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STATUS OF THE ENGINEERING OF THE ACRYLIC VESSEL

The following is a summary of the status of the engineering of the acrylic vessel as of June 19, 1991.

1. Design Criteria

Though the Design Criteria has been complete for a number of months, new requirements arise from time to time and the issue of the document is delayed while these are worked out and incorporated. However, once the present review of light transmission requirements is completed, it is proposed to issue the Criteria for approval with out further delay.

2. Vessel Layout

Drawings of the vessel are appended. These show the present layout of the vessel. It will be noted that there are "holds" on a number of dimensions. These holds concern the thickness of the chimney and of the shell of the upper hemisphere and they will be released once the second phase of the vessel stress analysis is complete.

It will also be noted that the vessel is suspended from 10 sets of ropes. While this is a change from what was shown in the "Grey Book", there is a general consensus amongst the members of the Vessel Committee that the vessel should be supported by ropes and not by an acrylic collar. There is also a consensus that the shell of the vessel should be loaded in compression. A memorandum, "Summary of Reasons Which Lead to Changing the Design Concept of the Vessel" documents the physics and engineering considerations behind these changes; it is in final review and will be issued shortly.

3. Stress Analysis First Phase

The first draft of the first phase Stress Report has been completed and a meeting was held to review it. Those taking part in the review included personnel from Los Alamos, from Ecole Polytechnique, from Monenco and from Swanson.

The report analyzes the stresses in the vessel under static conditions, the stresses at the rope grooves, the consequences of the failure of a rope set, the stiffness of the chimney in the vertical and horizontal directions and the resistance of the vessel to buckling.

The report shows that stress levels are within allowable limits, that the vessel can withstand the effects of a broken rope and that the chimney does not appear to need lateral guidance or vertical support at its upper end.

The critical buckling pressure of the vessel was found using a number of methods and each of these indicated that there was a theoretical factor of safety of approximately 7. The report went on to discuss real factors of safety pointing out that these were much lower than the theoretical and at the review meeting noted above, it was decided to use a capacity reduction factor of .2 and a safety factor of 4. As a result some as yet undefined part of the upper hemisphere of the vessel will have to be thickened.

4. Stress Analysis Second Phase

The second phase of the stress analysis will analyze the effect of rock bursts and earthquakes on the vessel; the work has started and it is expected to be completed in mid September 1991.

The model used will include the cavity water, the PSUP and the vessel. The model will allow for geometric imperfections in the vessel and the results from the analysis will include:

pressures on the vessel, vessel stresses and vessel deflections due a rock burst or an earthquake, be it from a point below the cavity or to the side of it;

an analysis of the safety of the vessel in buckling during such events;

a review of the effect of the implosion of a PMT on the buckling strength of the vessel;

a review of the effect of the loads from the neutron detector tethers;

recommendations on allowable fabrication and erection tolerances.

It is conceivable that these analyses will require that the vessel shell be thickened.

5. Procurement

A memorandum is being prepared regarding the vessel procurement process.

It will recommend that SNO purchase the acrylic material and supply it free issue to the vessel fabricator.

It will also recommend that SNO purchase, from each interested supplier of acrylic, a few sheets which have been specially formulated to meet project needs. When tendering on the supply of these sheets, the suppliers will also be asked to quote on the supply of all the acrylic needed to complete the vessel. Once SNO has tested the materials (for radio-activity, for optical properties after thermo-forming and for bonding), SNO will decide whose material to purchase.

The memorandum also reviews the relative merits of going out for tender for the vessel fabrication against negotiating a contract with a specific fabricator. It reviews the perceived competence of the various the fabricators and recommends that a contract be negotiated with one of them. The main advantage to negotiating a contract relates to schedule and it is recommended that a check estimate be produced so as to ensure that the cost negotiated is not unrealistic.

It is expected that the contract will be fixed price for that part of the work carried out in the fabricator's facility and cost plus for the work at site.

6. Specifications

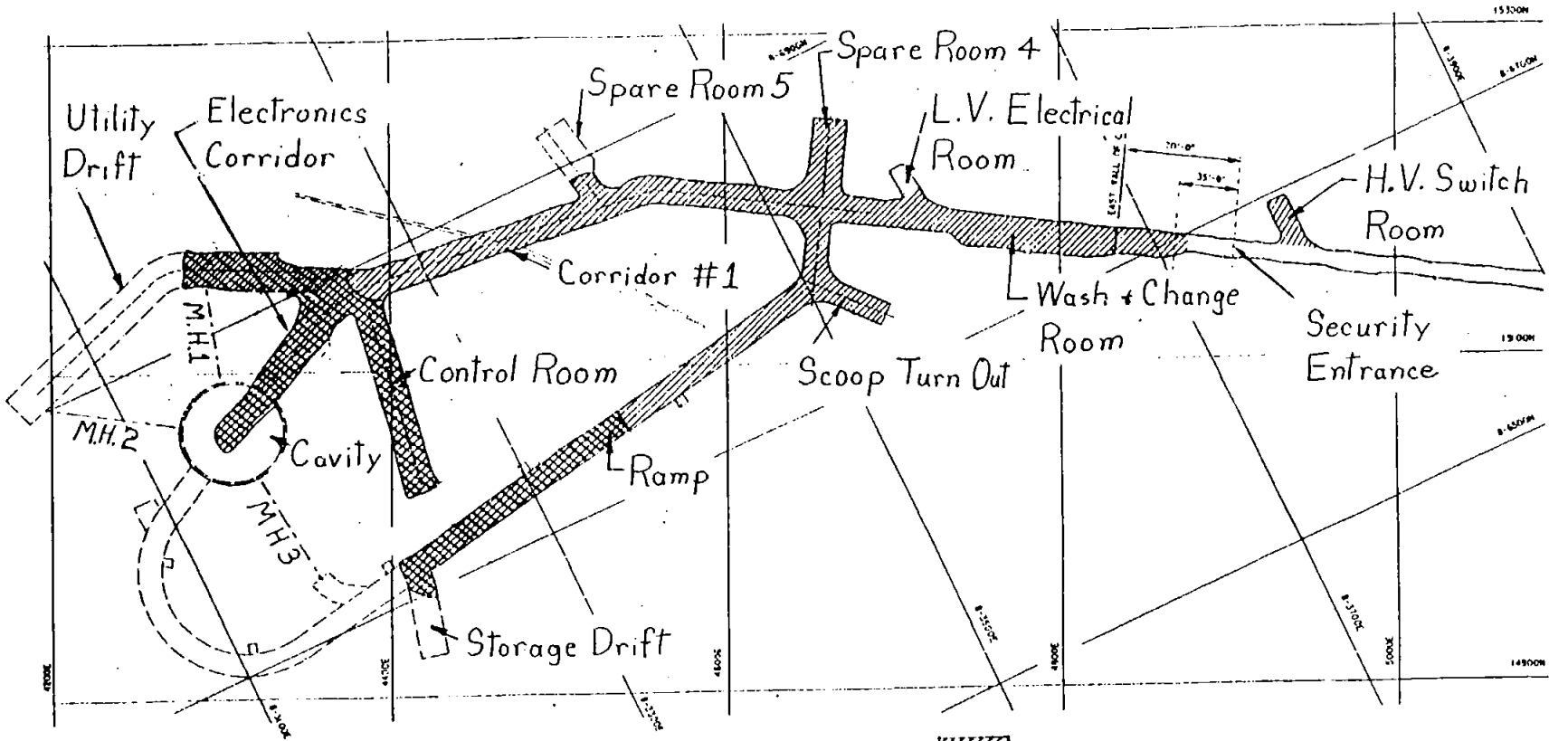
The technical specification for the supply of the acrylic material and for the fabrication of the vessel have both been prepared, reviewed by the Vessel Committee and its comments have been incorporated. The following points are of particular interest.

The fabrication specification requires that procedures be developed for essentially every process involved in the fabrication and erection of the vessel and it is estimated that an extra 30% of material will be needed to allow for development work and for errors during fabrication and erection.

The specification for the supply of the acrylic material will require that at least 80% of the material comply to the project radio-activity requirements and SNO will test coupons from each sheet cast. The 20% which does not comply will be specially marked and used exclusively for development work. (While one would like all material to comply to the radio-activity requirements, it is expected that the cost penalty for such a requirement would be substantial).

P. B. Cumyn

June 19, 1991



SUDBURY NEUTRINO OBSERVATORY

EXCAVATION PROGRESS

MAY/31/1991

4. Ground Convergence

Most of the rock movement resulting from the excavation of the large cavity will occur during & immediately after the excavation & the external monitoring of the cavity, discussed above, will be used to establish that the rock behaves as expected. Some long term creep is expected but the estimates for its magnitude are uncertain. The magnitude of the creep is an important parameter for the design of the cavity liner. The convergence in the diameter of the cavity is expected to be 0.4" in 10 years but an effect a factor of 10 larger can not be ruled out. Measurements of the convergence in the low voltage electrical room & in the high voltage switch room have started. These drifts were excavated in the summer of 1987 & April 1990 respectively. Invar bars have been embedded in opposite walls of these drifts & the gap between these (& their extensions) will be measured with a micrometer at intervals of about one month.

5. SNO Research Station

An existing drift on the 4600 level has been reconditioned for use by SNO as a research station. The space which is approximately 14' x 20' has a concrete floor & is enclosed by a block wall with a secure door. The walls & ceiling are shotcreted & have been painted to provide a surface that can be kept clean. The facility will be used for low background counting.

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