Australian Government

Department of Defence
Defence Support Group

Department of Defence

Manual of Infrastructure Engineering

Bulk Fuel Installation – Design

November 2011

FOREWORD

The *Manual of Infrastructure Engineering Bulk Fuel Installation Design (MIEBFI-D)* is the primary Defence policy document when determining design and engineering requirements for military grade aviation and maritime fuel farms and associated infrastructure. Its provisions are mandatory.

This manual can be accessed from the Defence Estate Quality Management System web site on the Defence Intranet. It is also available to the public on the Internet at http://www.defence.gov.au/im/.

The MIEBFI-D nominates *Regulations and Standards* as the minimum for the design and construction standard of fuel farms, but, recognising the unique nature of Defence fuel farms the manual generally nominates additional levels of engineering requirements than those required by *Regulations and Standards.*

All Defence new construction, refurbishment projects and some maintenance activities are required to be certified by the designer and contractor as meeting the associated engineering processes for the design and or construction requirements detailed in this manual.

For maintenance related policy, refer to the separate BFIMI. It is also available to the public on the Internet at http://www.defence.gov.au/im/.

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November 2011

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AMENDMENT CERTIFICATE		
Amendment		Effect
Number	Date	
0	22-11-11	Initial release
1	1-8-12	amended

Part 1 Procedural Requirements

1. Introduction

This Policy document outlines the basis on which Defence fuel farms will be designed and their installation certified as being compliant with prevailing Defence Standards and regulatory requirements.

The policy will apply to all Defence fuel storage and handling installations, but excluding those which are

- Defined as minor storages (per AS 1940 Table 2.1);
- Mobile facilities relating to service workshops and power generator plants;
- Fuel tanker and refuelling tanker parking areas; and
- Fuel tanker and refuelling tanker maintenance workshops.

Defence fuel farms vary from commercial facilities primarily in their requirement to store strategic quantities of fuel to meet any real or projected demand. The stored fuel volumes are generally larger and the turnover lower in relative terms when compared to commercial facilities.

This reduced fuel turnover and the subsequent increased potential for corrosion, contamination and product degradation due to prolonged stock holdings, requires a particular approach to design, which captures the unique Defence service requirements and builds on those used commercially.

The overall aim of this policy is to ensure fuel farm facilities are compliant with regulatory requirements, safe, functional, energy and environmentally efficient and will provide optimum Whole of Life (WOL) performance (Refer Appendix B).

The respective Commonwealth, State and Territory legislation, regulations, ordinances, Codes of Practice and Australian and international standards form the minimum construction standards acceptable to Defence.

Designers and Contractors are responsible for ensuring full compliance with this policy unless issued with an approved dispensation, as detailed in Section 4.4.

This manual describes technical design requirements for aviation and maritime fuels conforming to Australian Department of Defence specifications.

These fuels comprise:

Fuel Type	Specification	Description
F34 Avtur (FSII) Turbine Aviation Fuel	DEF(AUST)5240	a low flash point aviation fuel, categorised as “flammable” per AS1940 Sec 1.4.28
F44 Avcat (FSII) Turbine Aviation Fuel	DEF(AUST)5240	a higher flash point aviation fuel, categorised as “combustible” per AS1940 Sec 1.4.9
F18 Aviation Gasoline	DEFSTAN91-90	a low flash point aviation fuel, categorised as “flammable” per AS1940 Sec 1.4.28
F76 (FSII) Naval Fuel Distillate	206F	a higher flash point maritime fuel, categorised as “combustible” per AS1940 Sec 1.4.9

It should be noted that F34, F44 and F76 fuel types contain a number of additives described as FSII (fuel system icing inhibitor) and as such are NOT equivalent to commercial fuel grades.

Importantly, commercial aviation fuel JET-A1 does not conform to Defence specifications.

For equipment or component selection, the designer must be able to demonstrate direct compatibility with these fuel types.

Where other fuel types e.g. conforming to DEFSTAN, JP series, are presented as being equivalent, equivalence must be demonstrated to the Defence Technical Authority (refer sections 1.5 and 1.6, this manual)

This manual may also be used as a reference for design of land based fuel systems, typically for unleaded petrol and automotive diesel fuel (e.g. hazardous areas, separation distances etc.)

1.1 Definitions and Abbreviations

The following general definitions and abbreviations shall apply. They appear in the reference standards as well as the text of this document.

ACM	Asbestos containing material
ADF	Australian Defence Force
ADoD	Australian Department of Defence
ANSI	American National Standards Institute
APAS	Australian Paint Approval Scheme
API	American Petroleum Institute
AS	Australian Standard
ASEPE	Assistant Secretary, Estate Policy and Environment
ASME	American Society of Mechanical Engineers
A/G	Above Ground
BCA	Building Code of Australia
BFI	Bulk Fuel Installation
BFIMI	Bulk Fuel Installation Maintenance Instruction
BFQC	Base Fuel Quality Control
BFQCO	Base Fuel Quality Control Officer – RAAF & Army
BOCLE	Ball-On Cylinder Lubricity Evaluator
BS	British Standards
CDR	Concept Design Report (30% level)
CHAZOP	Control Hazard Operability Study
CIOG	Chief Information Officer Group
CMS	Comprehensive Maintenance Service
CO	Establishment/Base Commanding Officer
CPEng	Chartered Professional Engineer
DBC	Detailed Business Case
DDR	Detailed Design Report (90% level)
DEEP	Directorate of Estate Engineering & Policy
Defence	Department of Defence
DEFS	Director Estate and Facilities Services
DEMP	Directorate of Estate Maintenance and Policy
DEMS	Defence Estate Management System
DEQMS	Defence Estate Quality Management System
DMO	Defence Material Organisation
DN	Translated – Nominal Pipe Diameter
DQA	Directorate of Quality Assurance
DSG	Defence Support Group

DSO	Defence Support Operation Division
DSG-EPEB	Estate Policy and Environment Branch
DSO-RD	DSO Regional Director
DSO-BMS	DSO Base Manager Services
DSTO	Defence Scientific and Technology Organisation
DWG	Drawing (Computer Aided Design (CAD) file extension)
ERW	Electric Resistance Welded
FAT	Factory Acceptance Tests
FDB/FRB	Functional Design Brief/Functional Requirements Brief
FDR	Final Design Report (100% level)
FEED	Front End Engineering Design
FF	Fuel Farm
FQCC	Fuel Quality Control Centre
FSII	Fuel System Icing Inhibitor
FSS	Fire Safety Survey
GSSC	Garrison Support Services Contractor
HAZID	Hazard Identification
HAZOP	Hazard and Operability Studies
HIPAP	Hazardous Industry Advisory Papers
HV	High Voltage
ID	Infrastructure Division
LV	Low Voltage (under 1000 Volts)
JFLA	Joint Fuels and Lubricants Agency
MA	Maintenance Agent
MAOP	Maximum Allowable Operating Pressure
MFPE	The Manual of Fire Protection Engineering
MIEE	The Manual of Infrastructure Engineering – Electrical
MHF	Major Hazard Facility
NACE	National Association of Corrosion Engineers
NFI	Naval Fuel Installation
NFIS	Naval Fuel Installation Supervisor - RAN
NFPA	National Fire Protection Association (USA)
NOHSC	National Occupational Health and Safety Commission
NPER	National Professional Engineers' Register
NSC	National Standards Commission
NWQMS	National Water Quality Management System
OA	Operating Agent
OIML	International Organization of Legal Metrology
O&M	Operations and Maintenance

OIU	Operator Interface Unit
P&ID	Piping and Instrumentation Diagram
PC	Personal Computer
pdf	Portable Data File
PFD	Process Flow Diagram
PLC	Programmable Logic Controller
POL	Petroleum, Oils and Lubricants
PV	Pressure - Vacuum
RFT	Request for Tender
RTU	Remote Terminal Unit (related to SCADA)
QC	Quality Control
SAA	Standards Association of Australia (Now SAI Global)
SADFO	Senior Australian Defence Force Officer
SBC	Strategic Business Case
SCADA	Supervisory Control and Data Acquisition
SDR	Schematic Design Report (50% level)
SQRA	Semi Quantitative Risk Assessment
TA	Technical Authority
TAS	Terminal Automation Systems
U/G	Underground
URB	User Requirements Brief
UST	Underground Storage Tank
VSD	Variable Speed Drive
WHS	The Work Health and Safety Act 2011 (formally Occupational Health and Safety Act 1991)
WOL	Whole of Life

1.2 Application

Policy requirements apply to the design, construction and certification of fuel farm installations in ADF nominated bases in Australia and overseas. They are consistent with the maintenance and operational requirements described in the Bulk Fuel Installation Maintenance Instruction (BFIMI).

Allied facilities shall use this document as guidance only. This document is to be read in consultation with prevalent documents such as MIL-HDBK 1022A “Petroleum Fuel Facilities”.

Alterations or additions to existing installations shall comply with the policy document’s provisions in addition to those required by regulation and standards. Unless mandated by risk studies, these provisions will not generally be applied to any other existing facilities, which may lie outside of the scope of such alterations or additions.

When referring to “regulations and standards” in this policy document, they include all relevant respective Commonwealth, State and Territory legislation, Codes of Practice, Australian standards and where applicable, international standards.

For any differences noted between the requirements defined in these regulations and standards and those described in this policy, the said regulations and standards shall take precedence.

1.3 Fuel Farm Design Principles

To maintain supply capability, fuel quality and safety compliance, Defence fuel farm facilities shall conform to all applicable regulations and standards of the State or Territory in which they are located.

Fuel quality management and specific storage and handling requirements are mandated in the Australian Defence Standards. Referred to as DEF(AUST)s, these standards are available in electronic form from the Defence Materiel Organisation (DMO) website which can be accessed on the Defence Intranet. The designer will be given access to the DEF(AUST)s by DMO to the extent required.

Electronic copies are uncontrolled when printed.

No guarantees are offered as to the currency and applicability of hard copies.

Confirmation of DEF(AUST) currency can be referred to the DMO Common Services System Support Office.

The principle design standards, applicable to Defence fuel farm design are:

AS 1940-2004 The storage and handling of flammable and combustible liquids

Defence MFPE – The Manual of Fire Protection Engineering

The Manual of Infrastructure Engineering – Electrical (MIEE)

Defence and Australian Standards are considered to be mandatory in their application and directly align with AS 1940.

This policy shall be read in conjunction with DEF(AUST)5695B in its last approved version. The fuel farm design shall consider and incorporate the applicable operational requirements of this Defence standard.

Where Defence and local standards do not address the specific requirements, international standards and/or those of allied forces will be considered. Otherwise such standards shall be informative only.

Final design selection will be based on the extent to which the proposed approach:

- Meets the requirements of this policy;
- Offers value to Defence over the facility's projected life;
- Satisfies specific user requirements and supports Australian Defence Force capabilities; and
- Reduces the risk, perceived or real, that the design may pose to Defence personnel, the local community and the environment.

1.3.1 Conflicts between Defence Requirements and Regulations and Standards

Where this policy is in conflict with a relevant standard, DEEP must be consulted.

Where the conflict is with the relevant regulation or standard, the controlling authority must be consulted and DEEP kept informed.

The design will be required to document the conflict and the proposed course of action or approach.

The design shall seek formal Defence approval of the proposed method of resolution and the extent to which the resolution is to be documented for future reference.

All formal approvals shall be documented in the Design Report.

Clear acceptance of these approvals will be reflected in the project files and supporting documentation.

1.4 Referenced Documents

Regulations and Standards

A number of regulations and standards will be applied as a minimum to fuel farm design. Fuel farm components sourced from overseas and the potential use of fuel farm facilities by visiting allied forces may require reference to a range of international/ISO, British and American Standards.

1.4.1 Defence Requirements

Key Defence documents include:

- DEF(AUST)5695B;
- Defence Manual of Fire Protection Engineering (MFPE);
- The Manual of Infrastructure Engineering – Electrical (MIEE)
- BFIMI;
- Defence Estate Quality Management System (DEQMS); and
- Defence Handbooks and Manuals.

1.4.2 Statutory and Local Standards

Key references include:

- Commonwealth, State and Territory regulations (including electricity safety acts and regulations), Codes of Practice, Guidance Notes and Policy Statements; and
- Australian Standards (including AS/NZS 3000 and its referenced standards), (administered by SAI Global).

1.4.3 International Standards

These include:

- International Standards; and
- Allied Military Standards (such as MIL-HDBK1022A “Petroleum Fuel Facilities”).

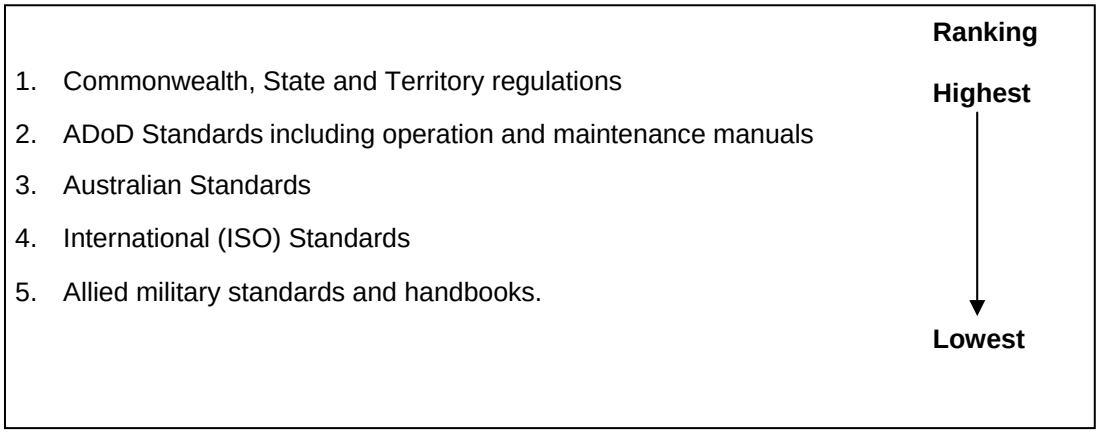
1.4.4 Technical Reference

Technical references include:

- Material safety data sheets issued by fuel refiners / suppliers to be read in conjunction with the relevant Defence Standards; and
- Technical data, operation and maintenance manuals provided by equipment component and control system manufacturers and suppliers.

1.4.5 Ranking

A range of standards applies to fuel farm design. They are ranked in their application, namely:



Where an issue cannot be resolved by reference to a standard at a specific level, reference may be made to the next lowest ranked standard.

1.5 Roles and Responsibilities

Defence Support Group (DSG), through Defence Support Operations division (DSO) is responsible for the provision and maintenance of facilities and fixed infrastructure to support Defence activities and capabilities.

Overall DSG carries the responsibility for the design, construction, and maintenance of fuel farm assets.

Key responsibilities are summarised below:

Assistant Secretary Estate Policy and Environment (ASEPE) is the DSG Technical Authority (TA) for the development and promulgation of Infrastructure Engineering policy.

Directorate of Estate Engineering Policy (DEEP) is the subject-matter expert responsible for developing technical engineering design policy, and for providing technical engineering support pertaining to the management and development of the Defence estate.

Directorate of Estate Maintenance and Policy (DEMP) is the subject matter expert responsible for developing technical engineering maintenance policy, and for providing technical engineering support pertaining to the maintenance of the Defence estate.

Estate Policy and Environment Branch (DSG-EPEB) is the subject matter expert responsible for establishing Defence and local region environmental requirements together with the provision of advice and guidance on all environmental issues relating to fuel farms.

Regional Director (DSO-RD) is responsible for the administration of CMS contracts, which apply to fuel farm facilities and for the administration and delivery of all maintenance and services to the Region.

Base Services Manager (DSO-BSM) is accountable for the delivery of base support management and services including the integrated delivery of agreed support services.

Other Key responsibilities:

The Joint Fuels and Lubricants Agency (JFLA) is the Defence Agency responsible for prescribing the technical integrity program which assures adequate fitness for service, safety and compliance with regulations for environmental protection, for ADF petroleum, oil and lubricants (POL). JFLA can provide authoritative advice on POL products, product specifications, and fuel quality control. This includes advice on fuel quality related aspects of the design and modifications of fuel facilities.

Head of Resident Unit (HRU) is responsible for the delivery of their capability, operational support, force generation and other Group/Service-specific products or service. (i.e. operation of a Military BFI).

COMCARE is responsible for workplace safety, rehabilitation and compensation in the Commonwealth jurisdiction. COMCARE is a statutory authority reporting to the Minister for Employment and Workplace Relations and administers two Acts of Parliament: the Occupational Health & Safety Commonwealth Employment Act 1991 and the Safety, Rehabilitation and Compensation Act 1988.

Operating Agent (OA) as the user of the bulk fuel installations, is responsible for its operation, fuel quality control and performing operating level tasks as agreed with the Maintenance Agent. The OA is also responsible for coordinating other responsible agencies to ensure the ongoing airworthiness and seaworthiness of stored aviation and maritime fuels.

The OA, as the designated “Responsible Person” retains overall responsibility for the fuel farm under all operating scenarios and situations.

The OA consists of the following appointments:

a. **RAAF Base Fuel Quality Control Officer (BFQCO)**
The BFQCO is appointed under the auspices of DEF(AUST)5695B. Either Defence personnel or Contractors under the supervision of the BFQCO manage and operate the RAAF's aviation fuel holdings. The BFQCO will provide technical support and assistance to the OA.

A principal focus will be the Permit to Work (PTW) system. The BFQCO will be trained in the assessment of the need for and application of the PTW as it applies to the specific facility;

b. **RAN Naval Fuel Installation Supervisor (NFIS)**
The NFIS is appointed under the auspices of DEF(AUST)5695B. Either Defence personnel or Contractors under the supervision of the NFIS manage and operate the RAN's maritime fuel holdings;

c. **ARMY Base Fuel Quality Control Officer (BFQCO)**
Either Defence personnel or Contractors under the supervision of BFQCO operate Army's aviation fuel holdings. Such operations are to be in accordance with RAAF requirements above to ensure compliance with airworthiness regulations; and

d. **Garrison Support Services Contractor (GSSC)**
Garrison Support Services Contactors are engaged at some establishments to provide Operating Agent's services. These Contractors operate under the supervision of the respective BFQCO or NFIS.

Maintenance Agent (MA) is responsible for ensuring that all Bulk Fuel Installation (BFI) facility maintenance including any operating level maintenance carried out by others, complies with the requirements of the BFIMI as it applies to fuel farms. The MA is managed through the CMS contract.

Sponsor is the group or individual responsible for the identification and scoping of demand and compliance requirements and the subsequent management of business cases to support the development of fuel farm facilities.

1.6 Sponsor

This policy is sponsored by DEEP on behalf of the Technical Authority ASEPE.

Enquires may be directed to:

Directorate of Estate Engineering and Policy,

Department of Defence,

Brindabella Park (BP-2-B049),

Canberra ACT 2600

Tel: (02) 6266 8178

Fax: (02) 6266 8211

2. Project Delivery

2.1 Master Planning

Project requirements will be determined within Defence by application of the Infrastructure Asset Life-Cycle Business Process. Key components and their inter-relationships are described in the DEQMS. (www.defence.gov.au/IM/im_main.htm)

The process is described in the following flowsheet (Figure 1), extracted from the DEQMS website.

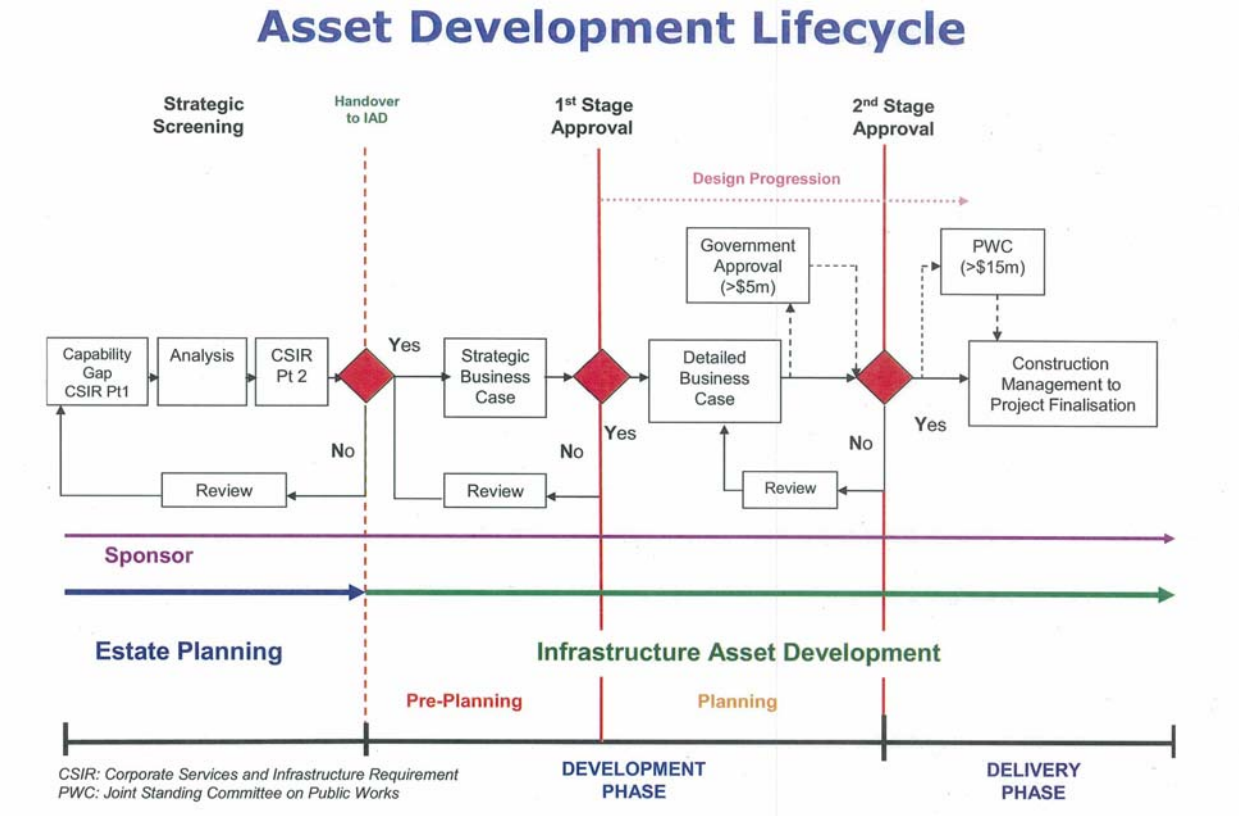


Figure 1 - Asset Development Lifecycle flowsheet

Fuel storage and handling requirements will be determined by reviewing existing (or non existent) facilities against user needs.

Implementation of Government policy by Defence will identify high level strategic needs.

Tactical requirements are likely to arise at Establishment level in response to identified shortcomings of existing systems.

In both cases, where the needs range from strategic to tactical, a capability gap will be determined and progressively conditioned to become the sponsored Strategic Business Case (SBC). Once approved, the SBC triggers the start of the detailed design and the Detailed Business Case (DBC), which draws heavily on the initial detailed design.

The DBC proceeds through to formal approval, which then supports the delivery phase of the project.

- The project delivery process, including cost estimate accuracy level, activities and deliverables required for both SBC and DBC are defined by IAD, and are detailed in the DEQMS (http://www.defence.gov.au/IM/traditional/project_planning/main.htm).

2.2 Design Process

The application of this policy document and procedures detailed in the DEQMS will provide a degree of standardisation of fuel farms. This stems mainly from the prescriptive nature of the various standards, which underpin this policy document.

It is anticipated that over time, a generalised template covering the design development will evolve. Software development in particular will lend itself to a high degree of standardisation and interchangeability across establishments, reflecting the application of standards and the relatively restricted supply of specialised instrumentation and components.

The review processes undertaken by Defence, such as HAZOP studies, reinforce the move to a standardised design and the ability to capture “lessons learned” across user groups.

The design will be developed taking into account:

- Compliance with design standards;
- Project and WOL costs;
- Maintenance of user functional requirements; and
- Utilisation of available and emerging technologies.

2.3 Functional Design Brief (FDB)

The Functional Design Brief (FDB) documents the specific requirements of the facility.

It shall be developed in accordance with the DEQMS and its structure will follow the referenced template. As the template is generally focussed on building and infrastructure development, there is scope within the design management process for it to be tailored to fuel farm applications and location requirements.

The FDB will link directly to the project’s SBC and provide a basis against which the final installation can be certified.

It may include facility functional requirements, existing system condition surveys, geotechnical and environmental assessments, site and heritage surveys.

The FDB will detail general and specific regional requirements and those described in this policy.

2.4 User Requirements Brief (URB)

The URB will describe the Establishment’s specific performance needs and reference any additional information, which is to be factored into the design development.

These will be used as a basis for commissioning demonstration and takeover.

Maintenance of this performance will be demonstrated through the Defects Liability Period.

2.5 Requirements of the Design

The Designer shall be responsible for developing the design in accordance with the FDB, this policy and the applicable regulations and standards. The final design shall deliver a fuel farm which is:

- Fully functional and able to maintain fuel quality as specified in the FDB;
- Sized to meet the URB and configured for ease of expansion to meet strategic requirements;
- Safe to operate and maintain;
- Reliable and flexible in operation;
- Compatible with existing facilities;
- In accordance with Defence policies, procedures and regional requirements; and
- Compliant with Commonwealth, State or Territory legislation.

Once constructed, the Designer shall certify that the installation conforms to these requirements and is ready for the commissioning stage.

2.6 Design Reporting Requirements

The Designer shall issue to the Project Manager design reports which detail:

- The progressed design against the agreed project timeline;
- Design costs to date and the balance to complete;
- The extent of compliance with regulations and standards;
- Design issues and non-compliances and how they are to addressed;

The format and timing for submission of these reports shall be in accordance with the DEQMS and this policy.

3. Documentation Standards

3.1 Background

This chapter describes the requirements for technical documentation required for fuel farm design. It details the document and drawing formats, their content and the sequence of preparation as the design is progressed from functional design level through to tender and construction.

Design documentation will typically comprise the following:

- Design Plan:
    - Refer to Appendix B of the MIEE for design plan requirements;
- Draft Verification Dossier:
    - Prepare a draft Verification Dossier in accordance with the requirements of the Australian Standards suitable for completion by the installation contractor;
- Specifications:
    - Process and mechanical;
    - Civil and building works;
    - Electrical, instrumentation and controls;
    - Environmental protection;
    - Fire protection system; and
    - Commissioning.
- Reports and references;
    - Concept Design Report (CDR);
    - Schematic Design Report (SDR);
    - Detailed Design Report (DDR);
    - Final Design Report (FDR);
    - HAZOP report;
    - Hazardous areas report;
- Equipment and instrument data sheets;
- Bill of materials:
    - Equipment list;
    - Piping list;
    - Instrument list;
    - Valve schedules; and
    - Cable schedules;
- Drawings:
  - Electrical
    - Hazardous areas classification diagram;
    - Electrical single line diagrams;

    - Electrical schematics;
    - Block diagrams;
    - PLC/PC circuit diagrams;
    - Earthing and bonding diagrams;
    - Lightning protection;
    - Cathodic protection systems;
    - Marshalling terminal diagrams;
    - ESD layouts;
    - Switchboard construction;
    - Instrument Specialties;
    - Remote communications and data links;
- Mechanical
    - Layouts;
    - Tanks (plans, elevations, sections);
    - Piping (plans, elevations, sections);
    - Valving and Piping Specialties;
    - Ship to shore connections;
    - Tanker loading/unloading stations;
- Structural
    - Building elevations and plans;
    - Building details;
    - Fencing and security;
    - Foundations;
    - Bunding;
    - Pathways, walkways and points of egress;
- Process
    - Piping & Instrumentation Diagrams;
    - Process Flow Diagrams;
    - Drainage/Water Management/Waste Fuel Management;
    - Oily water systems;
- Fire Protection;
- Labelling;
- Utilities and Services; and
- Drawing Lists, Symbols and Abbreviations

3.2 Documentation Process

The Designer is responsible for the development of documentation which will allow the design to be specified and constructed such that it meets the FDB and is within the approved capital budget.

The design will be formally reviewed at typically the 30% (CDR) and 90% (DDR) completion stages to ensure it meets the requirements described in this policy and is consistent with the various user needs. Formal reporting of the progress of the design is described in the following sections.

Procedurally, the design process and approval of the outcomes at the various milestones will follow the requirements described in the DEQMS.

3.3 Documentation Standards

A high level of importance is attached to the provision of design documentation ranging from initial or concept stage through to its maintenance in the “As-built” form.

The documentation shall be consistent, clear and precise to facilitate its use by stakeholders at each stage of the design and construction processes.

3.3.1 Specification of Equipment

Generally, equipment and materials shall not be specified by proprietary name, model or type. The design documentation shall list the service requirements and detail the material requirements in generic form.

Notwithstanding the above, it is also recognised that fuel farm design is a specialised field and that suppliers have evolved proprietary equipment designs, which specifically address Defence fuel handling and storage issues.

Where appropriate, Defence may elect to describe user requirements in such a way that:

- A standard configuration is to be adopted to facilitate rotation of operators among sites with a similar layout;
- A particular fuel farm may be used as a model or reference (including a “Lessons Learned” assessment); or
- Industry-based inputs are to be considered.

Any design, which nominates components by make or model, is subject to formal approval by Defence. Applications for such approvals shall be via the nominated sponsor (refer Section 1.6).

3.3.2 Text Documentation Format

The formats for all design documentation shall be as follows:

a. The page size shall be A4 but may be A3 where drawings are included;

b. Hardcopy text documents shall be single page printed;

c. Documentation shall be provided in both MS Word© and pdf formats;

d. Tables not in Word format together with calculations shall be provided in both MS Excel© and pdf format;

e. New sections shall commence on new pages;

f. Documents will carry a revision box detailing the document’s development and will include-

   i. A revision number;

   ii. The author’s name;

   iii. The reviewer’s name;

iv. The approver's name; and

v. The date of document approval/issue.

The document may also include the Designer's internal reference number.

3.3.3 Drawings Format

- The drawings shall be clearly legible when printed on A3 sheets.
- All drawings shall be to a professional standard and drawn in accordance with the relevant Australian, IEC or International (ISO) Standards.
- Electronic versions shall be provided in both "dwg" and "pdf" formats.
- Where appropriate, drawings scales must be shown. Sections at different scales presented in the same drawing shall be clearly notated. Graphic scales will be referenced to a particular drawing size.
- Drawings will carry a revision box detailing the document's development and will include:
  - A revision number;
  - A description indicating the principal reason for the revision;
  - The Designer's name and/or initials;
  - The checker's name and / or initials;
  - The approver's name and / or initials; and
  - Date of drawing approval/issue.
- The drawing must include the Defence project reference number and the Designer's internal drawing number and version. Where Defence mandates an assigned drawing number, this number will be used to identify the drawing and include version control;
- Symbols used in the drawing must comply with Australian Standards. Where the use of non-standard symbols is required, they should be intuitive representations of the service items and to the extent possible align with any industry – based symbols. A drawing which describes all symbols used through out the design shall be included in the design package.

The Designer may, with Defence approval, include its corporate logo / company identification on the drawing.

3.4 Requirements for Design Reports

A design report shall be developed which describes the entire design.

For a new facility, it will describe it in its entirety. For a modification to an existing facility, it will describe the modification and outline its impact on the existing/remaining facilities.

For system modifications, the design shall indicate the likely impact on existing facilities. The Change Management provisions of the Comcare sponsored Major Hazard Facilities (MHF) regulations may apply.

The design report will also document changes to utility services and environmental impact.

3.4.1 Design Report Requirements

The Designer shall submit design reports as required by the IM Design Management (www.defence.gov.au/ IM / Design Management/Progression) and in accordance with the respective project requirements.

For fuel farm development, design reports will be required at the following stages for Infrastructure Division (ID) / DEEP review:

a. Concept Design Stage (30%);

b. Schematic Design Stage (50%);

c. Detailed Design Stage (90%); and

d. Final Design Stage (100%).

3.4.1.1 Concept Design Stage

The Concept Design will describe the basic design features selected to address the various user requirements.

The service requirements including strategic reserves, transfer rates and basic configuration will be identified. The design will be graphically outlined using basic Process Flow Diagrams (PFD's) and Piping & Instrumentation Diagrams (P&ID's).

Outcomes will be presented in a formal Concept Design Report (CDR). The extent of design development at this stage is approximately up to 30%.

The first formal HAZOP Study assessment of the design will be conducted at this stage of the development.

The completion of the concept design stage will generally align with the Front End Engineering Design (FEED) milestone encountered in Industry.

3.4.1.2 Schematic Design Stage

The Concept Design will be advanced to the point where it is approximately 50% complete.

Status will be presented in a formal Schematic Design Report (SDR). At this stage, operating parameters and user requirements should be confirmed with the PFD's finalised and the P&ID's reflecting a high level of design certainty.

At this stage the Designer would have addressed the design-based actions identified at the initial HAZOP Study.

3.4.1.3 Detailed Design Stage

The design will be advanced to the point where it represents approximately 90% design completion.

Only minor changes would be anticipated through to 100% completion.

The second formal HAZOP Study will be undertaken. The study will:

a. Indicate that all design actions identified at the Concept Design Stage (30%) have been addressed;

b. Identify those design – based actions which can be closed off prior to completion of the design phase and those that will be held over pending inputs from the commissioning phase or the deflects liability period; and

c. Become a critical input into the design certification process (refer Section 4.2).

Status of this stage of the design will be presented in a formal Detailed Design Report (DDR). The DDR will also summarise the findings of the second HAZOP Study.

3.4.1.4 Final Design Stage

At this stage, the design will essentially be complete, with documentation in a form ready for tender.

A formal Final Design Report (FDR) will be prepared. This report will indicate how the design has been developed and how closure of the design issues has been achieved. It will detail any conditional outcomes which may constrain the design or require additional attention during the construction / commissioning phases.

The FDR will indicate the extent to which the Function Design Brief requirements have been satisfied.

At the completion of the final design, all document revisions will be set to “0” – Issued for Tender.

3.4.2 Design Report Components

Following review of each design report (i.e. CDR, SDR, DDR or FDR) DEEP will advise the need for further design report submissions.

All design report revisions shall be tracked to assist the review process by utilising track changes (per Microsoft Word) or otherwise notated. Changes so marked in any document will only extend to those from the last DEEP approved version. A clean copy of the design report without notation of revisions shall be submitted to Defence, with the version showing revision history made available on request.

The design report shall identify the key design objectives and the logic and approach used to meet these objectives.

The Design Reports will be progressively evolved to include:

a. The proposed scope of works and the system arrangements typically indicated via the PFD’s and P&ID’s;

b. The extent of compliance with Defence policies and guidelines, principal and referenced standards and regulatory requirements;

c. Any deviations from Defence requirements, the basis of such deviations and requirements to Defence acceptance;

d. The basis of sizing of major equipment items, provision for growth and equipment redundancy;

e. Battery limits, tie-in point locations and any supply issues considered;

f. System operation and the extent of system interlocking and safety – based controls; and

g. For the FDR, a statement that the final design meets the requirements of the FDB, this policy, the IM and applicable regulations and design standards.

3.4.3 Hazardous Area Report

Fuels are characterised by flashpoint as being either “flammable” or “combustible” (refer Section 5.6.1). Associated zoning requirements for the storage and handling of these fuels are described in the AS/NZS 60079 suite of Standards.

During the Concept Design Stage, a formal Hazardous Areas Report will be developed. It may be incorporated into the CDR or developed as a separate complimentary report. Its format will also be in accordance with State or Territory workplace requirements.

Electrical components to be installed in any hazardous areas shall be selected for their compliance with hazardous areas requirements. Accordingly, the final classification of hazardous areas is likely to occur by completion of the Schematic Design Stage and certainly prior to the procurement of any such equipment components.

Electrical equipment and instruments selected for hazardous area service shall be certified to ANSEx or IECEx or local standards for the relevant Hazardous Area Zone, protection type and temperature level rating which is also to be stamped on the components. Junction boxes, panels, electric motors and instruments shall be selected for the temperature conditions which they may be exposed to, including sunlight and heat sources. Where practicable, electrical equipment shall be located in a roofed area and/or protected from heat sources.

The hazardous area classification will define the:

- Zone;
- Gas classification;
- Temperature classification;
- Extremes of ambient temperature; and
- Any other requirements specific to the location.

3.5 Shop Drawings

3.5.1 Tender and Construction Documents

Tender and Construction Package documents will be sufficiently detailed to allow the Contractor to submit a representative price for the works and allow its construction with minimum potential for functional or cost variations to Defence.

The document package will consist of:

- Specification;
- Data sheets;
- Drawings;
- Reports; and
- Other documents necessary to define and support the project.

Specifications

Specifications shall address the following points, as applicable:

a. Description of the scope of works;

b. General establishment and service conditions as they relate to the site;

c. General construction standards, methods and materials;

d. Details of the works that have not been included on the drawings or elsewhere;

e. Control system templates and screen formats to be utilised and control philosophies to be followed; and

f. Any special Defence requirements to be addressed for the specific development.

Data Sheets

Data sheets will address the following as applicable:

a. Equipment description;

b. Applicable standards;

c. Equipment service and performance requirements; and

d. Required equipment features and characteristics;

Data sheets will indicate specific design requirements and the information to be confirmed by the supplier / vendor.

Drawings

As a minimum, drawings shall include the following:

a. Site plans showing location of the works piping runs, electrical cabling layouts and any constraints such as separation distances;

b. Equipment and tank layout, including location and size of nozzles, sample points and drains;

c. Piping and Instrumentation Diagrams;

d. Process Flow Diagrams;

e. Electrical hazardous areas classification diagram;

f. General arrangements indicating Plan, Elevation and Sectional views;

g. Single line diagrams of each major substation, HV switching station and distribution substation showing the general configuration, and protection that is proposed;

h. LV single line diagrams of LV primary systems showing the detailed system configuration, protection ratings and any other specific requirements;

i. Cable schedules listing cable ratings, sizes, insulation and core numbers;

j. Electrical schematic wiring including PC/PLC input/output connections;

k. Switchboard construction and the layout of key electrical controls and cable ducts;

l. Switches, glands, cabling and electrical appliances with a unique ID consistent with the equipment list in the Electrical hazardous areas classification diagram;

m. Earthing and bonding protection systems; and

n. Fire detection and suppression systems.

3.6 Shop Drawing Requirements

Detailed shop drawings shall be prepared covering all aspects of the works.

The Designer shall review the shop drawings and any other technical submissions to ensure that the proposed works comply with the design intent and are fully compliant with the referenced standards.

As a minimum, drawings shall include the following:

Valve and Line Lists

Detailing:

a. Tag numbers;

b. Nominal size and pressure class;

c. Manufacturer's standards;

d. Test and performance standards;

e. Joint and connection details;

f. Materials of construction including sealing materials; and

g. Any special Defence requirements.

Cabling

Detailing:

a. Cable schedules, field wiring diagrams and interconnection cabling diagrams. Cable sizes and numbering will be described; and

b. The final locations of cables, pits, cable joints, cable ladders etc..

Equipment Listing

Detailing:

a. Datasheet references;

b. Applicable machine design and construction standards;

c. Make, model and type of proprietary equipment;

d. Certified machine drawings; and

e. Ex rating and any additional inspection/maintenance as required by either the manufacturer or the Ex Certifying agency.

Electrical Panel and Switchboards

For electrical switchboards and panels, shop drawings will detail the following:

a. General assembly drawings showing the arrangement of the switchboard and detail:

    - Materials of construction;
    - Special construction features;
    - Location of both external and internal components;
    - Air circulation and filtration systems;
    - Busbar details;
    - Painting;
    - Labelling; and
    - Door details.

b. A single line diagram of the entire switchboard.

PLC and Instrumentation Systems

Detailing for systems containing PLCs or instrumentation systems:

a. Control configuration / architecture;

b. I/O schedules and drawings;

c. Loop drawings; and

d. OIU screen formats.

3.7 As-Built Documentation

3.7.1 As-Built Drawings

At the completion of construction, both the Construction design drawings and Shop Drawings shall be updated to reflect any changes that have occurred during the construction phase. The Designer shall verify that the updates accurately reflect the as-constructed configuration.

3.7.2 Operation and Maintenance Manuals

Comprehensive Operations and Maintenance (O&M) Manuals shall be provided to facilitate efficient operation and maintenance of the facility.

Depending upon the scope of works and the condition of any existing manuals, project information can be captured in either of two ways:

a. The new manuals shall incorporate the relevant sections of the existing manuals; or

b. The existing manuals shall be updated to reflect the new works.

Final format and content will be submitted for formal acceptance by the CMS.

In any case the information on redundant equipment shall not be left in manuals and active files.

Where not revised, existing drawings will be physically notated to show tie-in points for the new works.

The manuals shall contain short and long form operating instructions and a comprehensive maintenance schedule. The format of the maintenance schedule shall be consistent with that described in the BFIMI.

The text of the Operating and Maintenance Manuals, together with all drawings, illustrations and diagrams shall refer specifically to the equipment being supplied, and shall be specially prepared where necessary. General or generic instructions referring to typical equipment will not be acceptable.

Binders

The Operating and Maintenance Manuals shall be presented bound in four-ring black plastic coated A4 binders. These will be of heavy-duty construction with split prongs and designed for rough usage. The binder shall carry the project title, functional description/title and the Contractor's name, imprinted on the spine and the front cover.

Binders shall not exceed 75 mm in thickness when closed. If required, multiple binders shall be supplied, each clearly marked with a number. Each shall contain a full index for the entire manual and also a detailed index for its own content. The number of binders will be sufficient to ensure that the material contained in each (including drawings, if any) does not use more that 80 percent of that binder's capacity.

4. Certification and Verification

4.1 Conflicts between Defence Requirements and Regulations and Standards

The requirements describing the methods to be used by the Designer to resolve any conflicts between Defence requirements and the nominated regulations or standards are described in Section 1.3.1.

Importantly, DEEP must be kept informed of the approach to be taken by the Designer. Formal acceptance by Defence of the recommended approach does not in itself exonerate or release the Designer from ensuring the design meets the project brief.

4.2 Certification

All new fuel farm construction and major refurbishment projects must be certified that they meet the requirements prescribed in:

- This policy document;
- The referenced regulations and standards; and
- The codes of practice applicable to the region.

In addition to changes to physical assets, a major refurbishment may also include modification to control software, strategic fuel stockholdings, operational requirements, etc.

Demonstration of compliance with the local regulations and/or standards alone does not automatically infer a level of certification acceptable to Defence.

Defence requires the consultant to certify the design and all associated works as being fit for purpose, safe and in compliance with Defence requirements, described in the FDB and URB. Personnel nominated to undertake the certification shall be qualified to the level of CPEng as administered by Engineers Australia or have met the requirements for registration of the National Engineering Registration Board e.g. NPER.

Refer to the MIEE for requirements related to certification of hazardous areas.

Special certification requirements will be listed in the Commissioning and Handover Report as detailed in the DEQMS.

4.2.1 Design Certificates

Defence contracts require the Designer and where appropriate any sub-consultants engaged by the Designer to issue a formal design certificate which:

- Confirms that the final (and installed) design complies with the project's documentation; and
- Demonstrates that the design documentation complies with the requirements of the Contract and all applicable statutory regulations, where these requirements are defined in Section 1.2.

In addition to the certificate, the Designer will also provide copies in final revision of:

- The Design Report (refer Section 3.4); and
- The HAZOP Study report, which indicates any conditional acceptances (refer Section 4.4).

4.2.2 Hazardous Areas

The Designer shall certify that electrical installations located within hazardous areas are in accordance with Defence requirements and local applicable regulations.

Hazardous areas are those defined by application of the AS/NZS 60079 suite of standards. The Designer shall prepare a formal report, which summarises the classification of each of the areas/localities covered in the design and detail the basis for the assignment of area zoning.

All equipment installed in hazardous areas must have suitable ANZEx or IECEx certification appropriate for the application. All items must be properly labelled in accordance with the relevant standards.

4.3 Verification

Verification is the method by which design compliance can be demonstrated. It complements the certification process outlined above and is conducted in accordance with Design Management/Progression described in the DEQMS.

4.4 Alternative Design

Given the nature of existing fuel farms, local operational requirements and the on-going development of equipment and technical methods, a design approach not necessarily in accordance with this policy may be required.

In such cases, the Designer may seek the approval of the Defence Technical Authority for an alternative design or approach to be considered.

The primary drivers for acceptance by the Authority will be that facility safety and environmental compliance, Defence strategic capability, fuel product quality and Whole of Life cost performance are no worse than the options presented by application of this policy.

The acceptance of the alternative design will take into account previous performance and success, assessment of risk of failure and feedback from commercial industry.

Acceptance by Defence of any alternative method does not reduce the Designer's responsibilities to ensure that the project design requirements (as described by the project brief and application of this policy) and statutory requirements are met.

Alternative designs should be identified early in the design process, ideally at the concept or FEED stage prior to the commencement of detailed design.

4.4.1 Design Acceptance

The formal acceptance would be initiated by the Designer identifying the alternative approach.

Notwithstanding the requirements of Section 3.3.1, a description and reasons justifying the alternative would be documented by the Designer and forwarded to the Defence Project Officer. The Designer shall provide a high level of technical detail to describe and support the alternative, given the requirement to maintain agreed project timelines.

Note: alternative designs identified by Defence would be reflected in the Functional Design Brief.

The Designer's formal request will then be forwarded to the Assistant Secretary Estate Policy and Environment (ASEPE) for approval. As the responsible Technical Authority, ASEPE would seek a technical assessment and recommendation from DEEP to either approve or reject the alternative design.

ASEPE's request for assessment and recommendation should take the form of a Minute, with provision for the various levels of review, recommendation and approval. The Minute shall be prepared by DEEP and clearly describe:

a. The alternative design;

b. Its design features;

c. The justification for acceptance of the alternative over that described in this policy;

d. Technical assessment of the alternatives features including:

    1. Compliance with safety and environmental standards;
    2. Impact on Defence capabilities and strategic reserves;
    3. Maintenance of fuel quality (particularly during periods of low tempo); and
    4. The extent of compatibility of the alternative design with service requirements described in Sections 5.4 of this policy.

e. The impact of costs on delivery of the project and its WOL performance; and

f. Impact on design certification.

Copies of technical reports and assessments sought by DEEP shall form an attachment to the Minute.

Copies of finalised requests (approved or rejected) shall be forwarded to the Designer and the Defence Project Officer/Project Director. The original request should be held on the Defence project file.

5. General Requirements

5.1 Introduction

Defence fuel farm facilities shall conform to the requirements of all applicable Commonwealth, State or Territory legislation, codes of practice and guidance documents.

The principal design standard covering fuel farm design is AS 1940.

Where Australian Standards are not available, recognised international or allied military standards may be used. In all cases where the adopted standard is not Australian based, Defence approval shall be required.

The basis of selection of a final design will be the extent to which the design:

- Offers value for money, assessed on a Whole-of-Life basis;
- Meets or exceeds the requirements set by the relevant standards;
- Demonstrates compliance with personnel WHS (formerly OH&S) and Defence environmental protection policies; and
- Enables Defence to meet its operational and strategic capability responsibilities.

Unless otherwise mandated by Defence or the issuing standards authority, Australian Standards shall not be applied retrospectively to existing facilities. Prevailing standards shall be applied to all new facilities and modifications to existing installations.

5.2 Service Life

Fuel farms will be designed and installed to operate continuously with 100% availability at the extremes of temperature and humidity without loss of facility or reduction in fuel quality.

Equipment should be selected to ensure that the fuel farm can be reliably operated and maintained without loss of major components. As a guide, the following service life requirements should be adopted:

Component Type	**Design Life Requirements (Years)**
Non structural concrete	100
Structural concrete	75
Structural steelwork	50
Mechanical components	20
Electrical components	20
Instrumentation	10
Process Controls	10

5.3 Siting

Sites that will locate all new facilities and major modifications to existing fuel farms will be subjected to a geotechnical survey to the extent required to ensure that service life and environmental compliance can be achieved.

5.4 Equipment Selection

5.4.1 Standardisation

To the extent possible, the fuel farm conceptual design, selected components and software architecture should be standardised.

Standardisation will be applied firstly across fuel facilities within an establishment and then the region. It will focus on optimising the interchange ability of components and spare parts inventories.

The standardisation will drive the adoption of a common system hardware and control architecture configuration.

In addition to the material advantages of this approach, it will also provide an opportunity for the development of staff training programs having a common basis.

DEEP will oversee and co-ordinate fuel farm standardisation programs.

DEEP will advise the requirements to be addressed by the design process. The requirements will be regularly reviewed for compliance with prevailing standards and regulations, industry practices and feedback from “lessons learned” investigations.

When current standard components are to be replaced because they can no longer be supported, are obsolete or the technology is outmoded, the latest equipment shall be considered. DEEP guidance shall be sought and agreement required before specifying replacement major components or systems.

New standard equipment is to be provided for the facility through an appropriate performance specification. Performance specifications are to be referred to DEEP for comment prior to issue for tender and the selected equipment is to be reviewed by DEEP prior to procurement. Design reports, Tender Evaluation Board reports and technical evaluation reports are to be used for this purpose.

5.4.2 Supportability

Equipment shall be selected in part for the ability of the supplier to support it into the future, noting the design life targets referred in Section 5.2.

All equipment and associated spare parts shall be readily supported in Australia and ideally within the local region. Control software shall be selected giving consideration to the supplier’s ability to maintain access to control software and the ability to revise and update software within the context of Defence security requirements.

For major equipment items and systems, the supplier may be required to submit a Statement of Supportability, which confirms the commitment to support the component over its projected life. This statement will be in addition to any warranties or guarantees provided under commercial contract.

5.4.3 Maintainability

Fuel farms shall be designed for ease of component servicing and maintenance.

The layout and selection of equipment items shall take into account hazardous areas zoning issues and prevailing Defence and local WHS (formerly OH&S) compliance. The 90% design HAZOP requires the involvement of CMS personnel and Contractors and this presents a major opportunity for maintainability requirements to be considered and documented.

The performance and maintainability of existing equipment items will form a benchmark for the selection of any proposed equipment.

The Designer shall assess the requirements for critical spares to meet commissioning and on-going service operations. These spares will form part of the procurement contract.

5.4.4 Sustainability

The Designer shall consider where practical the following questions in relation to sustainability when undertaking fuel farm design assignments. The questions apply to both the materials to be selected in the farm's construction and operation together with its ability to safely store and handle fuels.

- Does the system minimise the quantity of fuel lost during storage, transfer and sampling operations?
- Does the design solution consider the lowest energy usage in relation to material manufacture, construction, operation, maintenance and deactivation?
- Can existing material, renewable or recycled material be utilised as an alternative to materials from non-sustainable sources?
- Has the use of hazardous materials been minimised in the construction and/or future operation?
- Can alternative energy sources be utilised as an alternative to reticulated electricity, gas or oil?
- Is there a potential to minimise complexity in manufacturing and construction, specialisation in operations or maintenance, special materials and procedures, quantity/size/volume/wastage etc?
- Is there the potential to maximise standardisation of components, energy recovery, parts life, parts recovery/reuse etc?
- Does the siting of the project consider impacts on biodiversity, the community and heritage, consistent with formal Defence Environment and Heritage policies?

5.5 Safety

5.5.1 Personnel Safety

The design shall minimise the potential for personnel to come into unexpected contact with fuels. This will be achieved by:

- Avoidance of unwanted or reverse flow conditions;
- Controlled depressurisation of pressurised fuel systems;
- Line isolation via:
  - Tagging procedures;
  - Lock-out procedures;
  - Double block/Double Block & Bleed Valving; and
  - Line Blinds Spade and Spectacle Blinds.
- Use of specialised fittings such as "dry-break" couplings; and

- Together with procedural requirements mandated at Establishment level and referenced in Defence standards, principally DEF(AUST)5695B.

5.5.2 Line Isolation

Line isolation is provided in the first instance to isolate facilities for maintenance purposes from active plant and for product segregation needs.

Line isolation will be achieved through the creation of a physical barrier by the use of open or closed valves, spool piece removal or installation of rated line spades either singly or in any combination. Figure 2 shows typical line isolation systems.

Such devices shall be pressure rated for ANSI Class 150 (PN 20) defined as the maximum for low pressure systems.

Valve tagging alone may only be used for short term isolation and where OA and MA staff remain unchanged. On this basis, short term isolation cannot extend beyond one shift.

A single block valve consists of a single assembly of two single block valves where the contiguous connection is not vented.

A double block and bleed assembly is one where a double block valve assembly's contiguous connection is fitted with a bleed valve (typically DN 25 size) vented to atmosphere. A pressure gauge may be installed adjacent to the bleed valve.

Check or non-return valves shall not be used as a means of safe isolation.

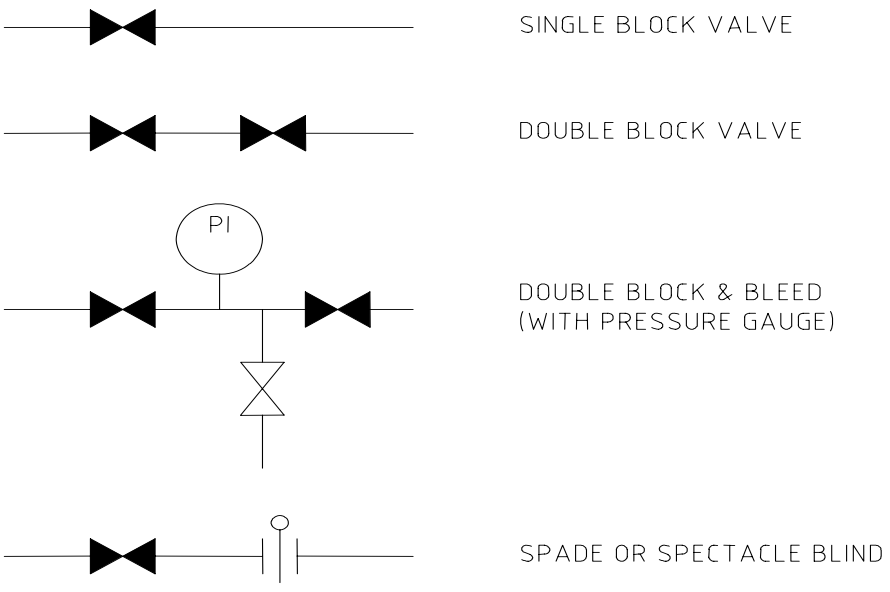


Figure 2 - Typical line isolation systems

5.5.3 Equipment Safety

Safety of equipment during construction, commissioning, operation, and maintenance shall form part of the selection criteria for such items in accordance with Section 5.4.

Access to and the ability to adjust or change critical features of the control system software shall be adequately protected to ensure that system performance cannot be degraded.

Software changes shall be password protected and follow a secure protocol such as the Management of Change process detailed in the MHF Regulations, administered by Comcare.

5.5.4 Fire Safety

As a minimum, fuel farm fire safety will be in accordance with the Manual for Fire Protection Engineering and the Building Code of Australia. Reference may also be made to local and international standards, particularly NSW HIPAP and NFPA.

Depending on the fuel service and the separation distances from protected works required by AS 1940, a formal fire safety study may be required. The study outcome may require a hazard risk assessment - typically quantitative, semi-quantitative or qualitative - to be undertaken.

5.6 Design Requirements

5.6.1 Fuel Types

For the application of AS 1940 and the associated commercial design standards, fuels are characterised by flash point as being either "**flammable**" or "**combustible**". It is this characterisation, which determines the extent and function of fuel farm design.

For Defence applications, fuels are further described in *DEF(AUST)206 "Handbook of Liquid Fuels, Lubricants and Allied Products"*.

This publication defines all fuels (military and civil) potentially required to be held by an ADF BFI, depending on its application, and the conditions under which they need to be held. Importantly, it details special additives and quality requirements which may differentiate the fuel from its supposed commercial equivalent.

This standard describes:

- Special parameters;
- Restrictions on use and storage; and
- Equivalent military or commercial fuels which may be substituted with or without conditions.

As an example: the addition of the additive FSII to kerosene-based turbine fuel to produce F34 Avtur does not produce a product identical to the commercial turbine fuel JET-A1. FSII is hygroscopic by design and therefore more robust means to remove water from fuel held in a BFI are required for F-34 than for Jet A-1. Similarly, Navy F76 slightly differs from commercial diesel grades.

The Designer is cautioned that reference to such commercial products or statements such as "compatible with jet fuel" do not automatically infer suitability with fuels referenced in DEF(AUST)5695B. Where direct compatibility cannot be demonstrated, additional supplier-based testing may be necessary or consideration abandoned.

Once characterised, the associated classification requirements for fuel storage and handling are described in the AS/NZS 60079 suite of standards.

5.6.2 Fuel Movements

All fuel movements shall be filtered during offloading, dispensing and recirculation operations. Filtration requirements, including design standards for filter units, are specified in DEF(AUST)5695B. Unless specifically approved, filter/coalescers shall not be fitted with bypass facilities.

Refer to Figure 3 below:

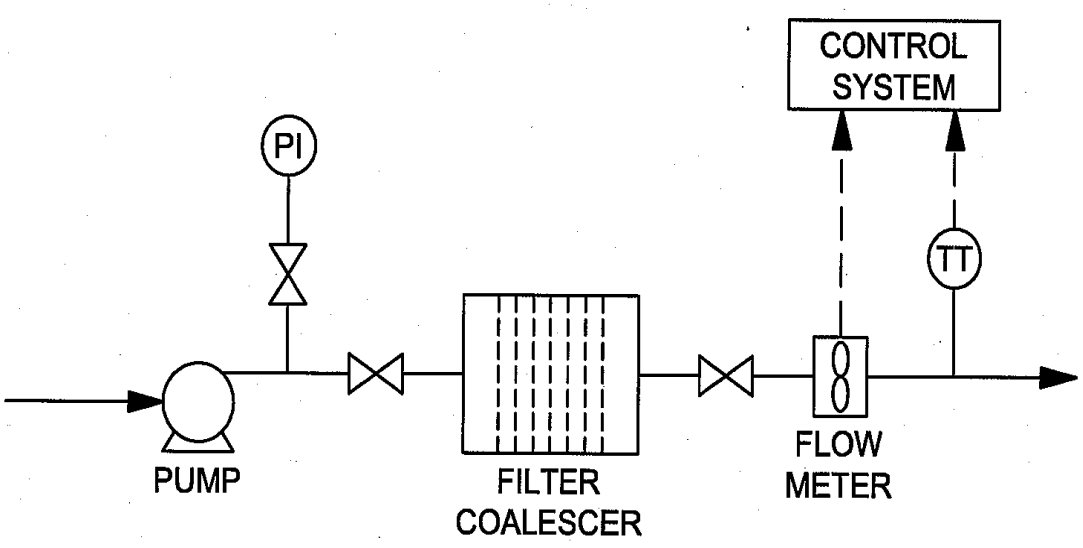


Figure 3 - Filtration system

Fuel flows will be metered to provide an instantaneous flow rate and a derived totalised flow. Flowrates will be temperature corrected to 15°C.

Fuel quantities (tank levels) in bulk storage will be continuously monitored. Any unexplained tank level change (± 2%) shall be alarmed and any associated operations shall be interrupted.

For offloading and dispensing, the change in tank level expressed as volume shall equate to the totalised flow to a tolerance of 2%.

Refer Figure 4 below:

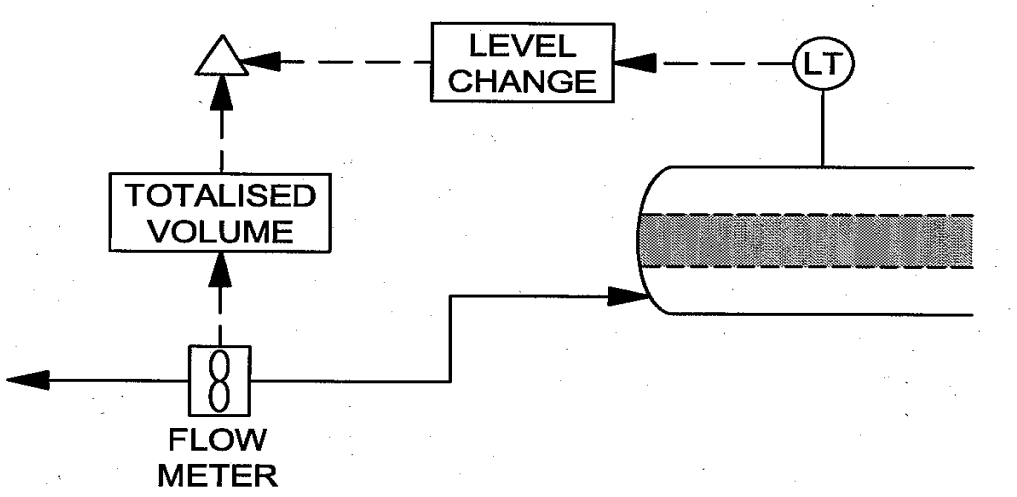


Figure 4 - Bulk storage continuous monitoring system

Fuel withdrawn for any reason from fuel storage or transfer system will not be automatically returned to the system unless its condition can be validated in accordance with BFQC or NFI procedures. Such volumes will either be returned to storage via an installed QCI system or discarded to a fuel slops management system.

Tank level, fuel flow and fuel temperature derived signals will be in a form suitable for use in remote monitoring and control applications.

5.6.3 Emergency Alarms

When activated, the following alarms will cause all fuel transfer operations to cease and require human intervention:

- Any emergency shutdown switch is manually operated;
- Any safety shower or eye was station is activated, unless bypassed for test purposes;
- Any fire alarm is activated;
  Note: Any local fire Break-Glass alarm (BGA) will be linked to the Establishment or Base fire alarm system.
- Any alarm override systems provided to enable system testing will be key-operated for bypass or isolation and time delay automatic reset if the period of isolation is exceeded.

5.6.4 Tanks

Pump priming problems may be experienced when attempting to return an empty tank to service after major maintenance or inspection. These problems can be exacerbated by the presence of an internal floating suction line. “Dry-break” couplings should be installed on the tank connections to help prevent fuel spills to ground. The couplings should also permit the cross-connection of a hose. By pressurising

the off-loading header, such a hose enables fuel flow back through the floating suction, displacing air pockets that may be present when a tank is brought into service. Refer to Figure 5 below:

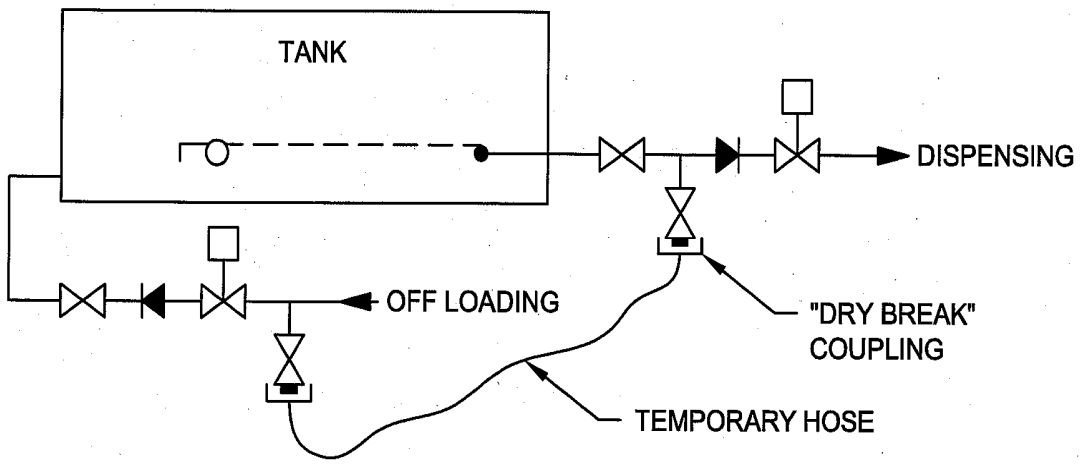


Figure 5 - Dry-break couplings installed on tank connections

5.7 Pipeline Hydrostatic Testing

New fuel pipework and modifications to existing which could potentially alter the pipework's integrity shall be tested to confirm that it conforms to the specified pipe pressure code/class.

Unless otherwise specified the testing shall be non-destructive. The default shall be hydrostatic testing in accordance with AS 4041 Section 6.7. The Designers shall specify the hold test pressure and the hold period for each pipe section to be tested.

Test medium selection shall take into account:

- Potential impact on the environment from a leak or fluid handling;
- Risks to personnel; and
- Hazards associated with subsequent repair / make-good e.g. via hot work.

For hydrostatic testing compressible fluids (gases) are not acceptable.

Additional requirements for hydrostatic testing are described in Sections 6.2 and 6.12.

5.7.1 Test Medium - Water

For hydrostatic testing the fluid medium should ideally be water, unless otherwise specified. Specific requirements with respect to the handling of water and drying of fuel lines are described in Section 6.2 of this document and in API/EI 1594 "Initial Pressure Strength Testing of Airport Fuel Hydrant Systems, 2nd edition".

5.7.2 Test Medium - Fuel

The use of fuel as the test medium requires a risk assessment and formal involvement of regional Defence staff.

Allowances shall be made for:

- Fuel storage and handling, usually via temporary hoses;
- Quarantine and segregation of fuel used for testing; and
- Spill / leak management particularly.
  - Retention;
  - Containment; and
  - Pipeline “defueling” and “degassing” for safe repair.

5.7.3 Pipeline Cleaning and Drying

Following a successful hydrostatic test the pipeline shall be cleaned and dried so that service fuel quality can be maintained at levels consistent with DEF(AUST)206 and DEF(AUST)5695B Part 5 “POL SAMPLING AND TESTING REQUIREMENTS”. API/EI 1585 “Guidance in the Cleaning of Aviation Fuel Hydrant Systems at Airports” should also be consulted.

Part 2 Technical Requirements

Contents

6. Key Elements

6.1 System Capability

Fuel Types:	◗ All; and ◗ DEF(AUST)206 – Handbook of Liquid Fuels, Lubricants and Allied Products.
Principal Standards:	◗ AS 1940 – The Storage and Handling of Flammable and Combustible Liquids; ◗ API RP 2350 – Overfill Protection for Storage Tanks in Petroleum Facilities; and ◗ Infrastructure Management (IM).
Reference Standards:	
Guidance:	◗ DEF(AUST)5695B – Petroleum, Oils and Lubricants Manual.; and ◗ MIL HDBK 1022A – Petroleum Fuel Facilities.
Commentary:	
System capabilities and requirements will be described in the Functional Design Brief and the User Requirements Brief.	

General Requirements:

1. Refer to referenced standards.
2. Maximum and minimum fuel flow rates and strategic stockholdings raise issues of operational turndown and fuel stockholding turnover respectively. The Designer shall validate all design requirements under maximum and minimum operational conditions.
3. The bulk fuel installation shall provide a safe working environment complying with legislation, Defence regulations, relevant Codes of Practice, Australian Standards and proven Industrial Practices, including fuel spill prevention, environmental protection, dangerous goods storage, fire protection, electrical safety and worksite practices.
4. The bulk fuel installation shall be cost-effective in capital and running costs over the life expectancy of 25 years or more. A detailed life costing analysis with consideration of the design life of the individual components of the fuel farm will be required as part of the preliminary design.
5. The bulk fuel installation shall deliver high quality fuel complying with the relevant Defence fuel specification, the fuel quality control and fuel technical integrity requirements for BFIs required in Parts 4 and 5 of DEF (AUST)5695B, deliver fuel efficiently in service and be easy to operate.
6. The Designer shall review refuelling capability requirements to recommend the optimum refuelling capabilities including flow and pressure during the preliminary design stage. An interactive systems analysis shall be carried out to demonstrate that the design of pumps and systems are optimised under the normal operations. The interaction of single and multiple pump operation and system hydraulics shall be considered. The review shall also clearly identify the costs associated with various design conditions to enable Defence to make an informed decision.
7. The design shall be simple to operate and maintain. Complicated configurations shall be avoided. To the extent possible, direction of fuel flows will be determined visually from the piping layout.

Storage

8. Storage working capacity denotes the maximum usable volume of fuel in a tank. The design shall calculate working capacities considering location of the facilities in relation with fuel suppliers, stock requirements, fuel supply reaction times and user group requirements. Final working capacities will be subject to Defence review and approval.
9. Total tank storage capacity consists of working capacity plus high, high-high, low and low-low volume allowance. The total storage capacity of fuel tanks shall be defined consistent with API 2350.

Refuelling Capability of Bulk Fuel Installation

10. A new bulk fuel installation should be designed to meet the following minimum requirements:

With QCI

a. Offloading fuel from offloading fuel tanker vehicle(s) into any one of the QCI tanks;
b. Transferring fuel from any one of the fuel storage tanks (including QCI tanks) to any other;
c. Circulating fuel of a storage tank via a filter/separator to improve fuel quality;
d. Dispensing fuel to refuelling tanker vehicle(s) from any one of the fuel storage tanks including the QCI tanks;
e. Offloading fuel from offloading fuel tanker vehicle(s) while refuelling tanker vehicle(s) are being replenished;
f. Allowing quality control and tests in any one of the storage tanks;
g. Meter proving (where installed) to allow periodic comparison testing between flow meters;
h. Allowing offloading and/or dispensing during emergency in the event of damage of offloading points and/or dispensing points;
i. Transferring fuel between bulk fuel installations (where required); and
j. Some of the foregoing operations may not be performed simultaneously.

Without QCI

a. Offloading fuel from offloading fuel tanker vehicle(s) into any tank;
b. Transferring fuel from any one of the fuel storage tanks (including QCI tanks) to any other;
c. Circulating fuel of a storage tank via a filter/separator to improve fuel quality;
d. Dispensing fuel to refuelling tanker vehicle(s) from any one of the fuel storage tanks including the QCI tanks;
e. Offloading fuel from offloading fuel tanker vehicle(s) while refuelling tanker vehicle(s) are being replenished;
f. Allowing quality control and tests in any one of the storage tanks;
g. Meter proving (where installed) to allow periodic comparison testing between flow meters;
h. Allowing offloading and/or dispensing during emergency in the event of damage of offloading points and/or dispensing points;

i. Transferring fuel between bulk fuel installations (where required); and

j. Some of the foregoing operations may not be performed simultaneously.

Refuelling Capability of a Hydrant Refuelling System

11. A new aviation hydrant refuelling system should be designed to meet the following minimum requirements in general:

    a. As a user requirement guide the number of hydrants is typically limited to eight (8);

    b. A maximum of six (6 off) HPs out of the total are to be used simultaneously unless otherwise advised;

    c. When only one HP is used, fuel is to be delivered at 3200 litres per minute unless otherwise advised;

    d. When any number of HPs is used, the total volume of fuel to be delivered will be in accordance with this section - Items (a) through (c) above;

    e. The fuel flow rate from a hydrant point can be controlled from a minimum of 400 litres per minute to a maximum of 3200 litres per minute (i.e. turndown ratio 8:1) unless otherwise advised;

    f. Redundancy in design should ensure a minimum of 50% pumping capability during the maintenance of a hydrant refuelling pump;

    g. Redundancy in design should ensure that 100% source of fuel supply for refuelling via road tanker is available during the maintenance of the hydrant refuelling system;

    h. The design should achieve the minimum flowrate of 400 litres per minute at the most (C4) hydraulically disadvantaged hydrant refuelling point at full flow condition of the hydrant refuelling system unless otherwise advised;

    i. Normal operating pressure at a hydrant point in a new hydrant refilling system is greater than 750 kPa in general. Minimum operating pressure at the most disadvantaged hydrant point is 750 kPa. Maximum operating pressure at the most disadvantaged hydrant point is 950 kPa unless otherwise advised; and

    j. When an existing system is extended, the operating pressure at a new hydrant point will be limited by that in the existing system.

Bulk Fuel Installation for Both Vehicle Refilling and Hydrant Refilling

12. During hydrant refuelling operations, the fuel farm is capable of the following operations (where practicable):

    a. Offloading fuel from fuel tanker vehicle(s) into any QCI tank(s);

    b. Allowing quality control and inspection of received fuel in any one of the fuel storage tanks;

    c. Refuelling hydrant points from designated fuel storage tanks;

    d. Dispensing fuel to refuelling tanker vehicle(s) from designated fuel storage tanks; and

    e. Some of the foregoing operations may not be performed simultaneously.

Metering

13. Bulk fuel installations require flow metering at each offloading point and dispensing point for inventory control.

14. Meter proofing is required at routine intervals as specified by Base operations and/or BFIMI.

6.2 Commissioning

Fuel Types:	◗ All; and ◗ DEF(AUST)206 – Handbook of Liquid Fuels, Lubricants and Allied Products.
Principal Standards:	◗ AS/NZS 1020 – The Control of Undesirable Static Electricity; ◗ AS 1076 Series – Code of Practice for Selection, Installation and Maintenance of Electrical Apparatus and Associated Equipment for use in Explosive Atmospheres (other than Mining Applications); ◗ AS/NZS 1200 – Pressure Equipment; ◗ AS/NZS 1518 – External Extruded High-Density-Polyethylene Coating for Pipes; ◗ AS 1692 – Tanks for Flammable and Combustible Liquids; ◗ AS/NZS 1768 – Lightning Protection; ◗ AS 1940 – The Storage and Handling of Flammable and Combustible Liquids; ◗ AS 2381 Series – Electrical Equipment for Explosive Atmospheres – Selection, Installation and Maintenance; ◗ AS/NZS 2832 Series – Cathodic Protection of Metals; ◗ AS/NS 2885 Series – Pipelines – Gas and Liquid Petroleum; ◗ AS/NZS 3000 – Electrical Installations (known as the Australian/New Zealand Wiring Rules); ◗ AS/NZS 3017 – Electrical Installations – Testing and Inspection Guidelines; ◗ AS/NZS 3100 – Approval and Test Specification – General Requirements for Electrical Equipment; ◗ AS 3846 – The Handling and Transport of Dangerous Goods in Port Areas; ◗ AS 3892 – Pressure Equipment – Installation; ◗ AS 3894 Series – Site Testing of Protective Coatings; ◗ AS 4041 – Pressure Piping; ◗ AS/NZS 60079 – Electrical Apparatus for Explosive Gas Atmospheres – Classification of Hazardous Areas; and ◗ API Std 650 – Welded Steel Tanks for Oil Storage.
Reference Standards:	◗ Defence Safety Manuals (SAFETYMAN); ◗ The Manual of Infrastructure Engineering – Electrical (MIEE) ◗ The Manual of Fire Protection Engineering (MFPE); ◗ Internal Painting of ADF Bulk Military Fuel Storage Tanks; ◗ Installation of Residual Current Devices In The Workplace – New and Refurbished Facilities; ◗ NOHSC:1015 – Storage and Handling of Workplace Dangerous Goods – NATIONAL STANDARD; and

	◗ NOHSC:2017- Storage and Handling of Workplace Dangerous Goods – NATIONAL CODE OF PRACTICE.
Guidance:	◗ The Work Health and Safety Act 2011 (formerly Occupational Health and Safety Act 1994); ◗ DEF(AUST)5695B – Petroleum, Oils and Lubricants Manual; ◗ MIL-HDBK 1022A – Petroleum Fuel Facilities; ◗ UK Defence Works Functional Standard Design & Maintenance Guide 05 – Specification for Specialist Works on Petroleum Installations – Mechanical; ◗ AS 2885.3 - Pipelines – Gas and Liquid Petroleum: Operations and Maintenance; ◗ AS 4897 – The Design, Installation and Operation of Underground Petroleum Storage Systems; ◗ API RP 1540 – Design, Construction, Operation and Maintenance of Aviation Fuelling Facilities; ◗ API/EI 1585 – Guidance in the Cleaning of Aviation Fuel Hydrant Systems at Airports ; and ◗ Australian Dangerous Goods Code.
Commentary:	

General Requirements:

1. Refer requirements detailed in Defence Infrastructure Management – Commissioning, Handover and Takeover.
2. Commissioning refers to operation of all the constituent functions of the completed works using fuels and all other working media, as far as possible, under actual working conditions.
3. The Contractor shall comply with Commonwealth of Australia's legislation and Defence regulations in safety on petroleum Installations, in particular, from the time that fuel is introduced to the works.
4. Commissioning shall ensure that:
    a. The operation of all the constituent functions of the completed works are satisfactory;
    b. The integrity of the completed works is satisfactory;
    c. Water used in testing procedures has been removed and all pipework and equipment dried to avoid fuel contamination;
    d. The fuel to be dispensed from the completed works must be of a high standard of cleanliness; and
    e. Commissioning shall not commence until a hazardous area verification dossier is in place, the electrical installation has been verified as safe by a competent person and the electrical safety regulator requirements have been met.

Pre Commissioning

5. The Contractor shall take all steps necessary during commissioning to reduce accidental loss of fuel or other oils to a minimum and contain any such leakage. The Contractor shall be responsible for any spills of fuel or oil that shall be cleaned up immediately they occur and any remediation of the ground that may be required. The Contractor shall be responsible for the disposal of fuel after commissioning in accordance with legislation.
6. The Contactor shall complete all works covered by the project and any other associated works that can be completed prior to the introduction of fuel into the system.
7. The Contractor shall prepare commissioning plans detailing the tests to be carried out and the programme and procedures. Reference must be made to the Commonwealth of Australia's legislation and Defence regulations in safety. This must incorporate procedures for the works. This must incorporate proposed emergency procedures that will be undertaken in the event of a site spillage. The commissioning plans shall be submitted to Defence for approval before commissioning is due to commence.
8. Defence shall be notified in writing of the proposed fuel supplies for commissioning or hydrostatic testing before they are required. The final requirement for fuel supplies shall be confirmed to Defence before the fuel is required at the site.
9. In cases where fuel is to be used for testing/commissioning, Defence will be responsible for the supply of fuel in limited quantities. The Designer/Contractor should estimate this quantity of fuel during the design phase and obtain agreement from Defence for the supply of the fuel. Any excessive quantity of fuel will be supplied by Defence and shall be paid by the Contractor. This requirement ensures that a high level of quality control in works will be maintained to minimise fuel leakage and area contamination in testing and commissioning. The Contractor shall be responsible for the provision of facilities and personnel to supply fuel and for the disposal of contaminated fuel, under the supervision of Defence.
10. Fuel shall not be introduced into the equipment pipelines, work or installation until the following have been completed satisfactorily:
    a. All essential checks and tests have been undertaken;
    b. The installation is in a suitable, safe condition to accept fuel;
    c. All emergency and safety procedures are in place;
    d. Hazardous Area Verification Dossiers have been updated;
    e. The testing of all electrical installations and bonding, earthing, tank internal probes, level switches and lightning protective systems;
    f. The issue to Defence of test certificates in respect of the testing referred to in the foregoing item e;
    g. The execution of alignment checks on all major items of plant and equipment such as pumps, pump motor and filters; and availability of certificates relating to performance and pressure test;
    h. Tank calibration data is available and calibration charts prepared;
    i. The testing of fuel storage tanks; with certification;
    j. The pressure testing of all piping; with certification;
    k. The execution of checks for completion on all plant, equipment, controls and automatic gauging and alarm systems and inclusions of all seals, cartridges and all other internal items;

l. All identification markings, danger/warning notices positioned;

m. Test internal probes and level switches; and

n. The testing of all bunding and environmental waste storage and treatment systems.

11. The Contractor shall provide to Defence written confirmation that the above checks have been undertaken and that the installation is in a suitable, safe condition to accept fuel. Prior to fuel being introduced to the installation, the prior approval must be sought from JFLA and Defence Operating Authority of the bulk fuel installation.

Testing Medium for Pipework

12. All above and below ground pipework shall be hydrostatically pressure tested prior to commissioning. Water should ideally be used as the testing medium so long as a methodology for removing and drying the pipework and equipment has been developed. Draining of water from fuel lines and drying pipework and equipment shall be performed following hydrostatic pressure tests.. When water is prohibited, an approved type of aviation fuel should be used as the test medium.

13. Where water is to be used as the testing medium, the water quality shall be assessed. The quality of water shall be such as to not cause unacceptable corrosion during or after the test and avoid residue of injurious solids. For example, particular care should be taken to minimize the chloride content in water when testing austenitic stainless steel pipe and pressure equipment.

14. The design must consider the inclusion of low points and vents for complete drainage of pipework. In circumstances where it is not possible or feasible to drain and dry the entire line, water shall be prohibited as the testing medium. Alternative tests with an FQC approved fuel and in accordance with AS 4041 shall be followed.

Pre-Commissioning Test

15. The minimum commissioning tests shall include all tests required by legislation, relevant Australian Standards, International Standards and military Standards; Codes of practice; manufactures' written instructions and industry best practice. These shall include, but not be limited to those in the following:

a. Tanks:

- Tested to API Std 650 and operational requirements described in AS 1940.

b. Pipework:

- Tested to AS/NZS 2885 Series and AS 4041;
- Welding tests – visual inspection, non-destructive testing and other necessary surveys; and
- Pressure tests of leak and strength.

c. Pressure Vessels:

- Tested to AS/NZS 1200 and AS 3892.

d. Pressure control and protective equipment:

- Tested to AS/NZS 1200, AS 3892 and manufactures' written instructions.

e. Where interior coating of fuel storage tanks, product recovery tanks, dump tanks, filter-water separators, relaxation chamber and the like are specified:

- Tested to AS 3894 Series in general unless otherwise stated in “Internal Painting of ADF Bulk Military Fuel Storage Tanks” document;
- Tested to “Internal Painting of ADF Bulk Military Fuel Storage Tanks” document; and
- Submission of all test results to JFLA and DSTO-MPD for approval.

f. Corrosion Protection:

- Defects survey for external protection coating;
- Visual, adhesion and 100% holiday inspection and all other necessary testing and inspection; and
- To AS/NZS 1518 for pipework externally coated with extruded high-density-polyethylene coating.

g. Cathodic protection:

- Tested to AS/NZS 2832 Series.

h. Electrical Services:

- Inspection and testing of electrical installations bonding, earthing and lightning protective systems in accordance with the relevant Codes and Australian Standards including, but not be limited to – AS/NZS 1020, AS 1076 Series, AS/NZS 1768, AS 2381 Series, AS/NZS 60079 Series, AS/NZS 3000, AS/NZS 3100 and AS/NZS 3017;
- The Contractor shall provide the client copy of “Notification of Electrical Works” or equivalent, together with all tests results, particularly, the earth test results; and
- The Contractor shall provide log books with the original test results as required for equipment and earthing systems.

i. Fire Services:

- Tested to MFPE and AS 1940.

j. SCADA:

- Factory acceptance tests and site commissioning tests.

k. Other Services:

- Other services including, but not limited to emergency generators, ventilation, pumping and reticulation, environmental control facilities, security, civil works, safety and emergency systems, lighting and building services shall be tested in accordance with legislation; relevant Codes of Practice; Australian Standards, International standards and military Standards; written manufacturer instructions (both factory acceptance tests and site tests) and industry best practice.

Acceptance Tests

16. Full working tests of all aspects of the installations shall be carried out in accordance with the approved commissioning plans.
17. Major contamination shall be removed from fuel using temporary strainers before insertion into filters of fine filtration elements.
18. The tests shall include verification of design functional and performance requirements, and checks of all modes of operations.

19. The tests shall include verification of design functional and performance requirements, and checks of all modes of operations.

20. The Contractor shall provide all testing equipment except fuel quality sampling equipment, and obtain approval of the satisfactory completed tests and accept this approval as a requirement for final completion of the Contract.

21. Fuel Specification Tests. Fuel provided by Defence for acceptance tests will be to the relevant Defence fuel specification and will be accompanied by a DQA release note and Fuel Test Report. A Defence appointment Fuel Quality Control Officer is to carry out an acceptance test in accordance with DEF(AUST)206 Annex B (include also BOCLE testing for lubricity improver additive) to ascertain if the fuel facility has effected the fuel specification. Any faulty workmanship, malfunction, lack of cleanliness, or non-compliance with the system specification shall be rectified to ensure that the system does maintain and dispense fuel within the fuel specification limits. The Contractor should carry out 14 day soak test for tanks, equipment and/or pipework where required.

22. Particulate Contamination Test. On completion of the system operational tests, Millipore samples shall be taken at each Millipore sampling point to test for particulate contamination. For acceptance, particulate contamination of the fuel in the system shall not exceed 0.2 mg/litre.

23. Fuel Losses. Defence will supply limited quantity of fuel at no expense to the Contractor for testing and commissioning. The Contractor shall log the movement of all fuel in and out of the system up to acceptance of the installation by Defence.

Use of Facility Prior to Completion of Acceptance Tests

24. If it becomes necessary to use the facility for refuelling aircraft prior to completion of tests, this shall not be taken as acceptance of the facility by Defence.

Training

25. The Contractor shall provide training to ensure Defence operators are capable of operating the aviation fuel facility correctly, safely and efficiently. The Contractor shall allow training up an agreed number of Defence operating personnel prior to the handover of the commissioned facility. The operating personnel will have had previous general aviation facility operational training and fuel product knowledge. The training should concentrate on the operational and maintenance requirements of the aviation fuel facility. Prior to training, the agreed operating and maintenance manual and a full listing of vendor equipment information should be available. It is expected the training will be conducted by an agreed number of specialists from the Contractor. At least, one specialist should have a full understanding of operating the fuel facility. The training should be both in classroom and on the job and allow 5 continuous working days. Each participant should have a set of trainer notes and handouts. All overhead transparencies and any other training aids used during presentations should be handed over to Defence.

26. Training shall be provided by persons being skilled and competent in the relevant areas as defined by the relevant Australian Standards.

Handover

27. The Contactor must prepare the full set of documents required for handover,, including all test certificates (including, but not be limited to, works test certificates of all electrical services, fire services, pressure vessels and valves, radiography records, painting tests and inspections and pressure tests), completed commissioning plans and records, Hazardous Area Verification Dossier and any other documents requested before handover. The set of documents shall be provided to Defence, including the Project Manager, Regional EFS Team, CMS Contractor and Users.
28. For upgrades to existing facilities, the Contractor must update existing Hazardous Area Verification Dossiers which need to be modified as a result of the new facilities. The modifications required to the existing Hazardous Area Verification Dossiers shall update drawings, equipment lists, certifications, maintenance records, reports and all the documentation required by AS/NZS 2381.1 and AS/NZS 60079.
29. At new sites or where no Hazardous Area Verification Dossier exists, unless otherwise directed the designer and Contractor shall develop a new dossier consistent with the above requirements
30. The full set of as installed drawings, in the required format with the correct number of copies, must be submitted, together with operation and maintenance manuals, prior to handover. Maintenance manuals shall include maintenance schedules, procedures and testing requirements for purchased equipment for the fuel farm.

Commissioning

31. A guide for the format of a commissioning plan is presented below:

FORMAT OF A COMMISSIONING PLAN

1.0 Introduction

1.1 Scope of the commissioning plan

1.2 Objectives of commissioning

1.3 Formation of commissioning team

2.0 Pre-commissioning philosophy

2.1 Pre-commissioning of fuel systems

2.1.1 Pre-requisites and their philosophy to be adopted prior to commencement of pre-commissioning

2.1.2 Activities and their philosophy to be carried out during pre-commissioning

3.0 Commissioning philosophy

3.1 Sequence of commissioning and details

3.1.1 Fire Protection systems

3.1.2 Electrical systems

3.1.3 WHS related systems

3.1.4 Environmental protection systems

3.1.5 Compressed air systems

3.1.6 SCADA, control and instrumentation systems

3.1.7 Air-conditioning and ventilation systems

3.1.8 Fuel systems

3.2 Commissioning of fuel systems

3.2.1 Pre-requisites and their philosophy to be adopted prior to commencement of commissioning

3.3 Activities and their philosophy to be adopted prior to commencement of commissioning

3.3.1 Various modes of operations and detailed procedures

3.3.1.1 Automatic mode

3.3.1.2 Manual mode

3.3.1.3 Local mode

3.3.1.4 Emergency mode

3.3.1.5 Operation interlocking

3.3.2 Processes of operation of the fuel systems to be demonstrated and detailed procedures

3.3.2.1 Offloading

3.3.2.2 Dispensing

3.3.2.3 Recirculation

3.3.2.4 Transfer

3.3.2.5 Product recovery

3.3.2.6 Meter proving

4.0 Contractor management responsibilities

4.1 Objectives

4.2 Teamwork

4.3 Contractor's responsibilities

4.4 Roles and Responsibilities of the Contractor's and its sub-consultants' key commissioning personnel

5.0 Safety in commissioning

5.1 Compliance

5.2 Competencies of those carrying out the work

5.3 Objectives

5.4 Management

5.5 Safety procedures

5.6 Emergency responses procedures

6.0 Documentation

6.1 Design

6.2 Construction

6.3 Commissioning procedures and documentation

6.4 Commissioning completion certificate

6.5 Preparation of handover documentation

6.6 Handover

6.7 Training

7.0 Pre-commissioning inspection and test plans

7.1 Programme and procedures

7.2 Fire protection systems

7.3 Electrical systems

7.4 WHS related systems

7.5 Environmental protection systems

7.6 Compressed air systems

7.7 SCADA, control and instrumentation systems

7.8 Air-conditioning and ventilation systems

7.9 Fuel systems

7.9.1 Tanks, their calibration and interior coating

7.9.2 Filter-water separators, relaxation chambers and their interior coating

7.9.3 Piping

7.9.4 Valves

7.9.5 Auxiliaries

7.9.6 Instruments

8.0 Site acceptance – commissioning inspection and test plans

8.1 Programme and procedures

8.2 Fire protection systems

8.3 Electrical systems

8.4 WHS related systems

8.5 Environmental protection systems

8.6 Compressed air systems

8.7 SCADA, control and instrumentation systems

8.8 Air-conditioning and ventilation systems

8.9 Fuel systems

6.3 Controls

Fuel Types:	◗ All; and ◗ DEF(AUST)206 – Handbook of Liquid Fuels, Lubricants and Allied Products.
Principal Standards:	◗ Defence Manual of Infrastructure Engineering, Electrical (MIEE); ◗ AS HB 13 – Electrical Equipment for Hazardous Areas; ◗ AS/NZS 1020 – The Control of Undesirable Static Electricity; ◗ AS 1076 Series – Code of Practice for Selection, Installation and Maintenance of Electrical Apparatus and Associated Equipment for use in Explosive Atmospheres (other than Mining Application); ◗ AS/NZS 1768 – Lightning Protection; ◗ AS 1940 – The Storage and Handling of Flammable and Combustible Liquids; ◗ AS 2381 Series – Electrical Equipment for Explosives Atmospheres – Selection, Installation and Maintenance; ◗ AS/NZS 60079 Series – Explosive Atmospheres; ◗ AS/NZS 2832 Series – Cathodic Protection of Metals; ◗ AS/NZS 3000 – Electrical Installations (Known as the Australian/New Zealand Wiring Rules); ◗ AS 4775 – Emergency Eyewash and Shower Equipment; and ◗ The Installation of Emergency Eyewash and Shower Stations at Defence Establishments – Australian Department of Defence. (Extract OPSMAN-3).
Reference Standards:	◗ The Manual of Infrastructure Engineering – Electrical (MIEE) ◗ The Manual of Fire Protection Engineering (MFPE); ◗ Defence Safety Manuals (SAFETYMAN); and ◗ API 2350 – Overfill Protection for Petroleum Storage Tanks.
Guidance:	◗ DEF(AUST)5695B – Petroleum, Oils and Lubricants Manual; ◗ MIL HDBK 1022 A Sections 3 - Petroleum Fuel Facilities; and ◗ API Manual of Petroleum Measurement Standards – Chapter 3 “Tank Gauging in Stationary Tanks”.

Commentary:

Control systems and process instrumentation have seen rapid development over recent years. Applied to fuel farms, digital technology has enhanced the ability to both locally and remotely manage fuel stockholdings, their quality and logistics.

Advances in technology will be reflected in on-going developments in instrumentation and changes to standards.

General Requirements:

1. The control systems shall function properly in the extreme outdoor environment of the Base.

2. The control systems shall be highly reliable. Overall systems availability shall be better than 99.96 (i.e. 8 hours downtime per 2 ½ year).
3. Minimum 25% spare capacity and 25% spare space shall be allowed for the control hardware in addition to the requirements identified in the final design.
4. The control systems shall be provided with protective features to prevent unauthorised activity or changes.
5. Control systems shall be either PLC or PC/PLC based. Operational software will be backed up with copies held locally and at DEEP.
6. All remote software access will be via the Defence Restricted Network. No unprotected domain access will be permitted to any operating or back-up software.
7. Dual pressure transmitters shall be installed for all critical systems and shall function on a "signal high select" basis.

Introduction

8. This section defines the general Defence requirements for automatic and manual operations of a bulk fuel installation. The Designer shall also refer to specific user requirements.
9. System control modes for Defence Fuel farms shall include: Automatic, Manual, Local, Hand (valves only), Emergency and Damage Control.
10. A standardised SCADA operator interface is required throughout Defence to ensure that:
    a. Training cost is reduced;
    b. In-service costs and the total cost of ownership is reduced through the utilisation of the same software by-
        - Minimising the need to provide several in-service support contracts;
        - Using proven technology where any major defects have been fixed in previous installations;
        - Minimising training costs as Defence has in-service experience with the software; and
        - Minimising both operational and ownership risk due to Defence previous experience and knowledge of the interface.
    c. The synergies available through standardisation of the interface are obtained.
11. Refer to "General Function Requirements" following this section for the detailed requirements of a SCADA system.
12. A bulk fuel installation shall be capable of operating automatically through a SCADA/Programmable Logic Controller (PLC)/Remote Terminal Unit system and manually through loader controllers. Local operation shall also be provided for offloading and dispensing pumps, bypassing the loader controllers. If the SCADA system fails, the system shall be able to be operated manually. Each mode needs to be independent to ensure that no single fault will render another inoperative.
13. All single point failures or actions that could disable the whole bulk fuel installation shall be identified by the Contractor/Designer and agreed with Defence.

14. It shall not be possible for the failure of a device on any unit of plant to disable another unit (e.g. loader controller for one pump will not disable any another pump or loader controller on failure).
15. As a minimum a PLC shall be provided for overall fuel farm control when operating in automatic mode. Where manual control is undertaken using a PLC, a separate PLC shall be used. This unit shall be identical to that used for automatic mode. All duplicated control equipment including any PLC shall be mounted in a separate enclosure from each other and only be connected by the PLC LAN.
16. The control equipment shall be located in an appropriate enclosure. Under no circumstances is the enclosure to be located within a hazardous area as defined by Australian Standards (AS) without prior Defence approval.
17. The controls shall be arranged in a logical and ergonomic manner with commonality of all control switches, indicators, meters and the like. Devices shall be of the type most suitable to convey their purpose.
18. There should be sufficient indicators and meters to easily and accurately portray the state and condition of the whole plant to semi skilled operators in all operating modes. The following are typical examples:
    a. The operator should understand why the pump is running; and
    b. It should not be possible for a pump to trip or shutdown without an indicator illuminating on its panel and in the SCADA. This also includes grouped trips or alarms such as fuel tank level. Similarly, it should be obvious to an operator why a pump won't or could not operate.
19. Protective systems shall operate in all operating modes.
20. Tank high-high and low-low alarms which initiate an over-ride action shall operate independent of any PC/PLC or SCADA based control system in all selected control modes.
21. Transmit identified alarms as detailed later in this section to other areas on the Base over the Base communication systems. The eyewash and emergency safety shower alarms and fire alarms shall also be transmitted to the appropriate area on base.
22. Only one operator should be used to serve one purpose in each indicator panel, i.e. One push button for alarm acknowledge; lamp test facility on each panel to test all lamps, LED's, etc. on that panel.
23. Maintenance will normally be performed by a Contractor third party who will be given access to individual items of equipment possibly only one at a time. It should be possible to easily give local control of these whilst the rest of the bulk fuel installation continues to operate automatically. Any action by this service Contractor shall not disrupt the automatic control.
24. Typical actions would include starting and stopping of pumps but would not normally include product movements. Protective alarms should always be in operation such that any tank alarm condition (e.g. H, HH, L, LL) would operate normally and stop the related pumps.
25. The bulk fuel installation shall be provided with suitable emergency connections to allow offloading or dispensing by either gravity or via portable air driven pump set and filtration unit.

Bulk Fuel Installation Control Modes

26. Mode selector switches at the respective items of plant shall be located at a position agreed by Defence. This shall include as a minimum each pump set and all automated tank valves.

27. Control Modes:

a. Automatic Mode

- In this mode, the bulk fuel installation operations are under the supervision of the SCADA control system which is used to authorise, validate and monitor all product movements through the SCADA system.
- All alarms and events are monitored by the SCADA system. Items of plant in manual or local mode will not be under SCADA automatic control, however, the SCADA system shall continue to monitor and log all events and alarms irrespective of the mode.

b. Manual Mode

- In this mode, the control is under the supervision of the loader controllers. Tank protective systems shall continue to function as for automatic mode except the SCADA permissive system would be bypassed in this mode. Offloading and dispensing pump operations shall be through the loader controller. The automated digital flow control valve control shall also be through the loader controller. Any automated tank valves shall have separate local control. Defence agreement will be required to any alternative.
- As for auto mode, pump operations would normally involve the operator using the appropriate touch key and entering the required details into the loader controller including the operation or process selection (e.g. amount of product).

c. Local Mode

- In this mode, controls are through the pump start/stop or tank valve open/close stations, effectively bypassing the SCADA and loader controller. Control (e.g. starting and stopping of pumps, and opening or closing automated valves) in this mode is by operator only.
- Tank protective systems will continue to function as for automatic mode except the SCADA permissive system, the high and low level protection and the loader controller would be bypassed in this mode.

d. Hand Operation (valves only)

- In this mode the valves are manually operated. This mode of operation is for all manual valves and for automated valves which can be overridden.

e. Emergency Control

- On the loss of electrical power in the bulk fuel installation, it shall be possible to operate the whole bulk fuel installation at all modes via operation of an emergency generator. The emergency generator should be sized and electrical services should be designed to achieve this purpose. Power back up to the bulk fuel installation can be done via link box or permanent generator installation.

f. Damage Control

- In the event of damage of offloading points and/or dispensing points, emergency connections shall be provided at fuel storage tanks and fuel reticulation pipeline to allow offloading and/or dispensing by gravity or portable air-driven pump set, hoses and filtration unit to be provided by the fuel installation Contractor.

Figure 6 shows BFI control mode levels:

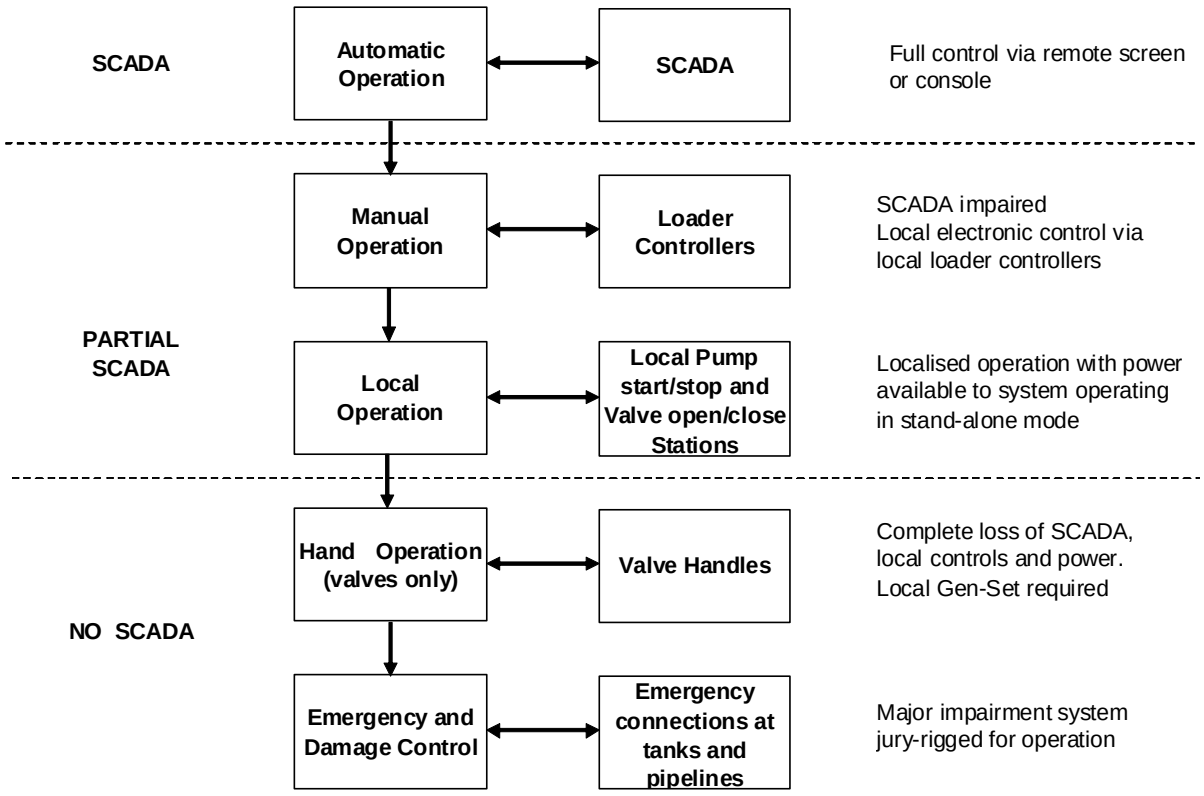


Figure 6 - Fuel Farm control mode levels

Operations

28. The fuel farm design and control system configuration shall ensure flexibility for all current and future operating requirements. Defence has four fundamental operations as follows:

    a. Offload: Receipt of product from road tankers to QCI tanks.

    b. Dispense: Transfer of product to Defence or other refuellers to allow aircraft refuelling.

    c. Storage: Storage of fuel in bulk.

    d. Transfer: Fuel transfer/recirculation within the fuel farm.

    For each operation, the control system can be configured in accordance with the following:

29. Mode Selector –

    a. Auto: The offloading and dispensing pumps are controlled by combination of the SCADA and loader controller. Other pumps are controlled by SCADA only.

b. Manual: The offloading and dispensing pumps are controlled by the loader controller only (This mode is not required for the other pumps).

c. Local: Control only through local start/stop stations. This mode is only normally used on failure of both the respective loader controllers for both offloading and dispensing pumps in each set/type (i.e. both dispensing pump loader controllers or both offload loader controllers) and SCADA system. Required for other pumps.

30. The mode selector location shall be secure to prevent unauthorised operation or be provided with key switch or similar to prevent any unauthorised operation at a location agreed by Defence. The start/stop station shall be adjacent to the associated pump, also at a location agreed by Defence.

31. Control features –

    a. Pump Start: Only works in local mode and starts pump only.

    b. Pump Stop: Only works in local mode and stops pump only.

    c. Loader Controller: Driver/operation interface fitted with touch key reader providing load selection, operation process selection and authorisation through the SCADA. Further details are provided on the loader controller functions indicated elsewhere in this brief.

    d. Emergency Stop: Emergency stops which acts directly on all pump motor circuits and closes automated valves.

32. Pump Indicators. The following indicators are required as a minimum in the remote pump control panel:

    a. Running: All modes.

    b. Common Fault: All modes. Combined fault indicator.

    c. Fuel Flow Established: Automatic mode at SCADA and Manual mode at load controller.

    d. Isolated: SCADA only. Provided, where available, to show the Fuse Switch Unit (FSU) has been manually opened.

    e. In Auto mode: SCADA only. Adequate indication is also required at the mode selector.

    f. In Manual Mode: SCADA only. Adequate indication is also required at the mode selector.

    g. In Local Mode: SCADA only. Adequate indication is also required at the mode selector.

    h. Each Pump Trip: All modes. Full alarm details shall be provided in the SCADA. Adequate indication for semi skilled operators is also required at the protective device to clearly show the tripped and healthy status.

    i. Each Pump Alarm: All modes. Full alarm details shall be provided in the SCADA. Adequate indication for semi skilled operators is also required at the protective device to clearly show the alarm and healthy status.

33. Pump Trips and Alarms. The following trips are required as a minimum:

    a. FSU Trip: Fuse switch unit trip.

    b. TOL: Thermal overload trip.

    c. Under Voltage: Adjustable voltage and time based trip.

d. Soft Starter Failure: Failure of soft start device takes the pump offline and prevents it from restarting.

e. Emergency Stop: Provided locally at pumps and also at each offloading point, dispensing point and control room as an entire bulk fuel installation emergency stop.

f. Low Fuel Flow: Time based trip through the loader controller preset at an appropriate time and flow rate.

g. Truck Earthing Connection Not Established: Trip provided through the loader controller.

h. Eye Wash/Safety Shower Shutdown: Provide trip for the eye wash and emergency safety shower activation to operate in the same manner as the emergency stop which stops all pumps and closes all automated valves.

i. High Fuel Temperature: (If necessary) Temperature based trip provided through the loader controller.

34. All other alarms and trips as required shall ensure the safe operation of the bulk fuel installation and its equipment. Suppress all consequential alarms and incorporate time delays wherever possible to prevent false alarms.

Valve Controls

35. Where required by legislation or Users, outlet valves of the fuel storage tanks together with the flow control valves for each respective offload and dispense pumps shall be automatically operated. The flow control valves are to be controlled automatically through a loader controller (Enraf 1010) and do not require local control. All other automated valves shall be provided with both automatic and local control.

36. When valve control is in automatic mode, open and close the valve as required (in automatic pump mode) in conjunction with the starting and stopping of the pumps and also under failure conditions such as an electrical mains failure and emergency stop conditions by closing the valve. The flow control valve is controlled by the loader controller in automatic and manual pump modes.

37. For valves provided with local control, when in local mode, the control shall be addressed via the open/close pushbuttons or other similar means with the control mode selector (where required) in the vicinity of the valve location. Final position and arrangement of the control is to be agreed by Defence.

38. All valves are to be provided with the ability for the operator to open and close the valve by hand.

39. Fail safe control valves shall be used for all automated valves.

40. The actuator of an automated valve shall incorporate a disconnect feature to permit override for manual operations mainly for actuator failure or where there is no power. The valve closure rate shall prevent excessive hydraulic pressure or surge.

41. Provide a control mode selector switch for automated valves to isolate the automatic controls where it is possible for the local operation and automatic operation to conflict and make the local control station active. The SCADA system shall show actual mode select for any valve with a mode selector switch. The control mode selector shall provide automatic or local selection/control position for each valve. In the event of a power failure, all automated valves shall close.

42. Operation of Emergency Stop or eye wash/safety shower shall close all automated valves in auto and local modes.

43. Automatic tank receiving and dispensing valves shall be simple to operate and designed for manual override in emergency situations.
44. Automatic tank receiving and dispensing valves shall close in an emergency or when not in use.
45. Mode Selector. Provide a mode selector only where there is potential for conflict between the operating modes. Where provided it shall be as follows:
    a. Auto: The tank outlet valves are controlled by the SCADA and the flow control valves are controlled by the respective loader controllers.
    b. Local: The valve is controlled by the local open/close station.
    c. Manual Operation: No mode selection. Actuation of the valve by the operator by hand.
46. The mode selector location shall be secure to prevent unauthorised operation or provided with key switch or similar to prevent any unauthorised operation.
47. Open/Close Station:
    a. Open: Only works in local mode. The valve automatic close function and failsafe operation shall be available and operate in this mode.
    b. Close: Only works in local mode.
48. Valves which have inherent operators may also be permitted provided the actual arrangement is provided for prior Defence agreement.
49. Valve Indicators. All valves that have a safety or environmental impact or are essential to ensure the correct fuel routing shall be provided with status monitoring for all modes (i.e. both at the SCADA and indicator panel). Minimum indication requirement includes all tank inlet and outlet valves, transfer/recirculation valves, and bund drain valves.
50. The following indicators are required as a minimum:
    a. Open.
    b. Close.
    c. Wrong Valve Path at the loader controller. (SCADA determines appropriate valve path and prevents further operation where valve position is wrong, such as when a tank inlet valve is open at the same time). This function also operates in manual mode where SCADA is still in operation.
51. All valves shall incorporate positive status indication at the valve so that the position (i.e. open or closed status) is clearly shown when viewed by an operator.
52. All valves and pumps shall be clearly labelled with their appropriate identification numbers.
53. A manual shut off valve, conforming to API 607 shall be installed between the tank and any automatic tank receiving and dispensing valves.

Tank Level Control

54. Defence requires the tanks to be provided with a two stage alarm system for all tanks except the product recovery tank where only a single system is required. To achieve this, the tanks shall be provided with high and low level protection and high-high and low-low level protection.
55. Defence requires all alarm conditions to operate in all operating modes, except where a power outage prevents operation.

56. High-High alarms should cease all operations at time of initiation of the alarm condition in all operating modes irrespective of the tank valve position. Restoring operations shall be possible by closing the associated tank inlet valve and ensuring the tank is effectively isolated. This is required to prevent faulty valve operation causing an overflow condition.
57. Low-low alarms should operate in a similar manner as the High-High alarms where damage could result from this condition, with the exception that only the dispensing pumps cease operation at the time of operation of the alarm condition. Restoring operations shall be possible by closing the associated tank outlet valve and ensuring the tank is effectively isolated.
58. The control system shall ensure that after the actuation of a High-High or Low-Low protection that pump operations can resume once the associated tank valve is closed and the operator has reset the system at the SCADA and indicator panel. The pump shall not automatically restart once the tank valve is closed. The process of restarting the pump should ensure that the associated valve is closed and the pump start sequence re-initiated by the operator. A reset is required for all alarms both at the SCADA and indicator panel. This is required for all operating modes.
59. Restarting the offloading or dispensing pump means that the touch key is used at the loader controller and appropriate details entered into the loader controller before starting the pump as with a normal start sequence. The loader controller should allow the resumption of the incomplete product movement without the need to dip the tanks and manually accrue the status of the product movement. (i.e. the loader controller retains transaction and status details).
60. The High-High and Low-Low alarm systems shall be separate and independent of the High and Low alarm systems, and automatic tank gauging systems. The shut down control of the High-High and Low-Low level alarms shall act directly on the pumps' control or power circuit.
61. Protective Systems. The shutdown by one protective system often affects other control units and may lead to activation of other protective system or operation of the system. Such interaction shall be evaluated and the system co-ordinated to ensure a safe and controlled shut-down. API 2350 should be used as technical guidance where applicable to determine the High-High and High alarm levels.
62. The setting and operation of High and Low tank levels alarms shall not reduce the usable capacity of fuel storage tanks that is the amount of fuel stored which can be extracted using the pump under normal operating conditions, specifically between the normal fill level (High level) cut off point and the Low level cut off point.
63. Alarms:
    a. All alarms shall be latched to prevent nuisance tripping and require manual reset by operator both at the indicator panel and the SCADA.
    b. Tank level alarm systems shall give audible warning and visual indication and automatic shut down of the pumping system for each fuel storage tank when an alarm condition occurs which is at Low, High (full), Low-Low or High-High (overfull) alarm conditions.
    c. Upon actuation of a dedicated alarm, an indicator light flashes, the rotating beacon activates and an audible device sounds. An acknowledge pushbutton is provided for silencing the audible device, stops the rotating beacon and switching the indicator light to a steady state. Another pushbutton is provided for test and reset. The alarm operating sequence should be as shown in the following table.

Alarm Operation and Requirements

Condition	*Action*
High-High	Stop all dispensing & offloading pumps and close all automated valves (where installed). Prevent pumps from re-starting until the associated tank inlet valve is closed and the tank effectively isolated. The tank can only continue filling operations when alarm condition is removed by re-establishing level below High for SCADA or only High-High where SCADA is unavailable and the alarm reset by the operator. Note: High-High alarms should cease all operations at time of initiation in all operating modes irrespective of the status of the tank isolation. Restoring operations shall be possible by resetting the system and ensuring the tank is effectively isolated. Where a tank has an existing alarm and the inlet is closed, no further action is required by the control system and pumps can be run normally whilst the tank remains isolated.
Low-Low	Stop all dispensing pumps and close associated automated valves. Prevent pumps from re-starting until the associated tank outlet valve is closed and the tank effectively isolated. The tank can only continue dispensing operations when alarm condition is removed by re-establishing level above Low for SCADA or only Low-Low where SCADA is unavailable and the alarm reset by the operator.
High	Stop associated offloading or dispensing pumps (dependent on the fuel reticulation path) and close associated automated valves. Prevent pumps from re-starting until the associated tank inlet valve is closed and the tank effectively isolated. The tank can only continue filling operations when alarm condition is removed by re-establishing level below High and the alarm reset by the operator.
Low	Stop associated dispensing pumps (dependent on the fuel reticulation path) and close associated automated valves (where installed). Prevent pumps from re-starting until the associated tank outlet valve is closed and the tank effectively isolated. The tank can only continue dispensing operations when alarm condition is removed by re-establishing level above Low and the alarm reset by the operator.

Notes:

i. If a tank inlet or outlet valve is open and a related alarm condition exists, the associated pump(s) shall stop immediately if already running and be prevented from re-starting.

ii. The alarm system needs to be reset by the operator at the SCADA and associated indicator panel.

iii. Automatic re-starting of the pumps on resetting the alarm or isolating the tank is not permitted. The operator shall manually reset the system before the pumps can be re-started (i.e. reset alarms, and re-initiate the pump start).

iv. The alarm indication shall only be cleared when the alarm condition has been removed (i.e. level is re-established) and reset by the operator. The operator needs to intervene to remove the cause. (E.g. tank level is re-established).

General Controls

64. Emergency Stop (ESD) shall be provided at each respective pump and also at the control room, each dispense and offload location as a plant emergency stops. They shall be configured shutdown the entire fuel farm by stopping all pumps and closing all automated valves.
65. The ESD shall be clearly labelled.

General Indicators and Alarms

66. Status indication shall be provided for the following as a minimum. These are to be provided in the SCADA and locally at each protective device or plant as appropriate unless indicated otherwise:
    a. All power supplies;
    b. Mains Connected (Defence preferred);
    c. Mains Failure (Defence preferred);
    d. Mobile Generator Connected (Defence preferred);
    e. PLC Failure (also on indicator panel);
    f. Emergency Stop initiated;
    g. Eye wash or safety shower activation; and
    h. Fire alarm indication (separate signal from fire indicator panel to SCADA).
67. Provide the following alarms to appropriate remote Base monitoring areas:
    a. Urgent Fuel Farm remote alarms to manned station via the fire indicator panel (FIP), including tank high-high level, ESD activation, safety shower activation or tank leakage indication.
    b. Fire Alarms – Appropriate alarms to Base fire indicator panel (note the above requirement for separate additional output to SCADA).

Loader Controller

68. Loader controller displays shall incorporate appropriate messages and indication to suit the required operations. All such indication shall be suitable for both. Automatic and Manual operation.
69. Loader controller should be the device used to control automated valves to avoid the possibility of the SCADA being a single point of failure for automatic valve operation. This is preferred so that the requirement for the operator to use local control is minimised.
70. Loader controller will validate the quantity of product only in conjunction with the SCADA system for a dispense operation.
71. When restarting a pump operation after being stopped part way through a transaction, the loader controller should retain the transaction and status details to allow the operator to complete the incomplete transaction without dipping the tanks.

72. Location of the load controller shall be adjacent to the vehicle/truck fill point in a position to enable the operator to monitor both the loader controller and the differential pressure gauges on the vehicle/truck. The final position shall be agreed by Defence.

Panel Layout and indicator requirements

73. An indicator panel is required at a prominent location visible from all locations at the fuel farm in a position agreed by Defence. Where one panel will not be visible at all locations around the fuel farm, provide additional panels.

74. Examples of the required functions are attached below. The panel shall also incorporate the following functions.

    a. Audible alarm (operate for both SCADA and hardwired systems);

    b. Visual alarm (red rotating beacon which operates for both SCADA and hardwired systems);

    c. Status indicators (e.g. pumps, valves, ESD);

    d. Acknowledge pushbutton;

    e. Reset pushbutton;

    f. Lamp Test pushbutton; and

    g. Other alarms (e.g. PLC failure, safety shower and eye wash where not appropriate at the actual eye wash/shower location, ESD activated).

75. Coordinate SCADA and hardwire alarms and indicators.

Alarms for Eye Wash and Emergency Showers

76. Each eye wash and emergency shower shall be fitted with local and remote alarm systems as per the DEQMS. A facility wide emergency stop shall be initiated on activation of any safety shower.

Colour Requirements

77. Indicators shall generally be as follows:

Meaning	**Designation**	**Indicator Colours**
Danger/Fault	Tank High-High or Low-Low level, pump fault, PRT Tank High or Low level.	Red
Caution/Warning		Amber
Normal	Valve position status indication	White or other suitable colour
	Pump run	Green

Note: Pump drive not ready can be equivalent to pump fault.

78. The rotating beacon and audible alarm shall operate as follow:

Signal device	***Alarm state (alarm actuated)***	***Acknowledge***	**Alarm condition reset and cleared**
Beacon	Rotating	Off	Off
Other indicators	Flashing	Steady	Off
Audible	On	Off	Off

Note: Reset when an alarm is not cleared to reactivate the alarm.

79. Audible Alarms. An audible alarm shall be provided when any one of the alarm points is actuated. The audible alarm shall comprise single frequency alarm. There shall be an appropriate mute button for the audible alarm where this function cannot be included with the acknowledge function.

80. Colour Coding. The colour of indication should generally conform to the requirements of AS/NZS 3947.5.1.

81. Signs and Notices. Signs and notices shall conform to DEF(AUST)5695B, AAP DI(AF) 7002.012-2, AS 1318 and AS 1319 where applicable.

82. A design investigation is required for the control systems which include, but is not limited to recommendations for improvement to meet the functional requirements and “Lessons Learned” from previous installations.

VALVE POSITION INDICATION		
VALVE POSITION	**OPEN**	**CLOSED**
TANK INLET	⊕	⊕
TANK OUTLET	⊕	⊕
TRANSFER/ RE CIRCULATION VALVE	⊕	⊕
BUND DRAIN VALVE	⊕	⊕

PUMP STATUS		
PUMP	**FAULT**	**RUNNING**
Pump	⊗	⊕

TANK LEVEL INDICATION				
TANK	Low	High	Low Low	High High
Tank	⊗	⊗	⊗	⊗
Product Recovery Tank	⊗	⊗	N/A	⊗

GENERAL ALARMS	
ESD OPERATED	⊗
SCADA PLC FAILURE	⊗
EYE WASH XX ACTIVATED	⊗
EYE WASH XX ACTIVATED	⊗
SAFETY SHOWER XX ACTIVATED	⊗
SAFETY SHOWER XX ACTIVATED	⊗
GENERATOR SUPPLY CONNECTED (if not obvious at panel)	⊗

Notes:

1. Eye wash and emergency shower are only required where there is no appropriate indication at the respective eye wash and shower.
2. Bund drain valves is composite signal which indicates when either of the two points are open.
3.

   ⊕ - White or green as appropriate

   ∅ - Amber

   ⊗ - Red

Configuration

83. Electrical and control cable colour coding will be in accordance with Appendix A.

84. For critical systems dual field transmitters shall be installed in parallel. They will function on a “safe signal” select basis. Deviations between transmitter outputs will be alarmed and tracked via SCADA.

85. Software look-up tables required for SCADA programming will be based on 3rd party certified strapping (volume vs. liquid depth) tables.

Redundancy

86. The design must include redundancy, stand-by and future provision allowance, with consideration of the need of additional cable ducts, switch board capacity and sub station sizing. Refer to Section 6.1-11 items f and g for minimum redundancy requirements, and to Section 6.3-3 and 6.3-90 for minimum spare capacity.

CONTROLS - GENERAL FUNCTIONAL REQUIREMENTS

Introduction

89. A SCADA system is to be installed in the bulk fuel installation. The operator interface of the system is to be located within the administration office of the bulk fuel installation. The SCADA system shall be designed to monitor and control the delivery, storage and dispensing of aviation fuel within the bulk fuel installation and in the hydrant refuelling facility (if applicable). As well as providing for inventory management to ensure the security of the stock holding by allowing for a full audit trail of all product movements, a secondary purpose of the system is to improve work health and safety, and environmental protection in relation to bulk fuel installation operations.

General Requirements

90. The SCADA system shall comply with the requirements in this chapter, and be tailored to the scope and requirements of the bulk fuel installation. The system shall have an overall system availability better than 99.96%. Minimum 25% spare capacity and 25% spare space shall be allowed for in the control hardware.

91. The SCADA system shall communicate using fibre optic cable network.

92. Valve automation is required for the outlet valves of the fuel storage tanks (where required by legislation) together with the flow control valves for each respective offload and dispense pump.

93. All valves that have a safety or environmental impact or are essential to ensure the correct fuel routing shall be provided with status monitoring for all modes. Minimum indication requirement includes, but is not limited to all tank inlet and outlet valves, transfer/recirculation valves, and bund drain valves.

94. The Contractor shall grant the Department of Defence a royalty free non-exclusive licence to make use of the software package for such purpose as it may, in its absolute discretion, required for the use in the SCADA system. The software shall be registered in the name of the Department of Defence for unlimited use at the bulk fuel installation. The Contractor shall provide Defence with the original copies of the software, and all access codes and passwords for the software system to permit the required maintenance through WOL.

95. Intrinsically safe barriers shall be required. The Contractor shall select all equipment to have appropriate classification and delineation of hazardous areas to AS/NZS 60079 Series. All outdoor equipment shall be to at least IP65 classification.

96. The SCADA system shall comply with all relevant Australian Standards and be protected against lightning in accordance with AS 1768.

97. The Contractor shall provide appropriate power supply. The Contractor shall also provide UPS (minimum 2 hours). A power supply failure shall not interrupt system operation and shall be alarmed on the operator station in the administration office. The Contractor shall provide equipment to protect the SCADA system for power surge and voltage spikes without affecting operation. The Contractor shall also provide power distribution and protective devices for the power supply.

98. Where possible, controls shall be located in air conditioned control rooms, particularly in facilities subject to high ambient temperature/humidity.

99. The Contractor shall provide furniture for the mounting the SCADA system and its peripheral equipment.

100. Operation of emergency stops is described elsewhere in this chapter. The feature shall be hardwired facility rather than a logic or software implantation.

101. The Contractor shall provide a dedicated alarm status screen in the SCADA system. Each change of state in an alarm device such as high level switch will require operator intervention to remove the cause.

102. The SCADA system shall incorporate an inventory management system that allows accurate on line control and monitoring of fuel transfers in and out of storage through software and hardware such as automatic tank gauging, transmitters, fuel offloading and dispensing flow meters, etc. The system provides inventory control (product reconciliation and leak detection), as well as issue trends and forward ordering instructions based on usage. Product level control shall ensure that the required usable capacity of a fuel storage tank is not compromised during normal operation. The system shall be capable of handling manually keyed-in data related to fuel movements and any corrections to fuel data particularly in relation to delivery dockets and slops returns. The system is capable of checking flow meters if required.

103. The SCADA system shall be configurable with routine maintenance requirements related to equipment and engineering services of the bulk fuel installation. The maintenance management system shall be configured to capture key operating parameters such as alarm logs, diagnostics, operating time, tank levels, etc.

104. The Contractor shall start-up and check-out the SCADA system after installation to ensure conforming to the design intent and specifications, and to ensure hardware and software integrity. The Contractor shall invite authorised Defence representatives to attend the activities.

105. The Contractor shall provide a comprehensive list of recommended and critical spare parts at the handover of the facility.

106. The Contractor shall provide spare parts required to successfully start-up the system and to support it for a period of one year.

107. Where hardware spare storage is required on site, the Contractor shall provide the space and any environmental conditioning requirements.

Operation – General Description

108. The SCADA system shall have the capability to identify personnel and dispense to trucks by the presentation of coded touch keys. This will allow for dispensing operations that are based on delivering a predetermined quantity of fuel on a compartment by compartment basis by authorised personnel only.

109. The SCADA supervisory program shall provide an overview of the facility and give access to various screens displaying process information such as tank levels, flow rates, pressures and temperatures. The operational status of control and operating equipment e.g. tanks, pumps, valves, emergency stop systems, grounding systems etc will be shown by colour animated displays on variety of mimic screens.

110. The SCADA system shall provide dedicated screens for system event logs, process alarm logs and process trends.

111. The SCADA system shall control the operations of delivery, storage and dispensing of aviation fuel.

112. The SCADA system shall include a Terminal Automation software package, which together with a custom designed supervisory program from a seamless integrated control application.

113. The system hardware, apart from the computer system and its ancillaries, consists of NSC/OIML Approved Cenelec/SAA rated “Ex d” Bay Load Controllers and a network of intelligent remote terminal units.

Terminal Automation Systems (TAS)

114. The Terminal Automation System shall interface with an approved explosion-proof load controller, which shall provide the entry point into the system for drivers & refuellers.

115. The primary function of the TAS package is to:

    a. Print Bills of Loading;

    b. Maintain databases on authorised personnel, vehicles, security passwords & instrument parameters;

    c. Print reports of product movement based on operators, trucks, tanks, etc;

    d. Maintain databases on completed loads, product densities, product movements, tank status, etc;

    e. Assign tanks to general dispensing, off-loading, re-circulation & meter proving duties;

    f. Assign specific primary and secondary tanks;

    g. Control the quarantining of tanks;

    h. Provide monitoring of tanks for leakage and unauthorised usage; and

    i. Provide traceability on product movements to allow for a complete audit of the facility.

Load Controller

116. The load controllers shall be approved by the National Standards Commission and/or OIML and should be an industry standard device that is used in similar applications to this or fuel terminals, with references in Australia. The controllers, installed at the dispensing and off-Loading points, shall provide the system interface to the drivers and refuellers. The load controllers shall be fitted with a touch key reader that will limit access to authorised personnel only, and provide load selection specific to the vehicle or aircraft being loaded.

117. The dispensing and off-loading controllers shall accept quadrature process inputs from a turbine flow meter and a temperature sensor and in conjunction with a digital flow control valve provide a low / high / low flow profile.

118. The mode of operation shall meet the requirements for the safe delivery of fuel into a tank or tanker refilling vehicle, provide an accurate cut off to all metering operations and prevent excessive pipe stresses.

119. If the main computer system is off-line, the controller will operate in a standalone mode, and will store up to 200 transactions, so that when the operating system is again available the transactions can be loaded and integrated into the system.

120. Multiple load controllers in the BFI shall be connected to a common ground system. TAS and instruments such as thermocouples and flow meters connected to load controllers shall be connected to the same common ground system.

Off-loading

121. Off-loading operations shall cover the bulk delivery of fuel into the fuel storage tanks.

122. Off-loading will be initiated by an authorised person, presenting a coded touch key to a touch key reader on the off-loading controller. The system shall use the coded information to identify the driver. This shall ensure that only authorised personnel will be allowed to the system and provide the information necessary for printing of bills of off-loading and movement reports.

Dispensing

123. The dispensing operations shall cover the delivery of fuel from the bulk storage tanks to tank refuelling vehicles for transfer to aircraft. Dispensing shall be initiated by an authorised person presenting coded touch keys for both the authorised person and the dispensing vehicle. The system shall use the coded information to identify the driver and vehicle involved in the operation. This shall ensure that only authorised personnel are allowed access to the system and provide the information necessary for printing bills of loading and movement reports. Identifying the tanker refuelling vehicles will allow the system to download to the controller the number and volume of compartments to be filled.

Re-circulation

124. Re-circulation shall provide for the transfer of fuel between fuel storage tanks and allow for fuel to be circulated through filters to improve quality. The SCADA system shall be capable of running a re-circulation operation. The source and destination tanks shall be selected and enabled on the SCADA control panel, and then the operation will be started by the operator presenting a specific re-circulation touch key to the selected dispensing and off-loading controllers. On completion of the operation the controller shall initiate the printing of movement reports.

Meter Proving and Calibration

125. To ensure the overall system accuracy, the SCADA system shall provide the means to carry out periodic meter proving and meter calibration.

Tank Calibration

126. The SCADA system shall incorporate a method of check calibrating the tank gauging system against the calibrated dip sticks and be supplied as part of the system documentation.

127. This will allow periodic checks of the tank gauging system to be carried out.

Tank Gauging

128. The tanks shall be provided with high accuracy level gauges. Automatic tank gauging performing inventory control (leak monitoring and product reconciliation) shall be compliant with API Manual of Petroleum Measurement Standards – Chapter 3 “Tank Gauging in Stationary Tanks”. The tank gauging system shall be capable of measuring product level, density (desirable), temperature and product/water interface.

129. Servo or radar type tank gauging shall be provided for vertical tanks.

130. Capacitance type tank gauging shall be provided for horizontal tanks containing clean fuel. Capacitance type tank gauging is not suitable for containment/dump tanks containing slops fuel. For these services, a suitable type of automatic tank gauging needs to be selected.

131. The tanks shall be monitored during periods of isolation and will activate an alarm should any product movement be detected whilst both inlet and outlet valves are closed. The tank levels shall be continuously trended to assist in identifying unauthorised product movements. Product movement reports shall incorporate a comparison between corrected volume measured by the flowmeter and the tank volume change for the operation.

Valves- Position Feed Back

132. During operations all valves with position feedback shall be continuously monitored to ensure that the correct flow paths for product integrity are maintained.

133. All valves with position feedback shall be able to be set to a maintenance mode from a SCADA screen. Valves in maintenance mode will have their position status ignored when the systems checks for flow path integrity.

Remote Engineering Support

134. The Contractor shall supply the SCADA system with the necessary hardware and software to allow connection to a remote engineering office to be authorised by Defence. This provides assistance with troubleshooting, downloading of system updates and to provide help and guidance to new operators. Any such connection shall comply with Defence security requirements and, in particular, Defence Security Manuals. This shall be logged and follow any applicable CIOG protocol. The Contractor shall provide a dedicated direct line capable of supporting data transfer via commercially available high speed modem.
Please note this requirement must be approved by Defence Security Authorities before implementation.

Fuel Integrity and Safety

135. Fuel integrity and safety of personnel is of prime importance in all fuel movements.

136. Before allowing any fuel movement to take place the system will, as appropriate, check the following:

a. Status of the enable buttons on the control panel;

b. Status of Compressed Air System;

c. The position of all valves fitted with position feedback switches;

d. Status of the ESD system;

e. Status of selected pumps;

f. Duty Tank Selection / Availability;

g. Duty tank fuel levels;

h. Status of truck grounding device; and

i. Any other safety permissives.

Operation – Bulk Fuel Installation

137. The facility shall be able to allow the bulk fuel installation operating personnel to select tanks for off-loading and dispensing duties at the start of each shift. Individual quarantine tanks shall be able to be selected for offloading, and individual tanks (quarantine and main) shall be able to be selected for dispensing, except for recirculation or meter proving operations. Tanks will not be permitted to have their inlet and outlet isolation valves opened at the same time.

138. The selection of metering proving, re-circulation or transfer modes of operation will disable dispensing and off-loading operations.

139. The entry of product into a tank will cause that tank to be place in quarantine.

140. System operators will be prompted for details of product tests before the system allows a tank to be placed back into service.

141. Tanks shall be dynamically colour coded on the main Recirculation Screen to show their duty assignments – None, Off-Loading, Dispensing, Recirculation Source, Recirculation Destination, Maintenance, Meter Proving and Quarantine.

Operation - Dispensing

142. A dispensing operation shall be initiated by an authorised person presenting its touch key to one of the dispensing controllers. Located at the Dispensing Points, the controllers shall work in conjunction with the SCADA system to control all aspects of the dispensing operation.

143. Before starting a dispensing operation the authorised person should check via a compartment dip the fuel level of all compartments to be loaded and make a note of the fuel volume in any part filled compartments.

144. A dispensing operation consists of the following phases:

    a. Tank Duty Selection;

    b. Valve Setting;

    c. Connection of truck earth, & hose system;

    d. Load selection;

    e. Loading; and

    f. Load Termination.

Dispensing Controller Displays

145. The dispensing controller displays shall be consistent with that of the existing RAAF SCADA installations.

Operation – Off-Loading

146. An off-loading operation is initiated by an authorised person presenting a touch key to one of the Off-Loading controllers. Located at the Off-Loading Points the controllers work in conjunction with the SCADA system to control all aspects of the Off-loading operation.

147. An off-loading operation consists of the following phases:

    a. Tank Duty Selection;

    b. Valve Setting;

    c. Connection of truck hose, & earth system;

    d. Load selection;

    e. Off-loading; and

    f. Load Termination.

Alarms

148. The SCADA shall include, but not be limited to the following:

    a. Process alarms will be listed on a Alarm Summary Page which includes and alarm acknowledge button;

    b. In addition to the General Alarm Page, and Alarm Summary and a Disabled Alarm page will also be provided;

    c. There will be two categories of alarm, Action and Alert with different audible tones; and

    d. In addition to the Alarms Screen all SCADA screens will give an indication of a current alarm.

Various Screens

149. Screens shall be based on as-built P&ID drawings and the final design report.

Liquid Levels

150. Water level only will be shown, not volume. The arrangement of the Tank Gauges and the provision of an alarm on detection of any water content make the requirements for water volume redundant.

151. Fuel levels and fuel volume will be shown.

Filter Condition

152. The filter differential pressure will be displayed as trend pages with Dispensing and Off-loading making up the pages.

Power Status

153. The details of power provision will be shown on this screen.

Operator Interface Display

154. In general, screens will be developed to match, where appropriate, the content and style of the other ADF Bases engineered to date and to capture lessons learned.

Design Reports

155. Design reports shall be provided in accordance with Defence requirements.

Commissioning

156. Commissioning is a process for archiving, verifying and documenting the performance of the system and its sub-system(s) to meet the operational needs defines for the facility according to the functional requirements, and capabilities of the documented design and specified equipment. This process is also for preparing the facility and system(s) for handover to Defence. It should include the preparation of operation and maintenance manuals and training of operation and maintenance personnel. The outcomes of commissioning should be a fully functional system(s) that has been fully tested and documented, and can be properly operated and maintained throughout the useful like of the facility.

157. The commissioning of a facility and/or system(s) is mainly carried out prior to practical completion. It is defined during the design stage and extended through all phases of a project. Commissioning may occur on a facility by facility or system by system basis rather than all at one time, depending on the size, complexity and inter-operability requirements of the project. This may also involve testing individual systems(s) initially, followed by complete functional

testing at all operational modes for the entire facility. The actual approach will need to be based on the size and complexity of a particular project, and need to be specified in the design document, and finalised and agreed prior to commencing commissioning activities. Accurate record keeping is a requirement and needs to be identified during the design stage.

158. The commissioning of a facility or system(s) comprise four phases – design, construction, acceptance, and post-acceptance, all of which will have impacts on the final commissioning plan and requirements of the commissioning process. All four phases should be addressed and applied accordingly, reflecting the significance and complexity of the project.

Factory Acceptance Test

159. A Factory Acceptance Test, witnessed by the Project Manager and an authorised Defence representative, shall be performed at the Contractor's works prior to shipment of the SCADA to site, Full testing shall be carried out by the Contractor prior to the FAT. The test reports have to be available to the Project Manager one week before the start of the FAT. Any failures discovered and replacements made should be logged in the reports, The FAT shall include check on workmanship, functional tests, with full simulation of all inputs and outputs, application tests and system integrity test. All defects, imperfections or deviation from specifications found during the test shall be corrected by the Contractor at the shortest possible time after completion of the FAT.

160. The Factory Acceptance Test shall be designed to demonstrate the correct functioning of the SCADA system, the Load Controllers and the Tank Gauging System. Where practical, all equipment will be simulated by either frequency, analog or digital input signals and all outputs will be simulated by indicator lamps mounted on test panels.

Site Acceptance Test

161. The Site Acceptance Test shall be designed to demonstrate that the interconnections and operations of all field equipment as installed and connected to the SCADA system are correct.

162. Operational activities such as every combination of tank change over and level control which have been previously demonstrated and accepted as part of the Factory Acceptance Test may be required to be repeated during the site acceptance test.

163. The Site Acceptance Test Schedule shall provide for a set number of test items to be randomly selected by Defence representatives.

Training

164. Training shall be provided on site and will consist of a general presentation of the SCADA system and detailed operational training to operating and maintenance personnel. As a minimum training shall include system overview and detailed requirements for the operation and maintenance of the delivered SCADA system.

As-Constructed Documentation

165. The Contractor shall provide all documentation in English. The documentation includes operating manual, system manual, maintenance manual and as-constructed drawings in "dwg" format. The operating manual includes systems overview, functional description and simple operating instructions. The system manual is to be used by the system engineers and details the relationship between the various parts of the delivered system, system configuration, engineering instructions and software descriptions from system and packages. Maintenance manual contains all data necessary for the maintenance of the delivered systems. The as-

constructed drawings contain all final drawings required for the design, manufacturing, installation, maintenance and operation of the delivered systems. List of all batteries within the SCADA should be included. The Contractor shall provide a minimum of three hard copies of the documentation – two copies to the Base and one copy to DEEP. Note: The maximum number of copies shall be defined in the contract documents.) The Contractor shall also provide an additional copy to Defence, in an electronic format approved by Defence.

Post Acceptance Support & Defects Liability Period

166. The Contractor shall provide all necessary support for the entire SCADA system during the defects liability period of 12 months to ensure that it operates correctly at all time and that any faults or repairs are repaired promptly with the replacement of faulty materials and equipment at the Contractor's expense. The Contractor shall carry out all routine inspections and maintenance work required by the SCADA system. At the end of the support period, the Contractor shall make a final service visit and certify in writing that the SCADA system is operating correctly. Subject to Defence security policy and clearance, the Contractor may be allowed to provide support from the supplier's main computer system to the SCADA system.

6.4 Corrosion Protection/Painting

Fuel Types:	◗ All; and ◗ DEF(AUST)206 – Handbook of Liquid Fuels, Lubricants and Allied Products.
Principal Standards:	◗ Internal Painting of ADF Bulk Military Fuel Storage Tanks; ◗ AS/NZS 1518 – External Extruded High-Density-Polyethylene Coating for Pipes; ◗ AS 1940 – The Storage and Handling of Flammable and Combustible Liquids; ◗ AS/NZS 2312 – Guide to the Protection of Structural Steel Against Atmospheric Corrosion by the use of Protective Coatings; ◗ AS 2700- Colour Standards for General Purposes; ◗ AS/NZS 2832 Series – Cathodic Protection of Metals; and ◗ AS/NZS 2885 Series – Pipelines – Gas and Liquid Petroleum.
Reference Standards:	◗ AS 1318, Use of Colour for the Marking of Physical Hazards and the Identification of Certain Equipment in Industry; ◗ AS 4897 – The Design, Installation and Operation of Underground Petroleum Storage Systems; ◗ API RP 651 – Cathodic Protection of Aboveground Storage Tanks; ◗ API RP 652 – Lining of Aboveground Petroleum Storage Tank Bottoms; and ◗ API RP 1632 – Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems.
Guidance:	◗ DEF(AUST)5695B – Petroleum, Oils and Lubricants Manual; and ◗ MIL HDBK 1022A Section 9.4.4, Petroleum Fuel Facilities.

Commentary:

Corrosion control of fixed fuel farm assets is required to ensure that contamination of fuels in critical services (aviation and marine) is controlled and asset operational life is maintained.

Applied electrical corrosion control systems will be used in combination with paint coating systems to ensure these assets are protected.

General Requirements:

1. All pipelines, machinery, structures and similar equipment shall be protected against corrosion. Corrosion protection shall be designed by certified specialists knowledgeable in corrosion control practice and installed by qualified personnel, approved by DEEP. Corrosion protection systems shall be applied in accordance with the manufacture's recommendations.
2. All materials used in the installation and which will come in contact with fuel to be used in aircraft, shall have not deleterious effect on fuel and fuel additives, and be resistant to corrosion by hydrocarbon fuel, fuel additives (e.g. FSII (DiEGME)) and water.

3. Corrosion caused by dissimilar metals shall be minimised. A holistic approach is required in material selection.
4. A design report concerning corrosion protection shall be submitted in the preliminary design stage.
5. Stainless steel shall not be painted.
6. Stainless steel in underground service shall be protected against corrosion.
7. In addition to this Guidance Note as a minimum, compliance with the coating manufacturer's instructions is mandatory.
8. Electrical compliance of airless spraying systems shall be checked against Confined Space and Hazardous Area compliance requirements.
9. Inspections and maintenance of applied electrical current devices and sacrificial anodes shall be addressed via the BFIMI.

Cathodic Protection

10. Cathodic protection shall comply with AS 2832 Series.
11. Refer to API RP 651, API RP 652 and API RP 1632.
12. Cathodic protection system design shall achieve the following objectives:
    a. Protect tank portions and piping in contact with soil;
    b. Minimise stray current effects;
    c. Capable of expansion, so that facility changes may be accommodated; and
    d. Minimise effects on operations and maintenance.
13. Obtain the services of certified Corrosion Specialist or Cathodic Protection Specialist or a registered professional Corrosion Engineer to perform all cathodic protection design and testing.
14. Cathodic protection systems shall be capable of monitoring system and protection performance. All materials used in the system shall be electrochemically compatible so that corrosion due to different materials is minimised.
15. An investigation is necessary to ascertain the need for, type of an extent of the cathodic protection system required. The investigation shall take into account current and voltage requirements, soil/electrolyte resistivity, environment temperatures, impervious tank dikes or other containment liners, foreign structures, water table, coatings used, electrical grounding system and influence of adjacent cathodic protection system. Cathodic protection shall be controlled so as not to damage the protective coating, pipe, or components. The outcome of this investigation shall be addressed in the preliminary design.

Tanks

16. For all underground steel tanks and tank bottoms of aboveground vertical tanks, provide cathodic protection in accordance with AS 2832 Series, API RP 651 and API RP 652. Where current tank design configuration electrically isolates the tank bottom from surrounding earth, install cathodic protection between the secondary containment liner and the tank bottom.
17. Underground tanks – Use double walled tanks as per AS 1940, where the inner wall is stainless steel (preferred) or internally painted carbon steel, and outer wall is of fibre-reinforced

thermosetting resin composite. Selection of tank materials shall be consistent with WOL requirements. All wetted carbon steel components shall be internally painted with epoxy coating in accordance with “Internal Painting of ADF Bulk Military Fuel Storage Tanks” document. All interiors should be 100% coated, including floor, shell, and underside of the roof.

18. Internal coatings will be applied to all internal surfaces, nozzles and terminate at the non-wetted surfaces of the tank nozzle flanges and stub connections.

19. The period from cleaning to application of the first stripe coating shall be carefully minimised to reduce the instance of flash rusting.

Piping

20. For all carbon and stainless steel underground piping, provide cathodic protection in accordance with AS 2832 series, AS 2885 series and API RP 651. Buried carbon steel shall be externally coated and cathodically protected.

21. Underground metal piping shall require external protection of suitable dielectric resistance such as high-density-polyethylene coating to AS 1518.

Structures

22. Obtain the services of a certified specialist to evaluate the need for cathodic protection on steel portions of fuelling support facilities. Comply with AS 2832 Series and AS 2885 Series.

Valve Pits

23. Penetrations at valve pits shall be liquid (e.g. fuel and water) – sealed. Metal pits shall have internal and external corrosion protection.

Exterior Surfaces

24. Aboveground external fittings and pipework made from ferrous and non-ferrous materials, excepting stainless steel, shall be thoroughly degreased, cleaned, primed and painted to AS 2885 Series and AS/NZS 2312. The paint shall be petroleum resistant and weatherproof. The finish colour shall be approved by DEEP to meet AS 2700.

25. Tank shell and roofs constructed of steel shall have their external surfaces painted in accordance with the following requirements:

    a. A rust inhibiting two pack epoxy primer which is chromate and lead free;

    b. A two pack high solids epoxy intermediate coating reinforced with micaceous iron oxide to resist moisture and high humidity;

    c. A final coat of catalysed two pack isocyanate free acrylic enamel to provide excellent, long term protection of tank surfaces against petroleum environment and weathering; and

    d. This painting system shall carry the appropriate APAS approvals;

    Stainless steel tank shell and roof external surfaces shall not be painted.

26. For other external steel surfaces not in fuel contact, except for stainless steel and unless otherwise specified, the coating system shall comprise:

    a. Base metal coating – epoxy zinc primer;

    b. 1st full coat – surface tolerant epoxy; and

    c. 2nd full coat – polyurethane.

The default colour shall be white.

27. The external surface of the floor for an aboveground vertical tank has a higher corrosion potential than for the tank walls. The external floor coating shall be specified with particular attention to water/moisture ingress, placement/soil contact and the presence of crevices.

6.5 Fuel Farm Deactivation

Fuel Types:	◗ All; and ◗ DEF(AUST)206 – Handbook of Liquid Fuels, Lubricants and Allied Products.
Principal Standards:	◗ Defence Safety Manuals (SAFETYMAN); ◗ AS 1940 – The Storage and Handling of Flammable and Combustible Liquids; and ◗ Local establishment rules and regulations.
Reference Standards:	
Guidance:	◗ DEF(AUST)5695B – Petroleum, Oils and Lubricants Manual; ◗ Work Health and Safety Regulations 2011; ◗ AS 4976 – The Removal and Disposal of Underground petroleum Storage Tanks; and ◗ MIL HDBK 1022A Section 13 and 14, Petroleum Fuel Facilities.
Commentary:	

General Requirements:

1. Local EPA or statutory regulations may mandate special conditions in addition to referenced standards. Consider on a case by case basis.
2. Deactivation may be permanent or temporary. For guidance refer to MIL HDBK 1022A Section 13 and 14.

6.6 Environmental Protection

Fuel Types:	◗ All; and ◗ DEF(AUST)206 – Handbook of Liquid Fuels, Lubricants and Allied Products.
Principal Standards:	◗ AS 1318 - Use of Colour for the Marking of Physical Hazards and the Identification of Certain Equipment in Industry (known as the SAA Industrial Safety Colour Code); ◗ AS 1940 – The Storage and Handling of Flammable and Combustible Liquids; ◗ AS/NZS 2832 Series – Cathodic Protection of Metals; ◗ AS/NZS 2885 Series – Pipelines – Gas and Liquid Petroleum; ◗ API Std 650 – Welded Steel Tanks for Oil Storage; and ◗ Local EPA regulations.
Reference Standards:	◗ Defence Environmental Policy; ◗ Defence Safety Manuals (SAFETYMAN); ◗ Work Health and Safety Regulations 2011; ◗ Commonwealth of Australia legislation, in particular, the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act); ◗ NOHSC:1015 – Storage and Handling of Workplace Dangerous Goods – NATIONAL STANDARD; and ◗ NOHSC:2017 – Storage and Handling of Workplace Dangerous Goods – NATIONAL CODE OF PRACTICE.
Guidance:	◗ DEF(AUST) 5695B – Petroleum, Oils and Lubricants Manual; ◗ DEI 16/2002 Referral of a Defence action that has, will have or is likely to have a significant impact on the Environment; ◗ EPA Guidelines – Design, Installation and Management Requirements for Underground Petroleum Storage Systems; ◗ API Manual on Disposal of Refinery Wastes, Chapter 3 and 5; ◗ AS 4897 – The Design, Installation and Operation of Underground Petroleum Storage Systems;; ◗ ISO 14000; ◗ MIL-HDBK 1022A – Petroleum Fuel Facilities; and ◗ ETL 1110-3-466 (U.S. Army Corps of Engineers) – Engineering and Design – Selection and Design of Oil/Water Separators at Army Facilities.

Commentary:

For requirements on wastewater management at bulk petroleum storage sites contact the local water management authority in the relevant State or Territory.

General Requirements

1. The Regional Environment Officer and/or the Senior Environmental Adviser shall be consulted in the planning, design, construction, commissioning and operation of the bulk fuel installation. The Maintenance Contractor responsible for the maintenance of bulk fuel installations shall be involved in the design, construction, commissioning, and defects liability period of the new installation in accordance with the maintenance contract.

Legislation

2. Bulk fuel installations shall be designed and constructed in a manner that will provide adequate safeguards and early warning systems against all kinds of leaks and spills. Designs shall comply with the most stringent legislation of Commonwealth of Australia legislation and foreign government legislation that are in effect at a particular facility.
3. Within the jurisdiction of the Commonwealth of Australia, adhere to the following environmental protection legislation:
    a. Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act); and
    b. State / Territory legislation in environmental protection and dangerous goods.
4. At facilities in other countries, consult Environment, Heritage and Risk Branch, DSG-IAD and appropriate service environmental directives.

Air Quality Control

5. Bulk fuel installations shall comply with Commonwealth of Australia regulatory requirements pertaining to air quality control.
6. Petroleum storage and dispensing facilities are common sources of air pollution. These type of emissions are to be restricted through requirements in Commonwealth of Australia legislation.
7. Aboveground storage tanks (excluding floating roof) shall be equipped with pressure and vacuum vents. Where required by legislation, the tanks are to be equipped with a closed vent system designed to collect all volatile organic compound (VOC) vapours and gases discharged from the tank.
8. Tanker dispensing points. Where required by legislation, tanker offloading and dispensing points are to discharge fuel vapours resulting from such operations into a closed system. The system is to lead to a vapour recovery or disposal system which is capable of removing a minimum percent of the petroleum vapour before final discharge into the atmosphere.
9. It is essential for Designers to review regulatory requirements to ensure incorporation of proper environmental controls. Commonwealth of Australia legislation is primary source for air quality requirements, but for particular facilities, it is also required to confer with Department of Environment and Heritage and regional EPA office.

Water Quality Control

10. National Water Quality Management Strategy (NWQMS) shall be complied for protection of the natural waters against pollution from discharge of petroleum and other chemicals.
11. Water discharge from the BFI shall meet all applicable discharge quality requirements.
12. Bunds and spill containment systems shall comply with AS 1940 and local EPA requirements.
13. Petroleum wastes and trade shall be separated, contained, treated and properly disposed.

14. Spill Prevention. A spill prevention control and response plan shall be prepared for the project. The plan shall be prepared for the project. The plan should include:

    a. Environmental impact assessment and risk assessment for design, construction and operation;

    b. Specific design features necessary to mitigate the risks identified in the risk assessment; and

    c. Demonstration that the bulk fuel installation is designed and constructed in a manner that will prevent spillage, and should such a spillage occur, prevent the spill from leaving the site and entering a sewerage water system, a storm water system or a waterway.

15. Install leak detection and monitoring wells on above ground tank bottoms, underground storage tanks, and underground piping. Ensure leak detection meets all the relevant legislation. Refer also to requirements of AS 1940 Section 5, EPA and MIL–HDBK 1022A sub-section 8.6.5 “FOUNDATIONS”.

16. Segregated Drainage Systems. Clean water such as stormwater should not mix with contaminated water such as oily water or wastewater. Mixing of these sources of water will adversely affect the performance of oil/water separators. Oily water should not be mixed with trade waste. The following requirements shall be observed:

    a. A clean stormwater drainage system is to be provided to only collect rainwater runoff from roofs, and open grassland. Stormwater runoff from outside the site shall be prevented from running across the fuel farm site;

    b. A dedicated oily water system is to be provided to collect oily water from operating areas such as:

        - Controlled drainage from tank bunds of storage tank areas;
        - Offloading and dispensing points;
        - Compounds for pumping facilities, filter-water separators and auxiliaries;
        - Oily water drainage from fuel quality control centre;
        - Oily water drainage from equipment/vehicle maintenance areas; and
        - Other areas where fuel spill or oily water could occur.

    c. Rain water in the operating areas in (b) shall be minimised by measures such as weather shelters; and

    d. A separate drainage system with separate treatment and/or collection system is to be provided for trade waste in areas such as weather shelters and the following:

        - Trade waste drainage from fuel quality control centre; and
        - Trade waste drainage from equipment/vehicle maintenance areas.

17. Oily Water Systems. An oily water system shall be provided at the BFI to collect product spills and prevent contamination of storm water systems, sewer systems, waterways and soil. The system shall be capable of containing potentially contaminated storm water from operating areas and treating it in oil / water separator prior to discharge to the storm water system. Slops should be collected in dump tanks or slop drums for removal from site by a contractor. Water from oil/water separators may be required to be further treated to meet legislation before discharge from the site. In some installations, evaporation ponds are required for final disposal of oily water. Flame

traps shall be provided to prevent migration of potential fire. A detailed design investigation is required for an appropriate oily water system.

18. Discharge. Isolation valves shall be provided on oily water drainage leaving the site to allow containment of product or firewater resulting from a spill or fire.

19. Oil/Water Separators. Contaminated or potentially contaminated water from oily water systems shall pass through gravity type oil/water separators. The selection of either a conventional API type separator or one with inclined parallel plates shall consider the parameters outlined below. Oil/water separators can be either of proprietary design and supply or custom fabricated for the specific application. Proprietary underground separators shall be provided with manholes into each compartment for inspection, maintenance and cleaning. For custom applications, they will be rectangular open top installations. Separator performance will be guaranteed to be IAW Defence and local environmental regulations. Underground oil/water separators are typically constructed of glass reinforced plastic. Underground steel vessels shall be double walled with provision for leak monitoring. Design and construction of the separators should consider the following minimum requirements:

    a. Guidance:

        - Army Corps of Engineers ETL 1110-3-466.
        - API Manual on Disposal of Refinery Wastes, Chapter 3 and 5.

    b. Consider the following items in sizing the oil/water separator:

        - Anticipated inlet flow rate of a 5-year, 1-hour duration storm event.
        - Type of fuel.
        - Specific gravity and viscosity of fuel.
        - Specific ambient and product temperature ranges.
        - Product storage capacity required.
        - Possible contaminants present.
        - Operating parameters – intermittent or continuous.
        - Treating oily water coming from all sources concurrently.

    c. Require parallel plates to be constructed from non-oleophilic materials such as fibreglass. Arrange the plates in either a down-flow or cross-flow mode so that the oil collects in the high point of the corrugations and rises to the top without clogging from settleable soils.

    d. Reliable oil removal from the surface of the separation chamber shall be required.

    e. Separator design shall involve significant engineering judgment. The separation chamber requires provision of three adequate separate storage volumes:

        - A volume for separated oil storage at the top of the chamber.
        - A volume for settled solids accumulation at the bottom of the chamber.
        - A volume required to give adequate flow-through detention time for separation of oil from the oily water stream.

    f. The surfaces of oil/water separators shall be corrosion-resistant and impervious to liquid such as fuel and water internally and externally.

g. The construction of oil/water separators shall be structurally robust to relevant Australian Standards.

h. The capacity of separators allows for storm/rain water ingress without causing overflow or carrying over of fuel to a sewerage water system, a storm water system or a waterway.

i. The separator shall be readily accessible for inspection, maintenance, cleaning and sampling. Visual inspection and probing for fuel and solids levels are critical to good operation. Provide guardrails and removable lids for the purpose of easy access and WHS requirements. The lids should be easily removable by one person without the use of special hoists or other equipment. The guardrails should have a removable section for access during cleaning operations. Both the guardrails and lids should cover any design loadings.

j. Access shall be provided for removal and maintenance of components, including parallel plates, tubes, coalescing filters, and other devices inserted into the separation chamber. These devices will require frequent cleaning. The design must include appropriate water, power and drainage services at the location of the oily water separator for maintenance purposes.

k. Underground oil/water separators are typically constructed of glass reinforced plastic. Underground steel vessels shall be double walled with provision for leak monitoring.

20. Dump Tanks. Dump tanks are used to collect slop for disposal and shall be designed and constructed similarly to “Horizontal Tank – Above Ground” or “Horizontal Tank – Under Ground” except for the following:

    a. The nominal fuel storage capacity for dump tanks is from 5,000 litres to 20,000 litres each, depending on the requirements of the bulk fuel installation;

    b. Person Access. At least one person access of minimum 750 mm internal diameter shall be provided;

    c. Sampling Hatch. A sampling hatch, 150 mm (minimum internal diameter) shall be provided at the tank to enable sampling of the fuel;

    d. Capacitance type tank gauging is not suitable for dump tanks containing slop. A suitable type of automatic tank gauging needs to be selected;

    e. Floating suction is not required. Pump suction suitable for slop transfer is required; and

    f. Tank level alarms are similar to that of a fuel storage tank except the following-

        - The High level alarm is to be set at half full of the tank or a suitable safety level for preventing spill and alerting operating personnel to clear the slops.

21. Within the design of the dump tanks, allowance shall be made for the placement and removal of pumps to assist with maintenance actions.

22. Slop drums located within a bunded area may be considered as an alternative to dump tanks, subject to design investigation.

23. Containment Pits/Tank. Containment pits/tanks are part of a dedicated oily water system for collecting contaminated water from operating areas. The following minimum requirements shall be observed:

    a. The pits/tanks shall be sized to contain oily water coming from all sources concurrently.

b. The capacity of the pits/tanks allows for storm/rain water ingress without causing overflow or carrying of oily water to a waterway, a sewerage water system, or a storm water system.

c. The surfaces of the pits/tanks shall be corrosion resistant and impervious to liquids such as fuel and water internally and externally.

d. The pits/tanks shall be readily accessible for inspection, maintenance, cleaning and sampling. Visual inspection and probing for fuel and solids levels are critical to good operation. Provide guardrails for pits for the purpose of easy access and WHS. The guardrails should have a removable section for access during cleaning operations.

e. Pumping facilities shall be provided to remove slop and pump oily water to oil/water separators for treatment.

f. The design of the pits/tanks shall consider allowance for the placement and removal of pumps to assist with maintenance actions. In some cases a small hoist and/or gantry may be built into the finished configuration to assist with maintenance tasks.

g. A containment tank shall be designed and constructed similarly to “Horizontal Tank – Under Ground” except for the followings:

- The nominal fuel storage capacity shall be determined following the design investigation of the sources of oily water and safety factors required to prevent spills.
- Person Access. At least one person access of minimum 750 mm internal diameter shall be provided.
- Sampling Hatch. A sampling hatch, 150 mm (minimum internal diameter) shall be provided at the tank to enable sampling of the fuel.
- Capacitance type tank gauging is not suitable for containment tanks containing slops or dirt. As suitable type of automatic tank gauging needs to be selected.
- Floating suction is not required. Pump suction suitable for oily water, slop or dirt is required.
- Tank Level alarms:
    - The high-high alarm shall occur prior to the pit/tank contents reaching the overfill level; High-high alarm shall be independent and hard-wired.
    - The high level alarm shall occur at a safety level to alert operating personnel to pump out oily water in order to ensure that sufficient ullage or capacity is available for collecting potential fuel spill in the operating areas or for oily water overflow.
    - The low level automatic shut down and alarm shall occur when oily water level is at the low stop of the discharge pump.

24. Evaporation Ponds. Evaporation ponds may be used in some installations for the final disposal of oily water where pond evaporation is significantly greater than rainfall. The ponds shall be lined to protect groundwater and soil and should be properly sized to achieve adequate evaporation rates in accordance with year-round climate conditions. Potential problems including air and odour emissions will require the water to be pre-treated prior to transfer to the pond.

25. Underground tank requirements. All underground tanks shall be of double-walled construction with an interstitial space for secondary containment and with leak monitoring systems. The Tank shall be constructed of a steel inner wall and fibre-reinforced thermosetting resin composite outer

wall with an interstitial space between the two walls. Design and construction shall observe the following minimum requirements.

a. Compliance with the relevant legislation;

b. Compliance with AS 1940 and AS/NZS 2832 Series;

c. Compliance with local EPA Guidelines in general;

d. Risk assessment and site classification to AS 4897, AS/NZS 60079 and local EPA Guidelines;

e. Impervious secondary containment;

f. Corrosion protection for tanks and associated underground piping (non-corrodible);

g. Spill and overfill protection;

h. High-High and High level alarms;

i. Leak monitoring (fuel storage tanks and product recovery tanks)-

- Automatic tank gauging (primary method);
- Inventory control measure be statistical inventory analysis (primary method);
- Interstitial space monitoring (backup method);
- Tank pit observation well (backup method); and
- Groundwater monitoring wells (backup method).

j. Leak monitoring (used oil (dump/containment) tanks);

- Automatic tank gauging (primary method);
- Interstitial space monitoring (backup method);
- Tank pit observation well (backup method); and
- Manual tank gauging (for used oil tanks less than 5,500 litres capacity (primary method).

26. Aboveground tanks. Design and construction of aboveground tanks shall observe the following minimum requirements:

a. Compliance with the relevant legislation;

b. Compliance with AS 1940, AS/NZS 2832 Series and API Std 650;

c. Impervious secondary containment – bunded compound and underneath tank bottoms;

d. Corrosion protection for tanks and associated underground piping (non corrodible);

e. Spill and overfill protection;

f. High-High and High level alarms;

g. Refer to MIL – HDBK 1022A, Sub-section, 8.6.5 “FOUNDATIONS” for vertical tanks; and

h. Leak monitoring –

- Automatic tank gauging (primary method);
- Inventory control measure by statistical inventory analysis (primary method);

- Leak detection system for vertical tank bottom (Install pipe or pipes through the concrete foundation ring wall as a telltale for tank bottom leaks. These pipes will also permit water beneath the tank to escape by gravity. In addition, provide a leak detection system for the tank bottom.) (backup method); and
- Groundwater monitoring wells (backup method) if required.

27. Offloading and Dispensing Points. Design and construction of offloading and dispensing points shall observe the following minimum requirements:

    a. Protect offloading and dispensing points by weather shelters designed for severe weather conditions. The following minimum requirements shall be considered.

        - Weather shelters shall cater for severe environmental conditions impacting operations;
        - Reducing stormwater runoff and eliminating the need for stormwater collection and treatment;
        - Accumulation of flammable vapour shall be prevented;
        - Ensure that the underside of the roof is high enough to provide operator head room when walking on top of the tanker vehicles; and
        - Ensure that structural design is in accordance with relevant Australian Standards.

    b. Spillage control in accordance with AS 1940, Section 8 “Tank Vehicle Loading Facilities”, Subsection 8.2.6 “Spillage control” shall be applicable to both dispensing and offloading points. The requirement for spillage control is applicable to road tanker vehicles defined in AS 1940 transporting combustible and/or flammable liquids, including fuel delivery tankers and waste tankers. Where possible waste handling shall be done in offloading areas. The retaining surfaces of spillage control facilities shall be impervious, using concrete (plus fuel-resistant membrane where feasible) for achieving liquid retaining qualities.

28. Compounds for Pumping Facilities, Filter-Water Separators and Auxiliaries. Design and construction of aboveground tanks shall observe the following minimum requirements.

    a. Protect compounds for pumping facilities, filter water separators and auxiliaries by weather shelters designed for severe weather conditions. The following minimum requirements shall be considered:

        - Weather shelters shall cater for severe environmental conditions impacting operations;
        - Reducing stormwater runoff and eliminating the need for stormwater collection and treatment;
        - Accumulation of flammable vapour shall be prevented;
        - Ensure that the underside of the roof is high enough to provide all necessary maintenance; and
        - Ensure that structural design is in accordance with the relevant Australian Standards.

    b. Spillage control to AS 1940, Section 8 “TANKER VEHICLE LOADING FACILITIES”, Subsection 8.2.6 “SPILLAGE CONTROL” shall be applicable to the compounds with the following expectations:

- The capacity of the spillage provisions shall be sufficient to contain the potential spill from the operation or maintenance of the equipment. Further capacity shall be added where relevant to provide for rain or clean-up or fire protection systems.
- The compounds shall be graded so that any spillage –
    - Will drain from the spillage area; and
    - Will prevent the spread of the spillage or fire to other areas.
- The retaining surfaces shall be impervious, using concrete (plus fuel-resistant membrane where feasible) for achieving liquid retaining qualities.
- Fuel spill collection areas shall be directed to an interception/recovery system.
- Fuel catchment systems will operate independently of stormwater drainage/recovery systems.
- Fuel spill collection systems shall be designed to recover the worst-case volume or 9000 litres, whichever is greater.

29. Underground Piping. Design and construction shall observe the following minimum requirements:
    a. Compliance with relevant legislation;
    b. Compliance with AS 1940 and AS/NZS 2832 Series;
    c. Compliance with local EPA Guidelines in general;
    d. Risk assessment and site classification to AS 4897, AS/NZS 60079 and local EPA EPA Guidelines;
    e. Secondary containment to be considered in areas where there is potential contamination of ground water and/or where there is a high water table;
    f. Corrosion protection for tanks and associated underground piping (non- corrodible); and
    g. Leak monitoring-
        - Line leak detection (primary method);
        - Interstitial monitoring if secondary containment is installed (backup method); and
        - Groundwater monitoring wells (backup method).
30. Spill pad hazardous areas zoning and drainage connections shall consider the position of the prime mover parked within the spill containment area.
31. Below ground stop or diverter valves shall be labelled and position clearly indicated. Valve handles shall be readily accessible above ground without the need to remove pit covers.
32. Tank Bunds. Tank bunds shall be provided in accordance with AS 1940 and legislation. Bunds shall be lined with an impervious membrane with fuel resistant sealer. The membrane shall be sealed to concrete bund walls and to concrete tank foundations. The membrane shall be protected by a top layer of appropriate materials against sunlight, traffic and all other types of damage. Piping and conduits shall be avoided where possible. (For example, stairs over bunded walls should be supported on the bund walls and cantilevered into the bunded area). Where small footings are unavoidable (e.g. piping support), they should be laid on concrete pads in fill material laid over the membrane.

33. Tank bund drain valves shall be maintained locked in the closed position. Valves will be manually operated as required to drain accumulated liquids from bunded areas. Automatic drain controls are not permitted.

34. Isolation valves. Tanks and equipment require isolation valves to prevent the accidental release of fuel into the environment during operation or maintenance. Provide double block and bleed valves at all sub-surface and aboveground piping connections to the tank shell of fuel storage tanks including drains, inlet valves and outlet valves.

35. Groundwater monitoring wells. Groundwater monitoring wells shall be designed and installed under direction of qualified environmental specialist. They will be installed in selected places at down gradient of the sources. They will be permanent construction and screened within the seasonal range of standing water level. The exact location and number of wells shall be determined in the preliminary design phased.

36. Product Recovery:

    a. Provide pumps, piping, valves and tanks to collect and store usable fuel which would otherwise become waste from operational or maintenance activities. Include a product recovery tank(s) to collect fuel/water mixtures from tank and equipment sumps, equipment drains, product saver tanks, high point vents, low point drains, and any other equipment from which fuel/water mixtures can be collected. Separate the fuel and water portions. Filter the fuel portion and return to bulk storage tanks. Do not discharge the water portion to sewerage system, stormwater system or waterway without additional treatment.

    b. Connect vent lines, air eliminators and pressure relief valves to a product recovery system to avoid spills to the environment.

37. Dewatering. Where dewatering is necessary and contamination is suspected, test the groundwater prior to construction to determine the extent of contamination. If the groundwater is, or has the potential to be, contaminated with petroleum products, refer the matters to Senior Environmental Advisers or Regional Environmental Officers promptly.

38. Spill Containment Paving. Adequate spill containment shall be incorporated into the drainage design to contain and control a spill resulting from accidental overfill, equipment, or malfunction. Offloading and dispensing areas, and compounds for pumping facilities, filter-water separators and auxiliaries shall include impervious concrete pavement with bunds, kerbing and/or other spill containment methods provided around the perimeter. For offloading and dispensing areas, the kerbing shall be sloped or rounded to facilitate truck access.

39. Concrete joints shall be sealed with petroleum resistant sealant to prevent leaks to sub-grade. Pavement shall be sloped towards drains that are piped to containment or treatment facilities in an oily water system. Drains shall be located so that liquid will flow away from tankers, equipment, and personnel. Drains should be accessible under fire conditions and away from the actual loading operation. Drainage systems shall be designed to prevent the spread of fire from one loading lane to another and to areas outside the loading areas. Fire traps shall be incorporated to safely flush and drain away and spills.

6.7 Facilities Maintenance and Inspection

Fuel Types:	◗ All; and ◗ DEF(AUST) 206 – Handbook of Liquid Fuels, Lubricants and Allied Products.
Principal Standards:	◗ BFIMI; ◗ Defence Safety Manuals (SAFETYMAN); ◗ Local Establishment Rules and Regulations; ◗ AS 1657 – Fixed Platforms, Walkways, Stairways and Ladders – Design, Construction and Installation; ◗ AS 1851 – Maintenance of Fire Protection Systems and Equipment; ◗ AS 1940 – The Storage and Handling of Flammable and Combustible Liquids. AS/NZS 2885 Series – Pipelines – Gas and Liquid Petroleum; and ◗ AS 3892 – Pressure Equipment – Installation.
Reference Standards:	
Guidance:	◗ DEF(AUST) 5695B – Petroleum, Oils and Lubricants Manual; ◗ Work Health and Safety Regulations 2011; ◗ MIL HDBK 1022A – Petroleum Fuel Facilities; ◗ UK Defence Works Function Standard Design & Maintenance Guide 08 – Space Requirements for Plant Access, Operation and Maintenance; ◗ AS 2885.3 - Pipelines – Gas and Liquid Petroleum: Operations and Maintenance ◗ AS 3846 – The Handling and Transport of Dangerous Cargoes in Prot Areas ◗ AS 4897 – The Design, Installation and Operation of Underground Petroleum Storage Systems; ◗ API RP 1540 Design, Construction, Operation and Maintenance of Aviation Fuelling Facilities; and ◗ Australian Dangerous Goods Code.
Commentary:	

General Requirements:

1. Principal reference is the BFIMI, which describes MA and OA reporting and responsibilities. The fuel farm design must comply with the BFIMI and the maintenance schedule requirements.
2. The design of the fuel farm shall allow all in-service sampling and testing to be carried out as prescribed by DEF (AUST) 5695B.
3. Refer requirements detailed in Defence Infrastructure Management – Business Support/DEMS.

4. The design shall provide walkways, crossovers, platforms, and stiles complying with AS 1657 where required, to enable easy access to all parts of the fuel storage facility that require to be operated or maintained. This is includes but is not limited to:
    a. Access into storage tank(s) bunds;
    b. Platforms and ladder access to the tops of above-ground horizontal fuel storage tanks;
    c. Platforms and spiral stairway access to the tops of vertical fuel storage tanks;
    d. Access to tank side valves for fuel storage tanks;
    e. Personnel access openings and/or ladder access to the inner of fuel storage tanks for internal inspection and maintenance;
    f. Access for the changing of elements in filter-water separators;
    g. Access to all valves, gauges, drains, sampling valves and leak monitoring of underground storage tanks (UST). Note – Components located in pits may require application of confined space entry procedures;
    h. All-weather non-skid paths for safe access to all facilities within the fuel farm compound; and
    i. Handrails, guards and work at height harness attachment points.
5. Refer to the following sections and their sub-sections in MIL-HDBK 1022A:
    a. 9.1.1 “DESIGN REQUIREMENTS”;
    b. 9.1.2 ”PIPING ARRANGEMENT”;
    c. 12.12 “PIPELINE INSPECTION” for smart pigging of pipelines;
    d. 4.7.9.2 “TYPES” and 4.7.9.4 “LOCATIONS” for isolation valves for pressure testing;
    e. 2.13.5.5 “Oil/Water Separators” for maintenance access to oily water separator; and
    f. Table 2 “APPURTENANCES” for person access opening, ladders and access for fuel storage tanks.
6. Refer to UK Defence Works Functional Standard Design & Maintenance Guide 08.

Pipelines

7. Facilities shall be provided to conduct routine inspection and testing of refuelling pipelines. Pressure tests will be carried out regularly to ensure that the pipelines are leak free. Manual pressure testing facilities (with minimum provision for the upgrade to automatic pressure testing facilities) should be provided for hydrant refuelling pipelines at appropriate locations. Smart pigging facility of pipework should be provided. Pipework design should make provision for (smart) pigging in those cases where the line is buried or inaccessible.
8. Provisions shall be made to drain equipment for maintenance. Hard piped drains shall be provided:
    a. When the equipment holds more that 19 Litres of fuel; or
    b. When the pipe which drains to the product recovery tank is within 3.7 m from the equipment.

Pits

9. The requirement for maintenance and inspection of pits shall be as follows:

    a. Pits fitted with covers shall be accessible without any undue effort;

    b. All cover lids and frames are to be designed to support wheel loads from aircraft and vehicle movements where applicable, ductile, corrosion-resistant, impact-resistant, and suitable for the intended use;

    c. The cover lids are to be weather proof and prevent water accumulation resulting in corrosion of equipment, operation and maintenance hazards, or mosquito disease;

    d. Valve pits of fuel systems are to have environmental seal in order to prevent leaking of fuel to the surrounding area;

    e. Waste fuel in pit drainage is to be contained in an oily water system, treated and disposed in accordance with legislation; and

    f. All pits are to be of adequate size for operation and maintenance, and for complying WHS (formerly OH&S) requirements. A pit requiring operator's entry for routine maintenance and inspection is to have fixed and robust access such as rungs.

Oily-Water Separators or Interceptors

10. Oily- water separators or interceptors shall have removable grating section on top and guarding rail all around. A removable railing section with pad lock shall be provided for maintenance access.

6.8 Filter/Water Separators (Coalescers)

Fuel Types:	◗ All; and ◗ DEF(AUST) 206 – Handbook of Liquid Fuels, Lubricants and Allied Products.
Principal Standards:	◗ AS 1200 – Pressure Equipment; ◗ AS 1210 – Pressure Vessels; ◗ AS 1940 – The Storage and Handling of Flammable and Combustible Liquids; ◗ AS 3892 – Pressure Equipment – Installation; and ◗ API / IP Spec 1581 - Specifications and Qualification Procedures for Aviation Jet Fuel Filter/Separators.
Reference Standards:	◗ MIL – PRF – 52308 J - Performance Specification – Filter-Coalescer Element, Fluid Pressure.
Guidance:	◗ DEF(AUST) 5695B – Petroleum, Oils and Lubricants Manual; and ◗ MIL HDBK 1022A – Petroleum Fuel Facilities.

Commentary:

Coalescer filter elements are usually constructed of synthetic fibres. On certain fuel services particularly during “first fills”, a considerable electrostatic charge can be generated within the coalescer unit. Section 2.17 of MIL HDBK 1022 A should be consulted for information on coalescer selection and installation.

While not considered to be filter water separators, line strainers are usually installed to protect mechanical components and instrument sensors from material damage. Recommended mesh sizes are summarised in MIL HDBK 1022 A Section 3.6.6. Materials of construction are as per the Defence requirements for filter/water separators (coalescers).

General Requirements:

1. A filter-water separator shall be provided downstream from each offloading pump and dispensing pump.
2. Filter-water separator bodies are classed as Pressure Vessels as per AS 1210 and qualify as pressure vessels for registration in accordance with State or Territory workplace regulations.
3. There is a strong preference for horizontal type vessels. Vertical units may be installed only where interference with existing facilities is unavoidable and in consultation with DEEP. For vertical units, consideration shall be given to permanent safe access and spill control during element change out.
4. Filter elements shall be selected for stable surge-free operation over the entire flow range.
5. Coalescer units supplied for new service shall be thoroughly inspected prior to elements being loaded for the first time. Units will be formally accepted by the BFQCO/NFIS representative.
6. For additions to existing fuel farms, new coalescers may be selected to match existing units. The principal driver for this will be the maintenance of common filter elements spares. DEEP should be consulted in such cases.

7. The target alarm point for coalescer element differential pressure will be approximately 30% of the element's estimated operating range.
8. Bolt assemblies used on coalescer bodies, pipelines, and pressure parts shall conform to the requirements of ANSI / ASME 16.5, material class ASTM A193.
9. Coalescer vessels will be tested in accordance with AS 1210 Section 5.10 on a frequency determined by the local regulations and the BFIMI.
10. Filter-water separator bodies and wetted components shall not be fabricated from aluminium.
11. Coalescer bodies constructed of carbon steel shall be painted internally and externally in accordance with the storage tank painting system, refer to item 28 of Section 7.4 of this policy document.
12. Filter separators are required for the mobile /portable offloading points and dispensing points.
13. Provision of filter separators shall comply with AS/NZS 1200 and generally with API/IP Spec 1581.
14. Refer to DEF(AUST) 5695B Part 5 "POL SAMPLING AND TESTING REQUIREMENTS".
15. Refer to MIL-HDBK 1022A, Sub-section 4.7.6 "FILTER/SEPARATORS".
16. Each filter/separator shall consist of a pressure vessel containing filter elements and coalescer elements. The full fuel flow should pass through the filter and coalescer, in that order, without bypass.
17. The housing on top fitted with an automatic air eliminator, a pressure relief valve and a sump in the bottom to collect separated water. The housing shall be designed and installed so that all free water will drain to the sump.
18. The filter/separator assembly shall be certified to comply with the latest edition of MIL-PRF-52308J using 152 mm diameter x 362 mm long coalescer elements and separator elements meeting the same size requirements. Detailed information is to be obtained from DEEP.

Accessories

19. Each filter/separator shall be complete with the following fittings:
    a. Inlet and outlet branches;
    b. Stainless automatic air eliminator with check valve;
    c. Pressure relief valve on top to suit body design with sight glass;
    d. Drain connection on water sump to suit body design with sigh glass and suitable drain cock to enable samples to be taken;
    e. Stainless steel, piston type direct reading differential pressure gauge with maximum indicator and 5 kPa graduations across the elements, differential pressure transmitter and connections;
    f. Water sump with dished bottom;
    g. A pressure gauge on the inlet and outlet of the filter/separator unit;
    h. Strainers upstream of filter-water separators when the filter-water separator is upstream of operating storage tanks;

i. Connect automatic water drains, manual drains, pressure-relief valves, and air releases to a permanently installed fuel recovery system;

j. Flow control valve having the capability to limit flow through the filter-water separator to the maximum rated flow capacity of the vessel unless hydraulic design provided such capability;

k. Cleanout and inspection connections;

l. Fuel sample points upstream and downstream; and

m. Provide a means to slow-fill the vessel. This is necessary to avoid static build up during the filling of the filter/separator.

n. The construction contractor shall provide essential spares for all units at handover, including but not limited to 2-off sets of filter / coalesce cartridges per unit. The maintenance contractor shall maintain the number of spares through the life of the maintenance contract.

Support

20. The filter-water separator vessel shall be supported on legs of sufficient height to provide at least 500 mm clearance under the drain point to allow access for a collection bucket in accordance with DEF(AUST)5695B.

6.9 Fuel Storage and Recovery Tanks

Fuel Types:	◗ All; and ◗ DEF(AUST) 206 – Handbook of Liquid Fuels, Lubricants and Allied Products.
Principal Standards:	◗ Defence Safety Manuals (SAFETYMAN); ◗ AS HB 13 -Electrical Equipment for Hazardous Areas; ◗ AS/NZS 1020 -The Control of Undesirable Static Electricity; ◗ AS 1076 Series -Code of Practice for Selection, Installation and Maintenance of Electrical Apparatus and Associated Equipment for use in Explosive Atmospheres (other than Mining Applications); ◗ AS/NZS 1200 - Pressure Equipment; ◗ AS 1692 -Tanks for Flammable and Combustible Liquids; ◗ AS/NZS 1768 - Lightning Protection; ◗ AS 1940 -The Storage and Handling of Flammable and Combustible Liquids; ◗ AS 2381 Series - Electrical Equipment for Explosive Atmospheres Selection, Installation and Maintenance; ◗ AS/NZS 3000 - Electrical Installations (Known as the Australian/New Zealand Wiring Rules); ◗ AS 3892 - Pressure Equipment - Installation; ◗ AS 3894 Series - Site Testing of Protective Coatings; ◗ AS/NZS 60079 - Explosive Atmospheres - Equipment - General Requirements; ◗ NOHSC:I015 - Storage and Handling of Workplace Dangerous Goods NATIONAL STANDARD; ◗ NOHSC:2017 - Storage and Handling of Workplace Dangerous Goods NATIONAL CODE OF PRACTICE; ◗ Australian Dangerous Goods Code; ◗ API 650 - Welded Tanks for Oil Storage; ◗ API Std 2000 -Venting Atmospheric and Low-pressure Storage Tanks: Non-refrigerated and Refrigerated; ◗ API RP 2350 – Overfill protection for Storage Tanks in Petroleum facilities; ◗ AS 4897 – The Design, Installation and Operation of Underground Petroleum Storage Systems;
Reference Standards:	◗ AS 1210, Pressure Vessels; ◗ AS/NZS 2832 Series - Cathodic Protection of Metals; and ◗ ASME / ANSI B 16 Series.
Guidance:	◗ DEF(AUST) 5695B – Petroleum, Oils and Lubricants Manual; ◗ MIL HDBK 1022 A Sections 2, 3 and 8, Petroleum Fuel Facilities; and

	◗ UK Defence Works Functional Standard Design & Maintenance Guide 05 - Specification for Specialist Works on Petroleum Installations –Mechanical.

Commentary:

Depending on tank type and size, stainless steel construction may provide a better WOL outcome. For carbon steel tanks the consideration of recoating in accordance with Defence standards shall be taken into account. Assessments conducted by Defence point to stainless steel being the preferred material of construction for horizontal tanks as large as 150 KL working volume.

The listed requirements apply to bulk fuel, QCI and waste/slops tanks.

For detailed design, the classification of the fuel type shall be in accordance with the description provided in DEF (AUST)206 – Handbook of liquid fuels, lubricants and allied products.

General Requirements:

1. The design and construction of aviation fuel storage tanks shall enable the safe storage of fuel and maintain the fuel within specification limits during its storage.
2. The design standards for Defence tanks are generally higher than is usual for commercial installations as the fuel is in storage a longer period of time. With this in mind, greater attention needs to be paid to details of construction which might generate water traps or pockets, debris collection or cause contact with materials which might degrade the quality of the stored fuel.
3. There are two forms of tanks used by Defence:
   a. Tanks with a vertical axis installed above ground level (VST), both types hardened and unhardened; and
   b. Tanks with a horizontal axis, installed:
      - Above ground;
      - Underground.
4. Fuel storage tanks are for either quality control inspection (QCI) purpose or bulk fuel storage. The number and size of QCI tanks and bulk fuel storage tanks shall be determined by each service in terms of capability requirements, defueling requirements and passive defence measures. DEEP and JFLA shall be consulted in determining these requirements.
5. QCI tanks provide quality control inspection including testing and any other activities that require segregation. These include occasional defueling and periodic tank inspections. The QCI tanks also provide operational flexibility for bulk fuel storage.
6. Product recovery tanks are for receiving sample returns from fuel storage tanks (if required), tanker vehicles and air-fuel bleed from various points in the fuel systems. They are used to settle fuel following dewatering and sampling. Once settled, clean fuel is quarantined, cleared by QC testing and returned to the main storage.
7. The size of the recovery tank shall be negotiated with the user/operator and JFLA. The size of the recovery tank shall be as small as possible whilst remaining practical, to reduce the chance of small quantities of unserviceable fuel contaminating larger volumes of otherwise serviceable fuel.
8. The maximum pumping rate shall be to determine tank overfill settings in accordance with API 2350.

9. Where vertical turbine pumps are used, the volume below the pump suction shall be excluded from the determination of the tank's working volume.
10. Tank venting will be determined in accordance with API 2000 and AS 1940.
11. Strapping (volume vs. liquid depth) tables shall be developed and maintained for all fuel storage tanks. For tanks less than 20 KL, the manufacturer's dip calibration will suffice. For tanks 20 KL and greater, volume shall be determined in increments of 2 mm liquid depth.
12. Strapping tables prepared for tanks of capacity equal to or greater than 20 KL shall be third party certified.
13. Service dispensing connections shall be fitted with floating suctions for tanks equal to or greater than 20 KL capacity.
14. Stainless steel tanks shall not be painted.
15. Underground tanks shall be protected against corrosion in accordance with AS 1940. Underflow drains and sampling facilities shall be installed to facilitate leak detection.
16. Unless otherwise specified, target design pump in/out flow rates are described in MIL HDBK 1022 A Section 9.1.1.1 and Table 1 "Design Flow Rates".
17. Tanks shall be labelled in accordance with AS1940 Section 5.2.2.
18. Tanks located north of the Tropic of Capricorn shall be provided with passive defence measures. These measures may include:
    - Hardening;
    - Deception;
    - Concealment; or
    - Dispersal.

Usable Capacity

19. The working/usable volume of a vertical storage tank shall be the volume between the low-low and the high-high level alarm points typically 1.4 to 2 ML.
20. The storage capacity of horizontal fuel storage tanks should not exceed 150 kL each, limited by transportation restrictions.
21. The nominal fuel storage capacity for product recovery tanks is from 5,000 litres to 20,000 litres each, depending on the requirements of the bulk fuel installation.

Tank Level Alarms

22. Each fuel storage tank shall have minimum:
    a. High-High level alarm;
    b. High level alarm; and
    c. Low level alarm.
23. Automatic shut down of pumping system shall occur at each level:

a. The High-High automatic shut down shall occur prior to the tank contents reaching the overfill fill level; this shut down control shall act directly on the pump's electric motor power supply. High-high alarm shall be independent and hard-wired;

b. The high level automatic shut down shall occur when the tank contents are at the normal fill level (design rated usable capacity); and

c. The low level automatic shut down shall occur when the floating off-take head contacts the low stop.

24. High-high level alarms and high level alarms shall comply with legislation, AS 1940 and API RP 2350.

25. High-high level alarm should be set at the safe fill level defined in API RP 2350. The setting of high-high level shall consider the following factors:

    a. The ullage for every fixed tank in which a flammable liquid is or is intended to be stored shall be determined by the requirements of AS 1940 and ADG Code but in no case may it be less than 3% of the total capacity of the tank;

    b. The safe fill level is below the overfill level defined in API RP 2350;

    c. The depth between the overfill level and safe fill level is adequate to absorb expected thermal expansion; and

    d. Minimum height necessary under foam inlets and trusses and other safe fill height considerations.

26. Safe fill level is a level up to which the tank is allowed to receive product delivery after the normal fill level is attained, The safe fill level is always below the overfill level. This is established by:

    - Determining the amount of time required to take the appropriate action necessary to completely shut down product flow before the level of product in the tank reaches the overfill level; and
    - Consulting Defence operating personnel for each specific tank as the level depends on the type of tank, its internal configuration and condition, and the operating practices.

27. High level alarm should be set at normal fill level defined in API RP 2350. The setting of high level shall consider the following factors:

    a. The normal fill level is below the safe fill level defined in API RP 2350;

    b. The normal fill level is a minimum of 2 minutes with pumps operating at their maximum rates below the safe fill Level, depending upon tank conditions and operator practices; and

    c. The normal fill level is a level up to which the tank is allowed to receive product at the maximum allowable receiving flow rate for a predetermined time prior to reaching the safe fill level. The normal fill level is established at the lower of the following two levels so that appropriate action can be taken to prevent an overfill:

        - A level that allows sufficient time for the flow to be completely stopped before the level of product in the tank reaches the pre-determined safe fill level. (Normal fill level never exceeds safe fill level.)
        - A level, determined after consulting with Defence operating personnel, depending on the tank's physical conditions or the operating practices that limits the tank capacity to less than that normally available at the usual safe fill level.

28. Low level alarm should be set at Low fill level which:

    a. Is a sufficient level above landed floating suction to avoid vortexing;

    b. Avoid the sucking up of contaminants from the tank floor; and

    c. Results in an amount of fuel remaining in the tank, access to which requires specific and additional measures to normal pump operation.

    Where required by design, low-low alarms should operate in a similar manner as the High-High alarms where damage could result from this condition, with the exception that only the dispensing pumps cease operation at the time of operation of the alarm condition.

29. Tank level alarms for a product recovery tank is similar to that of a fuel storage tank except the following:

    a. The High level alarm is to be set at half full of the tank or a suitable safety level for preventing fuel spill and alerting operating personnel to sample the content. This determines whether the content is suitable for reuse in the main storage.

Automatic tank gauging

30. Automatic tank gauging performing inventory control (leak monitoring and product reconciliation) shall be installed. The tank gauging system shall be capable of measuring product level, density (desirable), temperature and product/water interface. Capacitance type tank gauging shall be provided for horizontal tanks for containing clean fuel. Capacitance type tank gauging is not suitable for containment/dump tanks containing slops fuel. A suitable type of automatic tank gauging needs to be selected. Servo type tank gauging shall be provided for vertical tanks.

Horizontal Tanks - Above Ground

31. The capacity of each tank is limited by transportation restrictions and site excavation difficulties and should not surpass 150 kL.

32. The tanks shall comply with the requirements of AS 1692.

33. There shall be no obstruction to the free flow of water along the bottom of the tank towards the sump. Tank floor slopes vary from 1 in 30 to allow contaminants to be flushed to the tank sump by the incoming fuel.

34. Horizontal tanks with separate saddles shall have these welded to the shell plates to avoid crevice corrosion.

35. These tanks shall be connected to the site's electrical grounding system.

36. The tank shall be provided with the following fittings:

    a. Person Access. Two person access of minimum 750 mm internal diameter each is to be provided.

    b. Sampling Hatch. A sampling hatch, 150 mm (minimum internal diameter) is to be provided at each end of the tank to enable sampling of the fuel.

    c. Vent. Pressure/vacuum and emergency venting are to be provided in accordance with AS 1940 and API Std 2000. Five micron air filters are to be provided in the vacuum vents and to be of such capacity to enable maximum fuel discharge rate without excessive vacuum being formed in the tank. The dry filter elements are to be enclosed within a dustproof and weatherproof container to which is fitted the vacuum valve. When the tank is in a vacuum

state, relief air shall pass firstly through the vacuum valve, then the filter element and finally into the tank. Manometers for checking pressure/vacuum vents are to be provided.

d. Water Drain. The sump is to enable the complete drainage of any water and solid contaminates which has settled at the bottom of the tank. The sump is to be capable of being drained by the effects of gravity only through a stop cock. Clearance is to be provided under the drain point to permit the fitment of Millipore sampling equipment and the placement of a 500 mm high bucket.

e. Floating Suction. An off-take pipe swivelled to the outlet pipe and attached to a float which will enable fuel to be extracted from near the free surface of the fuel is to be fitted to the outlet pipe of the tank.

f. The intake of the off-take pipe is to be located at such a depth that air is not drawn into the off-take system.

g. A stop is to be provided to prevent the intake of the off-take pipe approaching the tank bottom nearer than 300 mm so that sediment is not drawn from the bottom of the tank.

h. A stainless steel chain is to be attached between the floating arm and an inspection hatch on the roof to enable routine checks on the free action of the floating off-take.

i. Inlet Connection. In order to minimise the possibility of sparking amidst aerated fuel in the turbulent conditions of fuel exiting a pipe into free air space of a tank, the inlet pipe is to be installed in such a manner that its aperture is completely submerged when the tank is at its minimum working level. The size of the pipe is to ensure that the nozzle velocity of the fuel shall not exceed 1 metre per second.

j. Earth Boss. Earthing bosses are to be fitted to the tank.

k. Level Control System. A level control system is to be provided which will enable the connection to a warning system providing an audible warning and a visual indication and automatic shut down of the pumping system when the fuel is at the low, high or high-high level for the tank.

l. Overfill protection is to be provided.

m. Automatic tank gauging is to be provided.

n. Pressure/Vacuum Breaker. A push button actuated valve which will equalise any pressure differential between the tank interior and atmosphere is to be fitted adjacent to, or incorporated in, the dipstick hatch.

o. Dip Stick. A dip stick tube incorporating a dip stick is to be fitted to enable the level of the fuel within the tank to be measured accurately to ± 150L. The tube is to be vented for not less than 90% of its length by a continuous slot or a series of overlapping slots not less than 6 mm wide so as to provide a pressure balance to the tank. The dip stick is to be anodised aluminium, or other non-sparking material compatible with the fuel. The dip stick is to be calibrated in 200 litre increments for the first and last 5000 litres and 500 litre increments for intermediate quantities. The dip stick is to be of a dark colour to enable graduations to be read in bright daylight.

p. Emergency Pressure Relief. Emergency pressure relief vents in accordance with AS 1940 and API Std 2000 are to be fitted.

q. Access Ladder. Where internal access to the bottom of the tank is not provided by bottom manholes, an internal access ladder shall extend from a tank top manhole to the bottom of the tank. If constructed of tubular section, construction shall be fully welded and constructed liquid tight. There shall be no hollow sections shall have open exposed internal surfaces.

37. Horizontal tanks will be fitted with a minimum of two manholes, located at opposite ends on top of the tank. One may be used to mount emergency relief systems. Vertical tanks will have two manholes mounted accessible at ground level and located to facilitate safe entry and cleaning. Vertical tanks must also have roof-mounted manholes to facilitate air extraction, gas freeing and visual internal inspections.

Horizontal Tanks - Above Ground Buried

38. Similar to Horizontal Tanks - Above Ground except for the following:

39. Exposed unprotected portions of the tank, person assess hatches etc above the tank mound shall be able to withstand blast pressure.

40. Tank fillings:

    a. Water Drain-off Pipe. A drain-off pipe, 25 mm bore, is to terminate within the sump so that discharging fuel through the drain pipe will completely scour the sump of collected water and solid contaminates. The sump should be capable of being drained by the effects of gravity only. As regular water drains will be taken from the drain-off pipe, the volume of fluid contained within the drain-off pipe should be kept to a minimum to avoid unnecessary wastage of fuel at each water draining operation. Clearance is to be provided under the drain point to permit the fitment of Millipore sampling equipment. A 25 mm male Camlock coupling is also to be fitted to the drainpipe. A dust cap is also to be supplied.

Horizontal Tanks - Below Ground

41. Similar to Horizontal Tanks - Above Ground except for the following:

42. The tanks shall comply with the requirements of AS 1692.

43. Refer also to MIL -HDBK 1022A, Sub-section 8.7 "UNDERGROUND HORIZONTAL STORAGE TANKS".

44. The tank shall be a double-walled tank with an interstitial space for secondary containment. The tank shall be constructed of a steel inner wall and a fibre-reinforced thermosetting resin composite outer wall with an interstitial space between the two walls.

45. Leak monitoring in the interstitial space shall be provided.

46. Exposed unprotected portions of the tank, manholes hatches etc above the tank mound shall be able to withstand blast pressure.

47. Tank fittings:

    a. Vent. Normal vents and emergency venting are to be provided in accordance with AS 1940 and API Std 2000. AS 1940 states that a pressure-vacuum vent shall not be fitted to any Category 4 underground tank. Five micron air filters are to be provided in the normal vents and to be of such capacity to enable maximum fuel discharge rate without excessive vacuum being formed in the tank. The dry filter elements are to be enclosed within a dustproof and weatherproof container to which is fitted the vents.

    b. Water Drain-off Pipe. A drain-off pipe, 25 mm bore, is to terminate within the sump so that discharging fuel through the drain pipe will completely scour the sump of collected water and

solid contaminates. The sump should be capable of being drained by a pump. As regular water drains will be taken from the drain-off pipe, the volume of fluid contained within the drain-off pipe should be kept to a minimum to avoid unnecessary wastage of fuel at each water draining operation. Clearance is to be provided under the drain point to permit the fitment of Millipore sampling equipment. A 25 mm male Camlock coupling is also to be fitted to the drainpipe. A dust cap is also to be supplied.

Horizontal Tanks -Below Ground (Product Recovery)

48. Similar to Horizontal Tanks -Below Ground except for the following:
49. The nominal fuel storage capacity for product recovery tanks is from 5,000 litres to 20,000 litres each, depending on the requirements of the bulk fuel installation.
50. Personal Access. At least one person access of minimum 750 mm internal diameter shall be provided.
51. Sampling Hatch. A sampling hatch, 150 mm (minimum internal diameter) shall be provided at the tank to enable sampling of the fuel.

Vertical Tanks - Above Ground

52. Each tank shall be constructed from steel in accordance with the requirements of API Std 650 and AS 1940.
53. Refer also to MIL -HDBK 1022A, Sub-section 8.6 "ABOVEGROUND VERTICAL STORAGE TANKS".
54. The tank shall be of cylindrical form with its axis vertical.
55. The tank shall be of welded construction with butt welded joints, however, the joints in the floor and roof may be lap joints providing it does not permit water to be trapped or for contamination pockets to be formed. The tank shall have a self supporting closed roof and the interior of the tank shall be free from bracing or structures.
56. Usable capacity. The usable capacity of the tank should be 1.4 ML, 2.0 ML, or a size adjusted to suit the requirements after due allowance for drainage, tank level alarm settings, ullage, foam inlets and trusses and other normal and safe fill height considerations.
57. Size. The diameter of the tank shall be kept to a minimum to reduce the surface area of fuel in contact with the vapour space commensurate with the maximum height of the tank permissible by airfield height limitations.
58. Internal drainage. The tank shall have a conical bottom having a radial slope of 1 in 30 minimum towards a central sump. There shall be no obstruction to the free flow of water along the bottom of the tank towards the sump. The plate layout together with the welding procedure must ensure that the floor is free from plate distortion and undulations. The construction of the floor shall permit an unobstructed drainage to a central sump and the floor is to be tested by flooding the floor after it has been cleaned and allowed to drain to the sump; no pools shall form or remain. This test shall be performed after the tank has been filled with water to its rated usable capacity and allowed to settle for seven days.
59. Sump. The sump capacity shall be at least 45 litres and have a minimum depth of 300 mm.
60. Roof. The tank shall have a self supporting roof with no internal members or stiffeners. Where possible the roof shall be attached to the walls with a frangible joint to permit the roof to detach

prior to other structural failure in the event of overpressure within the tank. In tanks where a frangible joint is not possible, emergency vents shall provide this capacity.

61. Foundation. The design and construction of the foundation shall ensure a stable base with the minimum of differential settlement. The design and construction of the foundation shall take into account loading due to varying levels so as to minimise deformation of the conical floor.
62. The foundation design should also allow for the future installation of a concrete wall, 0.3 metre thick, in contact with the shell walls and up to the full height of the walls. The requirements shall be confirmed with Defence in the planning stage or the preliminary design stage.
63. Underfloor Drainage. The design at the base of the tank ensure that rain or fuel spills will not penetrate the interface of tank bottom and the foundation.
64. Wall Joints. Shell plate joints shall be butt welded and ground flush on the interior of the tank.
65. Roof Joints. The plate joints on the roof interior shall show a continuous smooth weld which will prevent the entrapment or retention of water or contaminates; if joints are lapped, an external seal weld should also be applied to the other fillet depending on manner of roof lap welding.
66. Person access. Two shell manholes of 750 mm minimum diameter and two roof manholes of 750 mm minimum diameter shall be provided in each tank. The roof manholes shall be located near the perimeter of the tank, adjacent to an access walkway. Access through the shell wall manholes shall be possible from the ground without the aid of step ladders; the lower edge of the manhole shall be above the remaining fuel level after tank has been emptied to the lower stop.
67. Staircases and Walkways. A staircase complying with the requirements of AS 1657 shall be provided for access to the top of the tank. A walkway shall be provided on the top of the tank which will provide access to all service points on the roof and adjacent to roof mounted instrumentation. Treads are to be non-slip construction. Guard rails shall be provided to ensure the safety of the operator. Provision is to be made that the staircase is adaptable without hot work on the tank fabric to accommodate the 0.3 m encasement wall.
68. Foam Inlets. Each tank shall be fitted with foam injection nozzles where required by AS 1940. All tank nozzles not in use shall be fitted with a blank flange.
69. Sample Hatch. A 150 mm internal diameter sampling hatch shall be provided on the tank. The hatch shall be located on the roof in the proximity of the access stairway.
70. Vents. Pressure/vacuum vents and emergency vents shall be provided in accordance with the requirements of AS 1940 and API standard 2000.
71. The pressure/vacuum vents shall be located near or at the apex of the roof. Five micron air filters shall be provided in the vacuum vents and shall be of such capacity to enable maximum fuel discharge rate without excessive vacuum being formed in the tank. An emergency vacuum vent, shall be fitted to safeguard against the collapse of the tank in the event that the operating vacuum vent fails to operate. Manometers for checking pressure/vacuum vents shall be provided.
72. Water Drain-Off Pipe. To permit the daily drain of water, a 25 mm diameter pipe shall be installed with one end terminating in the sump and the other terminating outside the tank. The drain pipe shall not penetrate the sump or tank bottom. The configuration of the pipe in relation to the sump shall ensure the sump is completely scoured of collected water and solid contaminates.
73. Tank Drain Pipe. To permit complete draining of the tank below the low level stop, an 80 mm diameter pipe shall be installed with one end terminating in the sump and the other end terminating with a double ball valve arrangement and a dry break hose coupling outside the tank.

The pipe shall not penetrate the sump or the tank bottom. The pipe shall pass through the tank wall as low as is practicable.

74. Upper, middle and lower level sampling points of fuel shall be provided.

75. Floating Suction. A floating offtake which will enable fuel to be extracted from near the free surface of the fuel shall be fitted. The intake shall be suspended at such a depth that air is not drawn into the offtake system, nor is sediment drawn from the bottom of the tank. A stop shall be provided to prevent the intake approaching the tank bottom nearer than 300 mm. A stainless steel chain or cable shall be attached between the float arm and the 150 mm hatch on the roof to enable routine checks on the free action of the floating offtake.

76. Inlet. The inlet connection shall be installed in such a manner to cause the tank contents to flow in a single vortex pattern when fuel is discharged into the tank. The inlet shall be below the surface when the fuel level is the low level stop. The nozzle velocity of the fuel shall not exceed 1 metre per second.

77. Fuel Level Indicator. An automatic depth of fuel indication (float and tape type) shall be fitted to each tank. The visual display of fuel depth shall be capable of being read by a person at ground level. A calibration chart converting depth readings to quantity of fuel stored in litres (strapping tables) shall be provided for each tank. The indicator shall enable measurement of fuel quantity in the tank within the accuracy of ± 2000 litres shall be supplied.

78. Automatic tank gauging shall be provided.

79. Earth Boss. Earthing bosses shall be fitted to the tank.

80. The tank must be provided with cleats for attaching cables and instruments.

81. Fuel Level Control System. A level control system independent of fuel indicator system shall be provided which will give an audible warning, visual indication and automatic shut down of the pumping system when the high-high, high or low level conditions are reached.

82. Concrete Encasement Allowance. All pipes nozzles and fittings protruding from the wall of the tank shall be installed so that they remain functional if a 0.3 metre thick concrete wall is to be erected in contact with the shell wall. Flange joints of pipes shall also be outside the concrete wall. No allowance need be made on the shell person access as these may be recessed in the concrete wall. Other attachments to the tank shall be capable of being detached without the need for hot work to permit the erection of the concrete wall. Permanent level survey pads will be required and should be accessible outside the future concrete encasement in addition to those on the tank shell.

83. Vertical tank roofs shall be fixed, with frangible design. External floating roof designs are not permitted unless the design prevents the ingress of water onto the roof section.

84. Vertical tanks will be fitted with a minimum of three sample connections to facilitate sampling of the bulk liquid.

85. For vertical tanks, the floor plates shall extend out from the wall strakes and their edges sealed to prevent the accumulation and migration of water and salt under the floor.

Product Dewatering/Sampling Facilities

86. Product dewatering/sampling facilities shall be provided to satisfy sampling requirements of fuel storage tanks and product recovery tanks as required in DEF(AUST) 5695B.

87. Tank bottom sumps and upper, middle and lower levels of fuel storage tanks and product recovery tanks need to be sampled on a regular basis. Tank bottom sumps need to be sampled also when a tank is being put onto dispensing duty. Tank bottom sumps of product recovery tanks need to be sampled prior to pumping clean product back to main storage.

88. To facilitate the taking of samples, a separate tube leading to each of the upper, middle and lower levels of fuel at the rated usable capacity shall be installed within a vertical fuel storage tank. These tubes shall be connected to a product sampling/recovery system with suitable valving.

89. Horizontal fuel storage tanks require sampling at upper, lower and middle levels via a sampling hatch at the tanks.

90. A product dewatering/sampling system, consisting of sampling flask/pot, sight glass, trough, piping, valving and pumping facility, shall be provided at each fuel storage tank. The system draws samples, allows visual inspection and allows acceptable samples to be pumped back into the tank. The system also draws oily water and allows it to be pumped into a product recovery tank. Slops shall be disposed in accordance with legislation and shall not be put into product recovery. A Millipore sampling point shall be incorporated in the oily water draw off pipe. Where pumping back is not practical in a design, the system allows acceptable samples to be discharged into a product recovery tank.

91. A pump capable of producing an adequate flow rate shall be provided to enable clean fuel samples to be returned to the inlet pipe of the storage tank.

92. A product recovery/sampling system, consisting of sampling flask/pot, trough, sight glass, piping, valving and pumping facility, shall be provided at each product recovery tank. The system draws samples, allows visual inspection and allows acceptable samples to return to the recovery tank via the nearest tundish. The system draws oily water and allows oily water to be pumped into a containment pit/tank for subsequent treatment through an oil/water separator. A Millipore sampling point shall be incorporated in the water draw off pipe. The product recovery tank allows clean product to be pumped back into main storage preferably at the upstream of an offloading filter water separator. The tank also allows slops to be pumped out for disposal in accordance with legislation.

93. A pump capable of producing an adequate flow rate shall be provided to enable clean fuel samples to be returned to the main storage.

94. New tanks constructed of carbon steel shall be internally coated in accordance with the “Internal Painting of ADF Bulk Military Fuel Storage Tanks” document.

95. Fuel tanks will have a low point drain (LPD) system, typically a sloping floor with a gradient of 1 in 30 with no lips or raised sections to stop the flow of water to low point in the floor. For horizontal tanks the LPD will be at the opposite end to the service connections. For vertical tanks the LPD will comply with the requirements of API 650.

96. The fuel farm working area must be provided with lighting in accordance with operational needs.

6.10 Hazard and Operability Studies

Fuel Types:	◗ All; and ◗ DEF(AUST) 206 – Handbook of Liquid Fuels, Lubricants and Allied Products.
Principal Standards:	◗ Defence Risk Management Policy and Guidance; ◗ Defence Safety Management Manuals; and ◗ AS IEC 61882 – Hazard and operability studies (HAZOP studies) – Application guide.
Reference Standards:	◗ AS/NZS 3100:2009, Approval and Test Specification - General Requirements for Electrical Equipment; and ◗ UK Chemical Industry Association Guide 1977 (ICI/ Kletz format).
Guidance:	◗ DEF(AUST) 5695B – Petroleum, Oils and Lubricants Manual; and ◗ Work Health and Safety Regulations 2011.

Commentary:

AS/ IEC 61882 is the preferred over earlier ICI format as the approach and format can better address issues relating to control system integrity.

If the ICI format is used, it may be necessary to conduct a separate control HAZOP (CHAZOP) Study to ensure control system functions can be correctly assessed.

Once one format has been selected it shall be maintained and applied for the duration of the project.

General Requirements:

1. The modification and/or construction of a Defence fuel storage, reticulation and oil / water treatment installation requires Hazard and Operability Studies (HAZOPs) to be conducted during the design phase. The HAZOPs shall be extended to any existing fuel facilities in connection with the modification and/or construction to ensure that both the new existing installations and their interface are safe for operation.

Objectives

2. A minimum of two formal HAZOP studies shall be conducted for each project, namely:
    - 30% design development (preliminary);
    - 90% design development (advanced);
    - Defence may elect to conduct additional HAZOP's as required; and
    - Design changes initiated after the 90% HAZOP shall be subjected to the HAZOP process and reported as an addendum within the formal HAZOP report.

Outcomes

3. The HAZOPs shall ensure health, safety and environmental issues are addressed. In that study process, deviations from the design intent (including the potential for multiple contingent failure modes such as human error) should be discovered and analysed to determine the consequences. Significant consequences should be reviewed, and remedies should be recommended or flagged for further study. The outcome of the HAZOPs shall be incorporated into the design, construction, and operation and maintenance instructions.

HAZOP Team

4. The HAZOPs shall be conducted by a trained facilitator. The team shall have the necessary experience and balance and comprise the following:

    a. Project consultant;

    b. Designers;

    c. Defence Project Director/Officer;

    d. Relevant Defence Technical Authorities, such as DEEP, DEMP;

    e. Joint Fuel & Lubricant Agency (JFLA);

    f. DSO – Regional Director;

    g. Maintenance Contractor;

    h. Defence operating personnel;

    i. End users; and

    j. Construction contractor (if assigned).

5. The studies shall ensure that both the design and the operational constraints are fully understood, and that potential operational problems and theoretical limitations to design capability are properly explored.

6. The HAZOP Facilitator shall:

    a. Be independent (i.e. free of bias);

    b. Be experienced in HAZOPs technique and meeting control;

    c. Have sufficient technical knowledge to understand and control the discussions; and

    d. May contribute technically to the discussions.

HAZOP Reports

7. The HAZOP Facilitator shall prepare a HAZOP report for each study that details the process, discussion, findings and all agreed action items. Defence Project Director/Officer via project consultant shall ensure that all agreed action items are properly closed out in design, construction, and operation and maintenance instructions. A draft copy of the HAZOP report shall be given to each team member for review and comment, A final copy (both hard-copy and electronic copy) shall be given to each member for record.

8. Demonstration (functionally and documentary) of close-out of all items identified during HAZOP Studies is a mandatory requirement for certification.

6.11 Materials of Construction

Fuel Types:	◗ All; and ◗ DEF(AUST) 206 – Handbook of Liquid Fuels, Lubricants and Allied Products.
Principal Standards:	◗ AS/NZS 1518 – External Extruded High-density-polyethylene Coating for Pipes; ◗ AS 1940 – The Storage and Handling of Flammable and Combustible Liquids; and ◗ ASME / ANSI B 16 Series.
Reference Standards:	◗ DEQMS Painting of Marine and Aircraft Fuel Tanks; ◗ AS 4897 – The Design, Installation and Operation of Underground Petroleum Storage Systems; and ◗ API 650 Appendices I & O, Welded Tanks for Oil Storage.
Guidance:	◗ DEF(AUST) 5695B – Petroleum, Oils and Lubricants Manual; ◗ MIL HDBK 1022A – Petroleum Fuel Facilities; and ◗ NFPA 30 – Flammable and Combustible Liquids Code.

Commentary:

Austenitic stainless steels typically type 316/316L as a minimum. Alternate grades may be used on approval from DEEP.

General Requirements:

1. All materials used in the installation and which will come in contact with fuel to be used in aircraft, shall have no deleterious effect on fuel and fuel additives, and be resistant to corrosion by hydrocarbon fuel, fuel additives (e.g. FSII(DiEGME)) and water.
2. Unless otherwise approved, fuel for use in aircraft shall not be allowed to come into contact with:
   a. Ferrous materials other than austenitic stainless steels or coated carbon steel;
   b. Zinc (including all zinc coatings), zinc compounds and zinc bearing alloys;
   c. Lead and lead bearing alloys;
   d. Copper and copper bearing alloys containing 4% and above copper;
   e. Cadmium and its compounds; and
   f. Plastic materials.

   Particular attention shall be taken watching for seals, greases and protective coatings, avoiding these materials and ensuring compatibility with fuel, fuel additives and water.
3. For F34/FSII in aviation service, the use of coated or uncoated carbon steel and the use of copper and copper-bearing alloys in fuel contact shall be avoided.
4. Where appropriate, HDPE is permitted. For F34/FSII service, compatibility with FSII is required.

5. Brittle materials shall not be used where fracture could cause an escape of fuel. Materials such as packing, gaskets and coating shall be fuel resistant. Materials shall have the mechanical properties adequate to perform their duties reliably and for long periods under arduous circumstances.

6. Corrosion caused by dissimilar metals shall be minimised. A holistic approach shall be required in material selection.

7. The Designer and Contractor shall carry out thorough investigation into all materials for fuel handling elements of the fuel facility and provide recommendation for Defence approval.

Properties of Fuels

8. Refer to DEF(AUST) 206.

Precautions in Using Aluminium

9. The use of aluminium in piping and pressure vessel construction shall not be used. DEEP shall be consulted in all cases where aluminium is under consideration.

10. Aluminium tanks are not acceptable for fire safety reasons as the relatively low melting temperature of aluminium may result in the loss of tank content.

11. Aluminium alloys lose strength rapidly when exposed to higher temperature. Therefore the use of these materials is limited by the materials' strength and pressure rating at the maximum operating temperature.

12. Do not use aluminium alloys for tubing, fittings, equipment and accessories within a bunded or contained area where flammable or combustible liquids may be collected.

Piping

13. Pipework, fittings, bolts and nuts, and accessories shall be coated carbon steel or austenitic stainless steel (Type 316L).

14. Low point drains and containment surfaces where water and soluble FSII materials can accumulate require special treatment to minimise corrosion.

Exterior Pipe Coatings

15. Protect the exterior surfaces of all underground metal piping systems with a continuously extruded high density polyethylene coating system such as "yellow jacket" to AS/NZS 1518. Cathodic protection shall be required, refer to NACE guidelines for requirements.

16. Protect the exterior surfaces of all aboveground piping systems by coating in accordance with applicable service requirement. Stainless steel aboveground pipework is not required to be externally coated.

Fuel Storage Tanks and Product Recovery Tanks

17. Preference – austenitic stainless steel tanks.

18. Where life cycle costing for stainless steel tanks is not justified, use carbon steel internally painted with epoxy coating approved by DEEP to "Internal Painting of ADF Bulk Military Fuel Storage Tanks" document.

19. For life cycle costing related with carbon steel tanks, DEEP shall be consulted for repainting periods and maintenance schedules.

20. Bolts and nuts – austenitic stainless steel.
21. Internal nozzles and pipework – austenitic stainless steel where practical.
22. Floating suction – aluminium alloy or stainless steel.
23. Internal floating pans, if required, complying with MIL-HDBK 1022A.
24. Underground tanks – double walled tanks where the outer wall is of fibre-reinforced thermosetting resin composite. Refer to AS 1940 Section 5.9 for guidance.

Dump Tanks and Slop Tanks

25. Carbon steel internally painted in accordance with “Internal Painting of ADF Bulk Military Fuel Storage Tanks” document.
26. Bolts and nuts – austenitic stainless steel.
27. Internal nozzles and pipework – austenitic stainless steel where practical.
28. Floating suction – aluminium alloy or stainless steel.
29. Underground tanks – double walled tanks where the outer wall is of fibre-reinforced thermosetting resin composite. Refer to AS 1940 Section 5.9 for guidance.

Valves (general)

30. All valves – austenitic stainless steel stem and trim.
31. All valves – austenitic stainless steel bodies, bonnets and covers.
32. All valves – seats, body seal and stem seals to be fuel compatible such as Viton, Teflon (PTFE) or Buna-N.

Valves (specific)

33. Ball valves – austenitic stainless steel balls.
34. Valves (system control):
    a. Diaphragm actuated and pilot controlled globe valve.
    b. Austenitic stainless steel tubing.
    c. Viton or Buna-N diaphragm and disc ring.

Filter-water separators, static relaxation tanks and fuel quality monitors

35. Preference – austenitic stainless steel.
36. Where life cycle costing for stainless steel equipment is not justified, use carbon steel internally painted with epoxy coating approved by DEEP.
37. Life cycle costing should assume re-painting of the interior of carbon steel equipment every two years in the worst case scenario.

Pumps

38. Pump shaft – Stainless steel (typically Type 410 or 416).
39. Pumping casing, bearing house and impeller – austenitic stainless steel.
40. Submersible pumps – austenitic steel pumping casing, bearing house and impeller, and stainless steel shaft.

41. Material recommended in MIL-HDBK 1022A may be considered subject to Defence approval.

Other equipment

42. Strainers – austenitic stainless steel.
43. Pressure gauges – austenitic stainless steel.
44. Meters – austenitic stainless steel.
45. Fuel additives facilities - austenitic stainless steel.
46. Air eliminators and vents - austenitic stainless steel.
47. Product recovery/sampling equipment/ system - austenitic stainless steel.
48. Offloading manifold – austenitic stainless steel, subject to maximum allowable operating pressure at the manifold.
49. Other auxiliaries in contact with fuel or fuel/water vapour – compatible with fuel, FSII and water.

6.12 Pipelines

Fuel Types:	◗ All; and ◗ DEF(AUST) 206 – Handbook of Liquid Fuels, Lubricants and Allied Products.
Principal Standards:	◗ AS/NZS 1020 – The Control of Undesirable Static Electricity; ◗ AS/NZS 1200 – Pressure Equipment; ◗ AS 1940 – The Storage and Handling of Flammable and Combustible Liquids; ◗ AS/NZS 2885 Series – Pipelines – Gas and Liquid Petroleum; ◗ AS 3892 – Pressure Equipment – Installation; ◗ AS 4041 – Pressure Piping; ◗ AS 4343 – Pressure Equipment – Hazard Levels; ◗ DI (AF) AAP7002.027-99 – Electrical Bonding and Earthing Aircraft and Ground Support Equipment; ◗ API/EI 1585 – Guidance in the Cleaning of Aviation Fuel Hydrant Systems at Airports; and ◗ API/EI 1594 – Initial Pressure Strength Testing of Airport Fuel Hydrant Systems with Water.
Reference Standards:	◗ AS 1210 - Pressure Vessels; ◗ AS 2832.1 - Cathodic Protection of Metals, Pipes & Cables; ◗ ASME / ANSI B 16 Series; ◗ ASME B31.3 – Process Piping; ◗ ASME B31.4 – Liquid Transportation Systems for Hydrocarbons and Other Liquids; ◗ ASME B16.20 – Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed; ◗ ASME B16.21 – Non-metallic Flat Gaskets for Pipe Flanges; and ◗ BS 3381 – Specification for spiral wound gaskets for steel flanges.
Guidance:	◗ DEF(AUST) 5695B – Petroleum, Oils and Lubricants Manual; ◗ MIL HDBK 1022 A Sections 2 and 9 – Petroleum Fuel Facilities; ◗ AS 2885.3 - Pipelines – Gas and Liquid Petroleum: Operations and Maintenance; ◗ AS 3846 – The Handling and Transport of Dangerous Cargoes in Prot Areas; ◗ AS 4897 – The Design, Installation and Operation of Underground Petroleum Storage Systems; ◗ API RP 1540 Design, Construction, Operation and Maintenance of Aviation Fuelling Facilities; ◗ API RP 2003 – Protection Against Ignition Arising out of Static, Lightning and Stray Currents; ◗ Australian Dangerous Goods Code;

- CASA M139 Aerodromes.

Commentary:

Given the nature of POL products, threaded pipeline connectors will generally be restricted to relatively small line sizes (e.g. less than DN 25). Particular attention is required to ensure that threads are correctly sealed to minimise leakage and long-term seepage and potential contamination of POL products. Site and hand cut threads are not permitted; factory cut threads in accordance with the relevant piping code are required.

Unless required to match an existing piping code, the preference is for pipelines and fittings to conform to the requirements described in the ASME / ANSI B16 standards for pipes and fittings.

General Requirements:

1. Pipeline design shall provide for ease of alignment without the need to apply extreme force to the pipe joint or transmission of such stresses to the equipment components.
2. The use of dissimilar metals is to be avoided. Where galvanic corrosion is a potential problem, pressure rated insulating sections shall be provided to isolate dissimilar materials.
3. A risk assessment and fire safety study shall be provided at the design stage where double or single wall HDPE pipe is specified for exposure above ground or over-water service. Consistent with the fire safety study, consideration shall be given to:
    a. Ensuring the ability to quickly isolate fuel flow to the HDPE piping (e.g. wharf area); and
    b. Minimise the volume of fuel held in the above ground / over-water HDPE pipe.
4. For HDPE in F34/FSII service, compatibility with FSII is required.
5. Buried carbon steel and stainless steel pipelines shall be cathodically protected in accordance with AS 2832.1. Buried carbon steel pipelines shall be externally coated.
6. Stainless steel is the preferred pipe material. Careful consideration should be given to the design and operational requirements and WOL implications before specifying carbon steel pipes.
7. Not withstanding alternative testing media covered by Section 5.7, new pipeline sections shall be hydrostatically tested using water in accordance with AS 4041 Section 6.7 after fabrication. Sections shall be dried and cleaned prior to entering fuel service. Underground piping sections shall be tested prior to being covered. The minimum hold period for hydrostatic test shall be accordance with AS 4041, Table 6.7.3. Fuel header low points wshall be fitted with low point drains to facilitate regular removal of water or sediments. Drain valves will be fire safe rated ball valves conforming to API 607.
8. The actions and response of VSD's shall be considered in planned HAZOP Studies.
9. Unless otherwise specified, target design flow rates are described in MIL HDBK 1022 A Section 9.1.1.1 and Table 1 "Design Flow Rates".
10. Flange gaskets shall be NON-ASBESTOS CONTAINING MATERIAL (ACM) compressed fibre type with composite and binder confirmed suitable for the selected fuel which itself is described in DEF(AUST) 206.

Note: The graphite filled spiral wound metal gasket has been found to be unsuitable for critical fuel service e.g. F34 Avtur.

11. Non metallic gaskets must be compliant with ASME B16.21. Spiral wound gaskets must be compliant with BS 3381 and ASME B16.20.

12. Flanges fitted with composite fibre type gaskets shall each be fitted with an earth strap, which electrically connects the outside of one flange directly to the outside of the other, mounted across a flange stud bolt.
    Alternatively, earthing may be provided via a lugged tinned copper cable connected to lugs welded to the line adjacent to the pipe flanges.

13. Pipelines shall be labelled in accordance with DEF(AUST) 5695B.

14. Aboveground stainless steel pipelines do not need to be coated / painted.

15. For stainless steel 316 pipe in fuel service:

    - Sizes DN 200 and above, seamless or ERW pipe shall be used.
    - Sizes up to and including DN 150, seamless pipe shall be used.

    A weld joint factor of 0.85 per AS 4041 and ASME B31.3 shall apply.
    Strength of the heat affected zones (HAZ) and weld corrosion resistance must be equal to or greater than parent material.

16. Where stainless steel pipelines are mounted on supports other than stainless steel, polymeric insulators shall be installed to isolate the sections.

17. Underground piping sections shall be adequately protected from corrosion and impact to meet service life requirements.

    - Wrapped piping (Yellow jacketed), to extend a minimum of 300 mm above ground at the above ground/under ground interface.
    - Sleeved piping.

18. Fuel and service pipelines installed underground shall be bedded in a minimum lean concrete mix comprising bedding sand and dry cement mixed in the ratio 15:1 bedding sand: cement. Concrete pigmentation is not required unless otherwise specified for the environment/region.

19. Header low point drain connections shall be “set-on” design to minimise ledges and crevices within the header.
    Defence preference is for the drain connection to be constructed using proprietary “butt welded” fittings. Refer to Figure 7 below.

Figure 7 - Pipe fittings

20. Refer to MIL-HDBK-1022A, Section 9.1.1 “DESIGN REQUIREMENTS”, 9.1.2 “PIPING ARRANGEMENT”, 9.2 “ABOVEGROUND PIPING”, 9.3 “UNDERGROUND PIPING”, 9.6. “WELDING CRITERIA”, 9.7 “PIPING CONNECTIONS”, 9.10 “SAMPLING FACILITIES” and their sub-sections.
21. TIG welding should be used for pipework where practicable. Exact routes of the pipeline should be optimised and approved by DEEP.
22. Pipework shall have full traceability in accordance with the relevant fabrication standards. Traceability shall be established by manufacturing procedures, documentation and marking. A certificate of compliance with the relevant fabrication standards shall be provided.
23. The design of the piping shall be simple, minimizing connections, fittings and valves. The number of flanges shall be kept down to the minimum required for the removal of equipment or piping maintenance. Flanges shall have raised faces.
24. The internal surface of the pipe (including joins and seams) and valves shall be smooth and free of obstruction or recesses that may cause fuel contamination through the collection of water and debris in the pipes. Bends in the pipework shall be minimised to prevent vapour locking.
25. The piping shall be graded appropriately to drain points to enable complete drainage of the system.
26. Anchor structures and pipe supports shall be designed and installed to support or control pipe movement where appropriate, and thus protect equipment, such as pumps, tanks and valves from excess mechanical loading. Anchor structures and pipe supports shall be constructed to prevent wear and corrosion of the piping and should be designed to allow adjustment of the support.
27. Construction of dead legs shall be avoided as the dead legs may be subject to internal corrosion, freezing or rupture problems.
28. Manual high point vents and low point drains shall be provided to ensure that the pipelines can be totally drained and reprimed. These points shall have dust caps with captive chains. The drain and vent pipes shall terminate above a tundish, which is to be connected to a product recovery tank where practicable.

29. Air eliminators shall be provided at pumps, filter-water separators and where necessary to eliminate excessive air in fuel. Discharge from the air eliminators should return to product recovery and there shall be discharge indication via sight glass.

30. Pressure and thermal relief shall be provided where necessary to protect the aviation fuel reticulation system.

Flow Velocity

31. The velocity of flow shall be sufficient to enable removal of free water, from the low points in pipelines. Flow velocity shall also be selected to minimize static electric build-up, hydraulic surges and internal pipe erosion.

32. To reduce the generation of static, the point of entry into a tank shall be at a low level to ensure rapid submersion of the inlet fuel and to minimise misting, spraying and foaming. Fuel discharge velocity in the tank shall be kept low and should not exceed 1 metre per second until the incoming stream no longer breaks through the liquid surface and a second immiscible phase is not present.

33. When a submersible pump is to be used to dispense fuel from a fuel tank, the suction velocity shall provide a proper suction condition and the suction intake shall always be below the fuel level.

34. Refer to MIL-HDBK-1022A, Section 9.1.1.1 “HYDRAULIC DESIGN” and its sub-sections.

Anti-static design

35. The size of pipe shall be increased to permit a 30 second relaxation period for the dissipation of static electricity between all micronic filters, filter/separators and any outlet which can discharge into atmosphere, including initial filling of empty tanks and tankers, where an aviation fuel installation is to be designed to:

    a. Accept non-static treated fuel; or

    b. Cater for long fuel storage period which may reduce fuel conductivity to an unacceptability low level.

36. Refer to AS/NZS 1020; MIL-HDBK-1022A, Section 2.17 “ANTISTATIC DESIGN” and its sub-sections; and API RP 2003.

37. Refer to DEF (AUST) 5695B, Part 3 Section 2 Chapter 1 “STORAGE AND HANDLING OF BULK POL” and Part 4 Section 1 Chapter 1 “ELECTRICAL EARTHING AND BONDING”.

38. The Designer shall confirm the requirements for antistatic design during the preliminary design stage.

Surge Suppression

39. Pipework systems and equipment shall be designed to avoid unacceptable high surge pressure arising during operations. Surge suppressors (alleviators) may be used, but only in exceptional cases. Where it is not otherwise practicable to design the pipework systems to safely accommodate the anticipated surge pressures.

40. Surge pressure shall be controlled by:

a. A selection of proper design flow velocities;

b. Fixing opening and closing rates of critical valves; and/or

c. The use of surge suppressors (alleviators) (if justified).

41. When surge suppressors (alleviators) are required, they should be fitted with a dial gauge to indicate gas pressure and a Schraeder valve to facilitate topping of the gas. The equipment shall be mounted properly so that water and other contaminants cannot be trapped in the alleviator.

42. The requirement for surge suppression shall be determined. Surge suppressors shall be designed to AS/NZS 1200 and installed to AS 3892.

43. Refer to MIL-HDBK 1022A Section 9.1.3 ”SURGE ANALYSIS” and 4.7.5 “SURGE SUPPRESSORS”.

Hydrant Refuelling Pipelines

44. Location of hydrants pits shall consider the following:

- Parking positions of aircraft;
- Type of aircraft;
- The location of the aircraft refuelling intake stations; and
- RAAF refuelling practice and procedures.

The Designer shall prepare an aircraft parking plan in consultation with users, and a hydrant point location plan during the preliminary design phase for Defence’s acceptance.

45. Routing of hydrant refuelling pipeline shall consider the following:

a. The routing of hydrant refuelling pipeline shall be selected to ensure that:

- Excavation depth and the requirement for dewatering are minimised;
- Pipe alignment is the most economical;
- Disturbance to the operation of the apron is minimised during construction and pipeline maintenance;
- Flushing of the pipeline to low point drains by normal fuel flow is maximised;
- Flow of free water by gravity in the pipelines is maximised;
- Removal of water and contaminants is optimised; and
- Disturbance to the existing services is minimised.

b. Hydrant refuelling pipelines shall be closed loop (i.e. have a return line to the BFI) unless it is not economical or practical to do so. This requirement applies at all sites, particularly those with low fuel movements. The return line should allow fuel to be returned to any QCI and bulk storage tank.

46. The Designer shall prepare a routing plan including longitudinal sections during the preliminary design phase for Defence’s approval.

47. Isolating valves shall be provided to optimise refuelling capabilities of a hydrant refuelling system. A minimum of two hydrant points are to be operable when any branch hydrant pipeline or any

hydrant point requires shut-down for maintenance. It is desirable that each hydrant point can be isolated.

48. Pits for hydrant, high point vent and low point drain. Each pit shall be pre-fabricated, self contained unit including pit body, pit cover, equipment and/or valve and environmental seal. The minimum requirements shall be as follows:

    a. Water/fuel-tight Requirements:

    - Each pit is to be liquid tight.
    - Robust, water-tight and weatherproof cover lid and environmental seal are to be provided.
    - Water on the cover can be drained away easily. The cover, in conjunction with concrete surround, is to have channels to drain water effectively to the adjacent ground.
    - Penetration in the pit is to be water/fuel-tight, using proven construction.
    - Sheetflow on surrounding ground and potential source of water fall is to be considered to prevent water ingress into the pit.
    - Pits fitted with covers shall be accessible without any undue effort.
    - Hydrant pit top is to be adequately uplifted to prevent water ingress.
    - Pit drainage is to be provided where practicable.

    b. Strength requirements:

    - All cover lids and frames shall be designed, using appropriate materials to support wheel loads from aircraft and vehicle movements.
    - The materials selected for design shall be ductile, corrosion-resistant, impact-resistant, and suitable for the intended use.

49. Grading of the hydrant pipeline should generally conform to current aviation industry practice. The objective of grading the pipeline is to prevent free water and contaminants stagnating in the pipeline. The pipeline shall be graded so that water and contaminants are carried by the fuel flow and the effects of gravity to low point drains. The following should be adopted as the minimum design requirements:

    a. Minimum pipe fall (in the direction of fuel flow) shall be 1 in 400.

    b. Minimum pipe rise (in the direction of fuel flow) shall be 1 in 250.

Defence approval must be sought for non-nominated pipeline gradings.

50. The length of a spur hydrant pipeline, where the pipeline rises in the direction of fuel flow, is to be as short as practical to prevent trapping free water and contaminates.

51. Hydrant pipeline shall be levelled properly both during initial laying and during the operation life so that the effect of soil heaving on pipe fall is reduced.

52. MIL-HDBK-1022A Section 4.2.4 “Aircraft Direct Fuelling Systems” requires that the aircraft direct fuelling systems are configured in a loop with no dead ends. The loop is made up of the supply/return piping separated by a flushing/back-pressure control valve that maintains a constant pressure on the supply side pumping and relieves excess fuel not taken on by the aircraft(s) into the return portion of the piping and back to the tank. This configuration provides smooth operation

and eliminates surge pressure spikes that have been so destructive to aircraft fuelling systems of the past.

Fuel Hydrant, High Point Vents and Low Point Drains

53. A hydrant outlet shall be placed directly above the pipeline where practical. This arrangement ensures that any contaminants generated at the hydrant outlet are flushed to the low point drains of the pipeline by fuel movement and can be easily drained off.

54. A branch pipe of a main pipeline shall be connected to the top of the main pipeline where practical. This arrangement minimises the transfer water and any contaminants from the main pipeline to the branch.

55. Hydrant pits shall be furnished complete with equipment such as hydrant control valves and shutoff valves assembled in a pipe riser. All control valves shall be of the same manufacture and comply with the following standards:

    a. Fuel hydrant valves are to comply with the relevant IP Standard or API Standard, and have records of proven performance.

    b. Hydrant valves are to have slow opening actions adjustable between 5 and 10 seconds and slow closing actions adjustable between 2 and 5 seconds.

    c. Outlet diameters are to be 100 mm, compatible with the API inlet coupler of the RAAF hydrant refuelling vehicles. (The Designer/Contractor shall check with the users).

    d. The valves are to be complete with stone guard and valve closure lanyard.

    e. Pressure release valves are to be provided for ease of coupling.

    f. The design is to allow adaptor and pilot valve to be serviced without depressurising the hydrant refuelling system.

56. Fuel hydrant, low point drain and high point vent pits shall comply with the following requirements:

    a. The pits are to be 600 mm (24 inch) minimum in diameter. (The Designer/Contractor shall check with the users).

    b. Captive cover cable is to be provided.

    c. Flexible seal is to be provided to allow ground movement.

    d. The pit is to have a corrosion resistant body. Typical construction is hot-dipped galvanised, cast steel body with internal and external protective coating.

    e. The lid cover and frame are to withstand minimum design bearing load of 2070 kN/m^2.

    f. Accessories such as base sub-flange assembly, bonding strip, grip kit, etc. are to be provided.

    g. A standard earth reference point is to be provided on the concrete surround to accommodate an alligator-earthing clip.

57. Manual high point vents and low point drains shall be provided where necessary, but the number of vents and drains shall be optimised to minimise operational and maintenance demands. Piping shall be appropriately graded to ensure that the pipelines/whole system can be totally drained and reprimed. These points shall have dust caps with captive chains.

58. A low point drain should include a vertical riser, a thief tube, isolating valves (2 numbers in series are desirable), a tank unit with a pressure relief device and a chained dust cap. The vertical riser and thief tube shall be properly sized to minimise fuel waste, and maximise water and contaminant removal.

59. High point vent should be installed on the top of a hydrant refuelling pipeline and should be complete with a riser and an isolating ball valve.

“Cartless” Hydrant Points

60. Where 'Cartless' hydrant points are required, the following design features should be considered:

    a. Hydrant points are to be safe and easy for operations and fully accessible for maintenance.

    b. Hydrant points are to be compact in size with no interference to the RAAF Base operations.

    c. Hydrant points are to be marked in accordance with Defence requirements (JPLA -POLENG-AIR).

    d. All piping is to have enough mechanical couplings to permit ready equipment removal and should be designed to minimize vibration stress.

61. A hydrant point should include the following components as minimum:

    a. A stainless steel strainer and a fuel monitor with replaceable monitor elements.

    b. A flow meter with temperature compensation.

    c. A pressure control system that under flow or static conditions limits the refuelling pressure immediately downstream of the nozzle poppet to that required by the aircraft type and that under surge conditions limits the pressure immediately downstream of the nozzle poppet to an acceptable pressure. Aircraft delivery pressures are to be confirmed.

    d. Hoses, hydrant couplers, couplings and nozzles in accordance with Defence requirements (Refer DEEP and JFLA -POLENG-AIR).

    e. A dead-man refuelling control to provide immediate shutoff of fuel flow in an emergency.

    f. A thermal relief valve.

    g. Bonding and grounding reels in accordance with DI(AF) AAP7002.027-99 and other Defence requirements (DEEP/JFLA -POLENG-AIR). Refer also to AS/NZS 1020 and API RP 2003.

    h. A pump to meet delivery requirements, and surge suppressors may be included if required.

Underground Oily Water Drainage Pipeline

62. Design of underground oily water drainage piping systems shall include, but not be limited to considerations of:

    a. Properties of materials such as mechanical strength, chemicals' compatibility, internal and external corrosion, ageing, anti-static and electrostatic discharge hazard, etc;

    b. Pressure limitations for the worst case situation; and

    c. The possibility of uncontrolled flow of flammable aviation fuel through a drainage system.

63. Flame traps shall be allowed. The traps shall ensure that the flame of any burning flammable liquid on entering a drain is prevented from spreading through the drainage system. Flame traps are not intended to act as oily/water separators.

Facilities for Fuel Quality Control

64. Low point drains and fuel sampling points shall be provided where necessary for fuel quality control purposes to satisfy the requirements in DEF(AUST) 5695B.

65. A sampling point shall be fitted at the following locations that include, but are not limited to:

    a. Immediately downstream and upstream of a filter water separator;

    b. Sump sampling pipe of each aviation fuel storage tank or sampling vessel of each aviation fuel storage tank group;

    c. Low point drains of a hydrant refuelling pipeline (a Millipore sampling point at the sampling cart is an acceptable alternative); and

    d. The extreme ends of each hydrant refuelling pipeline and spurs.

66. Each sampling point shall be compatible for use with a standard Millipore gravimetric fuel sampling kit (Kit Fluid Fuel Sampling, NSN 6630-00-403-1906). Each sampling point shall be fitted with a chained dust cap.

67. A drain point shall end in a standard tap and Camlock fitting with a chained dust cap.

68. Access shall be allowed for a 500 mm high sampling bucket to be placed under an aboveground fuel sampling point or drain point.

69. Drain points shall be locked closed.

70. Tundishes with lid covers of adequate size (referring to acceptable existing equipment that is to be advised by users) shall be provided where appropriate for collecting samples. Tundishes for product recovery are to be connected to by a system of piping and valving to a product recovery tank.

71. Refer to MIL-HDBK 1022A, Section 9.10 “SAMPLING FACILITIES’ for sampling location requirements.

Sampling Cart for New Hydrant Refuelling System

72. A sampling cart shall be provided for sampling fuel from low point drains and bleeding air from high point vents if the Base does not have such a facility. The cart shall be portable and suitable for being towed by a working vehicle.
    The design and construction shall ensure that sampling operation· is efficient, safe and environmentally acceptable.
    The cart shall be capable of conducting full visual examination, suspended water checking, temperature and density measurement, and Millipore sampling.

    Hose units with suitable quick release, dry break couplings and chained dust caps are to be provided for transferring fuel from a sampling point to the cart. Facility to drain sampled fuel by gravity and by hand pump to the BFI product recovery or QCI tank shall be provided. The cart is to have a small storage tank with a level sight glass, two closed circuit samplers (one duty, one standby), equipotential bonding and earthing facility, and auxiliaries. The design and construction of the cart should be based the existing provision in RAAF Amberley, considering existing deficiencies and lessons learned to be advised by users. JFLA should be contacted should clarification of design requirements be necessary. Approval from JFLA – (POLENG-AIR) is required.

6.13 Pressure and Flow

Fuel Types:	◗ All; and ◗ DEF(AUST) 206 – Handbook of Liquid Fuel, Lubricants and Allied Products.
Principal Standards:	◗ AS 1940 – The Storage and Handling of Flammable and Combustible Liquids; and ◗ AS 4041 – Pressure Piping.
Reference Standards:	◗ AS 1210 – Pressure Vessels; and ◗ ASME / ANSI B 16 Series.
Guidance:	◗ DEF(AUST) 5695B – Petroleum, Oils and Lubricants Manual; and ◗ MIL HDBK 1022 A Sections 2 and 9, Petroleum Fuel Facilities.

Commentary:

Flowrates to be used are detailed in Clauses 14 and 15 of this Section. For other default flowrates refer to MIL HDBK 1022 A Table 1 (page 19).

Refer to tables on Pipeline Design, Valving and Fuel Storage and Recovery Tanks in this section.

System performance and critical system parameters are presented in the FDB and URB documents.

General Requirements:

Pressure Rating

1. The design report shall substantiate pressures and should nominate the Maximum Allowable Operating Pressure (MAOP) for the facilities.
2. As a guide, Defence fuel farm service pressures fall comfortably within the allowable service ranges conforming to ANSI Class 150 (PN 20).
3. New fuel reticulation pipeline shall operate at relatively low pressures.
4. The pipelines shall incorporate ANSI Class 150 fittings and equipment with a maximum allowable working pressure of 1960 kPa at 38 °C. This means that the total pressure including surge, pump shutoff pressure, and static pressure in any part of the system shall never exceed those maximum allowable working pressures.
5. Other equipment items such as offloading fuel tankers or aircraft refuelling tankers, which can be damaged by excessive shock pressures, require lower maximum surge.
6. When a new system is connected to an existing system, the maximum allowable working pressure will be limited by that in the existing system.

Pressure Limits Studies

7. Engineering studies that establish surge pressure and overall limiting pressure standards for the bulk fuel installation shall be required as part of the preliminary design.

8. Millipore fuel contamination monitors restrict maximum operating pressure at the monitors up to 700 kPa. Means (in accordance with the aviation industry practice) shall be required to limit the operating pressure at the monitors.

Hydraulic and Surge Analysis

9. A thorough hydraulic and surge analysis, and cyclic stress (service life) analysis of pipeline shall be required. An interactive pump and system analysis shall be carried out to demonstrate that the design of pumps and systems are optimised under the normal operations. The interaction of single and multiple pump operation and system hydraulics shall be thoroughly analysed.
10. Refer to MIL-HDBK 1022A, Section 9.1.1.1 “HYDRAULIC DESIGN’, Section 9.1.3 “SURGE ANALYSIS’ and their sub-sections for guidance.
11. In a hydrant refuelling system, the overall limiting pressure including surge pressure at each hydrant point of a hydrant refilling system shall be below the maximum design pressure rating of the pipeline, fittings and equipment, whichever is the lowest. The overall limiting pressure needs to be calculated/tested for the following scenarios:
    a. The closure of one hydrant valve at maximum flow; and
    b. The simultaneous closure of two hydrant valves at maximum flow.
    (The closure time of each hydrant valve shall be determined in accordance written technical specification given by the manufacturer).
12. Assume a near instantaneous shut-off by the aircraft in the design of aviation hydrant refuelling systems.
13. Hydrant refuelling vehicles are fitted with pressure control shut off valves. Surge analysis of hydrant refilling piping system shall consider this requirement. The Designer shall confirm with Defence the shut-off time during the preliminary design stage.
14. Tanker refilling vehicles are fitted with hydro-mechanical high level shut off valves for overfill protection. Surge analysis of dispensing piping system shall consider this requirement. The Designer shall confirm with Defence the shut-off time during the preliminary design stage. Some of the current fleets have a shut-off time between 2 to 5 seconds. Some are subject to modification and the shut-off time will be instantaneous.

Design Flow Rates

15. Flexibility shall be allowed in design flow rates in order to cater for the flow limitation of various types of tanker refilling vehicles (current and future), which need to be confirmed with Defence during the preliminary design stage.
16. Subject to confirmation by Defence for each new bulk fuel installation, the following flow rate will need to be used under normal or the most adverse hydraulic conditions.

a. Transfer between two storage tanks – one transfer pump (19 litres per second) and two transfer pumps (38 litres per second).

b. Offloading from one offloading fuel tanker to a QCI tank (19 litres per second).

c. Offloading from two offloading fuel tankers to a QCI tank (38 litres per second).

d. Dispensing from a storage tank to one refuelling tanker vehicle (19 litres per second).

e. Dispensing from a storage tank to two refuelling tanker vehicle (38 litres per second).

17. Variable flow during the ramp up and down of flow control valves in offloading, dispensing or transfer shall be considered in hydraulic design.

18. Design flow rates (Litres/second) from direct refuelling stations to aircraft shall consider the following:

    a. Delivery from a direct refuelling station to aircraft (Varies);

    b. Design flow rates for various types of aircraft (current and future) shall be confirmed with Defence during the preliminary design stage; and

    c. Allow variable flow rates in hydraulic design.

19. Design flow rates (Litres/second) from a hydrant refuelling system to aircraft shall consider the following:

    a. Delivery from a hydrant refuelling system to aircraft (Varies);

    b. Maximum flow, minimum flow and operating flow profile at normal or the most adverse hydraulic conditions shall be determined;

    c. Design flow rates for various types aircraft (current and future) shall be confirmed with Defence during the preliminary design stage; and

    d. Allow variable flow rates in hydraulic design.

6.14 Pumps

Fuel Types:	◗ All; and ◗ DEF(AUST) 206 – Handbook of Liquid Fuel, Lubricants and Allied Products.
Principal Standards:	◗ Defence Safety Manuals (SAFETYMAN); ◗ AS HB 13 – Electrical Equipment for Hazardous Areas; ◗ AS/NZS 1020 – The Control of Undesirable Static Electricity; ◗ AS 1076 Series – Code of Practice for Selection, Installation and Maintenance of Electrical Apparatus and Associated Equipment for use in Explosive Atmospheres (other than Mining Applications); ◗ AS/NZS 1768 – Lightning Protection; ◗ AS 1940 – The Storage and Handling of Flammable and Combustible Liquids; ◗ AS 2381 Series – Electrical Equipment for Explosive Atmospheres – Selection, Installation and Maintenance; ◗ AS/NZS 3000 – Electrical Installations (Known as the Australian/New Zealand Wiring Rules); and ◗ AS/NZS 60079 - Explosive Atmospheres - Equipment - General Requirements.
Reference Standards:	◗ API Std 610 – Centrifugal Pumps for Petroleum, Heavy Duty Chemical and Gas Industry Services; ◗ API Std 676 – Positive Displacement Pumps – Rotary; ◗ API 682 – Pump Shaft sealing System for Centrifugal & Rotary Pumps; and ◗ ASME B 73.1 – Specification for Horizontal End Suction Centrifugal Pumps for Chemical Process.
Guidance:	◗ DEF(AUST) 5695B – Petroleum, Oils and Lubricants Manual; and ◗ MIL HDBK 1022A Section 2, 3 & 9, Petroleum Fuel Facilities.
Commentary:	

General Requirements

1. As a minimum, centrifugal pumps shall comply with the requirements of ASME B73.1. API 610 may be applied to critical service applications.
2. As a minimum, pumps will be fitted with single mechanical seals conforming to API 682. Where fuels are pumped above their flashpoints, double seals conforming to API 682 shall be specified.
3. The priming of centrifugal pumps should be carefully assessed in situations where floating suction pipework has been drained or vented.
4. Electrically driven pumps should be used for the movement of fuel.

5. Where variable speed drives (VSDs) are used to regulate pump speed / performance, the performance of the VSD unit will be monitored and alarmed through the fuel farm control system.
6. Where VSD units are installed, flowrates will be ramped with hydraulic performance verified in accordance with MIL HDBK 1022A Section 9.1.3.
7. Unless otherwise specified, target ramp performance will be:
    - 0-100% linear ramp up for 0-10% of target volume delivered.
    - 100-0% linear ramp down for 90-100% of target volume delivered.
8. Unless otherwise stated in this policy, target fuel delivery rates are detailed in MIL HDBK Table 1 page 19.
9. Target linear fuel velocities should be in the range of 2.1 m/sec (to prevent sediment deposition) and 3.7 m/sec (minimise turbulence and control pressure drop).
10. Air driven pump(s) may be used for dewatering/sampling and for emergency operations, subject to design.
11. Air-driven diaphragm pumps, where compressed air is applied directly to the diaphragm present a potential risk in the event of diaphragm rupture and direct contact with fuel. This risk shall be formally considered in selecting this type of pump for fuel service.
12. Full construction details, including materials used, and performance data shall be submitted for approval to Defence during the design stage.
13. Refer to MIL – HDBK 1022A, Section 4 “PUMPS”, Sub- sections 4.7.8.1 “DESIGN REQUIREMENTS”, 4.7.8.2 “CENTRIFUGAL PUMPS”, 4.7.8.3 “VERTICAL TURBINE PUMPS”, 4.7.8.4 “ROTARY PUMPS”, 4.7.8.5 “DRIVERS”; 4.7.8.7 “ INSTALLATION” and 4.8.3 “PUMP CONTROLS”.
14. Offloading pumps – multistage/single stage centrifugal pumps of self priming type capable of handling entrained air, regardless of whether the suction source is above or below the pump centreline. The pumps should exhibit good vapour handling characteristics and be self-venting.
15. Dispensing pumps – submersible vertical turbine pumps for underground installation or multistage/single stage centrifugal pumps for aboveground installation. The pumps should be of the self priming type and be self venting.

Dewatering/Sampling and Slops Clearance Pumps

16. Dewatering/Sampling and slops clearance pumps – positive displacement pumps or submersible vertical turbine pumps. The pumps should be of self-priming type. A slops clearance pump that is used to transfer wastewater from a slops tank to a fuel/water interceptor should be non-emulsifying.
17. Additive injection pumps (if required) should be of the metering pump either reciprocating or diaphragm type. The pumps should be capable of capacity adjustment from 0-100% of specified design capacity with high accuracy in repeatability.

Hydrant Refuelling Pumps

18. Hydrant refuelling pumps shall be of multistage/single stage centrifugal pumps for aboveground installation. The pumps should be of the self priming type and be self venting. (Self priming

capability is not normally required for a hydrant line but such feature will be useful during maintenance when it is not necessary to expel all air in suction lines prior to pump operation).

19. The pumps shall have flat performance curve characteristic to avoid high pressures at low flow rates and provide a steady pressure over the full flow range. The pumps shall also have a continuously drooping performance curve characteristic to avoid hunting and surging under all operating conditions.
20. Combined single point dispenser / hydrant refuellers shall be designed to satisfactorily operate at pressures not exceeding 1900 kPa.

Multipurpose Pumps

21. Where pumps may be required to perform several duties, the design should ensure that any system requirements, e.g., the control of pressure, the use of control valves, etc. are considered to render the pumps suitable for all duties and to satisfy net positive suction head (NPSH) requirements.

General Characteristics

22. Electrical pumps shall be directly coupled to an electric motor capable of starting under load and with adequate power rating to meet the loads imposed by the pump. Motors located outdoor shall be weather proof to minimum IP 65. Motors shall be suitable for the particular hazardous zone.
23. Self priming capability should allow automatically extracting air and/or vapours from the suction side of reticulation system whenever the pump operates. The device should bring the pump up to full self prime condition within 30 seconds of pump start. The air/vapours should be automatically discharged to the atmosphere through an outlet located over an open drain which is connected to a product recovery tank. The primer device should not provide a leakage path around the pump from suction to discharge or vice versa.
24. Air elimination is essential for pumping fuel. The design shall ensure that all necessary air elimination facilities are incorporated.
25. The pump output shall be smooth in flow, free of gas inclusions or severe pulsation that may damage the fragile elements in the coalescer/filter housing.
26. Pumping system shall be stable in its operation and limit the surge pressures.
27. Pumps shall have an adequate NPSH. NPSH of the pumps shall be adequately higher than the suction head required by the system when pumping fuel under the most adverse hydraulic conditions. The effect of altitude on the pump performance shall be taken into account. The pump operate free of cavitation, vibration and excessive gas evolution.
28. Pump installation will be operating with operators in the vicinity of the installation. Accordingly, the selection of equipment and its installation shall take cognisance of the noise level during the pump operation. The noise pressure level should not exceed that required in legislation from a pump or group of pumps during their operation. Any enclosure of the pump to alleviate noise should not hinder servicing or maintenance access and shall be vented in accordance with AS 1940.
29. The pump installation shall provide a system that is inherently safe and reliable for moving fuel throughout the system.
30. Any fuel that is diverted from the basic reticulation to relieve line pressure of control rate of flow should not be returned to the storage tank from which it is being drawn. Nor should it be disposed of as waste. A loop system of fuel flow around the pump is acceptable provided the fuel is kept

within safe temperature limits. Where necessary, provide heat exchangers to maintain these limits.

31. The pumps shall suit the application and be of a proven and reliable design. Pumps shall be suitably designed for their individual service conditions and capable of continuous operation for all performance points over the entire range of operation with the specific suction conditions. Pumps shall be selected with their specific design duty point as close to peak efficiency as possible.
32. Pump sets shall be capable of remaining for long periods unused on site or in store without suffering any deterioration that would effect their efficient operation when brought into use.
33. Piping systems at pump locations shall be designed to allow for pump removal and maintenance. The pump design should allow partial dismantling without removing the connecting piping.
34. Piping systems shall be designed to prevent binding, misalignment, and seal wear on the pumps as well as to avoid structural limitations of the pump casing. Proper piping design techniques, anchoring of pipes and pumps, and stress analysis are preferred over flexible connections to the pumps. Drip and spill containment around the pumps should be provided.
35. A complete pump protection scheme shall be designed to prevent excessive cycling, pump bearings from overheating, excessive pressure, etc. The pumping system shall be capable of operating against closed valve so as to avoid frequent stop/start of the pumps when controlling the rate of flow. Pumps should be fitted with an adjustable timer control to enable the pumps to run on after cessation of fuel flow to prevent excessive cycling. Pumps capable of pressures in excess of the safe working pressure of hoses and loading facilities shall be provided with bypasses, relief valves, or other arrangements to protect against excessive pressure.
36. Pumps and motors rated for the same performance, wherever possible, should be interchangeable.

Offloading Pump Operation

37. A bulk fuel installation generally has a normal offloading shelter for normal operation. The offloading and dispensing shelters should be combined into one shelter where practical.
38. Minimum two offloading points with a pump each are to be installed.
39. Three loading points are to be installed in the normal offloading shelter if this is designed for offloading fuel from a triple road train.
40. Each offloading pump should be capable of pumping fuel from a tanker into a QCI tank. With all loading points pumping fuel into one tank, the duty flow rate from each pump is to be maintained.
41. A standard RAAF manifold, containing dry break couplings, shall be provided at each offloading point for tanker offloading. The designed shall consult DEEP for information.

Dispensing Pump Operation

42. Two dispensing point with a pump each is to be installed in a normal dispensing shelter. The offloading and dispensing shelters should be combined into one shelter where practical.
43. Each dispensing pump should be capable of pumping from a selected fuel storage tank into a refuelling tanker vehicle.
44. Two dispensing points can be used and maintain its duty flow rate when pumping simultaneously out of a selected fuel storage tank into two RAAF refuelling tanker vehicles.

45. Each pump should maintain its duty flow rate when circulating fuel from/to the tank via a filter/separator.

46. Each pump should maintain its duty flow rate when transferring fuel from one tanker to the other.

Emergency Offloading/Dispensing (O/D) Shelter (if required)

47. One mobile/portable offloading point is to be installed in an emergency O/D shelter.

48. One mobile/portable dispensing point is to be installed in an emergency O/D shelter.

49. These mobile/portable points are also to be used at the emergency connection points of each tank or tank group, subject to design.

50. The offloading point is to be provided with an electric pump, a filter/separator, a meter, a sampling pot and other auxiliaries.

51. The dispensing point is to be provided with an electric pump (if required), a filter/separator, a meter and other auxiliaries.

52. The mobile/portable offloading point allows offloading from a tanker vehicle to a fuel storage tank when the normal offloading shelter does not function.

53. The mobile/portable dispensing point allows dispensing from a fuel storage tank into a tanker refilling vehicle when the normal dispensing shelter does not function.

54. Each mobile/portable point is to be mounted on a trailer skid, so that two persons are capable of positioning it. Inlet and outlet connection should be provided with Camlock couplings. Earthing reels should also be provided. All mobile facilities shall be approved by DEEP prior to manufacturing.

Emergency Operation During Power Outage

55. A mobile/portable air-driven pump is to be provided for emergency operation. Each mobile/portable pump is to be mounted on a trailer skid, so that two persons are capable of positioning it. Inlet and outlet connection should be provided with Camlock couplings. Earthing reels should also be provided. All mobile facilities shall be approved by DEEP prior to manufacturing.

56. Operation of the air-driven portable pump enables:

    a. Fuel to be pumped from a fuel storage tank to a refuelling tanker vehicle if flow by gravity is inadequate; or

    b. Transferring fuel from one tank to another.

6.15 Valving

Fuel Types:	◗ All; and ◗ DEF(AUST) 206 – Handbook of Liquid Fuel, Lubricants and Allied Products.
Principal Standards:	◗ AS 1940 - The Storage and Handling of Flammable and Combustible Liquid; and ◗ AS 4041 - Pressure Piping.
Reference Standards:	◗ API 6D – Specification for Pipeline Valves; ◗ API 6FA – Specification for Fire Test for Valves; ◗ API 607 – Fire Test for Soft-seated Quarter-turn valves; ◗ API Std 608 – Metal Ball Valves – Flanged, Threaded and Butt-welding Ends; ◗ API 6A – Needle Valves; ◗ API 609 – Butterfly Valves; ◗ BS 5155 – Butterfly Valves; ◗ BS 1868 – Specification for Steel Check Valves (Flanged and Butt Welded Ends) for Petrochemical and Allied Industries; ◗ BS 5351 – Steel Ball Valves for the Petroleum, Petrochemical and Allied Industries; ◗ BS 5352 – Specification for Steel Wedge Gate, Globe and Check Valves 50 mm and Smaller for Petroleum, Petrochemical and Allied Industries; and ◗ BS 6755 Part 2 – Testing of Valves (Specification for Fire Type-Testing Requirements).
Guidance:	◗ DEF(AUST) 5695B – Petroleum, Oils and Lubricants Manual; and ◗ MIL HDBK 1022 A – Petroleum Fuel Facilities.

Commentary:

Valves to be flanged unless otherwise indicated.

Buried flanges shall be protected for corrosion. Defence preference is for flanged joints to be located within service pits.

General Requirements:

1. Use fire-safe valves in tank wetted service.
2. Incorporate anti-static design features.
3. Suitable for a working pressure of 1960 kPa at 38°C with weatherproof housing.
4. For fuel service, valve body materials of construction shall be type 316 stainless steel as a minimum (refer Section 11). Use of steel and cast iron require approval by DEEP.
5. Valves to be supplied with appropriate material test certification and shall be tested in accordance with relevant BS, ASTM and/or API Standards with test certification being provided.

6. Valve to be provided with positive, visual and mechanical indication of its position.
7. A robust position sensor shall be required at each automated valves and main manual isolation valves at tank shell, in fuel reticulation systems, at bund drains and at oily water systems. The purpose is to ensure that the valve status is indicated in the PID diagrams of the SCADA systems (if installed) of a bulk fuel installation.
8. Valves in liquid service are to be full bore type with bodies selected to minimise the hold up of contaminants.
9. Non-return (check) valves shall not be relied upon to provide the only means of fluid isolation.
10. Reverse flow shall be addressed by proper hydraulic design and formally assessed within the HAZOP Study.
11. Valve seal materials shall be selected mindful of fuel composition and the presence of any special fuel additives DEF(AUST) 206.
12. Where the second block valve is automatically actuated, a simple means shall be provided to enable this valve to be manually opened during an emergency.
13. Valves with cast iron bodies shall not be used in fuel farm service unless approved by DEEP.
14. Valve handles shall be lever type and located external to pits and bunds where applicable.

Gate Valves

15. Gate valves shall not be used due to potential trapping of dirt in the seat.

Ball Valves

16. To API Spec 6D or BS 5351.
17. Ball valves above size DN 80 shall be soft-seated double trunnion flanged type.
18. Full bore ball valves shall be used for open/shut service and/or when a quick shut off is required.
19. Reduced bore ball valves may be used for vent and drain points.
20. Non-lubricated and operate from fully open to fully closed with 90 degree rotation of the ball.
21. Refer to MIL-HDBK 1022A, Section 4.7.9.2 “TYPES” (Valves) and its sub-sections.

Check Valves

22. To API Spec 6D or BS 5352 / BS 1868.
23. Check valves shall be used to prevent reversal of flow in pipelines (not for positive isolation).
24. Swing type and tilting, non-slam type. Nozzle type check valves can be specified under certain conditions (e.g. where pigging does not occur).
25. Discs and seating rings to be renewable and of non-slamming type.
26. Refer to MIL-HDBK 1022A, Section 4.7.9.2 “TYPES” (Valves) and its sub-sections.

Double Block and Bleed Valves

27. To API Spec 6D.
28. Double block and bleed valves – double-seated, tapered lift, plug valves with a body bleed between the seats.

29. Provide double block and bleed valves:
    a. Where piping goes below/above ground and requires periodic pressure testing;
    b. In the cases where connections are made below tank liquid level. The primary block valve shall be maintained open in normal service. Flow will be isolated, controlled or throttled on the second valve. This valve will be automatically closed where there is no operation;
    c. At all sub-surface and above ground piping connections to the tank shell of fuel storage tanks including drains, inlet valves and outlet valves;
    d. Where there are separation of product services; and
    e. Between pier and tank storage.
30. Configuration with two ball valves arranged in series, with a body bleed in between, is an acceptable alternative at the tank shell of fuel storage tanks.
31. The valves provide a means by which the operator can assess if the valve seat is not sealing.
32. Do not use lubricated plug valves.
33. Refer to MIL-HDBK 1022A, Section 4.7.9.2 “TYPES” (Valves) and its sub-sections.

Line Blind (Spectacle) Valves

34. Line blind should be used when an infallible, leak proof and visible shut-off is required.
35. The valves may be used for isolating sections of pipelines prior to pressure testing.

Control Valves

36. Control valves are usually multi-functional and can be set either to control pressure, meter flow or other functions.
37. Line pressure actuated control valve shall be of hydraulically actuated diaphragm glove type. The valves shall be operated entirely by the line pressure.
38. The valve shall be fail-safe in defined position in the event of a diaphragm failure.
39. Valve closure time should be greater than 3 seconds unless otherwise stated.
40. Refer to MIL-HDBK 1022A, Section 4.7.10 “HYDRAULICALLY OPERATED DIAPHRAGM CONTROL VALVES” (Valves) and its sub-sections for guidance.

Pressure Relief Valves

41. Pressure relief valve should be of hydraulically actuated diaphragm globe type.
42. Adverse cascading effect of pressure relief valves in series shall be prevented.
43. The valve shall be preset, tested and stamped at the manufacturer’s works.
44. Maximum overpressure should be 10% during relief.
45. Isolating valves on a pressure system shall be secured open to ensure a properly functioning system.
46. Discharge from a pressure relief shall be directed to a lower pressure receptacle where the relieved liquid will not interfere with downstream conditions.

Valve Operators

47. Provide manually operated valves when not specified for remote, automatic, or emergency operation.
48. Use geared operators for ball and plug valves specified larger than 150 mm.
49. Provide locking tabs on valves to allow padlock to be used for lockout during maintenance.
50. Gear operated valves shall be designed to ensure that the gearboxes are easily removable and to allow for the future provision of electric or pneumatic power operations.

Automated Valves

51. Automated valves shall be operated by pneumatic power. Electric operation may be allowed subject to compliance with hazardous zone classification.
52. When valve control is in automatic mode, open or close the valve as required in conjunction with the starting or stopping of the pumps. Close the valve under failure condition such as an electrical mains failure, pneumatic power failure and emergency power failure conditions.
53. When valve control is in “local” mode, the control should be via an open/close push button or other similar means in the vicinity of the valve location with a control mode selector (where required).
54. Fail safe control (close) valves shall be used for all automated valves.
55. The actuator of an automated valve shall incorporate a disconnect feature to permit override for manual operations only for actuator failure or where there is no power.
56. The valve closure rate shall prevent excessive hydraulic pressure or surge.

Tank Actuated Valves

57. Tank actuated valves shall include:
    a. Pneumatic actuator – fail safe close
    b. Manual handwheel for manual operation;
    c. Declutchable gearbox;
    d. Local release lever to select handle/actuator operation;
    e. Solenoid valve for operation from SCADA;
    f. Fusible section of airline for safe-closing the valve under fire exposure;
    g. Position proving limit switches (to SCADA); and
    h. Local position indication.

Refer to Figure 8 for actuated valve configuration.

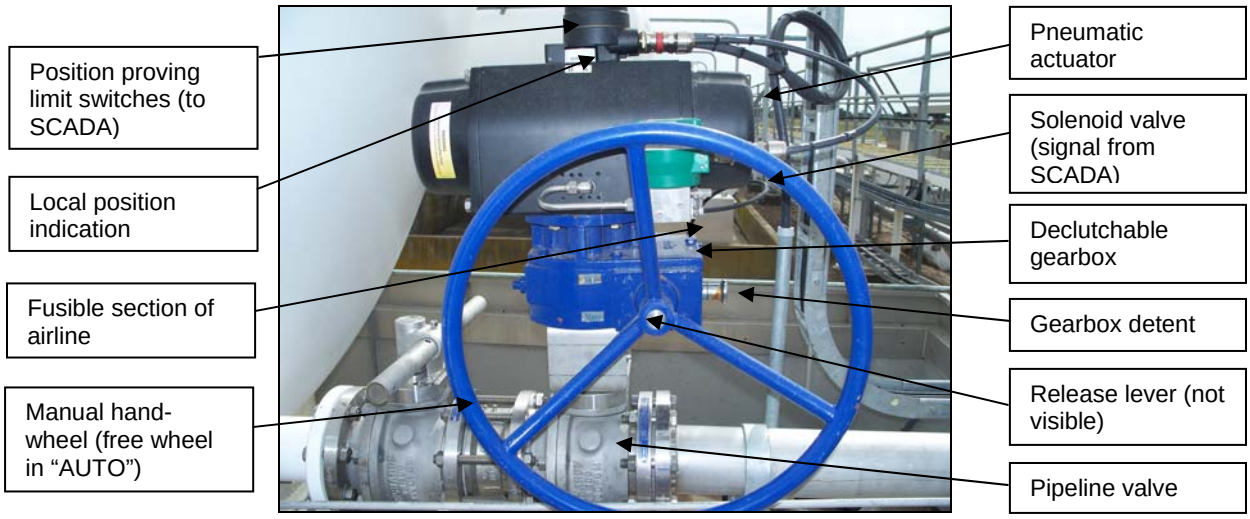


Figure 8 - Fuel Farm Automated Valve – Essential components

6.16 Tank Bunding

Fuel Types:	◗ All; and ◗ DEF(AUST) 206 – Handbook of Liquid Fuel, Lubricants and Allied Products.
Principal Standards:	◗ AS 1940 – The Storage and Handling of Flammable and Combusitble Liquids.
Reference Standards:	◗ EPA Victoria – Bunding Guidelines Publication 347, 1992; and ◗ API 650 Appendices I & O.
Guidance:	◗ DEF(AUST) 5695B – Petroleum, Oils and Lubricants Manual; ◗ MIL HDBK 1022A Section 8.11, Petroleum Fuel Facilities; and ◗ NFPA 30 – Flammable and Combustible Liquids Code.

Commentary:

The Victorian EPA Guideline No. 347 is comprehensive and consistent with the requirements of AS 1940.

It has found wide application across the Commonwealth, States and Territories.

These requirements apply to storage tanks with capacities greater than those described in AS 1940 Table 2.1 for Minor Storages. Minor storages may be bunded for compliance with Defence Environmental Policy.

General Requirements:

1. A means of determining fuel leakage under any bunded area shall be provided.

Horizontal Tanks:

2. Minimum concrete strength shall be 32 MPa.
3. Where possible, the tank support structure and bund will be cast as a single integral section.
4. The tank/saddle support height shall be above the maximum liquid level retained within the bund. Refer to Figure 9 for horizontal tank bund sketch.
5. All field joints will be cast with thermoplastic liquid stop seals. Seals will be compatible with the anticipated fuel types and remain flexible over the service life of the joint.
6. The bunded areas will drain to an underground oil/water separator or interceptor. The separator/interceptor will also provide for storage of recovered fuel which will be removed on a scheduled basis.
7. Trash screens shall be fitted to storage tank bunds to reduce solids loading on oil/water separator. The bund base shall be located on a thermoplastic membrane with under-drains in accordance with Code.

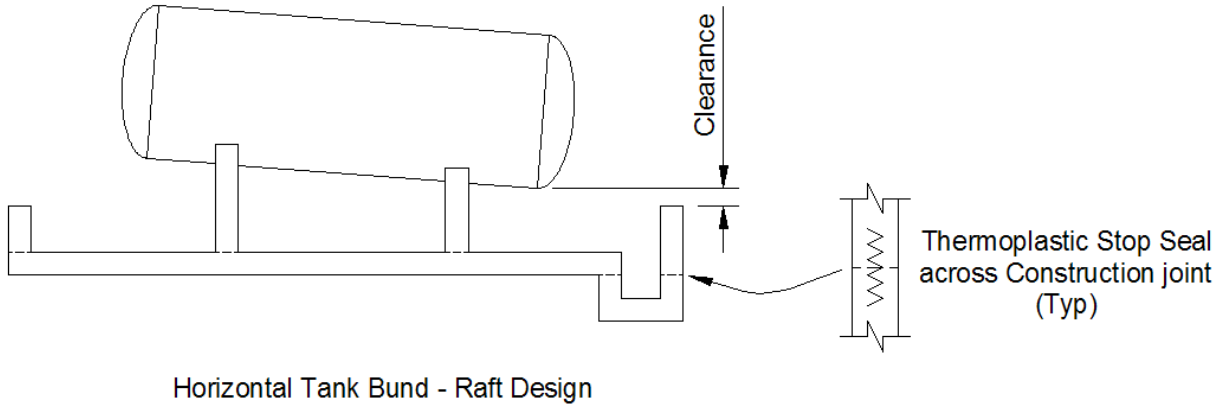


Figure 9 - Horizontal tank bund

8. Expansion joints shall be sealed with a suitable air-cured flexible polysulphide sealant. This material will be either cast or applied by gun.
9. Bund drainage shall be directed away from the tank(s) within the bund to a low-point collection sump. The sump drain shall be fitted with a knife gate valve, which can be operated externally without the need to enter the bund.
10. Wetted concrete bund surfaces shall be sealed to minimise the take up and absorption of fuel residues.
11. Compacted earth bunds shall be avoided where possible.

Vertical Tanks:

12. As per horizontal tanks above plus.
13. Tanks shall be located on ring beams elevated to ensure that the tank base will be above the maximum liquid level retained within the bund.
14. The bund surface shall be sealed or coated with a compatible material capable of retaining spilled liquid within the bund.
15. The bund design shall prevent the accumulation of liquids and dissolved salts at and under the tank base.

6.17 Fire Protection

Fuel Types:	◗ All; and ◗ DEF(AUST) 206 – Handbook of Liquid Fuel, Lubricants and Allied Products.
Principal Standards:	◗ Defence Manual of Fire Protection Engineering Chapter 23; ◗ AS 1940 – The Storage and Handling of Flammable and Combustible Liquids; ◗ AS/NZS ISO 21000 - Risk Management Principles and Guidelines; and ◗ Local EPA Regulations.
Reference Standards:	◗ Defence Environmental Policy; ◗ Work Health and Safety Regulations 2011; ◗ NSW HIPAP; and ◗ NFPA codes.
Guidance:	◗ DEF(AUST) 5695B – Petroleum, Oils and Lubricants Manual; and ◗ MIL HDBK 1022A Section 2 and 3, Petroleum Fuel Facilities.

Commentary:

The requirement for Defence to maintain a strategic capability indicates that the extent of fire protection indicated by Standard or local code may be insufficient.

Specific fire protection requirements will be determined through a formal risk assessment process, e.g. AS/NZS 31000 or semi-quantitative determination.

General Requirements:

1. The requirements of AS 1940 Section 11 shall be taken as the minimum acceptable.
2. A fire safety study shall be conducted when fusible materials such as plastic are specified for fixed installations.
3. A semi-quantitative analysis shall be conducted when required to comply with local planning requirements.
4. Fire protection shall be reviewed as part of any formal HAZOP Study, Design Review or qualitative risk assessment.
5. Fire protection prescribed in AS 1940 Table 11.3 shall be applied to any Defence fuel storage classed as Minor in AS 1940 Table 2.1.
6. Screwed or welded fittings for fire service pipelines are acceptable provided compliance with code AS 2419.1.

6.18 Radiation Safety

Fuel Types:	◗ All; and ◗ DEF(AUST) 206 – Handbook of Liquid Fuel, Lubricants and Allied Products.
Principal Standards:	◗ Defence Safety Manuals (SAFETYMAN), in particular- ◗ DI(G) PERD 19-3 “Radiofrequency radiation safety management in the Australian Defence Organisation”.
Reference Standards:	◗ AS 1940 – The Storage and Handling of Flammable and Combusitble Liquids; ◗ AS 3516 Series – Siting of Radio Communications Facilities; ◗ AS/NZS ISO 31000 - Risk Management - Principles and Guidelines; and ◗ BS 6656 – Guide to the Prevention of Inadvertent Ignition of Flammable Atmospheres by Radion Frequency Ignition.
Guidance:	◗ DEF(AUST) 5695B – Petroleum, Oils and Lubricants Manual; and ◗ MIL HDBK 1022 A – Petroleum Fuel Facilities.
Commentary:	

General Requirements:

1. In accordance with DI(G) PERS 19-3, DSl\1A provides policy guidance to radiation safety and DEEP provides policy guidance to the safe storage of fuels in radio frequency environment in Defence. These Defence agencies shall be consulted in the project planning stage or preliminary design stage.
2. BS 6656 shall be used for assessing the requirements for safe separation distance between a fixed fuel storage installation/fuel tanker parking area and communication facilities.
3. Refer to MIL - HDBK 1022A, Section 2 "GENERAL DESIGN INFORMATION", Sub-section 2.15 "ELECTROMAGNETIC RADIATION HAZARDS" and Sub-section 11.5 "AIRCRAFT REFUELLER PARKING".

Risk Assessment

4. Potential ignition hazards to petroleum storage, dispensing, or handling facilities; or biological hazards to people may be created by emissions from electromagnetic devices such as radio and radar.
5. The risks of ELECTROMAGNETIC RADIATION HAZARDS generated from communication facilities shall be assessed by competent radiation safety expertise in accordance with legislation, Defence regulations, the relevant Australian, International and Military Standards, and industry best practice.
6. When a new communication facility is proposed, the assessment shall be provided by the service providers.

7. All the risks identified shall be properly evaluated and treated to ensure safety.
8. Copies of risk assessment reports shall be submitted to Defence for reference in the project planning stage or preliminary design stage.

6.19 Fuel Quality Control Centre

Fuel Types:	◗ All; and ◗ DEF(AUST) 206 – Handbook of Liquid Fuel, Lubricants and Allied Products.
Principal Standards:	◗ The Manual of Fire Protection Engineering (MFPE); ◗ AS/NZS 2243 (Set) - Safety in Laboratories; ◗ AS 2381.1 – Electrical Equipment for Explosive Gas Atmospheres – Selection, Installation and Maintenance – General Requirements; ◗ AS/NZS 2982 – Laboratory Design and Construction; ◗ AS/NZS 60079 (Set) – Explosive atmospheres; ◗ State/Territory Dangerous Goods (Storage and Handling) Regulations; and ◗ Building Code of Australia (BCA).
Reference Standards:	◗ AS 4775 – Emergency Eyewash and Shower Equipment; ◗ AS 1668.2 – The Use of Ventilation and Air Conditioning in Bulidngs – Ventilation Design for Indoor Air Contaminant Control; ◗ AS/NZS ISO 31000 - Risk Management; ◗ Australian Dangerous Goods (ADG) Code 7th Edition; and ◗ The Installation of Emergency Eyewash and Shower Stations at Defence Establishments – Defence I.M. Policy.
Guidance:	◗ DEF(AUST) 5695B – Petroleum, Oils and Lubricants Manual; ◗ ANSI Z358.1 American Standard for Emergency Eyewash and Shower Equipment; and ◗ MIL – HDBK 1022A – Petroleum Fuel Facilities.

Commentary:

Base Fuel Quality Control Centres (FQCC) exist to conduct fuel testing required by DEF(AUST)5695B. The FQCC shall be designed to enable the safe handling, testing and storage of fuel samples, without presenting any unacceptable risks to personnel or facilities.

Consideration shall be given to any test reagent which may have a lower flash point/higher vapour pressure than the fuel type.

General Requirements:

1. Fuel Quality Control Centres (FQCC) design shall comply with the following ranked standards:
    - Defence;
    - Building Code of Australia;
    - Australian Standards;
    - State/Territory Codes; and
    - International Codes and Standards.

2. Where staff amenities and facilities are specified, they shall be separated from fuel handling areas so as not to present an exposure or fire hazard.
3. Fuel retention samples shall be stored in purpose-built, Code-compliant enclosures.
4. Fuel waste disposal systems shall be designed so as not to present any hazards from the build up of vapours within the disposal system.

Flammable Liquid Quantities Used and Stored

5. The amount of flammable liquids handled and held in the FQCC shall be minimised.
6. The maximum amount of flammable liquids that will be used or stored at any particular time, how they are used and how they are to be safely stored shall be documented.
7. Storage of flammable liquids shall be external, but close to the FQCC.

Delineation and Classification of Hazardous Areas

8. Delineation and classification of hazardous areas within the FQCC shall, as a minimum, address the following:
    a. Hazardous area classification internal or external to the FQCC;
    b. Risk assessment and mitigating strategies adopted;
    c. The need for explosion protection of equipment and, in particular, testing equipment by ventilation (Ex v) when the equipment is located in a hazardous zone; and
    d. The use of gas detectors and automatic shut-off for electricity and gas.
9. A Hazardous Area Verification Dossier shall be prepared in accordance with AS/NZS 2381.1 and AS/NZS 60079. The dossier shall be retained on site and in the DSG estate management system.

Planning, Design and Construction

10. The FQCC may be constructed as a separate structure or part of a facility provided at least one side of the laboratory is an external wall.
11. The FQCC floor shall be designed to contain any fuel spills up to a depth of 50 mm across the entire surface of the floor and shall be:
    a. Smooth, impervious and resistant to any petroleum products and chemicals used in the FQCC and easy to clean (including any low points);
    b. Of adequate mechanical and structural strength;
    c. Slip resistant in accordance with the requirements of AS 3661.1;
    d. Constructed of flame proof material;
    e. Designed to ensure any slab joints are constructed in such a way that they are sealed against penetration by hazardous materials;
    f. Covered to facilitate cleaning at the intersection of floors with walls and exposed plinths; and
    g. Electrically conductive to reduce static electrical hazards with an upturn of 300 mm at the walls in addition to the requirements of AS/NZS 1020 and AS/NZS 2982.1.

12. The FQCC walls shall be:
    a. Smooth, impervious and resistant to any petroleum products and chemicals used and easy to clean;
    b. Flame resistant (paints or coatings); and
    c. Resistant to water vapour infiltration from outdoors.
13. The walls and floors shall be resistant to the ingress of flammable gases/vapour/liquid into any cavities within the structures.
14. The ceiling shall be constructed of a rigid smooth faced, non-absorbent material with a washable gloss paint of light colour. Trapping or ingress of flammable gases/vapour in ceilings shall be prevented.
15. The FQCC shall have at least two separate means of egress, at least one of which shall be directly to the outside or to a fire isolated passageway and the other may lead to other areas of the building provided there is an alternate access to the exterior.
16. Benchtops shall be made of austenitic stainless steel with 150 mm splashbacks, free from joints as far as possible (otherwise appropriately sealed) and earthed in accordance with AS/NZS 1020. Ends of benchtops shall be sealed to end walls, sinks or similar.
17. There shall be a minimum of 1800 mm between benches or any other fixtures within the FQCC. Bench heights shall be 900 mm for working while standing and shall protrude over cupboards and drawers by 50 mm.
18. At least one benchtop shall be fitted with an integral vibration damped platform to support the operation of the analytical balance.
19. A minimum of 8500 mm (L) x 750 mm (W) of bench space shall be provided for QC testing and shall include the following:
    a. A twin bowl stainless sink and drying area;
    b. 1500 mm for visual/specific gravity/FSII testing; and
    c. 1500 mm for flashpoint testing.

    Refer to the Example Layout in Figure 10.
20. Space shall be provided on the benches for the following equipment:
    a. A 140L refrigerator;
    b. A utility oven of similar dimensions;
    c. Other equipment as identified in the FQCC Typical Equipment List attached at the end of this section.

    Refer to the Example Layout on the following page.
21. A minimum of one flammable liquid storage cabinet conforming to the requirements of AS 1940 shall be provided for the FQCC. Final storage capacity and location of the cabinet shall be determined by the user requirements and if located indoors shall be positioned such that it is not between an operator and the means of egress.
22. Cupboards shall be constructed of materials chemically compatible with those petroleum products and chemicals used within the laboratory. Provide adequate cupboard storage space for equipment to be used in the laboratory as follows:

a. Under the benches except for the sink area which will be reserved for waste containers; and

b. Above bench level (minimum of 600 mm above bench level and not exceeding 400 mm from the wall) except for areas allocated for the fridge and oven.

23. Benches, fixtures, fittings, cupboards and equipment shall be designed to eliminate the egress of vapour into void spaces (i.e. the space between walls, ceilings, etc) or the build up of vapour within an area inside the FQCC.

24. A bookshelf shall be provided with sufficient space to accommodate reference material and operator manuals.

25. As a minimum, provide two height adjustable stools with seat and foot support appropriate for working at benchtop height. Where a computer work station is provided, an adjustable office style chair (with or without arms) shall be provided.

26. Provide notices and signs in accordance with AS 2342. Clearly signpost entrances to the laboratory stating the hazards and those staff authorised to enter.

27. Lunch and restrooms shall not be located within the FQCC.

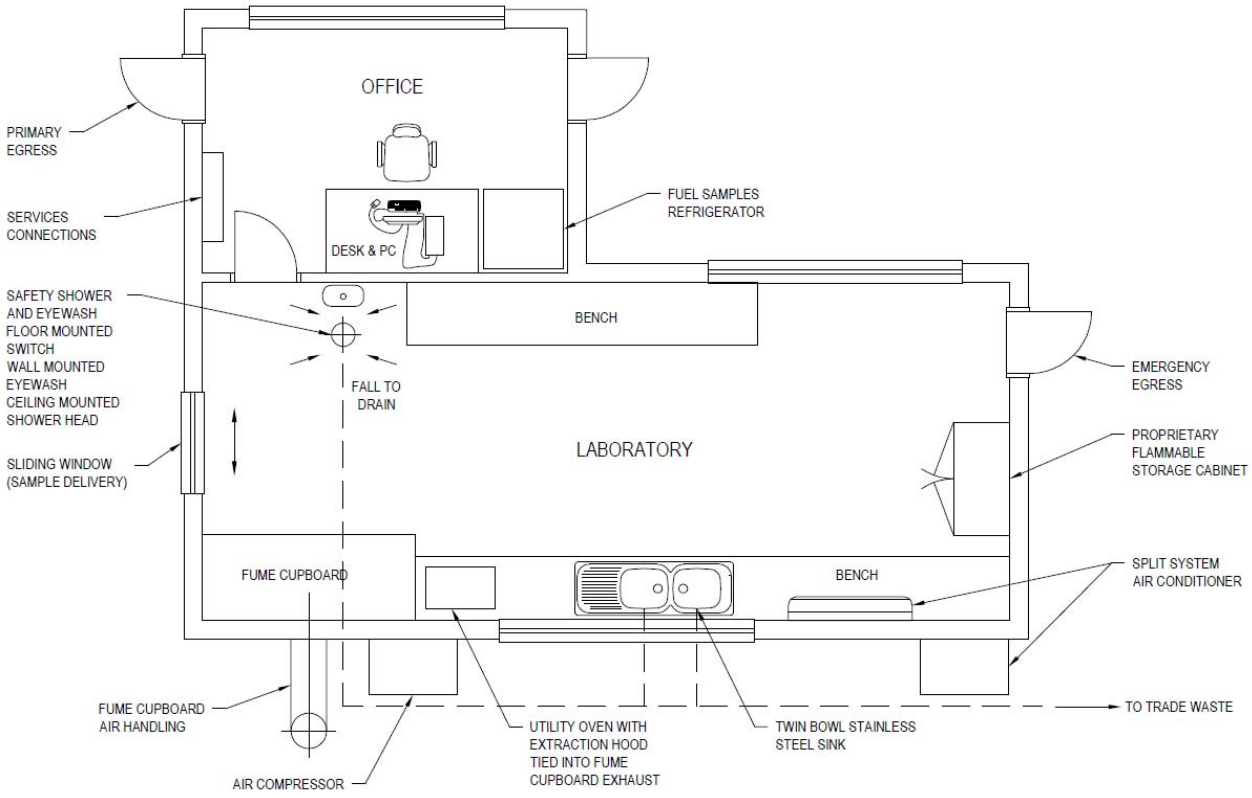


Figure 10 - Example FQCC Layout

Note to Figure 10**:** Components may be modified to suit available space/applications

Environmental Protection

28. An environmental risk assessment shall be carried out in accordance with the DEQMS Policy.
29. Waste petroleum products and chemicals (including washing waste arising from cleaning test equipment, waste fuel and spills) shall be segregated, contained and appropriately disposed in accordance with State/Territory Environmental and Dangerous Goods regulations.
30. Fume exhaust and dispersal shall comply with State/Territory Environmental and Dangerous Goods regulations. Fume exhaust and dispersal from fume cupboard(s) shall also comply with AS/NZS 2243.8 and AS/NZS 60079. Positioning of exhaust termination points shall comply with AS 1940.
31. Site management strategies shall be established to:
    a. Ensure contingency plans such as emergency action plan and spill response plan are in place in order to take prompt action to contain spills and prevent further contamination;
    b. Ensure adequate spill response kits are in place;
    c. Protect human health and the beneficial uses of the site and achieve the best practicable environmental outcome;
    d. Ensure clean up will meet the relevant State/Territory regulations; and
    e. Ensure spills are properly recorded in site logbooks.

Reticulated Services

32. The provision of reticulated services such as gas, hydraulic services, compressed air and liquid waste disposal shall comply with the requirements in AS/NZS 2982.1. Each service, including control valves, shall be labelled or identified in accordance with AS 1345 and Appendix D.
33. Each reticulated system within the laboratory shall be fitted with a suitable isolating device for each service type and shall be:
    a. Clearly identified;
    b. Located remote from the outlets in a readily accessible position;
    c. Located outside any defined hazardous zone; and
    d. Preferably located near an exit.
34. Water supply, plumbing, stormwater and drainage shall be provided in accordance with AS/NZS 3500 series. Provide one hot and two cold water taps for the sink at the benches. The second cold water tap is to be installed for distilled water. All drinking outlets shall be installed outside of the FQCC.
35. Provide four compressed air outlets above the bench. The system shall be regulated to 4 litres/second free air delivery (FAD). The quality of the air shall conform to ISA-7.0.01 Quality Standard for Instrument Air.
36. Hydraulic reticulation and disposal systems shall be constructed of materials that will be compatible with the fluid being reticulated, including wastes.

Electrical Services

37. All electrical wiring and services installed in the FQCC shall comply with applicable statutory legislation, local network provider's rules and regulations and relevant Australian Standards.
38. Computers and other benchtop appliances shall be connected to a master cut-off switch.

39. General power outlets (GPOs) will be double type to suit user requirements. All power outlets shall be located outside any defined hazardous zone. Power outlets at the benchtops shall be located 300 mm minimum above the benchtops. Power outlets shall be fitted with residual current devices (RCD) in accordance with Defence I.M. Policy – Residual Current Devices.

40. A telephone shall be located preferably inside the FQCC, but outside a defined hazardous zone (unless intrinsically safe) or nearby to the FQCC.

41. Electrical isolation will be in accordance with AS/NZS 3000. Emergency power isolation shall conform to AS 2243.7, AS/NZS 2243.8 and AS/NZS 2982.1. A risk assessment shall be carried out to determine the exact requirements for emergency isolation to prevent catastrophe and harmful effects. Normal electrical isolation and emergency isolation should be located outside any defined hazardous zone.

42. Provide artificial lighting system that achieves the illumination Lux level recommended in AS/NZS 1680 series. Fluorescent light fittings shall be fitted with appropriate colour-corrected tubes. Overhead lighting fixtures shall be appropriate to the hazardous areas analysis and shall prevent the accumulation of vapour in the ceiling space. Provide appropriate lighting under any overhead cupboards to provide adequate illumination of the workbench area, where required.

43. Lightning protection shall be provided in accordance with AS 1768.

44. Electrical installation shall be bonded and earthed in accordance with AS/NZS 3000. All non-current carrying conducting parts shall be equipotentially bonded and earthed in accordance with AS/NZS 3000, AS 1768 and AS/NZS 1020 where applicable.

45. Static electricity shall be controlled in accordance with AS/NZS 1020.

46. A copper earthing bar shall be provided to provide earthing and control static electricity for equipment at the bench areas. The earthing bar shall have tapped holes every 500 mm to allow earthing of equipment and shall be affixed around the internal perimeter of the laboratory at approximately 300 mm above the benchtop.

Equipment Fit Out

47. DEF(AUST)5695B Part 5 Section 1 prescribes testing requirements for various fuel types/grades. An equipment list at the end of this section identifies equipment necessary for testing of all fuel grades. The FQCC shall be fitted out with, and audited against, the equipment necessary to perform all tests, for fuel types/grades applicable to the FQCC in question. Contact JFLA for clarification if required.

48. Fume cupboards shall be a turbulent flow design and shall be designed, sited, constructed and installed in accordance with AS/NZS 2243.8 and AS/NZS 2430.3.6. Fume cupboard shall conform to user requirements and the following:

    a. It shall be fitted with an earthing strip;

    b. It shall be hard-wired in accordance with paragraph Clause 41 of this section;

    c. Be provided with a connection for vacuum (suction) and another connection for earthing of the equipment inside the working area. Both connections should be installed to the rear left hand wall (as viewed by an operator facing the fume cupboard) and approximately 100 mm above bench level);

    d. Fume cupboards shall be installed with an electrically driven vacuum pump. The vacuum pump shall be located outside any defined hazardous zones unless intrinsically safe;

e. A standby vacuum pump, fit for purpose, operating from a 240 VAC general power outlet. The standby vacuum pump shall operate in the event of duty vacuum pump failure; and

f. Cupboards shall not be installed above or below the fume cupboard.

49. A utility oven shall be installed with internal dimensions of 300mm (W) x 300mm (L) x 500mm(H), shall consist of two shelves and shall be capable of operating from 60°C up to 200°C continuously. The oven shall be located in accordance with the "Delineation and Classification of Hazardous Areas" clause of this section.

    Note: A conventional domestic oven is not suited to laboratory applications.

50. Gas water heaters and other water heaters with open elements shall not be installed in laboratories.

51. A refrigerator shall be installed outside any defined hazardous zones. It shall as a minimum, 140 Litres capacity, two shelves a freezer compartment and where possible a thermocouple type temperature sensor. The interior light shall be disabled and removed so as not to present an electrical hazard.

52. The refrigerator shall be located in accordance with the "Delineation and Classification of Hazardous Areas" clause of this section of the policy document and shall be clearly marked with "Laboratory Use Only – Do Not Store Food".

Heating, Ventilation and Air Conditioning (HVAC)

53. The design of the HVAC system(s) and fume exhaust(s) shall ensure a safe working environment and minimise risk of flammable gases/vapours build up within the FQCC. Additionally, the design of the HVAC system(s) shall achieve thermal comfort and prevention of condensation.

54. The HVAC system(s) and fume exhaust system(s) shall comply with:

    a. Building Code of Australia;

    b. Relevant Australian Standards which include, but are not limited to AS 1482, AS/NZS 1668 Series, AS 1940, AS/NZS 2243.1, AS/NZS 2381.1, AS/NZS 2243.8, AS/NZS 2982.1 and AS/NZS 3000;

    c. Relevant requirements in SAFETYMAN; and

    d. Relevant requirements in Defence I.M. Policy – Heating, Ventilating and Air-Conditioning Systems.

55. Ventilation shall be designed to limit the accumulation of airborne contaminants to safe levels in all affected areas where sources of such contaminants are present.
    Note: Fumes form flammable/combustible liquids are heavier than air and will accumulate at low levels in the QC laboratory.

56. Where required, ventilation explosion protection (Ex v) shall be in accordance with AS 1482.

57. Where practicable, airborne contaminants and vapour shall be removed from the FQCC environment at sources using local exhaust ventilation (i.e. floor level exhaust vents for flammable liquid vapours).

58. Fume cupboard(s), fume exhaust and dispersal shall comply with AS 1668 series, ASNZS 2243.1 and AS/NZS 2243.8.

59. Benchtop extraction/ventilation system, if installed, shall be designed not to interfere with the testing operations and have adverse WHS (formerly OH&S) impacts on the users. Requirements shall be confirmed with the users at the design stage.
60. Exhaust air and supply/make-up air shall be balanced at an appropriate air flow ratio. Air flow balance shall be maintained for all FQCC operations. The design shall allow appropriate safety interlocking of the systems for exhaust air ad supply/make-up air.
61. The HVAC system shall maintain a positive pressure above atmospheric pressure whilst fume cupboards are in operation and normal operation of doors.
62. 100% outdoor air intake for the HVAC system(s) with no re-circulation shall be provided.
63. The room design temperature shall be 22 ±2°C.
64. Indoor relative humidity control should be provided where required to prevent condensation and mould growth on indoor surfaces.
65. Refer to AIRAH application manual DA20 “Humid tropical air conditioning” as a guide for tropical environments.
66. Dedicated HVAC system(s) shall be provided for the FQCC. The Designer/Contractor shall submit a system selection and design report to address all related matters. The report is a live document which shall be updated and reviewed in various stages.

Health and Safety Requirements

67. Facilities shall comply with:
    a. Relevant Australian Standards;
    b. Relevant requirements in SAFETYMAN; and
    c. The Materials Safety Data Sheets (MSDS) of petroleum products and chemicals to be handled in the FQCC.
68. Fixed gas detection with adjustable alarm level shall be provided within the FQCC at bench and floor level and at any other appropriate position.
69. Provide safety shower and eyewash facilities in accordance with AS 4774 and Defence I.M. Policy – Emergency Showers and Eyewash Stations.
70. All safety showers and/or eyewash facilities shall have the following alarms:
    a. Local alarms;
    b. Audible and visual alarms to alert other personnel when a safety shower and/or eyewash facility is activated (to be mounted in areas which are occupied the majority of the time by other personnel); and
    c. Remote alarms which are connected to a responding area such as a medical facility, fire control station or an appropriate duty room for immediate assistance.
71. A first aid cabinet shall be supplied and fitted in a prominent location.
72. Hand washing facilities shall be provided in accordance with AS/NZS 2982.1.
73. Hazards signs and placards shall comply with WorkSafe Australia guidance notes. Safety signs shall comply with AS 1319.
74. Incompatible goods shall be segregated from one another as required by Dangerous Goods statutory legislation and AS 2243.10.

75. Signage limiting the quantity of flammable liquid used or stored shall be in accordance with Dangerous Goods statutory legislation.

76. The FQCC laboratory should be designed such that features that impact on human operation should meet the requirements of the relevant State/Territory Code of Practice, MIL-STD-1472 or equivalent to the maximum extent possible.

77. A safety noticeboard to list emergency procedures and particular hazards shall be installed in a prominent place within the FQCC.

Communications Fit Out

78. Computer and auxiliaries shall be located outside the FQCC, unless approved by Defence following a formal risk assessment.

79. When the computer and auxiliaries are to be located in the FQCC, the following requirements shall be observed:

    a. The FQCC shall be fitted for, but not with a desktop computer and printer;

    b. The computer and auxiliaries shall be located outside any defined hazardous zone;

    c. The computer work space shall conform to the Base IT configuration where the FQCC will be located; and

    d. The provision of DRN switching equipment shall be in accordance with the current base topology or the base topology provided as part of the project. Technical design is available from the Regional Technology Operations of DSG – Information Systems Division (DSG – ISD).

Fire Protection

80. Fire detection and protection shall be provided in accordance with MFPE, AS/NZS 2243.1 within the FQCC.

81. In the event of a fire, the shutdown and operation of the HVAC system(s) shall comply with AS/NZS 1668.1 and the shutdown and operation of the fume exhaust system(s) for fume cupboard(s) shall comply with AS/NZS 2243.8.

82. Fire drill instructions shall be prominently displayed and reviewed according to AS 3745 and MFPE.

Security

83. The FQCC shall comply with eDSM. New laboratories shall be intruder-resistant as a minimum. Existing laboratories that are to be refurbished shall be assessed in terms of physical security and upgraded where necessary.

Typical Equipment List for Fuel Quality Control Centre

Item	Preferred Item/Name	NSN	Qty
Fume Cupboard	DYNAFLOW Fume Cupboard	66-132-8483	1
Refrigerator	N/A	N/A	1
Vacuum Pump	Vacuum Pump for DYNAFLOW Fume Cupboard	66-114-5286	1
Vacuum Pump	240V Standby Vacuum Pump operating from a general power outlet for Fume Cupboard	N/A	1
Fuel Sampling Kit	Kit, Fuel Sampling – Millipore	00-496-9623	4
Monitor Sampling Kit	Filter Unit, Monitor Particulate	00-764-5761	2 Box
Oven	NVC OM24SE3	66-057-7454	1
Microscope	Microscope, Optical C/W Carry Case	33-033-9005	1
Microscope Light	Light, Microscope, Optical	01-073-0249	1
Filter Flask	Flask, Filtering – Side Arm -1 Lt	66-039-4385	2
Filter Flask Stopper	Stopper, Flask, Filtering, Side Arm – 1 Lt	66-057-8485	2
Laboratory Balance	Table, Balance, Laboratory	66-092-9642	1
Electrical Balance	Balance, Electronic	66-150-9537	1
Hydrometer	Hydrometer, Graduated, SG – 0.700 – 1.000	66-016-4638	2
Hydrometer	Hydrometer, Graduated, SG – 0.700 – 0.750	99-780-1125	2
Hydrometer	Hydrometer, Graduated, SG – 0.750 – 0.800	66-034-8057	2
Hydrometer	Hydrometer, Graduated, SG – 0.800 – 0.850	66-065-4324	2
Hydrometer	Hydrometer, Graduated, SG – 0.850 – 0.900	66-048-2560	2
Hydrometer	Hydrometer, Graduated, SG – 0.900 – 0.905	66-034-8209	2
Thermometer	Thermometer, -10 to +110° CELSIUS	66-041-7212	2
Dispenser Filter	Dispenser Unit, Filtering	00-688-7882	2
Forceps	Forceps, General Purpose	66-034-7199	2
Pressure Filtration Can	Can, Filtration, Pressure – 10 Lt	01-013-9145	1
Petri Dish	Dish, Culture, Petri	66-039-156	12

Item	Preferred Item/Name	NSN	Qty
100 ml Graduated Cylinder	Cylinder, Graduated – 100 ml	66-020-8569	2
100 ml bottle	Bottle, Screw Cap 100 ml	66-134-1280/ 66-094-1999	12
100 ml Bottle Stopper	Stopper, Bottle, Screw Cap – 100 ml	66-094-1998	12
Fuel Sampler	Aircraft Fuel Sampler	01-005-4490	2
Conductivity Meter	Test Kit, Conductivity	01-115-2398	2
Earthing wire	Braid Wire, Earthing	66-017-2014	2 m
Fuel Sampling Jar	Jar, Spring Fastener, Fuel Sampling	66-111-9628	2
Static Dissipater	Work Station Kit, Electrostatic	66-137-3090	1
47 mm Filter Screen	Holder, Filter Screen, 47 mm, Membranes	66-057-8481	2
47 mm Filter	Disk, Filtering, 47 mm Matched Weight	00-159-2438	2 Box
25 mm Filter	Disk, Filtering, 25 mm, 8 Micron	00-985-2098	2 Box
Flash Point Tester	Tester, Flash Point, Grabner Mini Flash	66-147-0757	1
Water Test Kit	Test Kit, Water, Shell	66-120-9313	4 Box
Syringe	Syringe, Hypodermic, 2 cc - FSII		4
Syringe	Syringe, Test Kit, Water, Shell	66-120-9314	4
Bucket	Pail, Utility, 14 Lt, Stainless Steel with Lid	66-091-3609	4
1 L Bottle	Bottle, Screw Cap, 1 Lt, Amber Glass	66-096-5604	24
500 ml Beaker	Beaker, Laboratory, 500 ml, Pyrex Glass	66-020-8363	2
Wash Bottle	Wash Bottle, Laboratory, 500 ml	66-020-9211	2
Cleaning Solvent	Solvent, Cleaning Compound, Hexane	66-133-3215	10 L
4 L Can	Can, Screw Cap, 4 Lt, Steel	66-035-4188	2
Refractometer	Refractometer, Atago		1
Respirator	Respirator outfit	66-093-3903	1
Cleaning Solvent Gun	Cleaning Gun, Pneumatic	01-259-8886	1
Safety Can	Safety Can, Fuel Transport	66-089-7844	2
Flask and Bulb	Flask and Bulb Assembly	00-225-3457	2
Hand Pump	Dispensing pump, hand type to suit 20 Litre Drum/Pail	66-082-4690	1
Digital Density Meter	Anton-Paar	66-109-5347	2
Glassware	Laboratory Testing		As required

Item	Preferred Item/Name	NSN	Qty
Funnel	Stainless Steel		2
Test Kit	Diesel Filterability		As required
Centrifuge		01-119-7870	1

Optional Equipment List for Fuel Quality Control Centre

Item	Preferred Item/Name	NSN	Qty
Static Cable	Cable, Assembly, Static, 5 ft	22-897-7659	2
Safety Harness	Harness, Safety, Individual, Rescue	66-023-1211	1
Rescue kit	Kit, Rescue	66-135-5010	1
Rescue Hoist	Tripod Hoisting Unit, Rescue Support	66-135-4947	1
Acetone	Acetone, Technical	66-042-7217	N/A
Air Line	Sabre Long Line, Breathing, Air	99-445-5889	1
Breathing Apparatus	Breathing, Air, Self-Contained	66-134-7227	2
Laptop Computer	Test Unit, Diagnostic	66-123-4437	1
Eagle Chemical monitor	Monitor, Chemical, Agent	66-127-3344	2
Thief Tube	Drum, Fuel, Sampling Tube, Foot Valve	N/A	2
Endodontic Scribes	Scribes Endodontic Explorers	N/A	2

6.20 Post Construction Documentation

Fuel Types:	◗ All; and ◗ DEF(AUST) 206 – Handbook of Liquid Fuel, Lubricants and Allied Products.
Principal Standards:	◗ Defence Document – Survey Specification for Facility Detail and As-constructed Site Survey; ◗ Defence Document – Data Capture Requirements for Communications Data – Digital data Convention – AutoCAD Specific; ◗ Relevant Australian Standards and Code of Practice; and ◗ Commonwealth of Australia legislation.
Reference Standards:	
Guidance:	
Commentary:	

General Requirements:

As-constructed Site Survey (Applicable to Airfield Related Projects)

1. The Contractor shall undertake as-constructed site survey in accordance with the Defence Document – Survey Specification for Facility Detail and As-constructed Site Survey.

As-constructed Drawings

2. The Contractor shall provide as-constructed drawings in the following forms:
    a. Two copies of full size hard-copy drawings;
    b. Three copies of A3 size hard-copy drawings; and
    c. Three electronic copies on compact disc complying with AutoCAD 2000. The drawing level structure shall be in accordance with the Defence Document - Survey Specification for Facility Detail and As-constructed Site Survey, and Defence Document - Data Capture Requirements for Communications Data – Digital data Convention – AutoCAD Specific.

Operation and Maintenance Manuals

3. The Contractor shall provide three copies of operation and maintenance manuals that provide:
    a. The description of the systems, the method of operation and maintenance requirements of the systems and each equipment (all information necessary for the satisfactory long-term operation and regular maintenance of all equipment and materials);
    b. All data (including manufacturers' data) of all equipment, detailed technical descriptions easily understandable by a trained technician not familiar with the equipment, with performance data and illustrations where appropriate; and
    c. Other requirements as stated in Section 7.2 "Commissioning" of this policy document.

4. The Contractor shall provide for equipment a log book for recording separate operational and maintenance procedures, materials used, test results, comments for future maintenance actions, notes covering the conditions of the installation, etc. The log book is sufficient in page number to receive for the defects liability and maintenance period and for a further period of 12 months.

5. Where practical, the operation and maintenance manuals and log books should be in electronic format that can be uploaded to DEMS-FM.

Operation and Maintenance Instructions

6. The Design Consultant shall be responsible for preparing the configuration and operating instructions. The format shall be approved by Defence. One of the following draft Defence Instruction (Air Force) should be used as reference:

    a. RAAF Base Darwin -"Aviation Fuel Installation -Fuel Farm, Hydrant System and Emergency Equipment", 2000.

    b. RAAF Base Scherger -"Aviation Fuel Installation -Fuel Farm and Emergency Equipment", 2000.

7. lf the new fuel facility is connected to an existing fuel facility, the instructions should cover both facilities. The instructions, including text and drawings, shall be produced in the form of hardcopy and electronic (Microsoft Word * for text and AutoCAD * for drawings). Three hardcopies and electronic copies on compact disc shall be required.

Approval

8. A draft copy of the post-construction documents shall be submitted to Defence for approval prior to the preparation of the final copy.

6.21 Labelling and Signposting

Fuel Types:	◗ All; and ◗ DEF(AUST) 206 – Handbook of Liquid Fuel, Lubricants and Allied Products.
Principal Standards:	◗ AS 1345 – Identification of the contents of pipes, conduits and ducts; ◗ AS 1940 – The Storage and Handling of Flammable and Combusitble Liquids; and ◗ Australian Dangerous Goods (ADG) Code 7th Edition;
Reference Standards:	◗ The Manual of Fire Protection Engineering (MFPE); ◗ AS 4775 – Emergency Eyewash and Shower Equipment; ◗ Building Code of Australia (BCA); and ◗ Local EPA Regulations. Work Health and Safety Regulations 2011;
Guidance:	◗ MIL – HDBK 1022A – Petroleum Fuel Facilities.
Commentary:	

General Requirements

1. Signposting, labelling and placarding shall comply with the applicable Defence standards, Australian Standards and federal and state legislation. Commonwealth Standards include AS 1940, AS 1345 and Defence standards.
2. Signposting, labelling and placarding shall be placed to provide a clear indication and where necessary a warning or instruction to tank farm operators and tanker drivers. They shall be constructed and securely mounted so that they are protected from impact and damage and do not present a hazard to personnel.
3. Colour codes shall comply with AS 1345 and Appendix A.

Pipelines

4. Pipeline labelling and signposting shall comply with AS 1345 and Appendix D.

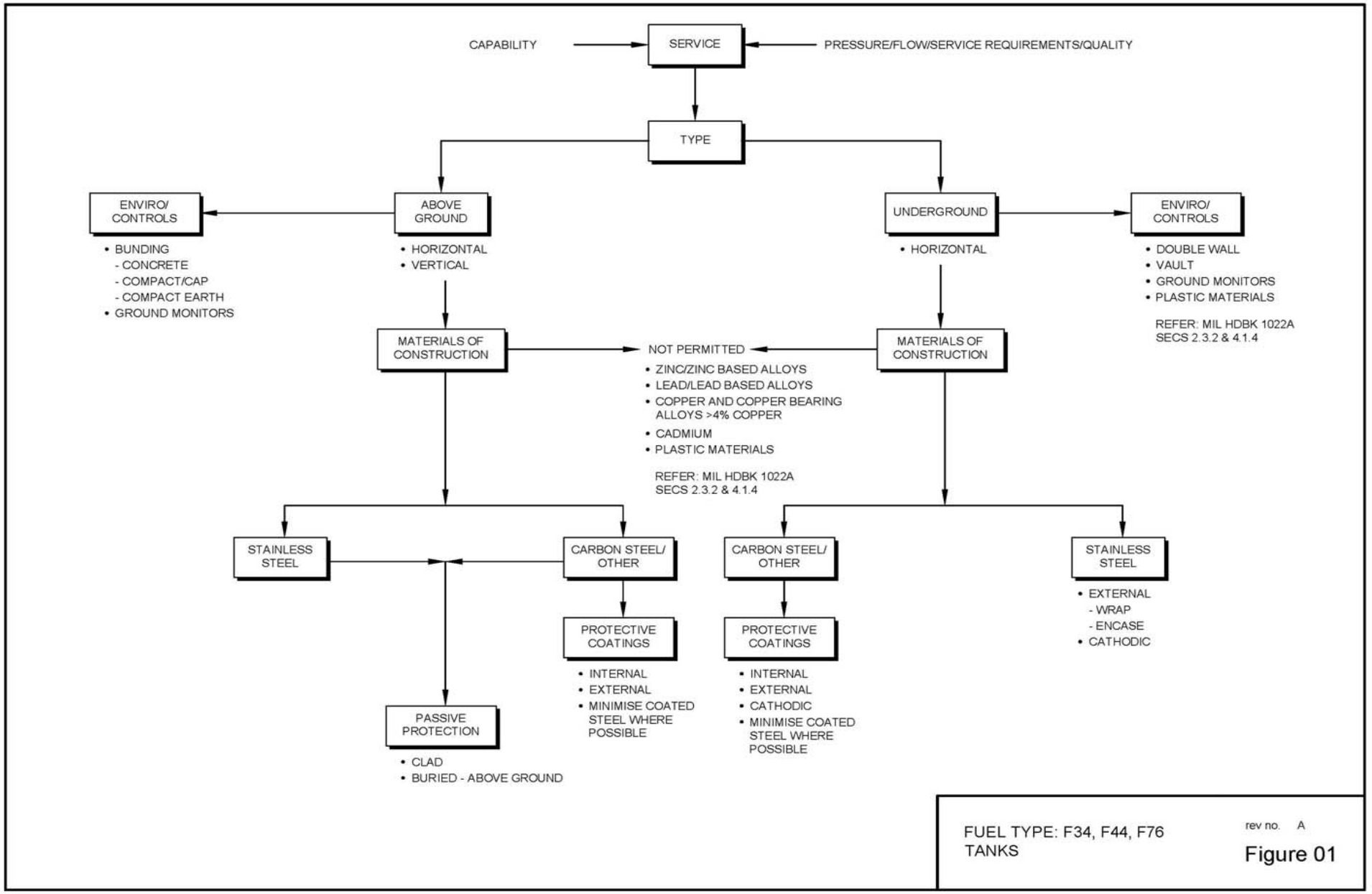
Tanks

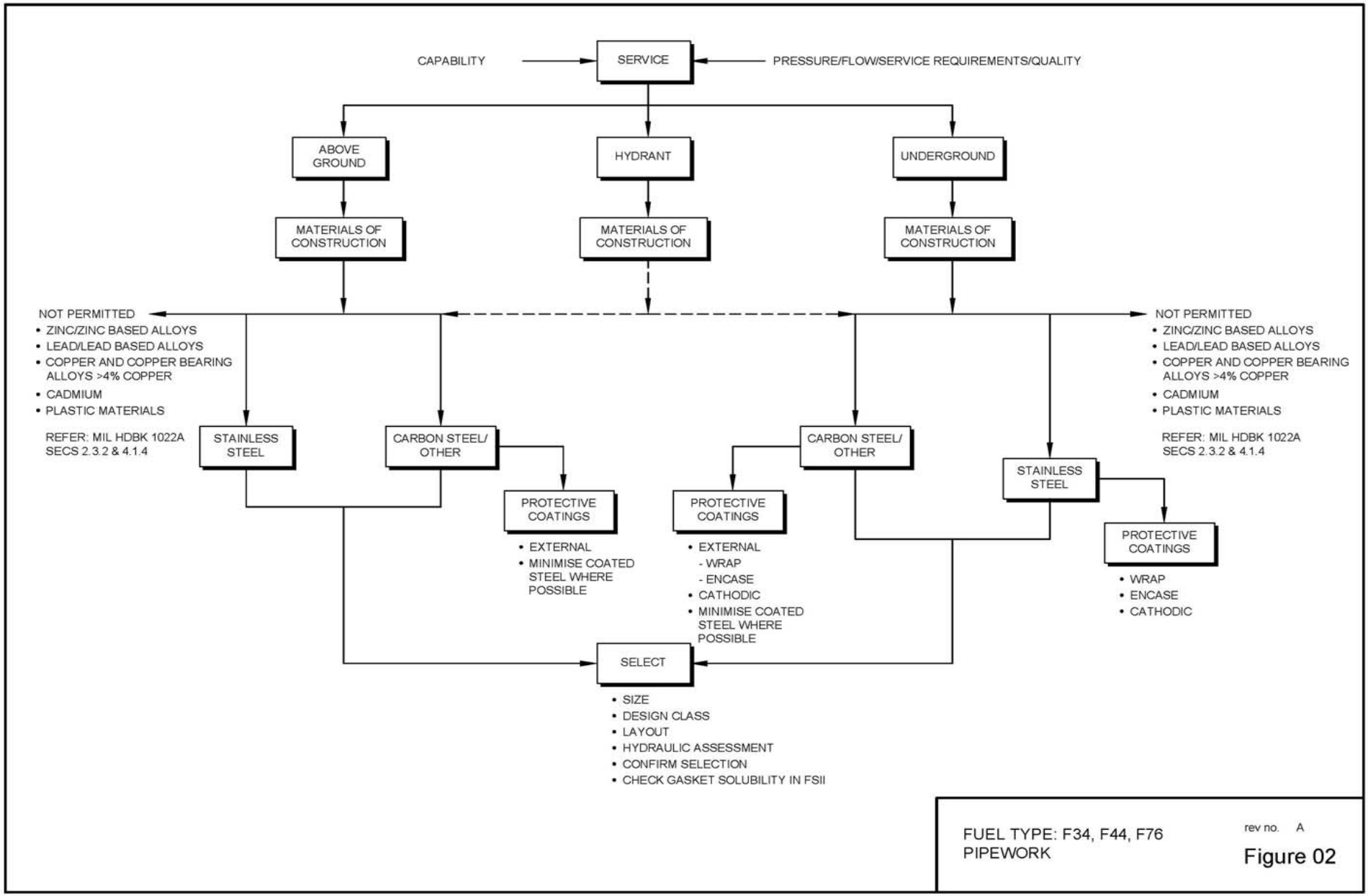
5. Tank numbering shall comply with AS 1940 Section 5.2.2.

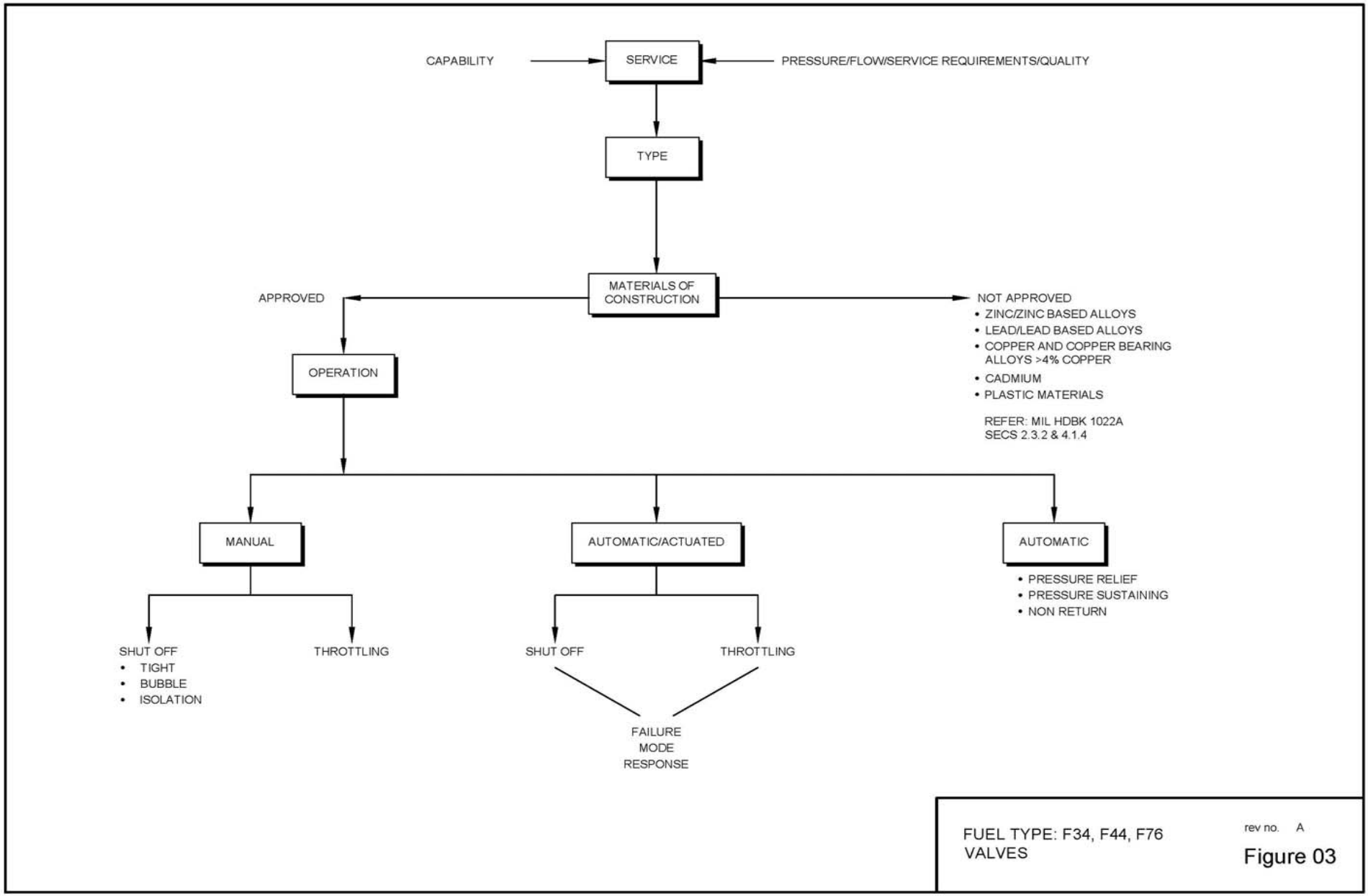
Tank and fuel farm enclosure

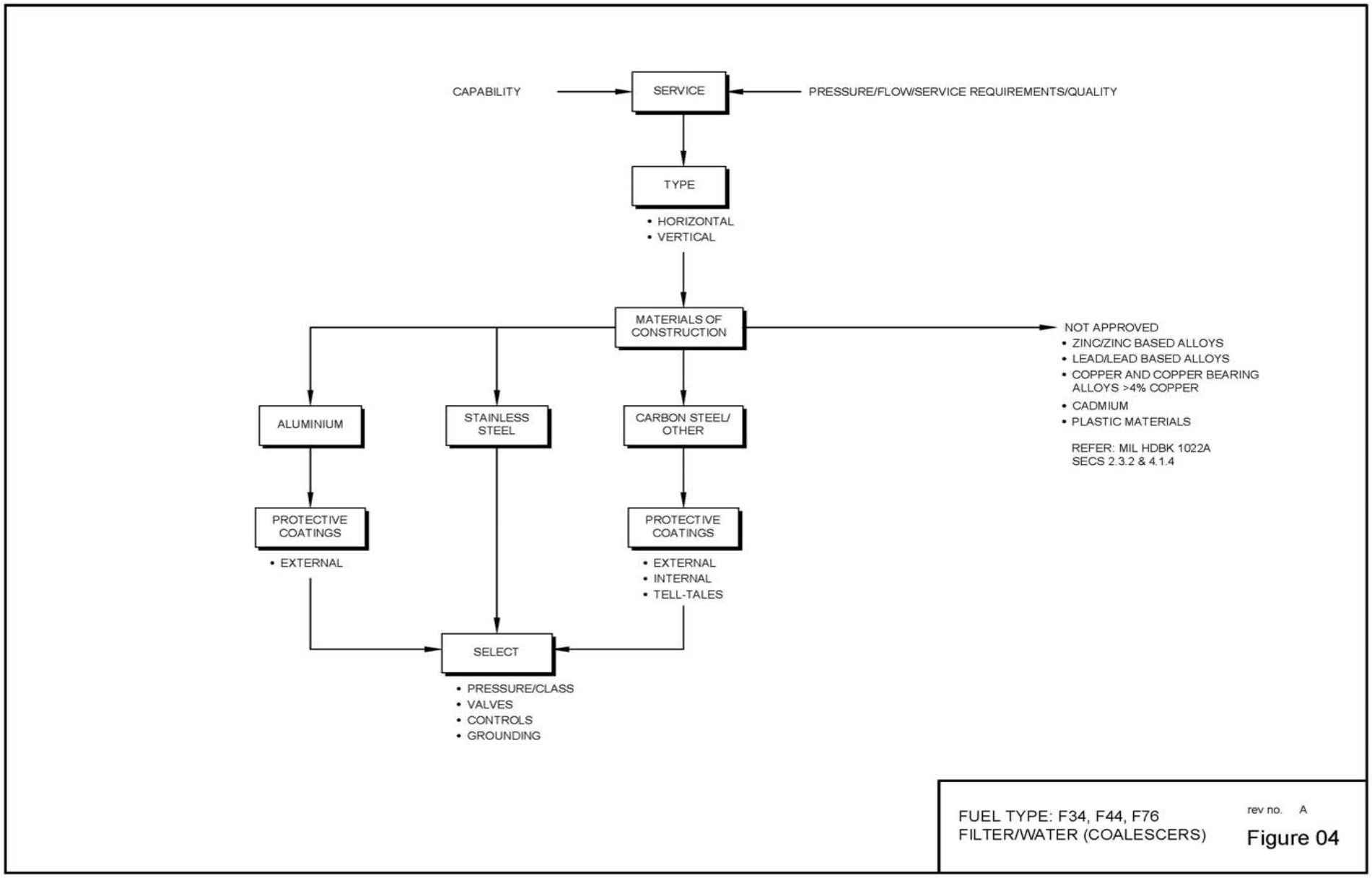
6. Signposting, labelling and placarding shall comply with Dangerous Goods markings per ADG 7th edition and State or Territory Dangerous Goods Regulations.

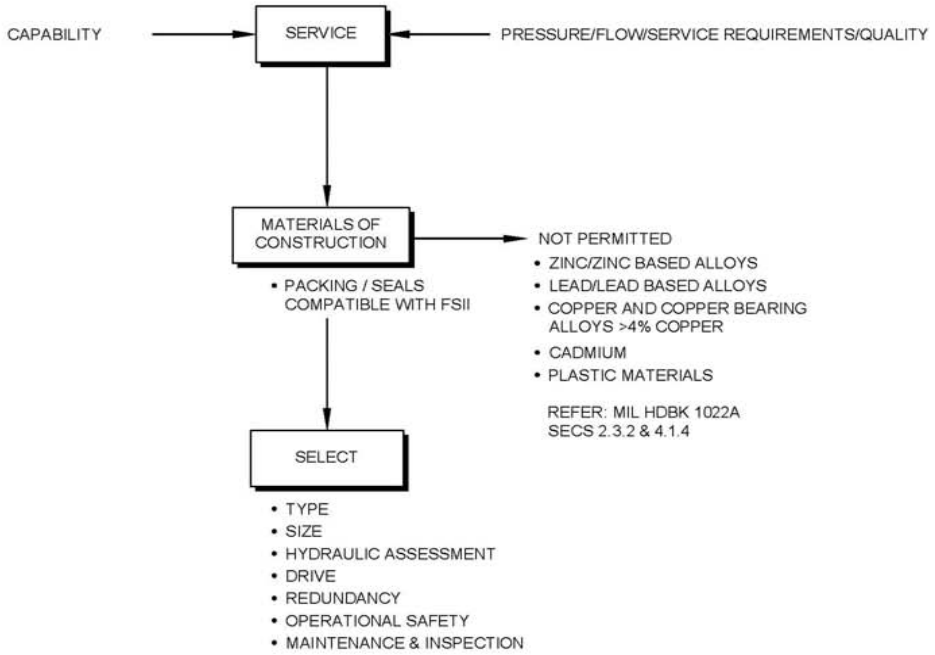
7. Design Guides


CAPABILITY
SERVICE
PRESSURE/FLOW/SERVICE REQUIREMENTS/QUALITY
TYPE
ENVIRO/ CONTROLS
ABOVE GROUND
UNDERGROUND
ENVIRO/ CONTROLS
• BUNDING
- CONCRETE
- COMPACT/CAP
- COMPACT EARTH
• GROUND MONITORS
• HORIZONTAL
• VERTICAL
• HORIZONTAL
• DOUBLE WALL
• VAULT
• GROUND MONITORS
• PLASTIC MATERIALS
REFER: MIL HDBK 1022A SECS 2.3.2 & 4.1.4
MATERIALS OF CONSTRUCTION
NOT PERMITTED
• ZINC/ZINC BASED ALLOYS
• LEAD/LEAD BASED ALLOYS
• COPPER AND COPPER BEARING ALLOYS >4% COPPER
• CADMIUM
• PLASTIC MATERIALS
REFER: MIL HDBK 1022A SECS 2.3.2 & 4.1.4
MATERIALS OF CONSTRUCTION
STAINLESS STEEL
CARBON STEEL/ OTHER
CARBON STEEL/ OTHER
STAINLESS STEEL
• EXTERNAL
- WRAP
- ENCASE
• CATHODIC
PROTECTIVE COATINGS
• INTERNAL
• EXTERNAL
• MINIMISE COATED STEEL WHERE POSSIBLE
PROTECTIVE COATINGS
• INTERNAL
• EXTERNAL
• CATHODIC
• MINIMISE COATED STEEL WHERE POSSIBLE
PASSIVE PROTECTION
• CLAD
• BURIED - ABOVE GROUND
FUEL TYPE: F34, F44, F76
TANKS
rev no. A
Figure 01


CAPABILITY
SERVICE
PRESSURE/FLOW/SERVICE REQUIREMENTS/QUALITY
ABOVE GROUND
HYDRANT
UNDERGROUND
MATERIALS OF CONSTRUCTION
MATERIALS OF CONSTRUCTION
MATERIALS OF CONSTRUCTION
NOT PERMITTED
• ZINC/ZINC BASED ALLOYS
• LEAD/LEAD BASED ALLOYS
• COPPER AND COPPER BEARING ALLOYS >4% COPPER
• CADMIUM
• PLASTIC MATERIALS
REFER: MIL HDBK 1022A SECS 2.3.2 & 4.1.4
STAINLESS STEEL
CARBON STEEL/ OTHER
PROTECTIVE COATINGS
• EXTERNAL
• MINIMISE COATED STEEL WHERE POSSIBLE
CARBON STEEL/ OTHER
PROTECTIVE COATINGS
• EXTERNAL
- WRAP
- ENCASE
• CATHODIC
• MINIMISE COATED STEEL WHERE POSSIBLE
NOT PERMITTED
• ZINC/ZINC BASED ALLOYS
• LEAD/LEAD BASED ALLOYS
• COPPER AND COPPER BEARING ALLOYS >4% COPPER
• CADMIUM
• PLASTIC MATERIALS
REFER: MIL HDBK 1022A SECS 2.3.2 & 4.1.4
STAINLESS STEEL
PROTECTIVE COATINGS
• WRAP
• ENCASE
• CATHODIC
SELECT
• SIZE
• DESIGN CLASS
• LAYOUT
• HYDRAULIC ASSESSMENT
• CONFIRM SELECTION
• CHECK GASKET SOLUBILITY IN FSII
FUEL TYPE: F34, F44, F76
PIPEWORK
rev no. A
Figure 02


CAPABILITY
SERVICE
PRESSURE/FLOW/SERVICE REQUIREMENTS/QUALITY
TYPE
MATERIALS OF CONSTRUCTION
APPROVED
NOT APPROVED
• ZINC/ZINC BASED ALLOYS
• LEAD/LEAD BASED ALLOYS
• COPPER AND COPPER BEARING ALLOYS >4% COPPER
• CADMIUM
• PLASTIC MATERIALS
REFER: MIL HDBK 1022A SECS 2.3.2 & 4.1.4
OPERATION
MANUAL
AUTOMATIC/ACTUATED
AUTOMATIC
• PRESSURE RELIEF
• PRESSURE SUSTAINING
• NON RETURN
SHUT OFF
• TIGHT
• BUBBLE
• ISOLATION
THROTTLING
SHUT OFF
THROTTLING
FAILURE MODE RESPONSE
FUEL TYPE: F34, F44, F76
VALVES
rev no. A
Figure 03

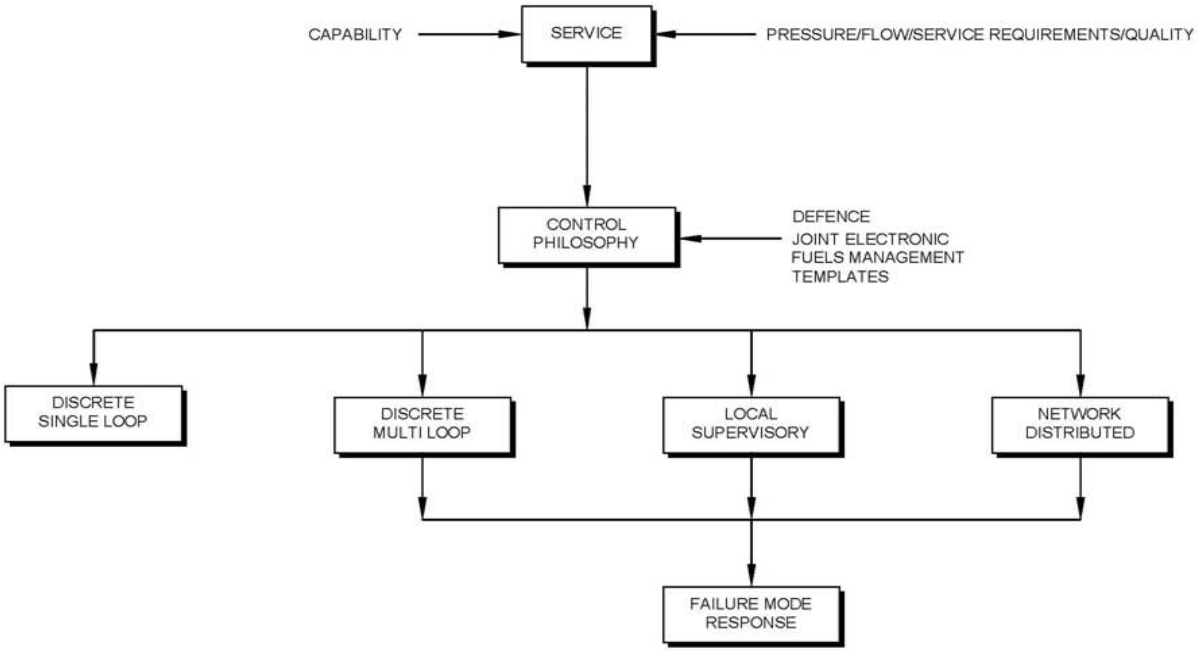

CAPABILITY
SERVICE
PRESSURE/FLOW/SERVICE REQUIREMENTS/QUALITY
TYPE
• HORIZONTAL
• VERTICAL
MATERIALS OF CONSTRUCTION
NOT APPROVED
• ZINC/ZINC BASED ALLOYS
• LEAD/LEAD BASED ALLOYS
• COPPER AND COPPER BEARING ALLOYS >4% COPPER
• CADMIUM
• PLASTIC MATERIALS
REFER: MIL HDBK 1022A SECS 2.3.2 & 4.1.4
ALUMINIUM
STAINLESS STEEL
CARBON STEEL/ OTHER
PROTECTIVE COATINGS
• EXTERNAL
PROTECTIVE COATINGS
• EXTERNAL
• INTERNAL
• TELL-TALES
SELECT
• PRESSURE/CLASS
• VALVES
• CONTROLS
• GROUNDING
FUEL TYPE: F34, F44, F76
FILTER/WATER (COALESCERS)
rev no. A
Figure 04



FUEL TYPE: F34, F44, F76
PUMPS

rev no. A

Figure 05



FUEL TYPE: F34, F44, F76
CONTROLS

rev no. A

Figure 06

Appendix A

Cable Types and Colours

Cable Type:

Cable type shall be selected to be suitable for the environment in accordance with the relevant Australian Standards. Also refer to and comply with the Australian Standards for hazardous areas.

Cable Colours:

Colour selection is to be generally in accordance with AS/NZS 3000-2007 Sections 3.8.1, 3.8.2 and 3.8.3.

Unless otherwise specified, provide 0.6 kV V-75 PVC insulated cables to AS 3147, for general internal wiring and heat resisting insulated cables for connection to equipment capable of raising the insulation temperatures above 75°C. Cable insulation shall be selected with consideration of maximum temperature caused by exposure to heat sources and sunlight.

Power cables shall be sized to suit a current carrying capacity of not less than the maximum continuous rating of the equipment mounted within the switchboard, or sized to withstand the “let through” energy of the circuit protective device, whichever is the greater. If the conductors are to be bunched or installed within wiring ducts, apply appropriate de-rating factor to AS 3008 Part 1 when determining conductor size. The minimum size power conductor shall be multistrand 2.5 mm².

Cable for control and indication circuits shall have insulated conductors of not less than 0.75 mm² with 32/0.2 stranding and otherwise sized to suit the current carrying capacity of the particular circuit.

Cables for analogue circuits shall be PVC insulated and PVC sheathed electronic instrument cables with stranded copper conductors with a cross sectional area of not less than 0.5 mm² for all 4 to 20 mA DC analogue circuits. Conductor pairs to be twisted and shielded. Sheath colour to be black.

CONDUCTOR COLOURS: Colour code the wiring as follows:

Multi Phase

A Phase:	Red
B Phase:	White
C Phase:	Dark Blue
Neutral:	Black
Earthing:	Green/Yellow

Single Phase Power

240 V AC Control Active:	Grey
240 V AC Neutral:	Black

DC Power and Control

24 V AC Control Active:	Purple
24 V AC Common:	Purple
24 V DC Positive:	Pink
24 V DC Negative:	Brown
Cubicle Wiring:	
4 to 20 mA Loop:	Orange
Field Wiring:	

4 to 20 mA Loop	White (positive source) and Black (negative return) twisted shielded pairs
IS Circuits	Blue

Install all wiring within PVC wiring ducts. The total cross section of the wiring within any one duct, including allowance for outgoing connections, shall not exceed 60% of the duct cross sectional area. If wiring is not installed in ducts, neatly bunch, support and lace it with PVC ties or strips. Provide protective insulation where bunched wiring or cables are in contact with metal, or pass through cut-outs in sheet metal.

Appendix B

Whole of Life Plan

Fuel Farm Design

Whole of Life Plan – Fuel Farm Design

Objectives:

To provide the lowest total cost of fuel storage and management over the life of the facility, consistent with:

Defence Green Building Requirements

Defence Environmental Policies covering: energy, water and waste

Balanced against other requirements such as security, heritage and WHS but at all times maintaining Defence capabilities.

Approach:

WOL and ESD are generally structured to achieve ESD outcomes for buildings.

For Fuel Farms, the primary focus will be to ensure that fuel is available as and when required at the specified quality.

This capability is to be delivered at lowest cost over the life of the facility.

This will be achieved by:

1) Minimising the volume of fuel lost and unable to be recovered for Defence service through fuel evaporation, sampling losses, spillage, transfer losses etc;

and

2) Minimising the capital and operating costs and the materials consumed over the fuel farm's life through selection of materials of construction, consumable elements such as filters, servicing requirements, purchased energy.

Application:

Fuel losses will be controlled by design, application of codes, adherence to the User Requirements Brief and mandated sampling procedures (e.g. DEF(AUST) 5695B)

Measures to determine WOL compliance will include:

- QA design assessment.
- AS 1940.
- Fuel Farm Policy (promulgated by DEEP).
- Prevailing Industry design and operations practices.

Specific areas which the design shall address include:

- Fuel management and treatment systems, including
  - Fluid movement/loss monitoring to indicate unauthorised fuel movement.
  - Coalescer/filter instrumentation to signal optimum change-out of elements.
  - Instrumentation to facilitate optimised fuel holdings and availability.
- Stormwater management including "first flush" and stormwater/fuel system segregation.

- Piping layouts which minimise the extent of fuel testing (consistent with DEF(AUST) 5695B) and the fuel purge/sample volumes.
- Tank conservation vent controls which limit and control tank free-breathing and evaporative losses.
- Tank ventilation filtration systems to control the inadvertent ingress of dust and contaminants.
- Consideration of an integrated design combining tank spill controls, passive impact protection and stormwater management into a single tank bund design.

Cost of Materials consumed or utilised will be controlled through:

- The financial assessment of both capital and variable operating costs presented on actual and discounted cost bases over the project's life.
- Materials selection conditioned by previous experience across Defence Establishments and Commercial Industry.
- The use of proven design architecture which seek to reduce "hidden" costs such as training and the impact of errors.

Financial assessments will be applied to materials selection for tanks and pipelines, energy consumption and servicing costs associated with mechanical items such as pumps and compressors, filter/coalescer consumables and spare parts management and servicing.

Timing and Reporting:

WOL assessment and ESD compliance will be regularly reported at agreed intervals during the design and procurement phases.

The final WOL design requirements will be recorded for future reference by operating and maintenance staff.

Reference:

WOL Costing for ESD initiatives in DBC V.1 4 September 2006 –DSG.

Appendix C - Reserved

Appendix D

Pipeline Labelling and Colour Coding

STANDARD COLOUR MARKINGS FOR AVIATION AND MARITIME FUEL STORAGE PIPELINES AND VALVES

STANDARD COLOUR MARKINGS FOR THE ADF

Above ground fuel hydrant systems and storage installation pipelines and valves are to be identified with the particular product contained therein in accordance with the following colour codes and pipeline markers as seen below:

a. **AVGAS*** 537 Signal Red and No 1 Blue

b. **AVTUR*** 642 Night Black and White

c. **AVCAT*** No1 Blue and White

d. **Naval Distillate*** Olive yellow (was buff) and White

(note * refer AS4977 – 2008 Petroleum products—Pipeline, road tanker compartment and underground tank identification)