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MSC.1/Circ.1398
10 June 2011

UNIFIED INTERPRETATION OF SOLAS REGULATION II-1/29

1 The Maritime Safety Committee, at its eighty-ninth session (11 to 20 May), with a view to ensuring a uniform approach towards the application of the provisions of SOLAS regulation II-1/29, following a recommendation made by the Sub-Committee on Ship Design and Equipment at its fifty-fourth session, approved the annexed unified interpretation concerning mechanical, hydraulic and electrical independency and failure detection and response of steering control systems.

2 Member Governments are invited to use the annexed interpretation from 20 May 2011 when applying the relevant provisions of SOLAS regulation II-1/29 and to bring it to the attention of all parties concerned.

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ANNEX

MECHANICAL, HYDRAULIC AND ELECTRICAL INDEPENDENCY AND FAILURE DETECTION AND RESPONSE OF STEERING CONTROL SYSTEMS

1 Scope

The interpretation applies to steering gear control systems, as defined in SOLAS regulation II-1/3.1, for the main and auxiliary steering gear, operable from the navigation bridge, for which SOLAS stipulates two steering gear control systems independent of each other (SOLAS chapter II-1, regulations 29.6.1, 29.7.2, 29.7.3, 29.15 and 29.16).

SOLAS chapter II-1, regulation 29.6.1, reads:

> "*Where the main steering gear comprises two or more identical power units, an auxiliary steering gear need not be fitted, provided that:*
>
> *.1 in a passenger ship, the main steering gear is capable of operating the rudder as required by paragraph 3.2 while any one of the power units is out of operation;*
>
> *.2 in a cargo ship, the main steering gear is capable of operating the rudder as required by paragraph 3.2 while operating with all power units; and*
>
> *.3 the main steering gear is so arranged that after a single failure in its piping system or in one of the power units the defect can be isolated so that steering capability can be maintained or speedily regained.*"

SOLAS chapter II-1, regulations 29.7.2 and 7.3, read:

> "*7 Steering gear control shall be provided:*
>
> *.2 where the main steering gear is arranged in accordance with paragraph 6, by two independent control systems, both operable from the navigation bridge. This does not require duplication of the steering wheel or steering lever. Where the control system consists of a hydraulic telemotor, a second independent system need not be fitted, except in a tanker, chemical tanker or gas carrier of 10,000 gross tonnage and upwards; and*
>
> *.3 for the auxiliary steering gear, in the steering gear compartment and, if power-operated, it shall also be operable from the navigation bridge and shall be independent of the control system for the main steering gear.*"

SOLAS chapter II-1, regulations 29.15 and 16, read:

> "*15 In every tanker, chemical tanker or gas carrier of 10,000 gross tonnage and upwards and in every other ship of 70,000 gross tonnage and upwards, the main steering gear shall comprise two or more identical power units complying with the provisions of paragraph 6.*

16 Every tanker, chemical tanker or gas carrier of 10,000 gross tonnage and upwards shall, subject to paragraph 17, comply with the following:

.1 the main steering gear shall be so arranged that in the event of loss of steering capability due to a single failure in any part of one of the power actuating systems of the main steering gear, excluding the tiller, quadrant or components serving the same purpose, or seizure of the rudder actuators, steering capability shall be regained in not more than 45 s after the loss of one power actuating system;

.2 the main steering gear shall comprise either:

.2.1 two independent and separate power actuating systems, each capable of meeting the requirements of paragraph 3.2; or

.2.2 at least two identical power actuating systems which, acting simultaneously in normal operation, shall be capable of meeting the requirements of paragraph 3.2. Where necessary to comply with this requirement, interconnection of hydraulic power actuating systems shall be provided. Loss of hydraulic fluid from one system shall be capable of being detected and the defective system automatically isolated so that the other actuating system or systems shall remain fully operational;

.3 steering gears other than of the hydraulic type shall achieve equivalent standards."

The requirements of SOLAS chapter II-1, regulations 3.1, 3.3, 3.13 and 29; and IEC Publication 60092-204 – Electric and electro-hydraulic steering gear (1987) have been considered, as far as containing requirements for the independency of the control systems.

2 Basic requirements

2.1 Two independent steering gear control systems should be provided and should be so arranged that a mechanical or electrical failure in one of them will not render the other one inoperative.

2.2 The term "steering gear control system" as defined in SOLAS chapter II-1, part A, regulation 3.1, should be understood as "steering control system" covering "the equipment required to control the steering gear power actuating system".

3 Separation of control systems and components

3.1 General

Wires, terminals and the components for duplicated steering gear control systems installed in units, control boxes, switchboards or bridge consoles should be separated as far as practicable. Where physical separation is not practicable, separation may be achieved by means of a fire retardant plate.

3.2 Steering wheel or steering lever

All electric components of the steering gear control systems should be duplicated. This does not require duplication of the steering wheel or steering lever.

3.3 Steering mode selector switch

If a joint steering mode selector switch (uniaxial switch) is employed for both steering gear control systems, the connections for the circuits of the control systems should be divided accordingly and separated from each other by an isolating plate or by air gap.

3.4 Follow-up amplifier

In the case of double follow-up control (see appendix, example 2), the amplifiers should be designed and fed so as to be electrically and mechanically separated. In the case of non-follow-up control and follow-up control, it should be ensured that the follow-up amplifiers are protected selectively (see appendix, example 3).

3.5 Additional control systems

Control circuits for additional control systems, e.g., steering lever or autopilot should be designed for all-pole disconnection (see appendix, examples 1, 2 and 3).

3.6 Feed-back units and limit switches

The feed-back units and limit switches, if any, for the steering gear control systems should be separated electrically and mechanically connected to the rudder stock or actuator separately.

3.7 Hydraulic control components

3.7.1 Hydraulic system components in the power actuating or hydraulic servo systems controlling the power systems of the steering gear (e.g., solenoid valves, magnetic valves) should be considered as part of the steering gear control system and should be duplicated and separated.

3.7.2 Hydraulic system components in the steering gear control system that are part of a power unit may be regarded as being duplicated and separated when there are two or more separate power units provided and the piping to each power unit can be isolated.

4 Failure detection and response of control systems

4.1 Failure detection

4.1.1 The most probable failures that may cause reduced or erroneous system performance should be detected, and should consider at least the following:

.1 power supply failure;

.2 loop failures in closed loop systems, both command and feedback loops (normally short circuit, broken connections and earth faults);

.3 if programmable electronic systems are used:

.1 data communication errors; and

.2 computer hardware and software failures; and

.4 hydraulic locking considering order given by steering wheel or lever.

4.1.2 All failures detected should initiate an audible and visual alarm on the navigation bridge. Hydraulic locking should always be warned individually unless system design makes manual action unnecessary.

Note: "Hydraulic locking" includes all situations where two hydraulic systems (usually identical) oppose each other in such a way that it may lead to loss of steering. It can either be caused by pressure in the two hydraulic systems working against each other or by hydraulic "by-pass" meaning that the systems puncture each other and cause pressure drop on both sides or make it impossible to build up pressure.

4.1.3 Alternatively to 4.1.1.2 and 4.1.1.3, depending on the rudder characteristic, critical deviations between rudder order and response should be indicated visually and audibly as steering failure alarm on the navigating bridge.

4.1.4 The following parameters should be monitored:

.1 Direction: Actual rudder position follows the set value.

.2 Delay: Rudder's actual position reaches set position within acceptable time limits.

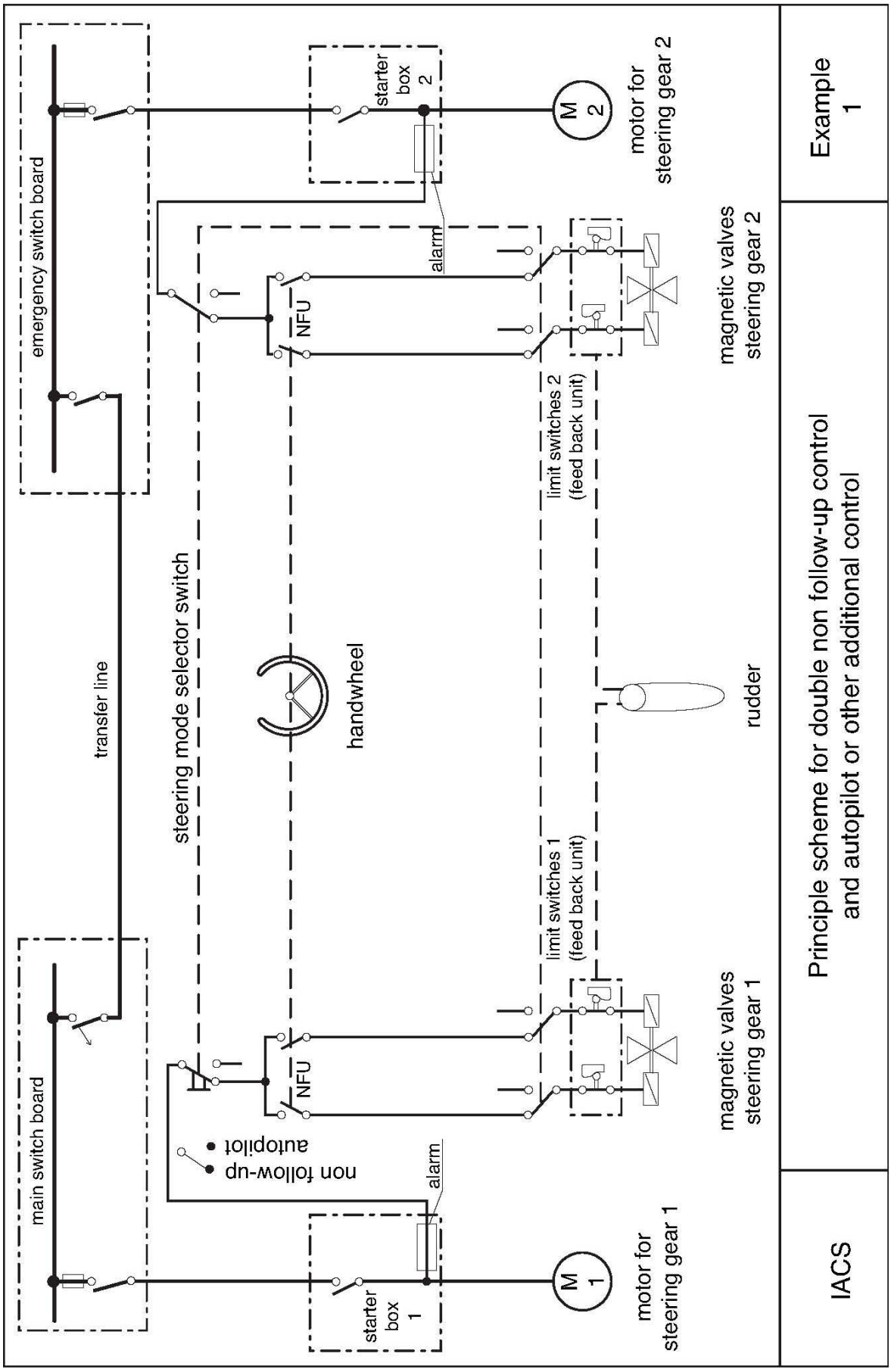
.3 Accuracy: The end actual position should correspond to the set value within the design offset tolerances.

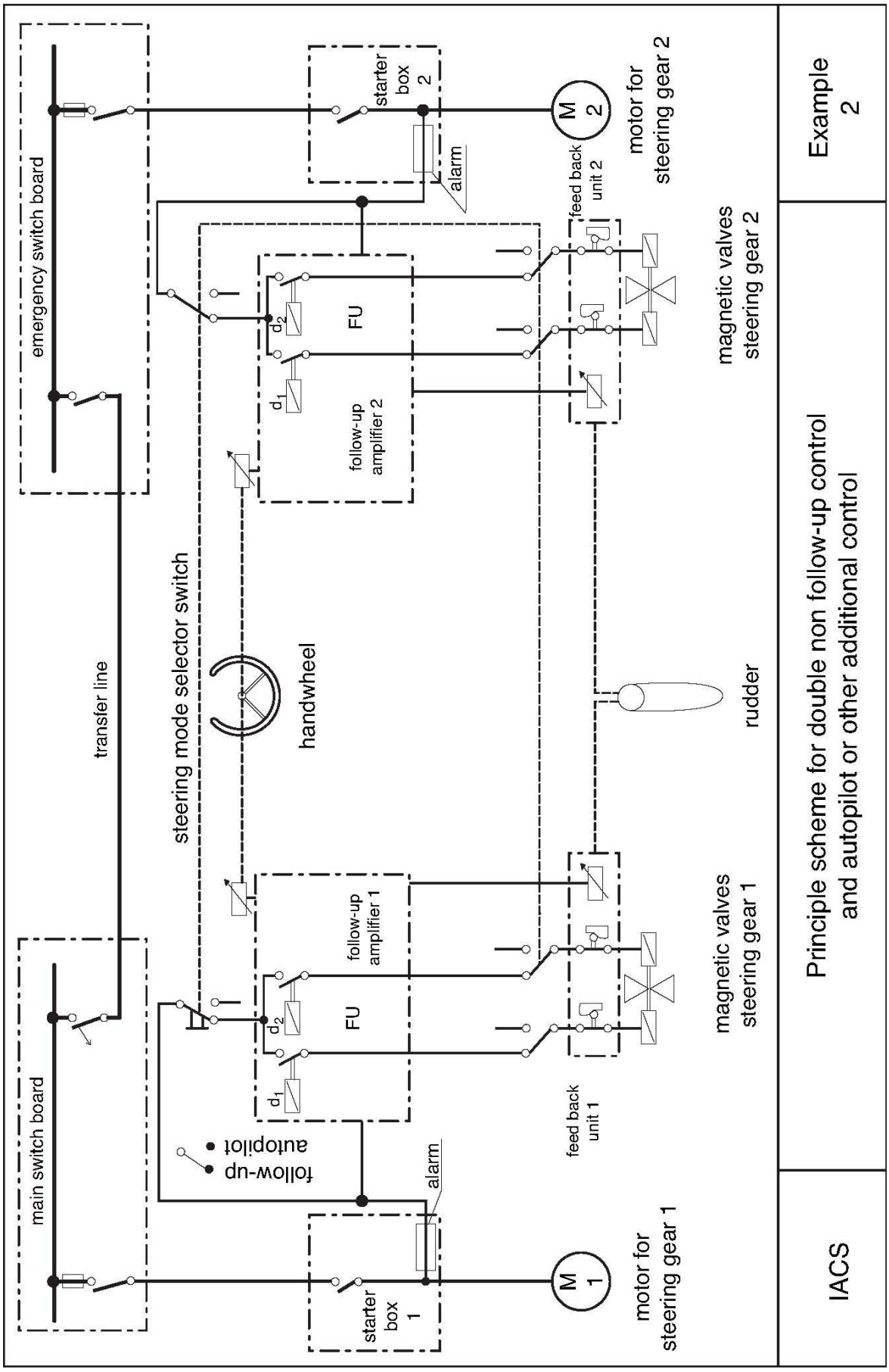
4.2 System response upon failure

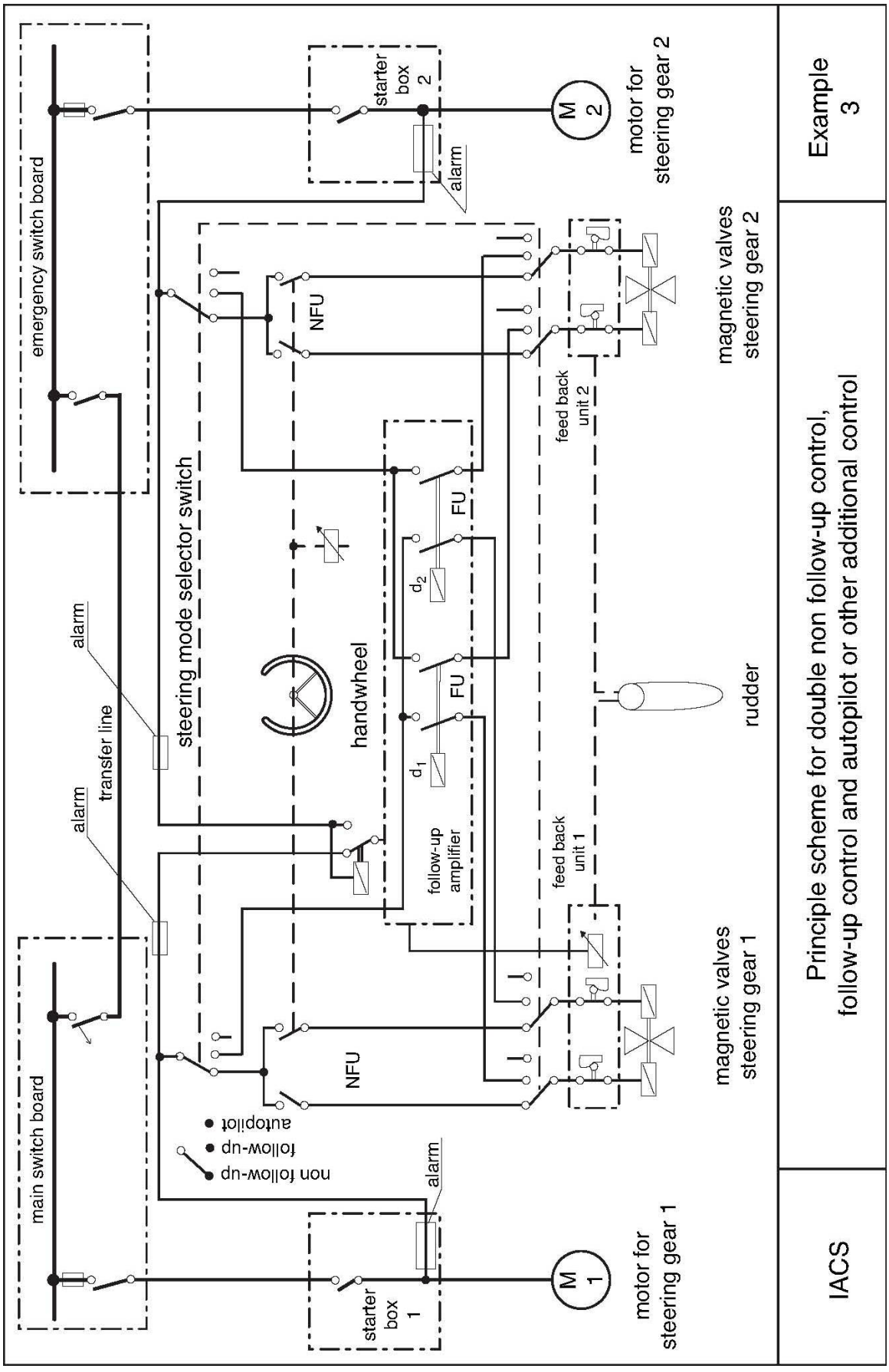
The most probable failures, e.g., loss of power or loop failure, should result in the least critical of any new possible conditions.

Appendix

Reference should be made to the following examples 1, 2 and 3, which can be regarded as basic design.


emergency switch board
transfer line
main switch board
steering mode selector switch
handwheel
rudder
non follow-up
autopilot
NFU
NFU
alarm
alarm
starter box 1
starter box 2
M 1
M 2
motor for steering gear 1
motor for steering gear 2
limit switches 1 (feed back unit)
limit switches 2 (feed back unit)
magnetic valves steering gear 1
magnetic valves steering gear 2
IACS
Principle scheme for double non follow-up control and autopilot or other additional control
Example 1


emergency switch board
transfer line
main switch board
steering mode selector switch
handwheel
follow-up
autopilot
alarm
starter box 1
starter box 2
M 1
M 2
motor for steering gear 1
motor for steering gear 2
FU
follow-up amplifier 1
follow-up amplifier 2
feed back unit 1
feed back unit 2
magnetic valves steering gear 1
magnetic valves steering gear 2
rudder
IACS
Principle scheme for double non follow-up control and autopilot or other additional control
Example 2


emergency switch board
starter box 2
alarm
M 2
motor for steering gear 2
magnetic valves steering gear 2
feed back unit 2
NFU
steering mode selector switch
FU
d_2
handwheel
d_1
follow-up amplifier
alarm
transfer line
alarm
feed back unit 1
rudder
main switch board
NFU
magnetic valves steering gear 1
autopilot
follow-up
non follow-up
alarm
starter box 1
M 1
motor for steering gear 1
IACS
Principle scheme for double non follow-up control, follow-up control and autopilot or other additional control
Example 3