




APPENDIX 3.2

DESIGN BASIS REPORT

DOCUMENT FACEPLATE

CLIENT:	Independent Pipeline Company
PROJECT:	Aviation Fuel Pipeline
CLIENT PROJECT NO.:	0362
TITLE:	Design Basis
DOCUMENT NO.:	0362-RT-0002-R1

APPROVALS FOR THIS ISSUE

REVISION NO.: 1	**PURPOSE: PLANNING ISSUE**		
Name	**Position**	**Signature**	**Date**
T Connolly **Author**	**Design Engineer**		03/11/2014
F O'Mahony **Reviewer**	**Project Manager**		03/11/2014
M Lennon **Approver**	**Project Director**		06/11/2014

HISTORY OF ISSUES / APPROVALS

REV	**DATE**	**DESCRIPTION OF CHANGES**	**FILE NUMBER**

Contents

1.0 INTRODUCTION

This document outlines the design basis for the aviation fuel pipeline system to be built between Dublin Port and Dublin Airport. This reflects the design, construction, operation and decommissioning intent for the system as envisaged at this stage of the project.

2.0 OVERVIEW

At present all aviation fuel is transported by road tanker from Dublin Port to storage tanks at Dublin Airport. The pipeline is designed to replace the existing road delivery system. Fuel will be pumped from existing tanks via a pipeline inlet station at Dublin Port direct into storage tanks at Dublin Airport.

The 14.4 km, 200mm (8") nominal bore pipeline operating at 40barg is capable of delivering 300 m^3 per hour (equivalent to 2,700 million litres per annum) of aviation fuel to Dublin Airport. The current fuel usage at the airport is 630 million litres per annum (2013) which is projected to grow (high demand Scenario) to 1,450 million litres by year 2035.

The pipeline delivering 170m^3 per hour at an operating pressure of 16 – 20 barg can supply an equivalent throughput of 1,500 million litres per annum.

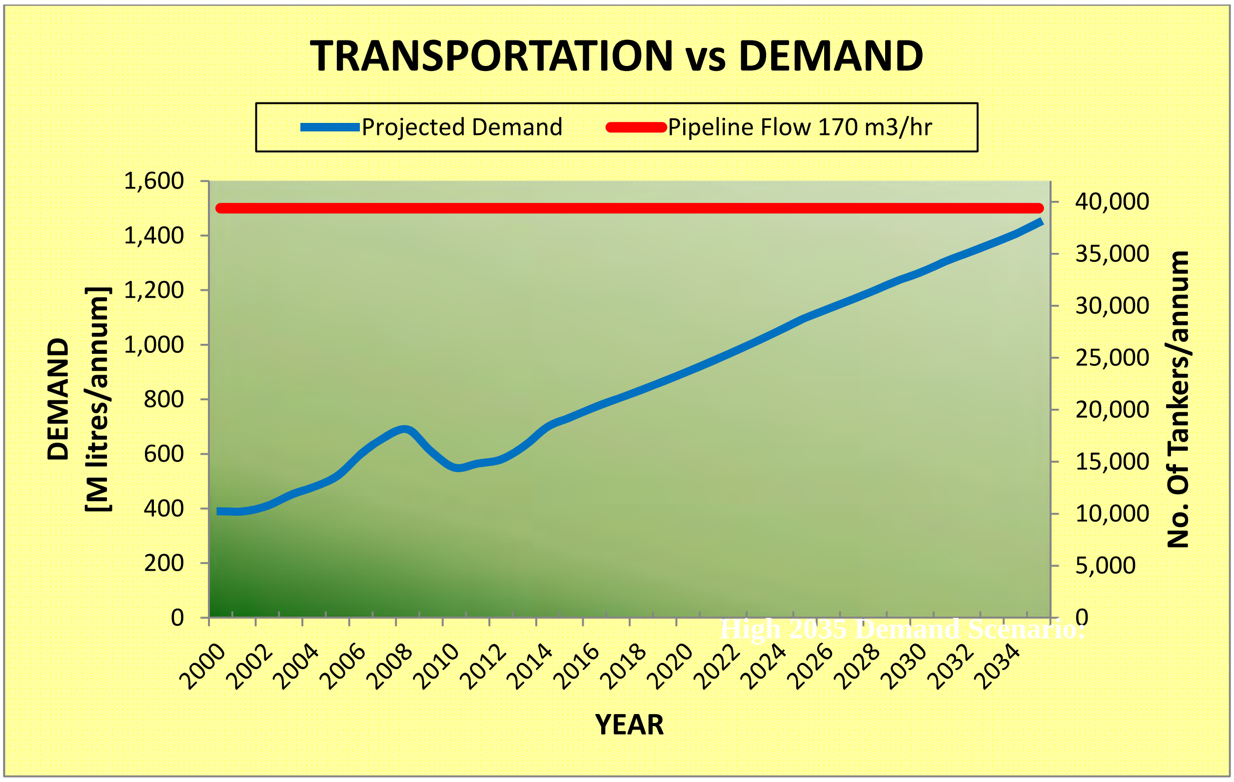


Figure 1 Transportation vs Demand

The current storage capacity at Dublin Airport is 3 No. 800 m^3 tanks. Dublin Airport Authority (DAA) plan to redevelop the Facility to incorporate 3 No. 5,000 m^3 tanks which is planned to be in place 2017. The design of the pipeline will cater for both existing and future proposed storage capacities.

3.0 PIPELINE SYSTEM DESIGN

3.1 Overall Standard

The Irish governing standard for fuel pipelines is I.S. EN 14161:2011 - *Petroleum and natural gas industries – Pipeline transportation systems (ISO 13623:2009 modified)*. This pipeline and associated facilities will be designed, built and operated in accordance with this standard. This will be referred to as 'the Standard' within this document.

3.2 System Definition

The complete system will consist of:

- Transfer pumps & piping from existing tanks to Pipeline Inlet Station (Dublin Port)
- Pipeline Inlet Station (Dublin Port) including:
  - Metering
  - Filtering
  - Pumps
  - Pigging facility
  - Communications & Control Centre
- 14.4 km, 200mm ND Pipeline
- Pipeline Reception Station (Dublin Airport) including:
  - Pigging facility
  - Pressure / Flow Control
  - Metering
  - Filtering
  - Communications & Control Centre

The pipeline system will incorporate a leak detection system so that early preventative action can be taken in the event of any leak. The pipeline will also have four Emergency Shutdown (ESD) Valves, one at the beginning, one at end and two intermediate locations to limit excessive leakage in the unlikely event of a rupture to the pipeline. Refer to Appendix A for overall pipeline schematic.

This system will have a design life of 50 years. The design life of a system can be extended by a process of revalidation conducted in accordance Section 13.5 of the Standard.

3.3 Fluid Characteristics

The characteristics of Jet A1 aviation fuel (Kerosene) are outlined in Table 1 below.

Property	**Description / Value**
Appearance	Clear water white mobile liquid
Odour	Characteristic hydrocarbon odour
Solubility in Water	Very slightly soluble
Boiling Point Range	150^{o}C to 300^{o}C
Flash Point	> 38^{o}C
Autoignition Temperature	220^{o}C
Vapour Pressure	<0.001 bar @ 20^{o}C
Vapour Density (air = 1)	4.5 (accumulates in low areas)
Relative Density	0.77 to 0.84
Viscosity	1.0 to 2.0 cSt @ 40^{o}C

Table 1 Fluid Characteristics

3.4 Fluid Category

Jet A1 is a Category B substance; i.e. “Flammable and/or toxic fluids, that are liquids at ambient temperature and at atmospheric pressure conditions.”

Fluids being transported via pipelines are categorised in accordance with Section 5.2 of the Standard based on the hazard potential with respect to public safety. Refer to Table 2 below[1].

Classification	Fluid Type
Category A	Non-flammable, water-based fluids.
Category B	Flammable and/or toxic fluids that are liquids at ambient temperature and at atmospheric pressure conditions. Typical examples are oil and petroleum products. Methanol is an example of a flammable and toxic fluid.
Category C	Non-flammable fluids that are non-toxic gases at ambient temperature and atmospheric pressure conditions. Typical examples are nitrogen, carbon dioxide, argon and air.
Category D	Non-toxic, single-phase natural gas.
Category E	Flammable and/or toxic fluids that are gases at ambient temperature and atmospheric pressure conditions and are conveyed as gases and/or liquids. Typical examples are hydrogen, natural gas (not otherwise covered in category D), ethane, ethylene, liquefied petroleum gas (such as propane and butane), natural gas liquids, ammonia and chlorine.

Table 2 Fluid Category

3.5 Pipeline Design Data

Pipeline Design Data	Description / Value
Means of Pressure	Centrifugal Pumps
Fluid Characteristics	As per section 3.1 above
Pipeline Length	14.4 km
Pipe Nominal bore	200mm
Pipe Wall Thickness	12.7mm
Pipe Specification / Material Grade	ISO 3183-1 L245 Carbon Steel
Operating Pressure	40 barg
Maximum Fluid Transfer Rate	300 m^3/hr @ 40 barg
Pipeline Fluid Volume	410 m^3
Relief Systems	Thermal and Surge Relief

Table 3 Pipeline Design Data

3.6 Pipeline Design Factor

The Pipeline Design Factor determines the maximum allowable operating stress in the pipeline. This is normally specified as a percentage of Specified Minimum Yield Strength (SMYS) of the pipe. In accordance with Section 6.4.2.2 Table 2 of the Standard, the design factor for this pipeline should not exceed 0.67 (i.e. 67% of SMYS) i.e. major roads.
The actual design factor which the pipeline will experience under maximum operating conditions is 0.18 or 18% of pipe SMYS.

3.7 Depth of Cover Requirements

In accordance with Section 6.8.2.1 of the Standard, the minimum cover depth for this pipeline environment (i.e. Residential, industrial & commercial areas) is 1.2m. Pipelines may be installed with less cover depth provided a similar level of protection is provided by alternative methods (e.g. impact protection, increased wall thickness).

[1] I.S. EN 14161:2011 Table 1

3.8 Emergency Shutdown (ESD) Valves

ESD valves which are remotely controlled will be installed at both ends and two intermediate points of the pipeline. In the unlikely event of a rupture to the pipeline, the provision of these valves will limit potential spill volume. These are strategically located to limit the drain down of the pipeline contents to any low point taking into account topography of the route.

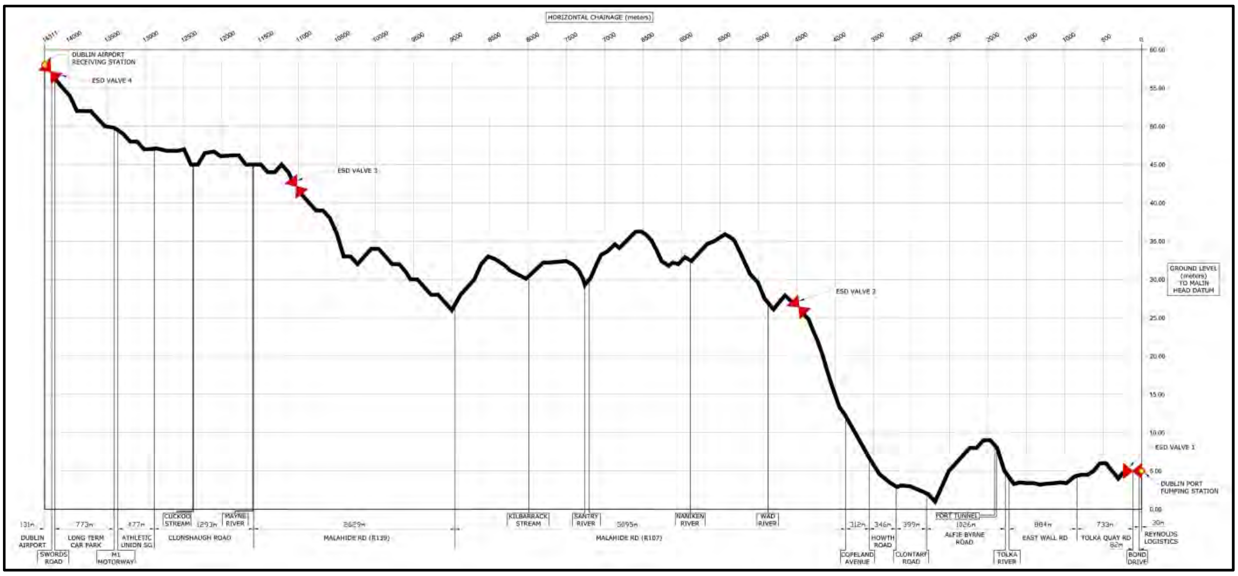


Figure 2 Positioning of ESD Valves

3.9 Pressure Test Requirements

In accordance with Section 6.7.3 of the Standard, the pipeline and its associated facilities is required to be hydrostatically strength tested to 1.25 x MAOP (1.25 times Maximum Allowable Operating Pressure) for 1 hour followed by a leak test at 1.1 X MAOP for 8 hours.

It is intended that this pipeline will be tested to a pressure of 1.5 x MAOP (i.e. 60 barg) for a duration of 24 hours.

3.10 Welding & Weld Examination

In accordance with Section 10.4.1 of the Standard, welding of pipeline, stations and supply lines will be carried out in accordance with ISO 13847, Petroleum and Natural gas industries – Pipeline transportation systems – Welding of pipelines.

NDT requirements shall be 100% radiography of all pipeline welds as detailed in Section 10.4.2 (sub section c) of the Standard.

4.0 MATERIALS & COMPONENTS

4.1 Pipe

The pipeline will be a 200mm nominal bore pipeline with 12.7mm wall thickness (Refer to Section 5.1), with external coatings to protect the pipe from corrosion.

Table 4 below shows various properties of the pipe to be used for the pipeline.

Design Parameter	Value/Units
Pipe Specification	ISO 3183-1
Material Grade	L245 Carbon Steel
Pipe Diameter	200 mm (NB)
Wall Thickness	12.7 mm
SMYS	245 MPa
Minimum Ultimate Tensile	415 MPa

Table 4 Pipe Specification

4.2 Valves

All valves will meet the requirements of ISO14313 / API 6D. Mainline valves on the pipeline will be full-bore ball valves of fully welded body construction. This type of valve will minimise potential for leaks and provide a double block and bleed arrangement for safe isolation. Valves on the pipeline will be welded into the line while valves in the stations may be flanged, but contained within a bunded area.

ESD valves will have an actuator which will automatically close in the event of a shutdown signal being given. The actuator will be suitable for permanent immersion in a fluid i.e. IP68 protection. Closing times of the ESD valves shall be 30-40 seconds.

These valves shall also be fitted with thermal relief around the ESD valves in the event of the valves being closed to cater for any changes in the fluid temperature.

4.3 Pipe Bends

All bends will meet the requirements of ASME B16.9. Bends within the pipeline inlet and reception stations will have a 3D bend radius. Pipeline bends will have a bend radius of 3D minimum and field pipe bends will have a minimum bend radius of 30D so that the line will be piggable. Also this will facilitate the use of the more advanced ‘intelligent’ internal gauging devices.

4.4 Flanges

All flanges will meet the requirements of ASME B16.5.

All flanges where possible will be WN/RTJ (Weld Neck / Ring Type Joint) exceptions being to facilitate the removable of equipment where RF (Raised Face) flanges may be used. The class rating on flanges and equipment from the Port storage tanks to the pumps inlet will be Cl150. Rating of all fitting on pipeline from the pumps outlet to the control valve at the pipeline reception station will be Cl600. Flanges downstream of the control valve to the Airport tank storage will be Cl150. Gaskets will be Octagonal Rings in accordance with ASME B16.20.

4.5 Flow / Pressure Control

This function will be provided at the Pipeline Reception Station by a control valve to maintain a backpressure in the pipeline and to facilitate changeover of tanks. The control valve will control the shutdown of the pipeline, and thus control surge conditions, in the event of pumps shutting down at the port end and / or automatic block valve closing. In the event of a loss of power or signal control valve will fail stay put.

4.6 Metering / Meter Proving

Fuel metering will take place upstream of the pumps in the Pipeline Inlet Station and downstream of the control valve at the Pipeline Reception Station. Fuel metering will be used for fiscal measurement of fuel deliveries between suppliers in Dublin Port and Dublin Airport as well as forming part of the pipeline leak detection systems. Meter proving will be installed in the Pipeline inlet Station to verify meter accuracy.

4.7 Pumps

The pumps will be controlled by variable speed drives and are required to be able to deliver the fuel at a maximum discharge pressure of 40 barg. The configuration is three 50% capacity pumps, two operating and one standby.

4.8 Filtration

Fuel filtration will be in accordance with Section 3.4 of JIG 3, Guidelines for Aviation Fuel Quality Control & Operating Procedures for Jointly Operated Supply & Distribution Facilities. A minimum of a 200 mesh/linear inch (60 microns) filter will be fitted upstream of the pumps in the Pipeline Inlet Station.

At the Pipeline Reception Station two 100% capacity coalescer filter / separators meeting EI 1581 5th edition requirements will be installed downstream of the control valve in a duty/standby configuration. Two duty/standby anti-static pumps will be installed at the upstream of the filter / separators to add static dissipator additive as required to the fuel to maintain acceptable levels of fuel conductivity prior to tank filling operations.

4.9 Surge Protection

The pipeline design will cater for any anticipated surge events during pipeline operation. A detailed transient flow analysis has been carried out to investigate the effects of surge pressures.

5.0 PIPELINE INTEGRITY

5.1 Pipe Protective Coating

5.1.1 Above Ground

Above ground pipework in the pumping or receiving facilities will have the following external finish.

Coat	Description
Surface Preparation	BS 7079 Part A1 Sa 2½.
Primer	Zinc rich epoxy, airless spray method, 50 microns dry film thickness.
Tie Coat	Two pack epoxy, airless spray method, 25 microns dry film thickness.
Build Coat	Two pack epoxy, airless spray method, 125 microns dry film thickness.
Finish	Acrylic polyurethane, airless spray method, 50 microns dry film thickness.
Finish Colour	According to BS 4800: 06 C 39.

Table 5 Pipe Protective Coating

5.1.2 Below Ground

The pipe will have a 3 ply external coating in accordance with DIN 30670 with no internal coating. The 3 ply external wrap will be made up as follows:

- 100μ powder epoxy primer layer
- 250μ intermediate adhesive layer
- 2.9mm polyethylene outer layer

All welds shall be grit blasted on completion of x-ray and have 3 ply external shrink wrap sleeve applied.

5.2 Cathodic Protection

An impressed current cathodic protection system with deep well anode groundbeds will be installed to prevent external corrosion of the pipe. This is to avoid and minimise sensitivity to stray currents e.g. as compared with a sacrificial anode system.

Deep well groundbeds rather than remote groundbeds will be employed to minimise the risk of interference with other buried services. There will be two groundbeds consisting of a borehole with silicon iron anodes and a mains powered transformer rectifier.

As the pipeline route is through an urban environment, major potential stray current interference proximities have been taken into account in the design of cathodic protection.

5.3 Integrity Monitoring

Consideration has been given to providing for internal pipeline inspection (intelligent pigs) with incorporation of pig traps and long radius bends in the design. An initial baseline corrosion survey / intelligent pigging run will be carried out in the first year of operation this will establish the pipe wall thicknesses etc.

Over the life time of the pipeline an inline corrosion survey (intelligent pigging) will be carried out at a frequency of once every 10 years. It is proposed to install a 100 m^3 (PST) Pipeline

Service Tank together with necessary valves upstream of the filters in the Pipeline Reception Station to accept the product during pigging. A recirculation system will be used to clean the contents as much as possible for re-injection into the system. Slops will be removed by vehicle.

5.4 Pipeline Design Life

As a requirement of the governing Standard it is necessary to define the design life of the system to ensure that the design shall be sufficient to demonstrate that the integrity and serviceability can be maintained during the design life.

Specifying a design life enables design decisions to be made in relation to:

- Structural integrity
- Corrosion and minimum wall thickness
- Amplitude and frequency fatigue cycling
- Safety evaluation and mitigation measures
- Adequacy of operating and maintenance, emergency response, and safety and environmental procedures

Taken all the above into consideration the pipeline system will have a design life of 50 years.

This design life can be extended subject to an engineering investigation being made of the design, operating conditions and history of the pipeline, to determine its condition and any limits for continued safe operation. This review should be conducted prior to the expiry of the design life and all issues identified above be considered as part of the engineering investigation.

The revalidated pipeline should be operated only under the conditions and the limits so established and approved.

6.0 LEAK DETECTION

6.1 Leak Detection Overview

Three types of leak detection will be applied on this pipeline:

- Visual inspection
- Computational model based leak detection
- External leak sensing

6.2 Visual Inspection

Fortnightly inspections will be carried out on the pipeline route. An operator will survey the route on foot to detect factors that could affect the safety and the operation of the pipeline. Inspections will focus on leaks and any third party activities along the route which may encroach on the pipeline.

6.3 Computational Model Leak Detection

Computational Model pipeline leak detection (CPM) with automatic shutdown will be installed in compliance with API Recommended Practice 1130 (2007, Reaffirmed 2012) and German TRFL ("Technische Regeln für Fernleitungen" - Technical Rules for Pipelines) which requires two different leak detection methods.

One leak detection model will be capable of detecting leaks during transients e.g. starting up, shutting down and changing flow conditions.

The leak detection systems will be chosen from specialist leak detection vendors with a significant installed base and proven track record on similar fuel product pipelines in Europe and particularly the UK.

Leak detection system will utilise current best available technology fiscal grade, OIML approved Coriolis 0.1% uncertainty mass flow meters at both ends of the pipeline.

The two computation models proposed are:

<u>Negative Pressure Wave</u>	API Method B.5. Analysis of the pressure and flow measurements to detect negative pressure and rarefaction.
<u>Flow/Pressure Model</u>	API Method B.4. Analysis of flow and pressure measurements using signature recognition to detect an imbalance anomaly which would indicate a leak. Flow/Pressure model will incorporate Mass Balance, Static Pressure (shut-in), and Leak Location functions

The anticipated performance figures for CPM leak detection are as follows:

Performance Criteria	Limit
Minimum detectable leak rate under static conditions	10 litres /hr
Minimum detectable leak rate under flowing conditions	1% of flowrate
Time to confirm 1% flowing leak	10 minutes (approximately 500 litres loss)
Response time for a 5% flowing leak	2 minutes (approximately 500 litres loss)
Response time for 10% or greater flowing leak	1 minute (approximately 500 litres loss)
Leak location accuracy	+/- 100 meters

The leak detection system will be calibrated and validated using leaks simulated by drawing off fuel at the terminals and at intermediate points along the pipeline route (section isolation valve chambers).

6.4 External Leak Detection

Sensitive environments will additionally have external leak detection. This will comprise a slotted duct installed in the pipeline trench with a sensing cable installed in the duct. The duct will have 0.5mm wide slots to prevent it filling with silt.

At present, there are not any proven technologies which can be utilised on a pipeline of this nature. Sensing technologies which are being developed are:

- Liquid Hydrocarbon Sensing Cable
- Fibre Optic Cable
- Vapour Sensing Tube
- Acoustic Emissions

The liquid hydrocarbon sensing cables are known to be reliable at detection but subject to false alarm if the ground is contaminated with hydrocarbons. If an alarm is detected the cable can be drawn out for inspection. It may be that periodic replacement is tolerable or more than one technology may be employed.

The open channel Tolka river crossing is identified for this protection. Other river crossings on the route are in culverts or in a concrete open channel.

6.5 Valve Chamber Leak Detection

Valve chambers will be equipped with liquid level sensors to detect and alarm flooding and hydrocarbon sensors to detect fuel leaks e.g. using Larco Oil on water sensors.

7.0 CONTROL & SUPERVISORY SYSTEMS

7.1 Overview

Pipeline operation will be controlled by a Safety Integrated PLC incorporating Safety Integrated Emergency shutdown, protection functions as well as normal operation controls. The design will be developed using IEC 61511 *"Functional safety - Safety instrumented systems for the process industry sector".*

Pipeline operation will be supervised by a SCADA system which will alert the operator when abnormal situations arise was well as affording the human machine interface for day to day operation.

7.2 Process Control

The pipeline inlet station at Dublin Port will be fully automatic designed for unattended operation with a manual intervention capability. Levels at the airport tanks will be transmitted to the pipeline inlet station. The status of all pumps and actuated valves will be monitored.

Pressures, flows and status of actuated valves will be monitored by a PLC/SCADA system covering the sending terminal, the receiving terminal and the intermediate block valves. The PLC's will be connected to the Leak Detection system and SCADA system located at both ends of the pipeline.

The control system will automatically control the start/stop of pumps and valve routing e.g. it will be possible to schedule automatic sequential re-filling of airport tanks and select source tanks.

The control valve at the airport end will control the discharge pressure to the tanks, backpressure in the pipeline. The control valve will also be used during tank switching at the airport.

The pumps will maintain a constant discharge pressure at the port end through the use of variable speed drives.

7.3 Safety Systems

Safety systems will be fail shutdown and will not have manual override facilities. Safety systems must be "healthy" to enable the pipeline to operate.

The pipeline process will be safeguarded by an emergency shutdown system incorporating Safety Instrumented Functions (SIF's) configured in the Safety PLC system following IEC 61511. Detailed design will be subject to hazard and failure modes analysis and involve a Layer of Protection Analysis (LOPA), where SIF's will be supplementary to primary containment features. Autonomous protection functions will be employed so that process safeguards are not reliant on operator action.

Fault conditions e.g. high level at airport receiving tanks will first trigger a Normal Stop so that SIF's are not relied upon for operational control.

It is envisaged that emergency shutdown will be activated by:

- Leak Detection from the LDS
- Manual Command (ESD pushbutton)
- Excess high level on airport tanks (separate from control level sensing).
- Excess high pressure

Reset after ESD will require a manual reset at the sending terminal.

7.4 Process Supervision

The process will be supervised 24/7 by a SCADA system. Alerts will be generated for abnormal conditions and the operator will be presented with live real-time status and historical trend data for the entire process from sending to receiving terminal.

The SCADA system will activate callout via SMS mobile messaging with an independent backup communications system if there is no response to the initial page. The SMS system will routinely send test messages throughout each day incorporating summary information. The SCADA system will alert the operator regardless of whether they are in the control room, outdoors on the plant or off site e.g. at the receiving terminal. It will also be capable of directly alerting 3rd parties e.g. Emergency Services.

7.5 Building Fire Detection

Building fire detection and alarm systems to I.S. 3218 will be installed for buildings at each end of the pipeline consistent with existing site building fire detection. Fire alarms will alert the operator and emergency services

7.6 Communications & Control Cable

A dedicated fibre optic communications cable will be installed in ducts in the pipeline trench and will connect both ends of the pipeline.

This is required in order to facilitate high speed communications between the pumping and receiving station for the leak detection system. The fibre optic cable will also have a secondary function where if interfered with (third party activity etc.), it will cause shutdown of the pipeline.

Cable ducting comprising 3 No. 40mm HDPE ducts shall be laid above the pipeline.

8.0 OPERATIONS

8.1 General

The facility will be operated using proven procedures and systems that industry currently uses in the UK.

It is proposed to run the pumps at night to avail of the lower electricity costs and run during the day hours as it becomes necessary to meet the demand for fuel.

8.2 Monitoring & Control

The SCADA system will monitor the operations and provide status display, alarm and event history and logging of measurements.

PLC based alarm system will alert the on-call operator using a pager. If the operator fails to respond, a backup callout via 24 hour call centre service will be initiated.

8.3 Visual Inspection

Fortnightly inspections shall be carried out on the pipeline route. An operator shall patrol/survey the route on foot to detect factors that could affect the safety and the operation of the pipeline. Inspections shall include the examination of block valve chambers and identify any third party activities along the route which may encroach on the pipeline.

8.4 Standby Capability

Provision will be made to have trucks available on standby to transport fuel to the airport in the event of a loss of the pipeline.

A loss of the pipeline could occur for any of the following reasons:

- Loss of ESB supply
- Break in pipeline
- Loss of Control Systems

It is anticipated that any loss of the line would not be greater than 2 days. A loss of 1 No. pump would not lead to a loss of capacity as 3 No. 50% pumps will be installed.

8.5 Product Quality Control

The fundamental quality control requirements are set out in the JIG (Joint Inspection Group) Regulations JIG 3: *Guidelines for Aviation Fuel Quality Control & Operating Procedures for Jointly Operated Supply & Distribution Facilities*. These state that for a dedicated single product pipeline, each batch must be sampled at its start, middle and end, and the specified control checks carried out.

In addition an instrument (densitometer) to monitor the density of the product is installed at the pipeline inlet station. This instrument is interfaced to the PLC/SCADA system and an alarm is raised if the measured values are outside permissible limits. A large variation from the stated specification density initiates a pipeline ESD. (Note: This may be include as part of the meter package)

Pipeline pigging for product quality reasons should not be necessary provided the line is flushed regularly at maximum flow rate.

8.6 Safety

A set of safety plans and procedures will be put in place to cover the event of an accident with the pipeline. This safety plan will include a link to the Dublin Port Company, Dublin City Council, Fingal Council and Dublin Airport Authority.

The plan will be based on existing plans used by aviation fuel transportation industry in Europe and adapted or modified as necessary to meet local conditions.

Automatic safety shutdown systems which protect the pipeline process will be verified (tested) at design proof test intervals which will be developed during detailed design. It is envisaged that proof test intervals will not in any case exceed 12 months.

8.7 Maintenance

The Safety, Health and Welfare at Work (General Application) (Amendment) Regulations 2012 came into operation on 1st January 2013. The Regulations insert a new Part 10 and Schedule 12 to the 2007 Regulations, relating to Pressure Systems.

In summary, the new Part 10 and Schedule 12 set out the requirements for the design, construction, safe operation, examination and testing of pressure equipment. They also provide for the maintaining of records of tests and examinations of such equipment. These provisions apply to all workplaces, in all industry sectors, which utilise pressure systems as part of their operations. This pipeline system is subject to these regulations.

Regular inspection of the pipeline will take place on a planned maintenance schedule. This will help to ensure that the line is properly maintained and meets the safety requirements.

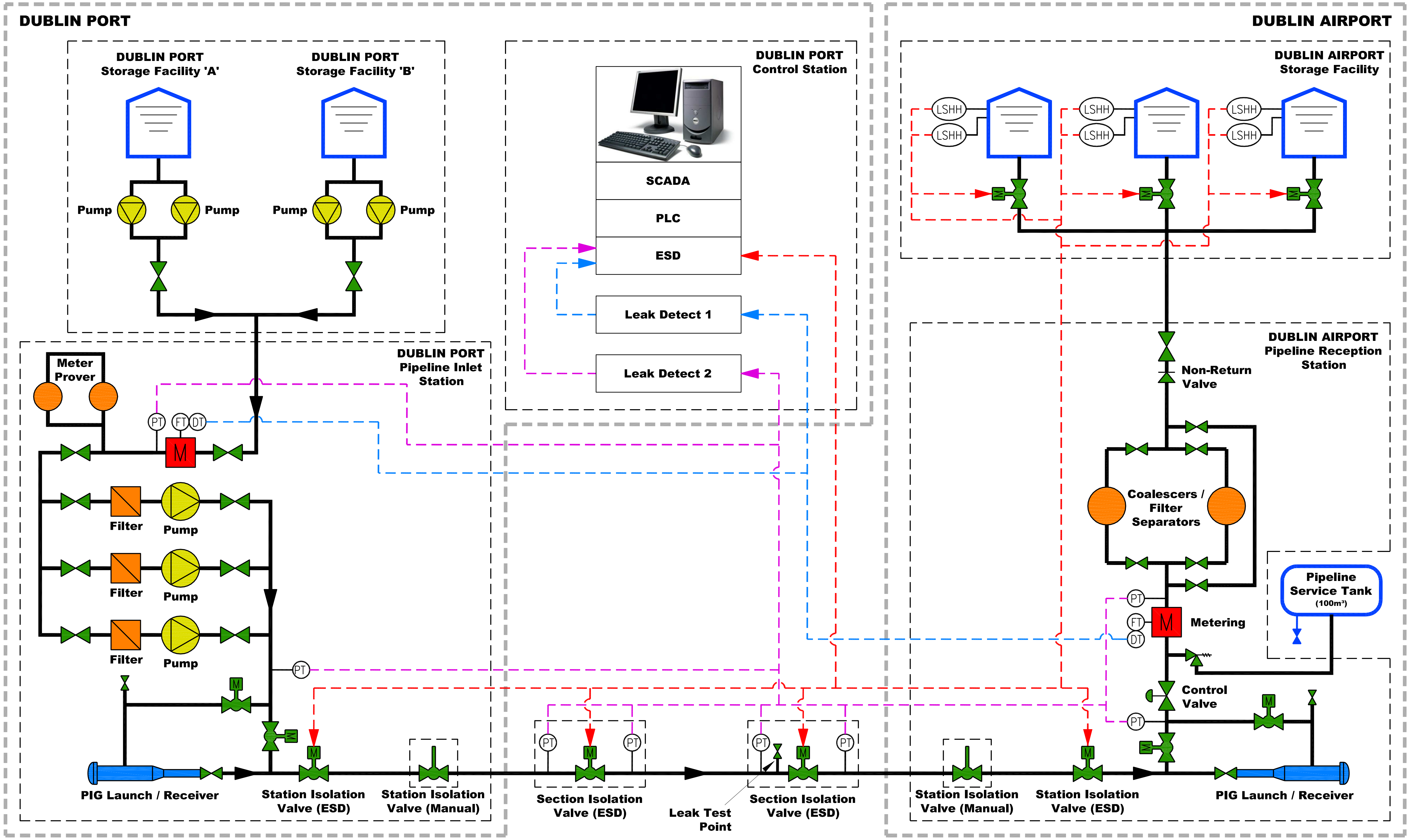
8.8 Decommissioning / Abandonment

Should the pipeline systems require to be abandoned it shall be decommissioned in accordance with Sections 13.2.4 & 13.6 of the Standard. The abandoned pipeline shall be left in a condition that is safe for the public and the environment. This is achieved by all the product being pumped, or pigged, out of a pipeline system using water or an inert gas.

Hazards and constraints that will be taken into -consideration when planning to drain include:

- Asphyxiating effects of inert gases
- Protection of reception facilities from overpressurisation
- Drainage of valve cavities, “dead legs”, etc.
- Disposal of fluids and contaminated water
- Buoyancy effects if gas is used to displace liquids
- Compression effects leading to ignition of fluid vapour
- Combustibility of fluids at increased pressures
- Accidental launch of stuck pigs by stored energy when driven by inert gas

APPENDIX A: PIPELINE SCHEMATIC



KEY

Aviation Fuel Pipeline

PT Pressure Transmitter

DT Density Transmitter

FT Flow Transmitter

LSHH Level Switch High/High

0	PLANNING ISSUE	TM 06/11/14	
REV	REVISION	REV.BY	A B C APPROVED

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On Behalf of: INDEPENDENT PIPELINE Co. Ltd.

Project: AVIATION FUEL PIPELINE

APPROVALS: A ENGINEER; B PROJECT MANAGER; C PROJECT DIRECTOR

PIPELINE SCHEMATIC

Scale: NTS/A3 | Status: FINAL | Drawing Number: 0362/D/06/P/0002 | Sheet 1 Of 1

APPENDIX B: PIPELINE ROUTE

LEGEND:

- PIPELINE ROUTE
- PUMPING / RECEIVING STATION

APPROVALS	
A	ENGINEER
B	PROJECT MANAGER
C	PROJECT DIRECTOR

Revision 1

REV	REVISION	REV.BY	A	B	C
1	REVIEW	RMD 07/08/14			
0	FOR INFORMATION	RMD 10/06/14			
			APPROVED		

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On Behalf of: INDEPENDENT PIPELINE Co. Ltd.

Project: AVIATION FUEL PIPELINE

Scale: NTS/A3

Drawing Number: 0362/D/01/G/0001

Title: ROUTE MAP

Status: DRAFT

Sheet 1 Of 1