SNO-STR-90-68

PMT Support Structure Activities at LBL
Kevin Lesko

Our activities so far this year have been to 1) perform searches for Manufacturers of geodesic structures, 2) perform literature searches on designing and constructing geodesic structures, 3) identify engineering and design personnel to begin major tasks when the "real" funding begins in October 1990, 4) analyze surface facility floor space requirements, 5) work on an alternative design for the geodesic structure, 6) address some problems associated with installation and integrating installation of the PMT support structure with the acrylic vessel, and 7) try to estimate the maximum number of PMTs which we could mount in the various designs using various PMT specifications.

The first two items do not require much comment, other than there are many manufacturers of geodesic structures in the public domain. The Mechanical Engineering department is in the process of identifying the necessary personnel for SNO. The timing appears to be good in that several large projects at LBL are gearing down so many experienced personnel will be available.

We have estimated the floor space requirements (SNO-STR-90-49). Our estimates are larger than existing floor space in the surface facility. It was suggested that temporary surface buildings could be erected. A major addition to the surface building would be to have a clean room contained within the building to assemble the work packages before transportation below ground. We would suspect that such a facility could be used by the acrylic vessel group and other groups as well. We feel that the very tight underground space requirements and the extremely tight time schedule for installation strongly argue for having additional surface space above ground.

We have begun work on an alternative design for the geodesic structure which is based on a six-frequency icosahedron. This design would have 20 principal triangles (as opposed to the 12 principal pentagons in the "Temple design"). We feel that there may exist savings of time and money by integrating the installation of the new design with the acrylic vessel and that the installation would appear to be more streamlined. This integration impacts the schedule (possibly favorably), it would require bottom access to the cavity, it would impact the underground and surface floor space requirements (acrylic vessel and PMT support would be installing simultaneously). By installing the upper portions of the geodesic structure before the acrylic vessel is begun reduces the risk of damage to the vessel. We have agreed to continue to research the installation problem and would like to host a workshop to address these issues.

Finally, we have addressed the problem of determining the maximum number of PMTs which each design could hold. This was required by the RFP for the PMTs. We were able to achieve good packing fractions for the smaller PMTs, such as 8, 9 or 10 inch diameter PMTs, but the large 20 inch has posed more difficulties. Basically we are trying to fit a PMT which is nearly the size of each triangle in the geodesic, and the packing fractions are quite low.

(extract from letter to Hamish Robertson from K.T. Lesko)
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We have assumed that the mounting flange would require approximately an inch on either side of the tube, so all diameters are effectively increased by 2 inches. It is also noteworthy that the reflectors for the smaller tubes will have approximately the same diameter as this mounting flange, so the packing will not be significantly altered by the presence of a reflector. We have used the dimensions of the smaller, 56 degree reflectors and have assumed that the mounting for the reflectors would increase their effective diameter by 2 cm.

Assumptions: 1) Panels placed at 8.75 m, this would actually have to be altered for each PMT to give the same placement of the reflector at 8.5 m.

2) In a number of different placements schemes we have very close (or real) interferences between PMTs, we have always assumed that when the placement was tight that we could relax the edge restrictions to place the greater number of PMT or if the reflectors interfere that we could increase the diameter of the structure slightly.

3) We have approximated the complications of the three-dimensional alignment, and we would probably lose a few more tubes due to the interferences of the PMT reflectors as they aim inwards and toward the acrylic vessel.

Please consider all these numbers as +/- 250 pmts or so. thanks.

Tube	Temple Design 4"*	Temple Design 1"**	New Design 4"*	New Design 1"**	Orange Peel 4"*	Orange Peel 1"**
8"+2	6120	9960	7200	9000		
10"+2	5160	7860	6000	7320		
50cm+2	1500	1620	1320	1760		1745

*these designs includes the additional requirement that no PMT be closer than 4" to the nearest metal strut, a requirement which was suggested by the Monte Carlo group at the Los Alamos SNO collaboration meeting.

**relaxing the above condition of 4" to the nearest metal strut, however we still required at least 1 inch to the each of each panel for mounting purposes. This reduces the number of tubes from the original Temple presentation.
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Note after meeting: additional work on mounting concepts has increased the 50 cm tubes to 2000-2100 PMTs.
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In some cases different numbers where used in the RFP, for the smaller PMTs the packing fractions were varying rapidly depending on who was using the CAD computer (physicists estimated larger numbers than did engineers or designers).

respectfully submitted,
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