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# GUIDELINE

# G1138

# THE USE OF THE SIMPLIFIED IALA RISK ASSESSMENT METHOD (SIRA)



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# 1. INTRODUCTION

Regulation 13 of Chapter V of the 1974 SOLAS Convention (as amended) states that "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".

The assessment and management of risk is therefore fundamental to the provision of effective marine aids to navigation (AtoN)[1] services. To address this, IALA published a recommendation on IALA Risk Management Tool for Ports and Restricted Waterways for use by National Members. This Recommendation has two primary components. These are the *quantitative* IALA Waterway Risk Assessment Program (IWRAP) Mk II tool[2], which requires a comprehensive dataset of AIS information, and the *qualitative* Ports and Waterways Safety Assessment (PAWSA Mk II) tool[3], which requires participation by up to 30 competent individuals comprising waterway users, stakeholders and agencies responsible for implementing risk mitigation measures. The International Maritime Organization (IMO) endorsed both these tools in 2010, which underscored the importance of formal risk management[4].

However, in many developing countries, good quality AIS data on which IWRAP depends is not available nor are there usually sufficient numbers of individuals with the necessary level of experience in the risk categories used by PAWSA. There is therefore a need for a simpler risk management tool for use by national Competent Authorities who cannot practically use IWRAP or PAWSA. The Simplified IALA Risk Assessment method (SIRA) was developed to enable Competent Authorities to assess the volume of traffic and degree of risk in their waters so that they can meet their obligations under SOLAS.

SIRA is intended as a basic tool to consider risk control options covering the potential undesirable incidents that a Competent Authority should address as part of its obligations under SOLAS Chapter V Regulations 12 and 13. It is intended to be used as part of objective stakeholder consultancy. As that Competent Authority builds its capacity, it is encouraged to use the more advanced risk management tools such as PAWSA and IWRAP. However, a satisfactory understanding of the maritime environment and maritime traffic patterns is an essential first step to understand the risk level within a waterway. SIRA is designed to assist that process.

# 2. BACKGROUND

The idea of developing a simplified risk management tool was first raised by the IALA Risk Management Steering Group (IRMSG) in late 2012. The IALA World-Wide Academy produced an initial version of the simplified tool in 2013, which was based on the risk management system endorsed by the AtoN Competent Authority of the Sultanate of Oman in 2006 and adopted by the AtoN service provider in Bahrain in 2010.

# 3. PURPOSE

The purpose of this document is to provide guidance on *SIRA*'s structured process which identifies hazards, and undesired incidents or scenarios in a given region. This leads to a *qualitative* estimate of the level of risk and the production of potential risk control options to reduce such risk to acceptable levels.

1 The overarching guidance on risk management is contained in IALA Guideline 1018

2 Guideline 1123 gives specific guidance on the use of IWRAP.

3 Guideline 1124 gives specific guidance on the use of PAWSA.

4 IMO SN.1/Circ.296 dated 7 December 2010.

# 4. THE SIRA PROCESS

## 4.1. OVERVIEW

The *SIRA* process is based on the principles set out in IALA Guideline 1018 on risk management. Risk is defined as the product of two factors – the *probability* (or likelihood) of an undesirable incident occurring and if it does occur, the severity of its potential long and short-term *impact* (or consequence).

The management of risk involves a structured process that identifies hazards and scenarios with associated risk before taking action to reduce the risk to "As Low As Reasonably Practicable (ALARP)" which is acceptable to stakeholders[5].

If the waterway being analysed is extended or complex, it may be divided into one or more zones for individual analysis. In this case, interaction between zones may be worth consideration.

A "hazard" is something that may *cause* an undesirable incident. The basic thinking behind the SIRA method rests on the fundamental causal relationship between hazards and the consequences of undesirable incidents, which the hazards may cause.

This causal relationship is illustrated in the figure below:


***Figure 1 Causal relationship between hazards and consequences***

The identification of hazards should be based on available information such as environmental data, adequacy of nautical charts, sea state and wind force, tidal flow, restricted visibility, ice, background lighting, natural hazards and dangers, nature of the seabed, changing bathymetry, volume of traffic, mix of traffic and other factors.

Based on the identified hazards, a number of possible incidents or scenarios is identified by a group of stakeholders. SIRA addresses each undesired incident or scenario, such as the grounding of a vessel on a reef or the collision between two vessels.

The probability or likelihood of the occurrence of each undesired scenario is estimated, as well as its impact (or consequences), considering both short- and long-term consequences.

The SIRA risk assessment process is based on IALA Guideline 1018, and includes the following steps:



5 Stakeholders are individuals, groups or organisations able to affect or be affected by a decision or activity related to AtoN service provision. Refer to IALA Guideline 1079 on establishing and conducting user consultancy for more information

6 "Allison" is defined as a vessel striking a fixed man-made object such as a pier or berthing dolphin

7 "Foundering" is defined as the sinking of a vessel that is not the result of an earlier collision. For example, a vessel might founder if its cargo shifted during bad weather

1. Select the waterway to be analysed
2. Define assessment zones and describe each area
3. Identify hazards within each zone and develop associated scenarios
4. Assess the probability and impact of each scenario
5. Identify and prioritize possible risk control options
6. Produce a comprehensive report of the risk assessment
7. Communicate result to decision makers

*Figure 2 The Risk Assessment Process*

Steps 2-6 of this process should be carried out in a one or two-day workshop, together with a group of relevant stakeholders. Preparation for the workshop includes performing a preliminary zone selection, describing each zone in detail, identifying all relevant stakeholders, and inviting those stakeholders who should participate in the workshop.

The outcome of the workshop should be documented properly in a written report, supported by a matrix with the details of identified hazards, scenarios and risk mitigating measures for each zone.

## 4.2. SELECTION OF ZONES

Countries have maritime regions in which the environmental conditions, volume of traffic and degree of risk vary. Examples are offshore zones, coastal zones, straits and choke points, restricted waters, major ports and riverine waterways. In broad terms, the offshore and coastal water zones can cover a large area, with smaller zones being defined for restricted waters and choke points.

By dividing waterways into defined geographical regions or zones, a risk assessment of each zone can be carried out and risk control options developed for that zone.

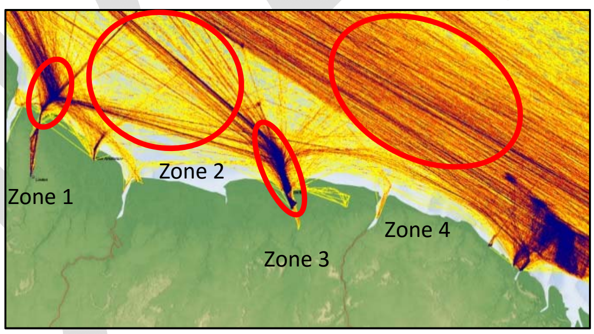


*Figure 3 Zone selection*

If zones are close to each other or overlapping, possible interaction between hazards in these zones should be considered. In some regions where there is considerable seasonal change (ice formation; tropical cyclones, increased leisure or fishing activity etc.) a separate analysis may be required for each season. There may also be variations between day and night-time conditions.

Once zones have been selected, each zone must be described in terms of:

- volume of traffic and mix,
- bathymetry (charts),
- geometry of routes in the area, traffic choke points and sharp bends,
- oceanographic, meteorological and environmental conditions,
- existing fixed and floating Aids to Navigation and routing measures,

* availability of VTS and pilotage,
* history of maritime incidents such as collisions and groundings,
* stakeholders of the zone.

The quality of the zone description is important since this information will be used to identify hazards, possible undesired incidents or scenarios, the probability of their occurrence and their possible short- and long-term consequences.

## 4.3. IDENTIFYING HAZARDS

Hazards can be grouped into the following categories:

* Natural,
* Economic,
* Technical,
* Human,
* Operational,
* Waterway complexity.

Hazard identification should be based on all available relevant information including:

* volume and mix of traffic along all routes and areas within the zone,
* geometry of routes in the area, traffic choke points and sharp bends,
* isolated dangers including wrecks and obstructions,
* quality of hydrographic data and charted information available,
* anchorages, fishing grounds; aquaculture and offshore energy sites and the routes to and from them,
* safe minimum depth (chart Datum) required for vessel operation within the waterway,
* meteorological visibility in the zone,
* passages through a narrow channel, restricted waters or port entry,
* possible effects low sun, background lighting or glare,
* spoil grounds, undersea cables, military exercise areas and Particularly Sensitive Sea Areas,
* historical evidence of natural and/or malicious interference to GNSS signals,
* information in IMO Ships' Routeing publication and Sailing Directions,
* problems with marine communications have been identified in the past,
* history of maritime incidents such as collisions and groundings.

When identifying hazards, largest scale charts covering the zone should be used, and if available, AIS density plots are very useful for describing actual routes within each zone.

Annex A lists examples of potential hazards inviting the user to determine those that could lead to one or more undesirable incidents within a specific area or zone. An undesirable incident can be caused by one or more hazards in combination.

## 4.4. DEVELOP SCENARIOS

The hazards identified may lead to a number of different undesired incidents or scenarios. Each hazard should be considered carefully, and the possible scenarios it may cause, should be identified and recorded. This can take the form of a workshop session, during which each identified scenario and the underlying hazards are discussed thoroughly with stakeholders.

Unwanted incidents or scenarios can be categorized as follows:

* Grounding,
* Collision,
* Allision ,
* Foundering,

- Structural failure,
- Other.

The probability of grounding will depend on many factors such as the bathymetry, draft and speed of the vessels and vessel motions in general within the zone. Consideration should be given to the effect of tidal range, maximum rate and direction of tidal flow in critical areas as well as prevailing wind-speed and direction.

The probability of collisions depends on navigational conditions, waterway configuration, type and volume of traffic. The basic types of collisions are: head-on, overtaking, bend, crossing and merging collisions. An analysis of the routes and their geometry, combined with the volume and mix of traffic can reveal probable collision scenarios in each zone.

The possibility of a vessel striking a fixed man-made object such as an offshore platform (allision) depends on the existence of such structures along the routes and density of traffic.

Foundering may be related to ship quality together with the experience of the crew operating the vessel.

Structural failure could be a failure of the vessel itself or a feature external to the vessel. This can be caused by extreme environmental conditions, poor maintenance or even malicious interference.

Human involvement is a significant factor, since the root cause of many unwanted scenarios can be related to human error. As such human factors must form an important consideration in the overall risk assessment.

Annex B lists examples of possible undesirable incidents or scenarios.

## 4.5. PROBABILITY AND IMPACT

SIRA specifies five levels of probability and five levels of the impact that each type of undesired incident or scenario would create. Each is allocated a score from which a risk value is calculated from the product of probability and impact. Probability and impact scores can be assessed against the criteria in the tables below:

| Classification | Score | Probability |
|---|---|---|
| Very rare | 1 | Very rare or unlikely, will occur only in exceptional circumstances and not more than once every 20 years. |
| Rare | 2 | Rare, may occur every 2-20 years. |
| Occasional | 3 | Occasional, may occur every 2 months to 2 years. |
| Frequent | 4 | Frequent, may occur once weekly to every 2 months. |
| Very frequent | 5 | Very frequent, may occur at least once every week. |

*Table 1 Descriptions of Probability*

| Description | Score | Service Disruption Criteria | Human Impact Criteria | Financial Criteria[8] | Environment |
|---|---|---|---|---|---|
| Insignificant | 1 | No service disruption apart from some delays or nuisance. | No injury to humans, perhaps significant nuisance | Loss, including third party losses, less than US$1.000 | No damage |
| Minor | 2 | Some non-permanent loss of services such as closure of a port or waterway for up to 4 hours | Minor injury to one or more individuals, may require hospitalization | Loss, including third party losses, US$1.000 – 50.000 | Limited short term damage to the environment. |
| Severe | 3 | Sustained disruption to services such as closure of a port or waterway for 4-24 hours | Injuries to several individuals requiring hospitalization | Loss, including third party losses of $50.000-5.000.000 | Short term damage to the environment in a small area, |
| Major | 4 | Sustained disruption to services such as closure of | Severe injuries to many individuals or | Loss, including third party losses of | Long term to irreversible damage |

8 Actual value may differ in different parts of the world. This could also include short and long term environmental consequences.

| Description | Score | Service Disruption Criteria | Human Impact Criteria | Financial Criteria[8] | Environment |
|---|---|---|---|---|---|
| | | a major port or waterway for 1-30 days or permanent or irreversible loss of services | loss of life. | \$5.000.000-50.000.000 | to the environment in a limited area |
| Catastrophic | 5 | Sustained disruption to services such as closure of a major port or waterway for months or years | Severe injuries to numerous individuals and/or loss of several lives. | Loss, including third party losses of over \$50.000.000 | Irreversible damage to the environment in a large area. |

***Table 2 Descriptions of Impact***

## 4.6. THE ACCEPTABILITY OF RISK

Having determined probability and impact scores by consensus, the risk value can be calculated in accordance with the matrix in the table below:

| | | PROBABILITY / (LIKELIHOOD) | | | | |
|---|---|---|---|---|---|---|
| | | Very Rare (1) | Rare (2) | Occasional (3) | Frequent (4) | Very frequent (5) |
| CONSEQUENCE (IMPACT) | Catastrophic (5) | 5 | 10 | 15 | 20 | 25 |
| | Major (4) | 4 | 8 | 12 | 16 | 20 |
| | Severe (3) | 3 | 6 | 9 | 12 | 15 |
| | Minor (2) | 2 | 4 | 6 | 8 | 10 |
| | Insignificant (1) | 1 | 2 | 3 | 4 | 5 |

***Table 3 Risk Value Matrix***

The next step is to determine whether those risks are acceptable or not. SIRA specifies four colour-banded levels of risk. These are shown in the table below:

| Risk Value | Risk Category | Action Required |
|---|---|---|
| 1 – 4 | Green | Low risk not requiring additional risk control options unless they can be implemented at low cost in terms of time, money and effort. |
| 5 – 8 | Yellow | Moderate risk which must be reduced to the *"as low as reasonably practicable"* (ALARP) level by the implementation of additional control options which are likely to require additional funding. |
| 9-12 | Amber | High risk for which substantial and urgent efforts must be made to reduce it to "ALARP" levels within a defined time period. Significant funding is likely to be required and services may need to be suspended or restricted until risk control options have been actioned. |
| 15-25 | Red | Very high and unacceptable risk for which substantial and immediate improvements are necessary. Major funding may be required and ports and waterways are likely to be forced to close until the risk has been reduced to an acceptable level. |

***Table 4 Action Required for Risk Categories***

## 4.7. RISK CONTROL OPTIONS

The objective of the assessment is to identify risk mitigation options for each undesirable incident that would, if implemented, reduce the risk to an acceptable level. These may include:

- improved co-ordination and planning,
- additional training and education,
- new or enforcement of existing rules and procedures,
- improved charted hydrographical, meteorological and general navigation information,
- enhanced aids to navigation service provision,
- improved radio communications,
- active traffic management such as Vessel Traffic Services,
- changes to the waterway,
- improved decision support systems,
- pilotage requirements.

Due to the nature of the process, the outcome of the risk assessment is qualitative/subjective, but the aim is to reach consensus on each risk control option so that the necessary arguments can be put forward to ensure the most appropriate measures are considered and possible funding addressed.

The resulting recommended risk mitigation options should be prioritized to facilitate decision making.

## 4.8. COMPLETING THE RISK MATRIX

The risk assessment itself takes the form of a matrix listing all scenarios, providing a quantification of the risk and considerations associated with each scenario. The most significant risks can then be identified and addressed in terms of mitigating options.

This enables decision makers to assign appropriate resources to implement the suggested measures reducing the risk to an acceptable level.

An example of the risk matrix can be found in Annex C.

## 4.9. REPORTING

It is important to prepare a formal record of the risk assessment process and its outcomes. This will provide evidence of the decision process and risk mitigation measures considered and recommended. It will also provide for a comprehensive record when future deliberations take place in the waterway.

The report should include:

- Description of the waterway and individual zones,
- Stakeholders present at the workshop and their relevant experience,
- Hazards and scenarios identified within each zone,
- Mitigating measures identified and recommended ,
- The completed risk matrix (Annex C),
- Any other amplifying information regarding the assessment.

# 5. REFERENCES


- IALA Guideline 1018 on Risk Management
- IALA Guideline 1079 on Establishing and Conducting User Consultancy
- IALA Guideline 1123 on the Use of IALA Waterway Risk Assessment Programme (IWRAP Mk II)
- IALA Guideline 1124 on the Use of Ports and Waterways Safety Assessment (PAWSA Mk II) Tool
- IALA Model Course E-141/1 for Level 1 AtoN Managers
- IALA Model Course E-141/3 on Risk Management
- IMO SN.1/Circ.296 dated 7 December 2010

# ANNEX A HAZARD EXAMPLES

| HAZARDS | | Remarks |
|---|---|---|
| Natural | Safe Minimum Depth (m) | |
| | Proximity of danger (NM) | |
| | Tide, wind, wave and current effect | |
| | Ice conditions | |
| | Minimum visibility (NM) | |
| | Low sun issues | |
| | Background lighting | |
| | Loss of PNT (geographical obstruction) | |
| | Earthquake and tsunami | |
| | | |
| | | |
| | | |
| Economic | Legal action problems | |
| | Insufficient AtoN funding issues | |
| | | |
| | | |
| | | |
| Technical | Shipborne Navaid failure | |
| | Quality and validity of charted information | |
| | Loss of vessel control | |
| | Loss of Communications | |
| | Loss of connectivity | |
| | Cyber interference | |
| | Aids to Navigation failure | |
| | Loss of PNT | |
| | Substandard ships | |
| | | |
| | | |
| | | |
| Human | Crew competency | |
| | Fatigue | |
| | Safety culture | |
| | Influence of alcohol and/or drugs | |
| | Availability and competency of VTS | |
| | Other AtoN provider competency | |
| | Availability and competency of pilotage | |
| | Piracy/terrorism | |
| | Political issues | |
| | Culture and language issues | |
| | Crew medical issues | |
| | Crew distractions | |

| HAZARDS | | Remarks |
|---|---|---|
| | | |
| | | |
| | | |
| **Operational** | Impact of smaller vessels | |
| | Fishing activities | |
| | Seasonal activities | |
| | Poor passage planning | |
| | Inadequate routeing guidance | |
| | Poor route monitoring | |
| | Poor promulgation of Maritime Safety Information (MSI) | |
| | Poor response to marking of new danger | |
| | | |
| | | |
| | | |
| **Maritime Space** | The existence of wrecks and new dangers | |
| | Crowded waterway issues | |
| | The existence of restricted areas<br>(e.g. ammunition, fish farms). | |
| | | |
| | | |
| | | |
| **Waterway complexity** | Sharp bends | |
| | Narrow fairway | |
| | Manoeuvring space | |
| | Traffic considerations | |
| | Limited available depth of water | |
| | New or existing obstructions | |
| | Mobile seabed | |
| | Channel siltation | |
| | | |
| | | |
| | | |

# ANNEX B SCENARIO EXAMPLES

| SCENARIOS | | Remarks |
|---|---|---|
| **Collisions** | Head-on | |
| | Overtaking | |
| | Bend | |
| | Crossing | |
| | Merging | |
| | | |
| | | |
| **Groundings** | Grounding on rock | |
| | Grounding on soft bottom | |
| | Grounding on wrecks | |
| | | |
| | | |
| **Allisions** | Windfarms | |
| | Oil rigs | |
| | Wave and tidal energy structures | |
| | Breakwaters | |
| | Aquaculture site | |
| | Aids to Navigation | |
| | | |
| **Foundering** | Capsizing | |
| | Sinking | |
| | | |
| | | |
| **Structural Failure** | Structural failure of vessel | |
| | Structural failure of features external to vessel (bridge, lighthouse etc.) | |
| | | |
| | | |
| **Other** | Engine fire | |
| | Cargo fire | |
| | | |
| | | |

## *ANNEX C EXAMPLE RISK ASSESSMENT MATRIX*

| Scenario | Description of incident | Root Cause(s) (Hazards) | Description of Consequences (Short term and long term) | Existing Risk Control Measures | Probability Score | Consequence Score | Risk Score | Further Risk Control Options |
|---|---|---|---|---|---|---|---|---|
| **1 Collisions** | | | | | | | | |
| 1.1 Tankers | Collision of tankers with any other type of vessel | Human Factors | Detrimental chemical spill- 100.000 tons and damage the coral area | Traffic Separation in place | 3 | 5 | 15 | VTS and oil spill response unit in place |
| 1.2 Fishing Vessels | 2 fishing vessels 10 passangers on board collided at a cross section at night time. | Lack of navaids and AtoN | 10 people died and 2 ships lost | None | 2 | 5 | 10 | Lit AtoN are installed at the spot and ships are equipped with AIS |
| | | | | | | | 0 | |
| **2 Groundings** | | | | | | | 0 | |
| 2.1 Grounding on Rock 1 - Tankers | 10,000GT container vessel run aground on a submerged rock while avoiding a drifting ice at nighttime | Drifting ice | Damage to hull and 10,000tons oil spilled | Radar | 1 | 3 | 3 | install a buoy on the shallow area |
| 2.2 Grounding on sand | 3 ton small fishing boat run aground on a sand bank | Lack of AtoN service | 24 hours delay of fishing activity | None | 5 | 1 | 5 | Install a beacon at the edge of bank |
| | | | | | | | 0 | |
| **3 Allision** | | | | | | | 0 | |
| 3.1 Grounding on breakwater | ro-ro passenger ship hit a breakwater | miscommunication between the captain, officer and helmsman | 10,000 oil spill and 5 people injured | Pilot | 4 | 4 | 16 | strengthen training and luminating light on the breakwater |
| | | | | | | | 0 | |
| **4 Foundering** | | | | | | | 0 | |
| 4.1 Pilot boat foundering | 20 tonnage pilot boat sank at a pilot point by water jet nozzle damage | insufficient number of crew member on board to deal with unexpected event | vessel sank | None | 4 | 1 | 4 | Crew training |
| | | | | | | | 0 | |
| **5 Other** | | | | | | | 0 | |
| 5.1 Sinking by misoperation | 256 TEU container ship sank from misoperation of the balast tanks. | Lack of competency of the crew | About 20 containers from the sunken vessel were spilled and floating inside the port. | None | 1 | 3 | 3 | Towing vessel ready at the port and EWMBs ready to be installed |