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04 December, 2020

**EIA Ordinance Register Office,  
Environmental Protection Department,  
27/F, Southorn Centre,  
130 Hennessy Road,  
Hong Kong**

**By Registered Post**

**Attn.: Mr. Simon Ho**

HO

10/12/2020

Dear Sir,

**Contract No. EP/SP/75/14  
Low-Level Radioactive Waste Storage Facility Follow-On Contract  
FEP-02/131/2002 - EM&A Report (Operation Phase) (Year 2020)**

We would like to submit herewith the Environmental Monitoring and Audit Report (Operation Phase) (Year 2020) regarding the operation phase of Low-Level Radioactive Waste Storage Facility at Siu A Chau, which is verified by IEC in November 2020.

A copy of this EM&A Report has been uploaded to our project website: <http://www.atal.com.hk/LLRWSF/> for public access.

For any enquiries regarding EM&A matters, please feel free to contact our Mr. Alfred Wong (Tel: 2565 3475, Email: [alfredwong@atal.com](mailto:alfredwong@atal.com)). Thank You.

Yours faithfully,  
For and on behalf of  
**ATAL Engineering Ltd.**

Raymond Yem  
Project Manager

RY/AKOW/DCHS/icih  
Encl. (1 copy)



cc. EPD - Mr. Ashley Pun (by email: [ash;eymhpun@epd.gov.hk](mailto:ash;eymhpun@epd.gov.hk))

**ATAL ENGINEERING LIMITED**

**Contract No. EP/SP/75/14**

**Low Level Radioactive Waste Storage Facility  
Follow-On Contract**

**Environmental Monitoring and Audit Report No. 5  
(Operation Phase)**

**Draft**

October 2020

Prepared and Submitted By



(Environmental Team Leader  
and Responsible Person)

**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.

Dr. John K.C. Leung

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## **EXECUTIVE SUMMARY**

This is the fifth Environmental Monitoring & Audit (EM&A) Report for the new Low Level Radioactive Waste Storage Facility Follow-On Contract.

The Low Level Radioactive Waste Storage Facility (Facility) has been running smoothly in the past 12 months and no contamination due to the operation of the Facility was observed in the surrounding environment.



## INTRODUCTION

### Background

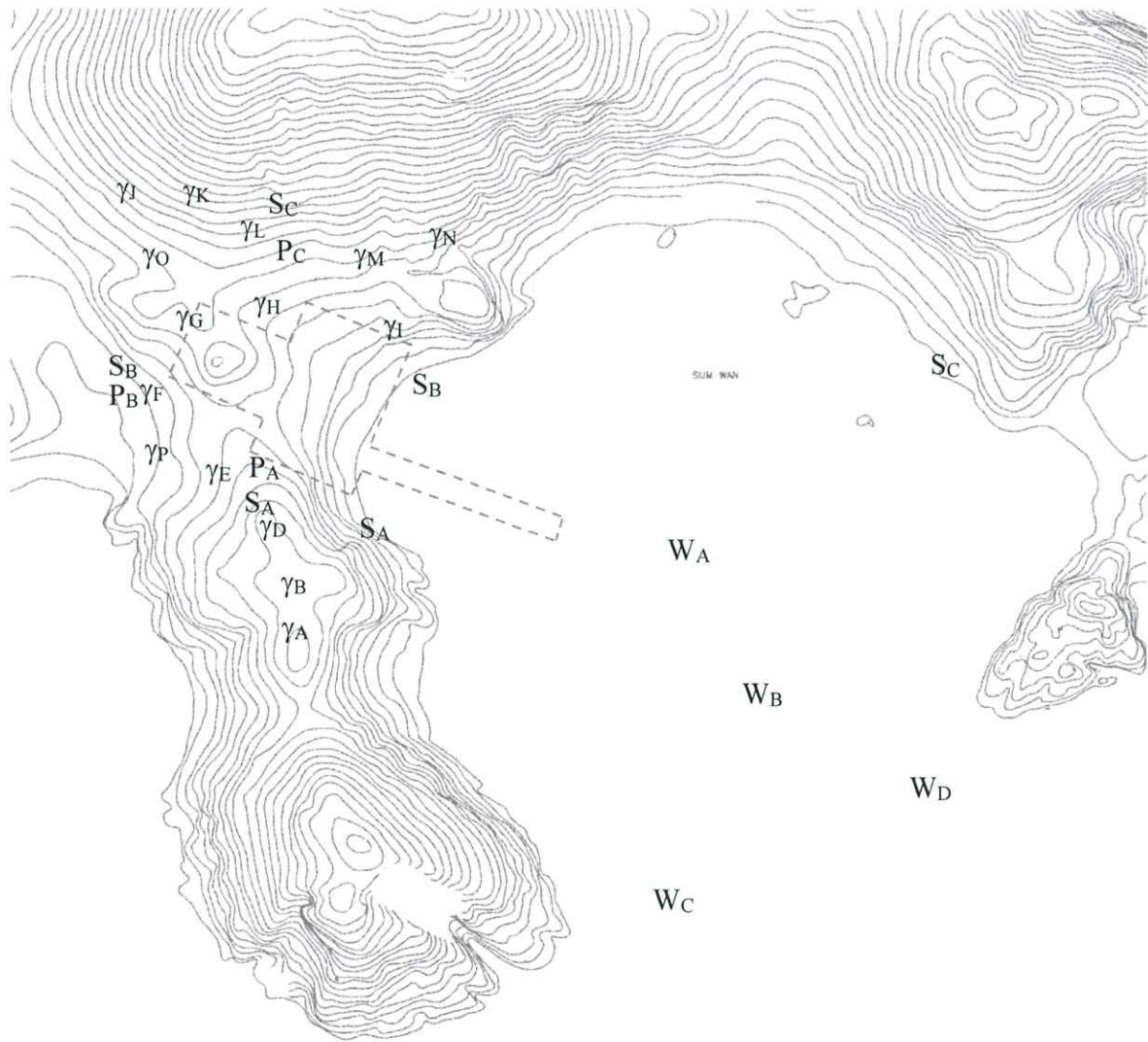
- 1.1 Various industrial, educational and medical facilities in Hong Kong have, for a number of years, used radioactive materials and generated radioactive waste. Most of the existing waste arisings were stored in disused air raid tunnels close to Queen's Road East in Wan Chai. Other arisings were stored 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 Low Level Radioactive Waste Storage Facility at Siu A Chau (LLRWSF) for 10 years. Thereafter, the ABJV will transfer the waste management skills for this Facility to Hong Kong.
- 1.4 The LLRWSF 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.
- 1.7 In 2015, ATAL was awarded the contract (Low Level Radioactive Waste Storage Facility Follow-On Contract) to operate the LLRWSF for another 10 years starting from January 19, 2016.

### Purpose of the Report

- 1.8 This is EM&A Report No. 5 (Operation Phase) for the Follow-On Contract. This report covers the monitoring period from August 20, 2019 to the date of sampling which was August 25, 2020.
- 1.9 The requirements of the operation phase monitoring and audit, monitoring scheme and monitoring equipment and procedures have been fully described in the EM&A Manual (Part 2). Please refer to that manual for reference.
- 1.10 This report also reports on any non-compliance of personnel doses, dose-rates on 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  $\gamma$  dose rates were measured. 3 soil samples; 3 sand samples; 3 grass samples; 8 seawater samples from 4 locations at two depths; 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  $\gamma$  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) (Oct 2005) for details.



**Fig. 2.1 Locations of the Sampling Sites**

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



**Ambient  $\gamma$  Dose Rates**

2.5 The measurement results are given in the last column in **Table 2.1(a)**. The last five years of results are given for comparison. **Table 2.1(b)** shows the mean  $\gamma$  dose rates. It is noted that the overall average value has remained similar during the monitoring period.

**Table 2.1(a) Ambient  $\gamma$  Dose Rates at 1 m above Ground**

Location	ILs	Net $\gamma$ Dose Rate ( $\mu\text{Sv h}^{-1}$ )					
		Baseline (2005)	2015	2016	2017	2018	2019
A	0.17	0.14	0.16	0.14	0.15	0.13	0.15
B	0.19	0.15	0.17	0.16	0.17	0.18	0.13
D	0.21	0.16	0.20	0.18	0.21	0.19	0.17
E	0.23	0.18	0.16	0.15	0.13	0.14	0.23
F	0.22	0.17	0.19	0.18	0.18	0.14	0.18
G	0.21	0.16	0.19	0.18	0.14	0.19	0.16
H	0.25	0.20	0.21	--	0.15	0.19	0.15
I	0.26	--	0.24	--	0.18	0.18	0.18
J	0.18	0.14	0.18	--	0.17	0.14	0.12
K	0.26	0.21	0.22	0.18	0.16	0.22	0.13
L	0.24	0.19	0.22	0.21	0.15	0.18	0.22
M	0.25	0.20	0.20	0.21	0.18	0.20	0.17
N	0.23	0.18	0.19	0.19	0.15	0.16	0.17
O	0.18	--	0.15	--	0.15	0.13	0.18
P	0.23	--	0.23	0.18	0.18	0.20	0.18

-- Not measured

Location	ILs	Net $\gamma$ Dose Rate $\pm$ 1 SD ( $\mu\text{Sv h}^{-1}$ )
		2020
A	0.17	0.16 $\pm$ 0.03
B	0.19	0.16 $\pm$ 0.03
D	0.21	0.20 $\pm$ 0.03
E	0.23	0.12 $\pm$ 0.04
F	0.22	0.19 $\pm$ 0.04
G	0.21	0.16 $\pm$ 0.03
H	0.21	0.14 $\pm$ 0.03
I	0.34	0.17 $\pm$ 0.03
J	0.20	0.19 $\pm$ 0.02
K	0.26	0.18 $\pm$ 0.03
L	0.24	0.19 $\pm$ 0.03
M	0.25	0.19 $\pm$ 0.02
N	0.23	0.17 $\pm$ 0.03
O	0.21	0.21 $\pm$ 0.03
P	0.23	0.21 $\pm$ 0.03

**Table 2.1(b) Comparison of Ambient  $\gamma$  Dose Rates for last 5 years**

<b>EM&amp;A Report No.</b>	<b>Mean Net <math>\gamma</math> Dose Rate (<math>\mu\text{Sv h}^{-1}</math>)</b>	<b>SU</b>
Baseline (2005)	0.18	0.026
19 (2015)	0.19	0.027
1 (2016)	0.18	0.022
2 (2017)	0.16	0.021
3 (2018)	0.17	0.028
4 (2019)	0.17	0.031
5 (2020)	0.18	0.025

- 2.6 The initial net  $\gamma$  dose rates at Location G & H were measured to be 0.23 and 0.25  $\mu\text{Sv/h}$ , which have exceeded the IL. The two sites were re-measured on October 30, 2020 and both results were normal. It is therefore concluded that the sites did not have elevated  $\gamma$  dose rates and the original measurements were not correct. The new measurement results are presented in the tables above. There is no exceedance of IL.

**Soil**

2.7 Soil samples were collected at 3 locations, 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 (ILs for <sup>226</sup>Ra, <sup>228</sup>Th, <sup>40</sup>K and <sup>137</sup>Cs are respectively 155, 218, 2544 & 2.31 Bq kg<sup>-1</sup>)**

Location	Collection Date	Activity Concentration (Bq kg <sup>-1</sup> )							
		<sup>226</sup> Ra	SD	<sup>228</sup> Th	SD	<sup>40</sup> K	SD	<sup>137</sup> Cs	SD
A	25 Aug 20	109	2.3	144	2.7	1020	9.9	0.0*	0.6
B	25 Aug 20	67.0	1.9	183	2.2	1055	8.2	0.0*	0.5
C	25 Aug 20	69.5	2.1	183	2.3	311	5.9	0.0*	0.5

\* Below minimum detectable activity of 1.86 Bq kg<sup>-1</sup>

**Table 2.2(b) Comparison of Activities in Soil Samples for last 5 years**

EM&A Report No.	Mean Activity Concentration (Bq kg <sup>-1</sup> )		
	<sup>226</sup> Ra	<sup>228</sup> Th	<sup>40</sup> K
Baseline (2005)	85	136	1030
19 (2015)	107	126	1015
1 (2016)	101	213	704
2 (2017)	91.8	165	878
3 (2018)	82.8	179	774
4 (2019)	92.2	184	825
5 (2020)	81.8	170	795

2.8 No exceedance of IL was observed.

**Sand**

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

**Table 2.3(a) Activity Concentration of Some Major Radionuclides in Sand Samples (ILs for  $^{226}\text{Ra}$ ,  $^{228}\text{Th}$  &  $^{40}\text{K}$  are respectively 54, 65 & 1520 Bq kg<sup>-1</sup>)**

Location	Collection Date	Activity Concentration (Bq kg <sup>-1</sup> )					
		$^{226}\text{Ra}$	SD	$^{228}\text{Th}$	SD	$^{40}\text{K}$	SD
A	25 Aug 20	35.7	1.1	32.1	1.3	534	5.5
B	25 Aug 20	41.0	0.9	34.6	1.0	352	4.0
C	25 Aug 20	37.0	0.9	32.0	1.1	380	4.3

**Table 2.3(b) Comparison of Activities in Sand Samples for last 5 years**

EM&A Report No.	Mean Activity Concentration (Bq kg <sup>-1</sup> )		
	$^{226}\text{Ra}$	$^{228}\text{Th}$	$^{40}\text{K}$
Baseline (2005)	31.9	36.7	979
19 (2015)	28.9	27.0	443
1 (2016)	26.5	25.3	433
2 (2017)	27.9	29.5	473
3 (2018)	30.9	32.6	526
4 (2019)	28.6	28.3	518
5 (2020)	37.9	32.9	422

2.10 No exceedance of IL was observed.



**Grass**

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

**Table 2.4(a) Activity Concentration of Gross  $\alpha$  and  $\beta$  Emitters in Grass Samples (ILs for  $\alpha$  and  $\beta$  activities are respectively 0.22 & 0.43 Bq g<sup>-1</sup>)**

Location	Collection Date	$\alpha$ Activity* (Bq g <sup>-1</sup> )	SD (Bq g <sup>-1</sup> )	$\beta$ Activity* (Bq g <sup>-1</sup> )	SD (Bq g <sup>-1</sup> )
A	25 Aug 20	0.021	0.001	0.369	0.003
B	25 Aug 20	0.041	0.001	0.421	0.003
C	25 Aug 20	0.020	0.001	0.244	0.003

\* Bq g<sup>-1</sup> refers to dry mass of grass

**Table 2.4(b) Comparison of  $\alpha/\beta$  Activities in Grass for last 5 years**

EM&A Report No.	Mean $\alpha$ Activity (Bq g <sup>-1</sup> )	SU (Bq g <sup>-1</sup> )	Mean $\beta$ Activity (Bq g <sup>-1</sup> )	SU (Bq g <sup>-1</sup> )
Baseline (2005)	0.083	0.044	0.33	0.03
19 (2015)	0.019	0.002	0.27	0.03
1 (2016)	0.008	0.006	0.24	0.03
2 (2017)	0.006	0.004	0.16	0.04
3 (2018)	0.013	0.003	0.21	0.06
4 (2019)	0.014	0.013	0.17	0.09
5 (2020)	0.027	0.012	0.34	0.09

2.12 No exceedance of Investigation Level is observed.

**Sea Water**

- 2.13 Approximately 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)**.
- 2.14 Similar to grass samples, the  $\gamma$  spectra are not reported. There is no sign of presence of  $\gamma$  emitters.
- 2.15 No exceedance of Investigation Level is observed.

**Table 2-5(a) Activity Concentration of Gross  $\alpha/\beta$  Emitters in Sea Water Samples (ILs for  $\alpha$  and  $\beta$  activities are respectively 1.52 & 9.3 Bq L<sup>-1</sup>)**

Location	Collection Date	Water Depth (m)	$\alpha$ Activity (Bq L <sup>-1</sup> )	SD (Bq L <sup>-1</sup> )	$\beta$ Activity (Bq L <sup>-1</sup> )	SD (Bq L <sup>-1</sup> )
A	25 Aug 20	1	0.00 <sup>#</sup>	0.14	5.80	0.42
		3.5	0.25 <sup>#</sup>	0.14	4.32	0.42
B	25 Aug 20	1	0.00 <sup>#</sup>	0.14	5.69	0.42
		6.5	0.00 <sup>#</sup>	0.14	5.46	0.42
C	25 Aug 20	1	0.00 <sup>#</sup>	0.14	4.55	0.42
		7.5	0.09 <sup>#</sup>	0.14	4.89	0.42
D	25 Aug 20	1	0.00 <sup>#</sup>	0.14	5.80	0.42
		5	0.16 <sup>#</sup>	0.14	5.80	0.42

<sup>#</sup> Below minimum detectable activity of 0.30 Bq L<sup>-1</sup> for  $\alpha$ .

**Table 2.5(b) Comparison of  $\alpha/\beta$  Activities in Sea Water for last 5 years**

EM&A Report No.	Mean $\alpha$ Activity (Bq L <sup>-1</sup> )	SU (Bq L <sup>-1</sup> )	Mean $\beta$ Activity (Bq L <sup>-1</sup> )	SU (Bq L <sup>-1</sup> )
Baseline (2005)	0.77	0.25	7.20	0.70
19 (2015)	0.00	0.00	6.34	2.08
1 (2016)	0.00	0.00	2.66	2.63
2 (2017)	0.00	0.00	1.97	2.32
3 (2018)	0.00	0.00	1.01	0.98
4 (2019)	0.00	0.01	2.47	1.65
5 (2020)	0.06	0.09	5.29	0.61

**Marine Organisms**

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

**Table 2.6(a) Activity Concentration of Gross  $\alpha/\beta$  Emitters in Fish Samples**  
 (ILs for  $\alpha$  and  $\beta$  activities are respectively 0.021 & 0.076 Bq g<sup>-1</sup>)

Sample	Collection Date	$\alpha$ Activity* (Bq g <sup>-1</sup> )	SD (Bq g <sup>-1</sup> )	$\beta$ Activity* (Bq g <sup>-1</sup> )	SD (Bq g <sup>-1</sup> )
1	25 Aug 20	0.002	0.000	0.056	0.002
2	25 Aug 20	0.002	0.000	0.045	0.002
3	25 Aug 20	0.002	0.000	0.036	0.002

\* Bq g<sup>-1</sup> refers to wet mass of fish flesh.

**Table 2.6(b) Comparison of  $\alpha/\beta$  Activities in Fish Samples for last 5 years**

EM&A Report No.	Mean $\alpha$ Activity (Bq g <sup>-1</sup> )	SU (Bq g <sup>-1</sup> )	Mean $\beta$ Activity (Bq g <sup>-1</sup> )	SU (Bq g <sup>-1</sup> )
Baseline (2005)	0.0093	0.004	0.068	0.003
19 (2015)	0.0100	0.006	0.035	0.015
1 (2016)	0.0077	0.008	0.014	0.005
2 (2017)	0.0000	0.000	0.055	0.012
3 (2018)	0.0000	0.000	0.032	0.032
4 (2019)	0.0000	0.000	0.029	0.010
5 (2020)	0.0020	0.000	0.046	0.010

- 2.18 There is no exceedance of IL.

**Table 2.7(a) Activity Concentration of Gross  $\alpha/\beta$  Emitters in Sea Snail Samples**  
 (ILs for  $\alpha$  and  $\beta$  activities are respectively 0.048 & 0.076 Bq g<sup>-1</sup>)

Sample	Collection Date	$\alpha$ Activity* (Bq g <sup>-1</sup> )	SD (Bq g <sup>-1</sup> )	$\beta$ Activity* (Bq g <sup>-1</sup> )	SD (Bq g <sup>-1</sup> )
1	25 Aug 20	0.003	0.000	0.050	0.002
2	25 Aug 20	0.004	0.000	0.038	0.002
3	25 Aug 20	0.006	0.000	0.033	0.002

\* Bq g<sup>-1</sup> refers to wet mass of sea snail flesh.

**Table 2.7(b) Comparison of  $\alpha/\beta$  Activities in Sea Snails for past 5 years**

EM&A Report No.	Mean $\alpha$ Activity (Bq g <sup>-1</sup> )	SU (Bq g <sup>-1</sup> )	Mean $\beta$ Activity (Bq g <sup>-1</sup> )	SU (Bq g <sup>-1</sup> )
Baseline (2005)	0.029	0.006	0.064	0.004
19 (2015)	0.006	0.005	0.045	0.023
1 (2016)	0.001	0.001	0.025	0.016
2 (2017)	0.003	0.001	0.017	0.002
3 (2018)	0.002	0.002	0.048	0.012
4 (2019)	0.005	0.005	0.041	0.002
5 (2020)	0.004	0.002	0.040	0.009

2.19 No exceedance in Investigation Level is observed.



**Airborne Particulates**

2.20 The measurement results are given in **Table 2.8(a) & 2.8(b)**.

**Table 2.8(a) Net Gross  $\alpha/\beta$  Activities in Airborne Particulate Samples (ILs are not defined)**

Location	Collection Date	$\alpha$ Activity (Bq per 1000 cm <sup>2</sup> )	SD	$\beta$ Activity (Bq per 1000 cm <sup>2</sup> )	SD
Blank		0.32	0.01	9.66	0.05
A1	25 Aug 20	0.13	0.02	0.85	0.07
A2	25 Aug 20	0.02	0.02	0.74	0.07
B1	25 Aug 20	0.12	0.02	0.46	0.07
B2	25 Aug 20	0.18	0.02	0.66	0.07
C1	25 Aug 20	0.00	0.02	0.04	0.06
C2	25 Aug 20	0.01	0.02	0.15	0.06

**Table 2.8(b) Comparison of  $\alpha/\beta$  in Airborne Particulate Samples for last 5 years (Units in Bq per 1000 cm<sup>2</sup>)**

EM&A Report No.	A		B		C	
	$\alpha$	$\beta$	$\alpha$	$\beta$	$\alpha$	$\beta$
Baseline (2005)	0.00	0.00	0.00	0.00	0.00	0.13
19 (2015)	0.00	0.44	0.00	0.10	0.09	0.56
1 (2016)	0.00	0.46	0.00	0.34	0.00	0.17
2 (2017)	0.03	0.37	0.01	0.26	0.04	0.27
3 (2018)	0.11	1.33	0.13	0.59	0.13	1.25
4 (2019)	0.04	0.36	0.05	0.57	0.04	0.18
5 (2020)	0.07	0.79	0.15	0.56	0.01	0.09

2.21 All activities are normal.

**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) (Oct 2005).

**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) (Oct 2005) 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  $5.42 \times 10^8$  Bq/month, which is below the A/L Levels.

4.6 The discharged  $\alpha$  and  $\beta$  activities were also below the A/L Levels.

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

**5. RECORD OF ENVIRONMENTAL COMPLAINTS**

5.1 No environmental complaint 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**

<b>Environmental Performance Requirements</b>	<b>Limit Levels</b>	<b>Action Levels (3/10<sup>th</sup> of Limit Levels)</b>
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**

<b>Environmental Samples</b>		<b>Investigation Levels</b>	
Net Ambient $\gamma$ dose rate ( $\mu\text{Sv h}^{-1}$ )	A	0.17	3 × SD of individual baseline dose rate
	B	0.19	
	D	0.21	
	E	0.23	
	F	0.22	
	G	0.21	
	H	0.21	
	I	0.34	
	J	0.20	
	K	0.26	
	L	0.24	
	M	0.25	
	N	0.23	
	O	0.21	
P	0.23		
Soil ( $\text{Bq kg}^{-1}$ )	<sup>226</sup> Ra	155	3 × SU of baseline samples
	<sup>228</sup> Th	218	
	<sup>40</sup> K	2544	
	<sup>137</sup> Cs	2.31	

	Other $\gamma$ emitters		Occurrence in any quantities
Sand (Bq kg <sup>-1</sup> )	<sup>226</sup> Ra	54.4	3 × SU of baseline samples
	<sup>228</sup> Th	64.8	
	<sup>40</sup> K	1520	
	Other $\gamma$ emitters		Occurrence in any quantities
Grass (Bq g <sup>-1</sup> )	Gross $\alpha$	0.22	3 × SU of baseline samples
	Gross $\beta$	0.43	
	$\gamma$ emitters not found in baseline		Occurrence in any quantities
Sea water (Bq L <sup>-1</sup> )	Gross $\alpha$	1.52	3 × SU of baseline samples
	Gross $\beta$	9.3	
	$\gamma$ emitters not found in baseline		Occurrence in any quantities
Fish (Bq g <sup>-1</sup> )	Gross $\alpha$	0.021	3 × SU of baseline samples
	Gross $\beta$	0.076	
Sea snails (Bq g <sup>-1</sup> )	Gross $\alpha$	0.048	3 × SU of baseline samples
	Gross $\beta$	0.076	
Airborne particulates (Bq per 1000 cm <sup>2</sup> )	Gross $\alpha$		Occurrence in any quantities
	Gross $\beta$		

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

