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Summary of the Objective Discussion of Solid and Liquid Targets for High-Power Sources

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The discussion of advantages and disadvantages of solid and liquid targets for 'high-power' sources started with the definition of 'high-power.' For 5 MW systems, there was a general agreement that a liquid target is necessary. Only when considering proton beam powers in an intermediate range is a choice between solid and liquid targets necessary. For this reason, the discussion was limited to beam powers between 0.6 MW and 1.5 MW, which includes many of the next-generation sources (the first stage of SNS and JAERI, as well as JHF, LPSS, etc.).

The two types of target systems were compared in six different areas: neutronic performance, thermo-hydraulics, structural aspects, materials considerations, radiation damage/target lifetime, and operational issues. From a neutronics point of view, fully engineered target systems should be compared. To date, comparisons have focused on changing target materials without regard to the peak proton current density for which the targets were designed. With no definitive calculations completed to date, the present state of knowledge would not select one target system over another solely on the basis of neutronic performance. From a thermo-hydraulics standpoint, both systems present some challenges that can probably be overcome with some effort. The issue of mercury wetting does not seem to be a problem as evidenced by data presented at this conference.

Structural issues are similar for the two types of target systems. When considering materials issues, fatigue tests are indispensable for evaluating solid clad target systems. For a liquid target system, study of Hg corrosion in a prototypic radiation field is necessary. Initial estimates indicate that, at 2 MW, a liquid Hg target may last twice as long as a solid target system (3 months vs. 6 months). However these estimates are just 'best guesses.' Materials irradiation studies should continue to build confidence in target lifetime estimates.

From an operations standpoint, the waste stream from a solid target system will be high due to the short target lifetime (roughly 3 months at 2 MW). In addition, a method of filtering Be-7 before it deposits in the target cooling loops is important for both target system, but particularly for a solid target system. R&D costs for a liquid target system are likely to be higher than for a solid target system, although the R&D cost for a solid target system will not be negligible (cladding materials and methods, verification of heat transfer coefficients for rod systems, etc.).

The conclusion of this discussion was a general agreement that solid and liquid target systems both have strengths and weaknesses for beam powers between 0.6 MW and 1.5 MW. Neither target system has a clear advantage over the other in this power range.