Sudbury Neutrino Observatory - Contamination Control

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

Twelve thousand square meters of surface area will be in the SNO cavity when construction is complete. Dust left on these surfaces may emanate radon and therefore contaminate regions of the detector well removed from the source material. Mine dust (6 ppm Th) is the main problem, but any granular material containing U and Th are problematic. Our goal is to reduce surface contamination to acceptable levels, which are derived by requiring that they be less than the unavoidable contributions from the bulk materials comprising the detector. Earlier articles[1] have described the cleanliness infrastructure in the SNO laboratory. During the last two years, experience has been gained through cleanliness monitoring and further measures have been implemented.

The rate at which mine dust settles on surfaces is inferred from measurements of iron, a 7% constituent of mine dust. These measurements are made using X-Ray Fluorescence Analysis (XRF). A monitoring program extending over several years has shown that the rate of mine dust deposition is typically between 1 and 3 $\mu g/cm^2/mo$. Since the construction period is longer, and the above deposition rates are higher than anticipated years ago, additional cleanliness measures are warranted. The solution to this problem has been the introduction of dust covers. Critical components such as the surfaces of the acrylic vessel (AV) are covered with tarpaulins just after being cleaned for the last time. The covers are designed for removal much later in the construction period. Ropes and fastening mechanisms are installed such that the covers can be pulled off from a remote location. (Tests have been made to verify that airborne dust deposited on the covers sticks.) Light/dust covers for the photomultiplier tubes (PMT) were designed, fabricated, and installed before the PMT panels were put in place on their support structure. Since the PSUP was installed, covers have been placed on top of the upper PSUP (i.e., on the back sides of the PMTs), which will be removed just before the water fill commences.

Procedures for the cleaning of the acrylic surfaces and for measuring the level of cleanliness were developed and recently implemented. The complete procedure involved many steps, but the basic cleaning agent was a dilute solution of Alconox. The level of contamination before and after cleaning was measured by applying a special (low in Fe) adhesive tape to the surface and then analyzing the tape in the XRF spectrometer. By applying the same piece of tape repeatedly to adjacent areas on the surface, the sensitivity of the technique could be increased by a factor of five. It was clear that the cleaning procedure was effective in removing surface contamination containing the elements Fe and Zn. (The Zn is believed to come from the galvanized scaffolding used in construction.) After cleaning, the residual mine dust (again, inferred from the amount of Fe) was well below the 0.1 $\mu g/cm^2$ value set as a tolerable upper limit for the AV. The sensitivity of the method is 0.025 $\mu g/cm^2$ of mine dust (1σ).

The upper hemisphere of the AV is now cleaned and covered.

Footnotes and References

†‡Die Arbeit wurde mit Unterstützung eines Stipendiums im Rahmen des Gemeinsamen Hochschulsonder-programms III von Bund and Ländern über den DAAD ermöglicht.

1. NSD Annual Reports: 1991, p.81; 1992, p.87; 1994, p. 101.