U.S. COAST GUARD MARINE SAFETY CENTER PLAN REVIEW GUIDELINE

REVIEW OF BOILER CONTROL SYSTEM

Procedure Number: E2-22
Revision Date: December 13, 2021

S. M. Peterson CDR, Chief, Engineering Division

Purpose

This Plan Review Guideline (PRG) explains the requirements for plan submittal for a Boiler Control System in accordance with the references below.

Contact Information

If you have any questions or comments concerning this document, please contact the Marine Safety Center (MSC) by e-mail or phone. Please refer to Procedure Number E2-22.

E-mail: msc@uscg.mil
Phone: 202-795-6729
Website: www.dco.uscg.mil/msc

Table of Contents

1. Applicability

This Plan Review Guideline (PRG) is applicable to all automatic main and auxiliary boiler installations aboard self-propelled vessels 100 gross tons and over certificated under 46 CFR Subchapter H, and self-propelled vessels 500 gross tons and over that are certificated under 46 CFR Subchapters D, I, and U; as well as OSV's over 1600ITC/500GRT.

2. References

a. Title 46 CFR 62.35-20 (Subchapter F), Oil-Fired Main Boilers
b. Title 46 CFR 63 (Subchapter F), Automatic Auxiliary Boilers
c. Navigation and Inspection Circular (NVIC) 2-89, "Guide for Electrical Installations on Merchant Vessels and Mobile Offshore Drilling Units."
d. Navigation and Inspection Circular (NVIC) 8-84, "Recommendations for the Submittal of Merchant Marine Plans and Specifications."
e. American Bureau of Shipping (ABS), "Marine Vessel Rules (MVR)"
f. Safety Of Life at Sea (SOLAS), Consolidated Editions, 1997, Chapter II-1, Parts D and E

3. Plan Submittals Required

a. A Qualitative Failure Analysis (QFA) (may also be identified as a Failure Mode and Effects Analysis (FMEA)) must be submitted for boiler control systems.

b. A Design Verification Test Procedure (DVTP) that provides tests that prove the failure modes considered in the QFA.

c. A Periodic Safety Test Procedure (PSTP).

d. Schematic and/or logic diagrams that describe functional relationships, description of operation and sequence of events, per 46 CFR 62.20-1(a)(3).

e. Remote control or automatic control system console drawings including internal component layouts and schematic diagrams.

f. Manufacturer or designer self-certification that the boiler control system meets the environmental design standards of 46 CFR 62.25-30.

g. Plans showing primary and secondary power sources for the boiler control system.

h. Coal Fueled Boilers are subject to special consideration, per 46 CFR 62.35-40(b).

4. Requirements for Oil Fired Boiler Control Systems

a. Each burner must have at least one flame detector.

b. Each burner must have a valve that closes automatically in 4 seconds when:

(1) Loss of burner flame occurs.
(2) Burner is not properly seated or in place.
(3) Trial for ignition fails; trial for ignition must be as short as practical and shall not exceed 15 seconds.
(4) Boiler safety trip control system is activated.

c. Each boiler must be provided with a boiler safety trip control system that automatically closes the master and all burner oil valves within 4 seconds:

(1) Boiler low-low water level;
(2) Inadequate boiler air flow to support complete combustion;
(3) A loss of boiler control power;
(4) Manual safety trip operation occurs; or
(5) There is loss of flame at all burners.

d. Boiler manual alternate control must be located at the boiler front (46 CFR 62.35-20(a)(2)).

e. After system line-up and start-up of auxiliaries, a fully automatic main boiler control system must only require the operator to initiate the following sequences:

(1) Boiler pre-purge.
(2) Trial for ignition of burners subsequent to successful initial burner light-off.
(3) Normal shutdown.
(4) Manual safety trip control operation.
(5) Adjustment of primary control set points.

f. All programming control subsystems and safety control system requirements must be met when a boiler (46 CFR 62.35-20(a)(5)):

(1) Automatically sequences burners;
(2) Is operated from a location remote from boiler front; or
(3) Is fully automatic.

5. Boiler Control Loops

a. Feedwater Control: At a minimum, automatic feedwater control subsystems must sense boiler water level and steam flow (46 CFR 62.35-20(b)).

b. Combustion Control: Automatic combustion control subsystems must provide the following (46 CFR 62.35-20(c)):

(1) Air/fuel ratio that ensures complete combustion and stable flame under light off, steady state, and transient conditions.
(2) Stable boiler steam pressure and outlet temperatures under steady state and transient load conditions.
(3) During boiler warm up, a low fire interlock to prevent high firing rates that may damage the superheater.

c. Boiler Control System Programming: The boiler control system must be programmed and equipped with the necessary interlocks to ensure safe ignition and normal shutdown of the boiler burners. At a minimum, the programming and interlocks must include:

(1) Pre-purge:
(i) Boilers must undergo a continuous purge of the combustion chamber and convecting spaces for a minimum of 5 air changes.
(ii) The purge must not be less than 15 seconds in duration and must occur immediately prior to the trial for ignition of the initial burner of a boiler.
(iii) All registers and dampers must be open and an air flow of at least 25 percent of full load volumetric air flow must be proven before start of

the purge period. The pre-purge must be complete before trial for ignition of the initial burner.

(2) Trial for ignition and ignition:

(i) Only one burner per boiler can be in trial for ignition at any time.
(ii) Boiler air flow during light off must be sufficient to prevent explosive accumulations of fuel.
(iii) The burner igniter must be in position and proven energized before admission of fuel to the boiler.
(iv) The igniter should remain energized until the burner flame is established and stable, or until the trial for ignition period ends.
(v) The ignition trial must be as short as practical for the installation, but must not exceed 15 seconds.
(vi) Failure of the burner to ignite during the trial for ignition must automatically actuate the burner safety trip controls.

(3) Post-purge:

(i) Immediately following normal boiler shutdown, an automatic boiler purge equal to the volume and duration of the pre-purge must occur.
(ii) Following a boiler safety trip control operation, the air flow to the boiler must not automatically increase. A post purge, in this case, must be under manual control.

6. Boiler Control System Power Supply

a. Two independent power sources are required for the boiler control system. One power source must be supplied from the emergency power source.

b. Failure of the normal power source must actuate an alarm in the machinery spaces.

7. Machinery Stop Stations

a. Machinery stop stations are required for machinery driven forced-draft and induced-draft fans, fuel oil transfer pumps, fuel oil unit and service pumps associated with oil fired main boilers. They must be located at a readily accessible position outside the machinery space containing the pumps or fans. The controls must be suitably marked and provided with protection against accidental operation and/or tampering, see 46 CFR 111.103-7.

b. The controls must be arranged so that damage to a corresponding switch or cable will automatically stop the equipment controlled.

c. For periodically unattended machinery plant operation, these controls must be provided at the Fire Control Station (46 CFR 62.50-30(h)).

8. Minimally Attended Machinery Plant Operation

a. Engineering Control Center (ECC) must include controls to place the main boiler and other vital auxiliaries in operation (unless automatic transfer is provided), and to shut down such equipment when necessary.

9. Periodically Unattended Machinery Plant Operation

a. Redundant main boiler auxiliaries and power sources must automatically transfer to the backup units upon failure of the operating units.

10. Automatic Auxiliary Boilers

a. For automatic auxiliary boilers follow requirements as delineated in 46 CFR Part 63, as applicable.

11. Disclaimer

This guidance is not a substitute for applicable legal requirements, nor is it itself a rule. It is not intended to nor does it impose legally-binding requirements on any party. It represents the Coast Guard's current thinking on this topic and may assist industry, mariners, the general public, and the Coast Guard, as well as other federal and state regulators, in applying statutory and regulatory requirements. You can use an alternative approach for complying with these requirements if the approach satisfies the requirements of the applicable statutes and regulations. If you want to discuss an alternative, you may contact MSC, the unit responsible for implementing this guidance.