Document Revisions

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Levels of Service

# Introduction

The SOLAS Convention[[1]](#footnote-1) Chapter V: Safety of navigation, Regulation 13 states the …..

Contracting Governments obligations regarding aids to navigation:

*Establishment and operation of aids to navigation*

1 Each Contracting Government undertakes to provide, as it deems practical and necessary, either individually or in co-operation with other Contracting Governments, such aids to navigation as the volume of traffic justifies and the degree of risk requires.

2 In order to obtain the greatest possible uniformity in aids to navigation, Contracting Governments undertake to take into account the international recommendations and guidelines[[2]](#footnote-2) when establishing such aids.

3 Contracting Governments undertake to arrange for information relating to aids to navigation to be made available to all concerned. Changes in the transmissions of position-fixing systems which could adversely affect the performance of receivers fitted in all ships shall be avoided as far as possible and only be effected after timely and adequate notice has been promulgated.

To meet these obligations the Contracting Governments must:

* provide aids to navigation at a service level as deemed necessary;
* in the provision of aids to navigation follow international recommendations and guidelines, e.g. IALA recommendations and guidelines; and
* provide information of aids to navigation, such as on the level of service and operational status.

The put full title of convention Chapter V Regulation 13 (Establishment and operation of Aids to Navigation) requires that contracting governments undertake to provide, as it deems practical and necessary either individually or in co-operation with other contracting governments, e of such Aids to Navigation (AtoN) as, in their opinion the volume of traffic justifies and the degree of risk requires, and to arrange for information in relation to these AtoN to be made available to all concerned.

In general, there are three components for aids to navigation services:

1. ‘extent’ which addresses whether a service will be provided by the contracting government or other agencies;
2. ‘the means’ by which to deliver the service (mix of aids to navigation required); and
3. ‘quality’ which addresses the performance of the service (the key component of performance is availability).

SOLAS Chapter V Regulation 13 establishes the general level of service statement in terms of the “extent”) of service. Each contracting government is expected to establish service level standards to determine where a service will be provided, based on a measure of benefits, costs and risks.

# National Obligations

* To fulfil the obligations established by the SOLAS Convention, it is recommended that National Authorities prepare a statement that identifies the level of service (LOS): Define the quantity and quality of the service for the areas under their jurisdiction and prepare the related Standards and Operational Performance Statements (OPS) for the LOS. A review must be carried out on a periodic basis so as to keep the document up-to-date to reflect changing patterns of use, growth of traffic, newly defined risk factors, changing technology and resource levels provided by contracting governments.
* Establish a formal mechanism for promulgating operational parameters and changes thereto that can be accessed by all potential users. This should include the means of immediate notification within practical limits when the failure of an AtoN is identified.
* Where responsibility for the provision of an AtoN service is delegated, for example to state, territory or local government organizations, or to port, harbour or waterway authorities, or local private groups, responsibility to ensure and/or enforce national obligations shall remain with the National Authority concerned. (Some Authorities may not have sufficient resources to approve and monitor all private and other authorities’ AtoN, but will enforce national standards if users report a problem).

## Level of Service Statement for Quantity

The Level of Service (LOS) standards and Operational Performance Statements (OPS) for quantity will vary both from country to country and for individual areas depending on usage patterns, degree of risk and the mix of aids to navigation provided. The LOS/OPS statements represent a commitment from the National Authority to mariners in general who are navigating or operating in the area, and to the government and/or other client groups responsible for funding the provision of the AtoN service. It is important that the LOS/OPS statements be clearly understood (easily understandable) and available to all concerned.

## Level of Service/Operational Performance Statements

It is recommended that LOS/OPS statements be prepared in three stages as follows:

### Step 1

Determine the maritime usage patterns for the area concerned and identify risk factors for both vessels and the environment in general, taking into account at least the following:

Nature and character of the area:

* depth;
* siltation;
* hazards;
* tides and currents;
* visibility, weather patterns and sea-ice conditions;
* distinctive shoreline features for both visual and radar navigation;
* background lighting/background environment and relative position of sun to traffic routes.

Traffic analysis including:

* type of traffic and vessel characteristics by user group;
* routes and speed including route marking requirements;
* volume of traffic by user group;
* type of cargo, particularly where hazardous.

Risk assessment including:

* basic navigational risks particularly in high traffic situations;
* risk to vessels caused by conflict between user groups;
* risk to the environment resulting from a maritime incident.

### Step 2

Develop an overall Navigation Plan for the area concerned indicating the mix of AtoN considered necessary to provide the required level of service in the most cost effective manner. This plan may also include appropriate vessel reporting, VTS, ship routeing measures to further reduce the risk of an incident. As far as possible, the NAVPLAN should ensure that failure of a single AtoN does not result in a major degradation of the overall AtoN service, or a substantial increase in risk.

* The NAVPLAN should also take into account the likely navigational aids carried by user vessels, including the probability that elements of these onboard navigational aids may themselves suffer failure. For this reason the number, type and mix of AtoN types provided must be considered in terms of short-term navigational aid failure during a critical manoeuvre, or extended period failure.

### Step 3

For each proposed AtoN, or system of AtoN, prepare an Operational Performance Statement (OPS). The format for the OPS will vary depending on the type of AtoN and mix of user groups.

For a light signal, the OPS should typically comprise a statement of the probability that the light can be seen at the required range when approached by a vessel at any random time whilst the AtoN is required for service. Inputs to this type of statement include the visibility in the area expressed as a cumulative probability by number of days and the AtoN equipment availability based on meantime between failures and meantime to repair: or alternately:

The statement may also be expressed in terms of the maximum operational capability of the light, or totality of lights in an area. Such an OPS would identify the minimum visibility level at which the light(s) can be seen at the required range when approached by a vessel at night. (Similarly for any visual system of aids including unlighted – e.g. AtoN system supports visual navigation until visibility is reduced below 1 nautical mile.)

The type of OPS will depend on the method established to measure or establish the LOS standards for the quantity of service.

There are a number of analytical methods available for the establishment of LOS standards and OPS, including:

#### Relative Risk

The level of service standard is based on a relative risk scale using quantified threats or risk factors to determine acceptable risk levels. Statistical probability ratios or percentages may be the basis for both the LOS and OPS.

#### Visual Design

The level of service standard is based on a standard percentage of time that operational aids will be seen, using predetermined acceptable risk levels based on professional judgement for each individual quantified threat or risk factor for each type and size of vessel. The OPS may be expressed in terms of percentage of time that the aids will be visible, due to known local atmospheric conditions, or as the minimum visibility level at which the AtoN system will support visual navigation; and below which radar or other electronic systems will be required.

For a radio AtoN such as a broadcast station providing differential GPS corrections, the LOS should take into account both the expected propagation conditions between the transmitting site and the user and the equipment availability of the AtoN itself.

## Level of Service statements for quality

### Equipment availability

The equipment availability of an AtoN is governed by the equipment operational reliability measured in terms of meantime between failure (MTBF) and the time to complete repairs in the event of a failure, measured in downtime or meantime to repair (MTTR). Where routine maintenance cannot be carried out during non-operational periods, an additional factor for planned downtime must be included.

Equipment with very high reliability may achieve the required availability, even with a large MTTR. National authorities should therefore consider including a maximum targeted downtime specified in the OPS, where usage and risk factors (importance of the aid) so dictate. MTTR depends not only on the ease with which a fault may be diagnosed and repaired on site, but also on access limitations (including weather and sea state conditions), availability of trained staff and spares holdings, etc.

The key elements in achieving high equipment availability are:

1. The choice of equipment that is inherently reliable.
2. The inclusion of active or passive redundancy features wherever availability targets or maximum downtime targets are not achievable due to remoteness of the site or limited access due to weather or sea state conditions.
3. The provision of performance measuring facilities whenever availability or downtime targets are not achievable, will allow potential failures to be identified and corrected before actual failure occurs. For an unwatched automatic AtoN, this will normally require provision of a remote monitoring system.
4. The availability of adequate trained staff and provision of suitable spares. In this context, national authorities should address the option of contracting out maintenance and repair tasks with care. In particular:
   1. Responsibility for meeting SOLAS Convention requirements cannot be delegated to the contracting organization.
   2. When contracting out is contemplated, the national authority concerned should retain sufficient design and performance assessment expertise to be able to audit the performance of the contracting organization in an efficient and effective manner.
   3. The contracting organization should meet appropriate Quality Management criteria including staff training requirements.

Levels of service statements for quality of service should be expressed as one, or a combination of the following:

* an overall percentage availability statement reflecting the percentage of time that any AtoN can be expected to be operational;
* percentage availability targets based on importance or type of AtoN;
* maximum downtime targets for AtoN overall, or within a specific area.

## Consultation and review of LOS

Development of the LOS targets, the NAVPLAN and the OPS for each AtoN or AtoN area, should be an iterative process in consultation with all user groups and funding organizations. It is recommended that the consultation process includes:

* regular meetings during the development of the LOS standards, OPS and NAVPLAN to review proposals and arrive at an equitable balance between service, risk and cost;
* review meetings facilitated by the creation of an Advisory Board, where appropriate, and by feedback from users.

It is recommended that national authorities put in place procedures to monitor the performance of individual AtoN and that regular reports of achieved equipment availability based on MTBF and MTTR are provided. As far as is practical, equipment performance monitoring with such reporting is required in addition to reports or equipment failure received from mariners.

## Risk Management

Risk is defined as the probability of suffering harm and injuries to persons, material or the environment.

Risk management is the term applied to a logical and systematic method of identifying, analysing, assessing, treating, monitoring and communicating risks associated with any activity and achieving the correct balance between the cost of an incident in human, material or environmental terms, and the costs of implementing measures to reduce the risk of such incidents happening.

The types of risk to be considered in analysing the need for an aid to navigation system are risk to:

* personnel at sea and shore inhabitants;
* property (ship, cargo);
* the environment from the effects of marine accidents.

The main elements of the risk management process are as follows:

1. Establish the content – this step establishes the boundaries and parameters of the risk analysis, particularly the:
   1. extent of the area under consideration;
   2. characteristics and nature of the traffic routes and marine traffic in the area;
   3. nature of the environmental factors applicable.
2. Identifying the risk – Identifying what, why and how things can arise as the basis for further analysis.
3. Analyse risk – determine any existing controls (aids to navigation) and analyse risks in terms of likelihood and consequence in the context of those controls. The analysis should consider:
   1. how likely is an event to happen, and
   2. what are the potential consequences and their magnitude.

Combine these elements to produce an estimated level of risk.

1. Assess and prioritize risks – compare estimated levels of risk against the pre-established criteria. Risks are then ranked to identify management priorities. If the levels of risk established are low then risks may fall into an acceptable category and treatment may not be required.
2. Treat risks – accept and monitor low-priority risks. For other risks develop and implement a specific management plan that may include implementation of aids to navigation, VTS, traffic separation, regulations or other measures relevant and which include consideration of funding.
3. Monitor and review – monitor and review the performance of the risk management system and changes to the original risk analysis parameters that may affect it.

The entire process is iterative and must be balanced. It must always be borne in mind that experienced professional judgement should be included in the final assessment process.

## Conclusion

Risk management is a process that can assist organizations in controlling risk and selecting the most appropriate course of action. While the risk assessment area cannot be devoid of value judgements it should be an objective engineering/scientific exercise aimed at approximating the truth about a possible threat to humans or the environment. The use of risk-based analysis can be seen as one of the tools for assisting decision making and identifying priorities and providing objective information during the consultative process.

Note : An example of a Level of Service (LOS) is provided at Annex A.

1. EXAMPLE AIDS TO NAVIGATION LEVEL OF SERVICE STATEMENT

**AIDS TO NAVIGATION**

1. Description

* The Aids to Navigation program involves the provision of short-range marine aids numbering over 17,000, including visual aids (fixed aids, lighthouses and buoys), aural aids (fog horns), radar aids (reflectors and beacons) and long-range marine aids, including electronic aids, such as the Differential Global Positioning System (DGPS).
* The benefit to mariners is safe, accessible and effective vessel transit in Canadian waters.
  1. Objective
* To facilitate safe and expeditious movement of maritime traffic.
  1. Services
* Provision of visual and aural aids to navigation such as fixed aids, lighthouses, buoys and fog horns.
* Provision of electronic positioning systems such as the Differential Global Positioning System.
* Provision of navigation safety information.

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| --- | --- |
| **Program: Aids to navigation** | |
| **Service: Provision of visual and aural aids to navigation such as fixed aids, lighthouses, buoys and fog horns** | |
| **Service** | **Service Standard** |
| An aids to navigation system is provided where the volume of traffic justifies and the degree of risk requires aids (as per program directives and procedures manual) under the following conditions:   * To guide mariners to and from harbours operated under Port Authorities or the CCG * To facilities supported by federal funds * In areas of adequate charts (CHS Charts) in conjunction with other marine services as part of an agreement made by the CCG * To allow re-supply of isolated communities that are dependent upon marine transportation, even where there is a lack of adequate charting * In harbours that predominantly serve commercial fishers   Short-Range Marine Aids ***may*** be established to:   * assist landfall, mark approaches to harbours, ports and waterways * mark channels or tracks * mark hazards * identify positions or courses * indicate preferred routes * separate traffic (e.g. to mark traffic separation schemes noted by specialized symbols on Canadian Hydrographic charts) * indicate special areas such as anchorage   Short-Range Marine Aids will **not** be provided:   * In waters for which this responsibility has been delegated to other authorities through legislation or signed agreements * In waters where there is a lack of adequate charting that restricts the safe use to those with local knowledge * In waters where adequate depth of water is not available for common use * In waters where the aid(s) cannot be maintained to targeted reliability levels * Exclusively for purposes other than navigation * To mark obstructions outside marked channels and away from charted routes and tracks. However, isolated dangers in waters which are known by adequate charting to be otherwise safe, and which are regularly frequented by an appreciable number of users, may be marked. * For other than public use and, thus, exclusively for the benefit of single or a small number of users, or to mark access to private or municipal facilities. | * Visual aids are designed, where feasible, to be visible at least 75% of the time during the worst month of the navigation season. This is calculated based on long-term weather observations from the Meteorological Service of Canada – Environment Canada. * Aural aids may be provided when the design availability target of 75% cannot be achieved by visual means alone, for uncertified commercial vessels only. * Radar aids may be provided when the design availability target of 75% cannot be achieved by visual means alone, for certified commercial vessels only. * The overall target level for operational reliability for the short-range aids to navigation system is 99%, calculated over a three-year period. |



1. International Convention for the Safety of Life at Sea, 1974. [↑](#footnote-ref-1)
2. Refer to the appropriate Recommendations and guidelines of IALA and to SN/Circ.107, Maritime buoyage system (now SN.1/Circ.297). [↑](#footnote-ref-2)