ECO Aviation Fuel Services Limited

PERMANENT AVIATION FUEL FACILITY

DESIGN AUDIT REPORT

as required by

THE ENVIRONMENTAL PERMIT

13 October 2010

Our Ref: ECO/EAFS/AE/10/L137
Your Ref:

Environmental Protection Department
Senior Environmental Protection Officer
(Regional Assessment) 2
27/F, Southorn Centre
130 Hennessy Road
Wan Chai, Hong Kong

By Hand

Attn: Mr Colin P Y Keung

Dear Sirs

Permanent Aviation Fuel Facility
Environmental Permit EP-262/2007/B

In compliance with Condition 4.1 of the captioned PAFF Environmental Permit, please find enclosed for your kind consideration four hard copies and one electronic copy of the Design Audit Report with Addendum for measures to prevent risk to life, fuel spillage, land contamination and water quality impact during operation of the Project. It also includes Operations, Maintenance, Quality Control & HSSE Procedures for the operation of the PAFF.

Please note that this Design Audit Report supersedes all previous design reports issued.

Yours faithfully
ECO Aviation Fuel Services Limited

Amin Ebrahim
General Manager - PAFF

AE/KCL/pc

Encl

cc AA (Attn: Mr Eddie Chui) – By Hand w/o Operations, Maintenance, Quality Control & HSSE Procedure

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ECO Aviation Fuel Services Limited

Report Title: Design Audit on PAFF

Date: October 2010

	Name	Position	Signature	Date
Auditor	KC Li	Consultant		13 Oct 2010
Reviewed By	Remko Oldenburger	Operations & Safety Manager		13/10-2010
Approved for Issue	Amin Ebrahim	General Manager		13/10/2010

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*** with cross references to the conditions of the Environmental Permit (No. EP-262-2007/B) and the recommendations laid down in Section 10.10.2 of the EIA Report (Register No. AEIAR – 107/2007)**

(This report supersedes all previous design reports issued)

Introduction

The Permanent Aviation Fuel Facility (PAFF), located on about 6.75 ha of land at Tuen Mun Area 38, consists of a tank farm, a two berth jetty and associated pipelines for receipt of Aviation Fuel from ships to the tank farm, and twin submarine pipelines from the tank farm to the existing pipelines located at the aviation fuel receipt facility at Sha Chau for transfer of Aviation Fuel from the tank farm to the Hong Kong International Airport (HKIA).

The tank farm has eight storage tanks each providing a storage capacity of between 22,000m^3 to 35,000m^3 with a total capacity of 264,000m^3. The ultimate design capacity of the tank farm is 388,000m^3. The tank farm will be provided with bundwalls and contained drainage system.

Other facilities within the PAFF include a pump platform where the pumps, filters and recovery system are located. A service and administration building houses the control room, security control, back up power generator, fire fighting equipment, transformers, switch rooms, workshop and store rooms. The building includes basic infrastructure, telecommunications, power supply and lighting.

Aviation Fuel is offloaded at a twin berth jetty sited approximately 200m offshore in about 17m depth of water. The jetty has been constructed on tubular piles. Tankers with capacity ranging from 10,000 to 80,000 dwt berth at the jetty.

Aviation Fuel is transferred to HKIA by means of buried 500mm diameter twin subsea pipelines which connects to the existing facility at Sha Chau. The length of the twin subsea pipelines is about 4.8km. The pipeline system is protected with a Cathodic Protection system and equipped with a permanent leak detection system.

In summary, the PAFF is a Project for delivery and storage of aviation fuel into the PAFF and transfer of the fuel to HKIA to meet the forecast demand of aviation fuel from the immediate future to the operational life time of the HKIA.

Purpose and Scope

This **Design Audit** examines the design of the Project in order to evaluate whether it complies with the conditions set out in the Environmental Permit (No. EP-262/2007/B) granted by the Director of Environmental Protection and the recommendations laid down in Section 10.10.2 of the EIA Report (Register No. AEIAR-107/2007).

The audit has reviewed the relevant layout drawings of the relevant part of the facility construction and equipment installation, and the actual site observations, to ensure that the Project is designed and built as far as practical, in accordance with the information and recommendations stipulated in the approved EIA Report and those stated in the Environmental Permit. As there are a huge number of drawings available for the Project, the drawings that have been attached represent only a part of them and may not necessary be the only drawings for the relevant part of the facility construction and equipment installation.

Conclusion

The results of the audit reveal that the PAFF has been built to internationally recognized standards and to the best practices for aviation fuel delivery and storage. The design arrangements and measures to prevent risk to life, fuel spill, land contamination and water quality impact during operations of the Project have been properly and effectively implemented, as far as practical, in accordance with the stipulated requirements in the afore-mentioned EIA Report and Environmental Permit.

Audit Details

(Results are designated **C** for conformance, **NC** for non-conformance)

I Conditions Set Out in the Environmental Permit

A. Containment Systems of Aviation Fuel Storage Tank Farm

A.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.

Findings	Result
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. 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 195% and 188% respectively, far greater than 110% of the largest aviation fuel storage tank in the bunded compounds. Moreover, 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. This 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. The building of 8 tanks with bund walls has been completed. Photos No. 34 & 37 show that they are located in bunded compound.	**C**

A.2 The bunds shall be partly sunken below the level of ground outside the bunds.

Drawings PAFF/BA/02/DWG/C/1721-1724 reflect that the bunds have been designed to be partly sunken below ground level outside the bunds in the EVA. See photo No. 5. The bunds for Phase 1a have been completed.	**C**

A.3 Wave Deflector shall be used at the bunds.

Drawings PAFF/BA/02/DWG/C/1721-1724 show designed installation of wave deflectors on the bund walls. See photos No. 3 & 7. The wave deflectors at the bunds have been completed.	**C**

A.4 Fire-retardant joints shall be used at the bunds.

Drawings PAFF/BA/02/DWG/C/1722-1724 show designed 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. See photos No. 4 & 6. The facility has been completed.	**C**

A.5 Intermediate bund walls shall be designed and constructed within the bunded compounds for each aviation fuel storage tanks.

Drawings PAFF/BA/02/DWG/C/1452 & PAFF/LC/02/DWG/C/0551 show the construction of internal bund (intermediate bund) walls within the bunded compounds for each aviation fuel storage tank. It meets the I.P. Code Part 19 "Fire Precautions at Petroleum Refineries and Bulk Storage Installations" item 3.4.2.5.4. See photos No. 2, 8 & 12. The set up has been implemented.	**C**

A.6 Two imperious security walls shall be designed and constructed outside the bunded compounds.

Drawings PAFF/BA/02/DWG/C/1721-1724 show the construction of two imperious 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. See photo No. 15. The security walls have been constructed.	**C**

A.7 A landscaped berm of at least 1.5m high shall be designed and constructed outside the bunded compounds.

Drawing PAFF/BA/02/DWG/C/1481 shows a landscaped berm of at least 1.5m high outside the outer security wall. See photos No. 18, 22 & 38. The set up has been completed.	**C**

A.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.

Drawing PAFF/BA/02/DWG/C/1727 shows 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. The installation of gates has been completed. See photos No. 25 & 26.	**C**

A.9 All the bund and security walls shall be properly designed and constructed using reinforced concrete to provide sufficient structure strength to withstand any liquid surged load in case of any accidents.

Drawings PAFF/BA/02/DWG/C/1726, 1728, and 1730 show that all the bund and security walls are constructed by reinforced concrete to provide sufficient structural strength to withstand any liquid surged load in case of any accidents. See photos No. 5 & 15. The construction has been completed.	**C**

B. <u>Drainage Isolation and Lining System for Aviation Fuel Storage Tank Farm</u>

B.1 Drainage system shall be properly designed and constructed for the aviation fuel storage tank farm to collect aviation fuel in case of spillage.

The drainage layout plans in Drawings PAFF/BA/02/DWG/C/1452 & PAFF/LC/02/DWG/C/0551 show the construction of the drainage systems with appropriate falls and gradients to collect aviation fuel in case of spillage. It meets the Hong Kong "Code of Practice for Oil Storage Installation" item 6.2.1. See photos No. 9 & 10. The set up has been completed.	**C**

B.2 Valves and oil interceptors shall be properly designed and constructed at the drainage system to prevent any oily discharge to the sea.

The drainage layout plans in Drawings PAFF/BA/02/DWG/C/1452 & PAFF/LC/02/DWG/C/0551 show the installation of valves at the drainage outlets of bunded compounds. These valves are normally in closed positions to contain any spillage. They will only be opened under close monitoring by competent persons to release any storm waters inside the bunded areas. The effluent from the drainage outlet has been designed to pass through the oil interceptors which will capture any aviation fuel present in the effluent to prevent any oily discharge to the public drainage system and then to the sea. This is meeting the Hong Kong "Code of Practice for Oil Storage Installation" item 7.1. See photo No. 11. The set up has been completed.	**C**

B.3 Impermeable lining shall be installed underneath all aviation fuel storage tanks to prevent seepage of aviation fuel to ground.

Drawing PAFF/BA/02/DWG/C/1705 shows the installation of impermeable lining (Claymat Containment Membrane) 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. See photos No. 23, 24, 35 & 36. As the construction of bottom plates for all 8 tanks has been completed, such requirement has been implemented.	**C**

C. <u>Overfilling Monitoring Systems and Leakage Detection Systems</u>

C.1 Tank overfilling monitoring systems shall be properly designed and constructed for the Project.

Appendix 2 reflects the setting of the high and high-high levels alarms on each storage tank. The high level alarm has been set by means of the level gauge of each tank and will trigger an alarm on the SCADA system for operations alert. The high-high level alarm has been designed to mitigate the reliance on one single system. A stand-alone device, a vibrating fork level limit switch, will be installed for detecting the high-high level and which will trigger an ESD for the closure of all inlet valves of the tank and the stoppage of all pumps immediately together with the sounding of an audible alarm siren to alert operating personnel through an independent routing system. Thus the tank overfilling monitoring systems has been properly designed at a high integrity level. See photo No. 19. The installation of the system has been completed.	**C**

C.2 Pipeline leakage detection system shall be properly designed and constructed for the Project.

Drawings PAFF/LC/01/DWG/M/0202-3 & 0207 show the installation of pipeline leakage detection system in the subsea pipelines using COWI Stat Leak System. The testing is by closing the sections of pipelines and by detecting any pressure drop within a specified period inside the pipelines. A pressure drop not due to thermal effect may indicate a possible leak in the pipeline. It will generate an alarm and activate the opening of the motor-operated valves to de-pressurize relevant pipeline section first and re-closing of them to isolate the problem section pending for immediate investigation. If leakage is confirmed, urgent repair will be arranged. The instrumentation has been installed for the subsea pipelines. See photos No. 40 & 41.	**C**

C.3 Impermeable lining leakage detection system shall be properly designed and constructed for the Project.

Drawing PAFF/BA/02/DWG/C/1705 shows the installation of an 80mm dia. leak detection pipe, in accordance with API 650, underneath the sump of each storage tank. The head of the pipe, which is perforated, is designed to situate above the containment membrane of the tank base and the pipe descending to the end outside the tank ring base. Thus the pipe will collect and drain out fuel, if any, to a designated containment well at the tank side. In this way, any leakage from the bottom of the storage tank can be detected. Also, the bunded areas are laid with impervious membrane to contain any spillage of fuel. See photos No. 1, 20 & 21. The construction of this design has been completed for all tanks.	**C**

C.4 Emergency shut down (ESD) systems shall be properly designed and constructed for the Project. All ESD systems shall be equipped with manual initiating devices.

Drawings PAFF/KG/02/DWG/E/7437 & PAFF/LC/03/DWG/M/0251 show the installation of manual-operated emergency shut down (ESD) buttons at the strategic points in the tank farm and on the jetty for emergency use. As soon as ESD is activated, all valves and delivery pumps will automatically shut down to isolate the fuel lines and stop the flow of fuel. The installation of ESD has been completed. See photos No. 39 & 42.	**C**

C.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.

Drawings PAFF/LC/01/DWG/M/0202 – 0203 & 0207 show 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 installation work has been completed. See photo No. 39.	**C**

D. <u>Installations at the Jetty</u>

D.1 The jetty shall be installed with defensive fenders.

Besides the fendering systems engineered to suit the full range of vessel sizes and types expected to use the berth, drawings PAFF/MA/03/DWG/C/2807-2808 show 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. See photos No. 13 & 14. The installation of the fenders has been completed.	**C**

D.2 The jetty shall be installed with coupling points with slop collection utilities connecting to oil interceptors.

Drawing PAFF/LC/03/DWG/M/0251 shows 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. On the other hand, coupling points on the vessels would be provided with slop trays to catch minor spills of aviation fuel during coupling and decoupling. The installation work has been completed.	**C**

E. <u>Sub-sea Pipelines Protective Measures</u>

E.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.

Drawing PAFF/LC/04/DWG/C/408 shows the sub-sea pipelines in accordance with the arrangement as shown in Figure 5 of the Environmental Permit No. EP-262/2007/B. 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. The protective armour rock layer does not protrude above the seabed. See photos No. 16 & 17 for the material used for the protective armour rock. The installation work has been completed.	**C**

II **Conditions Recommended in the EIA Report**

F.1 The marine jetty risk is dominated by impact, i.e. caused by the approaching vessel striking the jetty resulting in spill and fire. A number of measures are already proposed in the design – fenders designed for impact loads, use of tugs, use of pilots aboard every vessel, restriction on maximum velocity for approach, etc. Further measures to minimize the risks from impact events should be examined. These may include the use of a berthing aid system as a good practice measure. Under this system, two radar sensors located on the jetty would provide continuous information (ships position relative to the jetty, speed of ship and angle of ship related to berthing line) about the ships. Such advanced berthing aid systems are known to reduce the likelihood of berthing impact incidents.

Findings	Result
The two offloading platforms of PAFF Jetty are equipped with a docking aid system, SMARTDOCK DAS, manufactured by Harbour Marine. The system provides real time data of the vessel's distance and speed of approach relative to the jetty, in the critical 0 to 300 metres zone. With this data, the Pilot and vessel's Master can better direct tug and shipboard personnel can safely maneuver the vessel towards the jetty and therefore minimize any potential for damage to the berth or ship. Also the system has drift-warning monitoring capability after the mooring of the vessel. Besides, there are devices for measuring real time wind and current speeds and directions. See photos No. 27- 32.	**C**

F.2 The storm water drainage system for the PAFF site includes a fail safe final shutdown valve at the outlet that is actuated automatically on high-high level in the interceptor. The reliability of this system should be checked to ensure it complies with at least a SIL 1 specification (maximum probability of failure on demand 0.1) and this system should be included in the regular testing programme for safety critical systems.

Drawing PAFF/LC/02/DWG/M/0875 shows that there are High Level Switch and High-high Level Switch installed at the interceptor. The High Level Switch will raise an alarm in the Control Room while the High-high Level Switch will trigger the shutdown of the final outlet of the drainage system. Such shutdown valve is operated by a UPS system and is a fail safe device and will be closed when any ESD is actuated or when a failure of supply of electricity occurs, besides the activation of a high-high level alarm. The High-high Level Switch is certified as a SIL 2 specification. The system will be under regular testing programme by the contractor.	**C**

F.3 It should be ensured in the final design, if practical at negligible cost, that the limited area of pipework between the tank and pump platform bunds is contained and drains via the interceptor, rather than the storm water system.

Drawing PAFF/LC/02/DWG/M/0266 shows that the pipelines between the tank and pump platform bunds are rigid pipes laid underground inside pipe sleeves with link seal in between and internally coated with epoxy to prevent corrosion. There is also 150mm concrete surrounding the pipe sleeve. It is considered that there will be no likelihood of spillage that require drainage into the interceptor.	**C**

F.4 A regular checking procedure should be developed to ensure that bund valves for all contained areas are normally kept closed and only opened specifically to drain accumulated water and closed promptly afterwards..

The PAFF Terminal Operating Procedures Section 2.2 – Tank Operations, item 2.3.6 Tank Bund Water Management has incorporated procedures to ensure that bund valves for all contained areas are normally kept closed and only opened specifically to drain accumulated water and closed promptly afterwards. A copy of the procedure is attached in Appendix 6.	**C**

F.5 The operational procedures for storm water drainage should be prepared in the case of any spill or fire incident at the tank farm.

It is understood that due to the huge containment volume in PAFF, its operational procedures confirm that the outlet valve from the tank farm area to the public drainage is a fail safe device and is normally kept closed and only be opened under instructions and close attendance. This applies even to spill or fire incident. In case of risk of over-flooding ultimately from spill or fire incident, the valve can be decided to open remotely by the instruction of the authority who will have the right to allow contaminated effluent out flowing into the public drainage. Drawing No. PAFF/LC/02/DWG/M/0875 refers.	**C**

F.6 If practical, the access road to the PAFF should be designated a no waiting/parking area to facilitate fire service access and evacuation of the area in an emergency.

The access road of PAFF has been designated a no waiting/parking area. See photo No. 33.	**C**

F.7 The onsite and offsite Emergency Plans for PAFF should be developed and tested on a regular basis. Offsite emergency plans including evacuation plans and communication arrangements should be developed in conjunction with the Fire Services Department (FSD), Police, Marine Department and other agencies. Offsite emergency plans for the neighbouring sites will be prepared in order to have an effective evacuation within a short period of time. These will be submitted by the project proponent during detailed design of the facility.

The PAFF emergency plans already cover the evacuation plans and regular drills. The communication arrangement with the authorities and the neighbouring sites are being developed. It is worth mentioning that, as indicated in Figures 10.6 & 10.8 of the EIA Report, although the LSIR is predicted to be finite over the neighbouring sites, SWS mill building and Phase I of the Eco Park, the risk levels predicted are extremely small. Copies of Figures 10.6 & 10.8 of the EIA Report are attached in Appendix 5.	**C**

F.8 The off-site emergency plan should include procedures for the Police including the Marine Police, including cordoning-off the access roads, evacuating the neighbouring sites, and cordoning-off the sea lanes adjoining the site.

Emergency plans have been developed which include providing warning, evacuating and cordoning-off procedures.	**C**

F.9 The onsite and off-site emergency plans should consider tank to tank fire escalation, bund fire escalation and smoke effects from fires in developing suitable emergency response measures.

As in items 7 and 8 above, emergency plans have been developed which include providing warning, evacuating and cordoning-off procedures.	**C**

F.10 The operating procedures for unloading fuel from tankers at the jetty and for tank farm operations should include procedures in the event of thunderstorm warning, typhoon and lightning. Onsite emergency procedures should include actions to be taken in the unlikely event of ignition of vents due to lightning.

The PAFF Terminal Information Book Section 9.6 – Adverse Weather has incorporated procedures in the event of thunderstorm warning, typhoon and lightning. Event of ignition of vents due to lightning can be grouped into tank fire incident which has been addressed in the emergency response manual. A copy of the procedure is attached in Appendix 6.	**C**

F.11 Since the tank farm will be constructed in phases, suitable measures should be adopted for ignition control, for restricting access to operating areas and for tie-in with operating facilities. In particular, leak tight bund segregation between operational and construction areas will be necessary.

The Drawing PAFF/LC/02/DWG/C/0340 shows that the operating areas and the construction areas were separated by each bund walls. For the overlapping EVA areas, they were condoned off by temporary security fence and temporary end wall. Security guards were deployed at this divide line for security control. Any hot work and tie-in operations within the operating areas are controlled by a permit system.	**C**

F.12 It is assumed that any future buildings immediately adjacent to the site boundary will not be high rise to avoid the impact of any smoke ingress. Should high rise buildings be proposed in these areas in the future, incorporation of appropriate mitigation measures and an assessment of the residual risks would be recommended.

PAFF will monitor that no high rise buildings are planned immediately adjacent to the site boundary, and if there are, PAFF will request incorporation of appropriate mitigation measures and assessment of the residual risks.	**C**

F.13 Following the Buncefield incident in the UK, a detailed investigation is underway and initial recommendations have been made. Although there are very important differences between the PAFF and Buncefield, specific recommendations (e.g. tank overfill prevention, fail safe shut-off valves, shift handover and containment measures) should be reviewed and implemented as appropriate where they are not already in place.

PAFF has much larger containment volume, with tertiary containment, and equipped with independent high-high level automatic shut off device to prevent overfill. PAFF also has various fail safe ESD valves at strategic locations to shut-off the system in emergency. On the other hand, the shift handover system of supervisors incorporates a sign off log book on duty events during the handover between supervisors on each shift.	**C**

Appendices

Appendix 1 – The Auditor – Mr KC Li

KC Li got his Higher Diploma in Textile Chemistry in Hong Kong Polytechnic and Graduate Diploma in Waste Management in New South Wales in Australia. Li has spent over 32 years in the oil industry. He joined Shell Hong Kong in 1974 and had been the Airfield Manager, the Transport Manager, the Depot General Manager and the Plant Manager of various Shell Installations in Hong Kong and South China. He was one of the members who signed the acceptance of the newly-built Shell Tsing Yi Installation from the project contractor in 1990.

Later in 1995, he joined Caltex Oil Hong Kong as the Manager of Terminals and Depots who looked after the terminals and depots of Caltex in Hong Kong and South China. Between 1998 and 2009, he worked for AFSC at Hong Kong International Airport, as the Refuelling Manager and the Tank Farm Manager. He retired from AFSC in early 2009.

The Auditor's Remark on the Project

The incident at Buncefield (11/12/2005) has massive implications for the future fuel storage facilities. Subsequently, the Health and Safety Executive (HSE) and Buncefield Major Incident Investigation Board (MIIB) of U.K. issued relevant safety alerts and recommendations. PAFF, as a new fuel storage facility, has conformed to the design criteria laid down in the approved EIA Report and the Environmental Permit which exceeds the compliance with the recommendations of MIIB. The following is a brief summary of the risk reduction measures taken by the PAFF project.

1. Primary Containment- In order to prevent loss of primary containment, a High-High Level Alarm Instrument, independent to the tank level gauge as to increase the safety integrity level, is installed on each storage tank to avoid overfilling.

2. Secondary Containment – To prevent loss of secondary containment, bunds are partly sunken below the ground level outside the bunds to withstand the surge of spilled fuel and all joints of the bund walls are sealed with fire retardant sealants and stainless steel plates. Also, wave deflector is used on the bund walls to avoid/minimize bund overtopping when fuel is releasing instantly from bottom zip tear on the storage tank.

3. Tertiary Containment –
    - Oil sealed Security Wall is erected outside the bund wall;
    - Impervious liners are installed;
    - Two bunded areas are linked up to increase the containment volume;
    - Site drainage and sumps are designed in the bunded areas to drain fire fighting water to prevent flooding of fuel and foam under prolonged and spraying of fire water during fire fighting.

In complying with the approved EIA Report and the Environmental Permit design criteria, the PAFF project at the same time also meets to IP Code "Fire Precautions at Petroleum Refineries and Bulk Storage Installations" and other local safety requirements besides the MIIB's recommendations. Therefore, I consider that PAFF is constructed to be one of the lowest risk fuel storage facilities in the world.

Appendix 2 – Level Alarms Settings for Each Storage Tank

Leighton Contractors (Asia) Limited
Permanent Aviation Fuel Facility, Area 38 (H2104)
Tank Detector Level and Fill Level Work Sheet

Appendix 1 – Level Alarms Settings for Each Storage Tank

Tank Detector Level and Fill Level Work Sheet

Facility : Permanent Aviation Fuel Facility, Area 38
Tank No. : Tank No. 2, 4, 5, 6, 8 and 11 (43.5m diameter)
Location : Area 38, Tuen Mun
Code : Shell document: Storage Tank Level Instrumentation Systems "Recommended Engineering Practice"
Prepared By : Leighton Contractors (Asia) Limited
Date : 4 December 2008

I. Background Information

1. Maximum fill rate	=	3,500 m^3/ hr	(A)
Minimum Response time			
(i)High High Level to Overfill Level	=	15 minutes	(B)
(ii) High Level to High High Level	=	10 minutes	(C)
3. Minimum Fill level (Suction head limits for pump referred to the Steady State Analysis, Mar 08)	=	1.5m	(D)

II. Detector and Fill Level Setting

1. Volume (Depth mm) received during Response Time			
(i) 15minutes	=	875 m^3 (589mm)	(E)
(ii) 10minutes	=	583 m^3 (392mm)	(F)
2. Maximum Capacity (Gross Volume)	=	36,708 m^3	(G)
Overfill Level	=	24.7 m	(H)
3. Capacity at High-high Level	=	(G) – (E)	
	=	35,833m^3	(I)
High-high Level	=	24.111 m	(J)
4. Capacity at High Level	=	(I) – (F)	
	=	35,250 m^3	(K)
High Level	=	23.719 m	(L)
5. Capacity at Normal Fill Level	=	(K) – (F)	
	=	34,667 m^3	(M)
Normal Fill Level	=	23.327 m	(N)
6. Minimum Capacity	=	2,229 m^3	(O)
Minimum Fill level (Suction head limits for pump)	=	1.5 m	(P)
Top of the Floating Suction Arm Level	=	0.718m	(Q)
7. Capacity at Low-low Level (Minimum Capacity)	=	2,229 m^3	(R)

Leighton Contractors (Asia) Limited
Permanent Aviation Fuel Facility, Area 38 (H2104)
Tank Detector Level and Fill Level Work Sheet

Low-low Level (Suction head limits for pump) = 1.5 m (S)

8. Capacity at Low Level

100mm (1.65minutes) above the suction head limits for pump) = 1.539 m^3 (T)

Low Level = 1.60m (U)

Appendix 3 – Photos No. 1 to 42

(1) Bund area 5-May-2009 Spark test for containment membrane around T1

(2) Bund area 9-Mar-2009 General view for internal bund wall between T2 & T5

(3)	Bund wall 18-May -2009 General view for wall slab near T11

(4)	Bund wall 21-Mar-2009 Condition of fire resistance steel plate installation on wall joint

(5) Bund wall 27-May-2009 General view for wall slab behind T12

(6) Bund wall 9-Apr-2009 Erecting steel fire resistance plate at movement joint of wall

(7) Bund wall 23-Apr-2009 Stripping steel mould for wall near T11

(8) Bund wall 28-Mar-2009 Steel mesh condition for internal bund wall between T6 & T5

(9) Drainage 2-Mar-2009 Condition of drainage pipe & catch pit connect to internal bund wall

(10) Drainage 6-Nov-2008 Re-bar fixing for stage 2 oil interceptor chamber

(11) Drainage 7-Feb-2009 Installation of 300 DI pipe between BM1 to G2

(12) Internal bund wall 30-Jan-2009 Condition of wall slab near T1

(13) LP2 16-Jan-2009 Condition of PMF fender after installation

(14) LP 14-Jan-2009 Installation of PMF fender on pile

(15) Security wall 16-Dec-2008 General Condition for wall 1 & 2 behind T2 & T5

(16) Submarine pipe 10-Jun-2009 General view for rock fill in pipe trench

(17) Submarine pipe 23-Jun-2009 G700 rock material condition

(18) Landscaped berm outside the security walls 8-Jul-2009

(19) Installation of HH level alarm independent of the ATG 10-Jul-2009

(20) Containment for leak detection of the bottom of storage tank 15-Jul-2009

(21) Leak detection pipe underneath the storage tank opening out to a containment 15-Jul-2009

(22) Landscaped berm outside the security walls 8-Jul-2009

(23)	Tank 16-Mar-2009 Condition of containment membrane on bottom of tank

(24)	Tank 17-Mar-2009 Laying membrane in center of tank T12 for sump area

(25) Photo (4-Jan-2010) showing sealing of metal gates at security wall

(26) Photo (4-Jan-2010) showing sealing of metal gates at security walls

(27) BD 15-Jul-2009 Condition of laser box at BD2

(28) BD 15-Jul-2009 Condition of laser box at BD3

(29) LP2 14-Jul-2009 General view for display board on LP1

(30) Doppler Current Sensor

(31) Oceanographic Sensor Interface (1)

(32) Oceanographic Sensor Interface (2)

(33) Photo (4-Jan-2010) showing access road at PAFF designated a no waiting/parking area

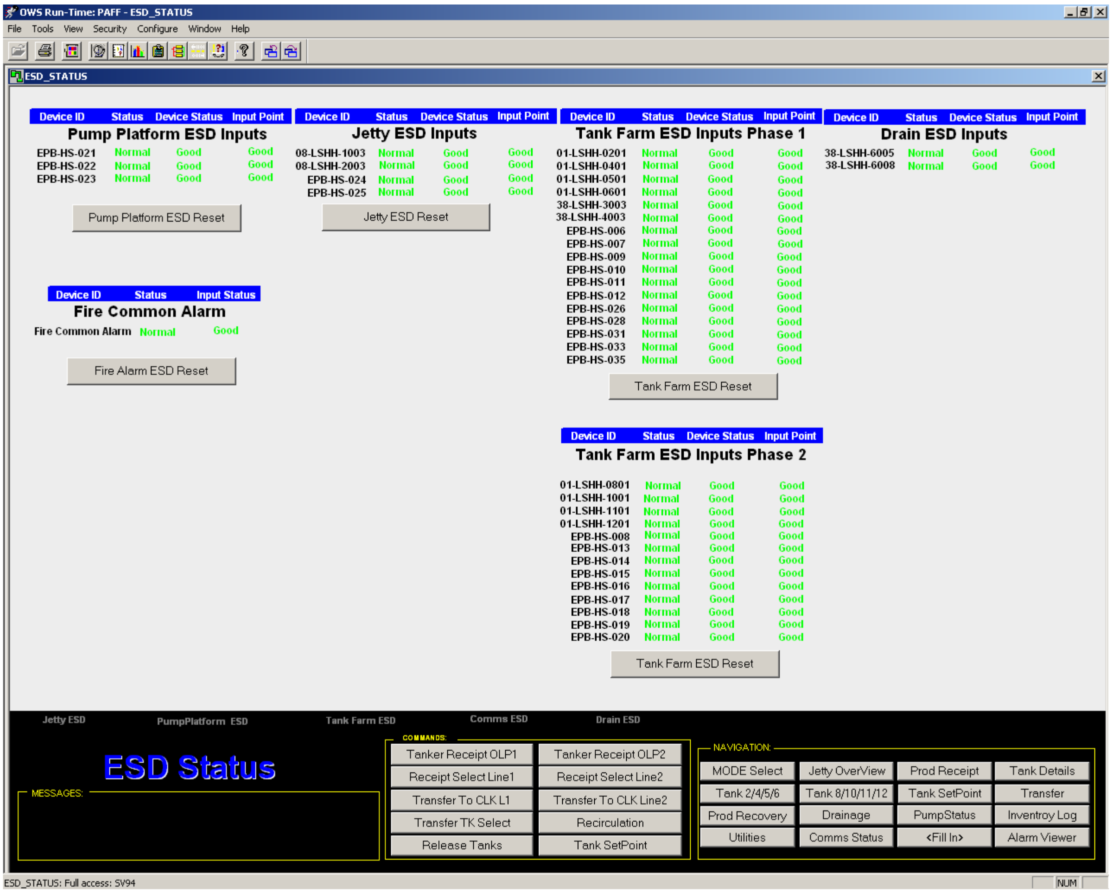
(34) Bunded Compound

(35) Impermeable Lining of bunded areas

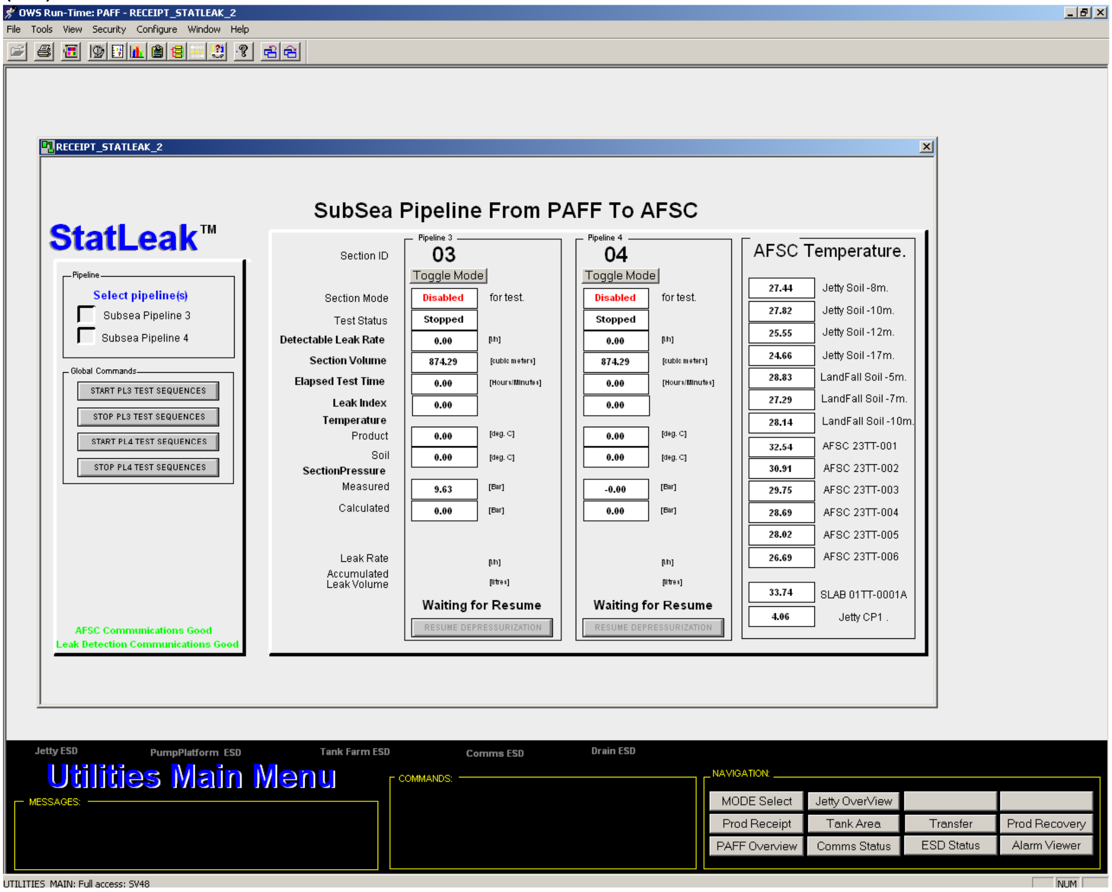
(36) Impermeable Lining of bunded areas

(37) Bunded Compound

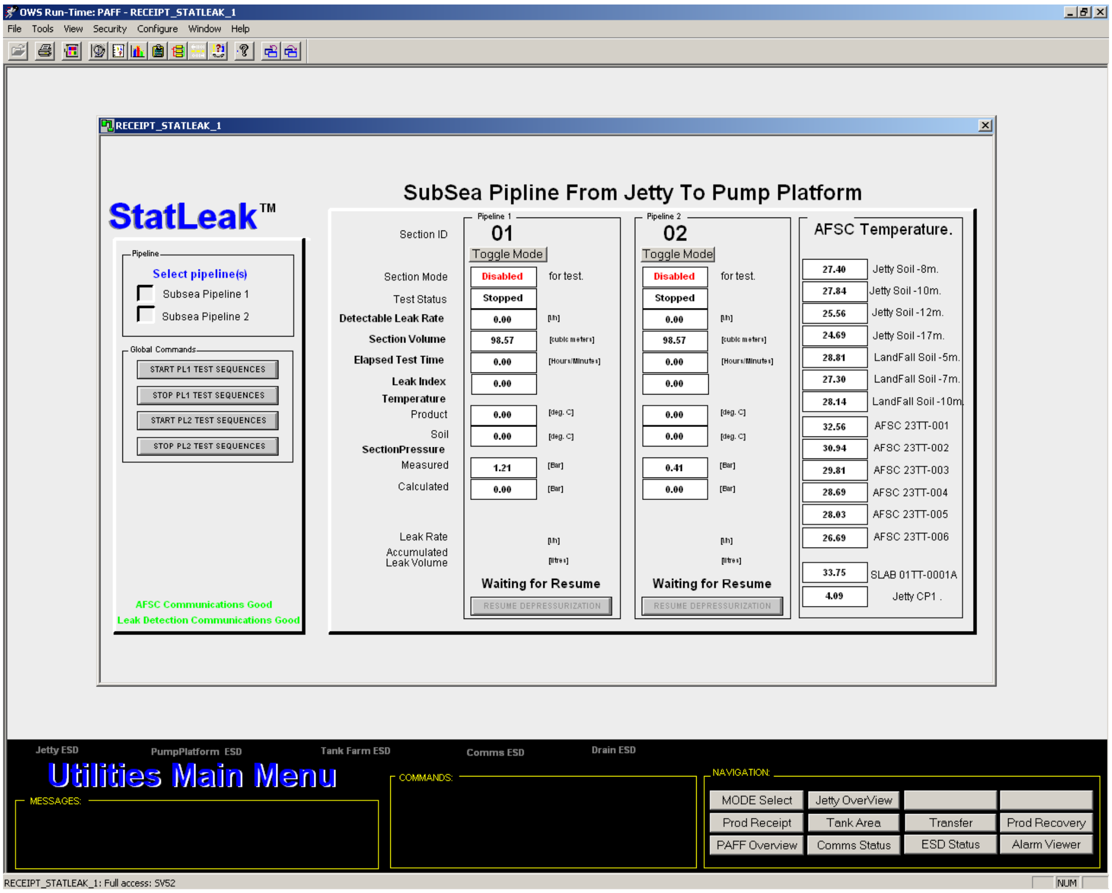
(38) Landscaped Berm



(39) ESD Screen



(40) Leaktest Screen



(41) Leaktest Screen

(42) ESD Device

Appendix 4 – 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)

Appendix 5 – Figures 10.6 & 10.8 of EIA Report

10.9 Comparison of Risk Levels With Criteria

10.9.1.1 Risk levels in terms of identified potential numbers of fatalities and frequencies have been summed for comparison with the criteria in the Technical Memorandum [20], as reproduced in Appendix H1. These cover both individual risk and societal risk criteria.

10.9.2 Individual Risk

10.9.2.1 Location specific individual risk (LSIR) levels have been evaluated using the ESR Rifle risk contouring package. LSIR contours make no allowance for the amount of time someone would be present at the location and risk levels for any individual or group (sometimes referred to as Individual Risk Per Annum or IRPA) will always be less than the LSIR.

10.9.2.2 An overview of the LSIR for the PAFF is shown in Figure 10.6. This shows no off-site risk levels that exceed the criterion of 1×10^{-5} /yr in the Technical Memorandum [20]. The highest identified risk levels are on the sea, associated with the jetty and the storm water outlet, peaking at 6×10^{-6} /yr.

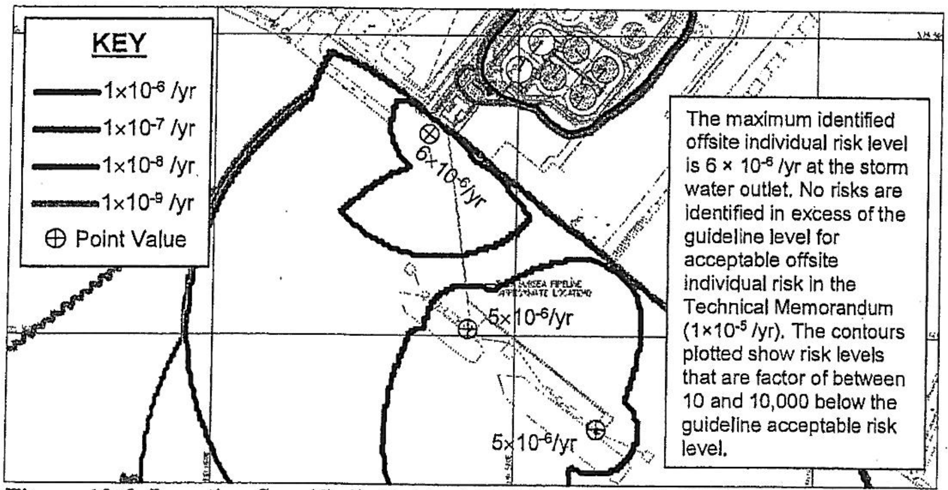


Figure 10.6: Location Specific Individual Risk Levels for the PAFF Showing All Identified Scenarios for the Final Development (12 Tanks)

10.9.2.3 The LSIR levels around the submarine pipeline are included in Figure 10.6 and contribute to the straight 10^{-9} /yr contour extending out along the pipe route to the West. The risk levels for the submarine pipeline to the AFRF at Sha Chau are shown on their own in Figure 10.7. These peak at 4×10^{-9} /yr immediately above the pipeline.

10.9.2.4 Individual risk levels from the existing pipeline from the AFRF to the airport will be similar to the those identified for the pipeline to the AFRF. They are not predicted to change due to the operation of the PAFF and are therefore not plotted in Figure 10.7.

10.9.2.5 The predicted LSIR values on land around the tank farm are much lower than for the jetty and storm water outlet, as shown in more detail in Figure 10.8.

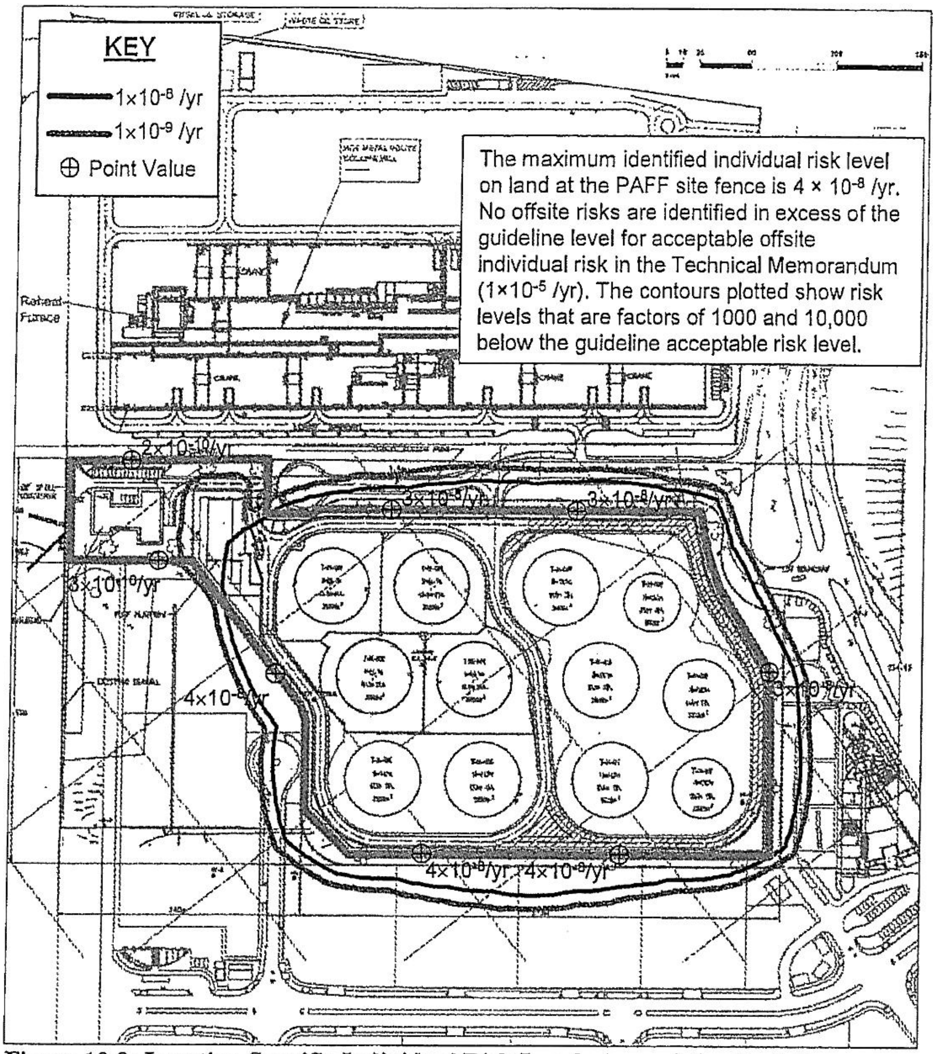


Figure 10.8: Location Specific Individual Risk Levels Around the Tank Farm From All Tank Farm Scenarios for the Final Development (12 Tanks)

10.9.2.6 Peak LSIR values on the PAFF boundary on land are predicted to be 4 × 10^{-8} /yr, with risk levels dropping to below 1 × 10^{-8} /yr on the public access road and a similar distance into the EcoPark areas. These risks are due primarily to Jet A1 releases retained within the site boundary, but where flame drag may impinge areas off-site. Since no allowance for escape is made in these areas, to avoid being optimistic, the risk here may in practice be overstated. However, the risk levels are well below the criterion of 1 × 10^{-5} /yr in the Technical Memorandum [20].

10.9.2.7 Although the LSIR is predicted to be finite over the SWS mill building and Phase I of the EcoPark, the risk levels predicted are extremely small. None of the off-site risks on land, for example, exceed typical estimates for the individual risk due to being struck by lightning (~10^{-7} /yr).

Appendix 6 – PAFF Operations, Maintenance, Quality Control & HSSE Procedures