FUSION NUCLEAR SCIENCE FACILITY-AT – A MATERIAL AND COMPONENT TESTING DEVICE

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Abstract. A Fusion Nuclear Science Facility (FNSF) is a necessary complement to ITER, especially in the area of materials and components testing, needed for DEMO design development. FNSF-AT, which takes advantage of advanced tokamak (AT) physics should have neutron wall loading of 1-2 MW/m^2, continuous operation for periods of up to two weeks, a duty factor goal of 0.3 per year and an accumulated fluence of 3-6 MW-yr/m^2 (~30-60 dpa) in ten years to enable the qualification of structural, blanket and functional materials, components and corresponding ancillary equipment necessary for the design and licensing of a DEMO. Base blankets with a ferritic steel structure and selected tritium blanket materials will be tested and used for the demonstration of tritium sufficiency. Additional test ports at the outboard mid-plane will be reserved for test blankets with advanced designs or exotic materials, and electricity production for integrated high fluence testing in a DT fusion spectrum. FNSF-AT will be designed using conservative implementations of all elements of AT physics to produce 150-300 MW fusion power with modest energy gain (Q<7) in a modest sized normal conducting coil device. It will demonstrate and help to select the DEMO plasma facing, structural, tritium breeding, functional materials and ancillary equipment including diagnostics. It will also demonstrate the necessary tritium fuel cycle, design and cooling of the first wall chamber and divertor components. It will contribute to the knowledge on material qualification, licensing, operational safety and remote maintenance necessary for DEMO design.