CLASS GUIDELINE

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Guidance for safe return to port projects

DNV GL AS

FOREWORD

DNV GL class guidelines contain methods, technical requirements, principles and acceptance criteria related to classed objects as referred to from the rules.

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

CHANGES – CURRENT

This is a new document.

CONTENTS

SECTION 1 GENERAL

1 Introduction

The new Safe Return to Port (SRtP) regulations for passenger ships affect the arrangement of various ship systems and call for changes in the work process and the scope for all parties involved in a new-building project. The most important topics in this connection are related to the need for different early phase activities involving the owner and yard, and the need for a more multi-disciplinary / system based approach throughout the new-building project.

This document describes the intentions and gives guidance on the most important issues in order to promote a successful application of the SRtP regulations.

The document is kept on a high level, the main purpose is to increase the awareness and give guidance on the work process and key activities that is considered necessary to meet the intentions of the regulations.

For regulations, technical guidance and interpretations, refer to documents listed in [5].

2 Background

The SRtP regulations became mandatory in July 2010, and are applicable for ship types described in [3].

Different IMO circulars have been issued to clarify intentions and interpretations related to the SRtP regulations (refer to [5]); in particular MSC.1/Circ. 1369 describes the expected approach for complying with the SOLAS regulations for SRtP. Other approaches may be proposed and accepted if considered equivalent, but this is subject to evaluation and approval by the flag state.

However, the SRtP regulations demand a significant change in the work process related to new-building projects and the IMO circulars leave much room for interpretations.

The SRtP process may not be seen as an isolated task or just a set of additional documents that may be handled by a single party – neither by the designer nor the yard. The SRtP process affects all technical disciplines and requires that each system is designed and assessed as part of the overall intentions of SRtP.

Previous new-building projects with vessels assigned different notations for redundant machinery arrangement, e.g. RPS (redundant propulsion) and DYNPOS AUTRO (dynamic positioning class III), have to a great extent demanded a similar approach for the machinery systems as the SRtP projects. However, the SRtP regulations have a wider and different scope and also different acceptance criteria. Further, the SRtP regulations affect not only machinery related systems, but also various other systems with a general service across the vessel – i.a systems related to fire safety and watertight integrity.

For the ships that shall fulfil SRtP regulations *in addition to* one of the notations for redundant machinery (DYNPOS, RP(x,%), there is a certain overlap between the coverage of SRtP and the voluntary notation, but as the scope, coverage, failure modes and acceptance criteria differ significantly, it is important to ensure that both schemes are covered in the project.

3 Application

The SRtP regulations apply to passenger ships having a length of 120 m or more, or having three or more vertical fire zones.

The regulation also applies to special purpose ships (SPS certificate/notation according to 2008 SPS code) intended to carry more than 240 persons in total (e.g. an offshore construction vessel).

Further, naval vessels that shall be constructed in compliance with the Naval ship code ANEP 77 are required to fulfil a set of requirements (given in ANEP 77) that to a great extent are equivalent to the SOLAS regulations on SRtP.

4 Definitions and abbreviations

ANEP 77	- Naval ship code (NATO)
Casualty threshold	- The maximum extent of an incident of fire or flooding where the ship shall be able to return to port under its own power – as defined in SOLAS.
IACS	- International Association of Class Societies
MSC	- Maritime Safety Committee (IMO)
Multi-disciplinary approach	- To ensure that the system design and verification incorporate the concerns of all different technical disciplines involved. This may assume that individuals possess competence beyond own discipline ('system' competence) or that the work process includes common system reviews where the persons from relevant technical disciplines are represented.
Remain operational	- The SRtP regulations require certain systems to 'remain operational' after a casualty within the threshold. The meaning of the notion 'remain operational' is elaborated in the Statutory Interpretations, ref. [5]. Another notion frequently used for the same in SRtP context is 'maintain capabilities'
SPS	- Special Purpose Ship (voluntary notation and certificate if applicable)
SRtP	- Safe Return to Port in the context of SOLAS
UR	- Unified Requirements (IACS)

5 Regulations and reference documents

The basic SRtP regulations and interpretations are given in the following documents.

- SOLAS + amendments:
  - Stability:
    - Reg. II-1/8.1.2: *Availability of essential systems in case of flooding damage*
  - Fire:
    - Reg. II-2/21: *Casualty threshold, safe return to port and safe areas*
    - Reg. II-2/22: Design criteria for systems to remain operational after a fire casualty (this regulation is strictly not related to safe return to port, but cover the scenario where the extent of the casualty is beyond the threshold, and return to port is no longer possible)
- IMO Circulars (interpretations)
  - MSC.1/Circ. 1369: Interim explanatory notes for the assessment of passenger ship systems' capabilities after a fire or flooding casualty (+ 1369 amendment)
  - MSC.1/Circ. 1368: Interim clarifications of SOLAS chapter II-2 requirements regarding interrelation between the central control station, navigation bridge and safety centre
  - MSC.1/Circ. 1291: Guidelines for flooding detection systems on passenger ships
- IACS UR (Unified Requirements)
  - M69: Qualitative failure analysis for propulsion and steering on passenger ships
- DNV GL-SI-0364 Statutory interpretations.

SECTION 2 SAFE RETURN TO PORT – INTENTIONS

1 Intentions

The overall intentions with the SRtP regulations are to increase the vessels' robustness and ability to safely return to port unsupported after an incident of fire or flooding, and thus reduce the likelihood of evacuation. The regulations define a casualty threshold, and provided that the fire/flooding is limited within that threshold, the vessel shall be able to return to port by its own power, and also providing a safe area for all passengers with a certain level of habitability / comfort / catering. The SOLAS II-1/reg.21 specify 13 systems that shall remain operational in the event of any casualty within a defined threshold – to support the voyage back to a safe port. The regulations also give requirements for system capabilities in the event that the casualty extends beyond the threshold, and the vessel must be abandoned (reg.22). In this document, the implications of both reg.21 and reg.22 are described in the context of Safe Return to Port - even though Safe Return to Port in principle is limited to regulation 21.

The SRtP regulations may be seen to cover 'two failure' scenarios and hence the regulations go beyond traditional SOLAS in many ways. The vessel shall be able to withstand an incident of fire and flooding (within the threshold), and in that reduced state be capable of returning to port with necessary systems operational to be prepared for the next failure.

The regulations are made on a functional level, in particular that the different ship systems necessary to ensure this safe return to port capability shall *remain operational* after the casualty. The level of performance required for a system to *remain operational* is a key issue. SOLAS does not specify this level of performance, neither is it specified in the MSC.1/Circ. 1369. Therefore, for each of the 13 systems required to *remain operational* (SOLAS II-1/reg.21), the intended level of performance must be defined and specified in the project. (For a clearer interpretation of what the notion *remain operational* implies, refer to the DNV GL Statutory Interpretation, Sec.1 [5]).

The regulations are intended to provide a practical basis that not only ensures a ship design that supports the functional intentions but also that the basis for on-board documentation and operational manuals is prepared during the design phase. So even though the SOLAS regulations are largely design requirements, there are strong links to the operational aspects and the intention is to ensure that the restoration and maintenance of system capabilities for the return to port voyage after a casualty is simple and feasible for the crew in an emergency situation.

As the regulations relate to a situation of fire or flooding, it is likely that the actual use of the SRtP capabilities will never or very rarely be needed in practice. This implies that the crew will gain very limited practical training on whatever operational actions that is needed to restore capability after a casualty and ensure a safe voyage back to port, unless specific training is performed regularly. This situation emphasizes the need for making systems robust with limited need for manual intervention beyond what is realistically feasible in an emergency situation.

2 Functional requirements

The *overall* functional requirements are intended to provide the following capabilities after an incident of fire or flooding:

- Ensure propulsion, steering, manoeuvring and navigational capabilities
- Ensure necessary service of the safety systems (fire safety and watertight integrity) in the remaining part of the ship that is not directly affected by the casualty
- Support safe areas for passenger and crew

for the duration of the return to port voyage.

If the casualty extends beyond the defined threshold and the ship must be abandoned, the regulations (reg. 22) require a limited number of systems to be remain available for 3 hours to facilitate an orderly abandonment.

The regulations do not define the capacities or capabilities necessary to fulfil this intention, this must be defined based on the vessels field of operation, and the intended level of comfort/catering for the passengers. This applies to all systems that are required to remain operational after a casualty. This means that length and duration of the return to port voyage must be defined in relation to the planned operation of the vessel, and cover the worst case scenario with the longest distance to a safe port.

In order to achieve the above functionality after any possible incident of fire and flooding, all systems affected by the regulations must be designed in accordance with the overall intentions. Furthermore, the IMO MSC circular requires that each system is analysed and assessed with regards to the overall intention, and that conclusions of compliance are stated for each of the systems.

3 Restoration of capabilities after a casualty

The SRtP regulations aim at ensuring that the vessel is capable of returning to port after a casualty occurring at open sea. In this respect, the aim is not to provide increased availability for the vessel systems in a specific critical operation – e.g. during manoeuvring in narrow waters. The MSC.1/Circ.1369 circular specifies that the systems must be restored within 1 hour following the casualty, and that a limited set of *manual actions* may be allowed in order to restore system operation and remain operational for the return to port voyage. However, the extent of such *manual actions* shall be limited, and there are strict pre-conditions for accepting the extent of manual actions that may be needed to restore system capabilities after a casualty. Consequently, all the systems required to remain operational after a casualty should be designed in a way that eliminate or minimize the need for manual actions.

In this context, the notion *manual action* is assumed to be:

— manual action / intervention to restore system capabilities after a casualty. This includes manual operations beyond normal routines, primarily actions that have to be performed *locally* at or near the equipment.

— manual actions / intervention beyond normal routines / procedures to maintain the system capabilities for the duration of the return to port voyage

The restoration time of up to 1 hour refer primarily to the systems needed for propelling and manoeuvring the ship back to port. The restoration time for the systems supporting the safe areas are normally not so critical to have up and running within that time frame. However, the systems needed to fight and mitigate the casualty (fire or flooding) can not be unavailable for an hour - and shall be quickly restored after the occurrence of a casualty (in the range of minutes). If manual actions are needed to recover the system functionality of these systems (e.g. isolating the origin/location of the casualty or the relevant MVZ), the extent of these actions shall be very limited and part of necessary operational procedures.

SECTION 3 WORK PROCESS

1 General

The Safe Return to Port regulations give functional requirements to many different ship systems that are supposed to remain operational after a casualty. These systems may be split in four principally different categories:

1) Systems that shall provide propulsion, steering and navigation
2) Systems related to fire safety and watertight integrity that shall remain operational across the vessel (fire detection and -fighting, watertight door operation, flooding detection, bilge etc.)
3) Systems to support safe areas
4) Systems that shall remain in operation for a period of 3 hours when the ship is abandoned (Reg.22)

The reason for splitting the systems in these four categories is that the SOLAS requirement of *'remaining operational in the remaining part of the ship not affected by the fire'* has very different implications for the four categories.

Category 1:

The various systems *supporting* the first category, e.g. power generation, propulsion and steering with necessary auxiliaries must be arranged to ensure *simultaneous availability* after a casualty that may occur in any compartment. This means that not only the main mechanical components belonging to the various systems must be arranged and located in the correct areas, but also that all necessary power supplies must come from the correct distribution; the control system must be from the correct controller node; all cabling must be routed through correct areas; and the same principle applies to any other system that the overall function depend upon, e.g. ventilation, instrument air to valves, cooling and ventilation etc.

In order to achieve this, the different design departments for the various systems must work in accordance with the same redundancy intent, taking height for the same possible casualties and the intended capabilities after the casualty. This means that these design intentions must be clearly stated through system concepts in the very early phase of a project, and that the design intentions are to be acknowledged and understood by all disciplines involved with the design. This may also involve sub-suppliers.

Most modern passenger ships that shall comply with the SRtP regulations have quite complex and integrated machinery installations, where the various systems and component depend on the integrated control and safety systems. It may be very hard or even unrealistic to operate the engine room safely and provide necessary capabilities for the return to port voyage without the support of functional control and safety systems. Even though it may in theory be possible to base the return to port capabilities on manual, local operation without functional automation systems, it is not considered feasible and practicable. It is therefore considered necessary to arrange the control and monitoring systems with a redundancy that supports the general redundancy of the machinery installations.

The general arrangement of the ship with a clear definition of which zones and compartments that are dedicated for the redundant systems must be made at an early phase, and the design and arrangement of all relevant systems must be made in accordance with the zone definition. If such general arrangement drawings with clear identification of which compartments/sections/zones that are allocated to redundancy zone A or B respectively, these drawings may be used by all the various technical disciplines during the design phase, and thus reduce the likelihood of design clashes that otherwise may be revealed during later assessments and inspections.

Category 2:

When it comes to the systems in category 2, the challenge is different. The key requirement is that the system *shall remain operational in any other compartment than the one directly exposed to the casualty.* For a system that serves many spaces like e.g. fire detection or bilge system, this implies that the system must be designed so that any casualty in one space does not impair the continued service in any other space. This is a quite strict requirement – a fire in a compartment shall not affect the continued service of the systems of this category in any other compartment.

It is not acceptable that the function (e.g. bilge) is lost in the whole main vertical zone after a casualty within the SRtP threshold – the system may only be lost in the compartment directly exposed to the casualty. This basically implies that all the systems must be designed with redundancy and arranged with sufficient physical segregation and routing of necessary pipes, cables and components to ensure that the system capabilities are maintained as required.

Note that the SRtP regulations open up for a limited set of manual actions in order to restore or maintain the system capabilities after a casualty. This means that it *may be acceptable* that a casualty in one compartment affect the system functionality beyond the border of the compartment – provided that the set of manual actions needed to restore and maintain the function is limited, identified clearly and demonstrated through tests – as applicable. The eventual extent of manual actions needed to restore and remain in operation must be considered as part of the system assessment – in order to evaluate if the SRtP regulations are met.

Category 3:

The systems required to be available to support habitability for a safe area e.g. water, sanitation, food, ventilation and light must be arranged to be simultaneously available in the assigned safe areas - after a casualty in any other compartment. For any given incident of fire within the casualty threshold, a safe area shall be available in *other* main vertical zones than the one exposed to the casualty. As for category 1 systems, a common redundancy intent and a general arrangement drawing identifying which compartments that are dedicated for components, piping and cables for each safe area must be developed and made available for all technical disciplines involved with the design and arrangement of the systems required.

Category 4:

This category includes the systems listed in SOLAS II-1/reg.22, i.e. those that are required to remain operational in a period of 3 hours to support an orderly evacuation of the ship.

In this scenario, it is assumed that any full main vertical zone (MVZ) is lost, and the systems shall remain operational in all other main vertical zones. This means that each system must be designed such that any casualty in one main vertical zone does not impair the continued service for 3 hours in another main vertical zone. Eventual pipes and cables that are required to remain in service through the damaged MVZ must be adequately protected.

2 Early phase activities

The capability requirements for many of the systems affected by the SRtP regulations depend fully on the intended operational pattern of the vessel including e.g. the number of passengers and crew, the level of performance after a SRtP casualty, the catering level for safe areas etc. Most cruise liners built after 2010 have 1000 nm as the defined SRtP range, ensuring sufficient capacity to reach port from any position in the Atlantic Ocean after a casualty. Vessels that are intended to cross the Pacific Ocean have been designed with a SRtP range of approx. 1450 nm, which is claimed to be sufficient to reach a safe port from any position during a Pacific crossing. For a Passenger Vessel, this capability will be listed in the List of Operational Limitations required by SOLAS Reg.V/30.

The SRtP regulations actually demand redundancy for many vessel systems and in order for the ship to be SRtP compliant, the two redundant parts shall be individually capable of the serving an eventual return to port voyage after a casualty. This implies that if a key component in a redundant system is unavailable due to maintenance, the vessel may no longer be SRtP compliant – even if basic SOLAS and class requirements are still met. As an example, a diesel electrical propulsion arrangement is often configured with four diesel generators in two separate engine rooms. If one of these four generators is out for e.g. maintenance, the vessel *may* no longer be SRtP compliant. This depends on whether the remaining single engine is sufficient to provide necessary power in a return to port voyage – following a possible casualty in the *other* engine room. Unless this contingency is planned for in the very early design phase and that e.g. sufficient additional redundancy is built into the auxiliary systems for each engine room, routine maintenance may become an operational challenge and a potential issue towards the flag.

The MSC circular opens up for a limited set of manual actions performed by the crew in order to get the ship systems up and running again after a casualty – and also limited manual interventions to keep the systems running during the voyage back to port. However, the extent of such manual intervention shall be part of the acceptance criteria for the system design. This means that the general intentions for manual intervention must be defined as part of the system concepts, and be available for the various system designers.

The above items illustrate that the owner have to be heavily involved in the early project phases, and that certain operational intentions are pre-requisites for developing the SRtP system conceptual documents.

The early phase activities shall result in certain conceptual documents and arrangement drawings that are subject to approval. Both the detail design activities and the approval, test and verification must be made with basis in the intended capabilities as described in the conceptual documents.

It is considered essential that sufficient efforts are put into defining and describing the system concepts and in particular the design intention; that this is adequately described in the system concepts – and most importantly that these documents are known and available to any party involved with the design and test.

As the conceptual documents are considered essential for the detail design, the concepts must be available before approval of the detail design drawings can commence.

App.A gives an example of a overall structure of a overall 'Ship's Description' document, and App.B shows a proposed structure of a 'System design philosophy'.

3 Multi-disciplinary work process

The various technical disciplines and eventual suppliers involved in the design of the different systems required by SRtP must observe and apply the same principal design intent and operational philosophy.

This means e.g. that the arrangement of piping for a process system must correspond to the arrangement of power, control and any other supporting systems necessary to maintain the function – taking the same possible casualties into consideration. This applies in particular to the propulsion and steering function, as these functions depend on many other auxiliary and supporting systems. Even though each machinery room may be largely autonomous and self-contained, the propulsors are normally located in a different zone and also depending on different auxiliaries.

The potential casualty scenarios are decided by passive fire protection, the extent of fixed fire extinguishing system and watertight integrity. It is very hard to achieve necessary co-ordination through a fragmented design process performed in separate disciplines; a multi-disciplinary work process must be adopted (system engineering).

One of the main challenges in this connection is probably to ensure that all piping, power supplies and controls including necessary cabling is done correctly in accordance with the redundancy intent. All equipment and cables related to either of the redundant systems (e.g. system ‘A’) must be routed through compartments that after an eventual casualty does not affect the other redundant system (system ‘B’)– and this approach must be taken for any other system allocated to the same redundancy group.

The multi-disciplinary nature of the SRtP regulations and the various tasks that need to be co-ordinated suggest that dedicated personnel should be assigned to deal with SRtP from the very beginning of the conceptual phase of a new-building project.

It is highly recommended to arrange SRtP kick-off meetings and workshops in the early phase of each project where key personnel from both the yard, owner and class meet to align the approach for the SRtP processes and go through the documentation strategy and -sequence to the necessary detail.

4 SRtP test strategy

SRtP compliance shall be tested and documented, and an SRtP test strategy should be made early in the project to ensure that necessary tests are performed efficiently at the most appropriate stage in the process. In order to avoid extensive testing of SRtP compliance at the later stages, the tests should as far as possible be done in connection with normal system commissioning and tests. The test strategy should include a plan for when and how and to what extent it may be verified that the consequence of representative SRtP casualties (fire/flooding) does not render any of the required systems inoperable in other compartments.

If a good SRtP test strategy is made and this strategy is reflected through the various phases of mechanical completion and commissioning, this may limit the extent of SRtP related tests in the late phases including quay – and sea trials. The test strategy may be a part of the Ship Description document (ref. App.A), or made as a separate document. In either case, it shall be submitted to class for information.

However, certain tests are anyway deemed necessary during the sea trial to verify the vessel capabilities after the dimensioning failure scenarios. The test program for SRtP quay- and sea trials shall be submitted for approval. This includes testing of the worst-case damage scenarios, which is normally considered to be loss of each complete engine rooms, loss of control room, possibly loss of bridge or other critical compartment. The main purposes of running these tests at sea are to:

- demonstrate that the complex machinery arrangement is designed to support simultaneous availability of all auxiliaries and supporting systems to enable operation of the remaining propulsion line after a casualty
- demonstrate that the power needed to achieve the intended speed necessary to reach port may be generated without exceeding thermal stability in the operable engine room
- demonstrate that the operation is feasible – that necessary means of control and monitoring for all necessary systems are actually available, that eventual manual actions necessary to restore and remain in operation are identified, available and manageable

In addition to the above described tests that shall be performed at the sea trial, it is assumed that the assessment (see [5]) identify certain tests that may be needed to demonstrate conclusions or assumptions from the analysis.

Furthermore, it is considered necessary to run a specific test to demonstrate compliance with the abandon ship scenario (SOLAS II-1/reg.22); this includes simulating loss of a complete (the most critical) main vertical zone – and demonstrate that the required systems remain operational in the other MVZ’s. 'The most critical zone' in this respect is normally considered to be the MVZ where a loss would have the biggest impact for the power generation and distribution system - i.e. the MVZ containing the engine rooms and switchboard rooms.

This test is normally done alongside.

5 Assessments

IMO MSC.1/Circ.1369 requires that each of the listed system required for the safe return to port voyage is assessed for compliance with the regulations.

These assessments are considered crucial for analysing and verifying compliance with the SRtP regulations, and the work involved with these assessments may be quite significant. The assessments require a structured analysis quite similar to the FMEA approach (Failure Mode and Effect Analysis), and this activity should be planned for and incorporated in the project plans.

The system assessments shall include an analysis of how the *actual design* of all SRtP systems meet the intentions of SRtP regulations, in particular to verify that the *outcome* of the detail design process is in accordance with the approved concepts, and in compliance with the SRtP regulations. The assessment shall identify and analyse the systems response to applicable fire and flooding casualties and demonstrate that the systems are not degraded beyond acceptable capability. The assessment shall be *conclusive* for each system where it is confirmed that each system is designed and constructed in accordance with the SRtP requirements. Eventual assumptions or pre-conditions, findings or uncertainties may have to be verified through deeper scrutiny and relevant tests.

An example of the expected structure and content of a system assessment is given in App.C. The assessment shall be based on the detail drawings and documentation of the actual design, and it is necessary to identify clearly the input documentation, data-models etc in the assessment documents to clarify this basis. The SRtP regulations is very much concerned with physical arrangement of components, routing of pipes and cables and the assessment must be based on sufficiently detailed piping and cable routing information to conclude on compliance.

The level of detail in the assessment of a system depends on the arrangement and dependencies of other systems. If e.g. a system is clearly separated by design in different compartments belonging to different redundancy groups, and that no cross-connection or common system dependencies exist, the assessment can stop on a high level. However, most systems depend on e.g. power supplies, control systems and other supporting systems, and will therefore need a detailed analysis of component location and cable/pipe routing of all sub functions needed for the system to remain in operation.

An important part of performing the assessments is to identify relevant tests that may be required to verify assumptions and findings. If e.g. the loss of a central compartment may affect both redundant systems, and it is necessary to manually intervene to re-establish the function, this should to some extent be verified on board – either when the ship is alongside or in some cases at sea-trials. The extent of tests needed to verify compliance with the SRtP regulations should be determined as part of the system assessments, and planned for when the various test protocols for system testing as well as quay – and sea trials are developed.

Vessels that are specified with the additional notations for redundant dynamic positioning DYNPOS or redundant propulsion RP(x,%), require that the system and machinery arrangement is analysed in an failure mode and effect analysis (FMEA). Even though the intentions, requirements and acceptance criteria for these notations differ from those of SRtP, there is a big overlap and it is highly recommended to align and combine the FMEA exercise with the SRtP assessment. The necessary tests and trials at sea for the different schemes may also be largely combined and made more efficient if planned and performed simultaneously.

6 Documentation and approval

The documentation that is required specifically for SRtP compliance is listed in the DNV GL statutory interpretations, ref Sec.1 [5].

The required documentation may be split into the following categories:

- **Overall / general documentation:**
  - General arrangement drawings with specific information related to SRtP
  - Ship description / design philosophy
  - SRtP test strategy (may be part of the overall ship description/philosophy)
  - Systems assessments. All the systems affected by SRtP must be designed in accordance with the principles laid down in the overall documentation and assessed for compliance with SRtP regulations. (These may be developed and presented in a common document or in separate documents provided that necessary dependencies and interrelations are covered)
  - SRtP Tests and trials procedure
- **For each SRtP system listed in SOLAS Reg.II-2/21 and in addition the integrated control system as well as the power generation and distribution system:**
  - System design philosophy including redundancy intent
  - System arrangement plans including principal cable routing for each of the systems
- (Documents supporting operational procedures and on-board manuals, refer to [7]. These documents are not to be submitted for approval, but will be inspected on board)

The system design philosophy and redundancy intent are the crucial documents describing how the systems shall be arranged to fulfil the intentions of the SRtP regulations. Note that the primary purpose of these documents is to ensure that all parties from different technical disciplines involved in the design of different sub- and auxiliary systems are made aware of the design intentions. These documents are considered necessary to clearly communicate the design intention to all parties involved with the design to ensure that the various contributions are aligned. Class approve the documents to verify that the intentions are acceptable and adequately described.

The detail design of the individual systems affected by the SRtP regulations should *not* be done before the design philosophy and redundancy intent documents are made. When approving the detailed system documentation, e.g. P&ID’s for a given system, compliance with the intentions of the design philosophy is essential.

The general intention of the work process is illustrated in Figure 1:

Figure 1 General intention of the work process

The ship design philosophy, the system concepts and the general arrangement plans describe the intended way of designing and arranging the systems affected by the SRtP regulations. These documents are then used as part of the design basis for the various disciplines and units that design the different part of the overall systems.

When the detail design is proceeding, the actual design shall then be assessed for compliance with the SRtP regulations and the design intentions, resulting in a conclusive assessment report. The final verification of compliance is then done though tests and trials.

A principal sketch of the overall time-line the SRtP document production is shown in App.D. Note that most of the documents are developed in the early phase of the project. The detail design of the various systems will be based on the early phase conceptual documents. If the conceptual documents are structured and clear, and the general arrangement drawings support the system philosophies, this may greatly simplify the subsequent SRtP process.

7 On-board documentation

The main intention of the Safe Return to Port regulations is to ensure that all relevant systems are arranged in a way that make it possible and feasible for the crew to restore capabilities and remain operational after an incident of fire or flooding. In order to facilitate this, the MSC circular has quite extensive requirements for the set of on-board documentation that shall be developed as part of the delivery. This on-board documentation shall form the basis for operational procedures and provide support to the crew in the event of a casualty.

According to the MSC circular, the on-board documentation shall in practice cover the full SRtP documentation package and in addition operation manuals covering the SRtP casualty cases as well as test, inspection and maintenance plans. The operation manuals shall include details of manual actions that are necessary to restore capabilities of the various systems after fire or flooding casualties.

The SRtP regulations intend to ensure that all relevant systems are designed to minimize the need for manual actions following a casualty, but for certain systems the set of e.g. local isolation valves that must be operated in the various casualty scenarios may be quite extensive. A casualty in a given compartment may affect multiple systems and there are numerous compartments on board. This must be taken into consideration when developing the operational manuals.

In order to meet the intentions of the SRtP regulations and achieve the above, the owner and yard must clarify and agree on the content and form of the on-board documentation, in particular related to the identification and description of necessary manual actions.

The on-board documentation is also supposed to be a basis for future system modifications and upgrades, so that eventual changes to the system arrangement do not degrade the robustness and system capabilities of the systems required for safe return to port.

APPENDIX A EXPECTED CONTENTS OF A SHIP DESCRIPTION / DESIGN PHILOSOPHY

This document is supposed to be the overall SRtP document as required by MSC.1/Circ.1369; containing the basic information of the vessel and the SRtP approach taken by the project. This document, together with the general arrangement drawings, is the starting point for defining the basic ship design intent for compliance with the SRtP regulations. This includes vessel description, overall arrangement, description if the SRtP casualty scenarios, SRtP range etc. The document should also provide an overview of the various systems affected by the SRtP regulations, and thereby give an overview of the system concepts and assessments. It is recommended to keep the detailed system design philosophies in the individual system documentation and keep this overall ship description on a general level. A possible structure of this document is described below.

1 Ship's description

1) **Introduction**
2) **Reference documents**
3) **Ship's description**
   - basic layout of the vessel
   - overall machinery configuration
   - intended area of operation, SRtP operational speed and range (dimensioning distance to safe port)
   - criteria adopted for safe areas and intended locations
4) **SRtP system overview**
   - identification of all SRtP systems that affected by the SRtP regulations, and that will be covered in system concepts and assessments. Note that this normally includes both power generation/ distribution and integrated control and monitoring systems
5) **Casualty threshold**
   - Definition of casualty threshold wrt fire
   - Areas of negligible fire risk
   - Definition of casualty threshold wrt flooding
   - intended approach for system protection, e.g. use of fire resistant cabling, protection of pipes etc
6) **Load balance and capacity**
   - overall power balance for the SRtP scenario (on an overall level; detailed power balance covered in other main class documents)
   - fuel capacity calculation for SRtP voyage
7) **Safe Areas**
   - intended arrangement of safe areas
   - intended level of catering / service level for the systems supporting safe areas
8) **Specific interpretations**
   - definition of 'remain operational'
   - definition and intended level of manual actions to restore capabilities and remain operational
9) **Test and verification strategy**
   - intended approach for test and verification of SRtP compliance, i.a. what will be tested as part of system commissioning and mechanical completion, what will be tested alongside, what will be tested at sea trials, how will SRtP tests be documented and be traceable

APPENDIX B EXPECTED CONTENTS OF A SYSTEM DESIGN PHILOSOPHY / CONCEPT

This appendix shows the possible structure and expected contents of a system design philosophy / concept. Such a document must be developed for each of the systems listed in SOLAS II-1/Reg.21 and in addition, the power generation / distribution system and the integrated control and monitoring system. The extent of the philosophy document and the need for illustrations naturally vary for the different systems; for a system like e.g. the flooding detection system, the system arrangement may be quite simple and the dependencies of other systems are limited - whereas the propulsion system demands a more extensive description to cover necessary design intentions of both the system itself but also the various auxiliaries supporting the propulsion function.

1 SRTP system concept - xx

1) **Introduction**

- to describe the intended arrangement and redundancy of the system xx to ensure that the requirements of SRtP are met, both with regards to SOLAS II-1/reg.8.1 (flooding casualty), SOLAS II-2/Reg.21 (Safe Return to Port) and Reg.22 (abandon ship) - as applicable.
- to give the detail design teams sufficient information to ensure that all parties involved with the design of system xx are informed, understand and follow the system design intentions.

2) **Design Intention**

   1) General

- the overall system arrangement and design intention, in particular the principles of redundancy / separation / protection intent, physical arrangement, principle location of equipment
- the intended system capabilities after a casualty, i.e. what does 'remain operational' imply for this system - after a casualty of fire or flooding. This may e.g. be that the remaining system will continue at it's initial level of functionality, remote control and automation
- the approach for eventual manual actions / local interventions that may be needed to restore system capabilities in relevant locations
- the eventual use of protection of cables, pipes, equipment to achieve the robustness, e.g. planned use of fire resistant cabling where appropriate routing is impractical

3) **Sub - systems**

- identify and describe the design intention of eventual sub-system that are part of the main system (e.g. for the fuel oil system this may consist of storage system, transfer system, treatment system etc)

4) **Auxiliary systems**

- identify and describe all auxiliary / supporting systems that the main system depends upon, and how these are arranged to support the design intention and robustness of the main system (two examples: 1. for propulsion, this may be e.g. the fuel oil, lub oil, cooling, ventilation etc in addition to electrical power, control and monitoring, control air, ventilation etc. 2. For watertight doors, this may include e.g. the control system and electrical power)

Supporting principle illustrations / drawings should be given in the text or as attachments showing the main system arrangement, the intended location in compartments and MVZ's, principal cabling and routing, identification of relevant boundaries/bulkheads/MVZ's.

APPENDIX C EXPECTED CONTENTS OF A SYSTEM ASSESSMENT

This appendix shows the possible structure and expected contents of a system assessment. Each of the systems required to remain operational after a casualty shall be assessed. As the nature of the systems vary widely, the contents and extent of the assessment may vary accordingly, but the principle structure as indicated below may be used as a general basis for all the systems. The assessment report may be developed as one common report covering all systems, or in separate reports for each individual systems covered by the regulations. In any way, it is essential that all systems that are needed to support an overall function, e.g. propulsion, are assessed with regards to simultaneous availability of the overall function.

1 SRTP system assessment

a) *Introduction*

   i) Purpose
   ii) Reference documents – identify which documents, databases, models etc the assessment is based upon
   iii) Abbreviations and definitions (if necessary)

b) *SRtP requirements* (applicable for the system)

   i) Relevant rules and regulations
   ii) Additional requirements

c) *Design Intent / redundancy intent*

   i) What is the design intention, how is the redundancy arranged, what level of performance is intended to be available after a casualty, are there particular casualties that may render the system in a state that demands extensive manual intervention
   ii) What is the intended use and dependency of fire rated cables and pipes for the systems to remain operational
   iii) What is considered as 'remain operational' for the system and what is the intended level of performance / capabilities (i.e. will automatic functions and remote control be available or will any particular manual intervention be required to restore and maintain operation)

d) *System description*

   i) General system layout, drawings and sketches of the system arrangement
   ii) Detailed system layout – to the extent necessary to enable the assessment including cable runs and piping
   iii) Identification of all supporting /auxiliary systems needed for the system to remain operational (e.g. power, control, ventilation, instrument air etc.)
   iv) Identification of eventual x-connections between the redundant systems

e) *System assessment (covering both the Safe Return to Port scenarios (reg.21) and abandon ship scenarios (reg.22))*

   i) Casualty scenarios
   ii) Identification of the different categories of casualties that may affect the system, preferably containing graphical illustration of casualties in the different compartment containing system components (e.g. – if there is a fire in the emergency centre in a MVZ, the control unit for the watertight doors may be lost whereas a fire /flooding in another watertight compartment may only cause loss of a single WTD)
   iii) Assessment of the consequence of all relevant casualty scenarios and the system capabilities, including all the supporting/auxiliary systems identified above. The assessment must conclude on compliance with the SRtP regulations, and if there are conflicts, possible compensating or mitigating measures must be described. Particular focus on casualties that may affect the x-connections or other common mode failures. If there are numerous scenarios, the casualty scenarios may be grouped for the different categories of casualties.

iv) Identification of necessary *manual actions* if needed to restore and maintain system capabilities in accordance with the design / redundancy intent described above.

f) *Verification and test*

i) The assessment should identify relevant tests to substantiate the analysis and eventual assumptions. If manual actions are needed after a casualty for the system to 'remain operational' – relevant manual actions should be covered. The eventual tests identified in the assessment may be done in connection with system tests or included as part of the quay- and sea trial programme.

g) *Conclusions*

i) The assessment must conclude on compliance. If additional detailed assessment is required to reach a conclusion, or if additional documentation from e.g. sub-suppliers are needed; or if detailed assessment of cable are necessary to reach a conclusion, the assessment must be continued in a second revision when such information is available.

APPENDIX D DOCUMENTATION TIMELINE

An illustration of the expected timeline of the development of the SRtP related documentation relative to the new-building project schedule is shown in Figure 1.

1 SRtP documentation

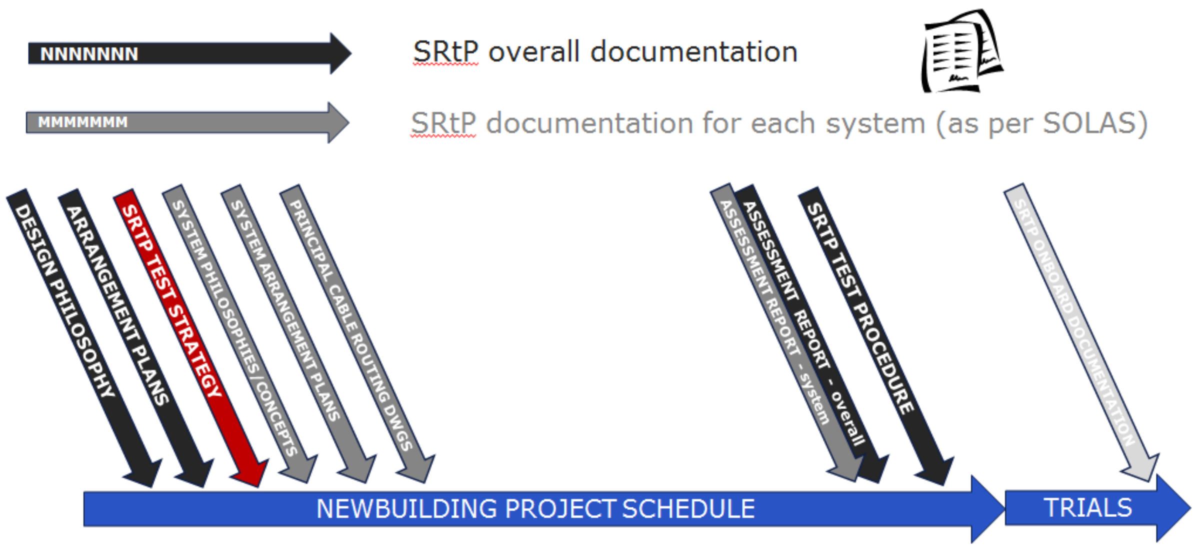

Figure 1 SRtP process and documentation

Note:

— The SRtP design philosophies and arrangement plans must be developed in the early phase of a project, and forms part of the specification for the detail design phase. This means that both the relevant sections at the yard as well as sub-suppliers must be aware of these documents when doing the detail design.

— The SRtP design philosophies and arrangement plans must be available for the approval engineer before any detail design drawings can be approved for the specific systems covered by the SRtP regulations (e.g. – the P&ID’s for the bilge system may not be approved before the bilge design philosophy document is available).

---e-n-d---o-f---n-o-t-e---

CHANGES – HISTORIC

There are currently no historical changes for this document.