DEP SPECIFICATION

FUEL SYSTEMS

DEP 20.05.60.10-Gen.

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DESIGN AND ENGINEERING PRACTICE

DEM1

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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the design of liquid and gaseous fuel systems as applied in oil refineries, petrochemical complexes and gas plants. This DEP is primarily intended for use by the Principal and the Engineering Contractor in the design of new facilities or the revamp of existing facilities. This DEP is not intended for direct use in equipment specification or procurement.

Fuel systems which are based on commercial grade liquid fuels and natural gas will not necessarily require such specific design features and a simplification may then be possible. However, many of the design principles are common to all fuel systems regardless of whether they are designed to handle the fuel variations typical of refinery systems or not, therefore the basic design considerations, principles and requirements described in this DEP are intended to be applied to these systems as well.

Also covered by this DEP are specific fuel system considerations for industrial gas turbines.

Details such as safety relief valves, heat tracing and insulation are not included. Equipment required for achieving the desired fuel condition may vary, e.g. the requirement for gas heating to compensate for expansion cooling or the use of a dedicated gas superheater to ensure dryness.

As there can be significant variations in fuel system requirements from one location to another where operational and environmental priorities may differ, this DEP cannot cover every system specifically.

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 January 2010; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorization to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to gas handling, oil refining, chemical processing and gasification. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process should 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.

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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.

1.3.2 Specific definitions

Term	Definition
Combustion system	The system within the consumer's plot which controls, safeguards and burns the fuel in the fired application
Consumer	The process or utility unit which will burn the fuel supplied.
Fuel	Substance which can provide self-sustaining combustion in air and provide a source of useful heat. In this DEP, fuel is in a form which can be measured and controlled within defined parameters, otherwise it is classed as a waste stream.
Fuel gas	Gaseous fuel which is produced on site, generally containing hydrocarbons and hydrogen with few inerts, and may be of variable composition/calorific value.
Fuel gas system	System which is typical of, but not restricted to, oil refineries in which gas is collected from various plant generated byproduct sources, mixed, balanced or supplemented with other auxiliary gas streams to meet requirements, controlled and supplied to process furnaces and utility boilers which use burners operating with a fuel gas pressure up to 200 kPag (30 psig).
Fuel oil	term used to describe oil-based liquid fuels generally, but excluding low boiling point fuels such as liquid butane or naphtha.
Fuel supply	Refers to the fuel supply conditions from the fuel system at the consumer's battery limit.
Fuel System	System which receives a fuel or a number of fuel component streams, stores the fuel as required, conditions the fuel so that it is suitable for use in the consumer's combustion system(s), and distributes the fuel to the consumer(s) at these required conditions.
gross calorific value (GCV)	Total heat produced by combustion of the fuel. See also **Higher heating value (HHV)**
Heating value	synonymous with **calorific value** and is the heat liberated by combustion of a fuel. It is expressed in heat units per unit mass for liquid fuels but for gaseous fuels it may be expressed on a mass, molar or volume basis.
Heavy fuel oil	Refers to fuel oil having a relatively high proportion of high boiling point residues and high viscosity.
Higher heating value (HHV)	Total heat produced by combustion of the fuel. See also **gross calorific value (GCV)**
Light fuel oil	Refers to fuel oil having a relatively high proportion of volatile components and low viscosity.
Low pressure gas	Refers to gas which has a calorific value similar to fuel gas but which is available only at a pressure below that of the main fuel gas system. It may be considered as a fuel when the pressure is still sufficiently high for it to be measured and controlled in a dedicated low pressure combustion

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Term	Definition
	system. See also **vent gas.**
Lower heating value (LHV)	Total heat produced by combustion of the fuel minus the latent heat contained in the water vapour (produced by combustion) discharged as flue gas. As this latent heat is not normally recovered, LHV represents the heat available to a consumer. See also **net calorific value (NCV)**
Natural gas	Refers to natural gas supplied by the national grid and, as such, has a closely controlled composition/calorific value and is normally available at high pressure
Net calorific value (NCV)	Total heat produced by combustion of the fuel minus the latent heat contained in the water vapour (produced by combustion) discharged as flue gas. As this latent heat is not normally recovered, LHV represents the heat available to a consumer. See also **Lower heating value (LHV)**
Offgas	Refers to gaseous product streams which can be combusted/incinerated but require the support of a fuel to provide sufficient heat to sustain combustion, and may be available only at a pressure near to atmospheric. Therefore, these gases are not considered as fuels. See also **Waste gas**
Syngas	Refers to gas produced from the gasification process (of either gas, oil or coal) and from which a major proportion of the hydrogen has been removed (for process feedstock), leaving a gaseous fuel of relatively low calorific value but available at high pressure. Hydrogen content of the gas may vary as process hydrogen demand fluctuates.
V_{50} viscosity	A viscosity characteristic used in fuel oil blending. It is based on the kinematic viscosity of the fuel oil, v, in the units of mm^2/s (centistokes), measured at temperature, t (°C), and corrected to 50°C according to the formula: $V_{50} = 19.2 + 118 * \log [(t+273)/323] + 33.5 * \log \log (v+0.85)$. NOTE: log is to base 10.
Vent Gas	Refers to gas which has a calorific value similar to fuel gas but which is available only at a pressure below that of the main fuel gas system. It may be considered as a fuel when the pressure is still sufficiently high for it to be measured and controlled in a dedicated low pressure combustion system. See also **Low pressure gas**
Waste gas	Refers to gaseous product streams which can be combusted/incinerated but require the support of a fuel to provide sufficient heat to sustain combustion, and may be available only at a pressure near to atmospheric. Therefore, these gases are not considered as fuels. See also **offgas**
Wobbe Index	Is an indicator of the interchangeability of fuel gases and is defined by the following fomula: Wobbe Index = heating value/(square root of gas specific gravity) The Wobbe Index has the same units of measure as the heating value and can be expressed on either a higher or lower heating value basis.

1.4 ACRONYMS

Acronym	Definition
ABS	Asphalt Burning System

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Acronym	Definition
BOD	Basis of Design
FO	Fuel Oil
GCV	gross calorific value
HHV	Higher heating value
IBP	Initial Boiling Point
LBF	Low boiling fuel
LHV	Lower heating value
LPG	Liquid Petroleum Gas
LRFS	Long Residue fuel systems
NCV	net calorific value
SRFS	Short Residue fuel systems
TSO	Tight Shut-Off

1.5 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 (5).

1.6 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated January 2010. The following are the main, non-editorial changes.

Amended per Circular 27/11

Old section	New section	Change
General	General	Segregation of content done as per the DEP transformation process. DEP is separated into three parts: DEP Specification: Project related content DEP Informative: Background and guidance for Project use DEP Practice: Asset life related information
General	General	Sparing requirements removed
2.5	2.5	Removed some of the Design Requirements DEP cross references
3.1.3	3.1.3	Added the alternative of off the shelf proprietary gas-liquid separators
3.1.5	3.1.5	Changed the SHALL [PS] to shall as the event did not meet the risk criteria for SHALL [PS]
4.1.4.2	4.1.4.2	Added the option of venting the tank vent to atmosphere if blanketed with nitrogen or steam.
4.1.5.5	4.1.5.5	Changed the SHALL [PS] to shall as the event did not meet the risk criteria for SHALL [PS]

1.7 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the Administrator at standards@shell.com, using the DEP Feedback Form. The DEP Feedback Form can be found on the main page of

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"DEPs on the Web", available through the Global Technical Standards web portal http://sww.shell.com/standards and on the main page of the DEPs DVD-ROM.

1.8 DUAL UNITS

Amended per
Circular 27/11
Dual units have been incorporated throughout this DEP.

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.

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