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PUBLICLY AVAILABLE SPECIFICATION

Maritime navigation and radiocommunication equipment and systems – Bridge alert management
Part 101: Guideline on implementation

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MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – BRIDGE ALERT MANAGEMENT

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IEC PAS 62923-101 has been prepared by IEC technical committee 80: Maritime navigation and radiocommunication equipment and systems.

The text of this PAS is based on the following document:

This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document

Draft PAS	Report on voting
80/1041/DPAS	80/1044/RVDPAS

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MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – BRIDGE ALERT MANAGEMENT

Part 101: Guideline on implementation

1 Scope

This document primarily provides support to other workgroups to include alert requirements in standards in line with Bridge Alert Management (BAM), and additionally provides support to designers to implement alert properties so that they conform with the BAM requirements.

This document is applicable, and is intended to provide guidance, when the intention is to implement BAM according to IMO Resolution MSC.302(87).

Based on the IMO decision to adopt the BAM Performance Standard MSC.302(87) as a high level leading umbrella standard for intended implementation of BAM, IMO resolved in MSC.302(87), 3.6, that in case of conflict with alert requirements in existing performance standards, MSC.302(87) takes precedence.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61162-1, *Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 1: Single talker and multiple listeners*

IEC 62923-1:2018, *Maritime navigation and radiocommunication equipment and systems – Bridge alert management – Part 1: Operational and performance requirements, methods of testing and required test results*

IEC 62923-2:2018, *Maritime navigation and radiocommunication equipment and systems – Bridge alert management – Part 2: Alert and cluster identifiers and other additional features*

IMO A.1021(26), *Code on alerts and indicators, 2009*

IMO MSC.302(87), *Performance standards for Bridge Alert Management (BAM)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62923-1 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

4 Purpose

4.1 Bridge alert management – Implementation

Resolution MSC 302(87) and the resulting testing standards IEC 62923-1 and IEC 62923-2 are a major step towards the harmonization of the priority, classification, presentation, handling and distribution of alerts generated by bridge equipment to draw the attention of their operator to out-of-the-ordinary situations. IMO stated in Resolution MSC.302(87) the intention for improved operational awareness, reduced unnecessary disturbance of the operator from their task at hand and improved decision support for the operator. Following this, a main purpose is to help the operator to decide what task or alert needs their attention first and which alert(s) can wait given the consequences of the underlaying problem being reported by the alert, thereby reducing the chance of operator errors and thus enhancing the safe operation of a ship.

The requirements posed in IEC 62923-1 and IEC 62923-2 brought many changes compared to the previous requirements with respect to generation, propagation and handling of an alert, changes that have consequences for new bridge equipment and for interfacing with pre-BAM equipment on board of existing ships. The now following steps are implementation of Bridge Alert Management in the individual equipment standards and actual application in equipment to reach the intentions IMO laid down.

This guidance document informs the reader in narrative form about the main components of BAM, about the differences between symptomatic alerts (pre-BAM) and functional alerts (conforming to the BAM concept) and about some significant changes with respect to replacing pre-BAM alerts with functional alerts (in particular the handling of power failures and system failures).

It should be regarded as an add-on to IEC 62923-1:2018, Annex E. It provides generic guidance on the concept of Bridge Alert Management (BAM). It is highly recommended to read IEC 62923-1:2018, Annex E, first, before specifying a BAM implementation in a standard as well as before designing/realizing such equipment.

Compared to a standard, this PAS is more limited in nature, as its intention is not to specify what alerts have to be generated to which condition; that is the task of an individual equipment standard and/or the designer of the equipment. Rather, it will provide characteristic examples of how an alert implementation can be designed to reach IMO's BAM goals, such that that author or that designer is able to use those examples as a guideline for their own alert design problem.

4.2 Structure of document

Clause 5 discusses a generic guideline to implement the latest version of BAM to realize an (updated) individual equipment standard.

Clause 6 provides a number of ideas to help understand when and how to specify the properties of alerts. It describes the difference between symptomatic alerts (pre-BAM) and functional (BAM) alerts.

Clause 7 provides a number of examples that help understand how legacy specifications of power failures and system failures should be reported conform BAM.

Clause 8 provides insights on the use of alert identifiers.

Clause 9 provides clarification on presentation of the list of active alerts.

Clause 10 discusses the potential assistance of IEC TC 80 Working Group 16 in the implementation of BAM in standards.

5 Implementing BAM in an equipment standard

5.1 Implementing a concept

As specified in IEC 62923-1 and IEC 62923-2, Bridge Alert Management (BAM) is a concept that has to be implemented in (bridge) equipment to enhance the capability of that equipment to fulfil the needs of mariners to process, understand and act upon information (alerts) provided by the equipment on out-of-the-ordinary situations such as errors, failures, dangers, etc. with potential negative consequences for the safe operation of the vessel. BAM is not a system, not a 'box' that does something if a signal is sent to it (see Figure 1). As such BAM does not replace any parts of equipment, rather it imposes additional requirements to all alert functions of (bridge) equipment. Therefore, BAM is a concept applied to any bridge equipment that may need to inform its operator on out of the ordinary situations.

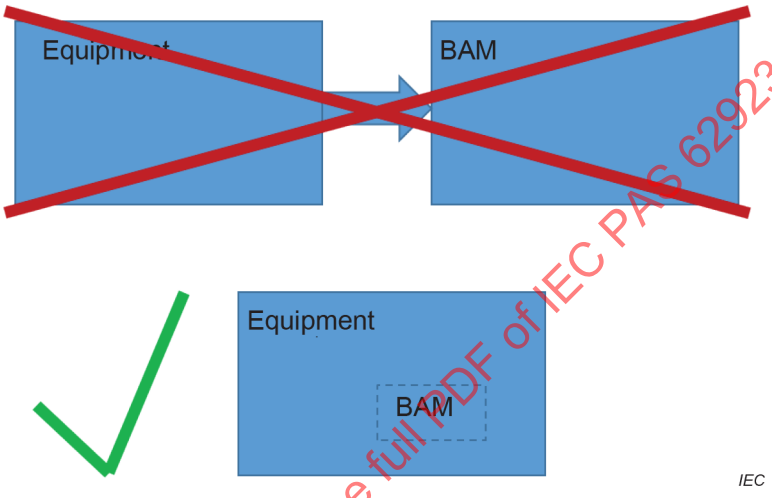

Figure 1 – BAM is a concept applied to equipment rather than a piece of equipment

BAM has a number of properties (as elaborated in Clause 6) that differ from the pre-BAM era. In particular, these are:

- an operator focused definition of alerts and prioritization (disturbance level, based on the level of hazard of a situation for the operation of the ship) of alerts;
- alert Category and audible signal as means to indicate where the operator can handle the alert;
- harmonization of alert sound; and
- facilities for the optional addition of a means for central presentation of alerts (Central Alert Management (CAM) system).

5.2 Implementation process

The following steps can be regarded as a rough guideline on how to implement BAM in an existing standard (it should be noted that many of these steps may not be relevant for the regarded standard).

– Remove (potentially conflicting) requirements regarding alerts and alert management that have an equivalent requirement in IEC 62923-1 and IEC 62923-2 and remove any alert-related references to IEC 61924-2, IEC 61162-1 and IEC 62288.

  Where necessary, replace them by a reference to IEC 62923-1 and IEC 62923-2.

– Add a generic requirement for the equipment to comply with IEC 62923-1 and IEC 62923-2.

  "The equipment shall comply with IEC 62923-1 and IEC 62923-2." is sufficient.

– Avoid adding explanation of IEC 62923 – if necessary engage in liaison with IEC TC 80 WG 16.

– Add a generic test to confirm compliance with IEC 62923.

  “Confirm by inspection of documented evidence that the EUT complies with IEC 62923-1 and IEC 62923-2.”

– Avoid adding any test already covered by IEC 62923 (ISO/IEC Directives discourage duplicated work).

– For the purpose of alert management, avoid adding duplicate requirements for the application of IEC 61162 series interfacing. This is already addressed in IEC 62923 and gives an undue focus on the technical side. Of course any overview of logical interfaces of the equipment can be expanded with the applicable BAM-related interfaces conforming to IEC 62923-1:2018, Annex C.

– Evaluate if the alerting defined in the standard is necessary and useful to the operator:

  - which detected abnormal situations have negative consequences for the operation, and thus need to be brought under the attention of the operator? These may be candidates for raising an alert;
  - which pre-BAM alerts report technical problems that have to be analysed first by the operator before they know the relevance of the problem and the way to deal with the situation or to resolve the problem. The alert needs to be replaced by a functional alert that informs the operator about the consequences for their operation and, where practicable, advice on how to act to deal with the consequences;
  - which pre-BAM alerts have the same consequences and require the same advice on how to act on the underlying problems: these can be taken together in a functional alert.

– Define the situations in which the equipment should provide alerts. As BAM introduces a change to operator-centred functional alerts taking into account the consequences of a situation for the operation, the type of newly defined alerts may be quite different from the alerts in the pre-BAM era.

  With the definition of situations in which an alert is to be provided, it is possible to specify an alert title and even an alert descriptive text. However, in that case it should be assessed for each alert if the situation for which an alert is to be provided has sufficiently standard consequences when taking into account the variety in scope, design and environment of equipment to allow a standardized alert title and/or alert description text in order to provide the user in all variations with correct and useful information for situational awareness and guidance for decision making (see 6.4).

  Results of such assessment can be:

  - a standard alert title is justified (e.g. when a distress message is received);
  - a standard alert title can be of value, but with good reason alternatives can be allowed when sufficient justification for the alternative is available, given the scope, design and environment of equipment;
  - a standard alert title is not appropriate. In such situation only the situation in which an alert is to be provided is to be defined, and guidance for an appropriate alert title and descriptive text can be provided.

– Evaluate requirements for audible indication (see 6.1.1) in order to avoid conflicts with the purpose of audible alert signals.

– Liaise with IEC TC 80 WG 16 regarding:

  - the alerts – to validate if the identified alert purposes are consistent with BAM principles; and
  - the alert identifiers – to assure that there are no identifiers assigned that already are designed to other types of alerts in other standards and that the mapping on standard alert identifiers is done consistent with their meaning. New alerts can be assigned a new alert identifier by WG16 only.

  It is important to note that only alert identifiers issued by WG 16 and confirmed after liaison with WG 16 will be taken on board in future editions of IEC 62923-2.

It may be necessary to show that original IMO requirements were removed on purpose or even to retain original IMO requirements that have been identified for removal in a note, to show to the reader what happened.

EXAMPLE 1 “With regard to alert management, MSC.302(87) supersedes <identification of the requirement>.”

EXAMPLE 2 “Note: Resolution MSC. 302(87) and derived IEC 62923-1 have superseded the requirement: <identification of the requirement and optionally the full requirement>”

5.3 Subjects for consideration when developing/modifying an individual equipment standard

5.3.1 General

The concept defined in MSC.302(87) and IEC 62923 requires that, when developing a new or modifying an existing individual equipment standard, the subjects described in 5.3.2 should be addressed in that standard.

It is important to note that most of the current IMO standards, and at the time of writing still also a lot of IEC Standards, are still based on alarm concepts from before the BAM-era. Where conflicts arise, the alert concept in these pre-BAM standards is superseded by BAM, and the updated standard needs to be adjusted to conform to IEC 62923, while preventing duplication of requirements.

Implementation of BAM therefore includes a thorough review to replace similar and conflicting provisions to BAM by a reference to IEC 62923-1 and IEC 62923-2. Examples of such an operation can be found in IEC 62288 from Ed.2 to Ed.3 and IEC 61924-2 from Ed.1 to Ed.2.

Finally, there have been standards that refer to preliminary, now superseded, versions of Bridge Alert Management, like IEC 61924-2 (Ed.2), IEC 62288 (Ed.2) and IEC 61162-1 (Ed.5). Such standards should be adjusted to have correct references. In this respect, one should remember the ISO/IEC policy (see Directives) that duplication of requirements in different standards is to be avoided to prevent inconsistencies and to enhance maintainability.

5.3.2 Description of subjects

The subjects for consideration are:

– correct terminology. It is especially important to realize that the related alert terminology, such as “alarm”, in the old situation had a different meaning (sometimes even between standards) than under the BAM concept, and needs alignment with the BAM concept. Sometimes the meaning of such terms does not even pertain to ‘alerts’ in BAM context at all. For example in GMDSS-related standards the term ‘alarm’/’alert’ could relate to the message transmitted over the radio instead of relating to the ‘alert’ to the operator that such a message is available. Compliance with BAM implies that the use of such terms are brought in line with the harmonized definitions defined in IEC 62923. Implementation should also clearly distinguish between similar terms for different matters (e.g. ‘BAM-alert’ and ‘GMDSS-alert’, which have a different meaning);

– a proper definition of useful (functional) alerts providing a clear message to the operator

  - to reflect on the operational consequences of a situation (see 6.4),
  - to make alerts sensitive to the context (see 6.5), and
  - to provide advice on what the operator should do to deal with the consequences of the situation;

– a clear separation of operational information from diagnostic information (see also 6.4). Diagnostic information, e.g. for fault finding, is not part of bridge alert management and should, as part of the ‘maintainer task’, be addressed through a different (part of the) user interface. Whereas this is an important user interface for someone responsible for repair and maintenance of systems, it is not important for the navigator and therefore not to be addressed by Bridge Alert Management;

– a prioritization such that the alert makes it very clear to the operator whether it heralds an imminent threat, or that he should address it as soon as he has the time, or whether it can be dealt with in due course (see 6.2);
– a categorization such that the operator is not unnecessarily forced to leave his current tasks at his task station and go to another workstation or application (see 6.3);
– optionally: requirements to support the presentation (visually and audibly) of alerts conforming to IEC 62923. Examples of such requirements are
  - more specific requirements for audible signals (e.g. to define 'short'), or the pitch/colour or volume of the signals. It is important to take into account that the sound of a warning should not be more distracting than the sound for an alarm, where practicable;
  - optional requirement for speech output;
  - optional prohibition of aggregation for specific alerts;
  - optional prohibition of functional alert grouping for specific alerts;
  - optional user-selectable alert priorities (e.g. IEC 61174);
– optionally: requirements to support the handling of alerts (silencing, acknowledging) in line with IEC 62923. Examples of such requirements are
  - possibility for specific requirements for alert escalation
    – escalation mandatory or optional (W to W, W to A)
    – escalation prohibited (W to A)
    – escalation interval (< 5 min) (W to W)
    – time/number of repetitions before escalation (W to A)
    – possibility of user-selectable settings (time, escalation or not)
  - optional transfer of an unacknowledged alert to BNWAS after a certain period
  - optional bypassing of the state 'rectified – unacknowledged' (e.g. CPA/TCPA alert)
  - optional prohibition of (the number of) silencing of an alert (e.g. IEC 62065)
  - optional local temporary silence function at the alert source. This function in the alert source temporarily silences the alerts raised by that alert source only. As a consequence, these alerts are silenced at the CAM as well, but other alerts, not raised by the alert source, will not be affected.
  - repetition frequency.

5.4 Role of a Central Alert Management system (CAM system)

A CAM system, including CAM-HMI, is not a mandatory SOLAS carriage requirement, but where it is provided it has to comply with MSC.302(87) and IEC 62923-1 and IEC 62923-2.

The main purpose of a Central Alert Management system is to realize one single workplace from which an operator can monitor, handle (under certain restrictions) and analyse (the logged data of) any alert raised by the connected equipment under the operator's responsibility. Compliance with BAM implies that equipment (alert source) has to be designed to handle all alert related functionality of MSC.302(87) and IEC 62923-1 and IEC 62923-1-2 even without the presence of a CAM system.

There is one type of system that mandatorily includes a CAM system: the Integrated Navigation System (INS, from IEC 61924-2 Ed.2 onward). Therefore, a bridge equipped with such an INS is by default equipped with a CAM system.

All BAM compliant equipment can be connected with a CAM system, either with an already fitted CAM system when fitting that BAM compliant equipment on board, or when a CAM system is fitted on board at a later time, see Figure 2.

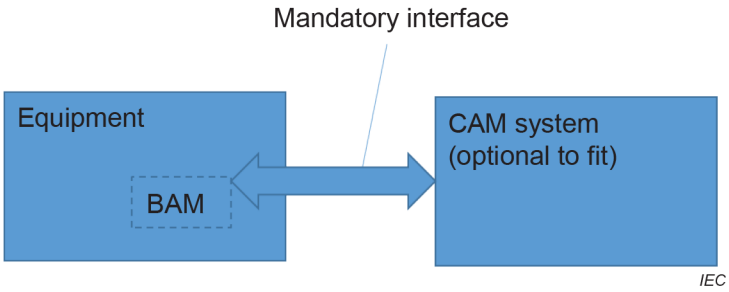

Figure 2 – Role of a CAM system in Bridge Alert Management

The main functions of a CAM system (see IEC 62923-1 for further details) are:

– display, sorted by display priority, of all alerts of the connected equipment (in addition to the display on the individual equipment);

– central temporary silencing of all audible alerts (warnings and alarms) of connected equipment;

– remote acknowledgement of alerts for which it can present relevant information to provide a basic understanding of the situation (category B alerts, warning and alarm);

– recording and display of the alert history for analyses;

– presentation of alerts for which the CAM system is the alert source (own alerts).

Standards should be written such that the presence of a CAM may not be assumed, as a CAM is not a mandatory SOLAS carriage requirement. However, BAM compliancy implies that the possibility of a connection to a CAM, and thus the possibility of commands from the CAM, always needs to be taken into account when drafting rules for individual (bridge) equipment. In the event that a BAM compliant alert source loses its connection with the CAM system (including possible backup arrangements), or the CAM system experiences a serious failure, the BAM compliant alert source should continue to provide all alert functionality without any changes in behaviour, unless the CAM system supports responsibility transfer and a transferred responsibility was lost due to the failure.

This means that the standard that implements Bridge Alert Management for equipment takes due account of the fact that, although a CAM can influence the equipment through the interface, that equipment is the one to implement all aspects of Bridge Alert Management, including for example alert definition and the alert HMI.

Equipment may be designed in a way that requires the presence of a CAM to provide the alert HMI. In this case, the equipment will need to be installed with the appropriate backup arrangements in accordance with the manufacturers installation requirements (see IEC 62923-1:2018, 6.5).

6 Alert properties

6.1 Harmonization of alert sound vs legacy alarm sounds

6.1.1 General

Also before BAM there have been equipment standards that specified alert sounds and a variety of sounds of a more functional nature, some even indicating a high sense of urgency. Some of these standards have been modified to meet IEC 62923, but there are still standards that have not been adjusted, for instance because they are not issued by IMO or IEC. Sounds for alerts in such standards should be harmonised with IEC 62923-1 and conflicts between sounds for alerts and sounds used for other purposes should be removed. IEC 62923-1 harmonizes sounds by identifying the following three types of sounds:

- Audible signals (related to alerts)

The purposes of an audible alert signal are:

– to attract attention of the operator to alerts of a certain priority;

– to indicate the priority (three short audible signals (e.g. beeps) implies ‘alarm’, two short audible signals implies ‘warning’);

– to indicate a place (=origin of the sound) where the alert can be handled.

IEC 62923-1 does not pose requirements for frequency and timbre (sound colour). Timing is regulated, but for some aspects there is leeway for interpretation (e.g. length of and interval between audible signals). The rationale behind this is that different sounds from different equipment may help the operator to distinguish between sound sources. Neither is it prohibited to provide different frequency and timbre per alert for the purpose of recognition of an alert, although:

a) voice announcement is intended for that purpose; and

b) distinction with respect to frequency or timbre will not in all cases be easy within two or three ‘short’ audible signals and a low repetition frequency (for warnings); example: received distress message. Sound definition requirements for a specific alert will be rare;

- (Optional) speech output (related to alerts)

  The purpose of using optional speech output to supplement the mandatory audible signals is to allow the operator to recognize a specific alert without having to move to the alert source or CAM-HMI and read the alert message.

  Speech is not allowed to disturb the mandatory audible signals that indicate priority ‘alarm’ or priority ‘warning’. It is up to the individual equipment standard or to the manufacturer/designer to specify how often speech will be inserted: only after the first two or three audible signals or also after repetitions and even for which alert(s) to apply speech support. However, one has to keep in mind that an important aspect of BAM is to avoid any sound that may distract from the operator’s main task and the time available for speech output is limited and subject to e.g. temporary silencing;

- Audible indication (including speech output, not related to an alert)

  While Bridge Alert Management, and therefore audible alert signals, is about alerting the mariner about abnormal system conditions, audible indications are about a system (function) that has identified some operational condition for which it has been designed to cause a functional sound (i.e. all sounds not related to alert management, such as feedback from pressing a button, confirmation of something happening as instructed, message arriving, reaching a setpoint, operation refused, etc.). As Bridge Alert Management is not about conditions that warrant a functional sound other than alert signals, IEC 62923 does not specify such audible indications. While audible alert signals are designed to be clearly recognisable as a warning or alarm sound, audible indications should preferably also be designed to be clearly recognisable as belonging to a specific function. Moreover, it is recommended to specify audible indications such that:

  – they are clearly distinguishable from a BAM alert;

  – are not startling (except when defined in conjunction with emergency alarms);

  – are less disturbing than BAM alerts; and

    - are either momentary or temporary without user interaction, or
    - stop after a defined user action on the equipment that is not related to alert management.

  Note that IEC 62923 does not specify how to handle a condition with an audible indication. That is up to the related individual equipment standard (if applicable) or the manufacturer (otherwise). It only specifies how to handle the accompanying emergency alarm.

6.1.2 Emergency alarms

Emergency alarms are defined in IMO Resolution A.1021(26) Table 7.1.1 and indicate an immediate danger to human life, the ship or its machinery. These alarms usually make many persons on board aware of an emergency condition and are accompanied by a BAM emergency alarm presented on the CAM-HMI. The audible signals for emergency alarms are defined in

IMO Resolution A.1021(26) and are provided by equipment outside the BAM concept as an audible indication. Therefore the BAM concept does not assign an audible signal for Emergency alarms.

6.1.3 Sounds in standards where MSC.302(87) does not take precedence

In some cases, the requirements set by IMO in Resolution MSC.302(87) do not take precedence over standards issued by other organisations, such as ITU. In these cases, when revising testing standards derived from such standards, it is necessary to merge these requirements in a way:

a) not against the BAM rules, and

b) retaining the intention of the non-BAM rules as far as possible.

In general the following two possibilities exist for the provision of sound:

1) Using audible indications; sound not specified by alert management, for which there are the following variants:

   a) not raising an alert at all, only providing an audible indication; or

   b) raising a caution and at the same time providing an audible indication (note that no BAM silence/acknowledge is possible); or

   c) raising an emergency alarm and at the same time providing an ‘audible indication’ (e.g. fire bells).

   For such audible indications BAM does not provide any requirements, although there are the recommendations provided in 6.1.1 “Audible indication (including speech output, not related to an alert)”.

2) Using an audible alert (warning or alarm) and their properties, where:

   a) the requirements can pertain to the character of the sound (within the requirements of ‘two/three short audible signals’ and the requirements for repetition of the audible signal (alarm) or for escalation (warning)). The character of the sound can for example be used for recognition of a specific alert or equipment; and/or

   b) the requirements can pertain to sound in the scheduled silence period (with optional speech output), in which another sound could be provided.

      During this period it is technically possible to provide a sound, which could be useful for legacy situations. Although the time for speech output is intended for voice announcement, the original intention of a specific sound is similar – recognition of a specific alert.

   In these cases:

   – it is important to take into account that the sound of a warning should not be more distracting than the sound for an alarm, where practicable;

   – requirements should state that the sound, including speech output, is subject to temporary silencing also from the CAM-HMI, if fitted; and

   – if allowed by the alert category, the alert is subject to acknowledgement of the alert from the CAM-HMI, if fitted.

6.2 Priority

An alert distracts the operator from other tasks. One should realize that MSC.302(87) caters for the downsides of having many high-priority alerts.

Apart from the obvious reason that too many high-priority alerts will make those alerts be taken less seriously, MSC.302(87) recognized that “redundant and superfluous audible and visual alarm announcements” (i.e. alarms and warnings in the BAM concept) cause “unnecessary distraction” from the mariner’s task of safe operation of the vessel. Such distraction in turn can be dangerous as well.

The priority of an alert (emergency alarm, alarm, warning, caution) is introduced to help a professional mariner to decide which alert to handle first, taking into account the current navigational tasks and thus helps the mariner to prioritize alert handling compared with other navigational tasks.

Unfortunately, mariners as well as equipment designers are sometimes so used to the high number of symptomatic alerts of pre-BAM systems that they feel uncomfortable with the low number of (high-priority functional) alerts due to implementing the BAM requirements. Some designers need the assurance that they will not be held responsible in case a mariner has missed a dangerous condition. However, one should realize that alerts are not intended to cater for unprofessional behaviour nor should they compensate for having a poor design. Rather, alerts should provide an aid to the mariner such that even in pressing conditions the mariner can prioritize navigational tasks appropriately taking into account all alerts present and all current tasks.

Therefore, it is important that the authors of an individual equipment standard, or an equipment manufacturer, properly specify the priority of an alert according to the criteria set by IMO, and do not misuse the priority of an alert to ensure that action will be taken.

In case a mariner fails to act on an alert of priority warning, BAM supports the escalation of an alert of priority warning to priority alarm for the case where the time frame of the danger associated with the alert goes from 'in due course' to 'immediate'.

The decision tree in Figure 3, derived from MSC.302(87), may be useful for classifying alert priorities in individual equipment standards or in manufacturer defined functionality.

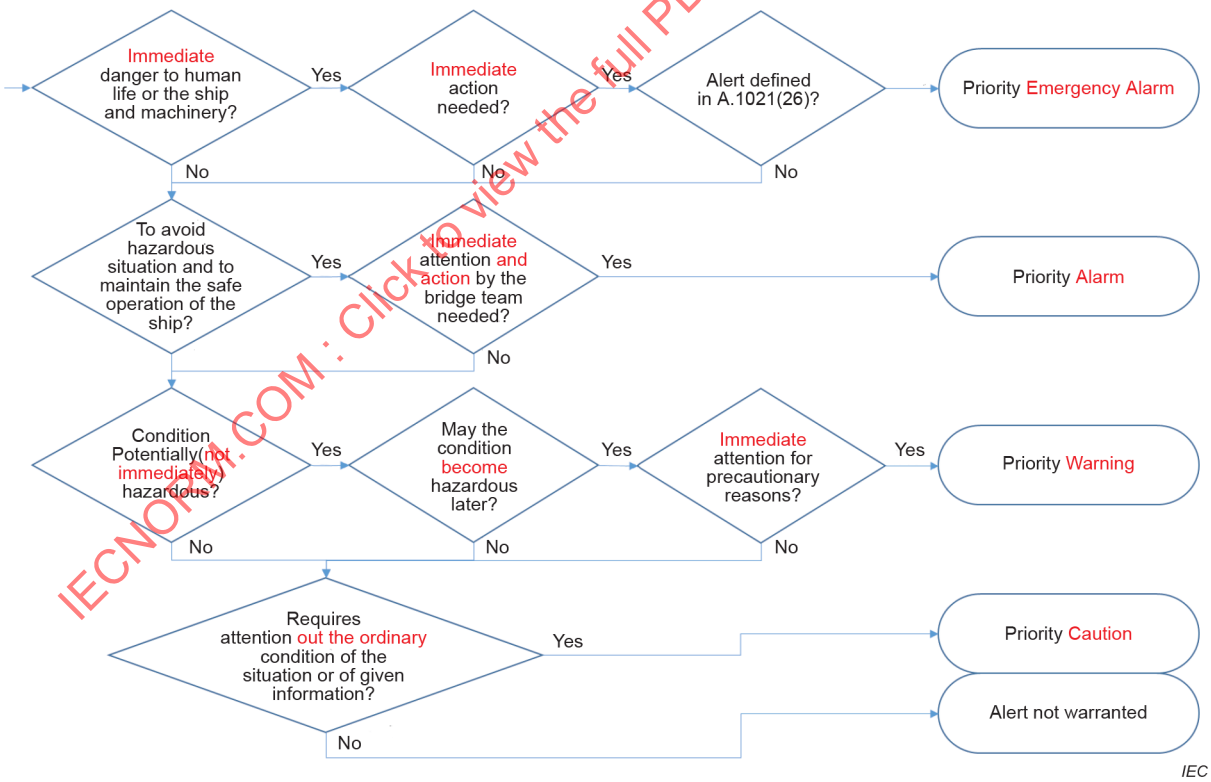

Figure 3 – Typical decision tree for the classification of alert priority

Authors of an individual equipment standard and equipment manufacturers should not make the mistake of escalating the alert priority from warning to alarm by default. BAM supports two types of escalation performed by the alert source, see Figure 4:

– in case the time frame of the danger changes from ‘in due course’ to ‘immediate’, the alert should escalate from priority warning to priority alarm;

– in other cases, the alert will escalate from priority warning to priority warning (effectively repetition);

If deemed necessary, the escalation time may be defined in a standard within the limits of IEC 62923-1.

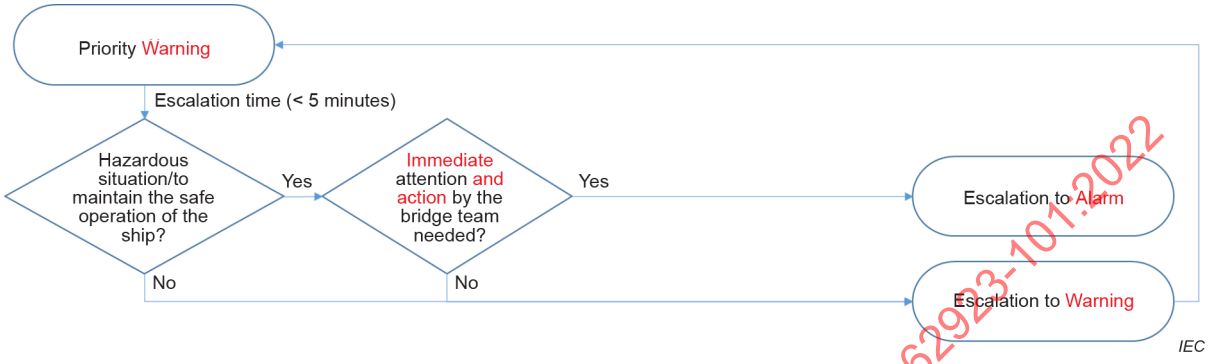

Figure 4 – Typical decision tree for the classification of alert priority after escalation of a warning

Cautions are alerts that pertain to out of the ordinary situations not warranting an alarm or warning. Just like other alerts, cautions provide situational awareness and should be functional (operational consequences) and provide guidance for decision making (operational advice) to deal with the situation.

Incorrect use of alerts of priority caution is one cause of having many cautions. Many cautions occurring at the same time could in practice give troubles. For example more important cautions could be obscured, and a high amount of cautions could lead to ignoring them. In general having a high amount of cautions is an indication of suboptimal alert definitions.

Cautions are not to be used for normal operational matters such as status indications, consequences of user actions and feedback from (un)successful operator actions. These matters should be dealt with by using either (permanent) indications or audible indications instead of by misusing the alert system.

Another known source of many cautions is the indication of technical information or causes (symptoms) of other alerts.

In case a problem is already operationally reported using an alert of higher priority, a parallel caution of explanatory nature or providing technical details should be avoided.

Optionally, if additional information is available for the user regarding the alert situation, such information may be presented at the equipment raising the alert. Additional related cautions should not be used.

Regarding technical information behind an alert (e.g. symptoms), a diagnostic user interface (often involving graphical presentation) or local event logging is better suited to give the operator a useful overview of the technical details than an alert list can do. Note that alerts are not designed to correct a situation.

6.3 Category

One of the problems of the pre-BAM era was that systems were usually designed such that generating an ‘alarm’ was usually equal to requiring the mariner to go to the human machine interface of the equipment raising the ‘alarm’, even in cases where, from a mariner point of

view, many ‘alarms’ were not very important compared to the task(s) that was being conducted or to other ‘alarms’.

The BAM concept defines the prioritization of alerts, with alarm being one of the alert priorities (see 6.2), and introduces other means to resolve the unnecessary trips to the HMI of the alert source. One of these means is the ability to (temporarily) silence all alerts from one or more central points (if fitted) to give the mariner time to finish what they were doing. But the most important means has been to associate each alert with a category in order to inform the mariner at which position the alert can be handled, which can now also be done at the CAM-HMI (if fitted) in most cases.

IEC 62923 recognizes three categories of alerts.

1) A category A alert requires graphical information to evaluate the alerted situation. Alerts like Collision alert (RADAR) or Anti-grounding alert (ECDIS) qualify for this category. Assigning category A to an alert imposes a requirement for the mariner to go to the alert source to evaluate the situation using indispensable graphical information and acknowledge the alert on the equipment itself, rather than on some CAM-HMI (if fitted) without such information. Category A however is not intended as means to increase the priority of an alert by enforcing mariner action.
2) A category C alert is an alert of one alert cluster (e.g. the engine room) to another alert cluster (e.g. the bridge). They are rare, as not many alerts of one source cluster are relevant for a mariner in another cluster and not already signalled in that cluster. Example: alerts from the main engine system that notify the bridge of an engine slowdown or an automatic emergency stop. Such information is important for the operation of the mariner being presented with the category C alert. However, it is the responsibility of another mariner, in the originating cluster, to resolve the underlying problem, so the mariner in the receiving cluster cannot acknowledge these alerts.

   An alternative implementation to the provision of a category C alert is the provision of a status signal to (bridge) equipment (e.g. a specific panel) that subsequently raises a category B alert.

   NOTE 1 Where equipment is connected by means of serial communication only, the configuration in the receiving system shows which cluster the alerts from this serial line pertain.

   NOTE 2 Where equipment is connected by means of network communication, the TAG block contains identification of the source and destination clusters (see IEC 62923-1:2018, Annex J).
3) All other alerts are category B alerts. As with category A alerts, these can be handled on the system that generates the alert. However, a CAM system (if fitted), using the received alert source identification, alert title and alert description text, is also able to show on the CAM-HMI the information for understanding in order to acknowledge the alert and to know how to deal with the situation.

It is important to notice what IMO states in MSC.302(87) about the main reason for harmonization of alerts:

> *“The BAM harmonizes the priority, classification, handling, distribution and presentation of alerts, to enable the bridge team to devote full attention to the safe operation of the ship”.*

With this statement IMO takes into account that it may not be an alert that is the most important and urgent matter to attend to. The purpose of an alert is to make the mariner aware of a potentially unsafe situation. By acknowledging or silencing an alert, the mariner merely confirms (this is logged in the alert history log) that:

a) it is known that there is a situation to attend to; and

b) there has been given a sufficient/basic understanding of the situation,

so that the mariner can prioritize what task to attend to: the task the mariner was doing prior to the alert(s) or dealing with a situation indicated by one of the alerts. Until the situation is resolved the alert remains displayed at both the alert source and the CAM-HMI.

It is further necessary to review the information made available to the mariner in an alert raised by the alert source for gaining a sufficient/basic understanding of the consequences of the problem for which an alert has been raised. IMO defined as a purpose of BAM:

> *“ supports the bridge team in its decisions for the necessary actions to be taken with associated requirements”.*

This was translated in IEC 62923-1 into

a) one individual alert for each detected out of the ordinary situation requiring attention,

b) functional alerts rather than alerts about technical symptoms, and

c) the ‘alert title’ and ‘alert descriptive text’ to describe the consequences of a problem and/or how to deal with the situation. These fields can be updated with actual values where necessary.

In most situations, the alert title and descriptive text are good enough for understanding the situation (this is a requirement) and “*… decisions for the necessary actions to be taken*”. Such alerts are of category B**.**

On the other hand, IMO recognized that for some alerts the ‘alert descriptive text’ cannot provide sufficient situational information and guidance for decision making, but that additional graphical information needs to be appreciated before the user has the required understanding of the situation at hand. In situations such as a collision alert (the RADAR picture provides essential graphical information, e.g. about traffic) and a route monitoring danger (the chart display provides essential graphical information, e.g. about geography), it is impossible to provide sufficient information in the alert descriptive text to reach even a basic understanding, let alone sufficient understanding of the situation and for “… *decisions for the necessary actions to be taken*”. The operator therefore needs to attend to the equipment that provides such essential information before he can rightfully acknowledge the alert and, if necessary at all, judge the time before it is necessary to act on the alert. A category A alert requires the operator to go to the alert source (to regard the graphical information it presents) before being able to acknowledge the alert.

However, one should be cautious when specifying the category of an alert as category A rather than as category B. The primary task of the mariner is to *devote full attention to safe operation***.** As the category A alert forces him to attend the source of the alert, it may interrupt him from a more important navigational task. Category B may be handled at a more convenient position, in particular in case of presentation at a CAM-HMI. One should even be more cautious when contemplating the use of category A for a warning. This is to be avoided as this may well result in more mariner disturbance than a category B alarm that can be acknowledged on the CAM-HMI. Provision of a suitably informative alert title and alert descriptive text for an alert may enable assignment of category B to avoid inappropriate assignment of category A.

EXAMPLE Instead of providing the mariner with a generic alert “failure” or “<function> failed”, with additional information provided graphically, it may well be possible to describe the information of the failure in the text of the alert, avoiding the need to view the graphical display to sufficiently understand the situation to prioritize it given the presence of other alerts and tasks.

The category B alert title and alert descriptive text should help the mariner to understand the problem, the appropriate action to be taken and the priority/timing of that action given the other tasks being conducted. For example, manoeuvring in confined waters is a critical operation. During this operation, the mariner should not be forced to leave the current workstation to attend some other workstation unless there is a very important reason for this interruption in which this cannot be avoided.

Another, more practical, disadvantage of assigning category A to an alert may occur in an implementation of bridge equipment that includes a CAM-HMI. Most audible alerts will be of category B, all of which can be analysed and acknowledged individually on that same CAM-HMI, while category A alerts cannot be acknowledged on the CAM-HMI. Forcing the mariner to attend the source of the alert may annoy that mariner who does not understand the rationale behind this design choice for category A. Some mariners may neither recognize the prohibition

nor understand the need to attend the source of the alert for acknowledgement. It is recommended to clearly explain this rationale in the user manual of bridge equipment in case category A alerts have been applied, and this needs to be part of training as well.

It is not an easy task to come up with a proper alert title and matching alert descriptive text without proper understanding of the operations on board and the situational awareness of the officer on watch. However, given the intentions of BAM, it is an important task, not only for authors of bridge equipment standards, but also for the manufacturers of such equipment.

6.4 Functional vs technical alerts

IMO makes a clear statement in MSC.302(87) about the main reason for harmonization alerts:

"The BAM harmonizes the priority, classification, handling, distribution and presentation of alerts, to enable the bridge team to devote full attention to the safe operation of the ship".

This statement makes it obvious that BAM is not intended to be an aid for fault finding and maintenance. Rather it is an aid for the bridge team that, in case of an abnormal situation, should inform the mariner about the consequences for the safe operation of the ship and guide them towards the appropriate operational response. This implies that the common practice of the pre-BAM era to alert about technical problems, and to leave it to the mariner to ponder about the consequences and the relevance of the technical problem for the task at hand, is no longer acceptable. The BAM point of view is that systems perform functions for the mariner to assist in the safe operation of the ship. In the case that the system detects an abnormal situation it has to alert the mariner about the functional consequences, hence the change from technical alerts to functional alerts (see also 6.2 regarding the use of cautions).

This change in thinking compared to the pre-BAM era is reflected in IEC 62923-1:2018, Annex E, which provides guidance on alert information.

ISO 11674:2019 on heading control systems is one of the first standards that explores these principles, thereby moving away from symptomatic alerts ('sensor missing') to a functional alert appropriate to the context.

For instance, in the case that the automatic heading control fails, the system may show, "Forced to Manual – Take Helm" (alert title – alert descriptive text), and the CAM-HMI (if present) will show "Autopilot – Forced to Manual – Take Helm" (source – alert title – alert descriptive text).

The underlying technical problem may be that the heading input of the system has failed. The mariner should not be bothered by this information. Rather the one responsible for repair and maintenance should be informed/alerted at a dedicated repair and maintenance HMI or display, preferably with some clue on how important it is to correct the technical problem. Such a diagnostic HMI can also go into greater detail and give more technical context than the alert list. As BAM is limited to the assistance of the mariner, it does not specify any requirements to assist in repair and maintenance.

The functional approach implies that one regards hardware and software modules (taking into account that every implementation differs in scope, functionality and layout) as entities that conduct tasks for other functions and, at the top of the hierarchy there is the mariner. Each module has to report its performance state to its users indicating whether or not it can perform its task or whether the performance may be changed. The report to the mariner is referred to as 'alert'. The reported alert(s) depend on the design of a system, on its inputs and on the tasks requested by the mariner. In other words, the context of the detected problem defines what the system has to report to the mariner and whether or not it is an alert.

EXAMPLE Failure of a heading sensor that is used as an input for a heading control system (HCS) for its task "automatic heading control". Depending on the context, the HCS may:

- raise an alert, for example:

  - "Lost Heading Control" – the HCS task 'automatic heading control' was in use and was forced to stop;
  - "Doubtful Heading" – the HCS task has selected an alternative sensor but misses a sensor for validating the heading integrity;
  - "HDG in fallback" – the HCS selected an alternative sensor;
  - "Heading control unavailable" – during manual control, automatic heading control cannot be engaged as the HCS misses a heading sensor; or
- raise no alert when the HCS had been switched off intentionally when the sensor failed.

These alert examples imply that the individual equipment standard should specify, within the context of the regarded equipment, the functional consequences for raising an alert rather than specifying the (technical) cause. In other words, it should define the situations for which the equipment demands the mariner's attention. The alert priority should indicate the urgency of a mariner response to that situation and the alert title and descriptive text should provide guidance for that response. In most cases a good alert title and descriptive text provide sufficient information for a proper mariner response and the category is "B". However, if the equipment presents graphical information essential for proper understanding of the situation and guiding the mariner, the category is "A".

Currently, some standards specify a (usually symptomatic) "cause" or "purpose" of an alert (e.g. "power failure"), rather than the operational situation that results from the occurring problem. This may cause a delay in the appropriate mariner response as it is then first necessary to deduce the consequences of the reported problem and find and assess the options to address the problem before a decision can be made about the appropriate response. A proper functional specification of an alert title and descriptive text provides both the situational awareness and guidance for decision making. For that purpose, the exact alert title and alert descriptive text should usually be equipment-specific to cater for implementation differences in scope, functionality and layout.

Other navigation equipment may also depend on the heading sensor in the above example (e.g. the RADAR or the ECDIS). Such equipment has to analyse the consequences for its own performance and generate an appropriate functional alert when necessary. Thus, a single cause within bridge equipment may result in several functional alerts for different situations, even several alerts of priority alarm. That is unavoidable in the case that multiple operational functions fail at the same time. This is also one of the reasons why one has to be cautious about the use of category A; the result could be that the mariner is called to different places simultaneously.

From the above, one may deduce a number of questions that should be answered when designing a proper functional alert for a specific combination of cause and operational consequences:

- is the alert intended for a system or a function that is in use, in (hot) stand-by, intentionally switched off or unintentionally switched off?;
- is the alert intended for a function used by the mariner for safe operation of the ship?;
- is the alert intended for a function not used by the mariner for safe operation of the ship?;
- is the alert about a function loss, a degraded function or a function that changes how the equipment conducts its task (e.g. by switching to another input or reverting to a redundant function)?;
- does the alert necessitate any action from the mariner or does the mariner simply have to take the information into account?

As a consequence of functional alerts and of taking the context into account, the number of alerts with different titles and/or different alert descriptive texts available to be raised is expected to increase, although the number of actual alerts with high priority raised to the mariner is expected to decrease and their improved information will reduce the cognitive load on the mariner.

6.5 Alert management using context information

6.5.1 General

While the equipment remains the same, the mariner has different use and expectations in different operational situations, depending not only on the state of the equipment, but also on its surroundings. As a result of the functional alerts, it is only logical that equipment responds with alert behaviour and information tailored to the specific situation. This decreases the unnecessary disturbance of the mariner and the risk of failure when performing the tasks the mariner is distracted from, and it increases the likelihood that the mariner will respond appropriately and in time when it is really necessary.

Although IEC 62923-1 mainly focusses on bridge alert management, other teams on board experience the same kind of challenges of too many alerts of too little added value. Therefore IMO has foreseen a more widespread use of BAM in other domains on board as well.

This Subclause 6.5 discusses some of the merits of applying the functional approach of BAM alerts in a wider context, taking into account the different types of operations conducted on a ship. In addition, it will discuss application to support other mariners, such as the technical officer responsible for the machinery of a ship.

The principles introduced can be used in all domains.

6.5.2 Different operational modes – Different alert requirements

Many standards that apply IEC 62923 focus on a bridge team that has to sail the ship safely from one place to another.

However, when a ship is at anchor or safely berthed alongside a quay, some navigation functions have become temporarily not in use and that has consequences on what alerts should be reported by the equipment.

The principles are explained by the following examples.

Example situation: The ship is berthed, ECDIS is up and running.

While route monitoring alerts are important when the ship is underway, when a vessel is safely berthed alongside a quay they are irrelevant and unnecessary disturbing.

- Example 1 As alternative to switching the ECDIS off in harbour, the ECDIS standard allows the ‘route monitoring’ function to be switched off thereby preventing any route monitoring alerts being raised (MSC.302(87)/1.4 / IEC 62923-1:2018 4.1). However, the chart loading and route planning functions are still available as are the internal diagnostics that identify whether or not the route monitoring function can or shall be switched on again.
- Example 2 An alternative solution is to allow in a standard, depending on the operational mode, a downgrade of alerts and replace them by equivalents with priority caution (thus reducing the alert priority) (criteria for classification of alerts (MSC. MSC.302(87)/6.2 / IEC 62923-1:2018 6.2.2.1) or even use indications instead of raising alerts (prevent unnecessary distraction (MSC.302(87)/1.4 / IEC 62923-1:2018 4.1)).

Of course the system should be appraised of the berthed situation and some safeguards (e.g. SOG < 0,3 knots) could be provided in case the mariner forgets to cancel this setting.

This opens a new approach towards designing the bridge of a ship, one with provisions via which the mariner may select an operational mode other than ‘navigation’ and where bridge equipment may change its alert behaviour given the selected operational mode.

6.5.3 Other operational sectors

The same approach to designing appropriate (functional) alerts translates to other situations, e.g. in an engine-room setting.

EXAMPLE 1 A high-level alert for a tank.

The purpose of this alert is to warn the mariner to take action to prevent the tank from either overflowing or bursting during pumping. So this alert, for example caused by the rolling motion of the ship, should not appear if the mariner, or some automatic system, has stopped the pumping or has closed some appropriate valves.

From a functional point of view, the alert should be triggered by the combination of two conditions: the detection of a high-level and a flow towards the tank.

EXAMPLE 2 A low-level alert for a tank.

When looking at the day-tank for the main engine, the low-level alert (warning or alarm) is to prevent the main engine from shutting down. But how useful is this alert if the main engine is not in use? From a functional point of view, an alert with priority caution indicating that one of the starting conditions of the main engine is not met, or an overview of the starting conditions shown to the engineer on watch, are better alternatives.

EXAMPLE 3 Pump operation.

The operation of a pump is often confirmed by means of a pressure sensor in the debit flow. When the pump is switched on, an alert may be raised indicating that the pump is not working because the pressure sensor does not measure the expected pressure. What does this alert imply? Options include:

- the pump is not working, may be stuck or not enough power;
- a valve is closed before or after the pump and/or sensor;
- there is no fluid available from the source, the pump is running idle;
- the pressure sensor gives a false reading;
- a pipe rupture.

So, how can the operator quickly draw a conclusion regarding the operation of the pump? Apparently, only using a pressure sensor in the debit flow is not good enough. Other information is necessary such as:

- the axial rotation of the pump; and/or
- the states of relevant valves; and/or
- the entry pressure at the pump; and/or
- the power consumption of the pump.

At least, the information to be reported in the alert message should consider the available data. In case of having only the pressure sensor in the debit flow “No expected debit flow from the pump” (assuming the sensor is working correctly) may be preferred over the more common “pump not working”.

From the above cases it is clear that sometimes it is necessary to re-think the information required before a conclusion (alert) is given and that one condition (symptom) alone is not always sufficient. It helps to make a thorough analysis of the purpose of an alert, including the situations in which the alert is appreciated or expected and situations in which the alert is of no use. Unfortunately it is usually much easier to detect and report a technical problem and let the

mariner ponder upon the consequences and the appropriate action, than to design a proper functional alert.

Standards should encourage contextual thinking and allow for the variability of the context to reduce the burden on the operator.

7 Pre-BAM power failures and alarm-outputs

7.1 General

IMO and other organizations in the past introduced requirements in individual equipment standards for equipment to provide some kind of output or “alarm” to signal that equipment experiences either:

– active alarms, and/or
– system failure, and/or
– power failure.

With MSC.302(87) IMO changed its approach towards the design of alerts and stated clearly that, when current standards contain alert management provisions in conflict with MSC.302(87), MSC.302(87) takes preference.

One of the changes was that MSC.302(87) requires alert communication, and that communication is to follow a standardized concept. That concept is defined in IEC 62923 and IEC 61162-1, applying amongst others ALF and ALC sentences. With the introduction / update of these standards, all other pre-BAM external communication/indication of the presence of alerts (e.g. dry contact or ALR/ACK communication) should be replaced by that concept (referred to as “BAM communication”). As BAM communication supersedes all pre-BAM alert communication, it is no longer allowed to introduce/prescribe ‘new’ legacy alert communication in individual equipment test standards for the purpose of external alert communication.

In the case that equipment has failed completely, it can no longer perform BAM communication. The lack of reception of an ALC sentence can be used by any listener as an indication that the equipment has failed completely; from a functional point of view, this use of the ALC sentences is comparable to a normally closed output contact. On the other hand, this may only represent failure of (a part of) communication or an alert source that has been intentionally switched off.

A dry (normally closed) contact may nevertheless be used as diagnostic signal, enabling other equipment to raise an alert (see ISO 11674).

7.2 Pre-BAM alerts

7.2.1 Applying ALR sentences

Some pre-BAM standards specify the use of ALR sentences. If the purpose of that sentence is to report an alert to the mariner, then this is superseded by the BAM concept and should be replaced by BAM communication and appropriate alert information (alert title, alert descriptive text).

The ALR sentence can remain in use to convey status information for non-BAM purposes, e.g. for activating a BNWAS (see IEC 62616).

7.2.2 Pre-BAM alert ‘alarm condition’

Some equipment standards require a dry contact to signal that it has detected one or more alarm conditions. This is no longer necessary as IEC 62923 clearly specifies that the equipment has to be able to transmit each individual alert to an optional CAM system by ALF message and to provide an ALC message holding a summary of the active alerts in the system. One could

say that BAM communication functionally fulfils the requirement of an ‘alarm condition’ output, only superseding the means.

7.2.3 Applying dry contacts to inform about abnormal conditions (e.g. system failure)

A system may apply dry contacts to indicate some internal status to a connected system. This may even be about whether or not some important internal function is performing in accordance with its design.

As long as such a contact is used as informative input to the connected system(s), the use of such a contact is not violating BAM. For simple systems, this approach may even have merits, as it allows the application of devices with no alerting capability to connect to a system that deduces from the dry contact whether or not they have to alert the mariner.

An individual equipment standard may decide to specify the use of a dry contact, not as ‘alarm’ or ‘alert’, but only as an extra facility in addition to its BAM compliancy (where relevant), for instance to be connected to a BAM compliant alert panel.

7.2.4 Pre-BAM alert ‘power failure’

There are various pre-BAM requirements formulated regarding how the system should report to the mariner a power failure while the system is still capable of continuing (e.g. by switching to another power source). All requirements for an ‘indication’ are outside the scope of the BAM concept.

The state of a dry contact, often used in the pre-BAM era as means to report an alert, is not a BAM compliant alert as it does not use BAM communication; it only reports a status and does not provide a situational awareness and guidance on how to respond.

Pre-BAM requirements on power failure alarms to the mariner, where in conflict with BAM, are superseded by the BAM requirement to apply BAM communication to transmit an appropriate alert that informs the operator about the consequences of the power failure (e.g. “Power input lost” – “Backup power selected” and priority caution). A pre-BAM requirement to use an ALR sentence is superseded by the BAM requirement to use BAM communication. An alternative to an alert can be to provide an ‘indication’ instead. An individual equipment standard could require a BAM alert, an indication depending on the situation or a status signal to enable external equipment (for example a BAM compliant alert panel) to raise an appropriate alert.

It is of course not the intention of the IMO and IEC standards for BAM to require all equipment to have an internal battery or alternative power source for the purpose of this power-related alert. Only certain types of equipment are required to have an alternative power supply (e.g. an internal battery). In such cases this is clearly specified in the performance standards.

Subclause 7.3 investigates means for detecting and alerting power failures when equipment has no internal power supply.

7.3 Alerting on power problems

7.3.1 General

Subclause 7.2 discussed some of the options about converting pre-BAM alerts to BAM compliant alerts. As with any system, including BAM compliant systems, what a system should do may be different to what it can do. This implies that the requirements in equipment standard with regards to how a power failure should be responded to will be constrained by the capability of the equipment to detect and report the power failure. The latter depends on the scope of the equipment in relation to its power sources.

7.3.2 Description

Unfortunately, pre-BAM standards are not always consistent in how they use power related terms. These definitions are important for a proper understanding of the alert capabilities of the equipment in power failure situations. This document uses the following definitions, some explicitly or implicitly derived from existing international standard ISO 11674:2019:

power input
connection point of the EUT to the electrical system on board

Note 1 to entry: A power input is an external interface to the EUT and may include any AC or DC voltage as defined by the manufacturer. An EUT may have multiple power inputs.

partial power loss
absence of sufficient electrical voltage on one power input, but not on all power inputs, of the EUT

total power loss
absence of sufficient electrical voltage on all power inputs of the EUT

Note 1 to entry: Partial power loss/total power loss: from a functional point of view, a power failure may imply that the power source is lost, but it may also imply that the power source is no longer meeting the specifications (e.g. the voltage has become too low), also called power reduction, or that the power has been disconnected. Information about the exact nature of the power failure is diagnostic information, not intended for the bridge team as users of the navigation equipment.

Note 2 to entry: Partial power loss/total power loss: Few systems have an internal power source. Therefore the definitions about partial power loss and total power loss do not take into account a possible internal power source.

internal power source
provider of electrical voltage as part of the EUT, independent of the electrical system on board, capable of supporting the functionality of the EUT in part or in full for a shorter or longer period.

Note 1 to entry: An uninterruptible power supply (UPS) can be an internal power source.

power source
provider of electrical voltage to one or more power inputs of the EUT

Note 1 to entry: A power source is part of the electrical system on board.

Note 2 to entry: A power source may contain or can be an uninterruptible power supply (UPS).

7.3.3 Discussion

Only few types of equipment have an internal power source. A requirement for ‘an alert’ cannot constitute a requirement to provide an internal power source by itself. That being said, without an internal power source the possibilities of an EUT to provide BAM compliant alerts on power input losses are necessarily limited to situations in which at least one power input of the EUT is still connected to sufficient electrical voltage.

Figure 5 shows possible power input configurations.

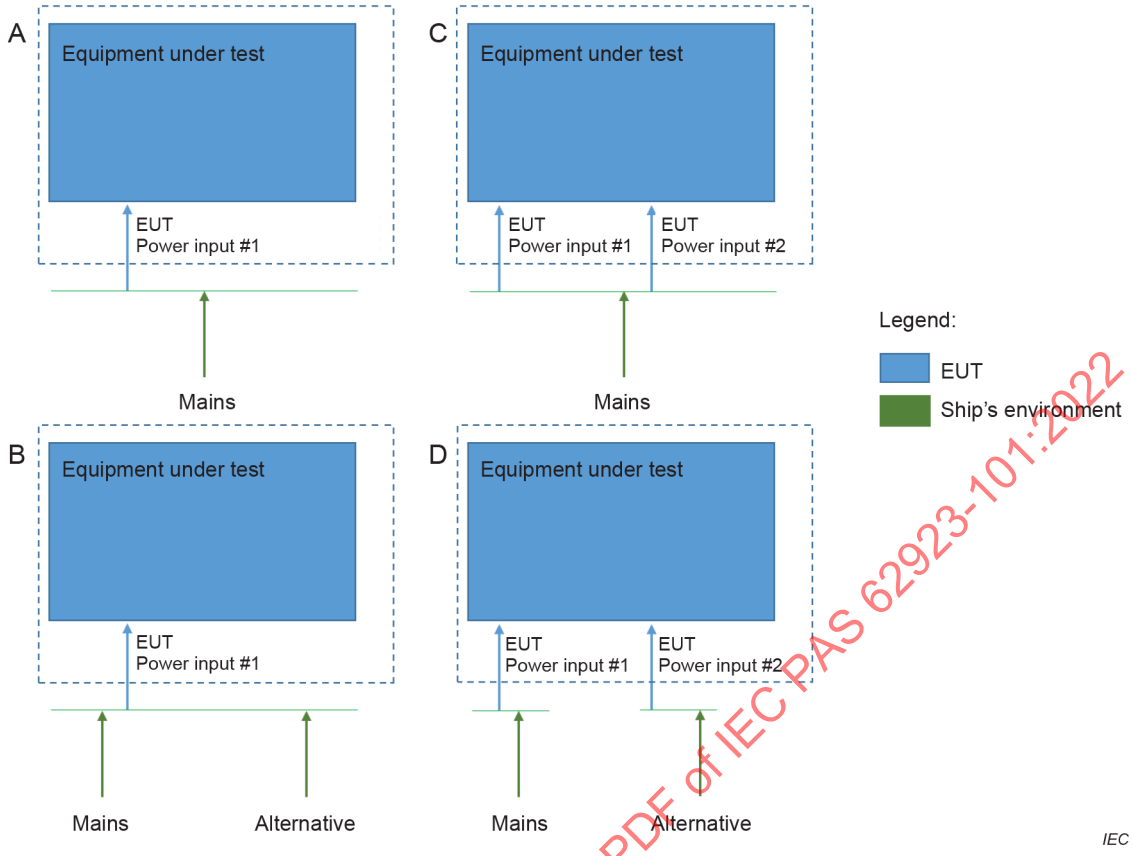

Figure 5 – EUT scope with one or two power inputs with one or two power sources

In configurations A and B, the EUT has one power input "EUT input #1" that can be monitored, regardless of the possibility that that power input may be serviced by one (A) or multiple power sources (B). Would "EUT input #1" lose (connection to) a power source, a BAM compliant alert is no longer possible to be raised by the EUT. Would either 'Mains' or 'Emergency' power source fail (B), the EUT has no way of knowing this.

In configuration C and D, the EUT monitors its two power inputs, and it can raise a BAM compliant alert when one of these fails (partial power loss). The EUT however has no way of detecting the functioning of the ship's power supply side.

7.3.4 Resolution

Equipment without an internal power source that experiences a partial power loss can be specified to provide an appropriate alert on the loss of all but the last remaining functioning power input.

Equipment containing an internal power source can be specified to provide an appropriate alert on both a partial power loss and a total power loss, but not on subsequent final failure of the internal power source (at most a pre-alert on imminent failure could be provided temporarily only). An alert can only be raised to indicate failure of the internal power source when an (external) power supply with sufficient electrical voltage remains available.

In the case of a total power loss, equipment without an internal power source cannot raise a BAM compliant alert. In such cases, where deemed appropriate, equipment can provide a status signal output to other equipment allowing an appropriate BAM compliant alert to be raised. This can, for example, be done using a normally-closed contact. In this case, individual equipment standards should include a requirement that the installation manual describes the necessary arrangements to ensure that the required total power loss alert can be raised.