ABS Notes

Use of Low Sulphur Marine Fuel for Boilers

Note: The following suggestions are provided for information purposes only and are not intended to replace any applicable local, national or international safety, operational or material requirements.

Regulations:

(1) Article 4b of "EU COUNCIL DIRECTIVE 1999/32/EC of 26 April 1999 relating to a reduction in the sulphur content of certain liquid fuels and amending Directive 93/12/EEC", as amended, introduces 0.1% sulphur limit (m/m) for marine fuel.

a. **Effective Date:** January 1, 2010.
b. **Applies to:** All types of marine fuel used by ships at berth for more than two hours in EU ports unless an approved emission abatement technology is employed or shore power is available.

(2) California Air Resources Board (CARB)

a. **Effective Dates:**

Phase I (in force) since July 1, 2009 [MGO (ISO 8217, DMA Grade) at or below 1.5%S or MDO (ISO 8217, DMB Grade) at or below 0.5%S]

Phase II - January 1, 2012 [MGO (ISO 8217, DMA Grade) or MDO (ISO 8217, DMB Grade) at or below 0.1%S]

b. **Applies to:** All types of marine fuel used by ships within California Waters (within 24NM of the California baseline - see “Foot Note -1”)

[Note: MGO = Marine Gas Oil; MDO = Marine Diesel Oil]

Foot Note 1 - Definition of California baseline:
“Baseline” means the mean low water line along the California coast, as shown on the following National Oceanic and Atmospheric Administration (NOAA) Nautical Charts as authored by the NOAA office of Coast Survey, which are incorporated in CARB by reference:
(A) Chart 18600, Trinidad Head to Cape Blanco (January 2002);
(B) Chart 18620, Point Arena to Trinidad Head (June 2002);
(C) Chart 18640, San Francisco to Point Arena (August 2005);
(D) Chart 18680, Point Sur to San Francisco (June 2005);
(E) Chart 18700, Point Conception to Point Sur (July 2003);
(F) Chart 18720, Point Dume to Purisima Point (August 2008); and
(G) Chart 18740, San Diego to Santa Rosa Island (April 2005).

All engines (main and auxiliary engines) and boilers are affected by the above Regulations. (As for boilers, please note that the EU Directive applies to main and auxiliary boilers, while the CARB Regulations apply only to the auxiliary boilers, i.e., non-propulsion boilers). This document addresses those issues that are associated with boilers operating on low-sulphur marine fuel.

See also "ABS Notes - Use of Low- Sulphur Marine Fuel for Main and Auxiliary Diesel Engines"
Please note that currently the requirements in the ABS Rules that cover the general requirements for piping, automation and electrical apply to systems/equipment used for low-sulphur fuels, for example, MGO (0.1%S by m/m) as fuel for boilers. Attention is drawn to the above mentioned Regulations relating to a reduction in the sulphur content of certain liquid fuels and the USCG Marine Safety Alert 03-09, dated June 16 2009 regarding the switching of fuel oil from residual fuel to distillate fuels in order to reduce emissions. Vessel owners and operators are invited to use the following for guidance.

In modern boilers, typically the control is integrated with an outside sourced control system. As such, starting with the boiler and control manufacturer and involving a person or outside consultant to be responsible for the overall arrangement including any needed design adjustments may be a prudent course of action. It is to be noted that where boilers and equipment are not originally designed to burn lighter types of fuels such as MGO, existing installations of boilers, burners/equipment and fuel systems may need to be modified as a consequence of the mentioned legislation. For such modified systems, certain ABS class requirements would apply. These “ABS Requirements” are identified separately from the “ABS Suggestions” in this document to provide clarity.

A). ABS Suggestions:

1. Owners are urged to determine whether they intend to operate within the areas affected by the above regulations. If such operations are intended and the vessel does not currently operate on low sulphur fuels, some modifications to the vessels’ installed equipment and systems may need to be carried out. The owners/operators are required to evaluate the boiler and other associated machinery/equipment operation with low sulphur fuel by systematically assessing the related potential risks involved. We recommend that vessel owners and operators consult with the boiler manufacturers and associated systems providers or other competent designer recognized by the boiler manufacturer/designer to determine whether or not their existing fuel systems/arrangements require modifications or additional safeguards regarding the intended use of MGO fuels. This should also include obtaining the manufacturers' opinion regarding fuel switching guidance/procedures, if applicable, particularly where the plant was not originally designed for use of MGO.

    a) Where the owner is satisfied that modifications to the vessels’ installed equipment and systems are not required, it is recommended that the risk analysis be maintained on board. As this is a safety issue, the above analysis substantiating the safe operation with low-sulphur fuel is to be available only for consideration during ISM audits as evidence that safe operation has been considered.

2. ABS considers that LNG carriers and oil carriers, where boilers burning HFO/MDO are used to power steam-driven cargo pumps, will also be affected by the new EU Directive, and CARB requirements requiring the burning of low sulfur content fuel while in port.

3. Where a boiler has been originally designed to burn only HFO/MDO, the following points should be noted:

    a) Usually during initial flashing from cold when furnace temperatures are low (particularly after repair) the boilers can use small amounts of MGO but cannot sustain use of MGO during normal operation to meet the normal steam demand without modifications.

    b) Boiler explosion can take place due to incorrect operations. For example, if the boiler furnace is not properly purged before ignition (i.e., pre-ignition purge) when there is a high pressure of fuel gas built up in the burner due to flame failure and the control system is malfunctioning or disconnected.

c) Unburnt fuel may be admitted to a hot furnace, following flame failure. This could result in an explosion in the furnace, as a source of ignition within the furnace could exist.

d) Systems providing fuel atomization may have to be re-assessed because steam atomization may not be suitable owing to vaporization of MGO fuel before exiting the burner tip. This could lead to flame instability, improper combustion, and possibly flame extinguishment. Equipment manufacturers should be consulted to determine the necessary safeguards.

e) Use of MGO may cause coke deposits on rotary cup types of burners. Protective heat shields are necessary to prevent coke build up. The changeover process should consider solubility of asphaltenes (i.e., fuel compatibility).

f) Existing burners designed for HFO/MDO may have to be modified or new types of burner assemblies accommodating both HFO and MGO may be necessary.

g) The existing piping used to transport heated HFO from the pump to the boiler may not be suitable to transport MGO, since (1) MGO needs to be delivered at ambient temperature (storage tank temperature) and (2) there exists a concern that MGO flowing through hot piping may vaporize creating vapor locks and causing irregular fuel flow towards the burner resulting in flame extinction. Therefore, MGO is not to be delivered through heated pipes to the burner. Consideration should be given to dedicated MGO delivery piping and accessories. The burning of MGO may also necessitate speedy and effective flame failure detection. Boiler/equipment manufacturers should be consulted for specific recommendations in this regard.

h) To avoid vaporization by heating of MGO in the piping system, heat tracing of fuel pipes should be turned off or heaters by-passed/switched off.

i) Flame stability should be considered. Where a boiler is designed to burn HFO instead of MGO, a flame failure may occur when the fuel is changed over to MGO. Photo cells may not have the color spectrum necessary for MGOs. Equipment and/or machinery manufacturers should be consulted for specific recommendations based on applications. Also, safety features to promptly and effectively deal with flame failures, and all of the possible ramifications of a flame failure, need to be developed/considered. For example, flame supervision may have to be complemented with another flame scanner due to different properties of HFO and MGO flames such as flame length.

j) Existing HFO pumps may have difficulties with suction of the light oil (MGO) because of viscosity (HFO is more viscous than MGO). Also, HFO has better lubrication properties than MGO. Accordingly, due to lack of lubrication, this may eventually result in overheating of the existing HFO pumps (unless it was originally designed to handle MGO). It may be necessary to install completely different and new types of pumps and associated valves to handle MGO.

k) HFO has a higher density and a lower calorific value than MGO. Therefore, if the original burner setting for HFO is not changed before using MGO to control the amount of fuel injected into the burner, increased smoke emissions may result from boiler uptake. Further, fuel/air ratio, governed by fuel pressure only, will be too rich for safe combustion.

l) A detailed fuel change-over operation manual should be readily available for the operating crew onboard.

m) In addition to the above, it is suggested that vessel owners and operators consider the following:

    i. A fuel system inspection and maintenance schedule should be established.

    ii. System pressure and temperature alarms, flow indicators, filter differential pressure transmitters, etc., should all be operational.

iii. System seals, gaskets, flanges, fittings, brackets and supports need to be maintained.

iv. A detailed system diagram should be available.

v. Initial and periodic crew training should be conducted. Their training needs assessments should be kept up to date.

n) Where a low load firing operation without a pilot (i.e., burning only gas) is proposed, and if such operation has not been assumed in the original boiler system design, ABS would recommend that a safety assessment be made for each individual operational case in order to ascertain safe operations. This should include, amongst other considerations, the following:

- Boiler management system and combustion control that is suitable for intended low load firing operation.
- Flame scanner type and positioning that are suitable to detect failure at low load firing operations.

o) It should be noted that when boilers are used for propulsion, maneuvering conditions may demand large and rapid load changes. Therefore, if boiler operation without a pilot under maneuvering conditions is proposed and such operation has not been assumed in the original boiler system design, ABS recommends that safety assessments be made for each individual operational case in order to ascertain the feasibility of such an operation.

p) The fuel oil systems in LNG ships with steam turbine propulsion are designed for HFO in combination with the boil-off from the cargo. Therefore, fuel oil systems in these vessels will need to be modified to use MGO. The reasons MGO is not to be used in the fuel oil systems in these vessels without modifications include the following:

- It is important that the fuel supply remain uninterrupted for propulsion boilers.
- Risk of failures in fuel pumps and valves.
- Unintentional fuel oil evaporation risks.
- For burners having concentric type fuel injectors, steam atomizing can heat up MGO.
- For burners having parallel tubes for steam and fuel oil, due to the lower temperature of MGO, tubes conveying MGO can distort due to temperature gradients.
- The design of the burner management system (BMS) and flame supervision is based on HFO.

B). ABS Requirements to be satisfied:

For modified systems, ABS requires the following:

- For boilers which have not been originally designed to continuously burn MGO, it may be necessary to carry out modifications to the existing fuel oil piping arrangements including the burner management and associated control systems. The owners/operators (or separate entities if employed) are required to evaluate the boiler operation with low sulphur fuel by systematically assessing related systems taking into consideration (but not limited to) these potential risks identified in items A) 3 (a) through (p) above as applicable, and appropriate measures are to be taken for safe operation of the boilers. Where modifications are identified, details of all

modifications together with the aforementioned design evaluation are required to be submitted to ABS for approval.

- Design modifications, if any, are to be carried out by the original manufacturer or a competent entity that is considered responsible for the modified design.

- Any modification to existing boiler installations (including piping arrangements and control systems) will be subject to ABS review and approval for both design assessment and survey. Accordingly, the details of the modifications considering the above suggestions are required to be submitted to an ABS technical office for review of general piping (such as pipe materials suitability, pressure, and fittings), automation and controls systems and other safety requirements in accordance with the applicable Rules.

- All modifications are to be carried out in accordance with approved drawings/details to the satisfaction of the attending Surveyor.