90 were detected above minimum detection levels in vegetation samples along the Bull run Stream and in the Northeast Area stream. the results ranged from 0.076×10^{-6} to $0.46 \times 10^{-6} \mu\text{Ci/g}$. Small historical deposits of radioactivity from Laboratory operations which ceased more than 25 years ago could be responsible for the presence of this radioactivity. However, the levels of radioactivity are so low that a person could consume several hundred pounds of this vegetation each year with the highest measured concentration of Strontium-90 and never exceed the NRC limits for individuals in unrestricted areas. Actually, this vegetation is not of the type used as a human food source.

From the above data, it was concluded that the stream sediment and vegetation analyses demonstrated that there was no evidence of any addition of radioactivity in the streambeds of the site's effluent streams. The results discussed in Section A also show that the liquid radioactive effluents from the Laboratory were being adequately controlled during 1992 such that no accumulation of radioactivity could have occurred in the site's stream sediments.

The results of the soil samples collected from and below the IWS wet-weather drainage ditch on Valley Welding Supply Company property show low levels of Cesium-137 at each sample location. Cesium-137 concentrations ranged from $<0.4 \times 10^{-6}$ to $7.7 \times 10^{-6} \mu\text{Ci/g}$. Strontium-90 was detected in two locations at levels of $<0.10 \times 10^{-6}$ to $0.62 \times 10^{-6} \mu\text{Ci/g}$. Typical background radioactivity concentrations in this area are $20 \times 10^{-6} \mu\text{Ci/gm}$. No other fission products were detected above the analytical detection levels. Concentrations of natural uranium were noted in two locations at levels slightly above ambient background levels. This data is consistent with previous data collected in April 1989 and shows that these levels of radioactivity do not represent any significant hazard to human health or the environment.

Non-Radiological: Soil samples were collected from beneath Wing 2 Right (W2R) and a proposed fire-main loop along Hangars 1, 2 and 3. The soil samples under W2R show the presence of coal tar residues throughout most of the area. The levels of specific coal tar compounds ranged from less than detectable to a maximum concentration of about 1100 mg/kg for phenanthrene. Laboratory operations are not considered to be the source of the coal tar residues since these materials were never used in any operations. However, the coal tar residues found in this area are typical of those found in common construction materials such as roofing tars. Therefore, the presence of these residues is likely the result of debris from the original construction of the Bettis site. Volatile organic compounds (VOCs) including tetrachloroethylene and its typical degradation compounds trichloroethylene and 1, 2-dichloroethylene were also found in portions of this area. The maximum concentrations of these VOCs were 1.1 mg/kg, 3.2 mg/kg and 9.7 mg/kg, respectively. These VOC levels are typical of those found at other locations onsite. TCLP results were well below their respective TCLP limits and no reactive cyanide or sulfides were detected.

The soil samples from the proposed fire-main loop revealed low level VOCs in several of these samples. The maximum concentrations of tetrachloroethylene, trichloroethylene and 1,2-dichloroethylene were 0.180 mg/kg, 1.8 mg/kg and 2.8 mg/kg, respectively. In addition, vinyl chloride, another degradation product of tetrachloroethylene, was detected in one sample at a level of 0.120 mg/kg. Polychlorinated biphenyls were detected in only one sample at the very low level of 0.5 mg/kg. The levels and types of chemical found in the soil from the proposed fire-main loop are similar to those found in other areas onsite.

Summaries of the results of the RFI samples and the results discussed above are reported to the EPA and PA-DER in the Bimonthly Progress Reports required by the Consent Order. The analytical results and an interpretation of their significance will be contained in the Draft RFI Report to be submitted to the regulatory agencies in December 1993.

During 1991, soil samples were collected from the excavation area where an underground diesel fuel tank near the L-Building had been removed. The sample analysis results indicated that diesel fuel residues were present in the area immediately near the tank. This was reported to the PA-DER on September 17, 1991 in accordance with the Pennsylvania Storage Tank and Spill Prevention Act. As a followup action, during 1992, water samples were collected from downgradient and upgradient groundwater monitoring wells to determine if diesel fuel residue had migrated from the tank area. It was determined that the contamination had not migrated. The sample analysis results and the results of the site assessment were documented in a closure report that was submitted to the PA-DER on November 17, 1992.

E. RADIATION MONITORING

The purpose of the environmental radiation monitoring program is to measure and verify that Laboratory operations do not

alter the natural radiation background around the Bettis site.

Radiation Sources

The source of radiation at the Bettis Laboratory includes small specimens of irradiated and unirradiated fuel materials which are handled, processed, and stored at the site. There are no nuclear reactors at the Bettis site.

Radiation Monitoring

Environmental radiation levels were monitored in the vicinity of the Bettis Laboratory with a network of lithium fluoride thermoluminescent dosimeters (TLDs). The approximate locations of the Bettis site TLD monitors are shown on Figure 6. Control TLD monitors were posted at sites remote from the Laboratory to measure the natural background radiation levels typical for western Pennsylvania. The control TLDs were located in nearby communities (Pleasant Hills, Reserve Township, Greensburg, Mt. Pleasant, Elizabeth, and Port Vue, PA). All TLD monitors were posted for quarterly exposure periods.

In addition to the TLD network which was the primary monitoring method, a radiation survey was conducted around the site perimeter.

Radiation Analyses

The environmental TLDs were calibrated by a 25 mrem exposure to a Cesium-137 standard source. Only TLDs which exhibited a response within $\pm 10\%$ of the mean response were selected for environmental radiation monitoring. The TLD radiation exposures were measured quarterly utilizing an automated TLD readout system which was calibrated prior to the processing of the TLDs. The environmental TLDs were annealed prior to posting and were read out following collection. TLD results were corrected to assure that the environmental TLDs reflected only the exposure received during the time they were posted in the field.

FIGURE 6 ENVIRONMENTAL DOSIMETER LOCATIONS

The perimeter radiation survey was conducted using a highly sensitive radiation instrument (PRM-7). This instrument was calibrated with Cesium-137 within six months prior to use and source checked for proper operation immediately prior to use.

Radiation Monitoring Results and Conclusions

The TLD results in Table 12 summarize the radiation levels measured during each quarter of 1992 at the Laboratory site boundary and at the offsite locations. These results agree, within measurement uncertainties, with the radiation levels measured at locations remote from the Laboratory. The annual average radiation exposure for the TLDs at the site perimeter was 70 mrem. The annual average radiation exposure at the offsite locations was 71 mrem.

A statistical t-ratio test (Student-t) was used to examine the differences in the mean values for the site perimeter and the offsite TLD radiation exposures. Based on the results, it was concluded that the TLD sample data for the site perimeter and for the offsite locations belong to the same population. Thus the exposure received by an individual located at the site perimeter is not different from that received from background radiation in the surrounding area.

The radiation dose rates measured during a survey along the Laboratory site boundary averaged approximately 0.01 mrem/hr which, integrated over the TLD exposure period in 1992, predicted an annual exposure of 72 mrem. The 1991 radiation monitoring results were consistent with the range of natural radiation levels of 82 to 104 mrem/year observed in a U.S. Public Health Service survey of the northwest and southwest areas of Pennsylvania (Reference (8)).

Also, the radiation monitoring results were consistent with the range of natural radiation levels of 79 to 105 mrem/year determined by an aerial radiation survey, Reference (9), that encompassed a 100

square-mile area around the Bettis site. Therefore, it was concluded that the radiation exposure to the general public at the Laboratory site perimeter was not above the exposure received from natural background radiation.

In addition to the routine environmental monitoring program discussed above, several special environmental radiation surveys were completed. These surveys are discussed below.

Thompson Run/Bull Run Scoping Survey

A visual and radiological scoping survey was performed in April 1992 of lower Bull Run stream and Thompson Run from its confluence with Bull Run to the Monongahela River. Although the radiation surveys were limited in detail, they were sufficient to identify any significant deposits of radioactivity in or near the streambeds. The majority of Thompson Run and Bull Run exhibited only natural background radiation levels (i.e., $\leq 10 \mu\text{r/hr}$). Only two areas in Thompson Run and one are in Bull Run indicated the presence of low level, residual radioactivity above that which is naturally occurring. The radiation level in the Thompson Run areas were 12-15 $\mu\text{r/hr}$; the maximum radiation level measured three feet above the surface in the Bull Run area was 28 $\mu\text{r/hr}$ at an isolated spot along the stream bank. Even at the location of the highest reading, no one could receive a dose in excess of the limits specified by the NRC in reference (4) for members of the public given the current occupancy of the area.

Inactive Waste Sites and Adjacent Areas

During 1992, detailed radiation surveys of the Inactive Waste Site (IWS), the IWS runoff area to Valley Welding Supply Company and a portion of Valley Welding property were completed. These areas are shown in Figure 5. All radiation levels were measured with a PRM-7 on 10 foot-by-10 foot grids at about three feet above the ground.

TABLE 12
ENVIRONMENTAL RADIATION MEASUREMENTS IN THE
VICINITY OF THE BETTIS LABORATORY CY 1992⁽¹⁾

Quarterly TLD Exposure Period	Number of Exposure Days	Number of Measurements (Site Boundary)	Mean ⁽²⁾	Max.	Min.	Number of Measurements (Off-site)	Mean ⁽²⁾	Max.	Min.
1st	90	19	17.3 ± 1.0	20	14	6	15.4 ± 4.4	23	10
2nd	93	18	15.7 ± 1.2	21	12	6	16.5 ± 5.8	25	10
3rd	91	20	16.7 ± 2.1	22	13	6	17.5 ± 7.1	27	11
4th	98	21	19.6 ± 1.5	28	17	6	19.5 ± 6.3	30	10

-
- (1) The uncertainties are within 95% confidence level.
(2) Results have been normalized to 91 days per quarter.

The radiation levels measured at the north end of the IWS and the developed portion of Valley Welding are consistent with natural background radiation levels for southwestern Pennsylvania as observed in References (8) and (9).

The radiation levels measured at the IWS and in the surface water runoff area from the IWS onto Valley Welding property range background to $18 \mu\text{r/hr}$; the maximum value ($18 \mu\text{r/hr}$) is about two times natural background for this area. Any radiation dose that could be received from this infrequently accessed area would be well below the radiation dose limits specified for members of the public by the NRC in Reference (4).

F. CONTROL OF CHEMICAL AND HAZARDOUS WASTES

Origin

The necessary use of chemicals at Bettis during 1992 resulted in the generation of relatively small volumes of chemical and hazardous wastes. These wastes included acid solutions, polychlorinated biphenyls, photographic solutions, oil solutions containing metals and organic solvents and other organic solvent contaminated solids.

Control Program

All hazardous wastes were managed in accordance with the Federal Resource Conservation and Recovery Act and the environmental regulations of the Commonwealth of Pennsylvania. Non-hazardous chemical wastes were managed in accordance with the Laboratory's NPDES permit and applicable federal and state regulations.

The control programs minimized the quantity of routine waste material generated, assured safe use and storage of the materials onsite, and provided for proper disposal of the wastes by vendors who operated under permits issued by federal and state agencies.

A principal component of the overall program was the control of the acquisition of chemicals for use at Bettis. Purchase orders for chemicals were reviewed to assure that potentially hazardous materials were necessary, that the amounts ordered were not excessive, and that procedures for use and disposal were in place before the materials were ordered. Bettis also used a chemical exchange program where groups within the Laboratory exchange chemicals rather than purchase new ones.

Specific training was provided to personnel who handled hazardous materials to assure that they were knowledgeable of safe handling techniques and emergency response procedures. After chemicals were used and no longer needed, they were accumulated in designated staging and storage areas where they were segregated and packaged for shipment. Storage and accumulation areas were inspected periodically to verify that hazardous materials were properly stored and controlled in accordance with approved procedures. Waste was stored only as necessary to accumulate sufficient volume for economical shipment to a waste disposal vendor.

Treatment and Disposal

No chemical or hazardous materials were disposed of at the Bettis site. Approximately 48,130 pounds of chemical and hazardous waste were transported by vendors to treatment/storage/disposal (TSD) facilities for final disposition. This total includes about 3571 pounds of polychlorinated biphenyl (PCB) wastes generated as a result of the Laboratory's PCB Elimination Program. The transportation vendors and the TSD facilities operate under approvals or permits granted by the cognizant state and federal regulatory agencies. Written documentation was received from the TSD facilities verifying that the waste was received and handled in accordance with requirements. Bettis chose treatment and disposal methods that would reduce long term concerns and threats to the environment.

Also during 1992, the EPA and PA-DER conducted on-site inspections of the Resource Conservation and Recovery Act program at Bettis. The Laboratory was found to be in compliance. No violations or items of non-compliance were found with current operations.

G. CONTROL OF RADIOACTIVE WASTE MATERIALS

Origin

Operation of the Bettis site during 1992 resulted in the generation of various types of low-level radioactive waste material. This material included liquids, filters, metal scrap, rags, resin, paper, soil, and plastic.

Control Program

The volume of waste containing radioactivity was minimized through the use of detailed work procedures and worker training to limit the amount of material that contacted radioactivity during work on radioactive systems and components; waste compaction was also used.

Detailed procedures were used during generation, handling, packaging and transportation of radioactive waste material. All radioactive wastes shipped offsite were packaged in accordance with applicable DOE disposal site criteria and the DOT regulations in Reference (10). In addition, all radioactive liquids were solidified prior to each shipment. Internal reviews were made prior to the shipment to ensure that the material was properly identified, surveyed, and packaged in accordance with federal and burial site requirements.

Disposal

Shipments of solid radioactive waste were made to an offsite DOE burial ground. During 1992, approximately 220 cubic meters of radioactive waste containing about 6.7 Curies of radioactivity were shipped from the Bettis site for burial.

H. ENVIRONMENTAL AND EFFLUENT MONITORING QUALITY ASSURANCE

Radiological: The Laboratory maintained an internal quality control program as well as participated in an interlaboratory quality assurance program in cooperation with the DOE (Environmental Measurements Laboratory, EML) and the EPA (Environmental Monitoring and Support Laboratory, EMSL). These programs were designed to test and demonstrate consistency and continued precision and accuracy of the Laboratory's radioanalytical techniques and results. The requirements for internal quality control followed the guidelines and practices recommended by the Nuclear Regulatory Commission in Reference (11) and the Environmental Protection Agency in References (6) and (12).

The EPA and DOE transmitted samples of water, air filters, vegetation, and soil for radiological analyses. Results were furnished to both agencies and are published periodically. Appendices A and B summarize the results from the radiological quality assurance cross-check programs. During 1992, the Laboratory demonstrated satisfactory performance in obtaining analytical results which met with the acceptance criteria of both the DOE and the EPA Quality Assurance Programs.

Non-Radiological: To demonstrate the precision and accuracy of the non-radiological analyses conducted for samples of influent city water and effluent water from the Bettis Site, quality control samples were submitted to the off-site contract laboratories. These samples consisted of reference standards obtained from the EPA or from a commercial source. The results of the quality control samples are contained in Appendix C. During 1992, the offsite contractor laboratories demonstrated satisfactory performance in the quality control program.

In addition, the offsite contractor laboratories were required to submit backup data for all analyses. These data were validated by chemists in the Bettis Analytical Chemistry group. This review entailed a check of calculations, standards, graphs and spike results. Trends that might indicate a problem in the contractor laboratory's programs were also evaluated. Problems noted in the review were resolved with the laboratory before final acceptance of the data.

I. ASSESSMENT OF RADIATION DOSE-TO-MAN

Effluent monitoring results at the Laboratory during 1992 demonstrated that radioactivity releases were negligible and well below the federal radioactivity concentration guides. Radiation exposure to the general public from Bettis airborne releases was too low to measure and could only be determined with calculational models using the effluent radioactivity data. Therefore, a conservative assessment of the radiation dose-to-man was performed by analyzing the exposure pathways whereby radioactivity might be transmitted from the Laboratory to the general public. The following potential exposure pathways were considered in this assessment:

1. immersion in the atmosphere containing the released radionuclides and their daughters,
2. ingestion of food directly contaminated by the release or produced in regions subjected to prior contamination,
3. an inhalation of gaseous and suspended radioactivity,
4. exposure to ground deposits and deposits in bodies of water,
5. ingestion of radioactivity in the drinking water supply, and
6. direct radiation from Laboratory operations.

Specific radionuclide composition of the airborne and liquid releases was factored into the assessment. The dose for each exposure pathway was explicitly calculated for each radionuclide and applicable daughters. The air pathway calculations used wind direction data and meteorological parameters that were measured by the Bettis meteorological monitoring system in 1992. The Bettis meteorological monitoring system utilizes a Handar tower which measures wind speed, gusts, wind direction, temperature, relative humidity, and inches of rain. The measurements are integrated over 15-minute intervals. The Bettis tower is part of the Atmospheric Release Advisory Capability (ARAC) service developed by Lawrence Livermore National Laboratory to model the atmospheric release of radioactive materials. The population distribution in the vicinity of the Bettis site was based on 1980 census data. The atmospheric dispersion of the Laboratory's radioactive airborne releases and resulting dose were calculated using an EPA approved computer program described in Reference (13). The dose due to liquid effluents was determined by modeling the diluted effluents to the nearest drinking water supply. Specific volumes and flow rates typical of the effluent streams and the Monongahela River were used. In addition, References (14) through (17) were used in conjunction with the computer program and the liquid effluent dilution to calculate the radiation doses-to-man. The radiation dose assessment of airborne and liquid radioactivity releases attributed to Bettis Laboratory operations during 1992 are presented in Table 13. Radiation doses were calculated for the whole body and most limiting organ of individuals at locations of maximum exposure on the site boundary and for the total population within 50 miles of the Laboratory.

The results in Table 13 show that the maximum whole body radiation exposure which any member of the public could hypothetically receive due to past and present operations ranged from 0.5 to 2.8

TABLE 13

**SUMMARY OF CALCULATED RADIATION DOSE-TO-MAN
FROM BETTIS LABORATORY OPERATIONS, CY 1992**

A. Maximum Hypothetical Radiation Exposure to an Off-Site Individual at the Bettis Site Perimeter	<u>Estimated Dose Equivalent,⁽¹⁾ mrem</u>	
	<u>Effective Whole Body</u>	<u>Maximum Dose Limiting Organ</u>
	Negligible ⁽²⁾	Negligible
1. Liquid Pathways		
2. Airborne Pathways		
a. Particulate Radioactivity ⁽³⁾ Release	0.0005	0.005 (bone)
b. Gaseous Radioactivity Release ⁽⁴⁾	0.516	3.78 (endosteal)
c. EPA Limit	10	
3. Direct Exposure Pathways		
a. Direct Radiation from Bettis Operations	Negligible	Negligible
b. Exposure to Bull Run Stream Sediments	0 - 2.3	0 - 2.3 (whole body)
Maximum Whole Body Dose to Individual	~0.5 - 2.8	
DOE Limit	100	
B. 50-Mile Population Radiation Exposure	<u>Estimated Population Dose Equivalent⁽¹⁾, (man-rem)</u>	
	<u>Whole Body</u>	<u>Maximum Dose Limiting Organ</u>
1. Liquid Pathways	Negligible	Negligible
2. Airborne Pathways	6.19	45.4 (endosteal)
3. Direct Exposure Pathways	0 - 0.01	0 - 0.01 (whole body)
Maximum Whole Body Population Dose	< 6.2	

Table 13 (Cont'd)

**SUMMARY OF CALCULATED RADIATION DOSE-TO-MAN
FROM BETTIS LABORATORY OPERATIONS, CY 1992**

- (1) The dose estimated for the liquid and airborne pathways is the committed "50-year" effective dose equivalent for the radiation exposure potentially received by an individual over a 50-year period following the ingestion or inhalation of the radioactivity released in this calendar year.
- (2) Bettis did not discharge any radioactivity due to current operations in to the liquid effluent streams.
- (3) The principal contributors to the calculated dose from particulate radioactivity releases were conservatively assumed to be Cobalt-60 and Thorium-232.
- (4) The contributors to the gaseous radioactivity releases were Radon-220 and its daughters, Krypton-85, Antimony-125, Iodine-129, and Iodine-131. The principal contributor was Radon-220 and its daughters. Since the 40 CFR 61 - Subpart H reporting requirements for the effective dose equivalent due to airborne radionuclides specifically excludes radon, the value given in that report of 0.0013 mrem does not include the 0.515 mrem due to radon provided in this report.

mrem. Nearly all of this very low potential dose would be from gaseous radioactivity and from exposure to the Bull Run soil and sediments that contain residual radioactivity from operations over 25 years ago. Based on a conservative estimate that an individual would spend as much as one hour per day, every day of the year, walking along the Bull Run stream bank in the areas with radiation levels above background, the annual hypothetical dose received would be approximately 2.3 mrem. This is less than the amount of additional radiation exposure an individual would receive from a cross country airplane flight (Reference 18). The maximum potential radiation dose is well below the most restrictive dose limits of the Nuclear Regulatory Commission as provided in Reference (4) or of the DOE and is less than 1% of the radiation exposure a person receives from naturally occurring radiation in the environment (300 mrem per year (Reference 18)). The dose resulting from the low levels of radioactivity in the laboratory airborne effluent is significantly less than the limits of the EPA in Reference (6).

In conclusion, the maximum radiation exposure to any member of the public as a result of operations at the Bettis Laboratory during 1992 was substantially below the radiation exposure limits established by the EPA, DOE, and NRC. Moreover, the accumulated radiation exposure received during 1992 by the total population of 3,200,000 within 50 miles of the site was

conservatively estimated to be approximately 6.2 man-rem which is negligible compared to the approximately 960,000 man-rem dose received from natural background radiation. Therefore, the radioactivity released from the Bettis Laboratory, as a result of past and present operations, has not resulted in any significant radiation exposure to the general public.

J. ENVIRONMENTAL PERMITS

Bettis has obtained or applied for the environmental permits required by the applicable regulations. Appendix D provides a listing of the environmental permits for the Bettis site. Bettis has operating permits, as required by the Allegheny County Health Department, for certain fuel-burning equipment. The site also has a National Pollutant Discharge Elimination System (NPDES) permit governing the discharge of plant waste waters to local streams. A Resource Conservation and Recovery Act (RCRA) Part B permit application has been submitted for a facility for the storage of onsite-generated hazardous waste pending shipment off-site. The facility is currently being operated in compliance with the RCRA requirements for interim status pending issuance of the Part B permit.

REFERENCES

- (1) Bettis Environmental Monitoring Procedures Manual, WAPD-RC/E(HE)-407.
- (2) Bettis Environmental Controls Manual, EC-1.
- (3) Title 40, Code of Federal Regulations, Part 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants.
- (4) Title 10, Code of Federal Regulations, Part 20, Standards for Protection Against Radiation.
- (5) Test Methods for Evaluating Solid Waste Physical/Chemical Methods, U.S. EPA, SW-846
- (6) Title 40, Code of Federal Regulations, Part 61, National Emission Standards for Hazardous Air Pollutants; Subpart H - National Emission Standard for Radionuclide Emissions from Department of Energy (DOE) Facilities.
- (7) Allegheny County Health Department Rules and Regulations, Article XX, Air Pollution Control.
- (8) "Summary of Natural Environmental Gamma Radiation Using a Calibrated Portable Scintillation Counter", Radiological Health Data and Reports, Volume 9, Number 11, pp. 620-695, November, 1968.
- (9) "An Aerial Radiological Survey of West Mifflin, Pennsylvania, and Surrounding Areas". EG&G/EM Survey Report, DOE/NR-8319, dated March, 1984.
- (10) Title 49, Code of Federal Regulations, Part 171 through 179, Hazardous Material Regulations.
- (11) NRC Regulatory Guide 4.15, dated February, 1979.
- (12) "Handbook for Analytical Quality Control in Radioanalytical Laboratories," EPA-600/17-77-008, dated August, 1977.
- (13) The Clean Air Act Assessment Package - 1988 (CAP-88) - A Dose and Risk Assessment Methodology for Radionuclide Emissions to Air, CAP88-PC, Version 1.0, March, 1992
- (14) DOE/EH-0071, "Internal Dose Conversion Factors for Calculation of Dose to the Public", U.S. Department of Energy, July 1988.
- (15) DOE/EH-0070, "External Dose-Rate Conversion Factors for Calculation of Dose to the Public", U.S. Department of Energy, July 1988.

REFERENCES (Continued)

- (16) ICRP Publication 30, "Limits for Intakes of Radionuclides by Workers", International Commission on Radiological Protection, Pergamon Press, 1978.
- (17) ICRP Publication 23, "Report of the Task Group on Reference Man", International Commission on Radiological Protection, Pergamon Press, 1974.
- (18) NCRP Report No. 94, "Exposure of the Population in the United States and Canada from Natural Background Radiation", December, 1987.

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APPENDIX A USEPA Cross Check Results - CY 1992

In addition to an internal Quality Assurance program, The Bettis-Pittsburgh facility participates in USEPA and DOE-sponsored external quality control sample analysis programs. On a periodic basis, samples are provided to Bettis and analyzed for various radiological attributes to verify the continuing analytical capabilities of Bettis. Appendix A lists the results of the analyses reported for those two programs, and Appendix B discusses three discrepancies noted during CY1992.

<u>DATE</u>	<u>ATTRIBUTE</u>	<u>REPORTED VALUE^(a)</u>	<u>KNOWN VALUE</u>	<u>units</u>	<u>ND(Xσ)^(b)</u>	<u>Note</u>
Jan92-Water	Gross Alpha	17.33	30.00 ± 8	pCi/liter	-2.09	
	Gross Beta	34.00	30.00 ± 5		1.39	
Jan92-Water	Pu239	3.13	16.8 ± 1.7	pCi/liter	-13.92	(c)
Jan92-Water	Sr89	53.00	51.00 ± 5	pCi/liter	-0.69	
	Sr90	20.33	20.00 ± 5		0.12	
Feb92-Water	Co60	40.67	40 ± 5	pCi/liter	0.23	
	Zn65	157	148 ± 15		1.10	
	Ru106	180	203 ± 20		1.00	
	Cs134	30	31 ± 5		-0.35	
	Cs137	45	49 ± 5		-1.50	
	Ba133	78	76 ± 8		0.43	
Mar92-Water	U	26.3	25.3 ± 3	pCi/liter	0.58	
Mar92-Air Filter	Gross Alpha	9.0	7 ± 5	pCi/filter	0.69	
	Gross Beta	48.3	41 ± 5		2.54	
	Cs137	13.0	10.0 ± 5		1.04	
	Sr90	16.7	15 ± 5		0.58	
Apr92-Water	U	5.17	4 ± 5	pCi/liter	0.67	
	Sr89	19.0	15 ± 5		1.39	
	Sr90	16.33	17 ± 5		-0.23	
	Co60	55.33	56 ± 5		-0.23	
	Cs134	22.67	24 ± 5		-0.46	
	Cs137	23.67	22 ± 5		0.58	
May92-Water	Gross Alpha	9.33	15.00 ± 5	pCi/liter	-1.74	
	Gross Beta	47.67	44 ± 5		1.27	
May92-Water	Sr89	29.00	29 ± 5	pCi/liter	-0.00	
	Sr90	7.00	8 ± 5		0.35	
Jun92-Water	Co60	21.00	20 ± 5	pCi/liter	0.35	
	Zn65	107.00	99 ± 10		1.39	
	Ru106	153.67	141 ± 14		1.57	
	Cs134	13.00	15 ± 5		-0.69	
	Cs137	16.00	15 ± 5		0.35	
	Ba133	94.67	98 ± 10		-0.58	
Sep92-Water	Gross Alpha	27.7	45.00 ± 11	pCi/liter	-2.72	
	Gross Beta	56.3	50 ± 5		2.18	
Sep92-Water	Sr89	19.0	20 ± 5	pCi/liter	-0.35	
	Sr90	13.0	15 ± 5		-0.69	

APPENDIX A
USEPA Cross Check Results - CY 1992

Appendix A
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<u>DATE</u>	<u>ATTRIBUTE</u>	<u>REPORTED VALUE^(a)</u>	<u>KNOWN VALUE</u>	<u>units</u>	<u>ND(X_σ)^(b)</u>	<u>Note</u>
Sep92-Air Filter	Gross Alpha	34.0	30 ± 8	pCi/filter	0.87	
	Gross Beta	85.0	69 ± 10		2.77	
	Cs137	22.0	18 ± 5		1.39	
	Sr90	25.3	25 ± 5		0.10	
Oct92-Water	Co60	10.7	10 ± 5	pCi/liter	0.24	
	Zn65	146.3	148 ± 15		-0.20	
	Ru106	161.7	175 ± 18		-1.28	
	Cs134	9.7	8 ± 5		0.59	
	Cs137	10.7	8 ± 5		0.94	
	Ba133	64.3	74 ± 7		-2.40	

Notes:

- (a) The reported value is the average of a triplicate set.
- (b) Normalized duration from the known as described in EPA-600/7-77-068 dated August, 1977.
- (c) See "Analysis Discrepancy Investigation Results".

APPENDIX B

USDOE Cross Check Results - CY 1992

<u>DATE</u>	<u>ATTRIBUTE</u>	<u>REPORTED VALUE^(a)</u>	<u>KNOWN VALUE</u>	<u>units</u>	<u>ND(Xσ)^(b)</u>	<u>Note</u>
9203-Air Filter	Be7	36.9	28.6 ± 2.9	Bq/filter	2.86	
	Mn54	6.80	5.97 ± 0.6		1.38	
	Co57	8.00	7.93 ± 0.79		0.09	
	Co60	6.40	5.81 ± 0.58		1.02	
	Cs134	4.60	4.44 ± 0.44		0.36	
	Cs137	6.41	5.76 ± 0.58		1.12	
	Ce144	7.44	6.39 ± 0.64		1.64	
9203-Soil	Sr90	5.92	4.50 ± 0.45	Bq/Kg	3.2	(c)
	Cs137	5.03	5.23 ± 0.52		-0.38	
	Pu239	28.1	25.5 ± 3.8		0.52	
9203-Vegetation	Cs137	25.9	24.6 ± 2.5	Bq/Kg	0.52	
9203-Water	Mn54	56.2	56.6 ± 5.7	Bq/liter	-0.07	
	Co60	99.9	94.0 ± 9.4		0.63	
	Sr90	20.7	21.3 ± 2.1		-0.29	
	Cs134	77.0	71.8 ± 7.2		0.72	
	Cs137	88.8	84.6 ± 8.5		0.49	
	Ce144	191	189 ± 19		0.11	
9209-Air Filter	Be7	381	308 ± 31	Bq/filter	2.37	
	Mn54	32.3	25.9 ± 2.6		2.47	
	Co57	6.8	6.4 ± 0.6		0.63	
	Co60	3.8	3.06 ± 0.31		2.42	
	Cs134	3.8	3.72 ± 0.37		0.22	
	Cs137	7.03	5.8 ± 0.58		2.12	
	Ce144	42.9	43.3 ± 4.3		-0.09	
	Sr90	0.215	0.137 ± 0.14		5.69	
9209-Soil	Sr90	10	9.57 ± 0.96	Bq/Kg	0.45	
	Cs137	260	285 ± 29		-0.96	
9209-Vegetation	Cs137	27.9	29.2 ± 2.9	Bq/Kg	-0.45	
9209-Water	Mn54	34.7	33.3 ± 3.3	Bq/liter	0.42	
	Co60	28.2	27.8 ± 2.8		0.14	
	Sr90	2.33	2.2 ± 0.22		0.59	
	Cs134	48.8	44.1 ± 4.4		0.96	
	Cs137	31	29 ± 2.9		0.69	
	Ce144	52.2	51.2 ± 5.1		0.20	
	Sr90	2.33	2.2 ± 0.22		0.59	

Notes:

- (a) The reported value is the result of a single determination.
- (b) Normalized duration from the known as described in EML-454 dated May, 1986.
- (c) See "Analysis Discrepancy Investigation Results".

ANALYSIS DISCREPANCY RESULTS

EPA Jan92 Pu/Water:

During this period, the ^{242}Pu tracer was recalibrated, and the data for the above sample was reviewed. During this review, it was discovered that an error in calculation was made, and the results as reported to the EPA were incorrect. The revised value for Pu239 was 14.8 pCi/liter, which is -2.04σ from the known and within control limits. These calculations were being performed by hand, but are now done using a computer.

DOE Mar92 Sr/Soil:

The result for Sr90-in-soil was outside the $\pm 3\sigma$ control limits. The Sr90-in-soil result for the Sept92 sample set was within the acceptable range. A larger sample aliquot was used for this Sept92 determination. Bettis will continue to analyze larger aliquots of DOE soil samples for Sr90 to minimize the effects of nonhomogeneity, and as discussed below, will also utilize longer counting times to improve accuracy at these low levels.

DOE Sept92 Sr/Air Filter:

The result for Sr90-in-air Filter was outside the $\pm 3\sigma$ control limits. This particular sample had a 2σ counting error of 17% (for a 100-minute count). To improve the experimental accuracy on future low level QC samples, Bettis will utilize increased counting times.

APPENDIX C

Appendix C

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TABLE 1

SUMMARY OF FIRST QUARTER SURFACE WATER QUALITY CONTROL DATA - CY1992

Parameter	Vendor Results (mg/l)	True Value (mg/l)	Acceptance Range (mg/l)
Alkalinity	260	275	245 - 305
Aluminum	0.55	0.523	0.428 - 0.617
Arsenic	1.75 ⁽¹⁾	0.110	0.082 - 0.130
Arsenic	0.090	0.093	0.069 - 0.110
Arsenic	0.123	0.132	0.099 - 0.156
Copper	0.23	0.226	0.185 - 0.267
Chromium	0.171	0.156	0.127 - 0.184
Cyanide	0.071	0.065	0.052 - 0.078
Fluoride	2.2	2.16	1.98 - 2.30
Iron	0.43	0.384	0.315 - 0.453
Lead	0.22	0.239	0.196 - 0.282
Nickel	0.31	0.314	0.257 - 0.370
Nitrate	7.75	7.66	7.17 - 8.01
Oil & Grease	24 ⁽²⁾⁽³⁾	37	28 - 46
Oil & Grease	51 ⁽²⁾	61.4	46 - 77
Oil & Grease	38 ⁽²⁾	49	37 - 61
pH	8.6 ⁽⁴⁾	9.1	8.9 - 9.3
pH	8.9	9.1	8.9 - 9.3
pH	9.0	9.0	8.8 - 9.2
Phenol	0.069	0.055	0.038 - 0.072
Suspended Solids	62	61.4	53 - 71
Suspended Solids	65	70	59 - 81
Suspended Solids	22	22.8	19 - 27
Total Dissolved Solids	1163	1260	1090 - 1420
Total Organic Carbon	37	31.9	27 - 37
Zinc	0.20	0.199	0.163 - 0.235

- (1) Vendor results not within acceptable range. All internal quality control conducted in conjunction with the analysis of the sample was reviewed, and it was determined that the high value may have been caused by improper volumetric preparation of the solution for analysis. The vendor resolved this problem and additional samples (see next sample results in Table) were submitted for analysis, and the results were within the acceptable range.
- (2) Units are mg/bottle.
- (3) Vendor results not within acceptable range. All internal quality control conducted in conjunction with the analysis of the sample was reviewed, and it was determined that the low value was caused by the vendor not using the entire contents of the sample bottle for analysis. The vendor resolved this problem and additional samples (see next sample results in Table) were submitted for analysis, and the results were within the acceptable range.
- (4) Vendor results not within acceptable range. The low pH results were attributed to a faulty field pH meter. A different pH meter was obtained and additional samples (see next sample results in Table) were submitted for analysis, and the results were within the acceptable range.

APPENDIX C

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TABLE 2

SUMMARY OF SECOND QUARTER SURFACE WATER QUALITY CONTROL DATA - CY1992

Parameter	Vendor Results (mg/l)	True Value (mg/l)	Acceptance Range (mg/l)
Alkalinity	258	255	235 - 275
Alkalinity	254	255	235 - 275
Aluminum	0.367	0.331	0.271 - 0.390
Arsenic	0.125	0.132	0.099 - 0.156
Copper	0.234	0.205	0.168 - 0.242
Chromium	0.166	0.156	0.127 - 0.187
Cyanide	0.060	0.065	0.052 - 0.078
Fluoride	2.4 ⁽¹⁾	2.16	1.98 - 2.30
Fluoride	9.0	10	9.0 - 11
Fluoride	9.0	10	9.0 - 11
Iron	0.371	0.337	0.276 - 0.398
Lead	0.255	0.232	0.190 - 0.274
Nickel	0.301	0.268	0.219 - 0.316
Nitrate	7.07 ⁽²⁾	7.66	7.17 - 8.01
Nitrate	9.06	8.83	7.8 - 9.8
Nitrate	8.01	8.3	7.4 - 9.2
Oil & Grease	41 ⁽³⁾	49	37 - 61
Oil & Grease	39.9 ⁽³⁾	49	37 - 61
Oil & Grease	28 ⁽³⁾	37	28 - 46
pH	9.0	9.1	8.9 - 9.3
pH	8.5 ⁽⁴⁾	9.0	8.8 - 9.2
pH	9.0	9.0	8.8 - 9.2
Phenol	0.066	0.055	0.038 - 0.072
Suspended Solids	66	61.4	53 - 71
Suspended Solids	21	22.8	19 - 27
Suspended Solids	25	22.8	19 - 27
Total Dissolved Solids	1650	1760	1530 - 2020
Total Organic Carbon	29	27.1	23 - 31
Zinc	0.104	0.093	0.076 - 0.110

- (1) Vendor results not within acceptable range. All internal quality control conducted in conjunction with the analysis of the sample was reviewed, and it was determined that the high value may have been caused by a trace amount of fluoride in the sulfuric acid used for distillation of the fluoride in the sample. The vendor resolved this problem and additional samples (see next sample results in Table) were submitted for analysis and the results were within the acceptable range.
- (2) Vendor results not within acceptable range. All internal quality control conducted in conjunction with the analysis of the sample was reviewed, and it was determined that the low value may have been caused by improper volumetric preparation of the solution for analysis. The vendor resolved this problem and additional samples (see next sample results in Table) were submitted for analysis, and the results were within the acceptable range.
- (3) Units are mg/bottle.
- (4) Vendor results not within acceptable range. The low pH results were attributed to a faulty field pH meter. A different pH meter was obtained and an additional sample (see next sample result in Table) was submitted for analysis, and the result was within the acceptable range.

APPENDIX C

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TABLE 3

SUMMARY OF THIRD QUARTER SURFACE WATER QUALITY CONTROL DATA - CY1992

Parameter	Vendor Results (mg/l)	True Value (mg/l)	Acceptance Range (mg/l)
Alkalinity	256	255	236 - 272
Aluminum	0.361	0.331	0.271 - 0.390
Arsenic	0.130	0.132	0.099 - 0.156
Copper	0.224	0.205	0.168 - 0.242
Copper	0.16	0.154	0.126 - 0.182
Chromium	0.163	0.156	0.127 - 0.184
Cyanide	0.28	0.320	0.23 - 0.41
Fluoride	2.2 ⁽¹⁾	1.81	1.65 - 1.94
Fluoride	2.0	2.16	1.98 - 2.30
Fluoride	1.9	1.81	1.65 - 1.94
Iron	0.356	0.337	0.276 - 0.398
Lead	0.252	0.232	0.190 - 0.274
Nickel	0.289	0.268	0.219 - 0.316
Nitrate	2.07	2.20	2.03 - 2.34
Oil & Grease	27 ⁽²⁾⁽³⁾	37	28 - 46
Oil & Grease	45 ⁽²⁾	49	37 - 61
Oil & Grease	36 ⁽²⁾	37	28 - 46
Oil & Grease	45.3	49	37 - 61
pH	8.6 ⁽⁴⁾	9.0	8.8 - 9.2
pH	9.0	9.0	8.8 - 9.2
pH	8.9	9.0	8.8 - 9.2
Phenol	0.17	0.200	0.15 - 0.25
Suspended Solids	64	70	59 - 81
Suspended Solids	28 ⁽⁵⁾	22.8	19 - 27
Suspended Solids	23	22.8	19 - 27
Suspended Solids	64	70	59 - 81
Total Dissolved Solids	1700	1760	1530 - 2020
Total Organic Carbon	29	27.1	23 - 31
Zinc	0.101	0.093	0.076 - 0.110

- (1) Vendor results not within acceptable range. All internal quality control conducted in conjunction with the analysis of the sample was reviewed, and it was determined that the high value may have been caused by a fluoride calibration curve that was biased positively. The vendor resolved this problem and additional samples (see next sample results in Table) were submitted for analysis, and the results were within the acceptable range.
- (2) Units are mg/bottle.
- (3) Vendor results not within acceptable range. All internal quality control conducted in conjunction with the analysis of the sample was reviewed, and it was determined that the low value may have been caused by a high water bath temperature. The vendor resolved this problem and additional samples (see next sample results in Table) were submitted for analysis, and the results were within the acceptable range.
- (4) Vendor results not within acceptable range. The low pH results were attributed to a faulty field pH meter. A new pH meter was obtained and additional samples (see next sample results in Table) were submitted for analysis, and the results were within the acceptable range.
- (5) Vendor results not within acceptable range. All internal quality control conducted in conjunction with the analysis of the sample was reviewed, and it was determined that a transcription error had occurred when the data was recorded. The vendor resolved this problem and additional samples (see next sample results in Table) were submitted for analysis, and the results were within the acceptable range.

APPENDIX C

TABLE 4

SUMMARY OF FOURTH QUARTER SURFACE WATER QUALITY CONTROL DATA - CY1992

Parameter	Vendor Results (mg/l)	True Value (mg/l)	Acceptance Range (mg/l)
Alkalinity	250	255	235 - 275
Aluminum	0.565	0.523	0.428 - 0.617
Antimony	0.300	0.257	0.192 - 0.303
Arsenic	0.098	0.110	0.082 - 0.130
Beryllium	0.132 ⁽¹⁾	0.108	0.088 - 0.127
Beryllium	0.098	0.108	0.088 - 0.127
Beryllium	0.113	0.108	0.088 - 0.127
Cadmium	0.107	0.106	0.087 - 0.125
Chemical Oxygen Demand	85	92.6	78 - 106
Chloride	268	254	236 - 272
Copper	0.223	0.226	0.185 - 0.267
Chromium	0.249	0.236	0.193 - 0.278
Cyanide	0.470	0.500	0.36 - 0.63
Fluoride	9.8	10	9.0 - 11
Hardness	322	318	273 - 362
Herbicide - 2,4-D	0.0042	0.00570	0.00100 - 0.00832
Herbicide-Silvex	0.00385	0.00430	0.00094 - 0.00610
Iron	0.430	0.384	0.315 - 0.453
Lead	0.274	0.239	0.196 - 0.282
Manganese	0.231	0.228	0.187 - 0.269
Mercury	0.0026	0.00332	0.0025 - 0.0042
Nickel	0.438 ⁽¹⁾	0.314	0.257 - 0.370
Nickel	0.262	0.314	0.257 - 0.370
Nickel	0.261	0.314	0.257 - 0.370
Nitrate	7.26	7.66	7.17 - 8.01
Oil & Grease	35 ⁽²⁾	37	28 - 46
Oil & Grease	50 ⁽²⁾	49	37 - 61
Oil & Grease	17	20	12 - 24
Pesticide-Aldrin	0.00154	0.00164	0.00069-0.002
Pesticide-4,4'-DDD	0.00196	0.00160	0.00050-0.0023
Pesticide-4,4'-DDE	0.00332	0.00320	0.00096-0.0046
Pesticide-4,4'-DDT	0.00115	0.00110	0.00027-0.0018
Pesticide-Dieldrin	0.00103	0.000852	0.00031-0.0012
Pesticide-Heptachlor epoxide	0.000625	0.000526	0.00019-0.00075
Pesticide-Methoxychlor	0.00524	0.00509	0.0019-0.0080
pH	9.0	9.1	8.9 - 9.3
pH	8.9	9.1	8.9 - 9.3
pH	6.0	6.0	5.9 - 6.08
Phenol	0.429	0.470	0.36 - 0.58
PCBs	0.0028	0.00253	0.00041 - 0.0032
Selenium	0.149	0.142	0.106 - 0.168

APPENDIX C

TABLE 4

SUMMARY OF FOURTH QUARTER SURFACE WATER QUALITY CONTROL DATA - CY1992

Parameter	Vendor Results (mg/l)	True Value (mg/l)	Acceptance Range (mg/l)
Silver	0.094 ⁽¹⁾	0.116	0.095 - 0.137
Silver	0.098	0.116	0.095 - 0.137
Silver	0.112	0.116	0.095 - 0.137
Sodium	290	282	240 - 324
Specific Conductance	2010 ⁽³⁾	1910	1660 - 2160
Sulfates	268	256	220 - 292
Suspended Solids	93	99.1	79 - 119
Suspended Solids	108	99.1	79 - 119
Suspended Solids	28 ⁽⁴⁾	31.8	28.1 - 35.2
Thallium	0.073	0.0739	0.055 - 0.087
Total Dissolved Solids	860	846	744 - 948
Total Organic Carbon	37	36.4	30 - 42
Turbidity	3.8	4.27	3.77 - 5.01
Zinc	0.238 ⁽¹⁾	0.199	0.163 - 0.235
Zinc	0.223	0.199	0.163 - 0.235
Zinc	0.215	0.199	0.163 - 0.235

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- (1) Vendor results not within acceptable range. All internal quality control conducted in conjunction with the analysis of the sample was reviewed, and it was determined that the high value may have been caused by improper volumetric preparation of the solution for analysis. The vendor resolved this problem and additional samples (see next sample results in Table) were submitted for analysis, and the results were within the acceptable range.
- (2) Units are mg/bottle.
- (3) Units are μ mhos/cm.
- (4) Considered acceptable due to minor significant figure differences between the vendor results and the acceptable range values.

APPENDIX D ENVIRONMENTAL PERMITS

AIR POLLUTION PERMITS

Operating Permits

ALLEGHENY COUNTY

<u>Unit</u>	<u>Permit Number</u>	<u>Renewal Date</u>
H-62148, H-62149	7032531 000 00512	January 1994
H-7157	7032531 000 00511	January 1994
C-1093	7032531 000 00509	January 1994
H-3132, H-3133	7032531 000 00901	January 1994
H-211500, H-211510 H-211520, H-211530	7032531 000 00600	January 1994

Installation Permits

Heat Source E	93-I-0001-C
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Water Pollution Permits

NPDES Permit Number Renewal Date

Bull Run Outfall 001 Northeast Area Outfall 002 Stormwater Outfall 003 Stormwater Outfall 004	PA0000914	July 24, 1992*
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Resource Conservation and Recovery Act

Chemical/Hazardous Waste
Storage Building

The RCRA Part B permit application was submitted to the PA Dept. of Environmental Resources and the U.S. Environmental Protection Agency on November 7, 1988.

Bettis currently manages hazardous waste in accordance with a Part A permit consistent with Pennsylvania requirements for interim status.

* Renewal application submitted to Pennsylvania Department of Environmental Resources on January 24, 1992.

END

**DATE
FILMED**

12/28/93