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TACTICAL FUEL HANDING EQUIPMENT (TFHE) - TECHNICAL CHARACTERISTICS

Edition D, Version 1

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NORTH ATLANTIC TREATY ORGANIZATION

ALLIED FUELS AND LUBRICANTS PUBLICATION

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NORTH ATLANTIC TREATY ORGANIZATION (NATO)

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NATO LETTER OF PROMULGATION

18 December 2020

1. The enclosed Allied Fuels and Lubricants Publication AFLP-07, Edition D, Version 1, TACTICAL FUEL HANDING EQUIPMENT (TFHE) - TECHNICAL CHARACTERISTICS, which has been approved by the nations in the Petroleum Committee, is promulgated herewith. The agreement of nations to use this publication is recorded in STANAG 4605.

2. AFLP-07, Edition D, Version 1, is effective upon receipt and supersedes AFLP-07, Edition 3, which shall be destroyed in accordance with the local procedure for the destruction of documents.

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4. This publication shall be handled in accordance with C-M(2002)60.

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RECORD OF RESERVATIONS

CHAPTER	RECORD OF RESERVATION BY NATIONS
Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Document Database for the complete list of existing reservations.	

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RECORD OF SPECIFIC RESERVATIONS

[nation]	[detail of reservation]
CAN	(1) Para 0202.1. Canada has only one air base that receives fuel by ship; it is only capable of unloading one ship at a time, (2) Para 0202.2. Canada's current capability to unload rail cars is one car at a time in accordance with the Fuel Storage and Distribution System (FSDS) 2018 Ver D. This will be a limitation for the foreseeable future, (3) Para 0403.1. Canada currently does not have 500m flexible hoses, (4) Para 0503.1. Canada's bladders are 90,000L in size because that is the limit by law in Canada in accordance with ULC S668; so operations in Canada are limited to 90,000L bladders. Canada can create a FSDS containing 4 x 90,000L bladders for about 300m3 of fuel storage, (5) Para 0603.1. Canada's normal capacity will be about 360,000L per FSDS (approximately 300m3), with a surge capacity of 1,440,000L (approximately 1,200m3), (6) Para 0603.7. Currently Canada does not issue dedicated spill, equipment to the FSDS or High Pressure Aviation Refuelling System (HPAR), and (7) Para 1602/1603.3. Canada currently provides task-tailored firefighting capability based on the capability of the local military installation or civilian infrastructure.
CZE	The Czech Republic reserves the right to fulfil requirements of the agreement in line with the financial resources and the organizational changes in the Czech Armed Forces.
GRC	Hellenic Navy doesn't currently have portable TFHE type equipment. Hellenic Air Force does not possess TFHE in the inventory.
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TABLE OF CONTENTS

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SECTION 1 TECHNICAL CHARACTERISTICS

Reference: STANAG 2536/AJP 4.7 Allied Joint Petroleum Doctrine

INTRODUCTION

0101. Multinationality and operations with non-NATO nations add a new dimension to logistic planning, requiring a common understanding of the operating procedures and interconnection between elements of the Petroleum Supply Chain. To achieve the required operational flexibility, TFHE is needed for the storage and distribution of operational fuel, particularly where the infrastructure or Host nation Support (HNS) is limited.

0102. TFHE is defined as “Portable equipment that is primarily designed for receiving, storing, distributing and dispensing fuel. It does not form part of, but may be connected to, a permanent petroleum installation”. The TFHE concept of operation is described in STANAG 2536 and AJP 4.7 Allied Joint Petroleum Doctrine.

0103. This AFLP defines the technical requirements of the NATO TFHE Capability Areas and their supporting modules.

GENERAL

0104. All TFHE-based systems must be able to receive, store and dispense (or move) fuel, in an austere environment while ensuring product quality. TFHE must be simple to transport, assemble and operate. Interconnectivity and technical compatibility is crucial to maximising Alliance and Partner nation capabilities while minimising the financial burden on any contributing nation. The key elements need not be the same for all nations, but in any multinational deployment, the elements must be technically compatible with respect to flow rates, system pressures and connectivity. This document does not specify how capability areas should be met but refers to the relevant technical STANAGs to define the required interfaces between supporting modules and the overarching technical criteria essential for interoperability.

0105. The appropriate filtration and means of blending additives is included when planning systems or procuring equipment, to ensure the delivery of quality aviation fuel.

CAPABILITY AREAS AND SUPPORTING MODULES

0106. To minimise the financial burden on any one individual nation, modules within capability areas are to be sponsored, financed and procured by member nations (although some nations may retain the complete range). Nations are requested to declare their TFHE modules in the bi-annual Defence Planning Questionnaire. The capability areas and supporting modules, which make up a TFHE system, are listed in the following table:

	CAPABILITY AREA						
Module	**Receipt**	**Storage**	**Issue**	**Distribution**	**Quality Assurance**	**Repair**	**Safety**
1a	Generic receipt						
1b	Receipt from Aircraft						
1c	Ship to Shore						
2a		Main BFI					
2b		Battlefield BFI					
2c		Forward BFI					
3a			Aircraft refuelling				
3b			Can filling				
4a				Cross country Pipeline			
4b				Bulk fuel Carrying Vehicles			
5a					Basic QA		
5b					Laboratory		
6a						Permanent Installation Repair	
6b						Pipeline Repair	
7							Fire-fighting
8							Pollution Control

0107. **Receipt**. While all storage facilities will have the ability to receipt fuel from road tankers complying with STANAG 3756, additional modules will provide a wider range of capabilities.

0107.1 **Receipt from Sea-going ships**. Where possible, deployed forces will use existing port facilities for the in-load of bulk fuel. If no suitable port facility exists, there will be a need to bring fuel ashore using a TFHE Ship to Shore system. A Ship to Shore System is required to in-load fuel across a beach when port facilities are either not available, damaged beyond immediate repair or lack capacity.

0107.2 **Receipt Over Land.** Several methods may be used to move fuel overland into, and within, theatre:

(1) **Inland .Waterways**. In some countries, rivers and canals provide important routes for the transport of goods. If inland waterways are available, providing Bulk Fuel Installations (BFIs) with the ability to off-load fuel into and receive fuel from barges will enable their use.

(2) **Rail Tank Cars (RTC)**. Where rail infrastructure exists, rail can be an efficient means of transporting fuel. The ability to off-load into and on-load from BFIs would enable the use of RTCs.

(3) **Permanent Pipelines**. Indigenous permanent pipelines offer an economic and potentially rapid means of moving fuel. As the pressures involved are normally much higher than those used in TFHE systems, connection to these systems is possible only if Pressure Reducing Equipment is provided.

(4) **Bulk Fuel Carrying Vehicles (BFCV)**. Use of military/commercial BFCVs may be the only viable means of transporting fuel overland into, or within, theatre. BFIs need to have the ability to receive from and load BFCVs.

0107.3 **Receipt by Air**. Although the total quantity of fuel that can be transported by air is limited, there may be a requirement for fuel to be delivered to early entry forces during the initial phases of an operation. Equipment to enable this process is vital for this capability.

0108. **Bulk storage**. The centre of the TFHE module system is the bulk storage capability. This capability allows deployed forces to hold fuel stocks wherever operationally necessary, providing commanders with the freedom of manoeuvre needed for military operations. Bulk storage and local distribution are required for the supply of fuel to tankers, vehicles, and both fixed and rotary wing aircraft at various locations in an operational theatre. Deployable Bulk Fuel Installations are required at various scales of effort. Each bulk fuel module must contain the necessary equipment to take receipts from and make issues into vehicles with couplings compliant with STANAG 3756. Additional receipt and issue capabilities can be provided by other modules.

0108.1 **Main BFIs**. Main BFIs will be used at 3rd line in the Joint Logistics Support Area and for all Deployed Operating Bases and therefore should be optimised for economies of scale, making full use of modern technology to minimise manpower resources. It is likely that Mechanical Handling Equipment will be needed for construction,

0108.2 **Battlefield BFIs**. Battlefield BFIs are required for use at 2nd line for direct support to ground force missions and as such, equipment should be man portable and optimised for reliability, speed of construction and simplicity of operation.

0108.3 **Forward BFIs**. These BFIs should be small, lightweight and highly mobile to provide support either to small land force groupings or to Attack Helicopters.

0109. **Issue**. Fuel is normally issued from TFHE storage into BFCVs, so the equipment to make issues to BFCVs will be included in the storage modules. Additional issue capabilities can be provided by modules to enable the capabilities below.

0109.1 **Aircraft refuelling**. While airfield bowsers provide a versatile means for aircraft refuelling, it is often more efficient and quicker to issue direct into aircraft using an aircraft refuelling module to provide a direct link from storage to aircraft.

0109.2 **Field Filling Plant for Small Containers**. The use of 20 litre containers at 1st line necessitates a mobile, efficient and safe means of filling. While this function can be performed by unit fuel carrying vehicles, the use of this module at a TFHE storage site provides an alternative means.

0109.3 **Convoy refuelling equipment.** There is occasionally the need to issue directly from BFIs to vehicles. Some nations may choose to use the same equipment to meet the requirements for both convoy refuelling and filling small containers.

0110. **Distribution**. Onward distribution from storage facilities will normally be in military Bulk Fuel Carrying Vehicles (BFCVs). It should be noted that the boundary between storage and distribution can be blurred, as many of the assets in this category have both functions.

0110.1 **Bulk Fuel Carrying Vehicles**. Forward distribution of fuel on wheels can be conducted in several ways, of which wheeled tankers are just one. Also included in this module are:

(1) Semi-trailers – These can be detached from the towing cab, allowing them to be used either as a distribution or a storage asset.

(2) Fuel dispensing racks – ISO container platforms with storage capacity of between 8,000 and 12,000 litres and an integral pump.

(3) ISO tank containers – tanks mounted on an ISO container platform offering about 20,000 litre capacity.

0110.2 **Cross Country Pipelines.** In some situations, there is advantage to be derived from reducing the amount of road movement that is needed. Temporary cross-country fuel pipelines

can enable this in circumstances where the threat level and volumes to be moved justify the time for construction and need for protection.

0111. **Quality Assurance**. Quality Assurance is essential to providing confidence in the fuel held in and issued from deployed THFE. Fuel testing according to the schedule and frequency specified in STANAG 3149 is a key element of fuel quality assurance. Fuel Testing Equipment can vary from simple tests to assure that the fuel is safe to use, to extensive checks to confirm that the fuel fully meets specifications. This STANAG defines two modules for fuel testing equipment in order to distinguish the different depths of testing that can be performed.

0112. **Environmental protection**. Environmental awareness must be considered as a priority issue. Units deploying TFHE must be aware of their responsibilities under STANAG 7102 and make an environmental protection plan based on the tactical situation, Host Nation (HN) and Sending Nation (SN) environmental policies and requirements. It is essential for nations deploying TFHE to provide Pollution Control Equipment (PCE) and Pollution Control Sorbents (PCS) to deal with spills and to enable the implementation of the environmental protection plan. Pollution Control measures should be designed to be able to meet the largest spill that could reasonably be expected and be tailored to the storage capacity and environmental risk.

SAFETY

0113. **Fire**. The main safety hazard with fuel is its flammability. The risk of fire is ever present at any storage installation. Deployable fuel installations must recognise this hazard and address it through safe equipment, safe design of installations, and safe systems of work. This must include a plan for responding to fire. The corresponding module should include assets necessary to support HN and SN fire safety policy.

0114. **Electrical**. All equipment components should be capable of being earthed and bonded to a sufficient standard to prevent the build-up of electrostatic charge. STANAG 3682 provides detail on the standard of earthing and bonding required for issue into aircraft. HN and SN standards will apply elsewhere.

SURVIVABILITY

0115. Like all essential supplies, fuel systems should be resilient to the effects of enemy action. There are no TFHE modules that are specifically included to improve survivability. Instead, survivability is achieved by application of tactics, techniques and procedures, some of which are listed below:

0115.1 **Dispersal**. Fuel storage locations are particularly vulnerable to air attack because they have a large footprint, distinctive shape and thermal signature. Dispersing a storage location over a number of discrete storage areas reduces the vulnerability of such locations.

0115.2 **Camouflage**. Camouflage sets should be designed for use in and around fuel facilities. Constructing decoy sites should be considered.

0115.3 **Redundancy**. Redundancy increases the chance of an installation continuing to function, sometimes in a reduced capacity, following an attack. In addition, repair kits and spare equipment should be provided to enable local repair of damaged equipment. At the operational level, redundancy involves holding spare systems and possessing different means of delivery and storage.

SECTION 2 MODULE 1a - GENERIC RECEIPT MODULE

0201. **General**. The storage module will include the ability to receive fuel using the NATO standard dry break coupling specified in STANAG 3756. This receipt module will enable receipts from BFCVs, RTCs or barges operating on inland waterways. Connections for each of these modes of transport are specified in STANAG 3756.

0202. **Characteristics**

0202.1 Capable of unloading 2 barges simultaneously and pumping directly into either Main BFIs or Battlefield BFIs.

0202.2 Capable of unloading at least 4 rail tankers simultaneously and pumping either directly to Main BFIs or Battlefield BFIs.

0202.3 Include an accurate bulk fuel meter.

0202.4 Include pumping equipment to allow movement of fuel by other than gravity.

0203. **Technical Requirements**

0203.1 Capable of connection to barges conforming to the specification in STANAG 3756.

0203.2 Capable of connection to rail tankers conforming to the specification in STANAG 3756.

0203.3 Capable of connection to commercial or military BFCVs.

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SECTION 3 MODULE 1b – AERIAL FUEL DELIVERY

0301. **General**. Aerial delivery systems may provide an initial source of supply into theatre. This will be by tanker aircraft landing to offload fuel from its onboard tanks. The module will therefore be equivalent to aircraft defueling equipment.

0302. **Characteristics**

0302.1 Capable of delivery on well-found airfields with minimum use of MHE. The equipment should include mechanical pumping and filtration.

0302.2 Include an accurate bulk fuel meter.

0303. **Technical Details**

0303.1 Capable of accepting fuel from fixed wing, rotary wing or tilt rotor aircraft using standard couplings (STANAGs 3105 and 3756).

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SECTION 4 MODULE 1c – SHIP TO SHORE SYSTEM

0401. **General**. A Ship to Shore System should be capable of unloading at least 1000 m^3 of fuel per day. It is to be capable of receiving fuel from commercial ships using standard industry manifold connectors. It must also be capable of delivering fuel into TFHE storage modules.

0402. **Characteristics**

0402.1 Capable of being installed in fair weather and sea conditions (sea state 3 or better).

0402.2 Capable of operation in moderate weather and sea conditions (sea state 5 or better).

0402.3 Capable of connection to standard commercial fuel offtake flanges.

0402.4 With the exception of components that are permanently aboard shipping, components of the ship to shore modules should be transportable by road to improve flexibility of deployment.

0402.5 Capable of day/night operations.

0402.6 Capable of off-loading to existing HN commercial or military storage or a Main BFI (module 2a) or Battlefield BFI (module 2b).

0403. **Technical Details**

0403.1 Equipped with suitable pumping equipment and piping/hoses to discharge the fuel up to 500m inshore.

0403.2 Compatible with Main and Battlefield BFI modules.

0403.3 The outlet connection to the next module in the supply chain should conform to the standard specified in STANAG 3756.

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SECTION 5 MODULE 2a – MAIN BFI – CAPACITY GREATER THAN 1,000m3

0501. **General**. Main BFIs will be used at 3rd line in the Joint Logistics Support Areas and in Deployed Operating Bases. Their size will give opportunities for economies of scale, but construction can be expected to require the use of Mechanical Handling Equipment (MHE).

0502. **Characteristics**. Main BFIs will be made up of storage, receipt, issue and pumping elements. These elements can be used in different combinations to build Main BFIs of differing capabilities. Each Main BFI will also have fire-fighting, pollution prevention, rainwater management and quality control equipment deployed to ensure safe operation. An accounting package will also need to be deployed. Main BFIs may be required to handle the following fuels, but it is unlikely that they will need to handle them all: F-18, F-34, F-35, F-44, F-54, F-58 and F-76.

0503. **Technical Details**

0503.1 **Storage Package**. The storage package should consist of flexible or rigid tankage capable of holding between 1000m^3 and 3000m^3 of fuel in several tanks. Tanks should be connected with pipework or flexible hoses. Storage tanks must be provided with secondary containment to reduce the risk of ground contamination. Secondary containment may be provided either as part of the TFHE package, or failing that, by means of earthworks. The latter method, while slower and demanding of additional resources, can reduce the amount of equipment in the TFHE package.

0503.2 **Pump Package**. Sufficient pumps should be included in the module to allow simultaneous receipt into and issue from the storage package. Pipework and valves sufficient to permit simultaneous issue and receipt should be included in the design of the BFI module.

0503.3 **Receipt Package**. The receipt package provides the capability to accept fuel from road vehicles or from other delivery means using one of the receipt modules. The connection system will be as specified in STANAG 3756. It will include flow meters on each receipt line to enable fuel accounting.

0503.4 **Issue Package.** The issue package provides the capability to provide fuel to vehicles, which may be aircraft refuelling bowsers or BFCVs to carry fuel forward. The issue package consists of the following components:

(1) A flow meter for the purposes of fuel accountability and, where applicable, billing procedures.

(2) Hoses or pipework for the delivery of fuel into vehicles, using the NATO coupling (STANAG 3756), which is the primary means for bottom-loading of bulk fuel carrying vehicles. Nations whose equipment does not comply with STANAG 3756 should ensure that they provide suitable adaptors.

(3) For aviation fuel supply, Filter/Water Separator Vessels complying with STANAG 3967 and STANAG 3583 are to be included.

(4) Blending equipment will be needed to ensure that F-34 can be generated from F-35 and should be incorporated into the issue package where required.

0503.5 **Grounding/Earthing System**. Equipment for grounding/earthing systems shall be provided with the pump and distribution packages described above.

0503.6 **Quality Assurance Equipment**. Provisions shall be made to allow for the taking of fuel quality assurance samples from fuel storage tanks, the outlet of filtration vessels and from the end of the issue line. The Main BFI module should be accompanied by Module 5a (Quality Assurance Equipment - Basic) as a minimum. This will provide the test equipment needed to ensure that the particulate and free water requirements of STANAG 3149 are met.

0503.7 **Environmental Protection Equipment**. Main BFIs shall contain the equipment necessary both to prevent spillages and also to contain any that occur. The equipment necessary will depend on the location, sensitivity of the environment and size of the BFI, so nations should exercise flexibility in determining their need for environmental protection equipment. Pollution control equipment is further covered in Module 8.

0503.8 **Fire-fighting equipment**. Fire-fighting equipment as specified in Module 7 should be deployed with each BFI.

SECTION 6 MODULE 2b – BATTLEFIELD BFI - CAPACITY BETWEEN 100 m3 AND 1,000 m3

0601. **General**. Battlefield BFIs are used at 2nd line for the direct support of ground force missions. Battlefield BFI equipment should consist of modular equipment capable of being easily transportable and be optimised for reliability, speed of construction, and simplicity of operation.

0602. **Characteristics**. Battlefield BFIs will be made up of storage, pump and distribution packages connected with suitable pipework. These packages can be used in different combinations to build Battlefield BFIs of various sizes. Battlefield BFIs should be suitable for handling the following fuels: F-18, F-35, F-34, F-44, F-54, F-58 and F-76.

0603. **Technical Details**

0603.1 **Storage Package**. The storage package should consist of flexible or rigid tankage capable of holding between 100m^3 and 1000m^3 of fuel in several tanks. Tanks should be connected with pipework or hoses. Storage tanks must be provided with secondary containment to reduce the risk of ground contamination. Secondary containment may be provided either as part of the TFHE package, or failing that, by means of earthworks. The latter method, while slower and demanding of additional resources can reduce the amount of equipment in the TFHE package

0603.2 **Pump Package**. Sufficient pumps should be included in the module to allow concurrent receipt into and issue from the storage package. Pipework and valves sufficient to permit simultaneous issue and receipt should be included in the design of the BFI module.

0603.3 **Receipt Package**. The receipt package provides the capability to accept fuel from road vehicles or from other delivery means using one of the receipt modules. The connection system will be as specified in STANAG 3756. It will include flow meters on each receipt line to enable fuel accounting.

0603.4 **Issue Package.** The issue package provides the capability to provide fuel to vehicles and aircraft. The issue package consists of the following components:

(1) For aviation fuel supply, Filter/Water Separator Vessels complying with STANAG 3967 and STANAG 3583 are to be included.

(2) Hoses or pipes capable of delivery of fuel into vehicles.

(3) A flow meter for the purposes of fuel accountability and, where applicable, billing procedures.

(4) Blending equipment will be needed to ensure that F-34 can be generated from F-35 and should be incorporated into the issue package where required.

0603.5 **Grounding/Earthing System**. Equipment for grounding/earthing fuel systems shall be provided with the pump and distribution packages described above.

0603.6 **Quality Assurance Equipment**. Provisions shall be made to allow for the taking of fuel quality assurance samples from fuel storage tanks and the outlet of filtration vessels. The Battlefield BFI module should be accompanied by Module 5a (Quality Assurance Equipment - Basic) as a minimum. This will provide the test equipment needed to ensure that the particulate and free water requirements of STANAG 3149 are met.

0603.7 **Environmental Protection Equipment**. Battlefield BFIs shall contain the equipment necessary both to prevent spillages and also to contain any that occur. Pollution control equipment is further covered in Module 8.

0603.8 **Fire-fighting equipment**. Fire-fighting equipment as specified in Module 7 should be deployed with each BFI.

SECTION 7 MODULE 2c – FORWARD BFI – CAPACITY LESS THAN 100m3

0701. **General**. Forward BFIs are used to provide support to small ground force units and rotary wing aircraft operations. Forward BFI equipment must be capable of being easily transportable by either vehicle or aircraft (rotary or fixed wing) and should be optimised for reliability, speed of construction, and simplicity of operation.

0702. **Characteristics.** Forward Area BFIs will be made up of storage, pump and distribution packages interconnected with suitable pipework or hoses. They will be capable of handling one or more of the following fuels: F-18, F-35, F-34, F-44, F-54.

0703. **Technical Details**

0703.1 **Storage Package**. The storage package should consist of flexible or rigid tanks capable of holding up to 100m^3 of fuel. The storage package should be capable of receiving fuel by means of the 3” dry-break coupling specified in STANAG 3756 using adaptors if necessary.

0703.2 **Pump Package**. This package consists of the pumps, pipework and valves required to move fuel between Forward BFI storage tankage and the issue package described in the following paragraph. (See Module 3a for pump design characteristics for fuelling aircraft.)

0703.3 **Receipt Package**. The receipt package provides the capability to accept fuel from road vehicles or aircraft using the connections specified in STANAG 3756. The use of a flow meter on the receipt line for fuel accounting is recommended.

0703.4 **Issue Package**. The issue package provides the capability to provide fuel to vehicles and aircraft. The issue package consists of the following components:

(1) Filtration equipment shall have sufficient capacity to match the system delivery flow rate. Filter/Water Separator Vessels shall comply with STANAG 3967 and STANAG 3583

(2) Hoses and pipework for connection of components and delivery of fuel into vehicles and/or aircraft.

(3) Refuelling nozzles suitable for providing fuel to vehicles and/or aircraft. (See Module 3a for aircraft fuelling module characteristics.)

(4) A flow meter to enable fuel accountability.

0703.5 **Blending equipment**. It is normal practise that only pre-blended fuels would be held in the Forward BFI, so the inclusion of blending equipment would be exceptional.

0703.6 **Grounding/Earthing System**. Equipment (grounding rods, cables, etc.) for establishing a grounding/earthing system with earth resistance as specified in STANAGs 3632 and 3784 shall be provided with the pump and distribution packages described above (paras 0703.2 and 0703.4).

0703.7 **Quality Assurance Equipment**. Provisions shall be made to allow for the taking of fuel quality assurance samples from fuel storage tanks, the outlet of filtration vessels and the end of the issue line. Quality assurance tests should be the minimum specified in STANAG 3149.

0703.8 **Environmental Protection Equipment**. Forward BFIs shall contain the equipment necessary to prevent spillages and also contain any that occur. Pollution control equipment is further covered in Module 8.

0703.9 **Fire-fighting Equipment**. Suitable portable fire-extinguishing equipment should be deployed with Forward BFIs.

SECTION 8 MODULE 3a – AIRCRAFT FUELLING MODULE

0801. **General.** This sub-package should consist of the equipment necessary to provide fuel directly to fixed, rotary or tilt wing aircraft.

0802. **Characteristics**. STANAGs 2946 and 3681 detail the minimum flow rates and pressures for aircraft refuelling systems which are not part of a permanent facility and provides details on aircraft refuelling nozzles.

0803. **Technical Details**. The module will include:

0803.1 Flow meter to measure the volume delivered for accounting purposes.

0803.2 Connections for delivery to aircraft in accordance with STANAGs 2946, 3105 and 3681.

0803.3 Earthing and bonding equipment in compliance with STANAG 3682.

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SECTION 9 MODULE 3b – ISSUES TO SMALL CONTAINERS OR END-USER VEHICLES

0901. **General**. The continuing need for 20 litre containers at unit level drives a requirement for a mobile, efficient and safe means of filling. This module outlines the performance of equipment to fulfil this function.

0902. **Characteristics**. The equipment must be compatible with TFHE in terms of the connections provided for receiving fuel (defined in STANAG 3756) and the equipment's flow rate and pressure characteristics. The unit must be easily transportable and not require specialist handling equipment for deployment and recovery. The equipment may include the means to decant fuel and wash containers prior to refilling. If it does, then there will be a need to manage the fuel used for can cleaning, which will include recycling and disposal. If this is not integral to the equipment, then it should be co-located and be subject to similar deployment and operating manpower constraints as the filling system.

0903. **Technical details**.

0903.1 The can filling rate should be at least 140 containers per hour.

0903.2 The equipment should be able to safely fill the following products:

(1) F-54 (Ground diesel).

(2) F-58 (Heating kerosene).

(3) F-67 (Gasoline).

0903.3 The inlet must be compatible with BFIs and Bulk Fuel Carrying Vehicles and comply with STANAG 3756.

0903.4 Fuelling nozzles suitable for providing fuel to tactical vehicles should be provided.

0903.5 If tankage is not integral to this module, then it will need to be deployed alongside one of the storage modules (module 2) or a BFCV (module 4b)

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SECTION 10 MODULE 4a – CROSS COUNTRY PIPELINE

1001. **General**. Cross Country Pipelines using rigid or flexible hoses can be used to distribute fuel from the rear areas towards the battlefield. The cross-country pipeline module should consist of at least 5 kilometres of pipeline with the appropriate pump stations to achieve the required flow rates. Coarse filtration or strainers will be fitted and expansion facilities included. Pumps and filters are to be designed to support a flow rate of 2,750 litres/ minute. Cross country pipelines may begin at pipeline off-take points, storage facilities or Main BFIs and will probably terminate in Main or Battlefield BFIs.

1002. **Characteristics**.

1002.1 Pipelines should be capable of being laid and recovered mechanically. They should also be capable of being laid and recovered by hand across broken or very steep ground.

1002.2 Maximum design pressure should be 40 bar. (The NATO standard working pressure for TFHE is 10 bar.)

1002.3 Pipelines should be provided with full bore section valves, check valves, air release valves and pipe anchors. Thermal expansion and transient pressure conditions should be incorporated into the design of cross country pipeline equipment.

1002.4 A gap crossing system is required, which should be capable of crossing both dry gaps e.g. roads, and wet gaps e.g. streams and rivers.

1002.5 Cross-country pipelines are to be capable of delivering fuel into TFHE storage modules, so must incorporate pressure reducing equipment.

1003. **Technical Details for Pump Stations**.

1003.1 Pump stations should contain 2 x 2,750 l/min 40 bar fuel pumps connected to allow one to be taken out of operation without affecting the flow rate. This will enable maintenance without stopping pipeline operations.

1003.2 Bulk, flow and pressure meters suitable for use in both packed and partially filled pipe conditions.

1003.3 A stone and sand trap on the receipt side of the pumps.

1003.4 2 x pig trap/launcher.

1003.5 A means to protect against transient surge.

SECTION 11 MODULE 4b – BFCVs AND OTHER MOBILE ASSETS

1101. **General**. All Bulk Fuel Carrying Vehicles should comply with the appropriate STANAGs and national legislation. Interoperability with regards to STANAG 3756 is essential.

1102. **Characteristics**. BFCVs are the main means for military distribution of fuel, and may also contribute to the storage function in smaller deployments, or those where host nation facilities are readily available. The term includes not only vehicles but also semi-trailers, trailers and tank containers.

1103. **Technical Details**.

1103.1 BFCVs will generally range in size from about 5,000 litres up to about 37,000 litres depending on role. They will incorporate dispensing pumps and flow meters. If intended for aviation fuel use, they are to incorporate suitable filtration. They will have the ability to transfer fuel to other BFCVs using bottom loading and may also have the ability to dispense fuel to the integral fuel tanks of vehicles.

1103.2 Semi-trailers will generally have a capacity between 10,000 litres and 37,000 litres. As they can be detached from the towing unit, they offer flexibility in operational use. If required they can be left as static storage, while the cab unit is employed on other tasks.

1103.3 Fuel dispensing racks are normally installed on a readily-liftable platform; either ISO container or flat-rack. They have a capacity of between 8,000 and 12,000 litres and include flow meter and pump.

1103.4 ISO tank containers are standard commercial containers designed to hold between 19,000 and 23,000 litres of fuel.

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SECTION 12 MODULE 5a – QUALITY ASSURANCE EQUIPMENT - BASIC

1201. **General**. The module provides the ability to assess the quality of fuel in forward deployed areas to STANAG 3149 (minimum QA Surveillance). It will be capable of conducting C or C+ testing and may be capable of conducting some B1 tests. This module will be capable of carrying out QA tests on the following fuel types:

1201.1 F-34/ F-35, (Aviation turbine fuels);

1201.2 F-54 (Ground diesels);

1201.3 F-67 (Automotive Gasoline).

1202. **Characteristics**. The module shall contain all the necessary equipment (except power and waste disposal facilities) to allow the conduct of C or C+ testing on fuels stored in BFIs (reference STANAG 3149, Annex C. Tables C-3 and C-4 cover C and C+ tests; for B1 tests see Tables C-5 through C-9).

1203. **Deployability.** The fuel testing equipment shall be air transportable.

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SECTION 13 MODULE 5b - QUALITY ASSURANCE EQUIPMENT - FULL

1301. **General**. The module provides the ability to assess the quality of fuel in deployed areas to STANAG 3149 standards. It will be capable of conducting B1 testing and, ideally, B2 and A testing. This module will be capable of carrying out QA tests on the following fuel types:

1301.1 F-18 (Aviation gasoline);

1301.2 F-34/F-35, F-44 (Aviation turbine fuels);

1301.3 F-54 (Ground diesels);

1301.4 F-67 (Automotive Gasoline);

1301.5 F-76 (Marine diesels) used in deployed equipment.

1302. **Characteristics**. The Module shall contain all the necessary equipment to allow the conduct of A, B2 or B1 level testing on fuels stored in BFIs (reference STANAG 3149, Annex C, Tables C-5 through C-9).

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SECTION 14 MODULE 6a – PERMANENT INSTALLATION REPAIR EQUIPMENT

1401. **General**. Indigenous permanent facilities can offer an economic and potentially rapid means of providing fuel facilities. However, they may be damaged and in need of repair or require modification to meet quality or safety standards. Occasionally, it may also be desirable to modify them to enhance output or to integrate them with other forms of TFHE. Equipment should be incorporated that is able to adapt or repair a facility to a permanent or semi-permanent condition including earthing and electrical isolation.

1402. **Characteristics**

1402.1 Complete equipment should be readily transportable.

1402.2 Equipment components should be man portable without the use of Mechanical Handling Equipment (MHE).

1402.3 Equipment should be operable in all weather conditions.

1403. **Technical Details**. The Permanent Installation Repair Equipment should contain components to provide the following minimum capabilities:

- Pipe cutting and bevelling equipment up to 300mm/ 12".
- Welding equipment for mild steel, stainless steel and aluminium.
- Hot Tapping and Stoppling equipment (pipes up to 300mm/12", branches up to 150mm/6”).
- Small flexible storage fuel tank.
- Various slip on flanges up to 300mm/12".
- Various over-pipe repair sleeves up to 300mm/12".
- Various pipe adaptors up to 300mm/12".
- Items to allow repairs of electrical isolation, surge protection and earthing.

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SECTION 15 MODULE 6b – PIPELINE REPAIR & BYPASS EQUIPMENT

1501. **Permanent pipelines**. Indigenous permanent pipelines may offer an economic and potentially rapid means of moving fuel forward. An ability to repair or modify pipelines to integrate them with other forms of TFHE can add to the efficiency of fuel movement in theatre.

1502. **Characteristics**.

1502.1 Capable of being connected to permanent infrastructure pipelines that operate at high (up to 100 bar) and low pressures.

1502.2 Able to reduce pressures to levels suitable for TFHE (10 Bar).

1502.3 Should be capable of being used to bypass damaged sections of permanent infrastructure maintaining operational flow rates.

1502.4 Should be able to be constructed by manpower with the aid of MHE.

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SECTION 16 MODULE 7 – FIRE-FIGHTING AND EMERGENCY WATER SYSTEMS

1601. **General**. This module will enable suitably trained personnel to conduct basic fire-fighting on a deployed Main or Battlefield BFI.

1602. **Characteristics**. It is intended that this fire-fighting module is used to contain a fire in part of a BFI to prevent escalation of the incident to the rest of the fuel storage facility with the resultant loss of stock. This can be achieved by various methods such as wetting/cooling components and dampening down the vegetation and undergrowth between parts of the installation. However, if the fire needs to be suppressed a suitable foaming agent should be used.

1603. **Technical Details**. It is suggested that the following equipment be scheduled in the module as a minimum:

1603.1 Lightweight portable fire pump with minimum output 1,600 ltr per min at 7 bar.

1603.2 Emergency water storage (EWS) tank with a coupling for a fire pump hard suction hose. If a suitable natural water feature exists, then it may be used instead of a vessel provided for the purpose. The water capacity of the EWS should be designed to be compatible with the fire plan.

1603.3 Hoses, basket strainer and foaming agent.

1603.4 Large portable foam fire-extinguishers.

1604. **Deployability**. This module shall be shipped in a suitable container as a complete equipment module to provide a fully comprehensive fire-fighting capability in defence of the BFI.

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SECTION 17 MODULE 8 – POLLUTION CONTROL EQUIPMENT AND SORBENTS

1701. **General.** This module shall be capable of providing as a minimum sufficient Pollution Control Equipment and Sorbents (PCE and PCS) to support the immediate containment and clean-up of operational spills. The equipment must be capable of being easily transported and quickly deployed in response to oil and fuel spills. It will also encompass the equipment needed to recover fuel from a fuel tanker which has been involved in an accident and needs to be emptied to permit recovery.

1702. **Characteristics.** BFIs can vary in size and the location may pose different environmental risks. To assist in planning for the deployment of PCE/PCS, the standard Pollution Control Equipment Module is defined as the PCE/PCS required to absorb 1,000 litres of fuel/oil. Planners will need to assess the risk involved in operating a BFI to determine the amount of PCE and PCS to be provided.

1703. **Pollution Control Equipment**. Pollution control equipment can include surface skimmers to remove fuel from the surface of a body of water, or booms to contain spillage on still water. It will also include digging equipment to remove contaminated soil or temporary bunds for containment of fuel spilling from vehicles

1704. **Pollution Control Sorbents**. The PCS must be water repellent and suitable for use across the range of oils and fuels. These sorbents and their wrappings must also be treated to dissipate static in order to reduce the risk of ignition from static electricity when operating in hazardous areas

1704.1 Land or water booms designed to contain and absorb spilled fuel, for example on the surface of a body of water.

1704.2 Pillows having a large surface area to quickly ab/adsorb oil and fuel spills.

1704.3 Sorbent rolls, mats, pads or equivalent material.

1704.5 Suitable materials for the storage of waste products marked up as hazardous waste to retain the used PCS until safely disposed.

1705. **Deployability.** The PCS in support of TFHE should ideally be deployed in an anti-static weatherproof mobile container, suitable for manhandling, stacking and transportation by MHE. PCE and PCS should be easily transportable by vehicle or air.

AFLP-07(D)(1)