IALA

GUIDELINE

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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:

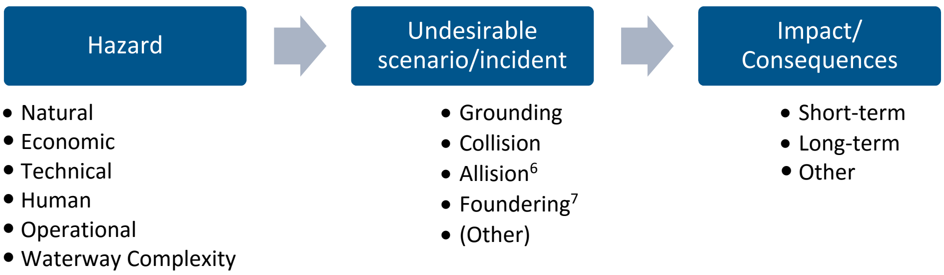

Figure 1 Causal relationship between hazards and consequences

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 "Allision" 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

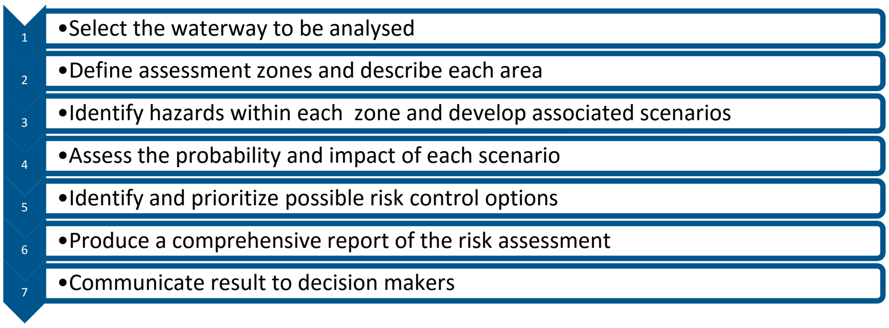

Figure 2 The Risk Assessment Process

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.

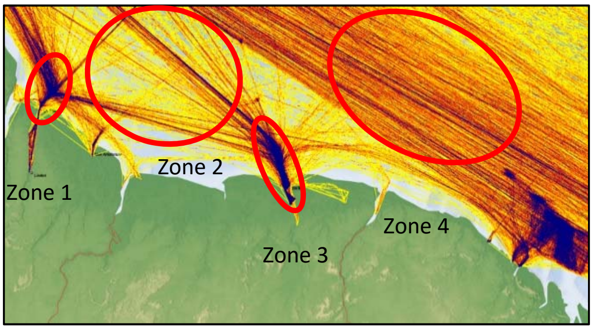

Figure 3 Zone selection

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,

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
Major	4	Sustained disruption to services such as closure of a major port or waterway for 1-30 days or permanent or irreversible loss of services	Severe injuries to many individuals or loss of life.	Loss, including third party losses of $5.000.000-50.000.000	Long term to irreversible damage 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 (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 10,000 tons 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 piot 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