Witnessing of low sulphur fuel changeover and operations
FOREWORD

DNV GL recommended practices contain sound engineering practice and guidance.

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Any comments may be sent by e-mail to rules@dnvgl.com

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CHANGES – CURRENT

This document supersedes the October 2013 edition of DNV-RP-D202. Changes in this document are highlighted in red colour. However, if the changes involve a whole chapter, section or subsection, normally only the title will be in red colour.

Changes October 2018, entering into force as from date of publication.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Reference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to RP</td>
<td>[1.1] - [1.4]</td>
<td>Update of the purpose of the document and description to applications.</td>
</tr>
<tr>
<td>References and definitions</td>
<td>[1.5] and [1.6]</td>
<td>New sections describing references, definitions and abbreviations used in the document.</td>
</tr>
<tr>
<td>Statement scheme</td>
<td>Sec.2</td>
<td>This section explains the pre-requisites and general procedure to obtain DNV GL statements.</td>
</tr>
<tr>
<td>Evaluation of test procedure</td>
<td>[4.3]</td>
<td>Fuel quality analysis at a laboratory is no longer required, instead, it is replaced by taking samples and visual clarity check.</td>
</tr>
<tr>
<td>Fuel system</td>
<td>[5.2]</td>
<td>Updates to new fuel type and general information.</td>
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</table>

Editorial corrections

In addition to the above stated changes, editorial corrections may have been made.
SECTION 1 INTRODUCTION

1.1 Background

MARPOL Annex VI regulation 14 sets the limit for the sulphur content of fuels used on-board ships operating in sulphur emission controlled areas (ECA).

The low viscosity associated with especially marine gas oil (MGO) and marine diesel oil (MDO) requires many vessels to make alterations to their machinery installations in order to enable operation on low sulphur fuel (LSF).

Though not required by classification, ship operators may be asked by e.g. charter parties to provide a statement pertaining to the capability of the vessel to operate on LSF, the effectiveness of fuel changeover procedures, or both. In such cases DNV GL may issue a statement in accordance with the procedure described in this recommend practice (RP). This document intends to address the requirements and prerequisites set by DNV GL.

1.2 Objective

The objective of this recommended practice is to provide guidance regarding the relevant requirements in connection with document preparations and DNV GL personnel's attendance necessary for issuance of low sulphur fuel statement.

1.3 Scope

This RP covers the recommended practices for obtaining DNV GL statements and tests involved for the issuance. It includes:

— list of documents to be submitted
— list of tests to be witnessed on-board and prerequisites
— test procedures for issuance of statements
— recommendation to fuel system with respect to new type of marine fuels.

1.4 Application

DNV GL has no specific requirements to the fuels used on-board and hence no specific requirements to alterations due to the type of fuel types on-board.

Where alterations are made to systems and components, it is subject to approval by class, drawings need to be submitted and approved prior to commencement of the alterations and after completion these alterations need to be verified and tested during an on-board classification survey. Approval and final acceptance of alterations are part of classification scope and, hence outside the scope of this RP.

Witnessing of the low sulphur fuel operation and issuance of the statement is not a class requirement and will be offered as a third party service.

Guidance note:

DNV GL also offers advisory service for vessel specific fuel oil change over manual and fuel changeover calculator (not classification service).

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1.5 References

Table 1-1 DNV GL documents

<table>
<thead>
<tr>
<th>Document code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNVGL-RU-SHIP Pt.4 Ch.7 Sec.6</td>
<td>Instrumentation and automation</td>
</tr>
</tbody>
</table>

Table 1-2 External documents

<table>
<thead>
<tr>
<th>Document code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MARPOL Annex VI</td>
<td>Bunker Delivery Note</td>
</tr>
<tr>
<td>ISO 8217</td>
<td>Petroleum products - Fuels (class F) - Specifications of Marine fuels</td>
</tr>
</tbody>
</table>

1.6 Definitions and abbreviations

1.6.1 Verbal forms

Table 1-3 Definition of verbal forms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>shall</td>
<td>verbal form used to indicate requirements strictly to be followed in order to conform to the document</td>
</tr>
<tr>
<td>should</td>
<td>verbal form used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required</td>
</tr>
<tr>
<td>may</td>
<td>verbal form used to indicate a course of action permissible within the limits of the document</td>
</tr>
</tbody>
</table>
### 1.6.2 Abbreviations

**Table 1-4 Abbreviations**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>BDN</td>
<td>bunker delivery note</td>
</tr>
<tr>
<td>DMA</td>
<td>marine distillate fuels in ISO category F</td>
</tr>
<tr>
<td>ECA</td>
<td>sulphur emission controlled area</td>
</tr>
<tr>
<td>FO</td>
<td>fuel oil</td>
</tr>
<tr>
<td>HFO</td>
<td>heavy fuel oil</td>
</tr>
<tr>
<td>LSF</td>
<td>low sulphur fuel</td>
</tr>
<tr>
<td>LSHFO</td>
<td>low sulphur heavy fuel oil</td>
</tr>
<tr>
<td>MDO</td>
<td>marine diesel oil</td>
</tr>
<tr>
<td>MGO</td>
<td>marine gas oil</td>
</tr>
<tr>
<td>OEM</td>
<td>original equipment manufacturer</td>
</tr>
<tr>
<td>RP</td>
<td>recommended practice</td>
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</tbody>
</table>
SECTION 2 STATEMENT SCHEME

2.1 Documents
Prior to the witnessing survey, it is important to hold all necessary documents on-board and to present to the DNV GL surveyor. These documents include LSF operation test procedure, ship specific fuel oil change over procedure and valid bunker delivery note.

1) LSF operation test procedure
   The test scope shall be agreed before surveyor's attendance. Local emission regulation will determine the possible scope of the witnessing survey.
   As soon as DNV GL receives the customer's application, DNV GL local station will contact the customer's representative. To obtain LSF statement from DNV GL, the scope of test shall, as a minimum, include the scheme of Sec.4. It shall be noted the scope of tests will be listed in annexes of the statement.

2) Ship specific fuel oil change-over procedure
   The document shall at least include the following information:
   — vessel identification and fuel oil (FO) system specifications
   — relevant FO system diagrams
   — detailed description of the fuel changeover procedure
   — calculation of total changeover time for complete switch-over to LSF (to avoid thermal shock, normally not more than 2 degrees per minute temperature variation along the FO system is recommended).

3) Bunker delivery note
   Bunker delivery note (BDN) shall contain information according to MARPOL Annex VI Appendix V, including the fuel viscosity.

2.2 Submission of application
To obtain the DNV GL statement, customer shall request a witnessing survey via my.dnvgl.com with specific item, in this case low sulphur fuel statement witness.
SECTION 3 WITNESSING OF FUEL CHANGEOVER

3.1 General
Fuel changeover is not a class requirement and hence verification of such a procedure will be done as a third party witness.

3.2 Changeover procedure
It is important to note that the high sulphur fuel (or mixed fuel) shall not contaminate the low sulphur fuel system/tanks (e.g. via fuel return pipes etc.)

The following items will be observed and adhered to during attendance in connection with fuel change over:

— Changeover shall be in accordance with an on board changeover procedure. The changeover procedure shall be available on-board and a copy of the procedure will be attached to the witness statement.
— Verification of the setting of the various valves to ensure that the fuel from the specified tanks is used.
— Verification of the fuel in each tank by taking a sample and visual checking of fuel clarity.
— At completion of the fuel changeover a sample shall be taken at the inlet or return of engines and boilers in operation during the changeover. No fuel oil analysis is required, but the clarity of the fuels has to be compared in order to see that the fuel changeover is complete.

Reference to the fuels shall be made through the bunker deliver note (BDN) which shall be attached to the statement.

Guidance note:
For MGO/MDO, the fuel sample shall be a clear fluid. If not clear the changeover is most likely not completed.

Depending on the size of the system and the consumption of the machinery, fuel changeovers may take considerable time, i.e. several hours.

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SECTION 4 WITNESSING OF OPERATION ON LOW SULPHUR FUEL

4.1 General
In connection with witnessing of operation on low sulphur fuel, the components in the statement scope shall have been in operation for at least 1 hour after calculated completion of the fuel changeover.

4.2 Test procedure
The vessel shall produce a test procedure which addresses the following issues:

1) Generator engines:
   — fuel to be used
   — verification of fuel quality at the engine inlet
   — operation of the engine on various representative load steps until stable conditions is reached
   — maximum load at which the engine will be tested
   — starting capability of the engine.

2) Boilers:
   — fuel to be used
   — injection medium (steam or air) where applicable
   — verification of fuel quality at boiler inlet
   — operation of boiler on various representative load steps until stable conditions are reached
   — start-up and shut-down capabilities
   — boiler control and safety system (esp. safety times).

3) Propulsion engines:
   — fuel to be used
   — verification of fuel quality at engine inlet
   — operation of engine on various representative load steps until stable conditions are reached
   — minimum stable engine speed in both directions of rotation, where applicable
   — maximum load at which the engine will be tested
   — starting capability of the engine in both directions of rotation where applicable.

4.3 Evaluation of test procedure
The test procedure will be evaluated against the below given recommended guidelines:

1) Generator engines:
   — Fuel quality at engine inlet shall be checked by taking sample and its visual clarity. The fuel sample shall be a clear fluid, if not clear the changeover is most likely not completed. Customer/DNV GL representative could request laboratory analysis if the on-board visual check is not found to be sufficient.
   — Fuel pressure at engine inlet shall be stable and in accordance with manufacturer’s recommendations.
   — In general 3 starts and stops are sufficient to demonstrate the starting capability.
   — Preferably 3 equally spaced load steps should be witnessed.
   — 10 minutes of operation should be sufficient to obtain stable running conditions.
   — Maximum test load should not be less than 65% of nominal rating. Special attention shall be paid to possible fuel oil leakages at couplings and flanges since these may easily occur due to the lower viscosity of most LSF.
   — Shielding, leakage collection and hot surface insulation are to be verified.
2) Boilers:
   — Fuel quality check as per item 1).
   — Fuel pressure at boiler inlet shall be stable and in accordance with manufacturer’s recommendations.
   — Testing of the control and safety system to the extent of a boiler survey is to be performed.
   — Safety times (see Table 4-1) shall be confirmed to be in compliance with class rules (DNVGL-RU-SHIP Pt.4 Ch.7 Sec.6 [7]). Remove flame detector once during start-up and once during operation to confirm compliance.
   — In general 3 satisfactory start and stop sequences should be sufficient.
   — Steady operation, i.e. flame is stable in colour and shape, on various loads is to be witnessed. Since lowest load is the most critical when operating on LSF it is recommend to witness operation for 20 minutes at the lowest load, 5 minutes on all other loads.

Table 4-1 Safety times

<table>
<thead>
<tr>
<th>Oil throughput [kg/h]</th>
<th>Safety times [s] (maximum) (^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>At start-up</td>
</tr>
<tr>
<td>up to 30</td>
<td>10</td>
</tr>
<tr>
<td>above 30</td>
<td>5</td>
</tr>
</tbody>
</table>

\(^1\) The safety time is the maximum permissible period of time during which the fuel oil may be delivered into the combustion space without a flame burning.

3) Propulsion engines:
   — Fuel quality check as per item 1).
   — For propulsion engines a manoeuvring trial should be conducted, including:
     — 2 starts and stops in each direction
     — stable dead-slow ahead and astern operation.
   — Preferably 3 equally spaced load steps should be witnessed.
   — Special attention shall be paid to possible fuel oil leakages at couplings and flanges since these may easily occur due to the lower viscosity of most LSF.
   — Shielding, leakage collection and hot surface insulation are to be verified.

Note:
Some vessels may experience an increase in ‘dead slow’ speed when operating on LSF, necessary to obtain stable operation.

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If the manoeuvring speeds differentiate significantly from those on regular fuel, relevant information on the bridge shall be updated.
SECTION 5 FUEL SYSTEM – GENERAL

5.1 Marine gas oil

According to ISO standard 8217 a marine gas oil (DMA) shall be bright and clear. Regarding changeover procedures, it is imperative to realise that most fuel supply systems will be closed loop systems where the fuel is kept in continuous circulation. When changing between HFO (heavy fuel oil) service tanks and LSF service tanks there will be, unless new separate piping has been installed, no direct change of supply to the consumers (engines, boilers), only a dilution of the fuel circulating in the supply system.

As there can be relatively large quantities of fuel circulating, the changeover time will be governed by the fuel oil consumption. With the main engine running, the blending in ratio may be in the region of 1% per 2 minutes. With only one auxiliary boiler or one auxiliary engine in operation the ration can be much lower.

To shut off tracing steam/steam to fuel heater too early may increase the viscosity of the fuel to the engines and/or the boilers to the extent that these will no longer function. As a result, damage to fuel injection equipment may occur.

If the fuel in the supply system is not kept in continuous circulation or the system emptied of HFO/flushed with distillate before heating is stopped, the HFO in the system will no longer be pumpable.

5.2 Low sulphur heavy fuel oil

The new type of heavy fuel oil (hereinafter LSHFO) is introduced in marine fuel market and growing number of vessels are using the fuel as an alternative to MGO. This tendency is due to its easier operation requirement and availability in the market while it fulfils the ECA low sulphur limits. However, this also requires great care in operation and may require modification of the fuel oil piping system.

The some of well-known LSHFO specifications and cautions are as below:

1) Heating in storage tank is normally necessary - in general, temperature of the fuel should not drop below its pour point plus an additional 10°C to avoid wax formation.

2) Dedicated piping is generally recommended to avoid compatibility issues with other grades of bunker fuel.

3) Before bunkering, the dedicated storage tank shall be thoroughly cleaned.

4) Cylinder lubrication should be monitored and a switch to lubricants with a lower base number should be considered.

It is recommended to consult with the engine manufacturer or original equipment manufacturer (OEM) whether the intended fuel type is compatible with the engines.

For more information regarding LSHFO operation, please contact DNV GL for further support.
CHANGES – HISTORIC

There are currently no historical changes for this document.
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