2006 Radiological Environmental Monitoring Report for the Combustion Engineering Site Brook and the Farmington River

I. INTRODUCTION

The Knolls Atomic Power Laboratory maintains a routine radiological environmental monitoring program for the Combustion Engineering Site Brook and the Farmington River. This is a continuation of the monitoring program conducted by Combustion Engineering, Inc., the operating contractor for the S1C Site from its construction until January 1, 1971.

Samples of water and sediment from the brook and Farmington River are analyzed annually for specific cobalt-60 radioactivity using a high-purity germanium gamma spectrometer system. Radiation levels along the brook are measured with a sensitive gamma scintillation survey meter. The Farmington River sampling was performed on August 4, 2006, and the brook sampling and surveying were performed on November 1, 2006.

A summary of the monitoring program results for the brook and Farmington River for 2006 is included in this report.

II. SUMMARY OF RESULTS

The following tables and figures summarize the monitoring results for 2006.

Low levels of cobalt-60 were measured in the sediment of the Combustion Engineering Site Brook. The highest measured concentration was 0.140 picocuries per gram. The average concentration was <0.032 picocuries per gram. For comparison, natural soil has several picocuries per gram of naturally occurring radionuclides. All measured concentrations of cobalt-60 are over a factor of ten below those required for unrestricted release of a site regulated by the Nuclear Regulatory Commission.

Cobalt-60 was not detected at any of the Farmington River sediment locations nor in any of the water samples taken from the brook or river. The radiation levels measured along the brook are consistent with background radiation levels. Farmington River water and sediment sample results show that past effluent from the S1C Site has had no adverse effect on the quality of the river environment.

III. DISCUSSION OF RESULTS

A. Measurement of Radiation Levels Along the Combustion Engineering Site Brook Bed

During 2006 radiation levels along the brook bed were measured using a sensitive gamma scintillation survey meter.

Table 1 shows the radiation levels measured at various locations along the brook during 2006. Readings are in counts per minute. These values are comparable to the radiation levels of three background locations. The survey locations are marked by stakes approximately 100 yards apart as shown in Figure 1. Radiation levels measured at any given location are subject to variations which depend on ground conditions and water depth of the brook. The results show that the radiation levels along the brook are consistent with past results.

B. Combustion Engineering Site Brook - Water and Sediment Samples

Samples of brook water and sediment were collected during 2006 at the locations shown in Figure 1.

A high-purity germanium gamma spectrometer system was used for analysis of all water and sediment samples to provide specific radionuclide identification. The decision level concentration (DLC) varies, depending on both the size (weight) of the sample and the background level at the time of measurement.

Table 2 shows the radioactivity concentration in approximately the top one inch of sediment collected from an area within a few feet of each stake. Overall, the low levels of cobalt-60 radioactivity in the sediment are consistent with past results and are decreasing. In fact, the yearly average level of the cobalt-60 in samples taken in 2006 is about one-half of the average of those taken in 2001, as would be expected due to radioactive decay if no additional cobalt-60 was added during the intervening years.

Table 3 shows the radioactivity concentration in one-liter water samples taken at each of the five locations in the brook. All brook water sample results were less than the sample specific cobalt-60 decision level concentration.

C. Farmington River - Water and Sediment Samples

Samples of Farmington River water and sediment were collected during 2006 at the locations shown in Figure 2. Sediment samples were collected with a dredge that samples approximately the top inch of sediment. The top layer of sediment is sampled, since it is more mobile.

All river water and sediment samples were analyzed for specific radionuclide radioactivity using a high-purity germanium gamma spectrometer system. The analytical results for Farmington River water samples (Table 4) show no significant difference in the river water upstream, downstream and opposite the mouth of the brook. All analytical results of Farmington River water were less than the sample specific cobalt-60 decision level concentration.

The analytical results for Farmington River sediment samples are shown in Table 5. All of the analytical results of Farmington River sediment were less than

the specific cobalt-60 decision level concentration. The river monitoring data show that the water released in the past by the S1C Site has had no adverse effect on the quality of the Farmington River environment.

IV. CONCLUSIONS

The environmental monitoring data collected continue to show a decrease in the low level cobalt-60 radioactivity in the brook sediment. Radiation levels measured at the brook area were consistent with natural background levels present in the area. During 2006, no S1C Site discharges were made to the brook or Farmington River.

Brook water samples contained no detectable cobalt-60 radioactivity. The low levels of cobalt-60 in the sediment are in a chemically insoluble metal oxide form and therefore residual cobalt-60 radioactivity in the sediment is not being taken up in the food chain. The brook area is on the property of and under the control of Combustion Engineering, Inc., and is not occupied by the general public. The results of the river water and sediment analyses show that S1C Site activities have had no adverse effect on the quality of the Farmington River environment.

The monitoring results reported herein indicate that the procedures used by the S1C Site to control radioactivity were effective in protecting both human health and the environment.

TABLE 1

Summary of Radiation Levels Measured Along the Combustion Engineering Site Brook – 2006

Location	Gamma Scintillation Survey Results Counts per Minute
1	4800
2	4400
3	4800
4	5400
5	5800
6	6200
7	6000
8	6200
9	7200
10	7000
11	7600
12	7200
13	6500
14	6600
15	5800

NOTES: Gamma scintillation survey results are based upon gamma radiation energies in the 0.1 to 8.0 MeV range.

Measurements taken at three background locations averaged 6500 counts per minute.

Measurements are taken at a height of three feet.

TABLE 2

Summary of Results for Combustion Engineering Site Brook Sediment Samples – 2006

Sample Location	Cobalt-60 Specific Concentration (pCi/gram) ①
1	<0.016
2	0.140
3	0.058
4	0.034
5	<0.013
6	0.049
7	0.016
8	<0.013
9	<0.015
10	<0.019
11	0.044
12	<0.015
13	<0.017
14	<0.012
15	<0.011
16	<0.033 ②

NOTES: ① Decision level concentration activity for a typical sample is between 0.011 and 0.019 pCi/g. Samples are analyzed wet.

② Average value for the three samples taken across the mouth of the brook.

When no cobalt-60 is detected in a sample, the decision level concentration (DLC) is reported. The DLC is the minimum value of the measured radioactivity concentration that provides a degree of confidence that a net positive amount of radioactivity is present in the sample analyzed. The "<" symbol indicates that no cobalt-60 photopeak was observed and the value following the symbol is the sample specific DLC.

TABLE 3

Summary of Results for Combustion Engineering Site Brook Water Samples - 2006

Sample Location	Cobalt-60 Specific Concentration ($x10^{-8}$ µCi/ml)
1	<0.873
4	<1.023
7	<0.817
10	<0.756
15	<0.756

NOTES:

When no cobalt-60 is detected in a sample, the decision level concentration (DLC) is reported. The DLC is the minimum value of the measured radioactivity concentration that provides a degree of confidence that a net positive amount of radioactivity is present in the sample analyzed. The "<" symbol indicates that no cobalt-60 photopeak was observed and the value following the symbol is the sample specific DLC.

TABLE 4

Summary of Results for Farmington River Water Samples - 2006

Sample Location		Cobalt-60 Specific Concentration ($x10^{-8}$ µCi/ml)
Upstream	1A	<1.078
	1B	<0.762
	1C	<0.934
Opposite	2A	<0.984
	2B	<0.825
	2C	<0.935
Downstream	3A	<0.823
	3B	<0.984
	3C	<0.984

NOTES:

When no cobalt-60 is detected in a sample, the decision level concentration (DLC) is reported. The DLC is the minimum value of the measured radioactivity concentration that provides a degree of confidence that a net positive amount of radioactivity is present in the sample analyzed. The "<" symbol indicates that no cobalt-60 photopeak was observed and the value following the symbol is the sample specific DLC.

TABLE 5

Summary of Results for Farmington River Sediment Samples - 2006

Sample Location		Cobalt-60 Specific Concentration (pCi/gram) ①
Upstream	1A	<0.012
	1B	<0.012
	1C	<0.013
Opposite	2A	<0.013
	2B	<0.019
	2C	<0.013
Downstream	3A	<0.013
	3B	<0.016
	3C	<0.013

NOTES: ① Decision level concentration for a typical sample is between 0.012 and 0.019 pCi/g. Samples are analyzed wet.

When no cobalt-60 is detected in a sample, the decision level concentration (DLC) is reported. The DLC is the minimum value of the measured radioactivity concentration that provides a degree of confidence that a net positive amount of radioactivity is present in the sample analyzed. The "<" symbol indicates that no cobalt-60 photopeak was observed and the value following the symbol is the sample specific DLC.

Figure 1
Combustion Engineering Site Brook Monitoring Locations

(1) Sample points are locations 1 through 16.

(2) Water samples are collected at stakes 1, 4, 7, 10, and 15.

(3) Sediment samples are collected at each location.

(4) Sediment samples are taken from all three locations (16E, 16C and 16W) at the mouth of the brook (**see inset**).

(5) Shoreline radiation surveys are performed at locations 1 through 15.

(6) The length of the brook from the Site to the Farmington River is approximately 3/4 miles.

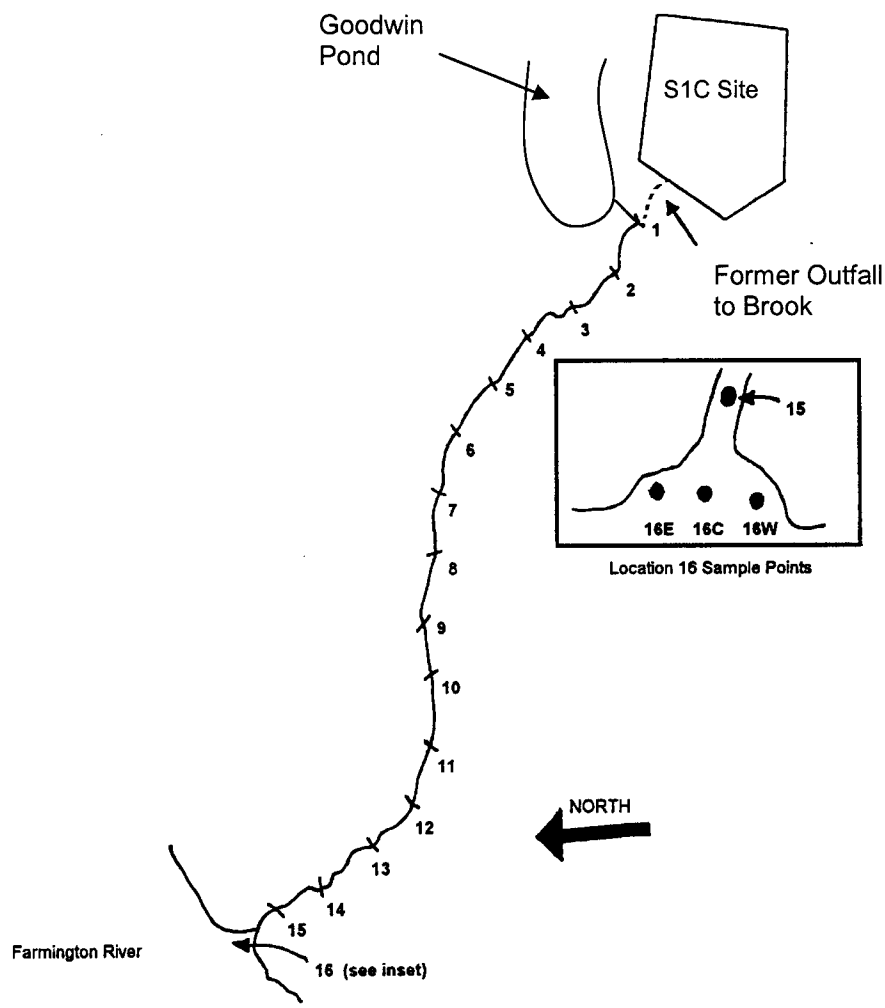

Figure 2
Farmington River Sampling Locations

(1) Locations 1A, 1B and 1C are 200 yards upriver from the brook release point, opposite the sand bar.

(2) Locations 2A, 2B and 2C are opposite the brook release point.

(3) Locations 3A, 3B and 3C are 500 yards downriver from the brook release point.

(4) Water and sediment samples are collected at each location.