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| From: e-NAV Committee | EEP20/52  Formerly e-NAV 13/output/17 |
| To: ANM, EEP VTS Committee(s)  & PAP | 22 March 2013 |

Liaison Note

Input on Disaster Recovery

# Introduction

In conjunction with other IALA Committees, the e-Navigation Committee has been requested to provide guidance on disaster recovery as part of IALA Strategy item 12. The Annex to this paper considers disaster recovery, from an e-Navigation perspective, but may not cover aspects relevant to each committee.

It was also noted that a reference to disaster recovery should be considered for inclusion within the NAVGUIDE, with deadline for inclusion of October 2013.

# Action requested

The ANM, EEP, VTS Committees & PAP are requested to consider:

1. Whether the information at Annex A could form the core of a general IALA Guideline on Disaster Recovery.
2. What additional information on disaster recovery can be provided by the other Committees.
3. Whether ANM should lead the development of this Guideline on disaster recovery.
4. PROPOSED IALA GUIDELINE ON DISASTER RECOVERY
5. Introduction

The 2010 IALA Conference was made aware of the ongoing dangers of natural disasters, with earthquakes in Chile and Haiti very much front page news immediately beforehand. The earlier Hurricane Katrina and Indian Ocean Tsunami, and more recent earthquakes severely affecting New Zealand and Japan, have further contributed to awareness of the risk.

This paper seeks to advise IALA members regarding:

* planning for disaster recovery;
* action required and support needed to recover from disaster;
* assess e-Navigation implications under disaster scenarios;

1. Disaster scenarios

Whilst every incident is unique and to some extent unforeseeable, there are common factors that may be used for general emergency planning and response activities. Incidents likely to affect IALA members are coastal or offshore in nature and typically are:

* earthquakes causing physical damage to infrastructure, disruption to the seabed; and/or
* tidal waves;
* volcanic eruptions;
* major fires destroying shore infrastructure;
* tropical cyclones causing physical damage to infrastructure;
* major flooding incidents;
* destruction derived from human conflicts.

The potential consequences of each of these scenarios can include death and injury to people, infrastructure damage including failure of power, water and telecommunications services, loss of housing etc.

From a maritime administration’s viewpoint, specific issues may include:

1. Port facilities being rendered inoperable by damage, and therefore unable to contribute to disaster recovery;
2. Port facilities being rendered inaccessible by change to the waterways and/or damage to the Aids to navigation infrastructure, namely:
   1. Channel bathymetry and limits;
   2. Physical AtoN (visual, Radar);
   3. DGNSS and/or other Augmentation systems;
   4. AIS base stations.
3. Disruption to Coastal navigation caused by damage to Aids to Navigation infrastructure, namely:
   1. Physical AtoN (visual, Radar);
   2. DGNSS and/or other Augmentation systems;
   3. AIS base stations;
   4. VTS supporting systems (RADAR, AIS, Communications).
4. Isolation of coastal communities or island by damage to the maritime transport infrastructure.
5. Potential damage to AtoN services

Shore-based AtoN may suffer damage including physical destruction or damage to the supporting structure, mechanical damage to the AtoN or loss of power supplies. In each case the response required will be different, and may involve the:

* repair of AtoN;
* implementation of temporary AtoN of similar or lesser output, at the same or different location;
* use of installed or temporary standby power supplies;
* re-survey of surviving AtoN positions.

In some cases, solar-powered AtoN may provide an adequate solution, in either the short or longer term. These are relatively easy to deploy, and are likely to be more reliable and safe than temporary mains power supplies.

It is likely that any local power supply network will be damaged or destroyed.

It is likely that any local communications network, fixed or mobile, will be damaged or destroyed. Any remaining network may be stressed by emergency service and personal communications.

The event of land mass movements, will not only affect the chart and hydrographic data but also any radio navigation system supported by terrestrial stations. The position shift of the referenced station has various levels of consequences in both satellite and terrestrial based system (e.g. DGNSS reference station and eLoran station).

1. Role of AtoN Authorities

Aids to Navigation authorities may be able to support disaster recovery by:

* utilisation of AtoN support vessels to physically mark re-opened shipping channels;
* restoration of AtoN services where these have been damaged, in both short and long term;
* provision of additional physical AtoN, or temporary Virtual AtoN to:
* mark channels;
* deliver recommend routes;
* mark cautionary areas.

Note: provision of virtual AtoN and AIS services relies on the availability of GNSS and AIS base stations.

* 1. DGNSS and terrestrial based radio navigation systems

The availability of DGNSS and /or terrestrial radio navigation systems to provide reliable and appropriate PNT information will be fundamental for the assistance in conducting local surveys, and in navigating relief vessels through restricted waterways into affected ports.

Where the AtoN authority has a policy of providing radio navigation services, restoration of damaged stations should form part of the Disaster Recovery Plan. This should include surveying of a temporary reference station, re-survey of existing equipment, provision of a power supply and erection of temporary MF antennae.

* 1. Virtual AtoN

Where it is likely that relief vessels will have the capability to utilise AIS AtoN, the deployment of Virtual AtoN from ship or shore-based transmitter offers a rapid response, either for the replacement of damaged or missing buoyage, or for additional marking of revised channels. For example, relief vessels may be of a greater or lesser draught than those that normally use the selected port, and alternative navigation channel marking may be appropriate.

AtoN authorities should consider the fit of AIS transmitters capable of broadcasting Virtual AIS to their service vessels, and should develop procedures for use of this equipment.

Virtual AtoN may also be used to provide guidance for routing.

* 1. Visual and radar AtoN

In a first stage visual AtoN may represent the quickest and most reliable solution to provide guidance to shipping. Three key factors are to be considered for their adoption:

1. Visual AtoN may be provided almost anywhere in short notice. Additionally, in their simplest design they don’t require any type of energy source (unlighted marks), but even lighted marks may be implemented in short time;
2. In those scenarios we may need some time until the stabilization of the environmental conditions. It is relatively easy to adjust the position and configuration of the visual AtoN in accordance with the changing environment;
3. In situations where the nautical chart or ENC are no longer reliable, visual AtoN may become the sole mean to provide navigational guidance. Visual AtoN support relative navigation techniques as opposed to radio navigation systems that provide an absolute position and therefore require chart information to be used. For instance, once a clear passage is identified, the implementation of one or more leading lines, possibly in conjunction with floating marks, is sufficient to support the execution of the passage plan.

When establishing floating aids or navigational channels, it is necessary to account for further changes in the seabed, as it will take some time for the stabilization of the sea bottom. These events may require changes in the buoy positions or alterations in the channel limits.

* 1. AtoN Authority response

Priority of AtoN repair / implementation must be preceded by an assessment of marine operational requirements (e.g. some channels may need to be changed).

Amongst other things, it is necessary to obtain the mission objective, collect meteorological and oceanographic information, and assess the available equipment and staff. Based on the obtained information, a rapid mission impact analysis has to be carried out in order to establish the best line of action.

For crisis response situations, the easiest way is to perform a risk assessment (probability/impacts) of the following stages and considering the described elements:

* + 1. First stage:

1. Positioning method: accuracy, reliability, data management, autonomy, personnel expertise.
2. Oceanographic and Weather conditions: visibility, currents, swell.
3. Survey boat: manoeuvrability, attitude, autonomy; personnel expertise.
4. Survey method; accuracy, reliability, data management, autonomy, tide observation, personnel expertise.
5. Area to survey: best, recommended and minimum option.
   * 1. Second stage, after defining the areas of action, assess:
6. Land preparation time.
7. Processing and plotting time.
8. Product / service appropriateness.

Established routes must be surveyed periodically, in order to account for large wrecks that may be rolling on the seabed. Additionally, at the surface it is necessary to monitor the floating debris, that might damage the AtoN and present a hazard to safe navigation.

In response to a large-scale disaster, the planning and conduction of disaster relief operations can benefit from the use of aerial / satellite imagery to identify the extent of any damage.

1. Impact of e-Navigation concept in disaster situations
   1. Advantages of e-Navigation based solutions:
2. Mixed solution of positioning and communication systems, represents a strength and enhances the resilience of the overall system.
3. The use of digital information facilitates the updates of databases, for instance as hydrographic surveys are concluded or new AtoN are implemented, it is relatively easy to provide and/or perform updates in the information systems (e.g. updates to the ENC in the ECDIS or AIS info into the radar).
4. Virtual AtoN may be used to provide guidance to shipping.
   1. Disadvantages of e-Navigation based solutions:
5. e-Navigation largely depends on electronic systems and on the provision and use of digital information. Deprivation of ENC information and / or radio navigation systems severely limits the capability to conduct navigation.
6. There is a trend in reducing Bridge personnel due to the implementation of systems such INS and IBS in the ships. Despite all the adopted measures to assure the integrity and reliability of the ships systems, those strongly rely on the provision of external services (e.g. ENC and PNT). If these are degraded, the ship may have to adopt traditional navigational techniques, which requires more bridge personnel that are no longer available.
7. Disruption of communication channels and networks will most probably affect the operation of a large numbers of Maritime Service Portfolios. Restoration of the full capability will obviously depend on numerous factors, namely on the type of information that it deals.
8. Planning for Disaster Recovery

Authorities will be in a better position to contribute to Disaster Recovery if they have developed contingency planning for such scenarios. Whilst it is difficult to anticipate every scenario, it is possible to develop a set of generic responses.

These responses should take into account that speed of response is often essential, as the most useful responses are those that are implemented within hours, or at most a few days, after the disaster event.

The Disaster Recovery Plan should include the development of joint plans with other relevant National and local agencies, and identification of potential areas of co-operation. The Plan should be exercised at regular intervals to ensure that personnel are aware of their roles and to feed back improvements into the Disaster Recovery Plan.

The Disaster Recovery Plan should include an assessment, based on a set of representative scenarios, of risks associated with damage to marine related infrastructures (navigational routes/channels, AtoN, port facilities). This plan should include a prioritized list of AtoN based on their categories and relevance within the designed scenario, (e.g. DGNSS stations, as they may provide relevant information to measure land mass movements, support survey works by providing greater accuracy/integrity).

Marine-based planning should include:

* the contribution that the authority may be able to offer to other agencies, or authorities in affected areas;
* the available stores (including fuel) to deploy, and from which place or port (for precautionary reasons, critical stores should not be kept at vulnerable places);
* buoyage stocks and availability, for deployment at short term;
* the shore-based staff that may reinforce ships staff, to assist with planning and communications roles, and other tasks related with disaster relief operations;
* a list of available survey-qualified staff;
* the available capabilities to collect and disseminate survey data, addressing following elements:
* existing geo-referenced information (chart data, AtoN, control points, images, …) and in which formats;
* portable / handheld radio positioning sensors;
* angle and distance measuring instruments;
* depth measuring instruments and sensors (echo sounders);
* tide observation instruments (tide pole or gauges);
* GIS capabilities to support the survey planning, data collection and provision of chart information (paper of digital format);
* data collection and data analysis software;
* plotting capabilities.

Shore-based planning should include:

* the available technical staff;
* the capabilities to deploy staff and spares;
* the spares (including fuel) holdings to facilitate the deployment of temporary shore-based AtoN;
* the buoyage spares holdings;
* capability to restore AtoN services, including DGNSS and AIS base stations;
* the capability to deploy electrical generators;

Early warning of potential disasters may be detectable by maritime systems; timely communication of such information to affected agencies should be provisioned.

It may be possible to use modelling techniques to better understand the impact of predictable disaster situations in areas such as safe navigation channels, flooding risk, communications infrastructure etc.

1. Contribution to other agencies to Disaster Recovery

Aids to Navigation authorities may be able to contribute to disaster recovery by utilisation of AtoN support assets with the following function:

* SAR vessels;
* helicopters (for reconnaissance and logistic purpose);
* survey vessels;
* utility purposes vessels;
* provision to supplies to cut-off communities.
  1. Use of AtoN support vessels

In Coastal disaster scenarios, a major part of disaster recovery involves the supply of bulk goods such as food, fresh water, temporary housing etc. This will be facilitated by the opening up of affected ports. AtoN support vessels may be particularly useful in these scenarios as, in addition to AtoN deployment capability, they **may**possess:

* survey and reconnaissance capability;
* lifting capabilities to transfer stores or vehicles;
* command and control capabilities to support disaster relief staff, namely:
* long range communications capabilities, by satcom or MF/HF radio.
* portable radio equipment (VHF, HF, satcom);
* the facility to transmit photographs and video images by satcom;
* provision of paper or digital charts and chartings facilities;
* computers and printers;
* handheld GNSS receivers;
* radars to support maritime surveillance, and temporary VTS facilities;
* meteorological support, access to weather analysis and forecast information, weather observations instruments (wind, temperature, pressure, …).
* accommodation facilities for emergency services or disaster relief agency personnel;
* surplus electrical generation capacity;
* fire-fighting capability, with possibility to deploy equipped personal to support land operations;
* potable water generators;
* kitchen facilities to support preparation of meals;
* refrigeration facilities;
* small boat provision and operating skills;
* gelicopter support facilities;
* support of SAR operations;
* technicians to support re-establishment/repair of shore facilities (electricians, mechanics, …).

1. References
2. IHO Resolution “IHO Response to Disasters” (1/2005 as amended),
3. IALA Guideline 1081 on Virtual Aids to Navigation Edition 1, 03/2010
4. Food for thought:

* utilization of available maritime assets such as: boats, ships, mariners, equipment (GNSS receivers, echo sounders, portable radios …);
* health and safety of personnel, as well as security of assets, equipment and stores;
* considerations over the application of bar sweep hydrographic survey; although it does not provide accurate information over the available waters, it is efficient in performing a safe navigation check of the surveyed area;
* utilisation of Precise Point Positioning (PPP) techniques should be considered, as these don’t depend on earth surface references;

Additionally, with carrier phase observation it is possible to measure the water level referenced to a Earth Centred Reference System.

* handheld GNSS receivers should have filter algorithms designed for survey applications (e.g. static observations);
* in some scenarios, it is extremely important to determine the impact on the tide pattern, since the tide alteration (spatial and time decorrelation to the modelled tide) may be sensed over some weeks;
* on the ship-side, it is necessary to develop new tools to facilitate the collection, edition, analysis and portrayal of marine information.

GIS based application may provide a relevant contribution to the required solution.