Defence Infrastructure Organisation

Practitioner Guide

Subject: High Flashpoint Class III Fuels – DSEAR (Dangerous Substances and Explosives Atmosphere Regulations)

Number: PG 2018 - 02

Document Aim:

This Practitioner Guide sets the Ministry of Defence (MOD) Standard for consistent compliance with the DSEAR (Dangerous Substances and Explosive Atmosphere Regulations) for high flashpoint Class III fuels on the MOD estate.

Document Synopsis:

This document provides procedural guidance on the process for risk assessment of specific high flashpoint Class III fuels used within and on the MOD estate. It is intended to assist the Competent Person (Assessor) set the Hazardous Area Classification for the DSEAR Assessment.

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		1.0	Mark Spooner	Initial
		2.0	Mark Spooner	Document Synopsis text change. Serial 1.2.1 text change. Serial 1.2.1 (2) text change. Serial 1.4.3 text change. Serial 3.1.2 AVCAT, Marine Dieso, DIESO MT & DIESO UK & general text change. Serial 5.1.1 text change. Serial 5.3.1 text change. Serial 5.5.5 text change. Serial 5.6.1 text change. Serial 5.6.2 text change. Appendix B serial 3 add text, Decision tree 2 add text, Decision tree 3 text removed. Appendix C Minor text changes to risk assessments and re-ordering. Serial 3.3.2 added.

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Equality and Diversity Impact Assessment

This policy has been Equality and Diversity Impact Assessed in accordance with the Department's Equality and Diversity Impact Assessment Tool against:
Part 1 Assessment Only (no diversity impact found).

FOREWORD

This Practitioner Guide here after known as the Guide is published by Defence Infrastructure Organisation (DIO) for application across all areas of the MOD. The Guide should be read in conjunction with JSP 375 Part 2 Volume 1 Chapter 9 – Dangerous Substances and Explosive Atmospheres. This Guide is mandated for all New contracts. For existing contracts, no work involving expenditure on any MOD account is to be entered into without prior authority from the appropriate MOD officer for that location or facility.

CONTENTS

1 Introduction

1.1 Background to the Document

1.1.1 Hazardous Area Classification (HAC) for explosive gas atmospheres is well established, with guidance published in various standards and industry codes of practice. Conversely guidance on high flashpoint fuels that could give rise to an explosive mist, is limited and is largely based on qualitative research. There is therefore a requirement to provide a consistent and methodical approach to HAC pertaining to flammable mists of high flashpoint Class III fuels on the MOD estate.

1.1.2 Prior to 1st June 2015 the Chemicals (Hazard Information and Packaging for Supply) (CHIP) Regulations provided criteria for the classification of substances based on their flash points. As of 1st June 2015, these regulations have been revoked. The definition of flammable liquids is now provided by the Classification, Labelling and Packaging Regulations (CLP) 2008 which apply different flash point temperatures than previously stated within the CHIP regulations (for reasons of international consistency).

1.1.3 A result of the changes, the upper flash point limit for 'Flammable' liquids have been increased from 55^{o}C to 60^{o}C. Therefore, under the CLP regulations diesel, gas oil and light heating oils are now classified as flammable liquids.

1.2 Aim of the Document

1.2.1 This Guide consolidates and presents the HAC requirements of the DSEAR regulations in relation to specific high flash point fuels in one document and presents a systematic approach to achieve compliance with the regulations. The aim of this Guide is to:

1. Ensure the MOD comply with the requirements of DSEAR (Dangerous Substances and Explosive Atmosphere Regulations).
2. Provide the Competent Person (Assessor) with a standardised approach to the classification of areas where explosive atmospheres may occur for high flash point class III fuel infrastructure.
3. To form the mandated basis for high flashpoint Class III DSEAR risk assessments across the MOD estate.
4. To provide and define a direct method approach for zoning and guidance for hazardous area classification drawings for Class III installation types.
5. Minimise the potential for explosive atmospheres through correct use and storage of high flash point fuels.
6. Provide designers and installers with guidance to engineer safe solutions, whilst ensuring compliance with the requirements of DSEAR.

1.3 Arrangement

1.3.1 Two methods are proposed within this guide to define infrastructure conditions where HAC can be limited by suitable control measures. With the application of either of the two methods then the requirement for HAC due to flammable mist formation of class III fuels can be limited to the ullage space inside the storage tank.

1.3.2 To achieve the aim, this guide is arranged in the following manner.

- Section 1 includes the introduction aim and scope,
- Section 2 includes the applicable statutory legislation, standards, and industry codes of practice relevant to Class III fuels,
- Section 3 defines the substances covered and not covered by this guide, including a list of standard definitions,
- Section 4 covers the types of infrastructure covered by this guide and the procedure for applying the direct example method to these types of infrastructure,
- Section 5 provides guidance on the requirements for record keeping, review periods, electrical and non-electrical apparatus requirements.
- Appendix A is the decision trees that will enable the user to determine the most appropriate risk assessment for the associated infrastructure,
- Appendix B is the risk assessments to be used alongside the HAC drawing and held within the explosion protection document.

1.4 Scope

1.4.1 This Guide is applicable to the following Class III infrastructure, plant, and equipment, including:

- Above and Below Ground Storage Tanks (workshop fabricated steel tanks, typically defined within BS EN 12285),
- Generator and Boiler Service Tanks,
- Mechanical Transport Fueling Installations (MTFI)
- Railway Locomotive Dispensing Installations,
- Marine Craft Dispensing Installations,
- Oil Water Interceptors (OWI).

Refer to section 4 for a definition of the above infrastructure.

1.4.2 This Practitioner Guide does not apply to the following:

- Waste product storage,
- Temporary storage infrastructure,
- Generator room dump tank,
- Storage of hydraulic fluids,
- Jerry can filling infrastructure,
- Heated tanks.

1.4.3 The following MOD infrastructure, plant and equipment is not suitable for the methods identified in this document and will be subject to the DSEAR risk assessment procedure as detailed within JSP 375 Part 2 Volume 1 Chapter 9 – Dangerous Substances and Explosive Atmospheres.

- Above and below ground bulk storage tanks of above 150,000 litres storage capacity (site welded steel tanks) – typically found on BFIs (Bulk Fuel Installations), PSDs (Petroleum Supply Depots) and OFDs (Oil Fuel Depots)
- Jetty offloading infrastructure (including pigging facilities and marine ship to shore loading arms),

- Class III pumping equipment and delivery networks where operators manage and control the operations but cannot observe all pipework and connection points (such as cross base and cross-country pipelines),
- Class III pumping equipment operating above 1 bar gauge pressure, where supervisory control is provided by instrumentation and control. Where operators are not present and cannot observe all pipework and connection points (such as fuel ring mains to service tanks controlled by level instrumentation).

2 Legislation & Standards

2.1 Legislation

2.1.1 The following sections provide a summary of the relevant legislation and codes to be adopted when undertaking DSEAR assessments at MOD infrastructure. A full list of referenced standards is provided within the Bibliography.

2.1.2 The primary UK legislation applying to the control of substances that can cause fires and explosions in the workplace is the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) (SI 2002 No.2776).

2.1.3 DSEAR 2002 requires employers to assess the possible risk of fires and explosions because of the use and storage of dangerous substances in the workplace. These risks must then be carefully managed by elimination or mitigation as far as is reasonably practicable. The aim is to protect employees and other people with potential for exposure to explosive risk, such as visitors to the workplace and members of the public. The Regulations complement the requirement to manage risks, as detailed in the Management of Health and Safety at Work Regulations 1999 (SI 1999 No 3242) document.

2.1.4 DSEAR 2002 puts into effect requirements from two European Directives: The Chemical Agents Directive (98/24/EC) and the Explosive Atmospheres Directive (99/92/EC). It also replaces a number of older regulations dealing with flammable substances safety.

2.2 European and UK Standards

2.2.1 British Standard BS EN 60079-10-1 is the UK implementation of EN 60079-10-1, which is identical in content to IEC 60079-10-1. It sets out the essential criteria against which the ignition hazards can be assessed and gives guidance on the design and control parameters which can be used in order to reduce such a hazard. It is concerned with the classification of areas where flammable gas, vapors or mist hazards may arise and may then be used as a basis to support the proper selection and installation of equipment in hazardous areas.

2.2.2 BS EN 60079-10-1 is intended to be applied where there may be an ignition hazard due to the presence of flammable gas or vapor, mixed with air under normal atmospheric conditions. (Atmospheric conditions include variations above and below reference levels of 101.3 kPa and 20°C).

2.3 HSE ACOP & Industry Standards

2.3.1 The Dangerous Substances and Explosive Atmosphere Regulations 2002 – Approved Code of Practice (ACOP) HSE L138 provides practical advice on how to comply with the (DSEAR) 2002. These Regulations require the elimination or reduction of risk of fire and explosion from substances connected with work activities.

2.3.2 The ACOP is primarily for an informed and experienced audience such as health, safety, and engineering professionals. It applies to workplaces that manufacture, store, process or use dangerous substances as defined in this publication.

2.3.3 The Energy Institute Model Code of Safe Practice Part 15: Area Classification for Installations Handling Flammable Fluids (EI 15) is recognised internationally as being de-facto guidance for determining hazardous zone areas in the petroleum industry. It is essential for HSE managers, design, process, and maintenance engineers, and all those involved in the HAC of installations handling flammable fluids.

2.3.4 EI 15 provides a demonstrable methodology for determining hazard radii and is applicable to all installations handling flammable fluids. It gives guidance on the classification of regions around equipment handling or storing flammable fluids and provides a basis for both the correct selection of fixed electrical equipment and the location of other fixed sources of ignition in those areas.

2.3.5 The Design, Construction, Modification, Maintenance and decommissioning of Filling Stations is published jointly by the Energy Institute and The Association for Petroleum and Explosives Administration. This publication provides information for those involved in the design, construction, modification, maintenance and decommissioning of facilities for the storage and dispensing of vehicle fuels, either retail or commercial premises.

2.4 MOD Standards

2.4.1 MOD Health and Safety Handbook JSP 375 Part 2 Volume 1 Chapter 9 – Dangerous Substances and Explosive Atmosphere leaflet supplements the guidance found within JSP 375 Part 2 Chapter 8 (Risk Assessment), and gives guidance for all MOD staff, both service and civilian. It lays out in broad terms what is required by a DSEAR risk assessment process.

2.4.2 JSP 317 is a document produced and maintained by the Defence Strategic Fuels Authority (DSFA). It lays down MoD standards of practice for the storage and handling of fuels and lubricants. The guidance contained within JSP 317 is derived from national legislation, international, NATO and national standards, professional codes of practice and guidance notes.

2.4.3 JSP317, Part 2, Chapter 3 deals with the classification of hazardous areas around equipment handling or storing flammable fluids where there is a risk of ignition due to the presence of flammable gas or vapors mixed with air under normal atmospheric conditions

3 Applicable Products

3.1 Products Covered by This Guide

3.1.1 Class III fuels. The system of classification of petroleum liquids including crude oils and its products based upon their flash points. Class III is defined as having a flash point above 55°C and up to and including 100°C.

3.1.2 The following high flash point fuels are included within the scope of the Guide.

• AVCAT - FSII	F-44	Minimum Flash Point 61°C – Tested to BS EN ISO 2719 (see Note[1])
• DIESO MT	F-54 (BS EN 590)	Minimum Flash Point >55 °C – Tested to BS EN ISO 2719
• DIESO UK	BS EN 2869 Class A2	Minimum Flash Point 56 °C
• Marine Dieso	F-76	Minimum Flash Point 61 °C (See Note[1])
• Gas Oil	BS EN 2869 Class D	Minimum Flash Point 56 °C – Tested to BS EN ISO 2719

Note[1]: AVCAT and Marine Dieso have a flashpoint above 60°C and are not classed as a flammable liquid as defined in 1.1.3, however, these products have been included within this document to assist the Operating Authority identify suitable hazardous areas should they deem them necessary when undertaking risk assessments of their installations/systems.

3.2 Substances not Covered by This Guide

3.2.1 Class 0, Class I and Class II as defined by table A1 within EI 15.

3.2.2 Specifically, the following flammable liquids typically handled and used within the MOD estate are not covered by this Guide –

- Hydraulic fluid(s),
- Waste oils,
- AL 11,
- AL 39,
- Kerosene based Fuels (AVTUR F-34, Jet A1 F-35, etc.),
- Proprietary replacement(s) for heating oil with a flash point of 55°C or lower,
- Petrol (F-67),
- AVGAS 100LL (F-18),
- Liquid Petroleum Gas (LPG).

3.3 Roles and Responsibilities

3.3.1 JSP 375 Part 2 Volume 1 Chapter 9 provides guidance on the definitions and requirements placed upon personnel. For the detailed roles and responsibilities required under the DSEAR regulations refer to the relevant section of JSP 375 Part 2 Volume 1 Chapter 9.

3.3.2 An Operator is a person duly authorised to undertake the operation specified in this document, in the case of an MTFI it is anybody duly authorised to draw fuel who is not a member of the public.

4 Typical Infrastructure

4.1 General

4.1.1 The following procedure sets out a methodical approach to verify compliance with the DSEAR regulations for high flash point Class III fuels. The approach is designed to create a consistent approach to risk assessment and HAC, and where applicable creation of a HAC drawing, of high flash point Class III fuel storage infrastructure.

4.1.2 All works associated with the application of the DSEAR shall be undertaken by a Competent Person as defined within JSP 375 Part 2 Volume 1 Chapter 9.

4.1.3 This Guide and the procedural guidance prescribed within is aimed specifically at the infrastructure relating to the containment of high flash point Class III fuels. The following section outlines the common types of infrastructure located at MOD sites both within the UK and overseas, which fall within the confines of this Guide.

4.1.4 All infrastructure that include a facility for storage of high flashpoint Class III fuels, including the varying types of above, below ground, intermediate, ancillary, and bulk storage tanks, are subject to the statutory obligations of the DSEAR regulations as listed within this Practitioner Guide.

4.1.5 Where manufacturers supplying proprietary equipment such as dispensers or packaged tanks also supply the product specific hazardous zoning information and drawings for that equipment, then that guidance should be used as part of the DSEAR assessment. This document should not be used to override or replace the manufacturer's hazardous zoning.

4.2 Above-ground Steel Tank (Horizontal Cylindrical, Rectangular, Integrally Bunded)

4.2.1 Above ground steel tanks are those that are wholly above ground and can be located either externally or within a building. Above ground tanks can be installed as either rectangular or cylindrical types.

4.2.2 Above ground single skinned steel tanks are generally found within a bunded area, consisting of an impermeable hard standing with walls to create an effective secondary containment area.

4.2.3 Typically, above ground steel tanks are built to BS 799 part 5 (single skinned tank), OFST 200 (double skinned tanks) and/or BS EN 12285 part 2 (workshop fabricated above ground single and double skin tanks). Where the design code or standard is not known then this PG still applies.

4.3 Plastic Integrally Bunded Tanks

4.3.1 Above ground plastic tanks including an integral bund (double skinned) construction that provides a form of secondary containment. Typically, these are thermoplastic tanks built to BS EN 13341 or OFST 100. Where the design code or standard is not known then this PG still applies.

Above-ground Steel Single Skin Tanks

Integrally Bunded Steel Above-ground Tanks

Integrally Bunded Plastic Above-ground Tanks

4.4 Underground Steel Tank

4.4.1 Tanks may be completely buried (below ground) or mounded, an installation whereby the tank is partially buried with the remaining above ground portion covered by earth. Below ground or mounded tanks are generally used for bulk storage of fuels, or to provide a safe below ground storage facility for the draining of day tanks during an emergency. Typically, the below ground tanks are laid in a horizontal fashion with access gained through an entrance manway, mounded tanks are often vertical installations.

4.5 Service Tank

4.5.1 A service tank is an auxiliary tank with a capacity not exceeding 1,000 litres, which isolates the main storage tank from the burner or generator.

4.5.2 Service tanks, built in accordance with BS 5410 part 2 and BS 799 part 5, can be cylindrical or rectangular in design.

Typical Service Tanks

4.6 Mechanical Transport Fueling Installations (MTFI)

4.6.1 Mechanical transport refueling infrastructure typically consist of fuel dispensing apparatus and an above or below ground bulk fuel storage tank. In some instances, the facility may be a packaged unit of an above ground tank furnished with integral dispensing point. The dispense point will often have an associated wet stock management system located in proximity, including electrical supply and fixtures.

4.6.2 Where a MTFI has mixed classes of fuel, typically Class I (Petrol) and Class III (Diesel), this guide only provides instruction on the Class III part of the MTFI. Any HAC drawings from the Class I infrastructure should be combined with the guidance contained within this guide, to produce a hybrid HAC drawing and risk assessment for the MTFI.

Typical MTFIs (Mechanical Transport Refueling Installations)

4.7 Railway Refueling Installations

4.7.1 Like the MTFI facility the arrangement will include a bulk storage tank and dispense point. The installation will generally be located by the railway line to allow a short as possible connection to the engine carriage. The dispense pump will be sized to provide a suitable flowrate of fuel for refueling activities in addition to any wet stock management system. Due to the infrastructure of the railway platform is likely that any bulk storage tank will be an above ground type.

Typical Railway Refueling Installation

4.8 Marine Refueling Installations

4.8.1 Located next to the water's edge or on a floating pontoon the refueling arrangement consists of a bulk storage tank, fuel dispense and a wet stock management system.

Typical Marine Refueling Installation

4.9 Oil Water Interceptors (OWI)

4.9.1 Underground storage tank used on surface water drainage systems to protect the environment from pollution by oils. They separate the oil from the water through gravity and they retain the oil safely until it is removed. They are generally installed to contain oil leaks from vehicles, plant, and accidental spillages.

4.9.2 On the MOD estate OWIs are generally located nearby refueling hard standing used for the parking of refueling Class III tankers, general car parking and MTFI refueling. Surface water runoff is directed thought the interceptor prior to discharge to the surface water drain.

5 Application of this Guide

5.1 Competence of Assessor

5.1.1 To apply this guide to DSEAR risk assessments, the Assessor appointed to undertake the assessments must be a Competent Person as defined by JSP 375 Part 2 Volume 1 Chapter 9.

5.2 Direct Example Approach

5.2.1 It is accepted that certain infrastructure of a standard layout and design, handling flammable substances, can be classified directly from typical examples. This is what is known as the 'Direct Example Approach'. The purpose being to ensure that the risks from class III fuels are either eliminated, or control and mitigation measures are employed to reduce the risk as far as is reasonably practicable. Where the risks cannot be eliminated then a standardised approach will ensure consistency in the classification of hazardous areas and the correct selection, installation and maintenance of electrical equipment, mechanical equipment, and other sources of ignition.

5.2.2 Installation types within the scope of this Guide shall be of a comparable construction therefore the direct example approach can be adopted in lieu of completing a full risk assessment, hazardous area drawings and where applicable calculations.

5.2.3 Established industry codes and standards provide guidance on the use of the direct example approach along with typical installations. This approach is primarily based on good professional engineering judgement. It must be recognised that the direct example approach can only be used in limited cases for infrastructure that is broadly similar in nature.

5.2.4 The Energy Institute document 'Design, construction, modification, maintenance and decommissioning of filling stations' 4th Edition (The Blue Book) contains the following statement that impacts the DSEAR assessment of Class III products. 'It should be noted that there may be a small release of vapor or mist when dispensing diesel. Any associated hazardous area is unlikely to extend for more than 100mm from the vehicle filler when refueling cars. Due to the creation of mists, larger hazardous areas may be associated with the refueling of larger vehicles at higher flow rates. It then provides direct example zone drawings based upon this statement.

5.2.5 Whilst there is no explanation other than the limited statement above for the presence of a flammable vapor or mist; when refueling vehicles with a trigger type diesel dispensing nozzle the intent of this statement and the example hazardous zones should be applied on the basis that the 'higher flow rate' referred to exceeds 40lpm.

5.2.6 Where infrastructure, installations or processes differ from those defined within the decision trees (within Appendix A) then a DSEAR risk assessment procedure as detailed within JSP 375 Part 2 Volume 1 Chapter 9 is mandated.

5.3 Method 1 – Operator Attendance

5.3.1 Where installations are small scale up to 150,000 Ltrs with operatives present and in control of the refueling or dispense processes. The main control measure is that the operator(s) can immediately stop the refueling or dispense process in the event of a product release.

5.3.2 Procedurally where operatives are present, and a leak occurs then the process should be stopped and the infrastructure in question should be taken out of service immediately.

5.3.3 For this control measure to be appropriate the following must be in place –

- Operator(s) are present for whole duration and in control of filling/dispense operation,
- The transfer process if pumped, can be stopped immediately and depressurised through emergency stop buttons and/or a trigger release nozzle by the operator(s),
- Operator(s) can monitor all pipe joints the full length of the pipework, or the joints are contained such that any leak shall not generate a mist (e.g., buried pipework, or use of flange guards).

5.3.4 If the above conditions are complied with then the duration and quantity of the release can be regarded as too insignificant to be considered for hazardous area classification.

5.4 Method 2 – Pressure Limitation

5.4.1 The propensity for a mist release is a function of several variables, with the operating pressure being one. Several published papers and industry codes of practice accept that at elevated pressures mists are easier to atomise through a hole or orifice. These papers and codes conclude that pressures as low as a few bars may produce a flammable mist. On this basis a limit of 1 bar gauge pressure limit is a chosen within this document as the upper limit within which a flammable mist will not occur for class III products.

5.4.2 Not every Class III product release will form a flammable/explosive mist. Releases from flanges, packing gland seals, connection points etc. will in most cases result in the formation of liquid pools, rather than mists. In these cases, a flammable atmosphere would not form directly from the release unless it impacted upon a hot surface.

5.4.3 For this control measure to be appropriate the following must be in place –

- Where gravity is responsible for the pressure head generated in the pipework, the pressure inside the infrastructure piping must be below 1 bar (gauge).
- Where operated at a pressure at 1 bar (gauge) or below then the possibility of a flammable mist formation is as low as reasonably practicable. Releases resulting from leaking flanges or valve glands below this pressure, will in most cases result in the formation of liquid pools.

5.5 Hazardous Area Classification

5.5.1 The application of method 1 or method 2 as detailed within section 5.3 & 5.4 negates the requirement for hazardous area zoning above ground, around piping, fill and drain connections.

5.5.2 Where engineering methods such as the tank fill pipe discharge is at the bottom of the tank and on the initial fill the flow rate is reduced to allow the pipe to be submerged. This will limit the possibility of fuel splashing and creating a potentially flammable mist inside the tank. Where this is the case and construction drawings are available to corroborate the tank construction then HAC of the tank and tank internals is not required.

5.5.3 Where splashing and sloshing of product occurs inside Class III product storage tanks there a risk of generating a potentially flammable mist. This risk is only present during the initial tank filling where the inlet pipe is above the liquid surface. Industry accepted practice is to classify these areas as zone 0.

5.5.4 As identified above at 5.2.4 & 5.2.5 for refueling vehicles above 40lpm with a trigger type diesel dispensing nozzle 'The Blue Book' direct example hazardous zones should be applied.

5.5.5 Where OWI's are installed at Class III infrastructure there is the risk of organic matter (such as grass cuttings, leaves etc.) being directed within. To take account of the potential degradation of organic matter and the subsequent generation of methane and hydrogen sulphide then the internals of the OWI must be risk assessed for hazardous zones as part of the DSEAR assessment.

5.6 Use of Decision Trees and Selection of Pro-Forma Risk Assessment

5.6.1 The Competent Person undertaking the DSEAR Risk Assessment for the respective facility shall start with decision tree 1 to determine the appropriate direct example risk assessment(s) to be selected and used.

5.6.2 Once the applicable direct example risk assessment(s) have been selected the Competent Person undertaking the DSEAR Risk Assessment is required to complete a HAC drawing. The generated HAC drawing must reflect the actual installation and its surroundings. For guidance on the layout, style, and mandatory contents of the drawing, refer to the DSEAR drawing specification located within JSP 375 Part 2 Volume 1 Chapter 9.

5.6.3 Where method 1 or 2 are applied then the HAC is limited to the ullage space inside the storage tank.

5.7 Application of the Guide within the UK

5.7.1 The guidelines given in this Guide are applicable to the full range of high flash point fuel storage infrastructure found on MOD Establishments and those occupied by the United States Visiting Forces (USVF). Both in terms of quality and safety the standard of work undertaken on United States Visiting Forces (USVF) sites must not be inferior to those executed on the UK MOD sites.

5.8 Overseas Estates

5.8.1 The Secretary of State has stated[1] that; “Within the United Kingdom (UK) we comply with all applicable HS&EP legislation” and that “Overseas we apply our UK arrangements where reasonably practicable and, in addition, respond to host nation’s relevant HS&EP expectations.”

5.8.2 The estates occupied by BF(G) apply their own local (German) regulations. The competency of the contractor is established prior to contract let and local procedures apply to the selection and appointment of the Competent Person. For this reason, while the general principles mentioned in this PG may be applicable, the document will be of limited use to BF(G) staff.

1 Health, Safety and Environmental Protection in Defence, A Policy Statement by the Secretary of State for Defence, June 2013.

6 Requirements

6.1 Electrical Apparatus

6.1.1 Electrical apparatus shall be suitably ATEX rated for the hazardous zone in which it is installed in accordance with BS EN 60079 Part 14.

6.2 Mechanical Apparatus

6.2.1 Mechanical apparatus shall be suitably ATEX rated for the hazardous zone in which it is installed in accordance with BS EN 80079-36.

6.3 Existing Apparatus

An existing installation is compliant for the purposes of this document when containing equipment or a protective system placed on the market on or before 30th June 2003 which complies with any health and safety provisions with which it would have been required to comply for it to be lawfully placed on the market in Great Britain on 23rd March 1994.

6.4 Installation Review Frequency

6.4.1 Before any installation or facility is modified or substance(s) stored change materially then the existing DSEAR risk assessment shall be reviewed. In some instances, the direct method approach detailed within this Guide may no longer apply and a full DSEAR risk assessment procedure as detailed within JSP 375 Part 2 Volume 1 Chapter 9 shall be carried out, irrespective of the date of any previous risk assessments.

6.4.2 Prior to operation of new Class III fuel storage infrastructure a DSEAR Risk Assessment shall be in place based on the approach provided within this guide.

6.4.3 All MOD 5014 forms shall be reviewed on an annual basis as stipulated on the form. The annual review shall determine any changes to the installation or infrastructure use and whether any previous non-conformities have been corrected.

6.5 Explosion Protection Document, Records and Corrective Action

6.5.1 The EPD shall be compiled with due cognisance of this Guide and include all items as defined within JSP 375 Part 2 Volume 1 Chapter 9.

6.5.2 Where operational deficiencies are identified through the process of applying this Guide, these shall be reported in writing to the Head of Establishment as soon as practicable. A copy of any reports shall be stored within the EPD.

6.5.3 Where non-conformities are identified as part of the application of this Guide, these should be recorded and suitable remedial action or control measures should be instigated based on the recommendations within the risk assessment.

7 Technical Authority

7.1 General

7.1.1 MOD Technical Authority is vested in Head Engineering (DIO SEE-Eng DH) DIO Safety, Environment and Engineering (SEE). Technical advice and assistance on DSEAR matters can be obtained from DIO. Approaches may be made through local DIO offices or directly to:

Principal Mechanical Engineer
Head of Mechanical and Fuels Infrastructure
Technical Services
Defence Infrastructure Organisation
RAF Mildenhall,
Building 680,
Bury St Edmunds,
Suffolk,
IP28 8NF
Tel: 01638 54 5835
MOD telephone: 9205 314 238 5835

7.1.2 This Practitioner Guide has been devised for the use of the Crown and its contractors in the execution of contracts for the Crown and, subject to the Unfair Contracts Terms Act 1977, the Crown will not be liable in any way whatever (including but without limited negligence on the part of the Crown its servants or agents) where the specification is used for other purposes.

Appendix A Bibliography

Reference	Title
British Standards	
BS EN 60079 Part 0	Explosive Atmospheres – General Requirements
BS EN 60079 Part 10-1	Explosive Atmospheres – Classification of Areas Explosive Gas Atmospheres
BS EN 60079 Part 14	Explosive Atmospheres – Electrical Installations Design, Selection and Erection.
BS EN 60079 Part 17	Electrical Apparatus for Explosive Gas Atmospheres – Inspection and Maintenance of Electrical Installations in Hazardous Areas
BS EN 60079 Part 20-1	Electrical Apparatus for Explosive Gas Atmospheres – Data for Flammable Gases and Vapors, Relating to the use of Electrical Apparatus
BS EN 1127-1	Explosive Atmospheres – Explosion Prevention and Protection – Basic Concepts and Methodology
Industry Standards / Codes of Practice	
Energy Institute	Model Code of Safe Practice Part 15: Area Classification Code for Installations Handling Flammable Fluids
HSE L138	Dangerous Substances and Explosive Atmosphere Regulations Accepted Code of Practice
HSE INDG 370	Controlling Fire and Explosion Risks in the Workplace
HSE HSG 51	The storage of Flammable Liquids in Containers
HSE HSG 176	The storage of Flammable Liquids in Tanks
HSE RR980	Research Report 980 - Generation of flammable mists from high flashpoint fluids: Literature review
Hazards 26 – Paper 38	Area classification of flammable mists: summary of joint-industry project findings
Defence Infrastructure Organisation Standards	
JSP 317	Joint Service Safety Regulations for the Storage and Handling of Fuels and Lubricants.
JSP 319	Joint Service Safety Regulations for the Storage and Handling of Gases.
JSP 375	MOD Health and Safety Handbook – Part 2 Chapter 9 Dangerous Substances and Explosive Atmospheres.
Policy Instruction 07/11	Compliance with Dangerous Substances & Explosive Atmosphere Regulations.
DSA 02 DLSR	Fuel and Gas Safety and Environmental Regulations (Previously JSP 309)
DSA 03 DLSR	Fuel and Gas Safety and Environmental Regulations Defence Codes of Practice (DCOP) (Previously JSP 309)

Appendix B Decision Trees

Decision Trees Explanation

For simplicity and to separate the different functions associated with storage tanks, the processes involved have been split into three distinct sections.

1. Tank Filling (The process of filling by a road tanker through the tank fill pipe),

   Tank filling can be undertaken by several methods, those covered by this guide are by gravity from a refueling tanker (typically to underground tanks) or pumped by a refueling tanker or fixed pumping set (typically to above-ground tanks). This process is always attended by an operator (tanker driver) to supervise the procedure and take relevant emergency action should an abnormal condition occur.

2. Tank Storage (The tank storage process bound by the tank shell),

   Tank storage is a relatively benign function where there are very little risks posed by Class III installations. Decision tree 1 screens these risks out that require a DSEAR risk assessment by other methods not covered by the direct example approach as defined within this guide.

3. Tank Dispense (The process of withdrawal of product from the tank through the tank outlet pipe).

   Like tank filling, tank dispense, or product withdrawal covered by this guide are by gravity (typically a feed to a boiler or generator day tank) or pumped to point of use.

The decision trees have been structured to guide the user through the process where they select (dependent on answers given) multiple risk assessments from appendix C. These risk assessments, when combined shall form the basis of the risk assessment for the entire storage tank facility. Inclusive of; tank filling, tank storage and tank dispense.

Each risk assessment is formed of five parts -

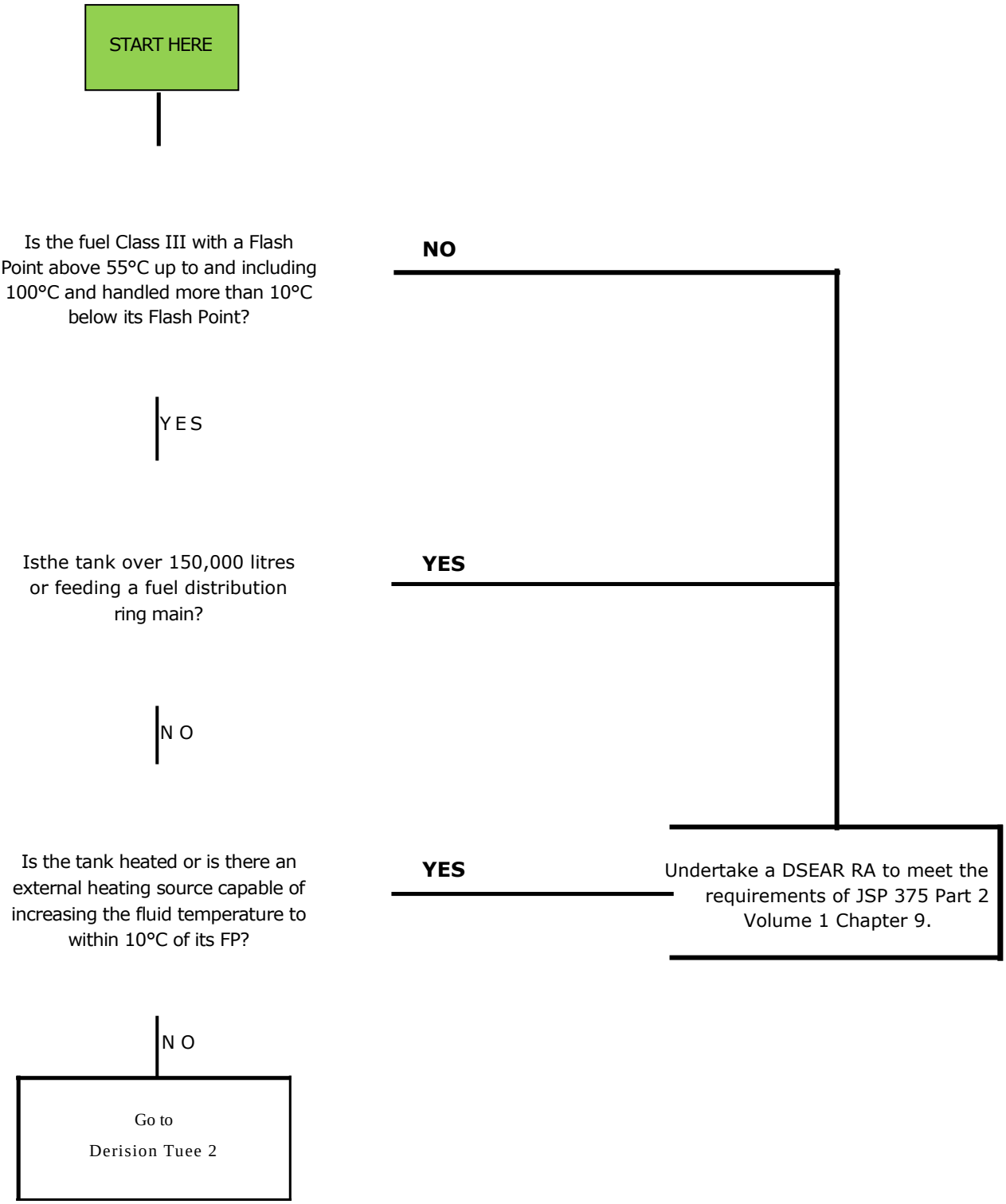
- Part 1 – Hazardous Area Classification Data Sheet – Flammable Material and Characteristics,
- Part 2 – Hazardous Area Classification Data Sheet – List of Sources of Release,
- Part 3 – Ignition Sources,
- Part 4 – DSEAR Risk Assessment,
- Part 5 – Risk Matrix Definition Table.

Part 1, 3 & 5 are common to each assessment but there are separate assessments covering Parts 2 & 4 for the eight systems covered by this document. These are ‘Gravity Filling’, ‘Pump Filling’, ‘Above Ground Tank Storage’, ‘Underground Tank Storage’, ‘Tank Gravity Discharge’, ‘Tank Pressurised Discharge Operator Attendance’, ‘Tank Pressurised Discharge Under 1 Bar’ & ‘MTFI, Railway and Marine Tank Storage & Dispensing’

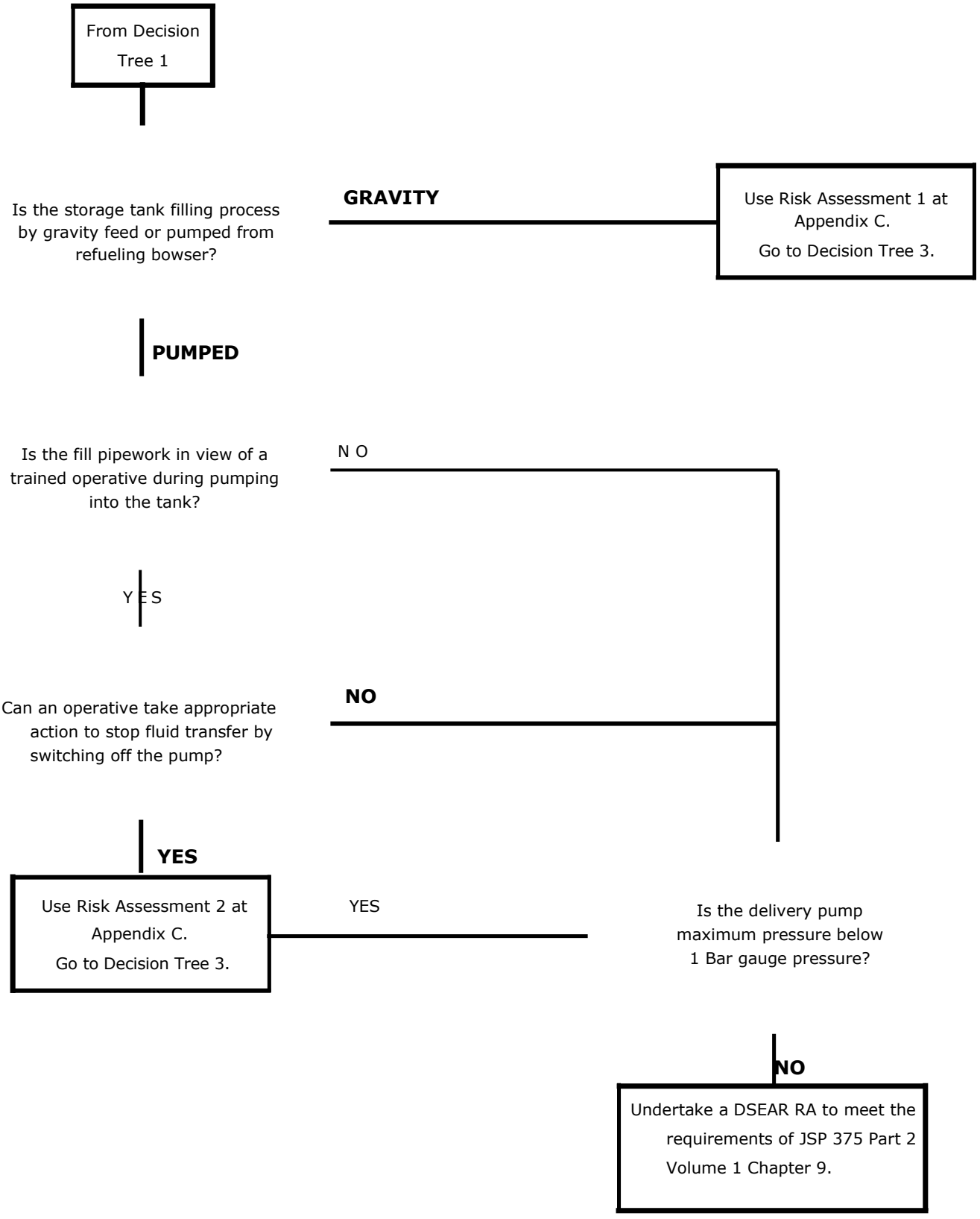
The HAC drawing for the facility can then be prepared in accordance with the DSEAR drawing specification located within JSP 375 Part 2 Volume 1 Chapter 9. To account for the risk of mist or spray formations inside the tank all tank internals shall be regarded as zone 0.

The HAC drawing along with the selected risk assessments shall form the direct example DSEAR risk assessment for the Class III installation.

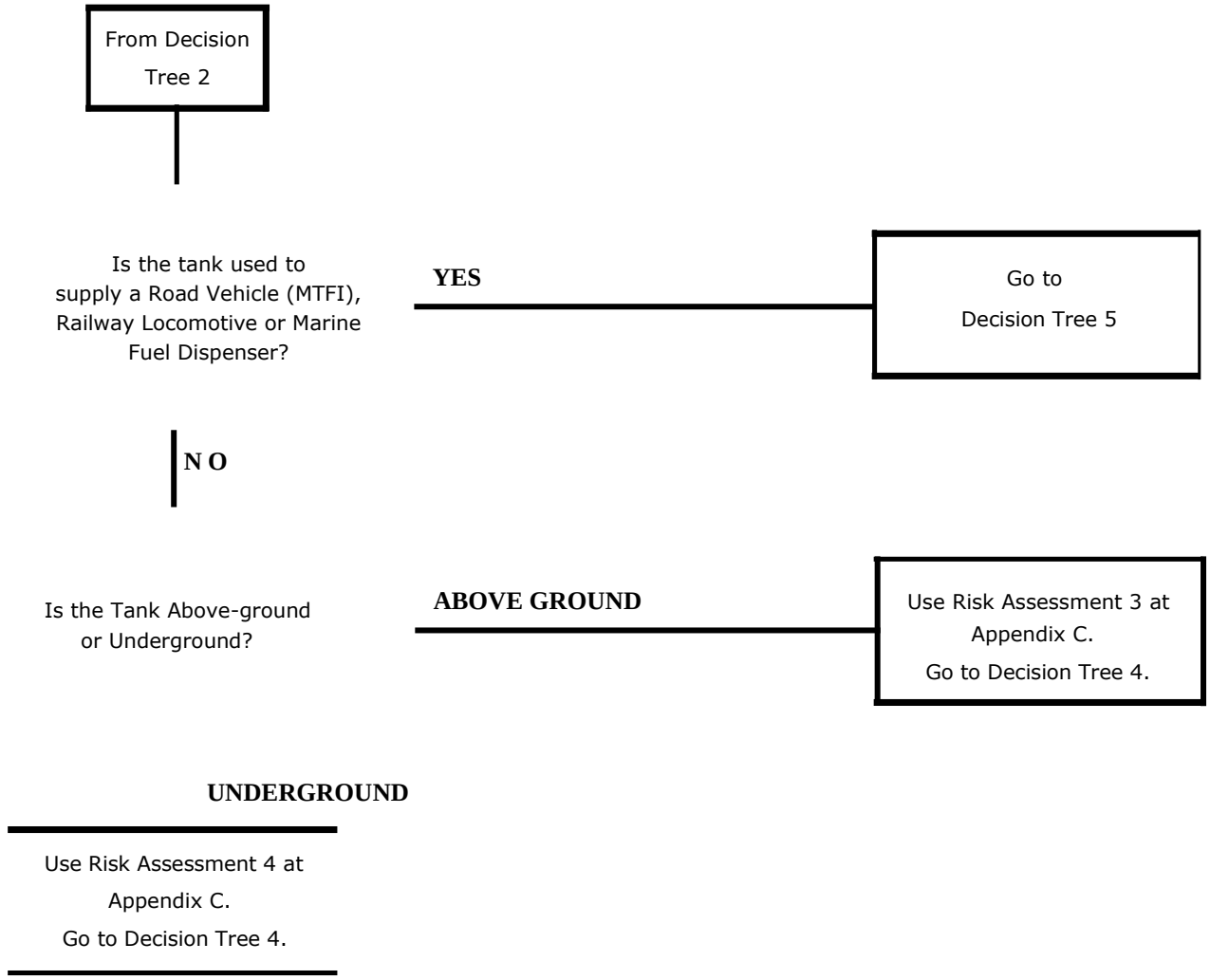
DECISION TREE 1



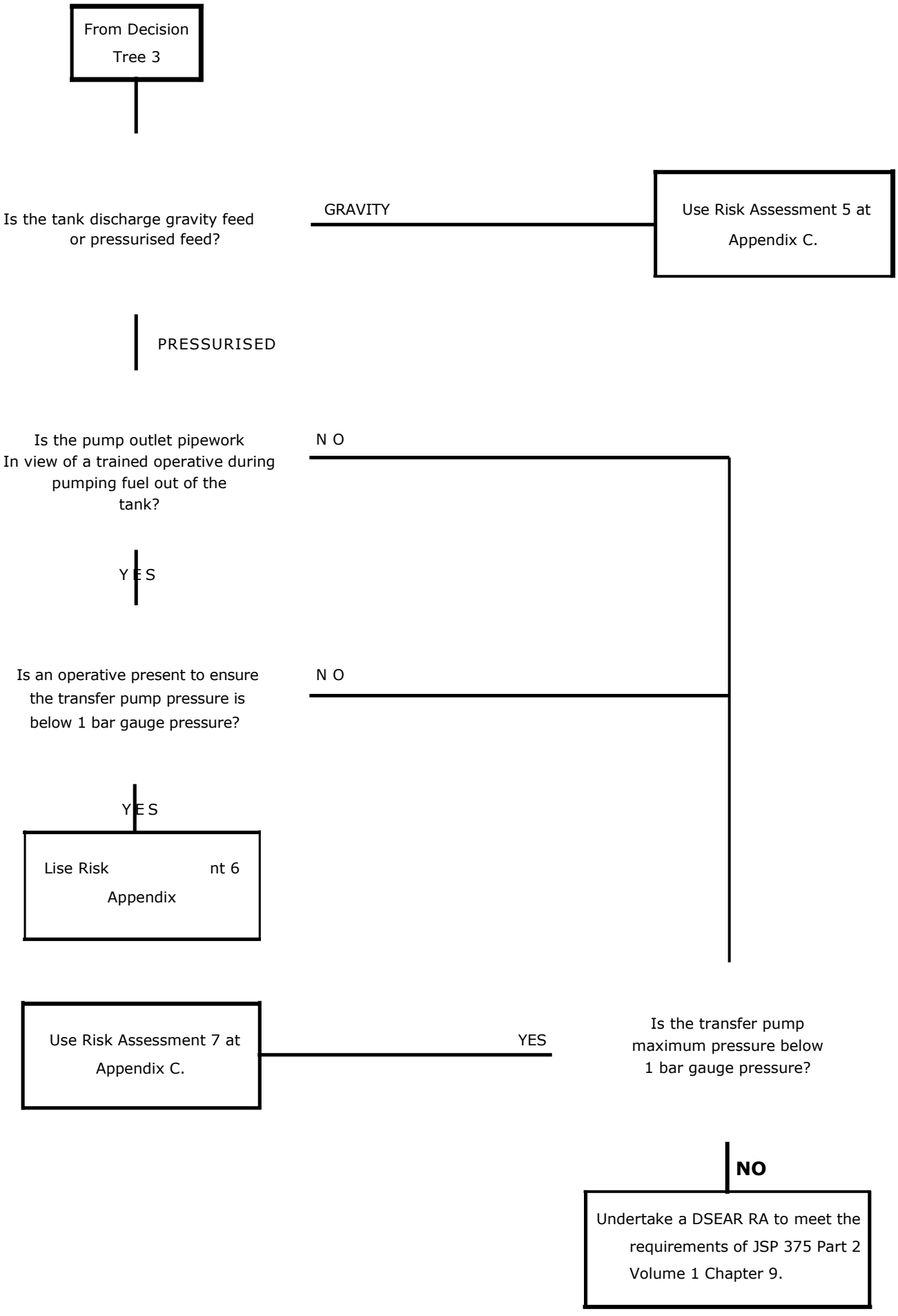
DECISION TREE 2 – TANK FILLING PROCESS



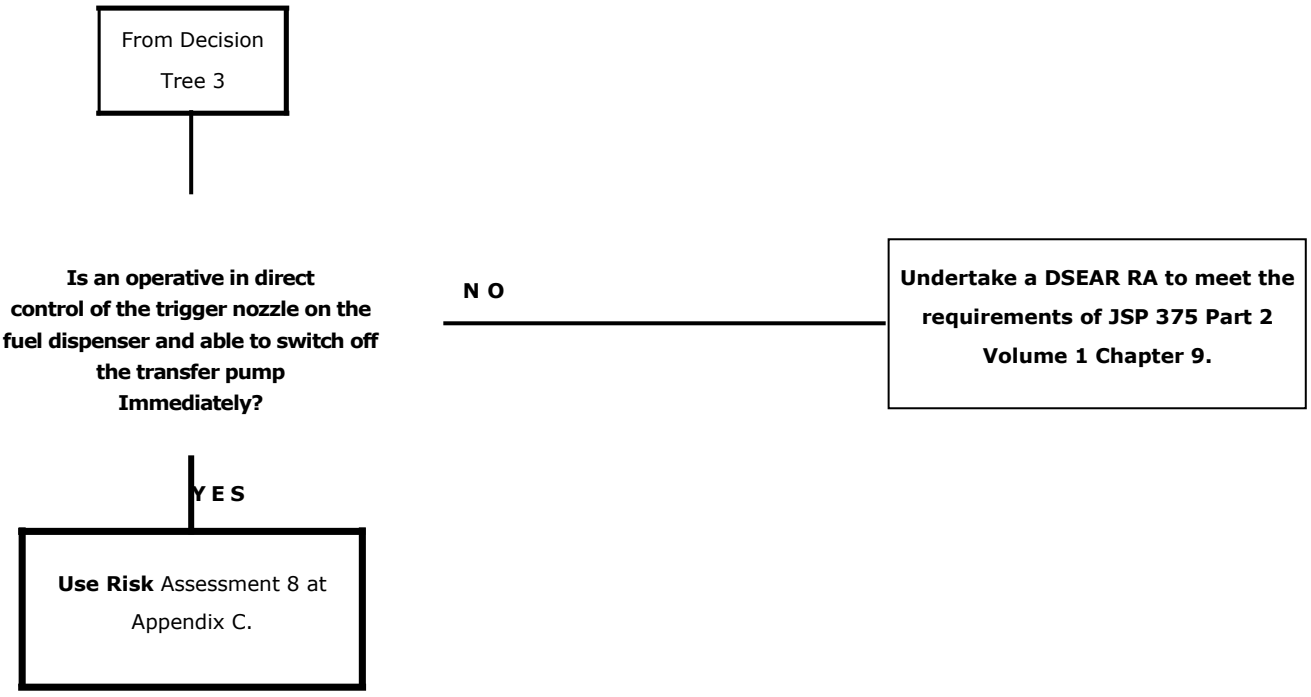
DECISION TREE 3 – TANK STORAGE



DECISION TREE 4 – STORAGE TANK DISCHARGE



DECISION TREE 5 – MTFI, RAILWAY and MARINE TANK STORAGE & DISPENSING



Appendix C Pro-Forma Risk Assessments

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DSEAR RISK ASSESSMENT – Part 1

**This Sheet to be Duplicated and Completed for all Risk Assessments*

Location:		
Date of Assessment:		
Prepared by:		Reviewed by:
Assessment Reference:		
Asset/Building Number:		
Description:	Fill Point for ---- Tank, Capacity -,--- litres	

Part 1:	**Hazardous Area Classification Data Sheet – Flammable Material List and Characteristics**										
Building/Asset Number							**Drawing reference –**				
Flammable Substance					Volatility		Lower Flam. Limit		Ex characteristics		Other relevant information and remarks
Name	Composition	Relative density gas/air	Flash Point °C	Ignition temp °C	Boiling Point °C	Vapor Pressure 20°C kPa	vol %	(g/m3)	Equipment Group	Temp Class	
DIESO UK*	100%	Heavier	>56	254	>150	-	0.6	-	IIA	T3	
AVCAT – FSII F-44*	100%	Heavier	>61	210	>150	<0.9	0.7		IIA	T3	
DIESO MT F-54*	100%	Heavier	>56	254	>150	-	0.6	-	IIA	T3	
Marine Diesel F-76*	100%	Heavier	>61	240	>180	<0.1	0.6		IIA	T3	
Gas Oil*	100%	Heavier	>56	254	>150	-	0.6	-	IIA	T3	

*Delete rows as appropriate to contents of storage tank.

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DSEAR RISK ASSESSMENT – Part 3

**This Sheet to be Duplicated and Completed for all Risk Assessments*

Part 3:	**Ignition Sources from BS EN 1127-1 (Delete as appropriate)**
Ignition Source	**Examples**
** These sources are not considered to be a credible source of ignition in the locations considered in and around the MOD estate.*	
Hot surfaces	Mobile plant exhaust temperature may reach ignition temperature. Smoking/Naked Flames.
Flames and hot gases	Hot work, welding and cutting work.
Mechanically generated sparks	As a result of friction, impact, or abrasion processes such as grinding, particles can become separated from solid materials and become hot owing to the energy used in the separation process.
Electrical apparatus	Opening/closing switches, loose connections, maintenance, and testing.
Stray electric currents	If parts of a system able to carry stray currents are disconnected, connected, or bridged even in the case of slight potential differences an explosive atmosphere can be ignited as a result of electric sparks and/or arcs. Moreover, ignition can also occur due to the heating up of these current paths.
Static electricity	The discharge of charged, insulated conductive parts can easily lead to incendive sparks.
Lightning	If lightning strikes in an explosive atmosphere, ignition will always occur. There is also a possibility of ignition due to the high temperature reached by lightning conductors. Large currents flow from the lightning strikes and these currents can produce sparks in the vicinity of the point of impact.
* RF electromagnetic waves from 10^4 Hz to 3 x 10^{11} Hz	Electromagnetic waves are emitted by all systems that and use radio frequency electrical energy (radio frequency systems), e.g., radio transmitters or industrial or medical RF generate generators for heating, drying, hardening, welding, cutting.
Electromagnetic waves from 3 x 10^{11} Hz to 3. x 10^{15} Hz	Radiation in this spectral range can – especially when focused – become a source of ignition through absorption by explosive atmospheres or solid surfaces. Sunlight, for example, can trigger an ignition if objects cause convergence of the radiation.
* Ionizing radiation	Ionizing radiationfor example, by X ray tubes and radioactive substances can ignite explosive atmospheres (especially explosive generated; atmospheres with dust as a result of energy absorption. Moreover, the radioactive source itself can heat up owing to internal absorption particles) of radiation energy to such an extent that the minimum ignition temperature of the surrounding explosive atmosphere is exceeded.
* Ultrasonics	In the use of ultrasonic sound waves, a large of the energy emitted by the electroacoustic transducer is absorbed by solid or liquid proportion substances. As a result, the substance exposed to ultrasonics warms up so that, in extreme cases, ignition may be induced.
* Adiabatic compression and shock waves	In the case of adiabatic or nearly adiabatic compression and in shock waves, such high temperatures can occur that explosive atmospheres (and deposited dust) can be ignited. The temperature increase depends mainly on the ratio, not on the pressure difference. pressure
* Exothermic reactions, including self-ignition of dusts	These can act as an ignition source when the rate of heat exceeds the rate of heat loss to the surroundings. Many chemical reactions generation are exothermic. These high temperatures can lead to ignition of explosive atmospheres and also the initiation of smoldering and/or burning.

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DSEAR RISK ASSESSMENT – Part 5

**This Sheet to be Duplicated and Completed for all Risk Assessments*

Risk Matrix Definition Table

RISK RATING (R) Likelihood (L) x Severity (S)		HAZARD SEVERITY (S)				
		Negligible 1 Negligible injury, no absence from work	**Slight 2** Minor injury requiring first aid treatment	**Moderate 3** Injury leading to a lost time accident	**High 4** Involving a single death or serious injury	**Very High 5** Multiple Deaths
LIKELIHOOD OF OCCURRENCE (L)	**Very Unlikely 1** A freak combination of factors would be required for an incident/accident to result	**LOW 1**	**LOW 2**	**LOW 3**	**LOW 4**	**LOW 5**
	Unlikely 2 A rare combination of factors would be required for an accident/incident to result	**LOW 2**	**LOW 4**	**LOW 6**	**MEDIUM 8**	**MEDIUM 10**
	Possible 3 Could happen when additional factors are present but otherwise unlikely to occur	**LOW 3**	**LOW 6**	**MEDIUM 9**	**MEDIUM 12**	**HIGH 15**
	Likely 4 Not certain to happen but an additional factor may result in an accident/incident	**LOW 4**	**MEDIUM 8**	**MEDIUM 12**	**HIGH 16**	**HIGH 20**
	Very Likely 5 Almost inevitable that an accident/incident would result	**LOW 5**	**MEDIUM 10**	**HIGH 15**	**HIGH 20**	**HIGH 25**

RISK RATING ACTION TO BE TAKEN		
LOW RISK	**1-6**	May be acceptable; however, review task to see if risk can be reduced further.
MEDIUM RISK	**8-12**	Task should only proceed with appropriate consultation with specialist personnel and safety team. Where possible the task should be refined to take account of the hazards involved or the risks should be reduced further prior to task commencement.
HIGH RISK	**15-25**	Task must not proceed. It should be redefined, or further control measures put in place to reduce risk. The controls should be re-assessed for adequacy prior to task commencement.

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DSEAR RISK ASSESSMENT 1 – GRAVITY FILLING
Part 2

Part 2:	**Hazardous Area Classification Data Sheet – List of Sources of Release**										
Source of Release		Flammable Substance			Ventilation			Hazardous Area			
Description	Grade of Release	Flammable Substance	Operating Temperature and Pressure °C	State	Type	Degree	Availability	Zone Type 0-1-2	Zone Extent (m) Vertical	Zone Extent (m) Horizontal	Any other relevant information and remarks
Fill Point Connection	S	*Insert substance from Part 1*	Ambient	L	N	VH	Good	N/A	N/A	N/A	Transfer of Class III fuel undertaken below pressure which a flammable mist or spray release could form. All leaks will be liquid well below its flashpoint.
Tank Fill Pipework Flange / Joint	S		Ambient	L	N	VH	Good	N/A	N/A	N/A	
Tanker Hose	S		Ambient	L	N	VH	Good	N/A	N/A	N/A	

Notes				**Ventilation**		
Grade of Release	C - Continuous (permanent or long periods of release) P - Primary (release expected during normal operation) S - Secondary (release NOT expected during normal operation) N - Negligible (DSEAR risk assessment not required)	State	G – Gas L – Liquid M - Mist LG – Liquid Gas S – Solid	Type: N – Natural A - Artificial	Degree: VH – High VM – Medium VL - Low	Availability: Good Adequate Low

Notes	
Normal Operations	This details the risk associate with normal operations of the installation. This covers all the non-exception activities associated with the installation.
Filling & Dispense Operation	Filling & Dispense operations have specific hazards above and beyond the normal operations. This primarily considers product tank filling, where this is an infrequent activity. Consideration is given to vehicle movement, connection/disconnection, and the product transfer.
Maintenance Operations	Refer to JSP 375 Part 2 Volume 3 Chapter 2 & 5.

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DSEAR RISK ASSESSMENT 1 – GRAVITY FILLING
Part 4

Part 4:	Hazardous Area Classification – DSEAR Risk Assessment								
Hazards	Hazard Consequence	No. of people exposed	Likelihood	Severity	Risk Rating	Control Measures to mitigate risk	Likelihood	Severity	Revised Risk Rating
Filling Operations									
Hot surfaces – vehicle exhausts	Provide enough heat to the product to produce a flammable vapor.	<5	1	4	4	Tanker engine switched off and parked in designated bays. Surrounding area cordoned off to vehicular traffic.	1	1	1
Flames and hot gases – welding/cutting & hot work	Provide ignition source and heat the product to produce a flammable vapor.	<5	1	4	4	Maintenance activities using tools near the fill point not allowed during refilling. JSP 375 Part 2 Vol 3 Chapter 2 & 5 define maintenance activities and procedures to be followed at class III installations.	1	1	1
Mechanically generated sparks - tools	Provide ignition source and heat the product to produce a flammable vapor.	<5	1	4	4		1	2	2
Electrical apparatus – portable electronic devices	Provide ignition source and heat the product to produce a flammable vapor.	<5	3	4	12	No portable electrical apparatus allowed in proximity during refueling. Tanker driver would stop fuel transfer in the event of a visible mist release.	1	3	3
Electrical apparatus – local installations	Provide ignition source and heat the product to produce a flammable vapor.	<5	3	4	12	Electrical equipment tested on a regular basis and IP rating correctly specified for the environment that it is installed. Tanker driver would stop fuel transfer in the event of a visible mist release.	2	1	2
Lightning	Provide ignition source and heat the product to produce a flammable vapor.	<5	2	5	10	All operations to stop during a lightning storm.	1	5	5

Electromagnetic waves from 3 x 1011 Hz to 3. x 1015 Hz	Provide enough heat to the product to produce a flammable vapor.	<5	1	4	4	Tank filling can be undertaken in direct sunlight. Ambient temperature unlikely to heat product near flashpoint.	1	1	1
Nearby combustible materials – ignition due to naked flames/hot surfaces.	Small incipient fire leading to a heat source to produce a flammable vapor and provide an ignition source.	<5	2	3	6	Good housekeeping around class III facilities to ensure all combustible materials are excluded by a minimum of 6m from sources of release.	1	1	1

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DSEAR RISK ASSESSMENT 2 – PUMP FILLING
Part 2

Part 2:	**Hazardous Area Classification Data Sheet – List of Sources of Release**

Source of Release		Flammable Substance			Ventilation			Hazardous Area			
Description	Grade of Release	Flammable Substance	Operating Temperature and Pressure °C	State	Type	Degree	Availability	Zone Type 0-1-2	Zone Extent (m) Vertical	Zone Extent (m) Horizontal	Any other relevant information and remarks
Fill Point Connection	S	*Insert substance from Part 1*	Ambient	L, M	N	VH	Good	N/A	N/A	N/A	Operating instructions in place and emergency stops fitted, should a mist form then the operator shall notice and cease operations immediately before a flammable mist can form. Or in the event of no operator supervision then the delivery pressure is under 1 Bar.
Tank Fill Pipework Flange / Joint	S		Ambient	L, M	N	VH	Good	N/A	N/A	N/A	
Tanker Hose	S		Ambient	L, M	N	VH	Good	N/A	N/A	N/A	
Transfer Pump Seals	S		Ambient	L, M	N	VH	Good	N/A	N/A	N/A	

Notes				**Ventilation**		
Grade of Release	C - Continuous (permanent or long periods of release) P - Primary (release expected during normal operation) S - Secondary (release NOT expected during normal operation) N - Negligible (DSEAR risk assessment not required)	State	G – Gas L – Liquid M - Mist LG – Liquid Gas S – Solid	Type: N – Natural A - Artificial	Degree: VH – High VM – Medium VL - Low	Availability: Good Adequate Low

Notes	
Normal Operations	This details the risk associate with normal operations of the installation. This covers all the non-exception activities associated with the installation.
Filling & Dispense Operation	Filling & Dispense operations have specific hazards above and beyond the normal operations. This primarily considers product tank filling, where this is an infrequent activity. Consideration is given to vehicle movement, connection/disconnection, and the product transfer.
Maintenance Operations	Refer to JSP 375 Part 2 Volume 3 Chapter 2 & 5.

For a complete DSEAR RISK ASSESSMENT 2 for Pump Filling, Parts 1, 3 and the Risk Matrix Definition Table must also be included and completed.

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DSEAR RISK ASSESSMENT 2 – PUMP FILLING
Part 4

Part 4:	**Hazardous Area Classification – DSEAR Risk Assessment**								
Hazards	Hazard Consequence	No. of people exposed	Likelihood	Severity	Risk Rating	Control Measures to mitigate risk	Likelihood	Severity	Revised Risk Rating
Filling Operations									
Hot surfaces – vehicle exhausts	Provide enough heat to the product to produce a flammable vapor.	<5	1	4	4	Vehicle to be suitable for product pumping without production of a flammable atmosphere and designated as at least an 'AT' vehicle as defined in ADR 2015. Surrounding area cordoned off to vehicular traffic.	1	1	1
Flames and hot gases – welding/cutting & hot work	Provide ignition source and heat the product to produce a flammable vapor.	<5	1	4	4	Maintenance activities using tools near the fill point not allowed during refilling. JSP 375 Part 2 Vol 3 Chapter 2 & 5 define maintenance activities and procedures to be followed at class III installations.	1	1	1
Mechanically generated sparks - tools	Provide ignition source and heat the product to produce a flammable vapor.	<5	1	4	4		1	2	2
Electrical apparatus – portable electronic devices	Provide ignition source and heat the product to produce a flammable vapor.	<5	3	4	12	Tanker driver would stop fuel transfer in the event of a visible mist release. In the event of no operator supervision then delivery pressure to be kept under 1 bar. Fuel pump, hose, and tanker all maintained in accordance with manufacturer's instructions.	1	3	3
Lightning	Provide ignition source and heat the product to produce a flammable vapor.	<5	2	5	10	All operations to stop during a lightning storm.	1	5	5

For a complete DSEAR RISK ASSESSMENT 2 for Pump Filling, Parts 1, 3 and the Risk Matrix Definition Table must also be included and completed.

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DSEAR RISK ASSESSMENT 2 – PUMP FILLING
Part 4

Electrical apparatus – local installations	Provide ignition source and heat the product to produce a flammable vapor.	<5	3	4	12	Flammable product contained within vessel. Electrical equipment tested on a regular basis and IP rating correctly specified for the environment that it is installed. Tanker driver would stop fuel transfer in the event of a visible mist release. In the event of no operator supervision then delivery pressure to be kept under 1 bar. Fuel pump, hose, and tanker all maintained in accordance with manufacturer's instructions.	2	1	2
Electromagnetic waves from 3 x 1011 Hz to 3. x 1015 Hz	Provide enough heat to the product to produce a flammable vapor.	<5	1	4	4	Tank filling can be undertaken in direct sunlight. Ambient temperature unlikely to heat product near flashpoint. Any liquid leaks to be cleaned up immediately and not allowed to accumulate. Fuel pump, hose, and tanker all maintained in accordance with manufacturer's instructions.	1	1	1
Nearby combustible materials – ignition due to naked flames/hot surfaces.	Small incipient fire leading to a heat source to produce a flammable vapor and provide an ignition source.	<5	2	3	6	Good housekeeping around class III facilities to ensure all combustible materials are excluded by a minimum of 6m from sources of release. Fuel pump, hose, and tanker all maintained in accordance with manufacturer's instructions.	1	1	1

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DSEAR RISK ASSESSMENT 3 – ABOVE GROUND TANK STORAGE
Part 2

Part 2:	**Hazardous Area Classification Data Sheet – List of Sources of Release**										
Source of Release		Flammable Substance			Ventilation			Hazardous Area			
Description	Grade of Release	Flammable Substance	Operating Temperature and Pressure °C	State	Type	Degree	Availability	Zone Type 0-1-2	Zone Extent (m) Vertical	Zone Extent (m) Horizontal	Any other relevant information and remarks
Tank Vent	S	*Insert substance from Part 1*	Ambient	L	N	VH	Good	N/A	N/A	N/A	Product stored well below its flashpoint. No pressurisation of liquid in storage. All leaks will be fluid.
Tank Drain Valve	S		Ambient	L	N	VH	Good	N/A	N/A	N/A	
Tank Dip Hatch	S		Ambient	L	N	VH	Good	N/A	N/A	N/A	
Tank Ullage	S		Ambient	L, M	N	VL	Low	0	Tank Internals		Zone 0 to cover the possibility of splashing during tank filling.

Notes				**Ventilation**		
Grade of Release	C - Continuous (permanent or long periods of release) P - Primary (release expected during normal operation) S - Secondary (release NOT expected during normal operation) N - Negligible (DSEAR risk assessment not required)	State	G – Gas L – Liquid M - Mist LG – Liquid Gas S – Solid	Type: N – Natural A - Artificial	Degree: VH – High VM – Medium VL - Low	Availability: Good Adequate Low

Notes	
Normal Operations	This details the risk associate with normal operations of the installation. This covers all the non-exception activities associated with the installation.
Filling & Dispense Operation	Filling & Dispense operations have specific hazards above and beyond the normal operations. This primarily considers product tank filling, where this is an infrequent activity. Consideration is given to vehicle movement, connection/disconnection, and the product transfer.
Maintenance Operations	Refer to JSP 375 Part 2 Volume 3 Chapter 2 & 5.

For a complete DSEAR RISK ASSESSMENT 3 for above ground tank storage, Parts 1, 3 and the Risk Matrix Definition Table must also be included and completed.

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DSEAR RISK ASSESSMENT 3 – ABOVE GROUND TANK STORAGE
Part 4

Part 4:	**Hazardous Area Classification – DSEAR Risk Assessment**								
Hazards	Hazard Consequence	No. of people exposed	Likelihood	Severity	Risk Rating	Control Measures to mitigate risk	Likelihood	Severity	Revised Risk Rating
Normal Operations (Storage)									
Hot surfaces – solar gain on tank skin.	Provide enough heat to the product to produce a flammable vapor.	<5	1	4	4	Quantity of fuel within tank should prevent large quantities of vapor generation. Zone 0 inside tank covers the potential for vapor generation.	1	1	1
Flames and hot gases – welding/cutting & hot work	Provide ignition source and heat the product to produce a flammable vapor.	<5	1	4	4	Maintenance activities using tools near the tank only allowed under a permit to work. JSP 375 Part 2 Vol 3 Chapter 2 & 5 define maintenance activities and procedures to be followed at class III installations.	1	1	2
Mechanically generated sparks - tools	Provide ignition source and heat the product to produce a flammable vapor.	<5	1	4	4		1	2	2
Electrical apparatus – portable electronic devices	Provide ignition source and heat the product to produce a flammable vapor.	<5	3	4	12	Personal electrical equipment not to be used near fuel storage tank.	1	3	3
Electrical apparatus – local installations	Provide ignition source and heat the product to produce a flammable vapor.	<5	3	4	12	Flammable product contained within vessel. Tank internal equipment tested on a regular basis and ATEX rating correctly specified for the environment that it is installed.	2	1	2
Lightning	Provide ignition source and heat the product to produce a flammable vapor.	<5	2	5	10	All operations to stop during a lightning storm.	1	5	5

For a complete DSEAR RISK ASSESSMENT 3 for above ground tank storage, Parts 1, 3 and the Risk Matrix Definition Table must also be included and completed.

Electromagnetic waves from 3 x 1011 Hz to 3. x 1015 Hz	Provide enough heat to the product to produce a flammable vapor.	<5	1	4	4	Vessel is installed outside in direct sunlight. Ambient temperature not likely to heat product near flashpoint.	1	4	4
Nearby combustible materials – ignition due to naked flames/hot surfaces.	Small incipient fire leading to a heat source to produce a flammable vapor and provide an ignition source.	<5	2	3	6	Good housekeeping around class III facilities to ensure all combustible materials are excluded by a minimum of 6m from sources of release.	1	1	1

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DSEAR RISK ASSESSMENT 4 – UNDERGROUND TANK STORAGE
Part 2

Part 2:	**Hazardous Area Classification Data Sheet – List of Sources of Release**										
Source of Release		Flammable Substance			Ventilation			Hazardous Area			
Description	Grade of Release	Flammable Substance	Operating Temperature and Pressure °C	State	Type	Degree	Availability	Zone Type 0-1-2	Zone Extent (m) Vertical	Zone Extent (m) Horizontal	Any other relevant information and remarks
Tank Vent	S	*Insert substance from Part 1*	Ambient	L	N	VH	Good	N/A	N/A	N/A	Product stored well below its flashpoint. No pressurisation of liquid in storage. All leaks will be fluid.
Tank Dip Hatch	S		Ambient	L	N	VH	Good	N/A	N/A	N/A	
Tank Ullage	S		Ambient	L, M	N	VL	Low	0	Tank Internals		Zone 0 to cover the possibility of splashing during tank filling.

Notes				**Ventilation**		
Grade of Release	C - Continuous (permanent or long periods of release) P - Primary (release expected during normal operation) S - Secondary (release NOT expected during normal operation) N - Negligible (DSEAR risk assessment not required)	State	G – Gas L – Liquid M - Mist LG – Liquid Gas S – Solid	Type: N – Natural A - Artificial	Degree: VH – High VM – Medium VL - Low	Availability: Good Adequate Low

Notes	
Normal Operations	This details the risk associate with normal operations of the installation. This covers all the non-exception activities associated with the installation.
Filling & Dispense Operation	Filling & Dispense operations have specific hazards above and beyond the normal operations. This primarily considers product tank filling, where this is an infrequent activity. Consideration is given to vehicle movement, connection/disconnection, and the product transfer.
Maintenance Operations	Refer to JSP 375 Part 2 Volume 3 Chapter 2 & 5.

For a complete DSEAR RISK ASSESSMENT 4 for Underground tank storage, Parts 1, 3 and the Risk Matrix Definition Table must also be included and completed.

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DSEAR RISK ASSESSMENT 4 – UNDERGROUND TANK STORAGE
Part 4

Part 4:	**Hazardous Area Classification – DSEAR Risk Assessment**								
Hazards	Hazard Consequence	No. of people exposed	Likelihood	Severity	Risk Rating	Control Measures to mitigate risk	Likelihood	Severity	Revised Risk Rating
Normal Operations (Storage)									
Flames and hot gases – welding/cutting & hot work	Provide ignition source and heat the product to produce a flammable vapor.	<5	1	4	4	Maintenance activities using tools near the tank only allowed under a permit to work. JSP 375 Part 2 Vol 3 Chapter 2 & 5 define maintenance activities and procedures to be followed at class III installations.	1	1	2
Mechanically generated sparks - tools	Provide ignition source and heat the product to produce a flammable vapor.	<5	1	4	4		1	2	2
Electrical apparatus – portable electronic devices	Provide ignition source and heat the product to produce a flammable vapor.	<5	3	4	12	Personal electrical equipment not to be used near fuel storage installation.	1	3	3
Electrical apparatus – local installations	Provide ignition source and heat the product to produce a flammable vapor.	<5	3	4	12	Flammable product contained within vessel. Tank internal equipment tested on a regular basis and ATEX rating correctly specified for the environment that it is installed.	2	1	2
Lightning	Provide ignition source and heat the product to produce a flammable vapor.	<5	2	5	10	All operations to stop during a lightning storm.	1	5	5
Nearby combustible materials – ignition due to naked flames/hot surfaces.	Small incipient fire leading to a heat source to produce a flammable vapor and provide an ignition source.	<5	2	3	6	Good housekeeping around class III facilities to ensure all combustible materials are excluded by a minimum of 6m from sources of release.	1	1	1

For a complete DSEAR RISK ASSESSMENT 4 for Underground tank storage, Parts 1, 3 and the Risk Matrix Definition Table must also be included and completed.

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DSEAR RISK ASSESSMENT 5 – TANK GRAVITY DISCHARGE
Part 2

Part 2:	**Hazardous Area Classification Data Sheet – List of Sources of Release**										
Source of Release		Flammable Substance			Ventilation			Hazardous Area			
Description	Grade of Release	Flammable Substance	Operating Temperature and Pressure °C	State	Type	Degree	Availability	Zone Type 0-1-2	Zone Extent (m) Vertical	Zone Extent (m) Horizontal	Any other relevant information and remarks
Pipe Joints	S	*Insert substance from Part 1*	Ambient	L	N	VH	Good	N/A	N/A	N/A	Transfer of Class III fuel undertaken below pressure which a mist or spray release could form. All leaks will be fluid.

Notes				**Ventilation**		
Grade of Release	C - Continuous (permanent or long periods of release) P - Primary (release expected during normal operation) S - Secondary (release NOT expected during normal operation) N - Negligible (DSEAR risk assessment not required)	State	G – Gas L – Liquid M - Mist LG – Liquid Gas S – Solid	Type: N – Natural A - Artificial	Degree: VH – High VM – Medium VL - Low	Availability: Good Adequate Low

Notes	
Normal Operations	This details the risk associate with normal operations of the installation. This covers all the non-exception activities associated with the installation.
Filling & Dispense Operation	Filling & Dispense operations have specific hazards above and beyond the normal operations. This primarily considers product tank filling, where this is an infrequent activity. Consideration is given to vehicle movement, connection/disconnection, and the product transfer.
Maintenance Operations	Refer to JSP 375 Part 2 Volume 3 Chapter 2 & 5.

For a complete DSEAR RISK ASSESSMENT 5 for Tank gravity dispense, Parts 1, 3 and the Risk Matrix Definition Table must also be included and completed.

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DSEAR RISK ASSESSMENT 5 – TANK GRAVITY DISCHARGE
Part 4

Part 4:	**Hazardous Area Classification – DSEAR Risk Assessment**								
Hazards	Hazard Consequence	No. of people exposed	Likelihood	Severity	Risk Rating	Control Measures to mitigate risk	Likelihood	Severity	Revised Risk Rating
Normal Operations (Discharge)									
Flames and hot gases – welding/cutting & hot work	Provide ignition source and heat the product to produce a flammable vapor.	<5	1	4	4	Maintenance activities using tools near the tank only allowed under a permit to work. JSP 375 Part 2 Vol 3 Chapter 2 & 5 define maintenance activities and procedures to be followed at class III installations.	1	1	2
Mechanically generated sparks - tools	Provide ignition source and heat the product to produce a flammable vapor.	<5	1	4	4		1	2	2
Electrical apparatus – portable electronic devices	Provide ignition source and heat the product to produce a flammable vapor.	<5	3	4	12	Personal electrical equipment not to be used in proximity to fuel installation.	1	3	3
Electrical apparatus – local installations	Provide ignition source and heat the product to produce a flammable vapor.	<5	3	4	12	Electrical equipment tested on a regular basis and IP rating correctly specified for the environment that it is installed.	2	1	2
Lightning	Provide ignition source and heat the product to produce a flammable vapor.	<5	2	5	10	All operations to stop during a lightning storm.	1	5	5
Electromagnetic waves from 3 x 1011 Hz to 3. x 1015 Hz	Provide enough heat to the product to produce a flammable vapor.	<5	1	4	4	Vessel is installed outside in direct sunlight. Ambient temperature not likely to heat product near flashpoint.	1	4	4
Nearby combustible materials – ignition due to naked flames/hot surfaces.	Small incipient fire leading to a heat source to produce a flammable vapor and provide an ignition source.	<5	2	3	6	Good housekeeping around class III facilities to ensure all combustible materials are excluded by a minimum of 6m from sources of release.	1	1	1

For a complete DSEAR RISK ASSESSMENT 5 for Tank gravity dispense, Parts 1, 3 and the Risk Matrix Definition Table must also be included and completed.

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DSEAR RISK ASSESSMENT 6 – TANK PRESSURISED DISCHARGE OPERATOR ATTENDANCE
Part 2

Part 2:	**Hazardous Area Classification Data Sheet – List of Sources of Release**										
Source of Release		Flammable Substance			Ventilation			Hazardous Area			
Description	Grade of Release	Flammable Substance	Operating Temperature and Pressure °C	State	Type	Degree	Availability	Zone Type 0-1-2	Zone Extent (m) Vertical	Zone Extent (m) Horizontal	Any other relevant information and remarks
Suction Pipe Joints	S	*Insert substance from Part 1*	Ambient	L	N	VH	Good	N/A	N/A	N/A	Class III fuel within suction pipe below pressure which a mist or spray release could form. All leaks will be fluid.
Transfer Pump	S		Ambient	L, M	N	VH	Good	N/A	N/A	N/A	Should a mist form then the operator shall notice and cease operations immediately before a flammable mist can form.
Pressurised Pipe Joints	S		Ambient	L, M	N	VH	Good	N/A	N/A	N/A	

Notes				**Ventilation**		
Grade of Release	C - Continuous (permanent or long periods of release) P - Primary (release expected during normal operation) S - Secondary (release NOT expected during normal operation) N - Negligible (DSEAR risk assessment not required)	State	G – Gas L – Liquid M - Mist LG – Liquid Gas S – Solid	Type: N – Natural A - Artificial	Degree: VH – High VM – Medium VL - Low	Availability: Good Adequate Low

Notes	
Normal Operations	This details the risk associate with normal operations of the installation. This covers all the non-exception activities associated with the installation.
Filling & Dispense Operation	Filling & Dispense operations have specific hazards above and beyond the normal operations. This primarily considers product tank filling, where this is an infrequent activity. Consideration is given to vehicle movement, connection/disconnection, and the product transfer.
Maintenance Operations	Refer to JSP 375 Part 2 Volume 3 Chapter 2 & 5.

For a complete DSEAR RISK ASSESSMENT 6 for Tank pressurised dispense, Parts 1, 3 and the Risk Matrix Definition Table must also be included and completed.

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DSEAR RISK ASSESSMENT 6 – TANK PRESSURISED DISCHARGE OPERATOR ATTENDANCE Part 4

Part 4:	**Hazardous Area Classification – DSEAR Risk Assessment**								
Hazards	Hazard Consequence	No. of people exposed	Likelihood	Severity	Risk Rating	Control Measures to mitigate risk	Likelihood	Severity	Revised Risk Rating
Normal Operations (Discharge)									
Flames and hot gases – welding/cutting & hot work	Provide ignition source and heat the product to produce a flammable vapor.	<5	1	4	4	Maintenance activities using tools near the pump not allowed during fuel transfer. JSP 375 Part 2 Vol 3 Chapter 2 & 5 define maintenance activities and procedures to be followed at class III installations.	1	1	2
Mechanically generated sparks - tools	Provide ignition source and heat the product to produce a flammable vapor.	<5	1	4	4		1	2	2
Electrical apparatus – portable electronic devices	Provide ignition source and heat the product to produce a flammable vapor.	<5	3	4	12	Personal electrical equipment not to be used in proximity to pump installation.	1	3	3
Electrical apparatus – local installations	Provide ignition source and heat the product to produce a flammable vapor.	<5	3	4	12	Flammable product contained within vessel. Electrical equipment tested on a regular basis and IP rating correctly specified for the environment that it is installed. Operator would stop fuel transfer in the event of a visible mist release.	2	1	2
Lightning	Provide ignition source and heat the product to produce a flammable vapor.	<5	2	5	10	All transfer operations to stop during a lightning storm.	1	5	5
Electromagnetic waves from 3 x 1011 Hz to 3. x 1015 Hz	Provide enough heat to the product to produce a flammable vapor.	<5	1	4	4	Vessel is installed outside in direct sunlight. Ambient temperature not likely to heat product near flashpoint.	1	4	4

For a complete DSEAR RISK ASSESSMENT 6 for Tank pressurised dispense, Parts 1, 3 and the Risk Matrix Definition Table must also be included and completed.

Nearby combustible materials – ignition due to naked flames/hot surfaces.	Small incipient fire leading to a heat source to produce a flammable vapor and provide an ignition source.	<5	2	3	6	Good housekeeping around class III facilities to ensure all combustible materials are excluded by a minimum of 6m from sources of release.	1	1	1

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DSEAR RISK ASSESSMENT 7 – TANK PRESSURISED DISCHARGE UNDER 1 BAR
Part 2

Part 2:	**Hazardous Area Classification Data Sheet – List of Sources of Release**

Source of Release		Flammable Substance			Ventilation			Hazardous Area			
Description	Grade of Release	Flammable Substance	Operating Temperature and Pressure °C	State	Type	Degree	Availability	Zone Type 0-1-2	Zone Extent (m) Vertical	Zone Extent (m) Horizontal	Any other relevant information and remarks
Suction Pipe Joints	S	*Insert substance from Part 1*	Ambient	L	N	VH	Good	N/A	N/A	N/A	Class III fuel within suction pipe below pressure which a mist or spray release could form. All leaks will be fluid.
Transfer Pump	S		Ambient	L	N	VH	Good	N/A	N/A	N/A	Transfer of Class III fuel undertaken below pressure which a mist or spray release could form. All leaks will be fluid.
Pressurised Pipe Joints	S		Ambient	L	N	VH	Good	N/A	N/A	N/A	

Notes				**Ventilation**		
Grade of Release	C - Continuous (permanent or long periods of release) P - Primary (release expected during normal operation) S - Secondary (release NOT expected during normal operation) N - Negligible (DSEAR risk assessment not required)	State	G – Gas L – Liquid M - Mist LG – Liquid Gas S – Solid	Type: N – Natural A - Artificial	Degree: VH – High VM – Medium VL - Low	Availability: Good Adequate Low

Notes	
Normal Operations	This details the risk associate with normal operations of the installation. This covers all the non-exception activities associated with the installation.
Filling & Dispense Operation	Filling & Dispense operations have specific hazards above and beyond the normal operations. This primarily considers product tank filling, where this is an infrequent activity. Consideration is given to vehicle movement, connection/disconnection, and the product transfer.
Maintenance Operations	Refer to JSP 375 Part 2 Volume 3 Chapter 2 & 5.

For a complete DSEAR RISK ASSESSMENT 7 for Tank pressurised discharge under 1 Bar, Parts 1, 3 and the Risk Matrix Definition Table must also be included and completed.

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DSEAR RISK ASSESSMENT 7 – TANK PRESSURISED DISCHARGE UNDER 1 BAR
Part 4

Part 4:	**Hazardous Area Classification – DSEAR Risk Assessment**								
Hazards	Hazard Consequence	No. of people exposed	Likelihood	Severity	Risk Rating	Control Measures to mitigate risk	Likelihood	Severity	Revised Risk Rating
Normal Operations (Discharge)									
Flames and hot gases – welding/cutting & hot work	Provide ignition source and heat the product to produce a flammable vapor.	<5	1	4	4	Maintenance activities using tools near the pump must be undertaken with a permit to work. JSP 375 Part 2 Vol 3 Chapter 2 & 5 define maintenance activities and procedures to be followed at class III installations.	1	1	2
Mechanically generated sparks - tools	Provide ignition source and heat the product to produce a flammable vapor.	<5	1	4	4		1	2	2
Electrical apparatus – portable electronic devices	Provide ignition source and heat the product to produce a flammable vapor.	<5	3	4	12	Personal electrical equipment not to be used in proximity to pump installation.	1	3	3
Electrical apparatus – local installations	Provide ignition source and heat the product to produce a flammable vapor.	<5	3	4	12	Flammable product contained within vessel. Electrical equipment tested on a regular basis and IP rating correctly specified for the environment that it is installed.	2	1	2
Lightning	Provide ignition source and heat the product to produce a flammable vapor.	<5	2	5	10	All transfer operations to stop during a lightning storm.	1	5	5
Electromagnetic waves from 3 x 1011 Hz to 3. x 1015 Hz	Provide enough heat to the product to produce a flammable vapor.	<5	1	4	4	Vessel is installed outside in direct sunlight. Ambient temperature not likely to heat product near flashpoint.	1	4	4
Nearby combustible materials – ignition due to naked flames/hot surfaces.	Small incipient fire leading to a heat source to produce a flammable vapor and provide an ignition source.	<5	2	3	6	Good housekeeping around class III facilities to ensure all combustible materials are excluded by a minimum of 6m from sources of release.	1	1	1

For a complete DSEAR RISK ASSESSMENT 7 for Tank pressurised discharge under 1 Bar, Parts 1, 3 and the Risk Matrix Definition Table must also be included and completed.

Part 2:	**Hazardous Area Classification Data Sheet – List of Sources of Release**

Source of Release		Flammable Substance			Ventilation			Hazardous Area			
Description	Grade of Release	Flammable Substance	Operating Temperature and Pressure ℃	State	Type	Degree	Availability	Zone Type 0-1-2	Zone Extent (m) Vertical	Zone Extent (m) Horizontal	Any other relevant information and remarks
Tank Vent	S	*Insert substance from Part 1*	Ambient	L	N	VH	Good	N/A	N/A	N/A	Product stored well below its flashpoint. No pressurisation of liquid in storage. All leaks will be fluid.
Tank Drain Valve	S		Ambient	L	N	VH	Good	N/A	N/A	N/A	
Tank Dip Hatch	S		Ambient	L	N	VH	Good	N/A	N/A	N/A	
Tank Ullage	P		Ambient	L, M	N	VL	Low	0	Tank Internals		Zone 0 to cover the possibility of splashing during tank filling.
Dispenser Pump up to 40lpm	P		Ambient	L, M	N	VH	Good	1/2	0.1/0.45	0.1/0.45	Pump and dispenser designed and constructed to recognised standards. Follow 'The Blue Book' for extent of zones.
Dispenser Pump >40lpm	P		Ambient	L, M	N	VH	Good	1/2	0.1/1.2	0.1/Hose dependent	
Dispenser Hose Connections	S		Ambient	L, M-	N	VH	Good	N/A	N/A	N/A	Should a leak form then the operator shall notice and cease operations immediately before a mist can form

Notes				**Ventilation**		
Grade of Release	C - Continuous (permanent or long periods of release) P - Primary (release expected during normal operation) S - Secondary (release NOT expected during normal operation) N - Negligible (DSEAR risk assessment not required)	State	G – Gas L – Liquid M - Mist LG – Liquid Gas S – Solid	Type: N – Natural A - Artificial	Degree: VH – High VM – Medium VL - Low	Availability: Good Adequate Low

Notes	
Normal Operations	This details the risk associate with normal operations of the installation. This covers all the non-exception activities associated with the installation.
Filling & Dispense Operation	Filling & Dispense operations have specific hazards above and beyond the normal operations. This primarily considers product tank filling, where this is an infrequent activity. Consideration is given to vehicle movement, connection/disconnection, and the product transfer.
Maintenance Operations	Refer to JSP 375 Part 2 Volume 3 Chapter 2 & 5.

For a complete DSEAR RISK ASSESSMENT 8 for MTFI, Railway and Marine Tank Storage and dispensing Parts 1, 3 and the Risk Matrix Definition Table must also be included and completed.

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DSEAR RISK ASSESSMENT 8 –MTFI, RAILWAY and MARINE TANK STORAGE & DISPENSING - Part 4

Part 4:	**Hazardous Area Classification – DSEAR Risk Assessment**								
Hazards	Hazard Consequence	No. of people exposed	Likelihood	Severity	Risk Rating	Control Measures to mitigate risk	Likelihood	Severity	Revised Risk Rating
Normal Operations (Discharge)									
Flames and hot gases – welding/cutting & hot work	Provide ignition source and heat the product to produce a flammable vapor.	<5	1	4	4	Maintenance activities using tools near the installation only allowed through a permit to work. JSP 375 Part 2 Vol 3 Chapter 2 & 5 define maintenance activities and procedures to be followed at class III installations.	1	1	2
Mechanically generated sparks - tools	Provide ignition source and heat the product to produce a flammable vapor.	<5	1	4	4		1	2	2
Electrical apparatus – portable electronic devices	Provide ignition source and heat the product to produce a flammable vapor.	<5	3	4	12	No portable electrical apparatus allowed within the hazardous area or in proximity during refueling.	1	3	3
Electrical apparatus – local installations	Provide ignition source.	<5	3	4	12	Flammable product contained within vessel. Operator to cease dispensing activities in the event of a leak to prevent the formation of a potentially flammable mist or large-scale liquid release. External electrical equipment tested on a regular basis and IP rating correctly specified for the environment that it is installed. Any equipment located within the hazardous areas associated with vehicle fueling or tank internal equipment ATEX rating correctly specified for the environment that it is installed.	2	1	2

For a complete DSEAR RISK ASSESSMENT 8 for MTFI, Railway and Marine Tank Storage and dispensing Parts 1, 3 and the Risk Matrix Definition Table must also be included and completed.

Lightning	Provide ignition source and heat the product to produce a flammable vapor.	<5	2	5	10	All operations to stop during a lightning storm.	1	5	5
Electromagnetic waves from 3 x 1011 Hz to 3. x 1015 Hz	Provide enough heat to the product to produce a flammable vapor.	<5	1	4	4	Fill point, dispenser and hose located outside in direct sunlight. Ambient temperature not likely to heat product near flashpoint.	1	4	4
Nearby combustible materials – ignition due to naked flames/hot surfaces.	Small incipient fire leading to a heat source to produce a flammable vapor and provide an ignition source.	<5	2	3	6	Good housekeeping around class III facilities to ensure all combustible materials are excluded by a minimum of 6m from sources of release.	1	1	1

Appendix D Supporting Document

1 Bar Limit - Method 2

This document supports a system pressure limit being placed at 1 bar as a control measure to reduce the risk of a mist or spray leak.

Energy Institute Model Code of Safe Practice Part 15: Area Classification Code for Installations Handling Flammable Fluids.

'*A1.2 Mists or sprays*
There is little knowledge on the formation of flammable mists and the appropriate extents of associated hazardous areas. Some of the issues related to the formation and the hazard of flammable mists are addressed in Pressurised atomisation of high flash point liquids - Implications for hazardous area classification, by P.J. Bowen and L.C. Shirvill.

It is important to realise that not every release will form a mist. Secondary grades of release resulting from e.g., leaking flanges, failure of packed glands, etc. will in most cases cause result in the formation of liquid pools, rather than mists. In these cases, a flammable atmosphere would not form directly from the release unless it impacted upon a hot surface.
This paper concludes that pressure differentials of only a few bars are sufficient to atomise commonly encountered liquids. Generation of mists created by the impact of liquid streams on a surface close to the point of release also appears to be possible. However, it does not make any recommendations for the extents of flammable mists and sprays.'

Hazards 26 – Paper 38 Area classification of flammable mists: summary of joint-industry project findings

Tentative New Guidelines for Area Classification of Mists
The aim of the current project was to produce new scientific information on the formation and mitigation of flammable mists that could be used by industry to develop evidence-based guidelines on area classification of mists. Although the project succeeded in producing a classification scheme for spray releases and relevant data from experiments and modelling, it should be recognized that this new information is limited in scope. Compared to the decades of research into flammable gas hazards, the work on flammable mists is still at an early stage. Because of the limited amount of data that has been produced in the current project, any extension of the results to generic guidance for all orifices, all pressures and all fluids is inappropriate. At best, the results presented in this paper should only be used as one input into a considered, professional examination of a given problem.

For those who need a straightforward recommendation on area classification of mists, there is already some limited information presented in EI15 (Energy Institute, 2015). The hazard radii given by EI15 are based upon model predictions of sprays where the hazard is defined as an average droplet concentration above an LEL of 43 g/m^3. This differs from the approach taken for gas releases, where the flammable envelope is typically taken to be an average concentration of $^1/_2$ LEL. The use of $^1/_2$ LEL instead of LEL is mainly to account for turbulence that causes instantaneous fluctuations in concentration above and below the average value (see Webber, 2002). It is currently unknown whether a similar criterion ought to be adopted for mists. There are also questions over the choice of 43 g/m3 for the LEL – as discussed above.

The suggested guidelines given below for each of the Release Classes are based on the limited amount of data available from the current project and must be treated with caution. For consistency with EI15, it is assumed that any flammable volume is limited to the distance to an average LEL concentration – but this remains to be established with confidence. The Release Classes discussed here are those described in Table 1 in terms of the flashpoint and Ohnesorge ratio. The Release Class must be based on the worst-case operational conditions, i.e., the highest operating pressure and the fluid properties that are appropriate for the highest operating temperature.

1. Release Class I:
Should be treated as EI15 Category C fluids. For pressures below 5 bar, the hazard radii given in EI15 for 5 bar should be used. Tests on Jet A1 showed that flammable mists were produced at a pressure of just 1.7 barg. A margin of conservatism is strongly recommended. ***It may be appropriate to consider any Release Class I with a pressure above 1 barg as capable of creating a hazardous zone.***

2. Release-class II:
a. For hole sizes of 1 mm or above and pressure below 20 bar: No flammable zone if there is no possibility of spray impingement, otherwise as EI15 Category C fluids. b. For conditions outside this range: Unknown – treat as EI15 Category C fluids.

3. Release-class III:
a. For hole sizes of 1 mm or above and pressure below 20 bar: No flammable zone created.
b. For conditions outside this range: Unknown - treat as EI15 Category C fluids.

4. Release-class IV:
Unknown – treat as EI15 Category C fluids.'