**ATAL-BELGOPROCESS JOINT VENTURE**

# Contract No. EP/SP/40/02

# Low Level Radioactive Waste Storage Facility at Siu A Chau

## Third 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 September 14, 2005 and October 19, 2005. The sampling was done on October 19, 2005.

There were some changes in the locations for measuring the ambient γ dose-rates. One location (Location C) was deleted from the monitoring scheme because it was too close to an adjacent one while two new locations (Locations O & P) were introduced to have a better coverage of the monitoring areas. Lastly, Location I was moved to a new location away from the fence. Their corresponding investigation levels are now included in Appendix 1, Table A1.2.

The beach on the southern side of the jetty has been formed. A sediment sample was collected from there.

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

# 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 third EM&A (Operation Phase) report, which is also the second 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 14 to October 19, 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 non-active areas of the Facility and the liquid and gaseous effluents.

## 2. MONITORING RESULTS

2.1 The sampling scheme has been changed slightly. 15 in-situ ambient γ dose rates were measured instead of 14. 3 soil 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 as in previous monitoring. However, the locations for sampling the sea sediment have been changed. **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.

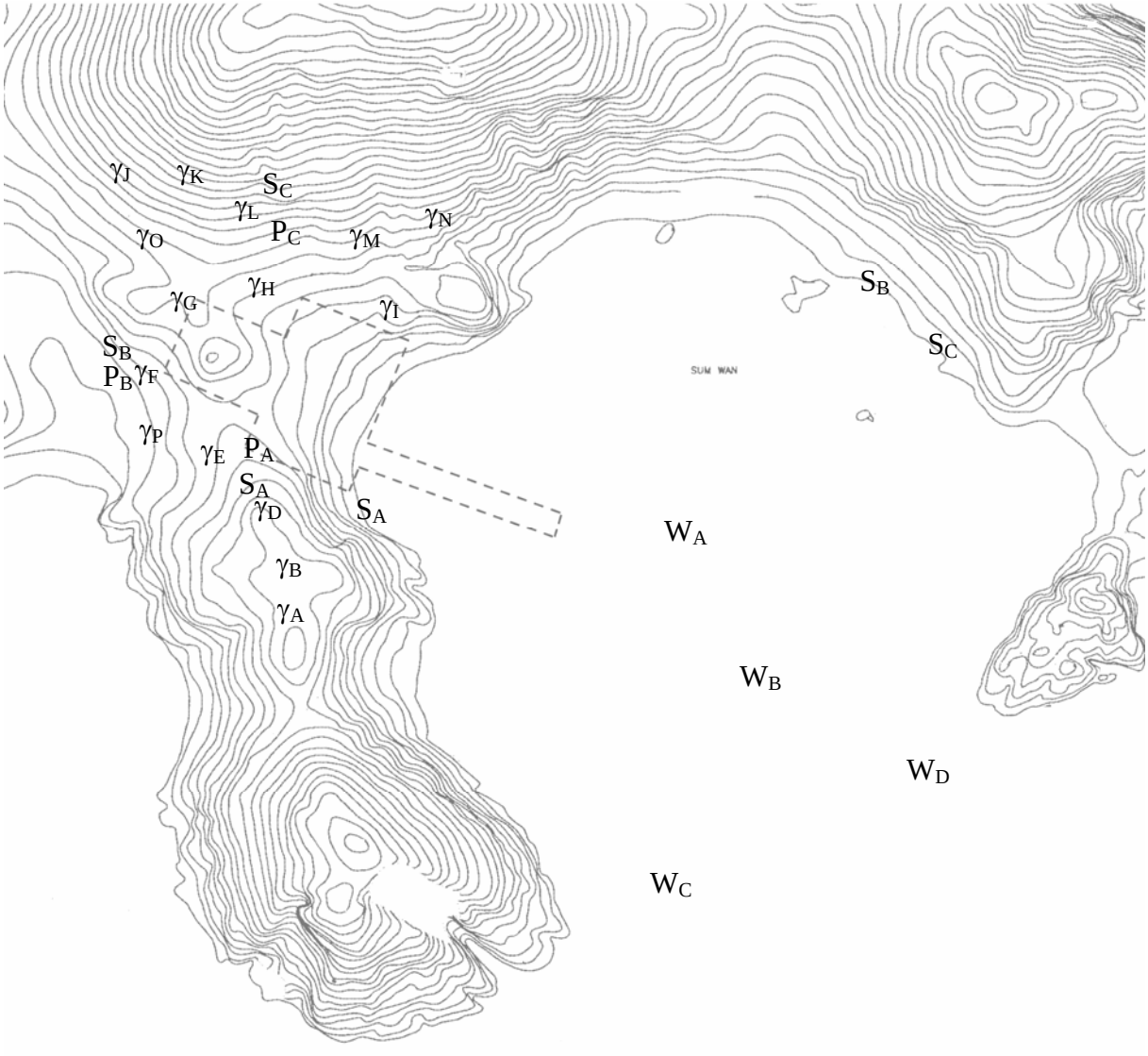


**Fig. 2.1 Locations of the Sampling Sites**

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

**Ambient γ Dose Rates**

2.5 There were some changes in the locations for measuring the ambient γ dose rates as follows:

a. Location I was shifted a bit northward because the original location is now situated on the slope at the fence.

b. Location C was deleted from the monitoring scheme because it was quite close to Location D and therefore was redundant.

c. Two new locations O & P were added. These two locations were not available during the construction phase. Their addition represents a better coverage of the monitoring area.

2.6 All measured γ dose-rates were below the Investigation Level and the mean γ dose-rate remains the same as previous results.

2.7 γ dose-rate at location A recorded some increases. But it is noted that the γ dose-rates at nearby locations B, C, D & E did not record similar increase. Furthermore the baseline γdose-rate at location A is much below the others, so it can be concluded that the baseline γ dose-rate at location A is incorrect.

2.8 Location L is located on the hill-side and therefore the orientation and the standing position of the γ dose-ratemeter will have a significant effect on the measured γ dose-rate. It is expected that this location will exhibit larger fluctuation in future measurements.

**Soil**

2.9 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.

2.10 The measurement results are more or less the same as the last one.

**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 The results of this monitoring are more or less the same as the last one.

**Grass**

2.13 Grass samples were collected in locations near to the soil samples. The γ-spectra are identical to the background of the γ spectrometer and do not reveal the presence of

any significant γ-emitting radionuclides.

2.14 All gross α and β activities of the samples are within the normal fluctuation of the baseline values and no exceedance of Investigation Level was observed.

**Sea Water**

2.15 The same 4 locations were chosen to collect the water samples at 2 depths.

2.16 There is no sign of presence of γ emitters.

2.17 All gross α and β activities are comparable to the baseline levels. No exceedance of Investigation Level was observed.

**Marine Organisms**

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

2.19 No exceedance of Investigation Level was observed.

**Airborne Particulates**

2.20 The sampling period was from September 14, 2005 to October 19, 2005.

2.21 Slight activities were detected in all three samples, but they are still much below the background activity of the cloth.

## 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 All measurement results are more or less the same as those reported in the Second EM&A Report.

3.3 γ dose-rate at location A has recorded a noticeable increase, but it is concluded that its Investigation Level was not correctly established. A new baseline γ dose-rate at location A will be estimated after one more measurement results is obtained next month.

3.4 γ dose-rate at location L has also recorded a larger variation. It is concluded that this was due to the difficulty in placing the γ dose-ratemeter at the same physical location because of the sloppy terrain.

3.5 The passive cloth sampler seems to have recorded a slight airborne activity. But the levels are still well below the background activity of the cloth itself.

## 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 statutory dose limit as recorded by TLDs.

**Dose Rates at Un-controlled Areas**

4.3 No exceedance of the Action/Limit Levels was observed.

**Liquid Effluent Discharge**

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

**Airborne Effluent Discharge**

4.5 The total radon released during the monitoring period was estimated to be $5.7 \times 10^8$ Bq/month, which is about 20% of the discharge limit.

4.6 The discharged $\alpha$ and $\beta$ activities were also below the discharge limit.

## 5. RESULT OF ENVIRONMENTAL COMPLIANCE AUDITS

5.1 It was reported in the 2nd EM&A Report that the radon released has exceeded the action level but not the limit level. Investigation showed that a few drums are emitting radon at a rate higher than anticipated according to the waste inventory.

5.2 The issue was discussed during the First Operation Meeting and methods were discussed to identify the high radon-emitting drums.

5.3 As a temporary remedial action, the most radon-emitting drum was shielded by an over-drum to reduce the emission. The technique is successful and the emission is now below the action level.

5.4 It is not evidenced from the environmental monitoring results that the higher radon emission rate has led to detectable increase in environmental radioactivities in the vicinity of the LRWF.

5.5 This incidence shows that the system installed for airborne effluent monitoring is appropriate and it can provide timely response.

5.6 The data-logging system in the LRWF has also been shown to be effective in providing accurate and useful data for internal management awareness and for proper operation of all the equipment.

5.7 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 ($3/10^{th}$ 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 ($\mu Sv\ h^{-1}$) | A | 0.20 | 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 | 0.30 | |
| | J | 0.24 | |
| | K | 0.32 | |

| | | | |
|---|---|---|---|
| | L<br>M<br>N<br>O<br>P | 0.25<br>0.31<br>0.29<br>0.24<br>0.29 | |
| Soil (Bq $kg^{-1}$) | $^{226}Ra$<br>$^{228}Th$<br>$^{40}K$<br>$^{137}Cs$ | 91.7<br>128.5<br>1497<br>1.36 | 3 × SU of baseline samples |
| | Other γ emitters | | Occurrence in any quantities |
| Sand (Bq $kg^{-1}$) | $^{226}Ra$<br>$^{228}Th$<br>$^{40}K$ | 32.0<br>38.1<br>894 | 3 × SU of baseline samples |
| | Other γ emitters | | Occurrence in any quantities |
| Grass (Bq $g^{-1}$) | Gross α<br>Gross β | 0.22<br>0.43 | 3 × SU of baseline samples |
| | γ emitters not found in baseline | | Occurrence in any quantities |
| Sea water (Bq $L^{-1}$) | Gross α<br>Gross β | 1.52<br>9.3 | 3 × SU of baseline samples |
| | γ emitters not found in baseline | | Occurrence in any quantities |
| Fish (Bq $g^{-1}$) | Gross α<br>Gross β | 0.021<br>0.076 | 3 × SU of baseline samples |
| Sea snails (Bq $g^{-1}$) | Gross α<br>Gross β | 0.048<br>0.076 | 3 × SU of baseline samples |
| Airborne particulates (cpm) | Gross α<br>Gross β | | Occurrence in any quantities |

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