1991 ODEN Expedition to the North Pole

Sponsored by:
Canadian Coast Guard Northern, Arctic Ship
The Polar Secretariat of the Royal Swedish Academy
The Swedish National Administration for Shipping and Navigation
The United States Coast Guard, Division of Naval Engineering

The Polar Secretariat of the Royal Swedish Academy was the organizing body for the ODEN 1991 Arctic expedition. The principal objective planned for the expedition was to carry out oceanographic and meteorological measurements in the Arctic Ocean with a view to improving the understanding of how the Arctic Ocean interacts with the rest of the world's ocean and atmospheric environment. The expedition would also provide an opportunity to gather ground truth data for the ERS-1 European Remote Sensing Satellite which would be newly operational in the summer of 1991, and to obtain valuable data on the performance of the unique icebreaking design of the ODEN itself during extended navigation in the Arctic.

The vessel's route was from Sweden north to Svalbard, then into the Arctic Ocean, to the Geographic North pole and then South to Greenland and home to Sweden. The Oden became the first "western" and the first non-nuclear vessel to achieve the Geographic North Pole

The objective of the research conducted by the Ship Technology included the collection and documentation of data concerning the hull and machinery system responses to ice loads and the associated ice conditions. In particular, the following areas were investigated:

- Measurement of Local Hull-Ice Impact Loads and Pressures
- Measurement of Rudder Loads and Steering Gear Pressures
- Measurement of Kort Nozzle Foundation Stresses

- Measurement of Global Hull-Ice Impact Loads
- Measurement of Propulsion Machinery Response to Propeller-Ice Interaction
- Extensive Documentation of Ice Conditions Along the Vessel’s Route

The important aspects of the data obtained through the Ship Technology Program during the ODEN '91 expedition can be summarized as follows:

- Measurement of high local hull-ice contact pressures in excess of 7.0 MPa;
- The maximum global hull impact loads recorded were lower than what had been anticipated, primarily because of the relatively open and unconfined ice conditions encountered and thus the lack of opportunity for heavy ramming operations against massive sea ice features.
- The dynamic response of the ODEN's machinery to a very large number of propeller-ice interaction events was obtained over the complete spectrum of ship operating modes and conditions.
- The propulsion-ice interaction data includes what are believed to be the first ever recordings of the transient response of the turbo blowers of mechanically coupled medium speed diesel engines during icebreaking operations, on a common time base with all other key machinery responses.
- Very high rudder and steering gear loads, sufficient to cause rupture of the protective relief membranes in the steering hydraulic system were recorded.
- The number of ice loading events recorded for both the hull and machinery were large and covered a statistically very significant number of hours of ship operations inside the polar pack.
- Through the cooperation among the Ship Technology Team, the Remote Sensing Team and the ship's personnel, extensive observations and measurements of the prevailing ice conditions throughout the voyage were obtained which should greatly assist in the ultimate interpretation of the data.