

ATAL-BELGOPROCESS JOINT VENTURE

Contract No. EP/SP/40/02

Low Level Radioactive Waste Storage Facility at Siu A Chau

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

Version 2.0

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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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EXECUTIVE SUMMARY

This report presents the results of the radiological monitoring work performed between August 2005 and September 14, 2005. The sampling was done on September 14, 2005.

The newly reformed land was still covered with nets for growing grass; hence no soil samples or grass samples were taken from those areas.

The beaches on both sides of the jetty are gradually forming. Sediment samples will be collected on those places in the future.

Some samples do show signs of increased activity over the baseline level, but the increase is very small. This could be a result of increase in airborne effluent release from the Facility or just normal fluctuation. A few more sampling times are required to determine whether the radiological levels have been changed.

No non-compliance with the environmental performance requirement was observed.

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 are stored in disused air raid tunnels close to Queen's Road East in Wan Chai. Other arisings are 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. 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 will also contain facilities for waste reception and repackaging waste, and administering the process. A jetty will be 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 second EM&A (Operation Phase) report, which is also the first 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 commencement of operation (August 2005) up to September 14, 2005.
- 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 un-controlled areas of the Facility and the liquid and gaseous effluents.

2. MONITORING RESULTS

- 2.1 The sampling scheme for this and subsequent monitorings is less extensive than the baseline measurement except the measurement of ambient γ dose rates. Ambient γ dose rates will be taken at exactly the same locations every time and therefore they would give a true picture of the variation of the radiation environment if there were any.
- 2.2 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 will not be the same every time.
- 2.3 In this survey, 14 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; 3 fish; 1 kg of sea snails and 3 airborne particulate samples were collected and analysed. Figure 2.1 shows the locations for taking various samples.
- 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.

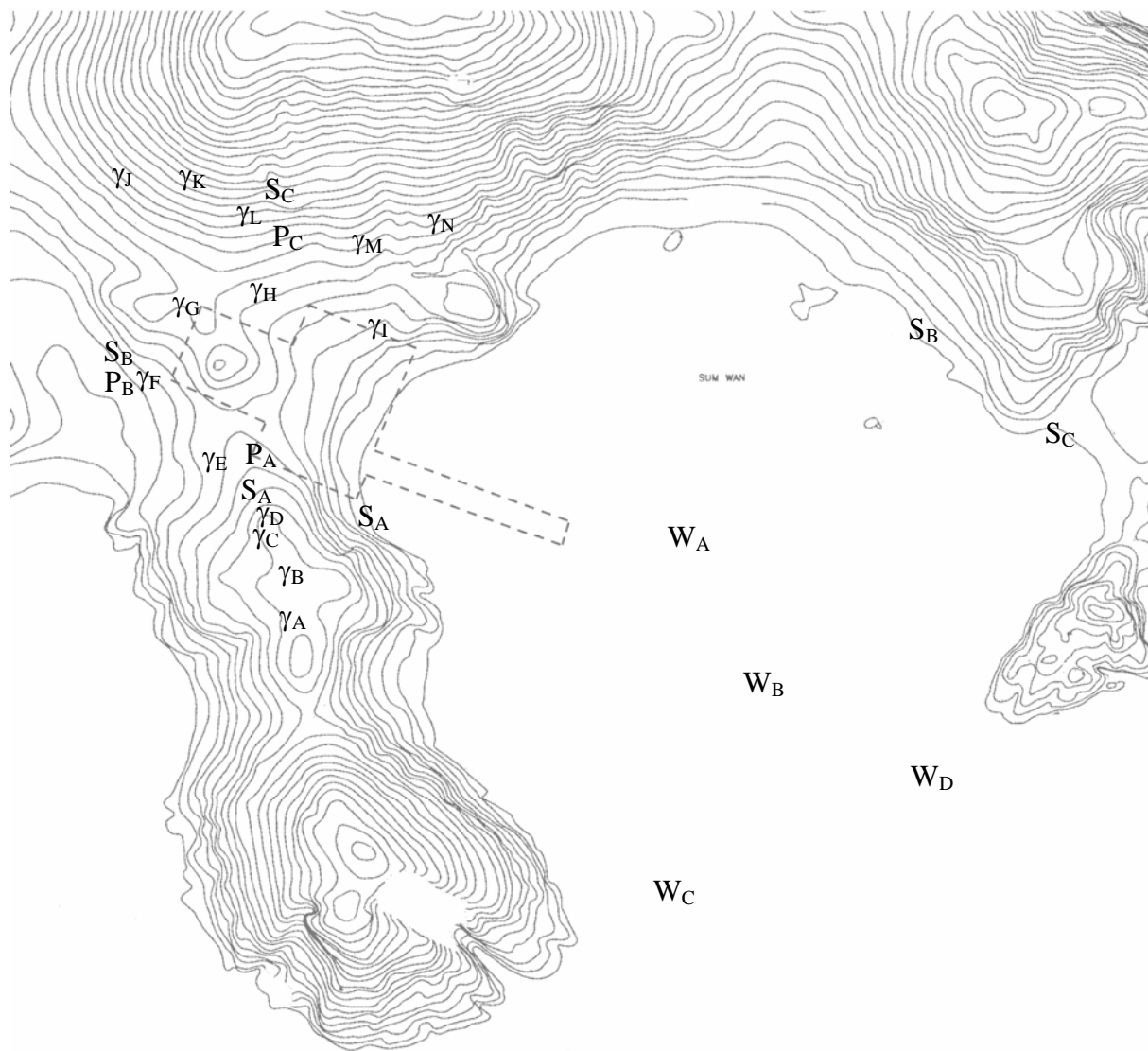


Fig. 2.1 Locations of the Sampling Sites

(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 It is worthwhile to mention that it is the trend at each location that matters, not the overall mean value.
- 2.6 All measured γ dose-rates were below the Investigation Level.
- 2.7 Location I was not measured and it will not be measured in the future because it is now located at the fence on a steep slope.

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.
- 2.9 Activity concentrations of ^{226}Ra , ^{228}Th , ^{40}K and ^{137}Cs in the soil samples were measured by γ -spectrometry. No exceedance of Investigation Level was observed.
- 2.10 Radionuclide contents in sample C are on the low side. This site corresponds to location H in the baseline monitoring which also gave low radionuclide contents.

Sand

- 2.11 Sand samples partly immersed in water along the shore were collected. A small sandy beach has formed at the southern side of the jetty and sand from the beach was also collected. This was not sampled in the baseline monitoring.
- 2.12 Activity concentrations of ^{226}Ra , ^{228}Th and ^{40}K in the sand samples were measured by γ -spectrometry. No exceedance of Investigation Level was observed.

Grass

- 2.13 Grass samples were collected in locations near to the soil samples.
- 2.14 The γ -spectra are identical to the background of the γ spectrometer and do not reveal the presence of any significant γ -emitting radionuclides.
- 2.15 Gross α and β activities of the ashed grass samples were measured in a low-level α/β counter and they were within the normal fluctuation of the baseline values.
- 2.16 No exceedance of Investigation Level was observed.

Sea Water

- 2.17 The same 4 locations were chosen to collect the water samples at 2 depths.
- 2.18 The γ spectra of all the eight water samples were within the normal fluctuation of the baseline spectra. No exceedance of Investigation Level was observed.

Marine Organisms

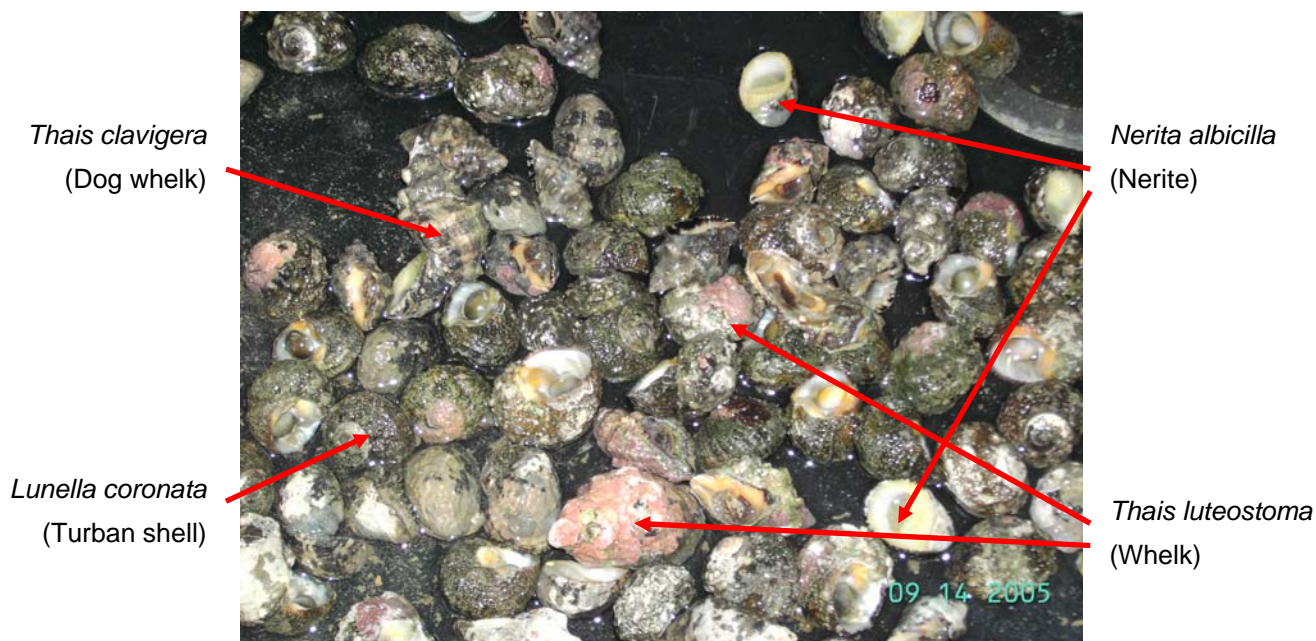
2.19 Three fish were caught at the jetty and sea snails were collected randomly along the shores.

2.20 Two species of fish were caught; they were *Siganus canaliculatus* (White-spotted spinefoot) and *Terapon jarbua* (Jarbua terapon). The sea snails are of various species, some identified ones are *Thais clavigera* (Dog whelk); *Nerita albicilla* (Nerite); *Lunella coronata* (Turban shell) and *Thais luteostoma* (Whelk).



Siganus canaliculatus
(White-spotted spinefoot)

Terapon jarbua
(Jarbua terapon)



Thais clavigera
(Dog whelk)

Lunella coronata
(Turban shell)

Nerita albicilla
(Nerite)

Thais luteostoma
(Whelk)

Figure 2.2 Identity of the fish and sea snails

2.21 Only the gross α/β activities in the ashed fish and sea snails samples were measured by the low-level α/β counter. γ spectrum was not measured because of the small sample volume.

2.22 No exceedance of Investigation Level was observed.

Airborne Particulates

2.23 The sampling period was from August 12, 2005 to September 14, 2005.

2.24 Each sampling cloth was cut into two halves and the gross α/β count rates were measured in a low-level α/β counter.

2.25 Location A seems to have detected a small activity, but it is still much below the background activity of the cloth.

3. REPORT ON ELEVATED ENVIRONMENTAL RADIATION LEVEL

- 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 The overall ambient γ dose-rate has recorded a 7% increase, which is still within the standard uncertainty of the baseline level.
- 3.3 The other samples do not show any systematic change in the measured activities. One of the fish samples recorded a higher β activity, but it was still below the Investigation Level.
- 3.4 It will need a longer monitoring period to ascertain the effect of the operation of the Facility to the environment.

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 The whole body doses of the workers are monitored by TLDs on a monthly basis. Individual doses for the month of August 2005 and the accumulated individual doses recorded up to and including August 2005 are all below the A/L levels.

Dose Rates at Un-controlled Areas

4.3 The dose-rates were monitored by a portable γ dose ratemeter. No exceedance of A/L levels was observed.

Liquid Effluent Discharge

4.4 No liquid effluent was discharged during the monitoring period.

Airborne Effluent Discharge

4.5 There was some problems with the stack monitor starting at around September 1, 2005 when the recorded α - and β -activities fluctuated widely from low to high values. Investigation has been conducted to rectify the situation.

4.6 Radon concentration in the Storage Vault was monitored by a continuous radon monitor. The result shows an exceedance of the action level but not the limit level. Investigation is being done.

4.7 The α - and β -activities for the period August 14 to August 30 was considered. After compensating for the presence of radon and its progenies, the released α - and β -activities were below the A/L levels.

5. RESULT OF ENVIRONMENTAL COMPLIANCE AUDITS

- 5.1 The Facility commenced operation on July 28, 2005. It is noticed that the γ radiations emitted from the waste drums are well shielded and the increase in γ dose rate outside the site boundary is negligible.
- 5.2 However with the introduction of some high activity Ra-loaded wastes, the radon concentration increased markedly. Investigation is being done to find out why radon leaks out of those drums at such a high rate.
- 5.3 This incidence shows that the system installed for airborne effluent monitoring is appropriate and it can provide timely response.
- 5.4 The doses received by the workers are reasonably low even though transportation of Batch A wastes was mostly done in August and September.
- 5.5 It is not evidenced from the environmental samples that the marked increase in airborne effluent discharge has led to increased fallout in the vicinity of the Facility.
- 5.6 No 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

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	0.20	3 × SD of individual baseline dose rate
	B	0.25	
	C	0.32	
	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	0.25	
	M	0.31	
	N	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		
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.