# Sudbury Neutrino Observatory - PMT Support Structure & Panel Arrays

*K.T. Lesko, Y.D. Chan, M. Dragowsky, M. Isaac, M.E. Moorhead†, E.B. Norman, A. Schuelke‡, and R.G. Stokstad*

The Sudbury Neutrino Observatory detector is a large heavy water Čerenkov detector designed to detect neutrinos in a 1000 tonne $D_2O$ target[1]. The detector has sensitivity to the total neutrino flux, $\nu_x$, independent of neutrino family (x= e, $\mu$, $\tau$) and to the $\nu_e$ flux, separately, by measuring charged and neutral current reactions and neutrino-electron elastic scattering. The detector is located 2 *km* below ground near Sudbury, Ontario Canada in an active nickel mine operated by INCO, Ltd. The $D_2O$ target is contained in a thin-wall acrylic vessel (AV) of 6 *m* radius, which is suspended in a 11 *m* radius cavity filled with ~7800 tons of ultrapure water. The $D_2O$ and the surrounding 1*m* shell of $H_2O$ are viewed by an array of 9456 8" Hamamatsu PMTs. Each PMT is coupled to a light concentrator[2] within a plastic hexagonal structure. The hexagons are assembled into 751 flat panel arrays each holding from 7 to 21 PMTs. The panel arrays are suspended on the 9 *m* radius stainless steel geodesic sphere (PSUP). This sphere is concentric with the acrylic vessel and is also suspended from the deck structure near the top of the cavity. The PSUP and the panel arrays were designed and fabricated by our group at LBNL.

The PSUP is based on a three-frequency iscosahedron sphere. The ~14,000 *kg* structure is capable of supporting a load of nearly 90,000 *kg*. All materials used in the fabrication of the geodesic sphere were carefully selected to contain < 15 ppb U or Th. All parts were cleaned and double bagged for installation in SNO's Class 2000 environment. In addition to the low level of permissible U and Th contamination, mine access and construction concerns heavily influenced our design. The final design consists of 270 struts, 91 nodes, a chimney ring and guide ring to permit the AV's chimney and suspension ropes to penetrate the PSUP and six ports for calibration devices. The upper half of the geodesic structure was installed underground in January and February, 1995.

The PMT panel arrays are fixed to the geodesic structure struts with adjustable and responsive mounts. These permit the panels to adjust to the flexing of the geodesic sphere the cavity if filled with water. The entire array changes from a net weight of 90,000 *kg* to becoming slightly buoyant (-2500 *kg*) due to the large displacement of the PMTs which necessitates the deployment of anchors at the bottom of the cavity. The PSUP struts will flex by .64 *cm* due to this change in weight. The panel mounts permit an accurate (<0.3°) alignment of the panels so that each PMT-reflector views the $D_2O$. The reflector-PMT coupling in the hexagons creates a nearly water-tight and light-tight seal with only small engineered leakages to permit water and air to escape during filling and water purification. Each panel is sealed to neighboring panels using thin opaque plastic membranes. All materials used in the fabrication of the panels, except the PMTs, were selected to contain <15 ppb U and Th and were packaged under cleanroom conditions. The upper half of the geodesic sphere was instrumented with PMTs (390 panels, 5000 PMTs) between April and August, 1995. The final installation will be completed in 1997.

*Footnotes and References*

† Present address, Oxford University, Oxford, UK OX13RH

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1. G. Ewan, *et al.* Sudbury Neutrino Observatory Proposal, SNO 87-12 (1987).

2. G. Doucas, *et al.* NIM **A370**, (1996) 579-96.