

ATAL-BELGOPROCESS JOINT VENTURE

Contract No. EP/SP/40/02

**Low Level Radioactive Waste Storage
Facility at Siu A Chau**

**Thirteenth Environmental Monitoring and Audit Report
(Operation Phase)**

Version 1.0

October 2009

Certified By



(Environmental Team Leader)

REMARKS:

The information supplied and contained within this report is, to the best of our knowledge, correct at the time of printing.

The Environmental Team Leader accepts no responsibility for changes made to this report by third parties.

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TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
BACKGROUND.....	2
PURPOSE OF THE REPORT	2
2. MONITORING RESULTS	3
AMBIENT γ DOSE RATES	5
SAND.....	8
GRASS	9
SEA WATER	10
MARINE ORGANISMS	11
AIRBORNE PARTICULATES	13
3. REPORT ON ELEVATED ENVIRONMENTAL RADIATION BACKGROUND.....	14
DOSE FOR RADIATION WORKERS	15
DOSE RATES AT UN-CONTROLLED AREAS	15
LIQUID EFFLUENT DISCHARGE.....	15
AIRBORNE EFFLUENT DISCHARGE	15
5. RESULT OF ENVIRONMENTAL COMPLIANCE AUDITS.....	16
APPENDIX 1	17
LIMIT LEVEL AND ACTION LEVEL	17
INVESTIGATION LEVEL	17

LIST OF TABLES

Table 2.1(a)	Ambient γ Dose Rates at 1 m above Ground
Table 2.1(b)	Comparison of Ambient γ Dose Rates with Previous Results
Table 2.2(a)	Activity Concentration of Some Major Radionuclides in Soil Samples
Table 2.2(b)	Comparison of Activities in Soil with Previous Results
Table 2.3(a)	Activity Concentration of Some Major Radionuclides in Sand Samples
Table 2.3(b)	Comparison of Activities in Sand with Previous Results
Table 2.4(a)	Activity Concentration of Gross α and β Emitters in Grass Samples
Table 2.4(b)	Comparison of α/β Activities in Grass Samples with Previous Results
Table 2.5(a)	Activity Concentration of Gross α/β Emitters in Sea Water Samples
Table 2.5(b)	Comparison of α/β Activities in Sea Water Samples with Previous Results
Table 2.6(a)	Activity Concentration of Gross α/β Emitters in Fish Samples
Table 2.6(b)	Comparison of α/β Activities in Fish Samples with Previous Results
Table 2.7(a)	Activity Concentration of Gross α/β Emitters in Sea Snail Samples
Table 2.7(b)	Comparison of α/β Activities in Sea Snails with Previous Results
Table 2.8(a)	Net Gross α/β Counts in Airborne Particulate Samples
Table 2.8(b)	Comparison of α/β in Airborne Particulate Samples with Previous Samples
Table A1.1	Limit Levels for Non-compliance and Action Levels
Table A1.2	Investigation Levels for Environmental Samples

LIST OF FIGURES

Figure 2.1	Locations of the Sampling Sites
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EXECUTIVE SUMMARY

This is the third yearly report after the Facility has been operated for 4 years and it presents the results of the radiological monitoring work performed between September 2008 and the dates of sampling for this report. Two samplings were done separately on October 6, 2009 and October 22, 2009.

As usual, all the non-living samples (γ dose-rate; soil; sand and sea water) exhibited radioactivity contents that were similar to those of previous years, while the living samples (fish; sea snails and grass) showed larger variations, in particular the fishes. Airborne particulates collected in filters were similarly less predictable because the collection of particulates depended very much on weather conditions throughout the year.

Overall performance of the Facility is fine and there is no evidence that the operation of the Facility has led to any adverse effect to the environment.

1. INTRODUCTION

Background

- 1.1 Various industrial, educational and medical facilities in Hong Kong have, for a number of years, used radioactive materials and generated radioactive waste. Most of the existing waste arisings were stored in disused air raid tunnels close to Queen's Road East in Wan Chai. Other arisings were stored temporarily (although in some cases for several years) at the point of use in educational institutions or hospitals.
- 1.2 A consultancy study in 1995 concluded that Siu A Chau was a suitable location for a purpose-built storage facility to which all waste will be transported, placed in stainless steel drums and stored.
- 1.3 In July 2003 ATAL-Belgoprocess Joint Venture Limited (ABJV) was awarded a contract to design, construct, and operate the LRWF at Siu A Chau for 10 years. Thereafter, the ABJV will transfer the waste management skills for this Facility to Hong Kong.
- 1.4 The LRWF was designed to have a storage vault that can initially store 260 drums of waste, each drum of 275 litres net capacity. The building also contains facilities for waste reception and repackaging waste, and administering the process. A jetty was built to provide marine access to the Facility.
- 1.5 The Facility is equipped with various radiation monitors inside the building specially installed for detecting all possible leakage of effluents from the building.
- 1.6 However, it is possible that minute activities may escape from detection and enter the biosphere, or an unexpected incidence would have resulted in a significant release of radionuclide from the Facility. It is one of the objectives of this environmental monitoring scheme to monitor whether in the long-term, the operation of the Facility will cause deterioration to the environment.

Purpose of the Report

- 1.7 This is the thirteenth EM&A (Operation Phase) report, which is also the third annual report on measurement results of environmental samples taken after the commencement of operation of the LRWF on July 28, 2005. This report covers the monitoring period from September 2008 to the dates of sampling which were October 6, 2009 and October 22, 2009. Ambient γ dose-rates; grass samples; water samples and sea snail samples were collected on October 6, 2009. Soil samples; sand samples; fish samples and airborne particulate samples were collected on October 22, 2009.
- 1.8 The requirements of the operation phase monitoring and audit; monitoring scheme and monitoring equipment and procedures have been fully described in the First EM&A (Operation Phase) Report. Please refer to that report for reference.
- 1.9 This report also covers the monitoring of personnel doses, the non-active areas of the Facility and the liquid and gaseous effluents.

2. MONITORING RESULTS

- 2.1 The sampling scheme remained unchanged. 15 in-situ ambient γ dose rates were measured. 3 soil samples; 3 sand samples; 3 grass samples; 8 seawater samples from 4 locations at two depths; 1 kg of sea snails; a few fish and 3 airborne particulate samples were collected and analysed as in previous monitoring. **Figure 2.1** shows the locations for taking various samples.
- 2.2 Ambient γ dose rates were taken at exactly the same locations and would give a true picture of the variation of the radiation environment if there were any.
- 2.3 Soil and grass samples were collected at more or less the same place as for the baseline. Since we need fresh surface soils that would have stored information of fallout since the commencement of the operation, the sampling sites shifted a little bit every time.
- 2.4 The uncertainties of the measurement results are given as standard deviation (SD) or standard uncertainty (SU). SD is given for individual sample and is calculated according to the number of counts recorded and assuming a normal distribution for the counts. SU is reported for each group of samples and it takes into account of the variance between samples. Please refer to the First EM&A Report (Operation Phase) for details.

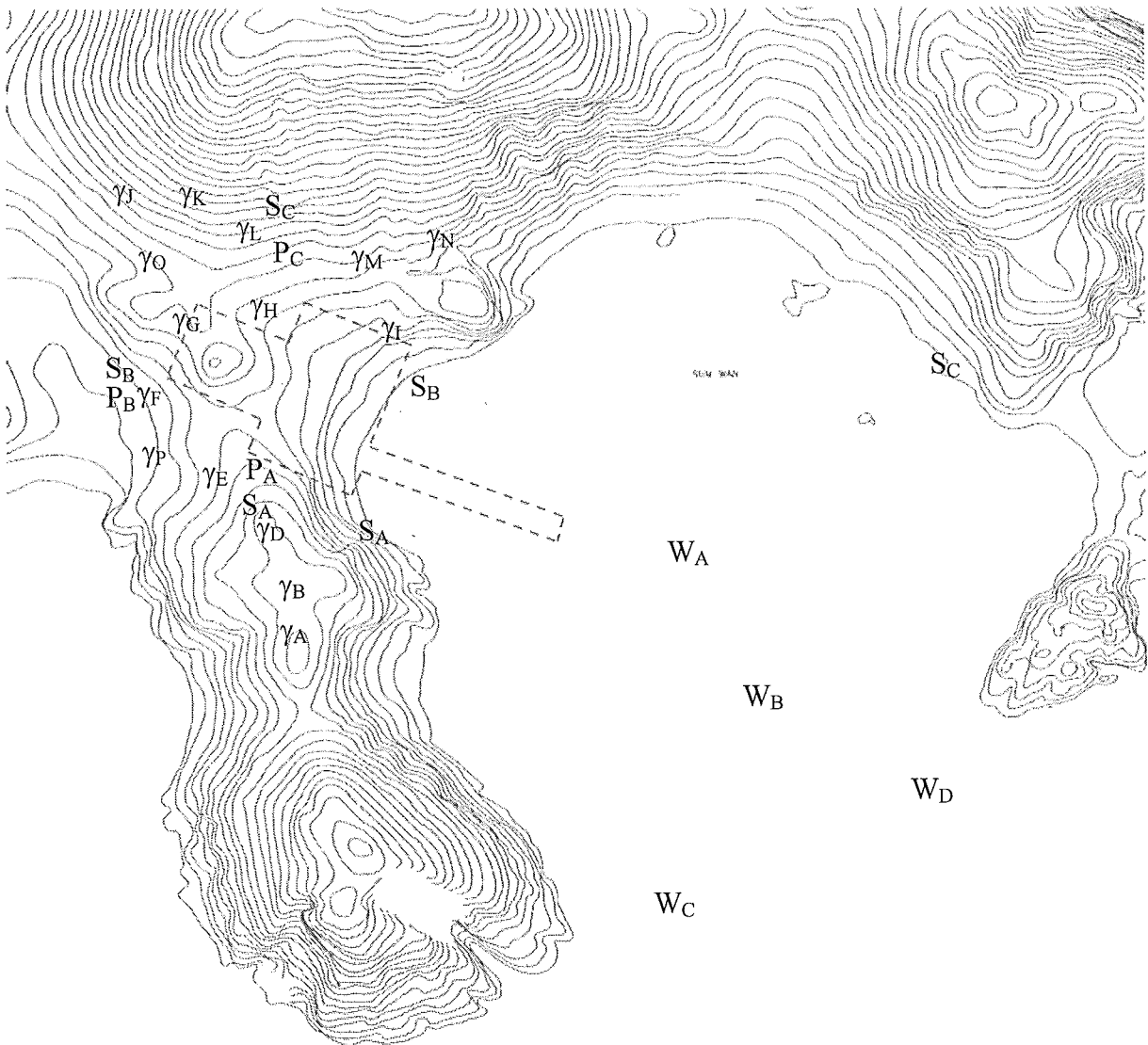


Fig. 2.1 Locations of the Sampling Sites

(γ : Ambient gamma dose rate; S: Soil or Sand; W: Water; P: Air particulates)
 (Grass sampling sites are the same as soil sampling sites)

Ambient γ Dose Rates

2.5 The measurement results are given in the last column in **Table 2.1(a)**. The 1st year results are average of all previous results measured within the 1st year. **Table 2.1(b)** also shows the results of the previous measurements for comparison. It is noted that the overall average value has not changed during the monitoring period.

Table 2.1(a) Ambient γ Dose Rates at 1 m above Ground

Location	γ Dose Rate ± 1 SD ($\mu\text{Sv h}^{-1}$)				
	Baseline (2005)	2006	2007	2008	2009
Boat	0.07	0.06	0.06	0.07	0.06 \pm 0.01
A	0.21	0.22	0.21	0.20	0.19 \pm 0.01
B	0.22	0.24	0.25	0.24	0.23 \pm 0.01
D	0.23	0.26	0.26	0.25	0.25 \pm 0.01
E	0.25	0.23	0.22	0.20	0.20 \pm 0.01
F	0.24	0.27	0.29	0.26	0.25 \pm 0.01
G	0.23	0.26	0.26	0.25	0.25 \pm 0.01
H	0.27	0.29	0.30	0.29	0.30 \pm 0.01
I	--	0.29	0.29	0.27	0.27 \pm 0.01
J	0.21	0.23	0.24	0.22	0.24 \pm 0.01
K	0.28	0.27	0.27	0.26	0.27 \pm 0.01
L	0.22	0.26	0.27	0.25	0.26 \pm 0.01
M	0.27	0.28	0.27	0.30	0.26 \pm 0.01
N	0.25	0.25	0.27	0.25	0.24 \pm 0.01
O	--	0.22	0.24	0.20	0.22 \pm 0.01
P	--	0.25	0.27	0.27	0.25 \pm 0.01

-- Not measured

2.6 No exceedance of Investigation Level was observed.

Table 2.1(b) Comparison of Ambient γ Dose Rates with Previous Results

EM&A Report No.	Mean γ Dose Rate ($\mu\text{Sv h}^{-1}$)	SU
1 (Baseline)	0.24	0.026
2	0.26	0.028
3	0.25	0.022
4	0.25	0.029
5	0.26	0.027
6	0.25	0.024
7	0.26	0.022
8	0.25	0.031
9	0.24	0.031
10	0.25	0.029
11 (2007)	0.26	0.025
12 (2008)	0.25	0.031
13 (2009)	0.25	0.028

2.7 The overall mean ambient γ dose-rate for this year is the same as those in previous years.

Soil

2.8 Soil samples were collected at 3 locations only, all from the undisturbed areas. These locations correspond to the passive air sampler locations which aim to detect dispersion of effluent leakages, if any, in the prevailing wind directions. The measurement results are given in **Table 2.2(a) & (b)**.

Table 2.2(a) Activity Concentration of Some Major Radionuclides in Soil Samples

Location	Collection Date	Activity Concentration (Bq kg ⁻¹)							
		²²⁶ Ra	SD	²²⁸ Th	SD	⁴⁰ K	SD	¹³⁷ Cs	SD
A	22 Oct 09	57	0.5	126.5	0.8	613	4.6	*	*
B	22 Oct 09	72.3	0.5	118.6	0.8	562	4.5	*	*
C	22 Oct 09	48.6	0.4	102.9	0.7	246	3.1	*	*

* Not detected

Table 2.2(b) Comparison of Activities in Soil Samples with Previous Results

EM&A Report No.	Mean Activity Concentration (Bq kg ⁻¹)							
	²²⁶ Ra	SU	²²⁸ Th	SU	⁴⁰ K	SU	¹³⁷ Cs	SU
1 (Baseline)	50.0	13.9	80.2	16.1	606	297	0.25	0.37
2	41.7	17.0	63.7	20.5	387	219	*	*
3	41.8	15.4	75.6	20.1	423	237	*	*
4	45.3	7.1	104.5	11.4	574	319	0.25	0.43
5	57.8	17.7	95.8	4.2	535	294	0.41	0.42
6	59.9	19.0	103.9	14.3	479	277	0.25	0.23
7	60.8	22.4	102.9	16.2	464	258	0.36	0.33
8	51.9	17.6	95.0	14.8	449	263	0.19	0.17
9	52.5	18.6	98.4	16.3	523	307	0.07	0.12
10	50.7	16.1	97.7	9.5	498	282	0.18	0.17
11 (2007)	52.8	15.7	106.8	16.9	483	253	0.27	0.01
12 (2008)	64.3	34.5	99.1	25.3	506	218	0.18	0.04
13 (2009)	59.3	12.0	116.0	12.0	474	199	*	*

* Not detected

2.9 No exceedance of Investigation Level was observed.

Sand

2.10 The measurement results are shown in **Table 2.3(a) & (b)**.

Table 2.3(a) Activity Concentration of Some Major Radionuclides in Sand Samples

Location	Collection Date	Activity Concentration (Bq kg ⁻¹)					
		²²⁶ Ra	SD	²²⁸ Th	SD	⁴⁰ K	SD
A	22 Oct 09	17.2	0.3	15.3	0.3	315	3.3
B	22 Oct 09	21.5	0.3	15.4	0.3	198	2.7
C	22 Oct 09	18.7	0.3	21.3	0.4	427	3.7

Table 2.3(b) Comparison of Activities in Sand Samples with Previous Results

EM&A Report No.	Mean Activity Concentration (Bq kg ⁻¹)					
	²²⁶ Ra	SU	²²⁸ Th	SU	⁴⁰ K	SU
1 (Baseline)	18.8	4.4	21.6	5.5	576	106
2	11.1	3.8	12.8	5.0	357	100
3	11.4	3.2	13.2	4.4	382	141
4	28.3	22.8	24.5	17.4	360	165
5	23.3	12.7	25.6	17.9	323	117
6	20.8	8.0	25.8	18.0	329	95.7
7	30.2	24.8	24.3	17.0	320	173
8	15.4	4.6	15.4	4.1	246	30.5
9	14.5	1.2	17.3	5.8	380	99.1
10	18.4	1.7	18.5	2.4	377	124
11 (2007)	17.0	2.4	18.6	4.4	397	71.3
12 (2008)	18.0	4.7	16.5	1.7	382	20.6
13 (2009)	19.1	2.2	17.3	3.4	313	115

2.11 No exceedance of Investigation Level was observed.

Grass

2.12 Grass samples were collected in locations near to the soil samples. The measurement results are given in **Table 2.4(a) & (b)**. The γ -spectra are identical to the background of the γ spectrometer and do not reveal the presence of any significant γ -emitting radionuclides, hence they are not reported here.

Table 2.4(a) Activity Concentration of Gross α and β Emitters in Grass Samples

Location	Collection Date	α Activity* (Bq g ⁻¹)	SD (Bq g ⁻¹)	β Activity* (Bq g ⁻¹)	SD (Bq g ⁻¹)
A	6 Oct 09	0.000 [#]	0.000	0.08	0.004
B	6 Oct 09	0.006	0.003	0.07	0.003
C	6 Oct 09	0.033	0.004	0.131	0.004

* Bq g⁻¹ refers to dry mass of grass

[#] Below minimum detectable activity of 0.006 Bq g⁻¹

Table 2.4(b) Comparison of α/β Activities in Grass with Previous Results

EM&A Report No.	Mean α Activity (Bq g ⁻¹)	SU (Bq g ⁻¹)	Mean β Activity (Bq g ⁻¹)	SU (Bq g ⁻¹)
1 (Baseline)	0.083	0.044	0.33	0.03
2	0.037	0.012	0.25	0.01
3	0.081	0.017	0.30	0.10
4	0.093	0.009	0.26	0.03
5	0.084	0.020	0.23	0.04
6	0.081	0.056	0.22	0.09
7	0.077	0.046	0.25	0.08
8	0.068	0.047	0.28	0.05
9	0.050	0.023	0.29	0.02
10	0.051	0.008	0.40	0.07
11 (2007)	0.030	0.022	0.27	0.06
12 (2008)	0.012	0.020	0.17	0.04
13 (2009)	0.014	0.016	0.10	0.03

2.13 No exceedance of Investigation Level was observed.

Sea Water

- 2.14 The same 4 locations were chosen to collect the water samples at 2 depths. The measurement results are given in **Table 2.5(a) & (b)**.
- 2.15 Similar to grass samples, the γ spectra are not reported. There is no sign of presence of γ emitters.
- 2.16 No exceedance of Investigation Level is observed.

Table 2-5(a) Activity Concentration of Gross α/β Emitters in Sea Water Samples

Location	Collection Date	Water Depth (m)	α Activity (Bq L ⁻¹)	SD (Bq L ⁻¹)	β Activity (Bq L ⁻¹)	SD (Bq L ⁻¹)
A	6 Oct 09	1	0.00 [#]	0.00	6.47	0.39
		3.5	0.00 [#]	0.00	6.65	0.38
B	6 Oct 09	1	1.15 [#]	0.00	6.43	0.38
		6.5	0.53 [#]	0.00	6.63	0.38
C	6 Oct 09	1	0.53 [#]	0.00	5.01	0.38
		7.5	0.36 [#]	0.00	4.88	0.37
D	6 Oct 09	1	0.00 [#]	0.00	3.79	0.28
		5	0.00 [#]	0.00	3.69	0.28

[#] Below minimum detectable activity of 2.32 Bq L⁻¹.

Table 2.5(b) Comparison of α/β Activities in Sea Water with Previous Results

EM&A Report No.	Mean α Activity (Bq L ⁻¹)	SU (Bq L ⁻¹)	Mean β Activity (Bq L ⁻¹)	SU (Bq L ⁻¹)
1 (Baseline)	0.77	0.25	7.20	0.70
2	0.49	0.47	6.10	0.46
3	0.57	0.21	7.43	0.80
4	0.71	0.50	7.00	0.81
5	0.92	0.44	6.15	0.64
6	0.63	0.28	6.99	0.37
7	0.25	0.28	6.30	0.45
8	0.19	0.23	5.84	1.34
9	0.32	0.29	5.21	0.38
10	0.70	0.35	8.35	2.19
11 (2007)	0.00	0.00	2.35	0.21
12 (2008)	0.00	0.00	4.08	0.42
13 (2009)	0.32	0.29	5.44	1.27

Marine Organisms

- 2.17 Fishes were caught along the jetty and sea snails were collected randomly along the shores.
- 2.18 The measurement results are given in **Table 2.6(a) & (b)** and **Table 2.7(a) & (b)** for the gross α/β activities in fish and sea snails respectively.

Table 2.6(a) Activity Concentration of Gross α/β Emitters in Fish Samples

Sample	Collection Date	α Activity* (Bq g ⁻¹)	SD (Bq g ⁻¹)	β Activity* (Bq g ⁻¹)	SD (Bq g ⁻¹)
1	22 Oct 09	0.000 [#]	0.000	0.074	0.003
2	22 Oct 09	0.023	0.003	0.097	0.003
3	22 Oct 09	0.000 [#]	0.000	0.067	0.003

* Bq g⁻¹ refers to wet mass of fish flesh.

[#] Below minimum detectable activity of 0.007 Bq g⁻¹

Table 2.6(b) Comparison of α/β Activities in Fish Samples with Previous Results

EM&A Report No.	Mean α Activity (Bq g ⁻¹)	SU (Bq g ⁻¹)	Mean β Activity (Bq g ⁻¹)	SU (Bq g ⁻¹)
1 (Baseline)	0.0093	0.004	0.068	0.003
2	0.0068	0.004	0.16	0.15
3	0.0116	0.005	0.026	0.006
4	0.0066	0.004	0.065	0.005
5	0.0040	0.004	0.056	0.010
6	0.0069	0.002	0.063	0.002
7	0.0120	0.021	0.047	0.035
8	0.0037	0.002	0.074	0.006
9	0.0100	0.004	0.062	0.050
10	0.0060	0.005	0.078	0.007
11 (2007)	0.0003	0.001	0.055	0.012
12 (2008)	0.0000	0.000	0.067	0.003
13 (2009)	0.0075	0.002	0.079	0.000

- 2.19 A slight exceedance of Investigation Level in sample 2 was observed. A number of small fishes were caught and their fresh was mixed and treated together to form 3 samples for measurement. Though one of the 3 samples showed a slight exceedance in Investigation Level, the overall average activity remained low.

Table 2.7(a) Activity Concentration of Gross α/β Emitters in Sea Snail Samples

Sample	Collection Date	α Activity* (Bq g ⁻¹)	SD (Bq g ⁻¹)	β Activity* (Bq g ⁻¹)	SD (Bq g ⁻¹)
1	6 Oct 09	0.003 [#]	0.003	0.034	0.002
2	6 Oct 09	0.006 [#]	0.003	0.039	0.002
3	6 Oct 09	0.001 [#]	0.000	0.032	0.002

* Bq g⁻¹ refers to wet mass of sea snail flesh.

[#] Below minimum detectable activity of 0.008 Bq g⁻¹

Table 2.7(b) Comparison of α/β Activities in Sea Snails with Previous Results

EM&A Report No.	Mean α Activity (Bq g ⁻¹)	SU (Bq g ⁻¹)	Mean β Activity (Bq g ⁻¹)	SU (Bq g ⁻¹)
1 (Baseline)	0.029	0.006	0.064	0.004
2	0.010	0.008	0.034	0.007
3	0.009	0.002	0.032	0.002
4	0.032	0.011	0.050	0.002
5	0.004	0.005	0.045	0.007
6	0.007	0.005	0.042	0.006
7	0.014	0.006	0.063	0.008
8	0.005	0.001	0.040	0.004
9	0.000	0.000	0.023	0.002
10	0.010	0.009	0.045	0.005
11 (2007)	0.000	0.001	0.043	0.002
12 (2008)	0.000	0.000	0.024	0.002
13 (2009)	0.003	0.003	0.035	0.004

2.20 All activities are comparable to the baseline levels and no exceedance in Investigation Level was observed.

Airborne Particulates

2.21 The sampling period was from November 12, 2008 to October 22, 2009.

2.22 Measurement results are given in **Table 2.8(a) & (b)**.

Table 2.8(a) Net Gross α/β Counts in Airborne Particulate Samples

Location	α Count-rate (cpm)	SD	β Count-rate (cpm)	SD
Blank	1.83	0.18	7.70	0.36
A1	1.53	0.29	4.33	0.64
A2	0.41 [#]	0.11	2.90	0.53
B1	0.00 [#]	0.00	1.40	0.39
B2	0.50 [#]	0.31	4.77	0.51
C1	0.50 [#]	0.26	0.03*	0.00
C2	1.07	0.32	3.52	0.52

[#] Below minimum detectable limit (α) of 0.53 cpm.

* Below minimum detectable limit (β) of 1.07 cpm.

Table 2.8(b) Comparison of α/β in Airborne Particulate Samples with Previous Results

EM&A Report No.	A		B		C	
	α (cpm)	β (cpm)	α (cpm)	β (cpm)	α (cpm)	β (cpm)
1 (Baseline)	0.00	0.00	0.00	0.00	0.00	1.17
2	0.09	1.38	0.00	0.39	0.00	0.00
3	0.04	0.45	0.00	1.18	0.13	0.86
4	0.12	1.75	0.65	2.18	0.00	0.28
5	0.35	0.94	0.24	0.66	0.07	0.83
6	0.18	0.33	0.00	0.02	0.00	0.00
7	0.16	0.75	0.16	0.09	0.20	0.00
8	0.84	4.87	0.24	1.64	0.09	1.84
9	0.91	3.03	0.29	1.36	0.09	0.42
10	0.32	1.97	0.11	1.05	0.00	0.03
11 (2007)	0.35	1.00	0.11	0.04	0.02	1.75
12 (2008)	0.26	6.18	0.42	5.51	0.19	2.83
13 (2009)	0.97	3.62	0.25	3.09	0.79	1.78

2.23 A small amount of α and β were detected, but their activities are comparable to the background.

3. REPORT ON ELEVATED ENVIRONMENTAL RADIATION BACKGROUND

- 3.1 The Investigation Levels for environmental samples have been established and they are given in Appendix 1. The relevant action plan is given in the First EM&A Report (Operation Phase).
- 3.2 A slight exceedance of Investigation Level was observed in one of the fish samples. Since the fishes were collected randomly from the sea, they will inevitably have large variation in radionuclide contents in their bodies. This is evidenced by the largest number of exceedance in fish samples among other samples observed in the past years.
- 3.3 The exceedance observed this time is very small and is within the largest fluctuation experienced in the past. Furthermore the overall average is small, so the slight exceedance in the fish sample should not be a concern.
- 3.4 No other exceedance was observed.

4. REPORT ON NON-COMPLIANCE

4.1 The Action Level and Limit Level (A/L Levels) for non-compliance have been established and they are given in Appendix 1 for easy reference. The relevant Event and Action Plan have been developed. Please refer to the First EM&A Report (Operation Phase) for details.

Dose for Radiation Workers

4.2 There was no record of exceeding the A/L Levels as recorded by TLDs.

Dose Rates at Un-controlled Areas

4.3 No exceedance of the A/L Levels was observed.

Liquid Effluent Discharge

4.4 There was no liquid effluent discharged during the monitoring period.

Airborne Effluent Discharge

4.5 The average total radon released during the monitoring period was estimated to be 5.9×10^8 Bq/month, which is below the A/L Levels.

4.6 It was noted that both the left and right jumbo filters removed on September 1, 2009 exhibited abnormally high α and β activities. The filters were assayed by γ -spectroscopy and the high activities were confirmed to be due to naturally occurring radionuclides of the U-238 and Th-232 series and K-40. It was concluded that the filters might have been contaminated by soil.

4.7 The discharged α and β activities were also below the A/L Levels.

4.8 The total airborne effluent discharge was below the A/L Levels.

5. RESULT OF ENVIRONMENTAL COMPLIANCE AUDITS

5.1 No compliant was received during the period.

APPENDIX 1

Limit Level and Action Level

The Limit Levels for non-compliance with the Environmental Performance Requirements during the Operation are shown in **Table A1-1**.

Table A1-1 Limit Levels for Non-compliance and Action Levels

Environmental Performance Requirements	Limit Levels	Action Levels (3/10th of Limit Levels)
Dose for radiation workers	1.67 mSv per month	0.5 mSv per month
Dose rate at un-controlled areas	1 µSv per hour	0.3 µSv per hour
Liquid effluent discharge	10 ALI per month	3 ALI per month
Airborne effluent discharge	10 ALI per month	3 ALI per month

Investigation Level

With the help of all the internal monitoring, it is unlikely that the effluents will cause any observable increase in the radiation levels in the vicinity of the Facility under normal operation. It is also not anticipated that any significant quantity of the radioactive wastes would be released to the environment under even the most severe natural disasters. Nevertheless when the environmental samples are found to have radioactivities higher than the normal fluctuation of the established baseline levels, some investigation has to be initiated. The levels that trigger the investigation are called investigation levels and they are given in **Table A1.2**.

Table A1.2 Investigation Levels for Environmental Samples

Environmental Samples		Investigation Levels	
Ambient γ dose rate ($\mu\text{Sv h}^{-1}$)	A	0.23	3 × SD of individual baseline dose rate
	B	0.25	
	D	0.27	
	E	0.29	
	F	0.28	
	G	0.27	
	H	0.31	
	I	0.32	
	J	0.24	
	K	0.32	
	L	0.30	
	M	0.31	
	N	0.29	
	O	0.24	
P	0.29		
Soil (Bq kg^{-1})	²²⁶ Ra	91.7	3 × SU of baseline samples
	²²⁸ Th	128.5	
	⁴⁰ K	1497	

	¹³⁷ Cs	1.36	
	Other γ emitters		Occurrence in any quantities
Sand (Bq kg ⁻¹)	²²⁶ Ra	32.0	3 × SU of baseline samples
	²²⁸ Th	38.1	
	⁴⁰ K	894	
	Other γ emitters		Occurrence in any quantities
Grass (Bq g ⁻¹)	Gross α	0.22	3 × SU of baseline samples
	Gross β	0.43	
	γ emitters not found in baseline		Occurrence in any quantities
Sea water (Bq L ⁻¹)	Gross α	1.52	3 × SU of baseline samples
	Gross β	9.3	
	γ emitters not found in baseline		Occurrence in any quantities
Fish (Bq g ⁻¹)	Gross α	0.021	3 × SU of baseline samples
	Gross β	0.076	
Sea snails (Bq g ⁻¹)	Gross α	0.048	3 × SU of baseline samples
	Gross β	0.076	
Airborne particulates (cpm)	Gross α		Occurrence in any quantities
	Gross β		

- SD is the standard deviation of a single sample.
- SU is standard uncertainty of the sample group.