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Integrated Extension Alarm System for Machinery and Cargo Monitoring

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Abstract: A marine automation system for merchant ships consists of machinery control & monitoring system and cargo control & monitoring system. Extension Alarm System (EAS) has been installed for machinery control & monitoring system to provide machinery alarms to bridge, cabins, and public areas. However, EAS of the latest marine automation systems requires the integrated functionality for both machinery and cargo monitoring. In this paper, we introduce general features of EAS and design Integrated Extension Alarm System (IEAS) for ACONIS-2000® system, which is the integrated marine automation system developed by Hyundai Heavy Industries co., ltd. Extension alarm panels of IEAS are classified by the system type and display the information received from the alarm server of ACONIS-2000®. Therefore, IEAS can transfer machinery and/or cargo alarms to the on-duty engineer according to the system type of alarms. In addition, IEAS provides the flexibility of the alarm group and duty configuration.

1. MARINE AUTOMATION SYSTEM

A marine automation system for merchant ships such as oil and gas tankers, bulk carriers, and containers consists of machinery control & monitoring system and cargo control & monitoring system. The main purpose of the system is to give ship's engineers and/or officers all the basic alarms and status information in order to maintain safe and efficient operation of the machinery and cargo equipment. Marine automation systems have capabilities of providing requirements such as alarm and monitoring, tank level indication, engine/ auxiliary/generator control, remote diagnostics, and system integration according to clients' preference.

There are many commercial marine automation systems: DataChief C20, MOS 2200, SSAS-Pro, and Mega-Guard MCMS. Each system is based on the architecture of distributed control concepts and provides similar functionality. The general features of marine automation systems are shown as follows:

Cost Efficiency

Saving labor costs through unmanned operation, improved maintenance by self-diagnostic features, and integration of engineer calling system, extension alarm system and fire alarm indication

Flexibility

Easy configuration of signals and functions, open platform for interfacing to external systems, modular design for easy adoption/extension, and cargo alarm system whether as integrated or stand-alone solution

User-Friendly Display

Intuitive graphical interface, easy operation with user friendly function, fast access to information anywhere on the ship, and various dedicated display pages such as mimic pages, alarm pages, group pages, trend pages, inhibit pages, and Day/Night vision

Safety and Reliability

Use of class approved equipment and functions and redundancy of various parts such as workstation, controller, power supply, and system network

2. EXTENSION ALARM SYSTEM

Extension Alarm System (EAS) provides machinery alarms to bridge, cabins, and public areas for an unmanned engine control room. Extension alarm panels at each location are connected with the marine automation system via the system network. They display the information for machinery alarms and settings such as alarm group status, alarm channel, operation mode, and on-duty selection. In addition, EAS has functions for operation mode selection, on-duty selection, and engineer call.

EAS has two operation modes: Engine Control Room (ECR) mode and Wheel House (WH) mode. ECR mode indicates a manned engine control room. In this mode, EAS need not transfer any machinery alarms to the on-duty engineer because the engineer in engine control room can acknowledge and take actions for activated alarms. Therefore, only extension alarm panels in engine control room and public areas are activated for machinery alarms. On the other hand, WH mode represents an unmanned engine control room. In this mode, EAS requires on-duty selection and should transfer machinery alarms to the on-duty engineer(s). For example, if the operation mode of EAS is WH mode and the on-duty engineer is the first engineer, extension alarm panels not only in bridge and public areas but also in the first engineer's cabin are activated for machinery alarms and the first engineer should acknowledge and take actions.

The on-duty engineer is responsible for acknowledgement of machinery alarms and taking actions to normalize the machinery status. If the on-duty engineer fails to do so, the other crews may face serious problems. To protect the failure of the mandatory work of the on-duty engineer, EAS provides the dead man alarm function. In other words, if a machinery alarm is activated and the on-duty engineer fails to acknowledge, a dead man alarm signal is given to all extension alarm panels of the ship when a pre-warning signal with duration of predefined time, generally 3 minutes, has expired.

3. INTEGRATED EXTENSION ALARM SYSTEM

In this section, we explain system architecture, hardware specification, and operation description of Integrated Extension Alarm System (IEAS) for ACONIS-2000® system.

3.1 System Architecture

IEAS provides two types of system architecture according to the ship owner's requirement. One is Ethernet-based architecture using switch, and the other is CAN-based architecture using CAN-converter. Ethernet-based type is more reliable than CAN-based type, but it is more expensive. Figure 1 shows system architecture of IEAS.

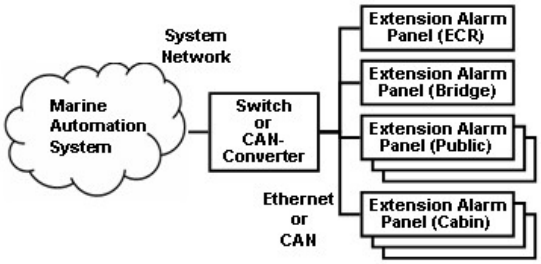

Fig. 1. System Architecture

3.2 Hardware Specification

Table 1 describes hardware specification of an extension alarm panel briefly.

Table 1. Hardware specification

CPU	Rabbit2000 – 18.432MHz
Memory	RAM 512KB Flash RAM 256KB
Display	5" STN Mono Graphic LCD (FL Back Light)
Power	DC 24V
Protocol	UDP Using Realtek RTL8019AS 10BaseT Ethernet Interface Chip or CAN Using MCP2515

3.3 Operation Description

Before operating the IEAS, extension alarm panels are required device settings. Basically, there are three device settings: system type, extension alarm panel type, and device address. First, the system type determines if the extension alarm panel will be operated for machinery alarms, cargo alarms, or all alarms. In other word, extension alarm panels are activated for alarms related to their system type only. Second, the extension alarm panel type indicates that the extension alarm panel will be installed in the dedicated location, i.e. engine control room or bridge. It is required because extension alarm panels of IEAS are designed to the unified hardware/software and only extension alarm panels in engine control room and bridge have functions for the operation mode selection and on-duty selection. Last, the device address is the identifier of each extension alarm panel.

The alarm server of ACONIS-2000® system manages not only machinery and cargo alarms but also their corresponding alarm group, and communicates with IEAS periodically. When an alarm occurs at any system area, the alarm server informs it to IEAS. Then, extension alarm panels of IEAS check that the alarm is machinery alarm or cargo alarm, and compare with their system type. Finally, extension alarm panels with the same system type as the alarm are activated. This shows that IEAS can transfer machinery and/or cargo alarms to the on-duty engineer according to the system type of alarms. Therefore, IEAS provides the integrated functionality for both machinery and cargo monitoring. Similarly, the dead man alarm is operated separately for machinery alarms and cargo alarms.

IEAS provides the flexibility of the alarm group and duty configuration. The alarm group and duty is configured using the configuration tool of ACONIS-2000® system according to the ship owner's requirement. Then, extension alarm panels download and display the configured information when initiated.

The extension alarm panel of IEAS is equipped with a LCD (Liquid Crystal Display) in addition to various function buttons. Figure 2 shows an extension alarm panel of IEAS.

Fig. 2. Extension Alarm Panel

REFERENCES

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