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DIESEL OIL SYSTEMS

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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 diesel oil systems as installed in oil and gas production facilities, gas plants, and manufacturing facilities. It covers both manned and unmanned installations and in particular systems that supply diesel to diesel engines that are covered in DEP 31.29.80.30-Gen.

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

The scope of this DEP is the complete diesel oil system as required for the reception, storage and treatment of the diesel oil and its distribution to the various end users, within the following boundaries:

- Diesel supply to facility - hose coupling at loading station;
- Diesel to users: block valve either upstream of day tanks or at equipment interface;
- Drains: open drain tundishes.

Other utilities which interface with the diesel system are outside the scope of this DEP.

The figures in this DEP are intended to illustrate process design concepts only. Details such as safety relief valves, heat tracing and insulation are not included.

As there can be significant variations in diesel oil system requirements from one location to another where operational and environmental priorities may differ, this DEP cannot cover every system specifically. Nevertheless, the design principles described in this DEP shall be considered in all designs and applied as relevant to the particular circumstances.

This is a revision of the DEP of the same number dated December 1998; 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 oil and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. 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.

1.3.2 Specific definitions

Term	Definition
Cetane Number	The Cetane Number is an index of ignition quality determined by comparison of the test fuel with fuels used as standards for high and low cetane numbers.
Cloud Point	The Cloud Point is the temperature, at which a cloud or haze of wax crystals appears at the bottom of the test jar when the oil is cooled under prescribed conditions.
Cold Filter Plugging Point (CFPP)	CFPP is an experimental measurement determining the flowing properties of diesel. It has replaced the Pour Point as more accurately predicting diesel's flow characteristics in engine fuel systems.
Pour Point	Pour Point is the lowest temperature, at which the oil is observed to flow when cooled and examined under prescribed conditions.
Not Normally Manned Installation (NNMI)	NNMI is an unmanned platform designed with minimum equipment for high reliability and minimum maintenance. NNMI's are operated remotely with small multi-skill teams visiting six to nine times per year.

1.3.3 Abbreviations

Term	Definition
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
AWS	American Welding Society
BNC	Non-pressure Cone Roof Tank
BND	Non-pressure Dome Roof Tank
BS&W	Base Sediment and Water
DCS	Distributed Control System
ESD	Emergency Shutdown
HAZOP	Hazard and Operability
NNMI	Not Normally Manned Installation

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 (5).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated December 1998. The following are the main, non-editorial changes.

Old section	New section	Change
2.1	2.1	Made applicability to downstream facilities as well as upstream facilities.
2.2	2.2	Moved the narrative of this section to Informative DEP.
2.3	2.3	Revised Hazardous Area Classification to be consistent with DEP 80.00.10.10-Gen or DEP 80.00.10.13, whichever is applicable.
2.4	2.4	Revised to address diesel driven emergency equipment.
2.4.1	2.4.1	Added action to be taken on gas detection.
2.4.2	2.4.2	Added action to be taken on fire detection.
3.2	3.2	Moved sparing or reliability consideration to Informative DEP.
3.3.1	3.3.1	Added diesel uses for downstream facilities.
3.3.2.6	3.3.2.6	Changed "should" to "shall".
3.3.2.7	3.3.2.7	Changed "should" to "shall".
3.4.1.1	3.4.1.1	Moved "Note" background information to Informative DEP.
3.4.1.1	3.4.1.1	Changed "should" statement to "shall".
3.4.1.2	3.4.1.2	Changed "should" statement to "shall".
3.4.1.2	3.4.1.2	Added spill containment requirements.
3.4.2	3.4.2	Changed both "should"s to "shall"s.
3.4.2	3.4.2	Moved "Note" background information to Informative DEP.
3.4.2.1	3.4.2.1	Moved the narrative of this section to Informative DEP.
3.4.3	3.4.3	Changed "should" to "shall".
3.4.4	3.4.4	Moved the narrative of this section to Informative DEP.
3.4.4.1	3.4.4.1	Moved the narrative of this section to Informative DEP.
3.4.4.1	3.4.4.1	Eliminated reference of use of potable water for process use.
3.4.4.2	3.4.4.2	Moved the narrative of this section to Informative DEP.
3.4.5	3.4.5	Changed four "should"s to "shall"s.
4.1	4.1	Changed "should" to "shall".
4.2.1	4.2.1	Changed "should" to "shall".
4.2.2.1	4.2.2.1	Changed two "should"s to "shall"s.
4.2.2.1	4.2.2.1	Changed "are typically" to "shall be".
4.2.2.2	4.2.2.2	Moved the narrative of this section to Informative DEP.
4.2.2.2	4.2.2.2	Changed six "should"s to "shall"s.
4.2.2.3	4.2.2.3	Changed "should" to "shall".
4.3.2	4.3.2	Moved the narrative of this section to Informative DEP.
4.3.2	4.3.2	Changed two "should"s to "shall"s.
4.4.1	4.4.1	Added requirement to provide air gap when using potable water for process.
4.4.1	4.4.1	Changed two "should"s to "shall"s.

Old section	New section	Change
4.4.2	4.4.2	Changed "should" to "shall".
4.5	4.5	Made reference to DEP31.29.80.30-Gen Section 3.4.5 to maintain consistency .
4.6	4.6	Added specificity to freeze protection requirement.
4.7	4.7	Changed "should" to "shall".

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

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.

2. GENERAL CONSIDERATIONS

2.1 THE ROLE OF DIESEL OIL IN FACILITIES

Diesel oil (2.2) may be used for various purposes in facilities. Its primary use, however, is that of a (motive) fuel, i.e., a substance that can provide self-sustaining combustion in air and provide a source of useful heat.

The term 'fuel' applies to both liquid fuels and gaseous fuels. Fuel systems can be divided into four different categories:

- fuel gas systems;
- crude oil and residual fuel oil systems;
- distillate liquid fuel systems;
- aviation fuel systems.

This DEP covers distillate liquid fuel systems, specifically those systems handling diesel oil, but it should be realised that there may be interaction with other types of fuel, e.g., where diesel oil is used as a back-up fuel for another type of fuel.

In this context, diesel oil is a refined fuel imported and stored to run emergency services and to provide power during start-up and maintenance turnarounds when produced gas/oil or imported electricity is not available. Typical users of diesel oil as a motive fuel are as follows. See (3.3.2).

- a) dual fuel (gas and diesel) turbine generator sets;
- b) diesel engine generator sets for emergency services, black start and/or basic services;
- c) diesel engine generator sets for drilling services;
- d) dual fuel (gas and diesel) mechanical drive turbine sets;
- e) diesel engine driven fire pump sets;
- f) water heaters.

Finally, there are a number of non-fuel uses of diesel. These include its use as a solvent for corrosion inhibitor in the main production facilities, back-filling of pipelines prior to commissioning, a solvent for well-stimulation chemicals, wellhead equalisation and as a light hydrocarbon to displace well completion fluid before production starts. This DEP does not cover those non-fuel uses of diesel.

2.2 DIESEL OIL PROPERTIES

Diesel oil is the generic term used for the distillate fuel oil supplied to facilities. In refineries, the particular distillate produced for industrial engines is known as gas oil, which is the distillate fraction boiling between 200°C (392°F) and 350°C (662°F).

Fuel characteristics shall comply with the equipment Manufacturer's fuel specification, and any noted departure from specification requirements shall be submitted for review.

2.3 HAZARDOUS AREA CLASSIFICATION

The hazardous area classification shall follow DEP 80.00.10.10-Gen. or DEP 80.00.10.13-Gen., as may be applicable.

2.4 SAFETY CONSIDERATIONS

Where diesel-driven engines are installed to drive emergency pump or generator, then they are required to work in general emergency situations and SHALL [PS] be located outside the hazardous area.

Actions on gas detection and/or fire detection shall be as set out below.

2.4.1 Action on gas detection

Status of hazard alert resulting from gas detection in hazardous areas SHALL [PS] cause automatic shutdown of electrical equipment not suited for hazardous atmosphere.

Where a supply of diesel has to be maintained during emergency situations, e.g., to the emergency generator, the electrical equipment shall comply with the hazardous area classification effective during such emergencies.

2.4.2 Action on fire detection

Status of hazard alert resulting from fire detection SHALL [PS] cause automatic shut-off of diesel supplies.

This SHALL [PS] be accomplished by automatic shutdown of the diesel forwarding pumps and automatic shut-off of the diesel outlet from bulk storage tanks. Supplies to and from day tanks SHALL [PS] be fitted with shut-off valves that can be operated from a safe position, i.e., outside the area where the tank is located.

NOTE: Fire pumps, emergency generator(s) and most other equipment are typically fitted with day tanks, so that there will be no immediate shut-off of diesel users in unaffected areas.

Following isolation of supplies to affected areas, the forwarding pumps can be restarted after inhibiting the pump shutdown signal.

2.5 INSTRUMENTATION AND CONTROL

Specific instrumentation requirements will vary from project to project, with the individual project requirements covering overall aspects such as central control room monitoring (DCS) and control requirements, use of local control panels, selection of pneumatic or electronic instrumentation, etc.

Instruments should be as shown on the figures included in this DEP. Instrument selection and design shall comply with DEP 32.31.00.32-Gen.; instruments shall be suitable for the applicable hazardous area classification (2.3).

3. SYSTEM DESIGN

3.1 SYSTEM DEFINITION

Within the context of this DEP, a diesel oil system is defined as the system which receives the diesel oil, stores it as required, conditions it so that it is suitable for use in the user's combustion system(s) or for other end uses (2.1), and distributes it to the user's at the required conditions.

3.2 DESIGN CRITERIA

3.2.1 Availability and sparing

Fuel systems are designed to supply fuel to the user's combustion system at conditions which allow safe, reliable and uninterrupted combustion as required by the process or utility unit. Unless specified otherwise, the diesel oil system shall be designed for continuous operation and an appropriate philosophy of component sparing per the design class chosen shall be applied to achieve the required availability.

3.2.2 Storage requirements

On-site storage requirements (4.2) will greatly depend on the frequency and reliability of supply, and on whether a plant, or parts thereof, has to operate in 'boxed-in' or 'island' mode.

Utility systems, particularly power generators, are often required to operate in 'boxed-in' mode when the rest of the facility is shut down and there is no fuel or power supply from outside the battery limits. In such cases, the on-site storage of fuel shall be sufficient to maintain the supply to these priority units over this period, taking into account such factors as duration of shutdown, fuel bunkering frequency, etc. If a diesel oil system is used as a back-up fuel system to maintain continuity of operation during an emergency when the main fuel supply is lost, the diesel oil system shall be on continuous standby.

The required storage capacity of the fuel system shall take account of all these factors.

3.2.3 Diesel oil quality requirements

The diesel oil system shall not only satisfy the user's rate of demand but also deliver the diesel at the correct pressure, temperature and composition.

3.2.3.1 Pressure

Frequently, the diesel oil end user has its own fuel oil pump to feed the diesel into the burners/nozzles at the correct pressure to ensure satisfactory fuel atomisation. Generally, these pumps will be fed from a buffer storage system (e.g., day tank) to protect them from diesel distribution system pressure variations as other system users draw off supplies, e.g., when storage tanks are filled up, etc.

The diesel oil distribution system needs to be able to supply these users at the correct pressure with allowance being made for system pipework pressure drops, static head effects, treatment system supply pressures and pressure drops across treatment plant, etc. In order to ensure satisfactory performance, the calculations shall take into account the system geometry and size of the piping runs, maximum expected flowrates and draw-off points, ambient conditions (affecting diesel viscosity) if the lines are uninsulated/or not trace-heated, and location/elevations of day tanks/end users.

3.2.3.2 Temperature

Low temperatures cause the viscosity of the diesel oil to increase or the diesel oil to solidify when the temperature falls below its cloud point. If the diesel oil pour point is less than 10°C (18°F) below the minimum ambient temperature, provision of diesel tank heaters and the insulation and heat tracing of exposed lines shall be installed. Such measures shall also be taken if the fuel supply temperature could approach the diesel cold filter plugging point.

3.2.3.3 Quality

Adequate diesel oil treatment systems shall be specified to ensure that the diesel oil quality meets the requirements specified by the equipment Manufacturer (2.2).

Gas turbines typically have relatively high diesel fuel quality requirements, and so the main features of the diesel oil system designs will depend on whether gas turbine quality or diesel engine quality diesel oil is required (3.4).

3.2.4 Diesel oil quantity requirements

The total demand for diesel oil will depend on the type and number of diesel oil users, as well as the operational phase of the facility (3.3).

3.3 SYSTEM DEMANDS

Diesel oil users shall be inventoried and the total system demand determined. As the number of diesel oil users, and their average demand might vary during the different operational phases of a production facility, the total diesel oil demand shall be calculated for the various operational phases to determine the governing case.

3.3.1 Operational phases

3.3.1.1 Production Facility

A production facility is characterised by various operational phases throughout its design life, each of them with its specific diesel oil demands.

3.3.1.1.1 Life support phase

The facility is not drilling, producing or exporting. No fuel gas is available. Typical users would be fire pumps, cranes, water heaters, and either the main turbine generator or the basic services generator depending on the required load. The emergency generator may also be in operation during this phase.

3.3.1.1.2 Drilling phase

The facility is drilling, but not producing or exporting. No fuel gas is available, unless commissioned from a nearby pipeline. Typical users would be fire pumps, cranes, water heaters, the main turbine generator and drilling services users. Note that this phase may be minimised by using early well production to supply fuel gas to the main generators, thereby reducing diesel fuel consumption.

3.3.1.1.3 Production phase

The facility is producing and/or exporting but fuel gas is temporarily unavailable. Typical users would be fire pumps, cranes, water heaters, main generators and possibly dual fuelled gas turbines in mechanical drive applications.

NOTE: While this will be a high demand period, it should only last for a short time until gas is reinstalled. If gas production were to be halted for a long period, production power demands would be reduced so that they could be supported by the basic services generator.

3.3.1.1.4 Annual shutdown

Drilling may be continuing, while production is shut down for a major maintenance turnaround. Cranes and main generators will be operating with no fuel gas available.

NOTE: With Tender Assisted Drilling (TAD), platform power and diesel for drilling during the drilling phase and annual shutdowns may be supplied from the tender.

3.3.1.2 Manufacturing facility

For the purposes of this DEP, a manufacturing facility is characterized by two operational phases, normal and loss of utilities, particular the loss of external electrical power.

3.3.1.2.1 Normal operation

The facility is in production. Typical users would be fire pumps, mobile equipment including cranes, and water heaters.