

Contents

Scope	xi
1. Introduction	1
2. Tank Safety Design Considerations	3
2.1 Design Factors versus Tank Type for Atmospheric Tanks	3
2.1.1 Fixed Roof Tanks	3
2.1.2 Floating Roof Tanks	4
2.2 Other Design Considerations – Tank Farm Layout	6
2.2.1 Introduction	6
2.2.2 Other Guidelines and Regulatory Directives	6
2.3 Vapour Collection/Recovery Systems	8
3. Overpressure/Vacuum of Tanks	9
3.1 Pressure Vacuum Valves and Open Vents	9
3.2 Tank Overpressure	10
3.3 Tank Vacuum	11
4. Dealing with Water	13
4.1 Water in Tanks	13
4.1.1 Heated Tanks	13
4.1.2 Precautions to Prevent ‘Froth-Overs’	14
4.1.3 Overheating	15
4.2 Rain Water on Floating Roofs	15
4.2.1 Single Deck Floating Roofs	15
4.2.2 Double Deck Floating Roofs	16
4.2.3 Risk Assessment	16
5. Ignition Sources in Oil Movements	17
5.1 Static Electricity	17
5.1.1 Control of Static Electricity	17
5.1.2 Electrostatic Ignition During Liquid Handling	18
5.2 Other Sources of Ignition	24
5.2.1 Diesel-Driven Equipment	24
5.2.2 Carbon Canisters	24
5.2.3 Level Instruments	24
6. Gas Freeing of Tanks and Pipelines	25
6.1 Fixed Storage Tanks	25
6.1.1 General Instructions	25
6.1.2 Removing Liquids	25
6.1.3 Removing Gases/Vapours	25
6.1.4 Isolation	26
6.1.5 Cathodic Protection	26
6.1.6 Scale and Sludge Removal	26
6.1.7 Materials Subject to Auto-Ignition	26
6.1.8 Fixed Roof Tanks – All Low Flash Materials	27
6.1.9 Floating Roof Tanks – Crude Oil and Products	27
6.2 Bulk Transport Vehicle Tanks	28
6.3 Pipelines	29
7. Tank Entry and Cleaning Procedures	31
7.1 Entry Procedures	31
7.1.1 Entry Without Breathing Apparatus for Inspection and Non Spark Producing Maintenance	31
7.1.2 Entry With Breathing Apparatus for Inspection and Non Spark Producing Maintenance	31
7.1.3 Other Considerations	32

7.2 Cleaning Procedures.....	32
7.2.1 General.....	32
7.2.2 Hazards to be Considered	32
7.2.3 Butterworth Washing®	33
8. Depressurising and Opening Gas Pipelines.....	35
8.1 Depressurising	35
8.2 Effective Valve Closure	35
8.3 Toxic Gases	35
8.4 Hydrogen Rich System	35
8.5 Entry of Air into a Gas System	36
8.6 Electrical Equipment.....	36
8.7 Residues.....	36
9. Tank Operational Inspection and Maintenance.....	37
9.1 Causes of Tank Damage	37
9.2 Oil Movements Operational Inspection	38
10. Tank Level Measurement and Overfill Protection.....	41
10.1 High Level Alarms	41
10.1.1 Fixed Roof Tanks	42
10.1.2 Floating Roof Tanks.....	43
10.1.3 Overfill Level.....	43
10.1.4 Tank Rated Capacity	43
10.1.5 High-High Level Shutdown	44
10.1.6 Level Alarm High	44
10.1.7 Normal Fill Level (Normal Capacity).....	45
10.2 Tank Low Level Alarms	45
10.3 Safeguards to Protect Overfill of Tanks During Transfers	45
10.4 Other Safeguards Against Tank Overfill	46
11. Lightning Strikes on Tanks	47
11.1 Mechanism of Roof Surface Charging	47
11.2 Precautions to Reduce the Impact of Lightning Strikes.....	47
11.2.1 Fixed Roof Tanks / Internal Floating Roof Tanks	47
11.2.2 External Floating Roof Tanks	48
12. Maximum Storage Temperature of Products	49
12.1 Mechanical Design Limitations.....	49
12.1.1 Tanks and Piping	49
12.1.2 Corrosion	49
12.1.3 Insulation	50
12.2 Water Vapourisation Risk	50
12.3 Rundown Temperature of Products	50
12.3.1 Slops/Recovered Oil Systems	51
13. Liquefied Petroleum Gas	53
13.1 Process Safeguarding Memorandum for LPG Storage Facilities	54
13.2 Operational Inspection at LPG Storage Facilities.....	54
14. Ship to Shore Activities	57
14.1 Safety Operational Requirements	57
14.1.1 Pigging.....	57
14.1.2 Surge Pressures	58
14.1.3 Loading Arms.....	58
14.1.4 Hazardous and Restricted Areas.....	58
14.1.5 Sources of Ignition.....	59
14.1.6 Restricted Pumping Rates	59
14.1.7 Insulating Means in Ship/Shore Connection	60
14.1.8 Operability of Inert Gas (IG) System	60
14.1.9 Condition of the Site’s Cargo and Bunker Hoses or Arms	60

14.1.10 Operating Parameters of Vapour Recovery Line	61
15. Truck and Railcar Loading/Unloading	63
15.1 Causes of Incidents	63
16. Oil Movements Shift Handover	65
16.1 Guidelines for Effective Shift Handover in Oil Movements	65
Appendix 1 Selection of Storage Tank Type.....	67
References	71
Bibliography	73

Figures

Figure 1 The 'EX' sign as stipulated by regulations	7
Figure 2 Roof collapse due to vacuum in the tank	11
Figure 3 Tank collapse due to rapid temperature changes	14
Figure 4 Management of risk of static electricity in oil movements	18
Figure 5 Overfill protection: tank levels	43

Tables

Table 1 Workplace requirements.....	8
Table 2 Operational inspection of LPG storage facilities.....	55