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| IALA Guideline |

Secretariat Note:

Please be aware of other IALA Guidelines on simulation and consider if this paper should be incorporated into an existing Guideline:

* Guideline 1058 from ARM
* Guideline 1097 from ENG
* Guideline 1027 from VTS

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Operation and Management For AtoN simulator-Proposal Draft

Edition 1.0

Document date

Revisions to this IALA Document are to be noted in the table prior to the issue of a revised document.

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| Date | Page / Section Revised | Requirement for Revision |
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# INTRODUCTION

Since the marine safety accidents have increased due to the large and higher speed of the harbour departures and vessel traffic. In the world's major countries, it is strongly required to make sure to ensure the safety of maritime traffic in coastal waters ports. The technology of Aids to Navigation (AtoN) simulator system is an innovative technology that can completely change the paradigm of AtoN design and AtoN placement method. IALA also recommended the simulator system as a tool for the AtoN design and AtoN placement plan.

According to the IALA Guideline 1058 on the use of simulation as a tool for waterway design and AtoN planning, the system needed to verify the design and planning aids to navigation, which can support a decision on AtoN design and placement planning. Simulation is a relatively low-cost method that used to meet user needs in an efficient manner for AtoN design. Improvements in the simulation of operating results help to demonstrate. The seaway design and operate of the relevant aids to navigation before the ship sailing. In addition, recommended for final Aids to navigation placement verification to use the Full Mission Bridge Simulation System.

According to the IALA Guideline 1097 on Technical features and technology relevant for simulation of AtoN, AtoN simulator is a system for support for decision for optimal aids to navigation utilization and efficiency of sea conditions and maritime traffic environment. The simulator can perform research and development of existing and future systems and aids to navigation system. The simulator is describe that it is important to users (designers, sailors) to participate in the simulation analysis and evaluation for the establishment planning of AtoN.

For this reason, AtoN simulator system has developed based on ship operation simulator. An AtoN Simulator provides simulation circumstances, including the topographical and environmental characteristics of a primary harbour and the characteristics of a navigating ship and the maritime traffic. AtoN are important in providing navigation information to a ship. Previously, planning the distribution of AtoN was carried out using the experience of an expert and a marine chart. Recently the size of the ships, the vessel traffic and the complexity of the harbour area are increasing, and so the need for a scientific design technique for planning the distribution of AtoN is increasing.

The proposed making AtoN simulator operation and management guidelines for AtoN simulator operation and management. This guideline contain the contents of the AtoN simulator system configurations definition necessary for the AtoN simulator operation and management, definitions of term used in operating the simulator, consideration on the simulation plan to review the range and preference before the simulation, simulator operating procedure defined by the step-by-step execution procedure, processing procedure in case of failure. Also, contain the procedure of backup and way for protection the simulator system and data retention, consideration for documentation to simulation analysis and results.

# SCOPE

This Guideline covers:

• System configuration

• AtoN placing adequacy module technology

• Simulation planning

• Operation perform

• Failure management

• Backup management

• Requirements for analysis, reporting and documentation

# DEFINITIONS

A list of definitions provided at ANNEX A.

# SYSTEM CONFIGURATION

The objectives of the AtoN Simulator are to develop the design and construction technology of an AtoN simulator system with full mission bridge, AtoN manager and operating equipment. Full mission simulation validates the effectiveness of the mix of aids to navigation in combination with specific manoeuvring aspects and definition of Standard Operating Procedures. The full mission simulator is characterised by a typical 210 degree field of view projected onto screens. Instrumentation, handling and communication equipment are real. The AtoN simulator system is developed to assist the decision making in AtoN design and placement plan, taking into account the impact of topographical, environmental and maritime traffic characteristics of a targeted navigation area.

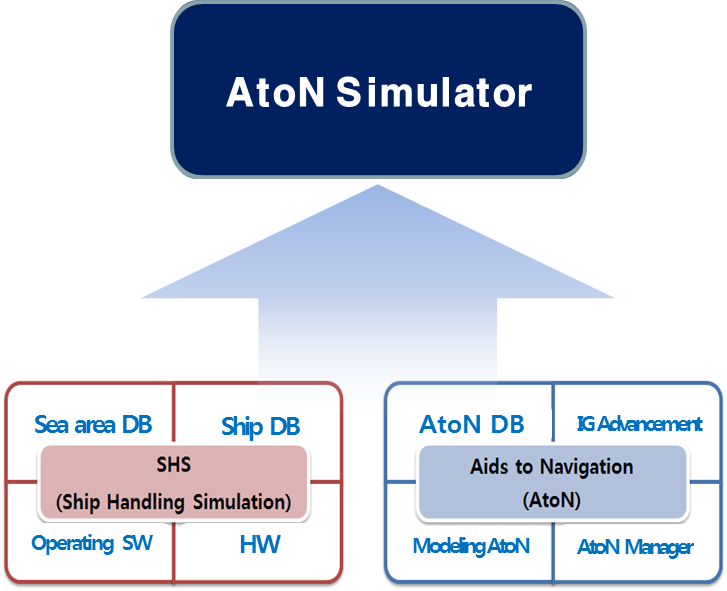


1. Full mission bridge of AtoN simulator



1. Operating and control equipment of AtoN simulator

The AtoN Simulator consists of ship handling simulator parts and AtoN operation parts. Ship handling simulation part consists of sea area DB, Ship DB, Operating SW, HW. Sea area DB and ship DB are simulation target area and target ship data. Operating SW and HW required for the ship handling and navigation. AtoN part consists of AtoN DB, IG, modelling AtoN, AtoN Manager. The database stores the properties (type, specifications, colour, visibility of light, etc.) of the various AtoN the existing in Korea, AtoN Manager is database management software that allows users to easily modify and edit the database and intuitively checking in conjunction with simulators and systems. Advancement of the three-dimensional image can be identified intuitively a number of effects on the establishment and relocation of the AtoN, Modelling AtoN should look similar to the real in simulation.



1. Configuration Diagram of AtoN Simulator
2. System configuration table

|  |  |  |  |
| --- | --- | --- | --- |
| **Division** | **Operation Room** | **Simulator Room** | **Note** |
| Function | · Control and operation simulator | · Visualization verification and training space  · AtoN placing adequacy verification  · AtoN functions adequacy verification |  |
| S/W | · AtoN Manager  · 3D images software  · IOS and Motion Solver | · Radar and ECDIS linkage SW  · Fog signal audio linkage SW |  |
| H/W | · Operation console  · 5 channel visualization display(5 EA)  · AtoN Manager monitor(1 EA)  · Simulator operation PC(3 EA) | · Visibility reproduction system: screen,  beam projector(5 EA)  · Ship control room(bridge)  · Sailing equipment: steering wheel, engine controllers,  radar, ECDIS, etc. |  |

# AtoN Modelling

AtoN are provided to help safe navigation by using light, shape, color, sound and radio. AtoNs provide a great deal of visual information and so the AtoN Simulator must be developed to reflect this point. The AtoN Simulator must create a realistic visualization of the maritime environment including the AtoNs. This system performs the design and implementation of a visualization system that is a sub-system of the AtoN simulator. This system reflects a variety of visualization factors related to AtoN. In addition, the AtoN experts can make decisions and evaluate the visual effects of the AtoN.

EMB000019900b00

1. Configuration of operation SW for visualization

This system is necessary to visualize the picture carried through the 3D modeling of the AtoN such as Manned Lighthouse, Unmanned Lighthouse, Beacon, Leading Light, Lighted Buoy, etc. The Visual System provides daylight, dusk and night scenes in true perspective and true colour. It shows the terrain features, waterways, AtoN such as lighthouses, navigation marks and buoys, etc.

|  |  |
| --- | --- |
| EMB000019900b0c | EMB000019900b0e |
| Manned Lighthouse | Unmanned Lighthouse |
| EMB000019900b0d | EMB000019900b11 |
| Beacon | Light Staff |
| EMB000019900b0f | EMB000019900b12 |
| LANBY | Buoy |

1. 3D modeling pictures of AtoN

# SIMULATION PLANNING

Listed below are a number of issues that should be carefully considered when planning a simulation study:

• The range of sea areas for simulate

• Environmental conditions of the sea areas

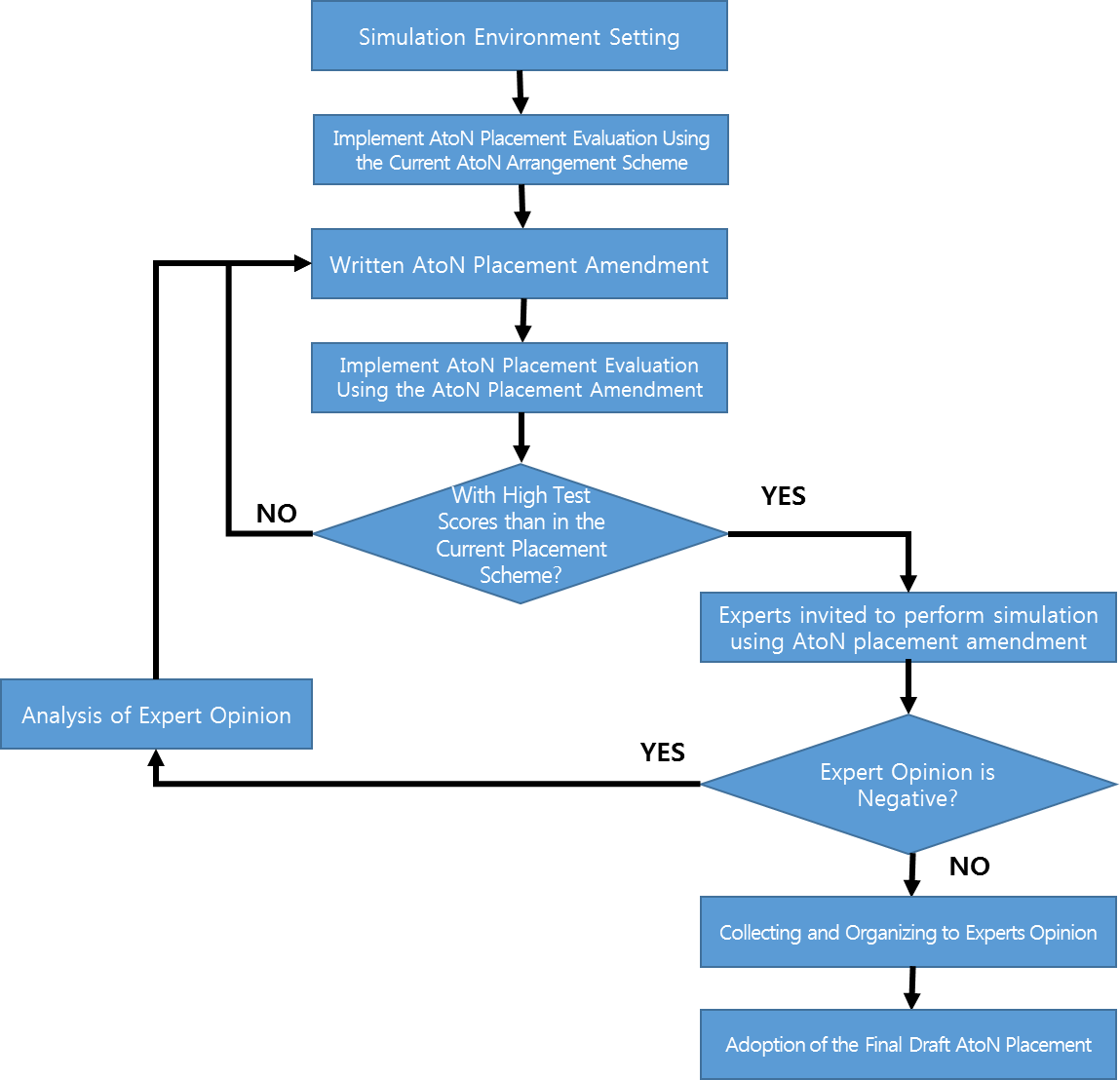
• The main passage of vessels and traffic volume of seaway

• Determining environmental simulation setting

• AtoN placement status of sea areas for simulate

# OPERATION PERFORMANCE

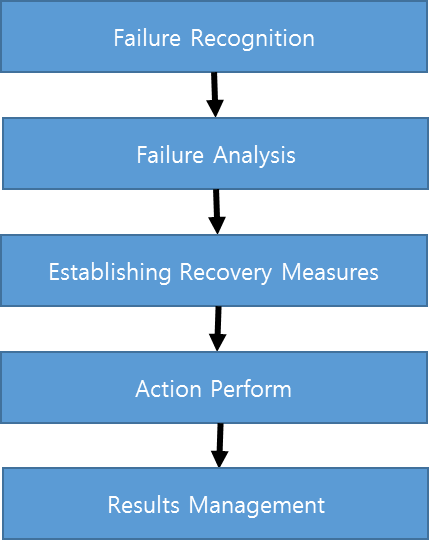
The operation of AtoN simulator conducted based on the established simulation planning. Figure 6 shows the basic simulator operating procedure. A simulator operation follows the basic operating procedure.



1. Operation Procedure Diagram

# FAILURE MANAGEMENT

Failure management is the process of observation, diagnosis, reporting, control and treatment whether the system failure for failure failures, service outages, etc. of the AtoN simulator target system. Procedure in the event of failure are show in Figure 7.



1. Procedure in The Event of Failure Diagram
2. Procedure description table

|  |  |  |
| --- | --- | --- |
| **Division** | **Procedure Description** | **Note** |
| Failure Recognition | · This step is checking the failure condition through the simulator operation. |  |
| Failure Analysis | · This step is determine to occurring failure circumstances and causes. |  |
| Establishing Recovery Measures | · This step is collecting a similar failure cases and establishing failure recovery measures by notifying the appropriate person. |  |
| Action Perform | · This step is performing failure recovery action based on recovery measures. |  |
| Results Management | · This step is writing a failure management notes failure recovery and future measure. |  |

# BACKUP MANAGEMENT

To ensure the permanence of AtoN simulator disasters such as fire or failure of aids to navigation simulator that become lost or damaged due to stored information or system with the data stored on separate media for a constant time difference, so that system or files even to a fire accident damage can be repaired with the backup contents.

1. Backup list table

|  |  |  |  |
| --- | --- | --- | --- |
| **Equipment** | **Target** | **Backup Contents** | **Cycle** |
| AtoN Manager PC | · The whole system of AtoN Manager PC. | · Full system backup | · 1 time / 1 month  · When system changes |
| IOS PC | ․ The whole system of IOS PC |
| IG Server(5 EA) | ․ The whole system of IG Server |
| Motion Solver PC | ․ The whole system of Motion Solver PC |
| RADAR PC(2 EA) | ․ The whole system of RADAR PC |
| NID PC | ․ The whole system of NID PC |
| ECDIS PC | ․ The whole system of ECDIS PC |
| ODD PC | ․ The whole system of ODD PC |
| AtoN Manager PC | ․ AtoN properties database | · Database backup | · 1 time / 1 month  · When content changes |
| IOS PC | ․ Ship motion characteristics database |
| ․ Scenario database |
| ․ Simulation results file |
| IG Server(5 EA) | ․ Modeling and ‘scd’ file |
| Motion Solver PC | ․ Motion Solver SW |
| ․ KRISO\_HOST |
| ․ KSSI\_HOST |
| RADAR PC(2 EA) | ․ RADAR\_host |
| AtoN Database | ․ AtoN database for each intendance |

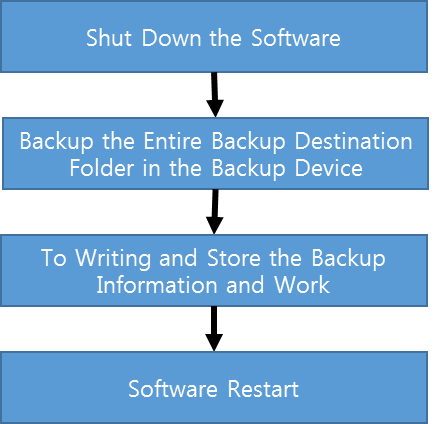
## Backup procedure

AtoN simulator backup proceed separated by system and database. The system follows the same procedure as in Figure 8.



1. System Backup Procedure Diagram

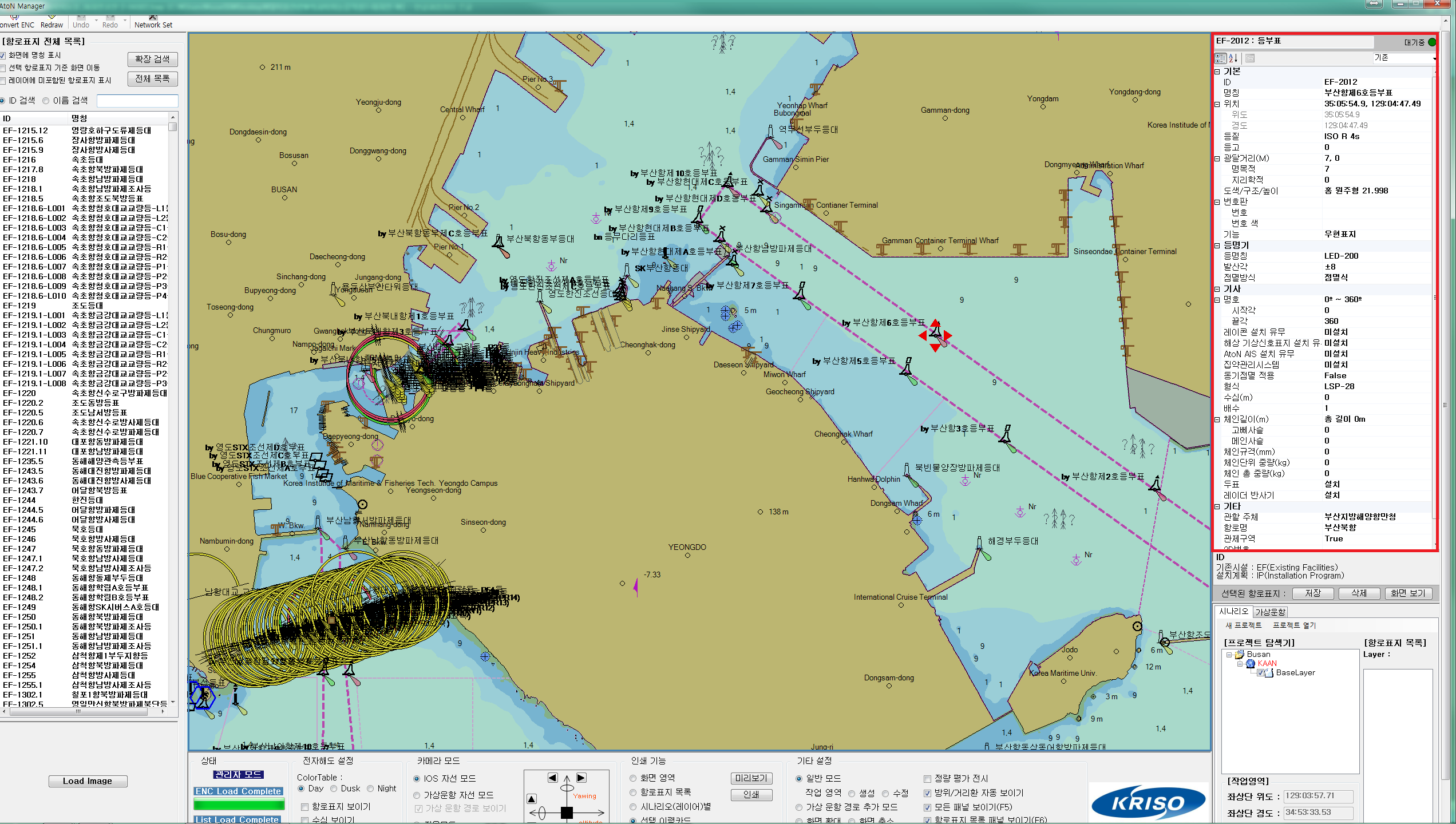
The database follows the same procedure as in Figure 9.



1. Database Backup Procedure Diagram

# ATON PLACEMENT ADEQUACY MODULE TECHNOLOGY

The AtoN Manager software was developed as a virtual/real AtoN management for AtoN simulation. The AtoN data software was assigned the difficult task of managing the conversion to electronic data; they are complicated large data that include the various properties of AtoN systems. In addition, the operation of an AtoN simulation system is needed for managing the database of AtoN properties effectively. Therefore, this system was a structural database of AtoN properties based on the analysis of AtoN properties for implementing visual simulation.



1. Picture of operation of AtoN Manager for AtoN simulation

IALA recommends the required illuminance which is needed to identify the aids to navigation. It does not mean the quantities for navigator to be able to figure out the existence of the AtoN, but the quantities for one to able to figure out the instruction of AtoN. Visibility of AtoN assumes that if the illuminance acquired on the eyes of the navigator is bigger than the required illuminance, the navigator can identify what the AtoN informs one of. The required illuminance for visibility is given by 2x10-7 lux for night and given by 1x10-3 lux for day. One for night is based on the assumption of no background light. One for day is based on the assumption of meteorological conditions with bright cloud or clear sky close to the direction of the sun.

The required illuminance for night needs to be compensated by containing the effect of the background light since the visual recognition is carried out by getting the light contrast between the interested light source and the background light. The required illuminance has to be determined according to the status of the background light. The state of the background light is mainly changed with the existence of the background light, the distributed area, and the intensity of the light source.

While the required illuminance is given by 2x10-7 lux for no background light, the required illuminances are recommended by 2x10-6 lux for minor background light and by 2x10-5 lux for substantial background light, respectively. Let denote the required illumination and denote the ratio of the background light. It is defined to employ the effect of the background light and is in the range from 0 to 1. It is defined that no background light corresponds to ; minor and substantial background lights correspond to and , respectively. Based on the relationship which Figure 1 shows and using a liner interpolation method, the logarithm of the required illuminance is formulated by employing the ratio of background light as follows.

 (1)



1. Relationship between the required illuminance and the background light

The visibility of an AtoN depends on the light source, the weather condition, and the position of the navigator on the sea. The visual range within which a navigator can detect and identify an AtoN increases according to the luminous intensity of the light source. Weather conditions are important: for example the visual range in clear air is greater than in fog. According to the position of the navigator - including the level of the eye, an AtoN may be affected by background lights or other AtoN. Also, the level of the eye affects the geographical range due to the curvature of the Earth. The emitted light is attenuated by dispersion and absorption during its passage through the air and the particles it contains. Thus the air conditions and the distance between the AtoN and the navigator set out the actual level of attenuation. For estimating the visibility, the light arriving at the navigator is quantified as the luminous incidence or illuminance, and is termed the ‘acquired illuminance’ when perceived by the unaided eye.

The visibility performance measures are introduced in order to quantify how well the navigator recognizes the signal provided by the AtoN light. In order to evaluate the performance measures, calculation of the performance by the simulation is carried out using the AtoN placement. Simulations should be carried out assuming that the AtoN database is reliable. For reasonable simulations, AtoNs are selected from the pre-installed AtoN at Busan port in South Korea. Since it has been installed for a long time and has guided many navigators, the placement can be considered to have been well adjusted. For simplification, the background effect created by facilities on land is ignored



1. Selected AtoN Placement at Busan Port(Korea)

The AtoNs to be investigated for visibility appear within dotted circles and are allocated twelve numbers. A ship’s virtual path along with the known waterway is established as the arrow line, the heading angle of which is -55.29°. The virtual cruise starts in the bottom right-hand corner at latitude 35.0785285° (north) and longitude 129.11338° (east) and ends at latitude 35.105793° (north) and longitude 129.065496° (east). For calculating the amount of recognition, the specified waterway is divided into about 550 small waterways of 10 meters in length.



1. Performance measures of AtoN Placement

The AtoN Simulator is designed to assist decision making for AtoN design and AtoN position planning according to the performance measures based on visibility for effective placement of AtoN with topographical, environmental and maritime traffic characteristics of the targeted navigation area.

# REQUIREMENT FOR ANALYSIS, REPORTING AND DOCUMENTATION

Must be able to analyse the simulation in order to provide the appropriate conclusions and recommendations.

The report should consider the following. :

• Purpose of Simulation

• Description using ship in the simulation

• Description simulator environment setting (Wind, Current, Wave)

• AtoN properties data

• Expert opinion on the current AtoN placement schema and amendment

• Description to result of Aton placing adequacy evaluation

As mentioned above, report shall include the proposed AtoN location and environment of the simulation for the simulation area. Data must present in a digital form.

2. DEFINITIONS

|  |  |
| --- | --- |
| **Term/Acronym** | **Expansion/Definition** |
| AtoN | · In IALA Guideline 1058 the following definition has been used:  An aid to navigation is a device or system external to vessels that is designed and operated to enhance the safe and efficient navigation of vessels and/or vessel traffic (includes Vessel Traffic Services (VTS)). |
| Simulation | ․ In IALA Guideline 1058 the following definition has been used:  Simulation is the process of designing a model of a real system and conducting experiments with this model for the purpose either of understanding the behaviour of the system or of evaluating various strategies (within the limits imposed by a criterion or set of criteria) for the operation of the system.  Thus the model must be designed to mimic the response behavior of the real system to events that take place over time. Therefore, for the purposes of this Guideline, a more accurate definition is as follows:  Simulation is the imitation of the operation of a real-world process or system over time. The act of simulating something first requires that a model be developed; this model represents the key characteristics or behaviours of the selected physical or abstract system or process. The model represents the system itself, whereas the simulation represents the operation of the system over time. |
| Channel | ․ In IALA Guideline 1058 the following definition has been used:  A stretch of water of limited width and depth generally in the approaches to ports and harbour with defined route(s) for vessel passage as marked by Aids to Navigation |
| Design Ship | ․ In IALA Guideline 1058 the following definition has been used:  One or more ship types selected for modelling in the simulation of a waterway. |
| Hardware | ․ The collection of physical elements that constitutes a computer system |
| Software | ․ The part of a computer system that consists of encoded information or computer instructions, in contrast to the physical hardware from which the system is built |
| Database | ․An organized collection of data. As written in the list, by storing integrated information of various application systems is a bundle of public data that can operation. |
| Backup | ․ Refers to the copying and archiving of computer data so it may be used to restore the original after a data loss event |
| AtoN Manager | ․ AtoN properties management program for AtoN simulator |
| IOS SW | ․ Responsible for operating the simulator, simulation settings and control for AtoN simulator program |
| ECDIS | ․ ENC and Information Display Program |
| Radar SW | ․ The vessel and other vessels position, speed, ship operation data display program |
| Modeling | ․ In IALA Guideline 1097 the following definition has been used:  The process of developing a schematic description of a system, theory, or phenomenon that accounts for its known or inferred properties and may be used for further study of its characteristics. |