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RESULTS OF THE R&D ASSESSMENT FOR THE BLANKET COMPARISON AND SELECTION STUDY*

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A research and development (R&D) assessment was carried out to identify all the major issues for the major blankets evaluated in the Blanket Comparison and Selection Study. A total of 29 issues were identified. Each issue is described in detail, the status of the data base for that issue is summarized, the required data to resolve the issue is identified and the approximate level of resources are indicated.

Each of the 29 issues is given a rating in terms of their consequences (C) and probability (P) of occurrence for each blanket concept to which each issue applies. An examination of these ratings will indicate how widespread the issue is in terms of its impact on more than one blanket concept. The overall severity of the R&D issue is indicated by the C x P score.

The major issues identified for blanket structural materials include welding/fabrication concerns and radiation-induced embrittlement for both ferritic steels and vanadium alloys. Of somewhat lesser concern is embrittlement of the stucture by hydrogen. Issues of concern for only vanadium alloys include chemical reactivity effects with the environment and the desire to use non-vanadium heat transport components outside the reactor to reduce costs.

The most important R&D issue for liquid metal breeders and coolants are MHD effects and corrosion problems. The MHD problem is particularly important for tokamaks. It is noted that the development of insulators for coolant ducts would greatly reduce the MHD pressures. It is also important, again particularly for tokamaks, to develop non water-cooled, near-plasma components for lithium, and to a lesser extent LiPb, blankets.

The major R&D concerns for solid breeder blankets are the temperature windows for the various ceramics to provide for acceptable tritium release and low tritium inventories, the ability to control the temperature in the breeder, the form of released tritium, the possible swelling of ceramics (particularly Li_2O) and the difficulty of accommodating reactor power variations in solid breeder blankets. Fabrication and re-fabrication by remote handling is also an important issue.

Two very important issues apply to almost all blanket concepts: tritium breeding and tritium recovery/control. Tritium breeding is a crucial issue for Li_2O designs without neutron multipliers (ternary ceramics must have a neutron multiplier). In general, the tritium breeding issue is more important for solid breeder blankets than liquid breeder blankets (it is not an issue

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for LiPb at all), and more important for tokamaks compared to tandem mirrors. Tritium recovery/control is a major concern for all blankets except lithium. It is particularly severe for FliBe blankets. The form of released tritium (T_2/HT or T_2O/HTO) has a major impact on tritium containment.

The primary issues related to using Be as a neutron multiplier are concerned with the ability to efficiently reprocess the Be (which is required because it is resource limited), tritium release from the Be directly into the primary coolant for some designs, and loss of mechanical integrity. Issues of special concern to molten salt coolants include stability of the salt in the fusion environment, neutron activation of the salt, and the chemical reactivity between Be and molten salts.

There are some blanket R&D issues that relate to first wall type considerations. The use of a stress relief configuration (grooved first walls) for tokamak first walls is crucial to accommodate the relatively high heat fluxes and erosion rates compared to tandem mirrors. Additional issues include coolant leakage into the plasma chamber and the difficulties of coolant/breeder cleanup for LiPb (activation of LiPb is also a concern) and FliBe. Finally, electromagnetic effects are an important issue, particularly for tokamaks.

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