

DEP SPECIFICATION

**ESD SYSTEMS FOR LOADING AND DISCHARGING
LIQUEFIED GAS CARRIERS**

DEP 30.06.10.20-Gen.

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DESIGN AND ENGINEERING PRACTICE

DEM1



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and give recommendations for the design of Emergency Shutdown (ESD) systems for marine loading and discharge terminals for liquefied gas carriers. This DEP seeks to clarify the design philosophy of the ESD system and describe the hardware required. It does not, however, attempt to cover engineering details, for which reference should be made to:

- DEP 31.06.15.10-Gen.
- Relevant DEPs for structures, piping, instrumentation and equipment.

This DEP includes recommendations aimed at achieving a measure of standardisation in the design and implementation of ESD systems at Group marine LNG and LPG terminals.

The structure of this DEP is as follows:

- main system components (valves, arms and ERSs, hydraulics, etc.)
- safeguarding system (logic functions and interlocks)
- additions for import terminals
- instrumentation

The main focus of this DEP is onshore-based ESD systems, its associated hardware and on the ship/shore interface.

Section (6) is for Import Terminals and states requirements in addition to those for export terminals to prevent duplications. Although this DEP is written for onshore-based ESD systems, it can be applied for offshore-based systems subject to an assessment of the extent of applicability based on the scope of the project.

This DEP contains mandatory requirements to mitigate process safety risks in accordance with Design Engineering Manual DEM 1 – Application of Technical Standards.

This is a revision of the DEP with the same number dated February 2013; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

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This DEP is intended for use in facilities related to marine LNG and LPG terminals. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases, the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The capitalised term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

The word **may** indicates a permitted option.

1.3.2 Specific definitions

Term	Definition
Accumulator System	System that provides sufficient hydraulic oil in case of electric power failure.
Apex Angle	Angle between inboard and outboard arm. (The highest point of the Marine Loading Arm)
'Dry Break' Uncoupling	Uncoupling without significant release of product.
ESDV	Emergency Shutdown Valve
Effective Valve Closure Time	This is the period within which a given ESD valve reduces the flow from 90 % of its steady state to zero
Instrumented Protective Function	A function comprising one or more sensors, a Logic Solver and one or more Final Elements whose purpose is to prevent or mitigate hazardous situations and that have SIL 1, SIL 2, SIL 3 or SIL 4.
Quick Connect/ Disconnect Couplers	The manual or hydraulic mechanical device used to clamp the loading arm to the presentation flange of the ship's manifold without the use of bolts.
Safety Integrity Level (SIL)	Discrete level (one out of four) for specifying the safety integrity requirements of the safety instrumented functions (IPF in this DEP) to be allocated to the safety instrumented systems (trip systems). Safety integrity level 4 has the highest level of safety integrity; safety integrity level 1 has the lowest.
Ship Manifold Valve	The first valve downstream the manifold presentation flange
Ship/Shore Link	Transmits ESD and communication signals from ship to shore or vice versa via compatible system
SIGTTO link	A standardised ship/shore link developed by SIGTTO members.
Slew Angle	Horizontal rotation angle of the arm assemblies.
Sway Values	Values of drift motions are sideways direction.
Total Valve Closure Time	This is the time taken for the valve to travel from the fully open to the fully closed position

1.3.3 Abbreviations

Term	Definition
CCR	Central Control Room
DBV	Double (Interlocked) Block Valves Associated With ERS
DCS	Distributed control system
ERS	Emergency release system; a system for quickly and safely disconnecting with minimal product spillage, consisting of a PERC and two isolation valves (DBVs), one upstream and one downstream of the coupler
ESD	Emergency Shut-Down
ESD-1	Emergency shutdown of the transfer operation in a quick controlled manner by closing the shutdown valves and stopping the transfer pumps. On board ships this stage is commonly referred to as emergency shutdown (ESD).
ESD-2	Emergency shutdown of the transfer operation (ESD-1) and simultaneous uncoupling of the LAs (operation of the PERC) after closure of both the DBVs.
FAR	Field Auxiliary Room
GBS	Position Indicator
GBZ	Position Switch with Trip Action
GZA	Apex or slewing angle over-extension alarm with emergency action
HBS	Backlighted Switch
HIC	Hand Indicating Controller
HZ	Push buttons for manual initiation of the ESD-1 and ESD-2 systems
IGC	International code for the construction and equipment of ships carrying liquefied gases in bulk
IMO	International Maritime Organisation
IPF	Instrumented Protective Function
IPS	Instrumented Protection System
LA	Loading Arm (also used for unloading)
LZA	Level alarm with emergency action
OCIMF	Oil Companies International Marine Forum

Term	Definition
OOS	Operational override switch; enables circulation through loading lines in the absence of a ship and testing of the ESD system of one jetty whilst a second jetty is in operation (indicated as HBS on Process Engineering Flow Schemes)
PERC	Powered Emergency Release Coupling
PLC	Programmable Logic Controller
PZA	Pressure alarm with emergency action
QCDC	Quick Connect/Disconnect Coupler
ROV	Remote Operated Valve. Operable from the CCR, these valves can have ESD functionality if they are hydraulically or pneumatically driven.
RSP	Removable Spool Piece
SIGTTO	Society of International Gas Tanker and Terminal Operators Ltd.
SIL	Safety Integrity Level
TOS	Test override switch; required to allow testing of initiating devices when the actual ESD-2 and/or ESD-1 action may not occur.
XZA	General Safeguarding Function

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets (). Other documents referenced by this DEP are listed in (9).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated February 2013. The following are the main, non-editorial changes.

Section/Clause	Change
All	Restructured and clarified requirements, enforced use of shall/should/may for normative statements.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using one of the following options:

Shell DEPs Online (Users with access to Shell DEPs Online)	Enter the Shell DEPs Online system at https://www.shelldeps.com Select a DEP and then go to the details screen for that DEP. Click on the "Give feedback" link, fill in the online form and submit.
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DEP Standard Form (other users)	Use DEP Standard Form 00.00.05.80-Gen. to record feedback and email the form to the Administrator at standards@shell.com .

Feedback that has been registered in the DEP Feedback System by using one of the above options will be reviewed by the DEP Custodian for potential improvements to the DEP.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

1.8 NON NORMATIVE TEXT (COMMENTARY)

Text shown in italic style in this DEP indicates text that is non-normative and is provided as explanation or background information only.

Non-normative text is normally indented slightly to the right of the relevant DEP clause.

2. GENERAL

The Terminal Emergency Shutdown (ESD) system has been developed to minimise risks during the transfer of liquefied gases between ship and shore loading and unloading installations. The ESD system includes fast closing valves, LAs equipped with emergency release couplers, and surge protection equipment (where required).

The first stage emergency shutdown system (known as the ESD-1 system) shuts down the product transfer operation in a controlled way by closing valves and stopping pumps in the shore facilities.

The second stage emergency shutdown system (ESD-2) activates the LA emergency release system (ERS) to disconnect the arm from the ship. 'Dry break' uncoupling is achieved by ensuring the closure of two isolation valves, one directly upstream and one directly downstream of the emergency release coupler (ERS) prior to the uncoupling action.

Valves are required for operation, maintenance and emergency shutdown. The closure of valves in the terminal or at the ship during loading or offloading will cause a pressure surge.

1. The common product supply headers shall be designed to withstand the maximum pressure due to surge by closure of valves.
2. Closure of any valve available in the system shall be subjected to detailed surge pressure verification which could necessitate a surge pressure relief system.
3. The following cases shall be evaluated when designing the ESD system:
 - a. lifting of the access gangway;
 - b. disconnection of ship/shore link in the event of a ship drifting away from the loading jetty.
4. The derived SIL levels in this DEP together with the instrumentation implementation description shall be the minimum standard for the described ESD systems, unless the project specific SIL Assessment leads to different SIL levels.

The available IPFs in the ESD system design covering LNG and LPG terminals have been classified generically.

5. Local circumstances or alternative process line-ups could result in higher SIL scores. Therefore, the SIL results of every project or process line-up modification in an existing facility shall be reviewed as presented in this DEP.

3. MAIN SYSTEM COMPONENTS

3.1 MANIFOLD VALVES

3.1.1 Ship manifold valves

Ship manifold valves are not in the scope of this DEP.

3.1.2 Jetty manifold valves

1. Each LA (vapour and liquid) shall be provided with a remote operated valve as primary isolation for connection and disconnection of the LAs.

This valve is called the LA ROV for both liquid and vapour transfer arms.

2. The Loading Arm ROVs SHALL [PS] meet all of the following requirements:
 - a. remote operated;
 - b. fire-safe;
 - c. tight shut off valves;
3. If the Loading Arm ROV has ESD functionality, whether pneumatically or hydraulically operated, it SHALL [PS] be fail safe, i.e., close automatically on loss of actuating power.
4. The LA ROV shall be provided with a mechanically secured means of setting or adjusting Total Valve Closure Time.
5. The LA ROVs shall be fitted with proximity switches to indicate when the valves are in the 'closed' and 'not closed' position, which are incorporated in the safeguarding logic of ESD-1.
6. The LA ROVs shall not close faster than the ESD-1 valves in the loading lines.
7. If a jetty is equipped with multiple liquid LAs, and if one liquid LA is designed to be the backup for the vapour return arm, the switch SHALL [PS] not be made through the use of additional ROVs, but be carried out by means of spading and using a removable spool piece (RSP) as per the piping class.
8. If LAs have been manifolded for multiple product transfer, each arm SHALL [PS] be provided with a LA ROV at each manifold connection.
 - a. The logic system SHALL [PS] inhibit the opening of a second Loading ROV when another is in the 'not closed' position.
9. The Total Valve Closure Time for a Loading HIC shall be reviewed as part of surge pressure verification.

Loading HICs are for operational purposes only and are not related to the ESD system.
10. A manual isolation valve should be installed upstream of each LA ROV to allow maintenance of the LA ROV while the other LAs remain operational.