1996 Oden Expedition to the North Pole
Sponsored by: Transport Canada

During the summer of 1996, the Swedish Icebreaker ODEN sailed via Novaya Zemlya into the Arctic Ocean, and to the Geographic North Pole. ODEN's mission during this expedition was to serve as a platform for the collection of geological, geophysical, meteorological and biological data on the Arctic Ocean environment, as well as providing an opportunity to obtain data relevant to the ice strength design of ice-going shipping operating in Polar Pack Ice.

The objective of the Ship Technology Program was to obtain full scale measurements of the ice loads acting on the hull side shell just aft of the midship's area, together with comparative measurements in the bow waterline area so that the magnitude distributions of the ice impact loads in these two areas could be compared.

While extensive full scale measurements of bow ice loads have been made on many different ice going vessels, there is very little full scale data available to support the specification of ice strengthening requirements in other parts of the hull. Continuing incidence of damage to side shell structures in ice-going shipping throughout the world has suggested that current design practice underestimates the ice loads that can act in this area.

The 1996 voyage consisted of two legs with a crew change between each leg. The Ship Technology field crew consisted of two persons, one of whom was on the vessel for the full trip while the second joined the vessel for the second leg only. The contracted period for data collection was during the second leg only, but a number of data events of interest were collected during the first leg as well.

The expedition departed Gothenburg Sweden on July 12th, 1996. ODEN's route took her north, across the top of Norway and into the Barents Sea between Novaya Zemlya and Franz Josef Land, then north-east to approximately N87°, E140° where two weeks of ocean floor

geological drilling was attempted. On August 25th, the crew change was carried out with the vessel at N86°, E130°, using Russian planes and helicopters to carry two personnel to the ship via St. Petersburg and the Siberian port of Dixon. Following the crew change, ODEN proceeded east between N85° and N87° to E180° and from there, due north, arriving at the Geographic North Pole on September 10th. The vessel then returned south between E5° and E20° reaching the edge of the Polar pack at about N82° on September 19th.

For this program, two locations on ODEN'S hull were instrumented. The main instrumented area was on the vessel's starboard side just aft of midships. This is the area that sustained the heaviest damage during this icebreaker's 1991 Arctic Expedition. The second area included three of the longitudinal frames in way of the bow waterline area that had been previously instrumented for measurement of bow local loads during the ship's 1991 Arctic Ocean Expedition. Three video systems were also installed to collect the views looking forward over the bow to the horizon, looking aft over the instrumented side shell area, and vertically downward over the starboard side to be used for determining ice thickness. A log of ship operations and hourly ice observations was kept by project personnel whenever the vessel was under way throughout leg two. Ice cores were taken when the vessel was stopped using the Transport Canada developed RAPID-CORE system to determine ice properties.

A total of 1179 and 1133 data files were collected on the bow and side shell data acquisition systems, respectively. The data collection systems were run continuously as transient recorders while the vessel was underway, making the data ideally suited for long term load estimation.

To reduce the measured data from the hull load panels to engineering units, frame load calculations were performed based upon simple beam theory. Detailed analysis to determine pressures, pressure-area relationships and comparisons to other data sets remains for future work. The peak frame load on the bow was 8.2 MN while the peak frame load on the side shell was 5.4 MN. The stress levels in the side frames were found to frequently approach yield and in a number of cases non-elastic deformation of the side frames was recorded.