FUSION MATERIALS IRRADIATIONS AT MARIE'S FISSION FUSION FACILITY

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Los Alamos National Laboratory's proposed signature facility, MaRIE, will provide scientists and engineers with new capabilities for modeling, synthesizing, examining, and testing materials of the future that will enhance the USA's energy security and national security. In the area of fusion power, the development of new structural alloys with better tolerance to the harsh radiation environments expected in fusion reactors will lead to improved safety and lower operating costs. The Fission Fusion Facility (FFF), one of three pillars of the proposed MaRIE facility, will offer researchers unprecedented access to a neutron radiation environment so that the effects of radiation damage on materials can be measured *in-situ*, during irradiation. The calculated radiation damage conditions within the FFF match, in many respects, that of a fusion reactor first wall, making it well suited for testing fusion materials.

The proposed FFF will use a spallation source to generate neutrons. Spallation sources have long been considered for testing fusion materials [1]. The spallation source will be driven by an existing $1B-class high-power proton linear accelerator at the Los Alamos Neutron Science Center. A power upgrade of the accelerator, from 1 MW to 1.8 MW, will provide calculated peak damage rates in iron of 50 dpa per full-power year, with a 300-cm^3 irradiation volume exceeding 20 dpa per full-power year. While the He-to-dpa ratio ranges from 4 to 30 appm/dpa, a large fraction of the irradiation volume offers a He-to-dpa ratio in the range of 8 to 13 appm/dpa. The FFF calculated primary knock-on atom spectrum, while harder than that of fusion reactor first wall, is softer than that of other proposed fusion materials irradiation facilities. Calculated burn-in of transmutants is similar to that seen in a fusion reactor.

The FFF is being designed with unprecedented *in-situ* diagnostic capability in order to provide researchers greater insights into the fundamental processes of radiation damage by neutrons, such as phase, lattice orientation, elastic strain, and dislocation density. Such data can be used to validate radiation damage models.

[1] See, for example, J.M. Perlado, M. Piera, and J. Sanz, J. of Fusion Energy 8 (1989) 181–192.