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Proposal for a Fusion Prototypic Neutron Source at LANSCE

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The U.S. Department of Energy's Office of Fusion Energy is evaluating options for a Fusion Prototypic Neutron Source (FPNS) to irradiate materials test specimens to high dose in an environment with characteristics that are similar to the first wall of a fusion reactor burning D-T fuel. One of the candidates under study is a spallation neutron source at the Los Alamos Neutron Science Center (LANSCE). Key parameter guidelines for the facility include the ability to achieve a damage rate in iron of 8 to 11 dpa per calendar year with a He-to-dpa ratio of approximately 10 appm/dpa within an irradiation volume of at least 50 cm³. The design proposed for LANSCE employs an innovative annular target with the fusion materials irradiation region occupying the central flux trap inside the annular target. The design employs a well-focused (1 mm rms in both transverse planes) beam painted on the front face of the annular target in an ever-expanding circular pattern 17 times over the course of the 850- μ s beam pulse. Assuming 1 MW of 800-MeV protons incident on the tungsten target, calculations indicate a damage rate in iron of 20.6 dpa per full-power year averaged over a 53-cm³ volume. The calculated He-to-dpa ratio in this volume is 14.6 appm/dpa, near the desired value of 10 appm/dpa. The central irradiation zone is divided into three 120° sectors, each with its own independent temperature control, which satisfies another key parameter guideline. To save construction costs, the target station could take advantage of substantial existing infrastructure at LANSCE, including a large experimental hall with two adjacent unused hot cells, and a large amount of steel shield blocks on site. But the real cost savings comes from the use of the existing LANSCE accelerator to deliver 1 MW of proton beam, with only marginal investment in the accelerator itself.

Primary authors: PITCHER, Eric (Los Alamos National Laboratory); BATYGIN, Yuri (Los Alamos National Laboratory)

Presenter: PITCHER, Eric (Los Alamos National Laboratory)

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