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An Overview of an Accelerator-Based Neutron Spallation Source*

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Abstract. An overview of the feasibility study of a 1-MW pulsed spallation source is presented. The machine delivers 1 MW of proton beam power to spallation targets where slow neutrons are produced. The slow neutrons can be used for isotope production, materials irradiation, and neutron scattering research. The neutron source facility is based on a rapid cycling synchrotron (RCS) and consists of a 400-MeV linac, a 30-Hz RCS that accelerates the 400-MeV beam to 2 GeV, and two neutron-generating target stations. The RCS accelerates an average proton beam current of 0.5 mA, corresponding to 1.04×10^{14} protons per pulse. This intensity is about two times higher than that of existing machines. A key feature of this accelerator system design is that beam losses are minimized from injection to extraction, reducing activation to levels consistent with hands-on maintenance.

INTRODUCTION

Research based on slow neutron beams has been crucial to advances in fundamental sciences, technology, and medicine. Neutron studies have provided information critical to the understanding of new materials and have made key contributions to material sciences, such as the study of structure and excitations of high-T_c superconductors, interfacial structure of polymeric and magnetic layers, and spin dynamics in highly correlated metals.

Proton accelerators can be used to produce intense bursts of neutrons. Pulsed sources allow performance of real-time experiments and provide low background noise since the source is off for a good fraction of the time.

A proton synchrotron system capable of delivering 1 MW of beam power was designed for the Intense Pulsed Neutron Source (IPNS) Upgrade Feasibility Study at Argonne National Laboratory (ANL) (1,2). The RCS and associated research facilities are housed in the 50,000 m^2 of space in the former 12-GeV Zero Gradient Synchrotron (ZGS) area. The ZGS Ring Building houses a 190-m circumference, 2-GeV RCS. Two adjoining experiment halls house two neutron-generating target stations, each serving 18 neutron beamlines and instruments. Figure 1 shows the proposed facility layout. Enclosures for the linac and low energy transport line (LET) are the only new conventional facility construction and are also shown in Figure 1.

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