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# Characteristics of vessel traffic monitoring functions in the Navi-Harbour 5000 system

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**Key words:** VTS, VTS operator, traffic monitoring, traffic areas, navigation safety

**Abstract**

Increasing of the navigation safety level, especially in difficult and heavy traffic areas, is the main reason of VTS creation. The Navi-Harbour 5000 is the one of the newest systems created for VTS system management and it fulfils requirements included in IMO Resolution A.857(20). Main system functions of the vessels traffic movement monitoring are characterized in this article. The effectiveness of the VTS operator work should be increased by proper configuration and use these functions in everyday service.

## Introduction

Vessel Traffic Service (VTS) can be defined as *"a service implemented by a competent authority, designed to improve safety and to improve vessel traffic and the protection of the environment. The service should be able to interact with the traffic and to respond to situations developed in the VTS area"* [1].

According to many papers and documents (including SOLAS chapter V rule 12) properly designed VTS should contribute to the level of safety of life at sea, safety and efficiency of navigation, the effective protection of the marine environment in the vicinity of the coastal zone and offshore installations increasing. It should prevent possible negative effects resulting from the traffic of the sea. The basic principles of the introduction and implementation of VTS systems were also defined in SOLAS Convention. Vessel traffic control system and VTS operating procedures should comply with guidelines of the International Maritime Organization (IMO) and the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA). Detailed guidance on the implementation of traffic control systems gives IALA Recommendation V-119, and the IALA Recommendation V-128 (IALA Recommendation V-128 Operational and Technical Performance Requirements for VTS Equipment) which refers to the operational and technical requirements of VTS equipment.

Depending on the operating range of the system the protection, terminal, route or sea VTS can be distinguished. Of course, the range of services provided by the system is the result of the area characteristics and desirable function to fulfill during supervision. An important component of any system are VTS operators. Only professionally qualified and competent staff properly equipped can provide a high level service.

The solution proposed by the Transas regarding VTS systems fully meets these requirements. The Navi-Harbour 5000 is one of the better-designed systems which let to create and manage vessel traffic services (VTS) at any area. It is designed to improve the safety of navigation and planning of traffic in coastal waters. This system meets the basic functions recommended by the IMO and has additional features (e.g., SAR, Special Operations on Zones).

In recommendations of IALA V-128 (IALA Recommendation V-128 Operational and Technical Performance Requirements for VTS Equipment) basic operational requirements of the VTS system are discussed, which include [2]:

– VTS radar system;
– Automatic Identification System (AIS);
– communication system;
– closed-circuit television (CCTV);
– hydro-meteorological monitoring devices;
– VTS database system.

The authorities while planning areas under the supervision of the VTS are required to establish a system of administrative management, which is responsible for the preparation of local regulations regarding the traffic control system (not conflicting with the provisions of A.857 (20) Resolution).

## Characteristics of Navi-Harbour of Transas 5000 System

The Navi-Harbour system made by Transas allows to carry out all VTS functions, receive information about navigational situation and all tracked objects (in tabular or graphic form) and enable vessel traffic monitoring along the ability areas including the targets movement planning and appropriate alarms generating (according to the criteria set by the operator). The system also allows digital recording of all navigational situation data and thus the possibility of later retrieval and these situations analysis (which is particularly important in the event of failure or while vessels violate regulations in force in the waters covered by the system).

Main window of the system with data structures and system alarms tables is shown in figure 1.

The main menu contains a full list of functions to enable the user the proper execution of their duties. The acquisition of objects (with a choice of sources of information on the subject), the identification and implementation of data units, cargo, destination port and other relevant information, the ability to display data in tabular and graphical form (on a chart), their analysis in general terms of traffic and mutual threats occurring between the selected targets may be included to the basic functions of the system.

Since an operator must know and take into account existing regulations on areas under VTS surveillance it is also a great help, to configure the operating alarms available.

The most significant are:

- CPA / TCPA limits exceeded alarm;
- target manual / automatic acquisition;
- target manual / automatic drop from tracking;
- loss of sensor alarm due to lack of proper input signals;
- Zone Alarm – an alarm in special target zones;
- grounding on route alert when the vessel's grounding;
- XTE out on a route – established recommended route cross track error alert;
- course out of route alert when ship deviates from the recommended course;
- speed limit breach on route alarm when target exceeded recommended speed limits;

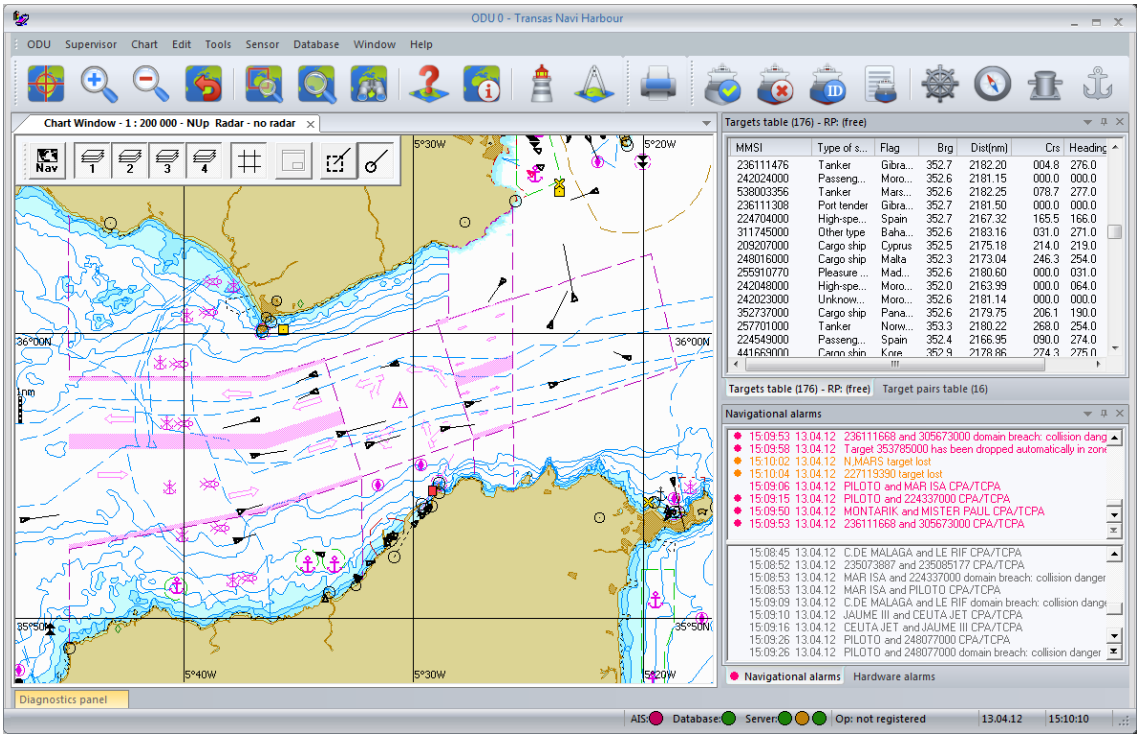


Fig. 1. Navi-Harbour 5000 – the main window of the system [3]

- enter / leave route line alarm when target exit / enter the recommended specified route;
- dangerous DTE alarm on exceeding the minimum distance to the edge of the fairway.

Effective use of the system, especially when service covers restricted water areas with diverse characteristics and where occurs heavy ship traffic, can't be limited only to the use of a basic set of functions. VTS operators knowing the capabilities of the system should also properly use additional functions that, when properly configured (taking into account the characteristics of the area and the operator's own needs) will be a significant help in supervision over the ships movement. The designation of special zones, routes or areas with recommended speed limits or traffic intensity, should ensure strict compliance with the local regulations and help to create standard procedure (using the same criteria) in case they are exceeded.

## Characteristics of the vessel traffic monitoring functions available in the Navi-Harbour 5000

### Recommended routes

The Navi-Harbour system allows you to create so-called designated/recommended routes (*Route Profile*). This function is particularly useful for systems to monitor the vessels traffic consisting mainly in canals, rivers or fairways and let to define a certain safe lane width. These are exactly the traffic lanes and consist of some segments of a certain adjustable width. The area of each segment is determined by crossing the centre line and determining an acceptable deviation of the vessel from the axis. In addition, you can specify the maximum and minimum speed limit on the selected section of route (Fig. 2).

Created route consists of a single lines so that ships are moving from one to the next waypoint. Each route has its own name and can contain any number of waypoints. The start and the end of the line are treated as reference points of the route. One line of the route may consist of several segments. Each of the recommended route has a set of individual parameters, the operator adapts to the requirements applicable to the area.

The use of recommended routes that were created involves assigment of moving ships to selected route. From that moment, the system monitors the positions of assignated targets in relation to the axis of created route and their speed. Of course, when the limits imposed by the operator are exceeded, corresponding alarm will be generated to turn operators attention to the incident. Alarm acknowledgment by the operator will automatically display on the screen the position of the offending vessel. Another advantage of the recommended routes is the ability to use them in the prediction of the expected vessels positions and to determine their potential passing positions with other vessels. The operator is able to determine the change in the speed of ships in order to obtain the correct passing positions. For this purpose operator should use the diagram *Route profile* (Fig. 3). In practice, it is used to determine the safety place of vessels passing positions on the fairways and channels. In the diagram, there are points that are essential for the system operator for the correct assessment of the situation on the fairway.

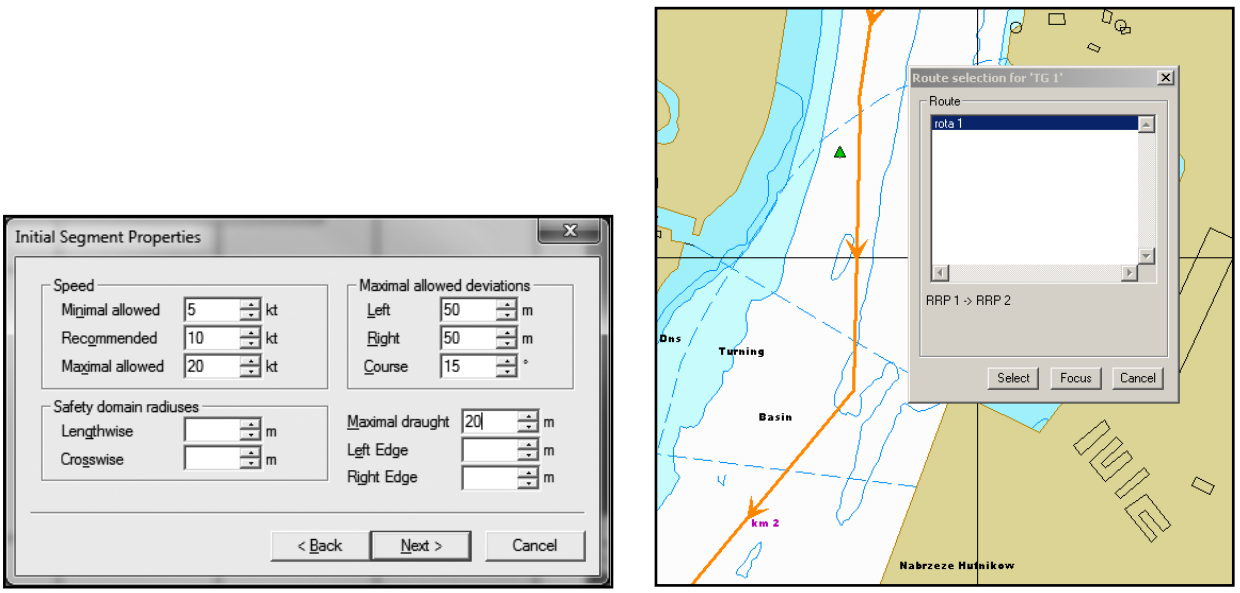


Fig. 2. The initial parameters and presentation of recommended route created on the chart [3]

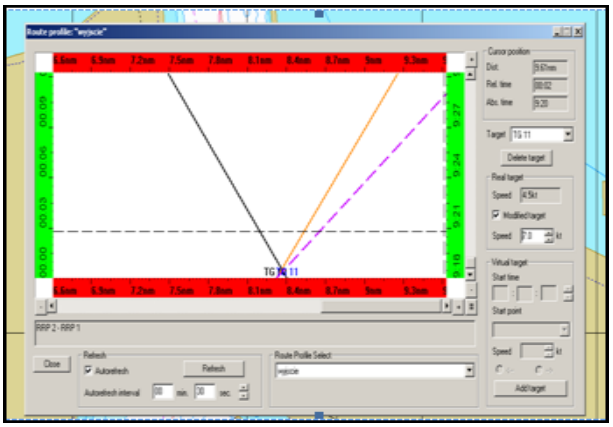

Fig. 3. Diagram *Route profile* for a selected recommended route

Additional possibility of using the diagram *Route profile* it is to generate virtual objects (Fig. 4), allowing the operator to plan the traffic planning on a given sector of the route for example when deciding whether to add new units to the traffic (leaving the berth, entering the fairway by units waiting at anchor).

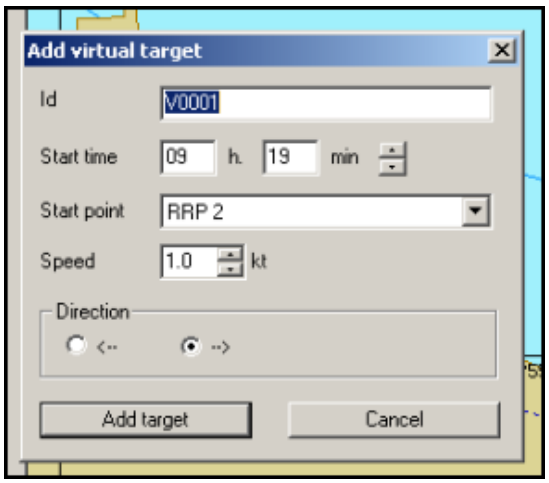


Fig. 4. Window to create a virtual object in the Diagram *Route profile*

### Simulated echoes

In Navi-Harbour 5000 system, you can create so-called simulated echoes (Fig. 5). These are the objects artificially generated by the operator by entering information about the position, course and speed that can be obtained for example by direct radio communication with the ship, which the operator is not directly monitoring. This function allows you to enter information about ships that are on the radar, for which the information is also available in the AIS. This makes it possible to monitor the vessel presence until that echo appear on the radar screen and allows to acquire the object manually.

Before that happens, the operator can analyze the motion of the ship surrounded by other ships and (in the event of an emergency situation) to take appropriate action.

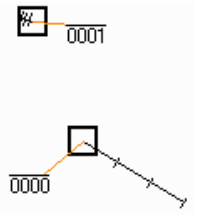


Fig. 5. Echoes simulated by the operator – Navi-Harbour 5000

### Special areas of the Navi-Harbour system

The system allows the VTS operator to create special areas in which automatic tracking control is conducted. These areas are designated as special zones and can be identified as:

– traffic zone;
– auto acquisition zone;
– drop zone;
– responsibility zone;
– guard zone;
– zone special tracking mode.

The operator for each of these zones can set individual alarms generated only when a particular situation occurs in a specific part of the monitored area. This allows a better fit of alerting function to the specifications of the type of area, which can eliminate unnecessary alarms, useless for safety. This has an important impact on the way the operators response to the generated alarms, because too many unimportant or even unnecessary alarms may decrease his watchfulness and provoke automatic alarms reset without proper analysis.

The parameters of each alarm can be adjusted by setting the alarm status and determine its type (info, notice, warning or alarm). In the alarm parameters setting it is also possible to choose the alarm sound, the alarm text (text message alert) and the alarm delay. When alarm limits are exceeded selected zone alarm is generated and it can be found in the navigation alarms table.

With Traffic zone the user can create lines in vicinity of which the speed limit, the number of ships, banned sectors etc. can be generated. Designating the maximum or minimum speed on the fairway provides a necessary information for the operator about the traffic flow (no alarm) or breach of the rules (for example, the possibility of causing damage to jetty or vessels moored in the harbor). Exceeding any set value is indicated by the appropriate alarm and by showing the location of an alerted situation.

Depending on the operator's needs automatic acquisition zone could be created. In these areas,

objects start be tracked automatically. The system Navi-Harbour target acquisition object can be performed by radar or by using AIS data. The operator in a very simple manner may set automatic acquisition area. In this case the operator is notified by an alarm that a new object had been added to acquisition by automatic acquisition zone (Fig. 6).

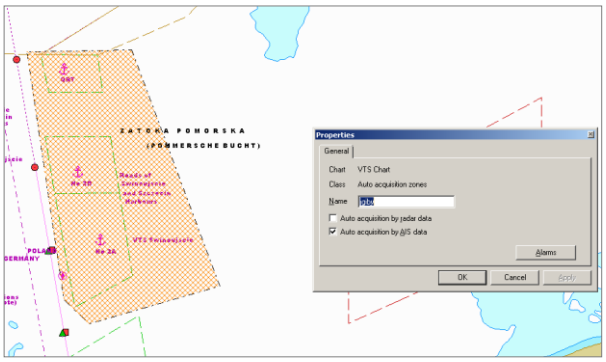


Fig. 6. Example of Nav-Harbour automatic acquisition zone

It is also possible to create zones where objects are automatically removed from tracking (Drop zones). There are two types of that type zone. The first type is a zone in which only lost objects are removed (Free zone). In this area, the operator also has the ability to set preferences so that the lost objects are not removed (keep), or objects would be deleted after a chosen time (after drop). There is also a possibility to enter a function "*always keep Identified*", which will cause that all lost objects will be deleted except identified ones. If operator selects "*continue moving after lost*", the movement of the lost object will be calculated according to the data available prior to disposal.

The second type of such zones (*No service*) are areas in which all objects will be removed. For such a zone it is only possible to set the parameters described above (*keep* and *drop after*).

Another important for the VTS operator areas are a safety zones (guard zones) designed to generate alarms when the object approaches the zones border (or exceeds it). Guard zones area settings enable the operator to make a decision for moving targets regarding to next manoeuvres without undue delay, which could arise as a result of an oversight of a particular ships position.

An area of responsibility (responsibility zones) is also worth mentioning which is meant to distribute the responsibility on selected operator stations, as well as very useful in the traffic monitoring function (reporting lines), which are set to generate a message about exceeding ship position with necessary contact with VTS center for relevant reports sending.

The system allows the creation of special tracking mode zones for automatic tracking mode choose (data from radar or AIS).

## Conclusions

An overview of the basic set of traffic monitoring functions of Navi-Harbour 5000 system is described in this paper. These functions are designed to facilitate the VTS operator work by faster his reaction for potentially dangerous situation. Thanks to NH5000 incidents are reported quickly and automatically in the form of information, warnings or alarms. Especially important for VTS operators is the possibility to create all kinds of special zones (with individual alarm system) and the recommended route (with a large number of options available that describe the sections of the route). These capabilities give the operators of specific VTS system's ability to match the individual needs and take into account both the specific characteristics of the area, as well as local regulations.

However, it is also noted that the benefits may bring only the functions that will be used in a proper manner by properly trained personnel. Therefore, attention should be paid to the adequate training methods, both at the basic and advanced level.

It is also very important that operators should work properly supervised and, therefore, they couldn't give up an adequate possibilities to set up and operate the system fully and properly. They work couldn't base only to their own intuition and routine behavior, which may lead to the level of safety reduction.

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