ECO Aviation Fuel Services Limited

ANNUAL AUDIT REPORT

For

PERMANENT AVIATION FUEL FACILITY

Environmental Permit
EP-262/2007/B

Date of Audit :		04 March 2026
Prepared By :	Tsang Wai Yip, HSE Officer	10 March 2026
Approved By :	Sylvia Har, General Manager	11 March 2026

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Introduction

ECO Aviation Fuel Services Limited (EAFS) is the operator of the Permanent Aviation Fuel Facility (PAFF), which is located on 9.28 ha of land at 9 Lung Hong Street, Tap Shek Kok, Tuen Mun. PAFF consists of a tank farm, a twin berth jetty and associated pipelines for receipt of aviation fuel from ocean tankers to the tank farm, and twin submarine pipelines from the tank farm to the aviation fuel receipt facility at Sha Chau Island.

PAFF is accredited with ISO14001.

The tank farm has eight storage tanks of which six (6) 35,000m^3, one (1) 32,000m^3 and one (1) 22,000m^3 respectively thus providing a total storage capacity of 264,000m^3. The tank farm is provided with bund walls and a contained drainage system.

Other facilities within PAFF include a pump platform, where the pumps, filters and recovery system are located. An administration building houses the control room, security control, backup power generator, firefighting equipment, transformers, switch room and workshop.

Aviation fuel is unloaded at a twin berth jetty located approximately 200 meters offshore where water depth is about 17m. The jetty is constructed on tubular piles and designed for berthing tankers of deadweight tonnage ranging from 10,000 to 80,000.

Aviation fuel is transferred to Hong Kong International Airport (HKIA) by means of twin subsea 500mm diameter pipelines to the Sha Chau island custody transfer facility located at 4.4 kilometers south of PAFF. The transfer pipelines are installed with cathodic protection system and leak detection system.

In summary, PAFF is for storage and delivery of aviation fuel to HKIA.

Purpose and Scope

This Annual Audit reviews the performance of the design arrangements and measures mentioned in Condition 3.5 of the Environmental Permit (EP-262/2007/B).

In this report, there are photos and inspection records made available for review. The photos and inspection records that have been attached are representative of the facilities and associated operation process.

Conclusion

The results of the Year 2025 - 2026 Annual Audit reveal that the Environmental Permit Condition 3.5 requirements are adhered.

Audit Details

Results are designated as "**C**" for Conformance, "**O**" for Observation and "**NC**" as Non-Conformance.

1 Conditions Set Out in the Environmental Permit

1.1 Containment Systems of Aviation Fuel Storage Tank Farm

1.1.1 All aviation fuel storage tanks shall be located in bunded compounds with capacity of more than 110% of the contents of the largest aviation fuel storage tank in the bunded compounds.

Observation	Result
It was confirmed in the Design Audit Report dated October 2010 that :- 1. The tank farm storage consists of two bunds each designed to have six tanks, of which 4 tanks in each bund (a total of 8 tanks) have been built. 2. The calculation of bund wall containment volume in Drawing PAFF/RJ/02/DWG/G/3015(EX) shows that the current containment capacities of each of the two bunds are far greater than 150% of the largest aviation fuel storage tank in the bunded compounds. 3. Both bunds are interconnected for the overflow so that in normal circumstances, the overall containment capacity is double the size of a single bunded compound, or greater than 300% of the largest tank for the 8 tank facility. 4. The design meets the I.P. Code Part 19 "Fire Precautions at Petroleum Refineries and Bulk Storage Installations" item 3.4.2.5.5 and the Hong Kong "Code of Practice for Oil Storage Installation" item 4.1. There had been no change made after the completion of construction since October 2010. Photographs No. 1 & 2 show that all eight tanks are located within bunded compounds.	**C**

1.1.2 The bunds shall be partly sunken below the level of ground outside the bunds.

Observation	Result
It was confirmed in the Design Audit Report dated October 2010 that :- 1. Drawings PAFF/BA/02/DWG/C/1721-1724 illustrate that the bunds have been designed to be partly sunken below ground level outside the bunds in the EVA. There had been no change made after the completion of construction since October 2010. Photographs No. 3 & 4 show that both bunded areas are lower than the ground level outside the bunds.	**C**

1.1.3 Wave Deflector shall be used at the bunds.

Observation	Result
It was confirmed in the Design Audit Report dated October 2010 that :- 1. Drawings PAFF/BA/02/DWG/C/1721-1724 illustrate the design and installation of wave deflectors on the bund walls." There had been no change made after the completion of construction since October 2010. Photograph No. 5 shows that wave deflectors are located at top of the bunds.	**C**

1.1.4 Fire-retardant joints shall be used at the bunds.

Observation	Result
It was confirmed in the Design Audit Report dated October 2010 that :- 1. Drawings PAFF/BA/02/DWG/C/1722-1724 illustrate the design and installation of special fire-retardant joints at the bunds. The components consist of Flexcell Compressible Filler and Nelson Fire Stop Product ES1399 Joint Sealant (capable of 4 hours of fire resistance). All visible parts of the joints are covered by stainless steel plates on the inside. There had been no change made after the completion of construction since October 2010. For phase 1a bund, the external steel plates are fixed in. For phase 1b bund, the steel plates are embedded in the concrete and span across the construction joint. Photographs No. 6 & 7 show that visible parts of the joints are covered by stainless steel plates on the inside at phase 1a.	**C**

1.1.5 Intermediate bund walls shall be designed and constructed within the bunded compounds for each aviation fuel storage tank.

Observation	Result
It was confirmed in the Design Audit Report dated October 2010 that :- 1. Drawings PAFF/BA/02/DWG/C/1452 & PAFF/LC/02/DWG/C/0551 illustrate the construction of internal bund (intermediate bund) walls within the bunded compounds for each aviation fuel storage tank meeting the I.P. Code Part 19 "Fire Precautions at Petroleum Refineries and Bulk Storage Installations" item 3.4.2.5.4. There had been no change made after the completion of construction since October 2010. Photographs No. 8 & 9 show that intermediate bund walls are in place.	**C**

1.1.6 Two impervious security walls shall be designed and constructed outside the bunded compounds.

Observation	Result
It was confirmed in the Design Audit Report dated October 2010 that :- 1. Drawings PAFF/BA/02/DWG/C/1721-1724 illustrate the construction of two impervious security walls outside the bunded compounds as the tertiary and fourth containments after the tank itself as the primary containment and bund wall as the secondary containment. There had been no change made after the completion of construction since October 2010. Photographs No. 10 & 11 show that two impervious security walls outside the bunded compounds are complete in place.	**C**

1.1.7 A landscaped berm of at least 1.5m high shall be designed and constructed outside the bunded compounds.

Observation	Result
It was confirmed in the Design Audit Report dated October 2010 that :- 1. Drawing PAFF/BA/02/DWG/C/1481 illustrates a landscaped berm of at least 1.5m high outside the outer security wall." There had been no change made after the completion of construction since October 2010. Photographs No. 12 & 13 show that a landscaped berm of at least 1.5m high outside the outer security wall is in place and properly maintained.	**C**

1.1.8 Gates at the security walls shall be properly designed and constructed to provide sealing in case of any fuel spillage within the aviation fuel storage tank farm.

Observation	Result
It was confirmed in the Design Audit Report dated October 2010 that : 1. Drawing PAFF/BA/02/DWG/C/1727 illustrates that solid gates at the security walls would provide sealing in case of any fuel spillage outside the bunded areas within the aviation fuel storage tank farm." There had been no change made after the completion of construction since October 2010. Photographs No. 14 & 15 show that the gates at security walls are in place.	**C**

1.1.9 All the bund and security walls shall be properly designed and constructed using reinforced concrete to provide sufficient structural strength to withstand any liquid surge load in case of any accidents.

Observation	Result
It was confirmed in the Design Audit Report dated October 2010 that : 1. Drawings PAFF/BA/02/DWG/C/1726, 1728, and 1730 illustrate that all the bund and security walls are constructed by reinforced concrete to provide sufficient structural strength to withstand any liquid surge load in case of any accident." There had been no change made after the completion of construction since October 2010. Photographs No. 16 & 17 show that all the bund and security walls are in place.	**C**

1.2 Drainage Isolation and Lining System for Aviation Fuel Storage Tank Farm

1.2.1 Drainage system shall be properly designed and constructed for the aviation fuel storage tank farm to collect aviation fuel in case of spillage.

Observation	Result
It was confirmed in the Design Audit Report dated October 2010 that : 1. The drainage layout plans in Drawings PAFF/BA/02/DWG/C/1452 & PAFF/LC/02/DWG/C/0551 illustrate the construction of the drainage systems with appropriate falls and gradients to collect aviation fuel in case of spillage. 2. The design meets the Hong Kong "Code of Practice for Oil Storage Installation" item 6.2.1. There had been no change made after the completion of construction since October 2010. Photographs No. 18 & 19 show that the impervious lining is in good condition and the drainage falls towards interceptor for collection.	**C**

1.2.2 Valves and oil interceptors shall be properly designed and constructed at the drainage system to prevent any oily discharge to the sea.

Observation	Result
It was confirmed in the Design Audit Report dated October 2010 that : 1. The drainage layout plans in Drawings PAFF/BA/02/DWG/C/1452 & PAFF/LC/02/DWG/C/0551 illustrate the installation of oil interceptors and valves before the drainage outlets of bunded areas. The oil interceptors are designed to intercept and contain spillage while the valves are normally kept in close position as further precaution. They will be opened to release storm water inside the bunded areas as necessary. 2. The design meets the Hong Kong "Code of Practice for Oil Storage Installation" item 7.1. There had been no change made after the completion of construction since October 2010. Photographs No. 20 & 21 show that the valves at the oil interceptors and are kept in normal-close position.	**C**

1.2.3 Impermeable lining shall be installed underneath all aviation fuel storage tanks to prevent seepage of aviation fuel to ground.

Observation	Result
It was confirmed in the Design Audit Report dated October 2010 that : 1. Drawing PAFF/BA/02/DWG/C/1705 illustrates the installation of impermeable lining underneath all aviation fuel storage tanks and within the bunded areas to prevent seepage of aviation fuel to the ground due to leakage from the storage tanks. This meets the I.P. Code Part 19 "Fire Precautions at Petroleum Refineries and Bulk Storage Installations" item 3.4.2.5.2. " There had been no change made after the completion of construction since October 2010. Photographs No. 22 & 23 show construction record of the impermeable lining at various locations.	**C**

1.3 Overfilling Monitoring System and Leakage Detection System

1.3.1 Tank overfilling monitoring systems shall be properly designed and constructed for the Project.

Observation	Result
It was confirmed in the Design Audit Report dated October 2010 that : 1. Tank overfilling monitoring system is in place for each tank. 2. Alarms are set by means of the level gauge of each tank and will trigger an alarm by the SCADA system for operator alert. 3. Additional alarms were designed to supplement the 1st level protection system and independent level switches are installed for the high-high levels and would trigger Emergency Shutdown for the specific tank inlet valve immediately together with an audible alarm for the control room operator. According to appendix 2, PAFF has strict control to monitor and protect storage tanks from overfilling. The normal-fill-level and high level alarms have been set by means of the level gauge of each tank and would trigger alarm for operator alert. The high-high level alarm is set by electronic level gauge of each tank and would trigger an Emergency Shutdown of the tank inlet valves. A critical high alarm is installed to supplement the 1st level protection system of which an independent level switch is installed for detecting the critical high level and would trigger an Emergency Shutdown of the tank inlet valves. PAFF performs regular inspection on the functionality of the level alarms with traceable records. Photographs No. 24, 25 & 26 show that the high level alarm setting in the SCADA system, the regular testing on the high-high level alarm and test record.	**C**

1.3.2 Pipeline leakage detection system shall be properly designed and constructed for the Project.

Observation	Result
It was confirmed in the Design Audit Report dated October 2010 that : 1. Drawings PAFF/LC/01/DWG/M/0202-3 & 0207 illustrate the installation of pipeline leakage detection system in the subsea pipelines using COWI Stat Leak System software. The test is carried by closing inlet/outlet section of specific pipelines and measure pressure drop within a specified time period within the pipeline. A pressure drop not due to thermal effect may indicate a possible leak in the pipeline and will generate an alarm for immediate investigation. The Leak Detection System and associated instrumentation were installed and the software had been updated by the vendor after the completion of construction in October 2010. Photograph No. 27 shows the Leak Detection System is installed on the computer.	**C**

1.3.3 Impermeable lining leakage detection system shall be properly designed and constructed for the Project.

Observation	Result
It was confirmed in the Design Audit Report dated October 2010 that : 1. Drawing PAFF/BA/02/DWG/C/1705 illustrates the installation of 80mm diameter leak detection pipe in accordance with API 650 underneath the sump of each storage tank. 2. The head of the pipe is perforated and designed to situate above the containment membrane of the tank base with the pipe descending to the end outside the tank ring base, ensuring the pipe will collect and drain out fuel, if any, to a designated containment well at the tank side. Therefore, any leakage from the bottom of the storage tank would be detected and the bunded areas are laid with impervious membrane to contain fuel spillage. 3. The construction of this design has been implemented for all tanks. There had been no change made after the completion of construction since October 2010. Photographs No. 28 & 29 show the tell-tale pipe installed and the as-built fuel collection chamber.	**C**

1.3.4 Emergency shutdown (ESD) systems shall be properly designed and constructed for the Project. All ESD systems shall be equipped with manual initiating devices.

Observation	Result
It was confirmed in the Design Audit Report dated October 2010 that : 1. Drawings PAFF/KG/02/DWG/E/7437 & LC/03/DWG/M/0251 show the installation of manual-operated emergency shutdown (ESD) buttons at the strategic points in the tank farm and on the jetty for emergency use. 2. As soon as ESD is activated, all valves and delivery pumps will shut down automatically to isolate the fuel lines and stop fuel flow. The installation of ESD is in place. There had been no change made after the completion of construction since October 2010. Regular inspection is performed on the ESD functionality with records kept in the maintenance system. Photographs No. 30 & 31 show the ESD system and the regular testing.	**C**

1.3.5 The ESD system shall be initiated automatically in case of actuation of fire alarm system, overfilling monitoring system of aviation fuel storage tanks and leakage detection system of sub-sea pipelines.

Observation	Result
It was confirmed in the Design Audit Report dated October 2010 that : 1. Drawings PAFF/LC/01/DWG/M/0202 – 0203 & 0207 illustrate the installation of ESD system which will be triggered automatically in case of actuation of fire alarm system, overfilling monitoring system of aviation fuel storage tanks and leakage detection system of sub-sea pipelines. The installations are in place. There had been no change made after the completion of construction since October 2010. PAFF performs regular inspection on the functionality of the ESD interface with records kept. Photographs No. 32, 33, 34 & 35 show the regular testing on the ESD interface and testing record.	**C**

1.4 Installations at the Jetty

1.4.1 The jetty shall be installed with defensive fenders.

Observation	Result
It was confirmed in the Design Audit Report dated October 2010 that : 1. On top of the standard fender system engineered to suit the full range of vessel sizes and types expected to use the berth, drawings PAFF/MA/03/DWG/C/2807-2808 illustrate the installation of defensive fenders on the shore side of the jetty and end protection units to protect against possible collision from small craft straying into the area. 2. The defensive fenders are in place. There had been no change made after the completion of construction since October 2010. Photographs No. 36, 37 & 38 show that the fender system is installed both at sea side and shore side of the jetty.	**C**

1.4.2 The jetty shall be installed with coupling points with slop collection utilities connecting to oil interceptors.

Observation	Result
It was confirmed in the Design Audit Report dated October 2010 that : 1. Drawing PAFF/LC/03/DWG/M/0251 illustrates the provision of oil interceptors and bunded areas to contain any dripping from the coupling equipment after disconnection from the ships and the minor spill will go into the slop collection utilities connecting to the oil interceptors. There had been no change made after the completion of construction since October 2010. Photographs No. 39 shows that the slop collection utilities are installed to recover excess aviation fuel during coupling and de-coupling.	**C**

1.5 Sub-sea Pipelines Protective Measures

1.5.1 The sub-sea aviation fuel transfer pipelines shall be properly designed and constructed to prevent or minimize any damage or leakage risk. The sub-sea pipelines shall be protected in accordance with the arrangement as shown in Figure 5 of the Environmental Permit No. EP-262/2007/B. The sub-sea pipelines shall be buried at least 3m below the seabed level and covered with protective armour rock layer of at least 1.2m thick. No protective armour rock layer shall be protruded above the seabed.

Observation	Result
It was confirmed in the Design Audit Report dated October 2010 that : 1. Drawing PAFF/LC/04/DWG/C/0408 illustrates the sub-sea pipelines in accordance with the arrangement as shown in Figure 5 of the Environmental Permit EP-262/2007/B. 2. The sub-sea pipelines have been installed in a dredged trench and have been buried at least 3m below the seabed level and covered with protective armour rock layer of at least 1.2m thick. 3. The protective armour rock layer does not protrude above the seabed. 4. The installation is in good order. There had been no change made after the completion of construction since October 2010. According to the latest hydrographic survey result in February 2023 (attached in Appendix 4) and there is no evidence of damage to the rock-fill protection layer over the subsea pipelines.	**C**

Appendices

Appendix 1 – The Auditor – Mr. Tsang Wai Yip

Mr. Tsang is the HSE Officer of EAFS responsible for monitoring the compliance of the Environmental Permit requirements.

Mr. Tsang holds a Bachelor Degree in Environmental and Occupational Safety and Health and has completed an internal auditor and ISO 14001 training from recognized organization.

Mr. Tsang has been working in heavy industry and manufacturing since 1993 and has solid experience in compliance auditing.

Appendix 2 – Level Alarms Settings for Each Storage Tank

Tank Operating and Overfill Alarm Setting

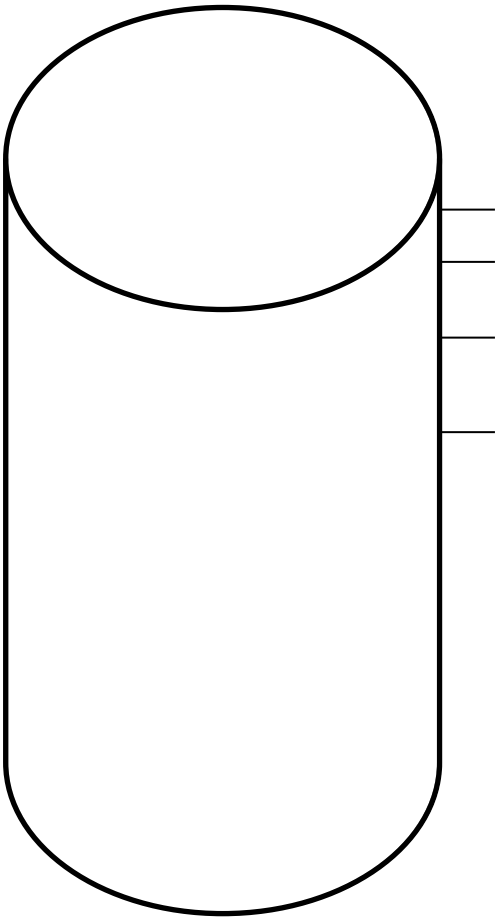
As per American Petroleum Institute guideline “API 2530”

Permanent Aviation Fuel Facility (PAFF)

I. PRIMARY DATA

1. Demonstrated response time to close tank outlet and inlet valves when an alarm is activated = “A” min.
2. Volume transferred into the tank for a period of “A” min. = “B” m^3
3. Volume “B” m^3 with 1.5 factor of safety margin = “C” m^3

II. ALARM AND FILL LEVEL SETTINGS



Level Descriptions	Actions and Alarms
Critical Height (CH) = The Level equivalent to Licensed Volume, triggered by Independent Level Switch	Shutdown Alarm + Close inlet / Outlet Valves
High-High Level Alarm (HHLA) = CH – “C”	Shutdown Alarm + Close Inlet / Outlet Valves
High Level Alarm (HLA) = HHLA – “C”	High Alarm
Normal Fill Level (NFL) = HLA – “C”	Annunciation

Appendix 3 – Photos No. 1 to 39

(1) Four tanks are located within bunded compound – Phase 1a

(2) Four tanks are located within bunded compound – Phase 1b

(3) Phase 1a bunded compound is lower than the ground level outside the bunds

(4) Phase 1b bunded compound is lower than the ground level outside the bunds

(5) Wave deflector is located at top of the bund

(6) Visible parts of the joints are covered by stainless steel plates on the inside at phase 1a bund

(7) Maintenance works have been performed on sealant at joints

(8) Intermediate bund walls are provided in place near T-01-004

(9) Intermediate bund walls are provided in place near T-01-002


(10) Two impervious security walls are provided outside the bunded compounds

(11) Two impervious security walls are provided outside the bunded compounds

(12) Landscaped berm is maintained at least 1.5m high

(13) Landscaped berm is maintained at least 1.5m high

(14) Gates at security walls with sealant are maintained in good condition

(15) Gates at security walls with sealant are maintained in good condition

(16) This shows the thickness of the bund wall provided

(17) This shows the thickness of the security wall provided

(18) Impervious lining are maintained in good condition

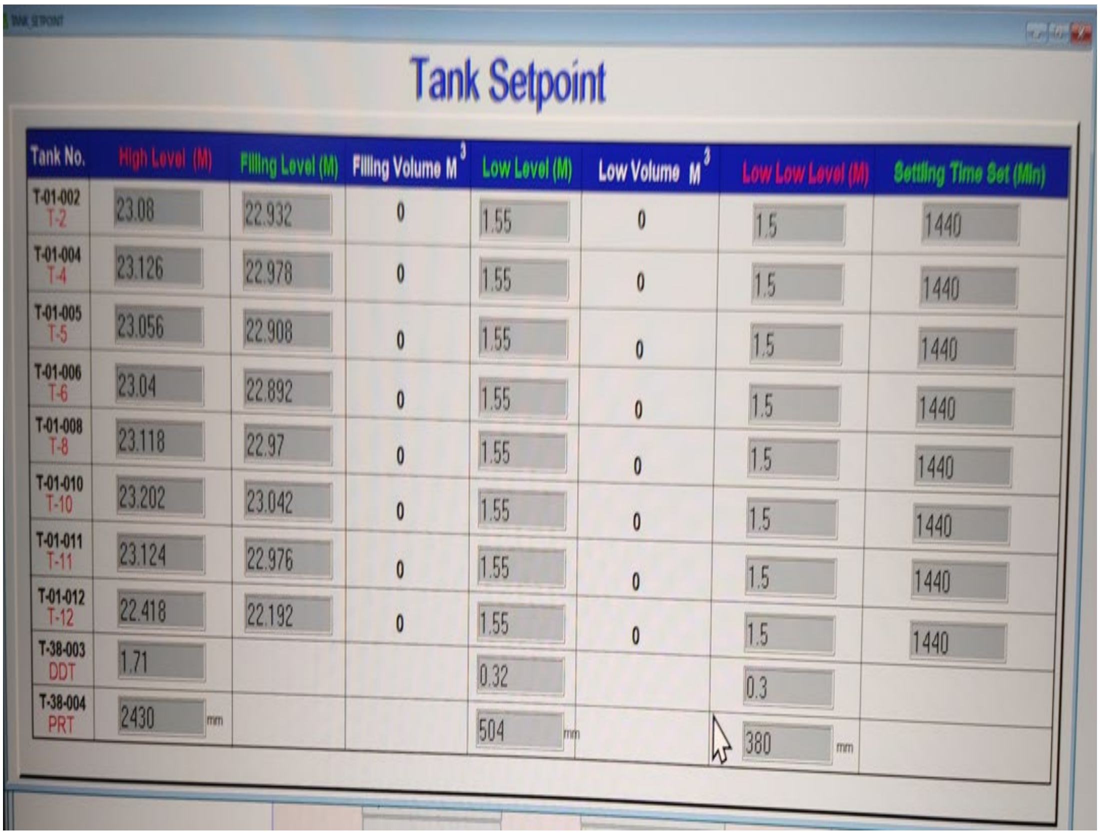
(19) Tank farm is with appropriate gradient and the drainage falls to interceptor for collection

(20) Outlet valve provided for Phase 1a Interceptor with instruction sign to keep "normally closed"

(21) Outlet valve provided for Phase 1b Interceptor with instruction sign to keep "normally closed"

(22) Record photo shows impervious membrane being installed on top of tank foundation

(23) Record photo shows imperious membrane laid at tank center sump with tell-tale pipe embedded for leak detection



Tank Setpoint

Tank No.	High Level (M)	Filling Level (M)	Filling Volume M^3	Low Level (M)	Low Volume M^3	Low Low Level (M)	Settling Time Set (Min)
T-01-002 T-2	23.08	22.932	0	1.55	0	1.5	1440
T-01-004 T-4	23.126	22.978	0	1.55	0	1.5	1440
T-01-005 T-5	23.056	22.908	0	1.55	0	1.5	1440
T-01-006 T-6	23.04	22.892	0	1.55	0	1.5	1440
T-01-008 T-8	23.118	22.97	0	1.55	0	1.5	1440
T-01-010 T-10	23.202	23.042	0	1.55	0	1.5	1440
T-01-011 T-11	23.124	22.976	0	1.55	0	1.5	1440
T-01-012 T-12	22.418	22.192	0	1.55	0	1.5	1440
T-38-003 DDT	1.71			0.32		0.3	
T-38-004 PRT	2430 mm			504 mm		380 mm	

(24) High Level Alarm being set in the SCADA System

(25) Regular inspection performed on overfilling monitoring device (High-High Level Alarm)

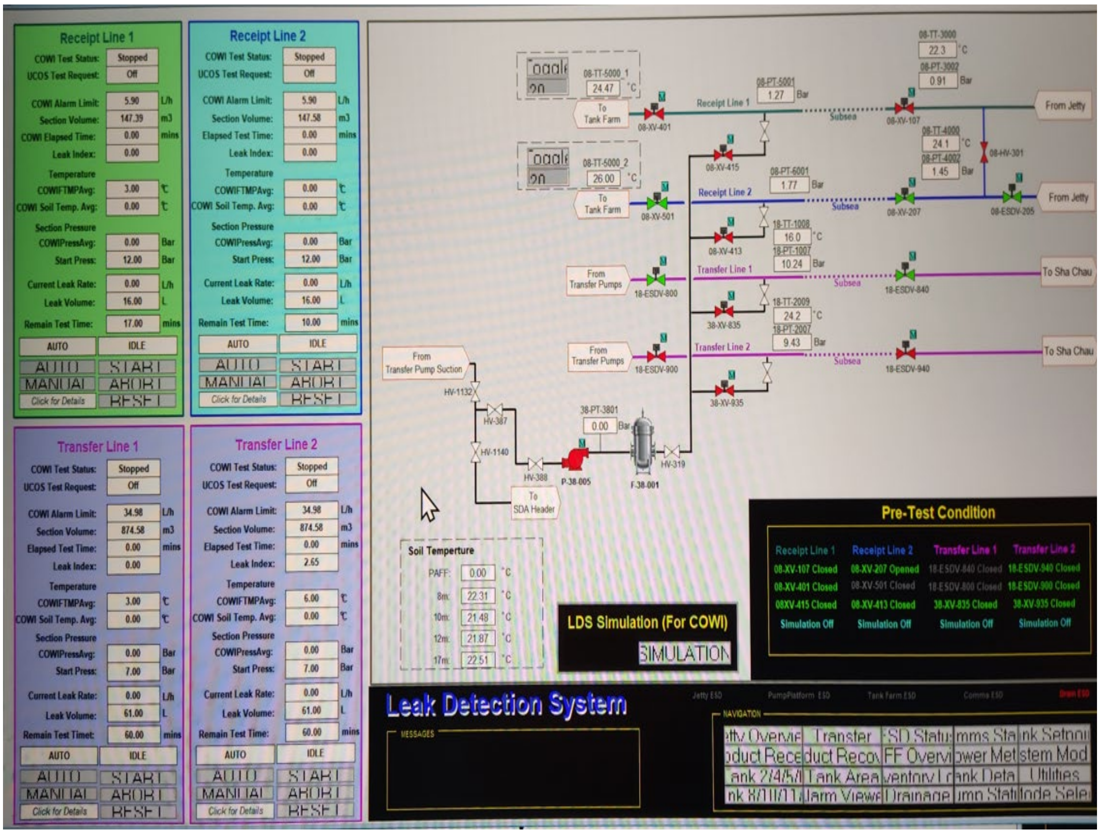
Vertical Tank Surveillance

Item No.	Item	Acceptance Criteria/Ref. Standard	Compliance ✓ Yes	No	Note Fault & Ratification Completed/Action Required
Tank No.		T-01-002 (Fill in tank no. xxx)	Surveillance Date: 12-1-2016		
1.0	**Tank Shell**				
1.1	Tank Shell	Any areas of flaking paint or corrosion. Inspect wind grinder and floor to shell areas.		✓	
1.2	Tank Shell Joints	Any signs of weeping, leaks or wetness from welded or reverted shell joint.		✓	
1.3	Stairs handrails and walkways	Any corrosion or paint flaking on stairways, treads, walks, handrails and underside of stair landings? Any structural damage.		✓	
1.4	Fixed Roof	Any visible damage, excessive corrosion or abnormal penetrations on roof top plates?		✓	
2.0	**Foundation**				
2.1	Foundation shape	Is the original foundation shape retained	✓		
2.2	Foundation	Are there signs of cracks or differential settlement? Dis it allow water to drain away from the tank edge?		✓	
	Foundation water retention	Are there signs that water is retained on shoulder areas?		✓	
3.0	**Valves**				
3.1	Valve operation	Are the valves free to operate and do the spindles have lubrication?	✓		
3.2	Security Valve and openings	Are all the valves not open/in sued locked? Are all spare nozzles, drain points ect. Positively secured by cap plug or blank?	✓		
3.3	Vents	Are vents operating correctly, no blockage by insects or bird nest?	✓		
3.4	Earthing connection and conductors	Is there any fraying or cables or damaged ot corroded conductors, connections or earth's takes?	✓		
3.5	Other tank roof fittings	Are the cable trays all in serviceable condition, free from damage and corrosion?	✓		
4.0	**Fire Protection**				
4.1	Cooling sprays & deflector plates	Any blockage with debris or any visible corrosion?		✓	
4.2	Base foam injection valve	Is the valve opened?	✓		
4.3	Top foam pourer	Are there any signs of corrosion or blockage to the pourer, aerator or supply piping? Are pipe bracket to tank secure?	N/A		
5.0	**Overfill Protection**				
5.1	Independent hi-hi level alarm	Does the alarm operate correctly?	✓		
5.2	Tank high level alarm	Does the alarm operate correctly?	✓		

Page **1** of **2**

Form No. PAFF_MNT_014_EQ_R1

(26) Record for regular inspection performed on overfilling monitoring device (High-High Level Alarm)

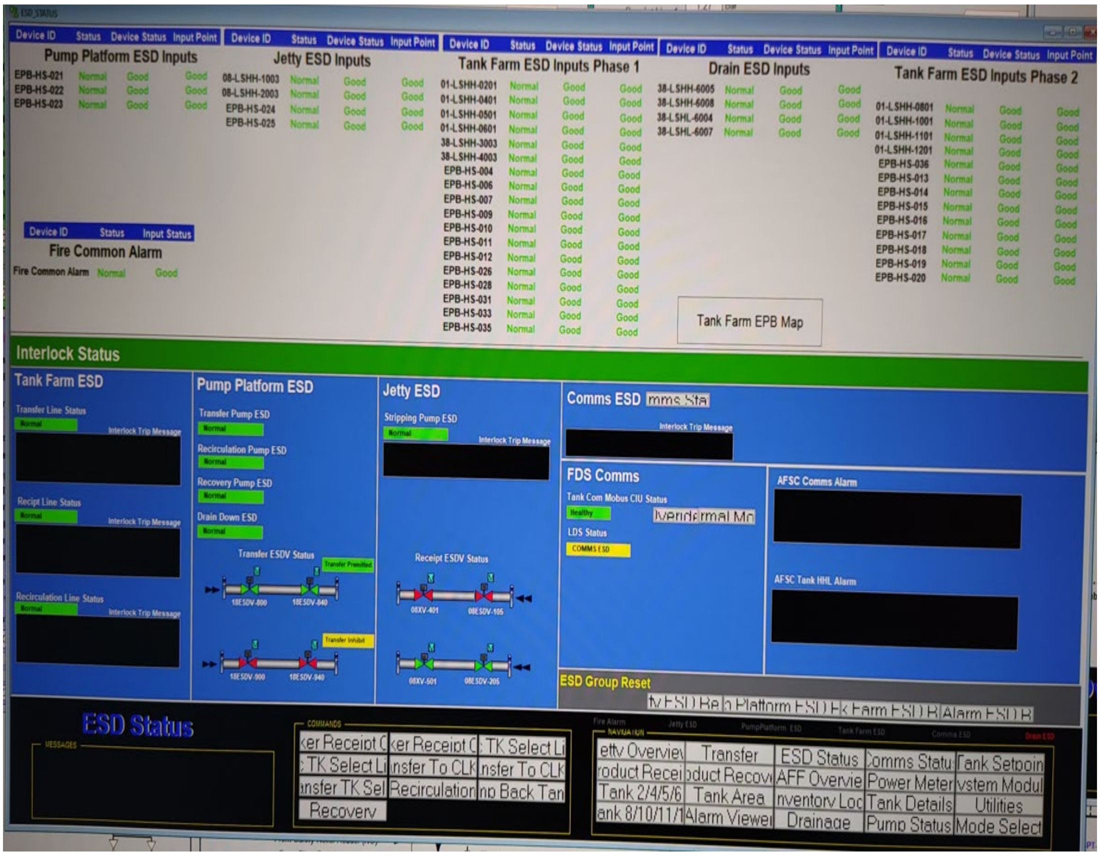


(27) Leak detection “COWI Stat Leak System” installed into computer

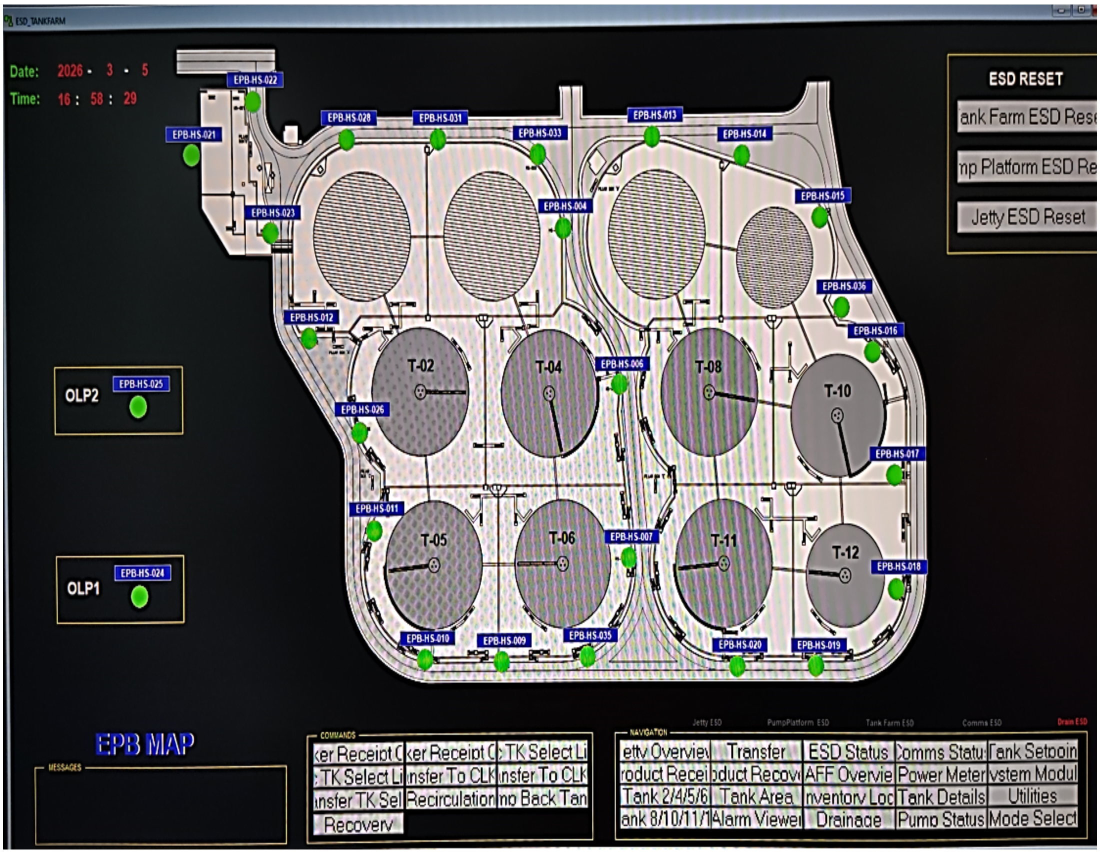
(28) Leak detection tell-tale pipe underneath the storage tank opens out to a collection chamber

(29) Collection chamber located adjacent to tank foundation is maintained in good condition with periodic inspection

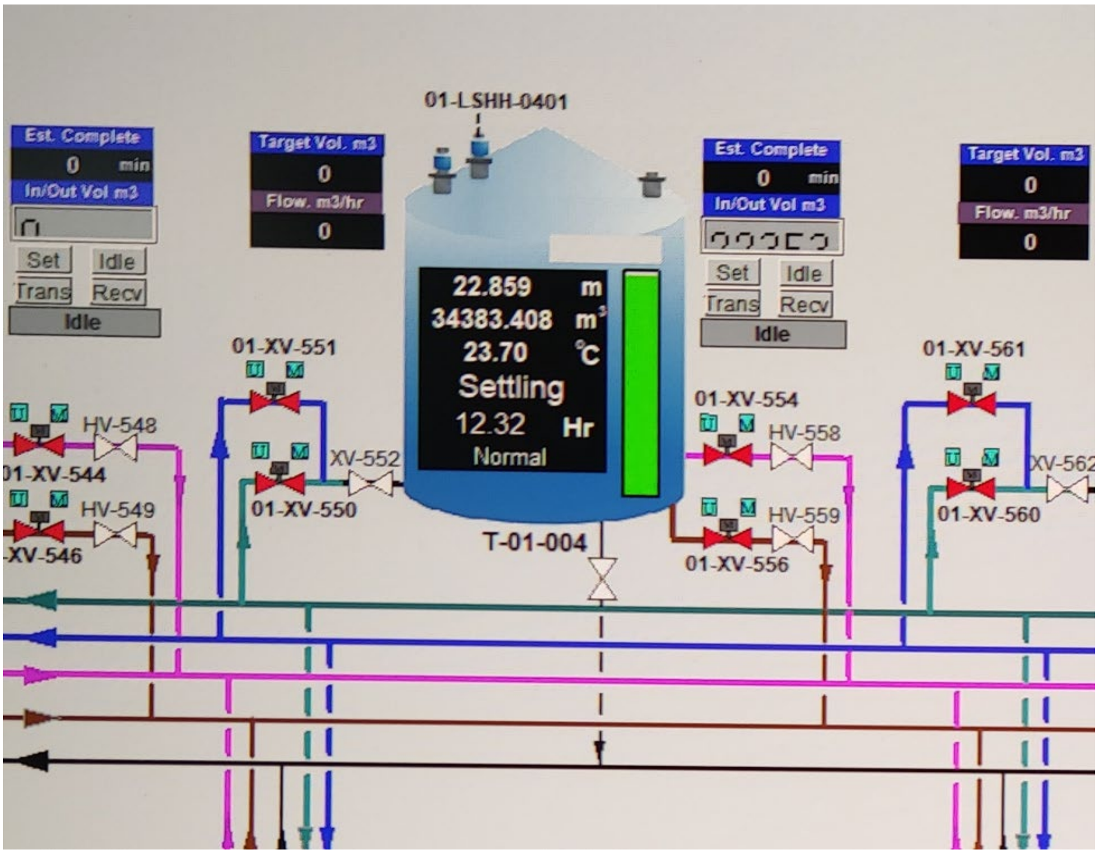
(30) ESD device is maintained in good condition and being tested periodically



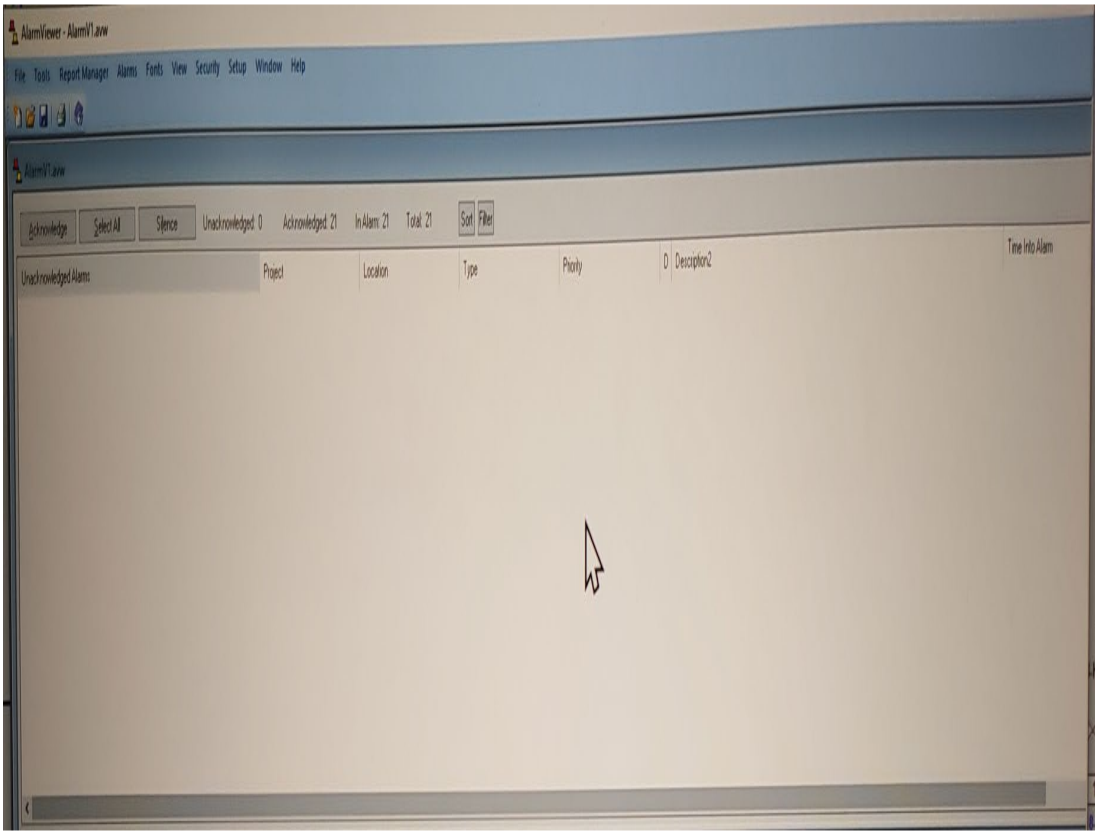
(31) The ESD regular testing as shown in SCADA System



(32) The ESD regular testing as shown in SCADA System



(33) The ESD test signal as shown in SCADA System



(34) Once the system received ESD test signal, the valves will be closed automatically and shut down the operation as shown in SCADA System

急停按鈕測試

測試日期 26 JAN 2026

當值輪班主管 [illegible]

在測試時
按下前須在SCADA關閉急停按鈕功能
重置後須在SCADA開啟急停按鈕功能

Pump Platform

急停按鈕			按下		重置	
			功能正常	故障	功能正常	故障
1	EPB-HS-021	近 Stadis 450 添加處	☑	☐	☑	☐
2	EPB-HS-022	近 D15 出口	☑	☐	☑	☐
3	EPB-HS-023	在EVA近PRT	☑	☐	☑	☐

Tank Farm

急停按鈕			按下		重置	
			功能正常	故障	功能正常	故障
4	EPB-HS-012	近 T02 位置	☑	☐	☑	☐
5	EPB-HS-026	近 T02 位置	☑	☐	☑	☐
6	EPB-HS-011	近 T05 位置	☑	☐	☑	☐
7	EPB-HS-010	近 T05 位置	☑	☐	☑	☐
8	EPB-HS-009	近 T05 及T06 位置	☑	☐	☑	☐
9	EPB-HS-035	近 T06 位置	☑	☐	☑	☐
10	EPB-HS-007	近 T06 位置	☑	☐	☑	☐
11	EPB-HS-006	近 T04 位置	☑	☐	☑	☐
12	EPB-HS-004	近 T03 位置	☑	☐	☑	☐
13	EPB-HS-033	近 T03 位置	☑	☐	☑	☐
14	EPB-HS-031	近 T01 及 T03 位置	☑	☐	☑	☐
15	EPB-HS-028	近 T01 位置	☑	☐	☑	☐
16	EPB-HS-013	近 T07 位置	☑	☐	☑	☐
17	EPB-HS-020	近 T11 位置	☑	☐	☑	☐
18	EPB-HS-019	近 T11 及T12 位置	☑	☐	☑	☐
19	EPB-HS-018	近 T12 位置	☑	☐	☑	☐
20	EPB-HS-017	近 T10 及T12 位置	☑	☐	☑	☐
21	EPB-HS-016	近 T10 位置	☑	☐	☑	☐
22	EPB-HS-036	近 T09 及T10 位置	☑	☐	☑	☐
23	EPB-HS-015	近 T09 位置	☑	☐	☑	☐
24	EPB-HS-014	近 T07 及T09 位置	☑	☐	☑	☐

Jetty (Test on the first berth of the month)

急停按鈕			按下		重置	
OLP 1 Testing date:		21 Jan 2026	功能正常	故障	功能正常	故障
25	EPB-HS-024	OLP 1 待工室外	☑	☐	☑	☐
OLP 2 Testing date:		16 Jan 2026	功能正常	故障	功能正常	故障
26	EPB-HS-025	OLP 2待工室外	☑	☐	☑	☐

PAFF_OPS_W052_R0 Effective from 01 Apr 2021

(35) Record for regular testing performed on ESD device

(36) Fenders are installed at sea side of the jetty

(37) Fenders are installed at sea side of the jetty

(38) Fenders are installed at shore side of the jetty

(39) Slop collection utilities are used for coupling and de-coupling of the loading arms

Appendix 4 - Seabed Level Survey Result

1. INTRODUCTION

1.1. Project Background

The Permanent Aviation Fuel Facility (PAFF) was built to meet the demand for aviation fuel, with the twin subsea pipelines to connect from Tuen Mun Area 38 to the existing temporary fuel receiving facility adjacent to Sha Chau. Engineering Survey and Geophysics Limited (ESG) was appointed to carry out bathymetric survey for the submarine pipeline route of the PAFF in Tuen Mun. The survey commenced and completed on 24th January 2026. This report records the bathymetric survey results of aviation fuel facility near Sha Chau. The survey area is shown below.

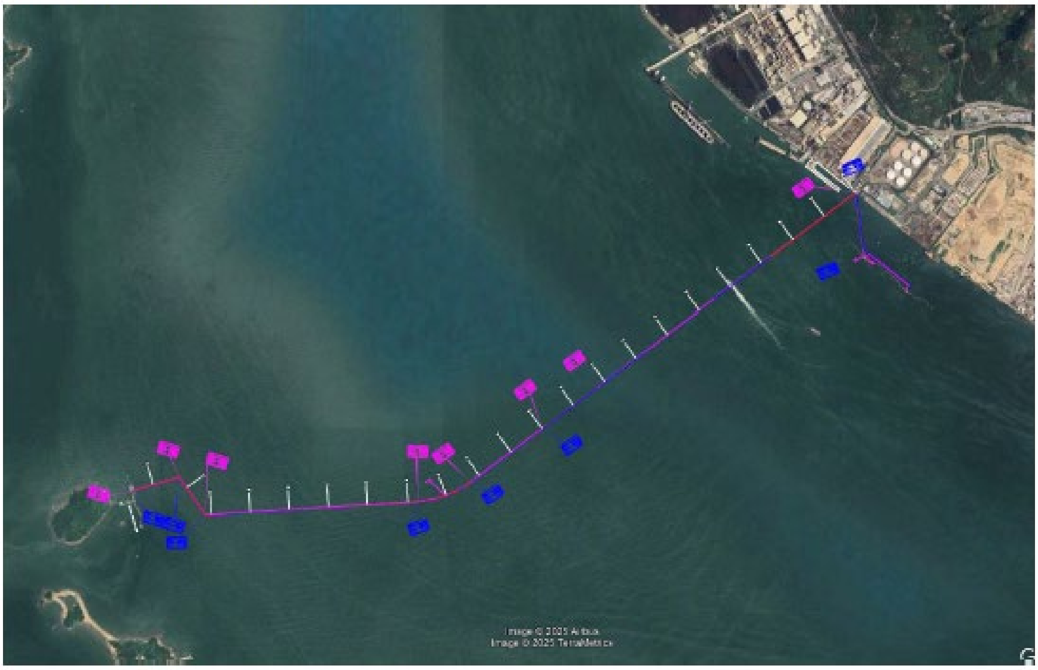


Figure 1: Survey Extent

1.2. Abbreviations

The abbreviations included in this article are as follows:

Table 1 : Interpretation of Abbreviations

Abbreviation	Interpretation
CD	Chart Datum
CRP	Common Reference Point (Datum) of the survey vessel
DGPS	Differential Global Positioning System
EOL	End of Line
ESG	Engineering Survey and Geophysics Limited
GNSS	Global Navigation Satellite System
HSE	Health, Safety & Environment
IMU	Inertial Measurement Unit
L.A.T.	Lowest Astronomical Tide
MBES	Multibeam Echo Sounder
m/s	Metres per second
MSL	Mean Sea Level
MRU	Motion Reference Unit
PAFF	Permanent Aviation Fuel Facility
PD	Principal Datum
PPE	Personal Protective Equipment
ppm	Parts per million
pps	Pulse per second
QC	Quality Control
RTK	Real Time Kinematic
s	Second
SBES	Single Beam Echo Sounder
SOL	Start of Line
SQP	Survey Quality Plan
SSS	Side Scan Sonar
SBP	Sub - Bottom Profiler
TBC	To be Confirmed

1.3. Survey Objectives and Methods

The objectives of the survey are

- To map the seabed in great details;
- To present the survey data in formats for construction propose.

The Multibeam Echo Sounding (MBES) Survey were planned in the survey area to achieve the survey objectives. Specified survey objectives and corresponding survey methods are listed in the table below.

Table 2: Objectives and corresponding survey methods

Objectives	Survey Method
Seabed Topography Survey	Multibeam Echo Sounding (MBES)

1.4. Survey Operations

Following is the survey date and corresponding survey operation.

Table 3: Survey date and corresponding survey operation

Survey date	Survey Operation
24/1/2026	MBES

2. GEODETIC SURVEY PARAMETERS

2.1. Horizontal Datum

The parameters for the datum, projections and transformation to be utilised throughout the Project are listed in Table 4. Survey operations, processing and reporting have been carried out in the Hong Kong 1980 grid.

Table 4: Datums and projection parameters used in this project

Datum parameters		
Datum	Hong Kong 1980 Geodetic Datum (HK80)	WGS84
Spheroid	International Hayford 1910	World Geodetic System 1984 (WGS84)
Semi-Major Axis (a)	6378388m	6378137m
Inverse Flattening (1/f)	297	298.257223563
Grid Projection	Transverse Mercator	Transverse Mercator
Projection parameters		
Latitude of Origin of Projection	22°18'43.68'' N	0° (Equator)
Longitude of Origin of Projection	114°10'42.80'' E	111° E
False Easting (metres)	836694.05	500 000
False Northing (metres)	819069.80	0
Scale Factor along Central Meridian	1	0.9996
Transformation Parameters (ITRF96 - epoch 1998:121 to HK80 Geodetic Datum)		
Translation	Rotation	Scale Factor
162.619 dx	0.067741" rx	+1.094239 ppm
276.961 dy	-2.243649" ry	
161.763 dz	-1.158827" rz	

2.2. Vertical Datum

Depths in these surveys were referenced to Hong Kong Principal Datum (HKPD) , using tide levels measured around the survey areas during the survey.

The datum in use or implied in Hong Kong are illustrated in Figure 2.

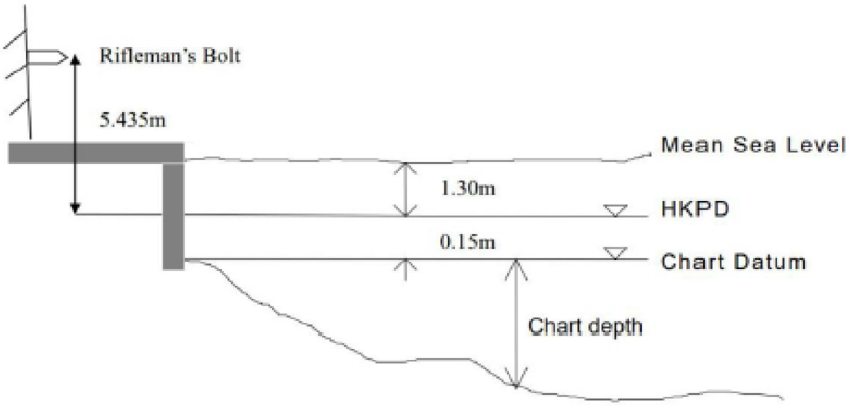


Figure 2: Schematic diagram of vertical datums in Hong Kong

3. VESSEL AND EQUIPMENT

3.1. Survey Vessel

A 14.5m long survey vessel was mobilized. Prior to the survey work, one static vessel survey was performed and then the locations where the equipment would be installed were calculated.

Figure 3: Survey vessel

3.2. Positioning Equipment

The positioning equipment for this survey consisted of an integrated GNSS/INS solution centred on the Applanix OceanMaster Inertial Measurement Unit (IMU). This high-performance navigation system provides precise motion compensation and positioning essential for high-resolution multibeam surveys. The OceanMaster IMU delivers attitude accuracies of 0.02 degrees for roll and pitch and 0.03 degrees for heading, ensuring that vessel movements are accurately measured and corrected in real time.

Real-time GNSS RTK corrections were supplied through the NTRIP client integrated within the NORBIT GUI, using the HxGN SmartNet network to achieve centimetre-level positioning accuracy. The tight integration of GNSS and inertial data significantly reduces positioning uncertainties and improves the reliability of the bathymetric dataset. Together, the GNSS receiver and the OceanMaster IMU provide a robust, stable, and high-precision positioning solution suitable for detailed post-installation surveys.

3.3. Multibeam Echo Sounder

The NORBIT iWBMS multibeam sonar system was utilized for this survey. Recognized for its compact size, light weight, high resolution, and advanced feature set, the iWBMS is well suited for rapid and repeated installation on vessels of opportunity due to its efficient single-cable setup. GNSS RTK corrections were integrated into the system in real time through the NTRIP client built into the NORBIT GUI, using the HxGN SmartNet network to ensure high-accuracy positioning throughout the survey.

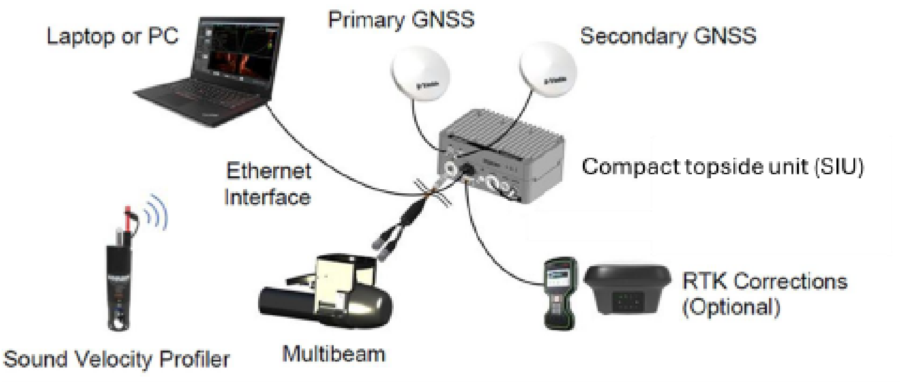


Figure 4: iWBMS hardware setup

Data acquisition was performed using the logging functions integrated within the NORBIT GUI, while survey progress was monitored through NORBIT DCT, the company's proprietary browser-based data acquisition interface. This software provides a clear and intuitive overview of survey operations on any standard web browser and allows remote access for office-based personnel through a secure VPN connection, enhancing overall operational oversight.

The iWBMS X, employed in this project, is NORBIT's most compact and lightweight high-resolution multibeam system, delivering 0.9 × 1.9-degree beam widths at a frequency of 400 kHz. The system incorporates the Applanix OceanMaster IMU, offering roll and pitch accuracy of 0.02 degrees and heading accuracy of 0.03 degrees, ensuring precise motion compensation. It supports frequency agility between 200 and 700 kHz and provides full motion stabilization—including roll, pitch, and yaw—with up to 1024 beams. The wet-end weighs only 8.5 kg and is connected to the dry-end via a single interface cable, allowing rapid mobilization and ease of handling. This configuration maintains excellent portability and user-friendliness without compromising measurement quality, making it highly suitable for detailed and reliable post-installation bathymetric surveys.

Figure 5: iWBMS integrated system

3.4. Sound Speed Equipment

Sound Velocity Profiler

The AML- 3/Hydro SVP is a high accuracy time of flight sound speed sensor capable of measuring sound speed in depths up to 500 meters. The measured sound velocity profile was imported into the survey data acquisition software for use online and stored in each .DB file.

Surface Sound Velocity Measurement

An integrated real-time sound velocity sensor within the NORBIT iWBMS system is used to measure surface sound velocity directly at the transducer depth. This value is essential for accurate beam steering and is automatically streamed into the system without requiring any external sensors or cabling. The surface sound velocity is fully integrated into the iWBMS sonar head, providing continuous real-time measurements and enabling ongoing quality control against the validity of the sound velocity profile.

4. EQUIPMENT CALIBRATION AND VERIFICATION

On-site calibration and verification were performed under the supervision of a Senior Surveyor and a Senior Geophysicist, both with over three years of experience in geophysical survey.

QPS QINSy was used as the main data collection and line tracking software on the vessel. A QPS Vessel Template Database file (DB) was created for the vessel. Prior to calibration and verification of the equipment, the settings in the QPS Vessel Template Database file (DB) need to be verified to be correct, including sensor offsets, relative draft, etc.

4.1. Draft Measurement

The draft of the survey vessel varies depending on water and fuel consumption, people onboard, equipment, etc. Draft measurement with verification shall be carried out and documented to determine transducer draft before and after the survey. The average draft value will be applied to depth measurement in post processing software. Refer to Appendix B for Draft Measurement Record.

4.2. Inertial Navigation & Attitude Measurement System

a) NORBIT iWBMS multibeam sonar system calibration

After the iWBMS system starts, it powers its built-in INS system and automatically begins the self-calibration process. This self-calibration process takes approximately 3-5 minutes. When the iWBMS has not reached calibration, the INS parameters at the top of the WBMS GUI software will display red, indicating that calibration is incomplete. When the iWBMS reaches calibration, the INS parameters at the top of the WBMS GUI software will display green, indicating that calibration is complete. For information on the NORBIT iWBMS multibeam sonar system before and after calibration. Refer to Appendix C for the iWBMS Calibration.

b) GNSS Check

By receiving RTK corrections from SatRef Network RTK services, iWBMS integrated system can provide position information with RTK precision to survey equipment. GNSS health check shall be implemented to ensure the positioning accuracy within +1m before and after the survey. The verification procedures are performed as follows.

(1) Position accuracy of second independent RTK GNSS System was verified by placing the satellite receiver on known survey control point on the wharf and recording 1 minute of positioning measurements, which were compared with coordinates of the station.

(2) After position accuracy of the RTK GNSS System was verified, the satellite receiver was placed close to the acoustic centre, both measurements from satellite receiver and NORBIT iWBMS multibeam sonar system were logged simultaneously.

(3) Two survey results of the same location were compared against each other to verify position accuracy of iWBMS System. Refer to Appendix D for the iWBMS System position accuracy verification report.

4.3. Multibeam Echo Sounder

a) Sound Velocity Profile

Sound velocity profile measurements shall be carried out and documented to model the spatial and temporal variations of sound velocity before and after the survey.

The measured sound velocity value shall be entered into data collection software Qinsy for depth measurement correction prior to commence the survey. Refer to Appendix A for Sound Velocity Profiles.

b) Bar Check

Bar Check deploys a calibrated sound-velocity bar 2-4 m below iWBMS MBES transducer, then recording MBES data measured with the bar sequentially at 2 m, 3 m, 4 m even 5 m below the transducer. The results of the measurement were compared against corresponding depth of the Bar to verify the accuracy of water depth measurement. Refer to Appendix E for the Bar Check records.

c) Patch Test

Prior to starting data collection, MBES calibration procedure Patch Test was performed in order to measure the angular misalignment between the transducer and Applanix OceanMaster Inertial Motion Unit (IMU). In addition to angular misalignment, Patch Test can also be used to determine latency between MBES and positioning system.

Latency	patch tests were performed by running survey lines in the same direction at varying speeds over a slope.
Roll	patch tests were performed by running reciprocal survey lines at equal speeds over a flat seabed.
Pitch	patch tests were performed by running reciprocal survey lines at equal speed over a slope.
Heading	patch tests were performed by running parallel survey lines at equal speeds over a slope.

Each pair of specific survey lines were analyzed to calculate angular misalignment and Latency, which were entered into the Vessel Template Database file that was used in QINSy to correct depth measurements in real-time. In the post-processing stage, resultant patch test values were imported data processing software Qimera to re-process the data. Please refer to Appendix F for MBES System Patch Test Record.

5. DATA ACQUISITION

5.1. MBES Data Acquisition

Once the vessel reached the survey area, some test lines were run to compare the effect of different parameters to determine and set suitable acquisition parameters.

After the echo sounders properly calibrated, the running speed of survey lines shall be not greater than 6 knots. The iWBMS integrated system MBES data was monitored in real time during all acquisition efforts. Raw information, including surface sound velocity, time synchronization, and ping rate, were displayed and monitored in the iWBMS Controller Interface during acquisition.

5.2. On-Line Real-time QC

The following sensor information will be displayed on the online navigation computer, which will be continuously monitored by the online surveyor:

- Roll, Pitch, Heading information;
- Heave compensator information;
- Positioning system status;
- Time synchronization information;
- Sensor update rates.

6. DATA PROCESSING

6.1. Bathymetric Data

Qimera was exclusively utilized for MBES data processing. Processing steps are detailed below.

(1) MBES raw data in .db format were imported Qimera with the vessel configuration.

(2) Patch test data were analyzed in Qimera Patch Test Tool to determine roll, pitch and heading offsets, and Latency, which were used to correct the data.

(3) Post-processing heave data from iWBMS and tidal data provided by Hong Kong Observatory were imported Qimera to correct the depths. Refer to Appendix G for Tidal Data.

(4) Create Dynamic Surface, clean data automatically and manually, identify features. Generally, if one location was covered by swaths from two or more survey lines, the soundings from different survey lines should be mutually consistent.

(5) Export the processed data.

7. RESULTS & CONCLUSIONS

7.1. Seabed Topography

This survey was conducted on January 24, 2026. The seabed level ranged from -22.3 mPD to -1.1 mPD. The shallowest water is in the eastern seawall area of the survey area. The pipeline crosses the fairway at approximately KP0.6 to KP1.2, which is the deepest part of the survey area, with a seabed level ranging from approximately -20 mPD to -22 mPD. The results, shown as contour plots, cross-sections and long-sections do not show any evidence of damage or major disturbance to the rockfill protection layer covering the pipelines. The current seabed bathymetry is similar to original seabed profile (2007) and to the last survey carried out in 2025. Please refer to Appendix H for details.

Figure 6: Overview of the bathymetry across the survey area

Jaden LIU (HKIS Membership #:9491)
Director
Engineering Survey and Geophysics Limited

Appendix 5 – Drawings

List of Drawings

PAFF/BA/02/DWG/C/1452
PAFF/BA/02/DWG/C/1481
PAFF/BA/02/DWG/C/1705
PAFF/BA/02/DWG/C/1721
PAFF/BA/02/DWG/C/1722
PAFF/BA/02/DWG/C/1723
PAFF/BA/02/DWG/C/1724
PAFF/BA/02/DWG/C/1726
PAFF/BA/02/DWG/C/1727
PAFF/BA/02/DWG/C/1728
PAFF/BA/02/DWG/C/1730
PAFF/KG/02/DWG/E/7437
PAFF/LC/01/DWG/M/0202
PAFF/LC/01/DWG/M/0203
PAFF/LC/01/DWG/M/0207
PAFF/LC/02/DWG/M/0266
PAFF/LC/02/DWG/C/0340
PAFF/LC/02/DWG/C/0551
PAFF/LC/02/DWG/M/0875
PAFF/LC/03/DWG/M/0251
PAFF/LC/04/DWG/C/0408
PAFF/MA/03/DWG/C/2807
PAFF/MA/03/DWG/C/2808
PAFF/RJ/02/DWG/G/3015(EX)