D. Physical Aspects of Cold-Moderator Design, A. D. Taylor, RL

During a discussion of the physical aspects of cold moderator design, the following points emerged:

- The principal aim in cooling a moderator is to extend the slowing down region, thus avoiding the complications in the behavior of the time pulse (and hence instrumental resolution) which occur with the onset of the maxwellian. This advantage has to be traded off against: a) the restriction of choice of moderator material, and b) the penalty imposed by the cryogenics on the geometric coupling between target and moderator.

- Candidate materials for a 20 °K moderator are liquid hydrogen and methane. The former has a low hydrogen density (ρ = 0.042 atoms Å^{-3}) which leads to poor coupling and broad peaks in the slowing down region. This increased leakage may be somewhat reduced in reflected systems. Tests on a liquid hydrogen moderator at ZING-P' are expected to take place in the early summer of 1979. Methane has a relatively high hydrogen density (ρ = 0.078 atoms Å^{-3}) and has low energy modes which aid rapid thermalization. It was suggested that the polymerization of methane, which has been attributed to radiation effects may result from the catalytic action of traces of the chlorinated solvents which are used as cleaning agents.

- Cold neutron moderators may be improved by the use of a reflector/filter, for example, polycrystalline beryllium for $\lambda > 4$ Å or a single crystal of beryllium or silicon which will operate over the entire thermal range.

- A TiH_2 moderator (ρ = 0.08 atoms Å^{-3}) will be built by the Rutherford Laboratory towards the end of 1979 for operation on the Harwell linac at both ambient and liquid nitrogen temperatures. Thermodynamic and radiation damage properties of this hydride at 77 °K have yet to be established.

- It was suggested that a comprehensive literature search be made for radiation and engineering behavior of potential pulsed-source moderator materials.

The reduction in coupling efficiency for a reflected wing moderator as a function of cryogenic gap has been estimated by a Monte Carlo method. The results are illustrated in Fig. II-D.1. The gap is defined to include both the vacuum space and the structural materials of the cryostat and moderator vessels. (The penalty is more dramatic for an unreflected system as shown by the dashed curve in Fig. II-D.1; the unreflected data were taken from LA-6020).

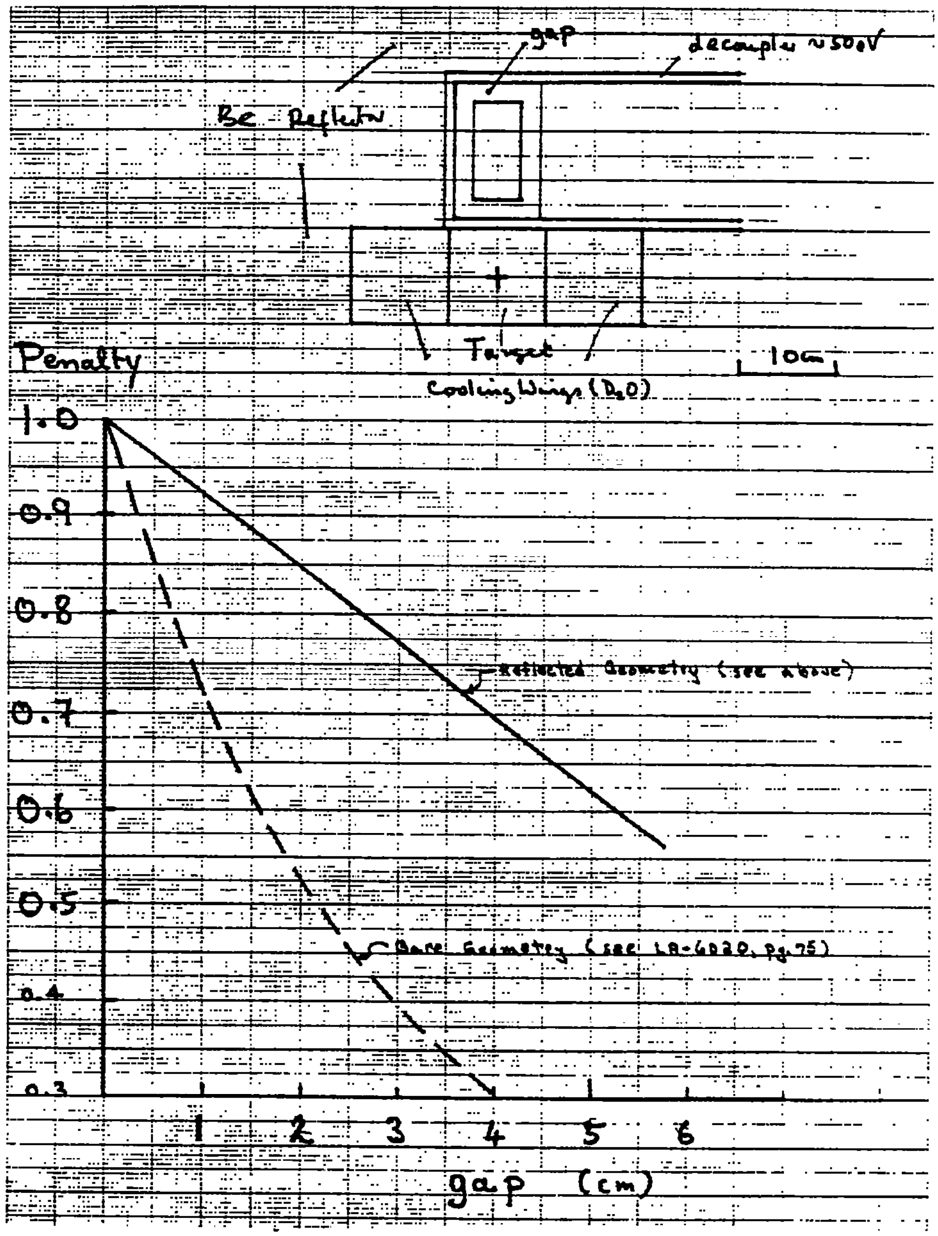

Fig. II-D.1. Illustration of penalty in moderator neutronics of varying the gap between the target and moderator.