

## **THE HYDROGRAPHIC AND WRECKSEARCH VESSEL "DENEb" AS AN EXAMPLE FOR A MODERN SURVEY VESSEL**

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### **Abstract**

The Survey, Wrecksearch, and Research Ship (VWFS) "DENEb", built at the Peenewerft in Wolgast, is the latest in the fleet of the German Federal Maritime and Hydrographic Agency BSH (Bundesamt für Seeschifffahrt und Hydrographie). It is a sister-ship to the existing VWFS "ATAIR" and "WEGA" and is intended as a successor to the Survey Vessel "CARL FRIEDRICH GAUSS" and the old Survey and Wrecksearch Vessel "DENEb" taking over their tasks. The "DENEb", commissioned in the late fall 1994, is equipped with a currently unique combination of sensors and a prevailing system concept for navigation and hydrographic tasks, which changes the traditional concept of having an Operating Navigation System separated from the Hydrographic Survey System. The main operating area of this new vessel is the Baltic Sea, but other tasks will be performed in accordance with the requirements.

### **INTRODUCTION**

As the general design of the "DENEb" is similar to that of her sister-ship, it is required that there should be hydrographic processing capabilities not only on the mother-vessel, but also on the two survey launches. This is also applicable to the positioning equipment, which consists of SYLEDIS, Differential GPS and Laser 3D positioning (ATLAS POLARTRACK).

For the "DENEb" itself, besides a single beam triple frequency echosounder system and an echosounding system utilising an array of 11 transducers installed midships in the hull, perpendicular to the direction of travel and being used to determine the shallowest point during wrecksearch (Fahrentholz), a multibeam echo

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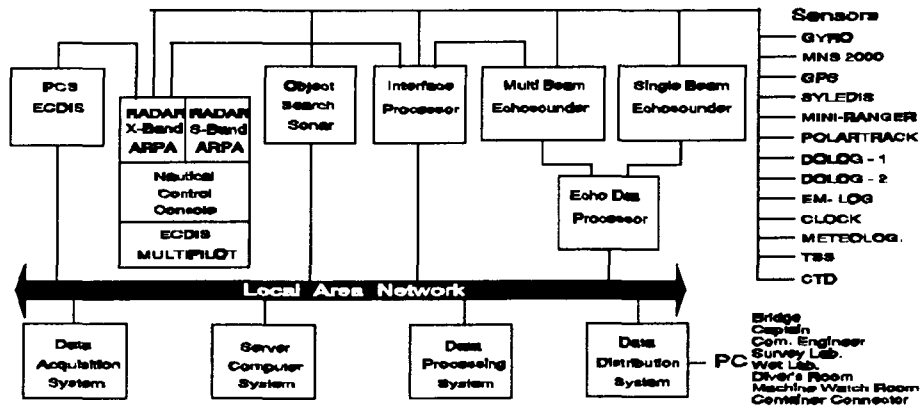


FIG. 2.- General Layout of the System.

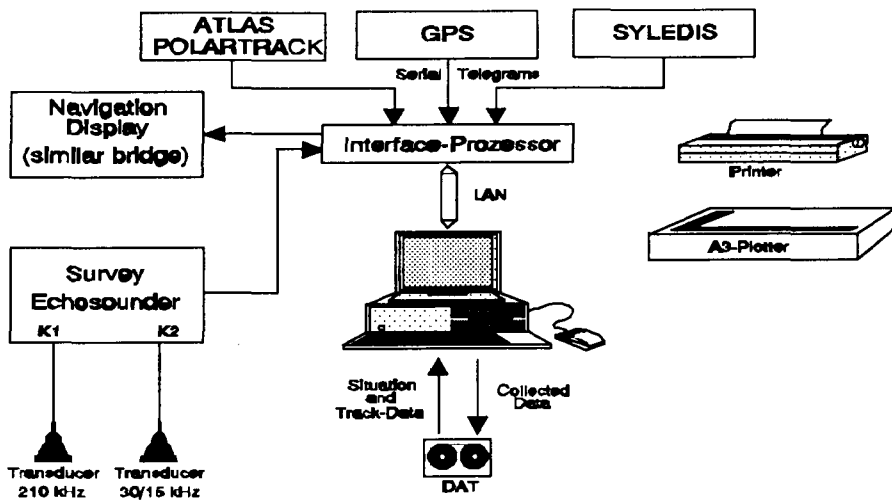


FIG. 3.- Subsystems Description.

To provide a back-up process, the Sub-System Navigation receives additionally and directly some of the most vital position sensor data. Furthermore, and to avoid duplication, besides transmitting the position and the time data on the LAN, the Interface Processor transmits directly a calculated survey position on a supplementary line to the navigation system and the multibeam system. The interface processor operating program is normally downloaded from an incorporated flash memory during the initialization at power up, but could also be booted from the server computer. The hard-wired flash memory can be re-programmed with the regular computer facilities onboard, in case the sensors employed are changed for whatever reason.

A physical part of the interface processor is the Echodata Processor, which provides the link between the real-time echosounder systems with the Hydrographic Survey System based on the UNIX operating system. The necessity for incorporating such a dedicated real-time data acquisition system results from the high data rate of the multibeam system and the unified treatment of both - single and multibeam - echosounder data. This data treatment and exchange involves not only the echosounder data, but also any other connected sensors (navigational and environmental). The data collected and transmitted on the LAN are checked and an error message is originated if data is erroneous, providing data safety and a high standard of ship efficiency.

### 3. Server Computer System

The Server System controls the centralized data storage, data handling and data provision for all subsystems connected to the LAN. The main functions can be characterized with:

- Collection of:
  - \* Sensor data of the interface processor
  - \* Echosounder data of the Data Acquisition System
- Data storage on disk and tape
- Collection of data telegram for the data distribution to the LAN connected subsystems, like the Data Processing System and the PC-based Data Distribution System
- Provision of utility programs for data storage on mass-media, also utilisable by the Data Acquisition and Data Processing System. This includes:
  - \* Input of program-updates and distribution to other LAN- connected computer systems (CD-ROM)
  - \* Input/Output of echosounder data (Optical Disk)
  - \* Input/Output of planning data and survey data of the Survey Launches (DAT tape)
  - \* Input/Output of resulting data like planning, survey and processed data (DAT tape)
  - \* Input/Output of backup copies of the database (DAT)
  - \* Protocol of system status and diary of data processing performed.

Furthermore, external communication via SATCOM for data exchange and service to and from land is utilized from the server computer system.

#### 4. Hydrographic Survey System

Four distributed work places constitute the actual Hydrographic Survey System of the "DENEb".

- Data Acquisition System
- Auxiliary Work Place Data Acquisition
- Data Storage and Utility System
- Data Processing System

##### a) Data Acquisition System

The following primary functions are performed by the Data Acquisition System, which provides itself two work places at the data acquisition work station adjacent to the ATLAS HYDROSWEeP MD multibeam system and an X-terminal in the single echosounder area, both located in the bridge.

- Survey control and data acquisition
- Echosounder control (Hydrographic Echosounder and Multibeam System)
- Sensor Control (Other sensors)
- Navigation support and survey planning

Furthermore, functions normally related to the Data Processing System are available via Remote Login, in cases where this work station is not used for on-line data acquisition and quality control. The idea behind, is again to provide a back-up process for all on line and off line system functions of the total system.

##### b) Data Processing System

In order to provide the best performance of the data processing system without being limited by time share constraints through a commonly shared central processing unit, the Data Processing System utilizes a high performance work station providing a great efficiency in data processing and chart production. To even increase the postprocessing expedition, other available work places can be utilized. The most vital functions can be obtained from the other work stations of the hydrographic survey system as a back-up. In general, the following functions are normally performed at this work place:

- Data editing and processing
- Data presentation and printing/plotting
- Interactive calculation of geodetical and nautical functions

Data processed are transferred to the server system for storage and retrieval on request.

### c) Data Storage System

The Data Storage system serves, in principle, to store and serve any data collected and processed, as well as to provide utilities for all the LAN-connected users. Furthermore, functions normally provided by one of the other work stations, are, to a practical extent, available from this Server System in case of back-up needed. The functions available from this system are summarized as:

- Data collection of:

- Sensor data provided by the Interface Processor
- Echo data (multi and single beam) from the Data Acquisition System
- Data storage on MO-disk and DAT-tape and keeping of filesystem
- Establishment of data telegram and distribution to LAN-users
- Provision of utility programs (i.e. output on mass storage media)
- Data Input/Output of:
  - Echodata (MO-disk, DAT-Tape)
  - Data transfer with survey launches (DAT-tape)
  - Processed data (MO-disk, DAT-tape)
  - Backup of Database (DAT-tape)
  - Diary and system parameter logging

A SATCOM connection can be established with either the home base or with the system supplier to improve the service and for the transfer of raw and processed data. This way, a remote diagnosis of a possible failure in the system or subsystem can be made, enabling the crew on-board to reduce the time for repairs and to keep the MTBF as high as possible.

### 5. Data Distribution System

The PC based Data Distribution System (DATADIS, Maritec) uses serial links (RS 422) to distribute the sensor data to various wall-connectors in order to provide access to such data via user-PCs. Some of those connectors are located in the bridge, laboratories and survey processing area, and an outdoor connector for inter-connection of containerized equipment is located in the deck. A feedback of certain data is available to the compass system and weather station (RS 422) and to the side scan sonar and the radiation sound (RS 232, 20mA).

### 6. Object Search Sonar

Various international incidents of dangerous lost cargo and abandoned material and the increasingly serious situation resulting from the debris remaining from the Second World War lying in the Baltic Sea have required efficient detection facilities to be utilized in German waters. For this reason the "DENEb" and two other vessels received a high resolution Object Search Sonar ATLAS OSS-11Z, derived from the mine hunting sonar ATLAS OSS-11M. The sonar antenna can be rotated about in all axis, with more than 130 search beams and search sector of 90 degrees. The typical detection range is more than 800 metres. Detected objects can be marked and measured and such position data is transferred via

LAN to be stored on the server computer system. This way, vital and relevant data can be directly processed and incorporated to the ECDIS database.

## 7. Navigation System

Based on a standard Navigation and Command System ATLAS NACOS 55-2, the customized navigation system for the "DENEb" takes into account both the growing requirement for information elements and safety aspects and the simultaneous decrease of manpower on the bridge, providing an intense functional integration of systems which prevents an increase of displays and controls. This is especially important for this vessel due to the very limited space available on the bridge. The consequent integration of primary navigation, collision avoidance system, ECDIS, track pilot and radar within one console enables the navigator to monitor the situation and to control the ship's track simultaneously without leaving the station. The overall display of information from different sensors and sources ensures redundancy and quality check of position and information and, at the same time, reduces the workload for the navigator. An alternative display presentation on the NCC display provides a means of on - line check of swath coverage of the multibeam system, enabling the navigator to possibly deviate from the planned course and thus prevent unsurveyed bottom areas due to terrain features and having to resurvey this area again.

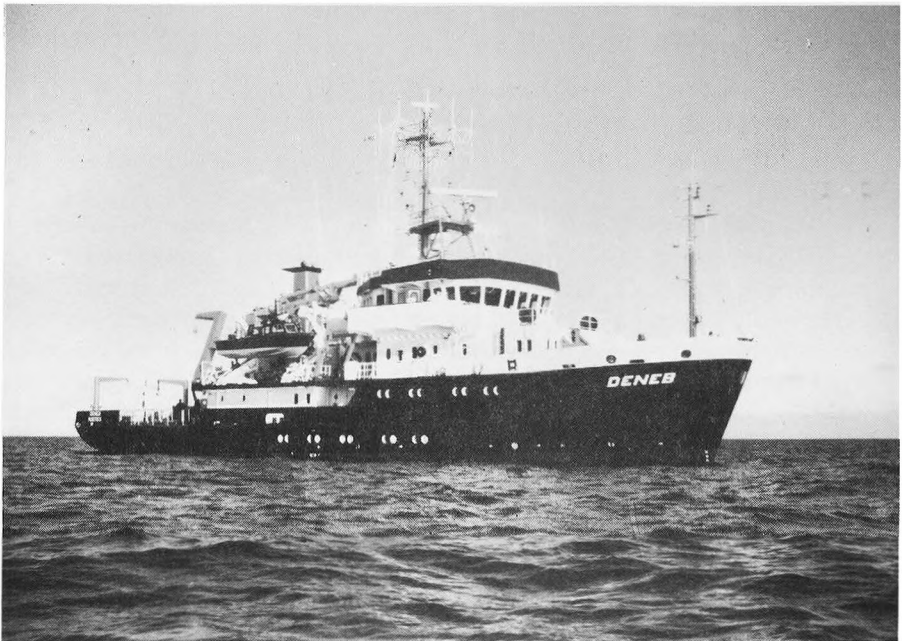


FIG. 4.- Photo showing the "DENEb" during construction at the Peenewerft, Wolgast

### Conclusion

The Hydrographic and Wrecksearch Vessel "DENEb" of the German Federal Maritime and Hydrographic Agency is currently one of the most advanced hydrographic survey vessels in Europe, intended not only to fulfill the German requirements in hydrographic surveying, but also to contribute substantially to the establishment of an internationally developed database of the IMO/IHO Electronic Chart Display and Information System (ECDIS). The sensors used and the data processing capabilities will provide the operators with state of the art equipment to efficiently survey shallow and medium depth waters on national and international level. The incorporated Object Search Sonar ATLAS OSS-11Z will provide a means of supervising the 42,000 to 65,000 tones of toxic munitions, dumped in the Baltic Sea right after the Second World War and the additionally dropped 200 tones during the former German Democratic Republic. The Marine Environment Protection Committee of the International Maritime Organization considers the issue of lost cargo in national and international waterways so important, that it has raised a discussion about the introduction of such systems, enabling lost cargo to be found quickly. The "DENEb" is internationally the first hydrographic vessel providing such high performance search capabilities and thus, is a pacemaker in this increasingly important issue.

### References

- 1) Dr. Ing. W. Ellmer, BSH Hamburg, Logging and processing of survey data on board the DENEb, *International Hydrographic Review*, Vol. LXXI, No. 2, Sept. 1994.
- 2) Photo "DENEb" courtesy of Peenewerft Wolgast, Germany.