

PWI Gaps vs. Tools: General Requirements on the Tools
Theme 3 PWI Panel

	Theory & Modeling	Existing/Upgraded/New Test Stands	Existing/Upgraded Confinement Facilities	New Confinement Facility
SOL and Divertor Plasma Turbulent heat and particle transport SOL particle flows Impurity transport Radiation transport He pumping	<i>Increase focus on edge, SOL and divertor, integrated with PMI effects. First-principles simulation of edge transport, critical gradients and intermittency. Non-Maxwellian f. Improved neutral and photon modeling.</i>	<i>Measurements of f. Measurements of turbulent transport, impurity flows.</i>	<i>Development of SOL width scaling. Detailed tests of advanced SOL and divertor models including first-principles turbulence simulations. Development of new diagnostics. Identification of missing edge physics.</i>	<i>Detailed long pulse, Demo-relevant power, hot walls tests of advanced SOL and Divertor model, including first-principles turbulence simulations. Extensive diagnostics for long-pulse, high-power, hot walls.</i>
Erosion & Redeposition Impurity generation RF sheaths Dust production Morphology changes Component lifetime Energetic α effects	<i>Improved PMI models including dust production and stability of deposited layers. Linkage to improved SOL models. Coupled RF antenna and SOL sheath models. Mixed material characterization. Neutron and alpha effects.</i>	<i>Tests of PMI models for erosion, including stability of redeposited layers and dust production under Demo conditions. In-situ tests of material surface dynamic response. Tests of techniques for dust removal. Tests on neutron irradiated materials.</i>	<i>Tests of integrated PWI/PMI models. RF sheath effects, redeposition. Development of new diagnostics. Tests of techniques for dust removal. Identification of missing edge physics.</i>	<i>Long pulse, Demo-relevant power, hot wall tests of integrated PWI/PMI model, erosion, redeposition, RF effects, including fast ions. Neutron-irradiated coupons. Extensive diagnostics. Tests of techniques for dust removal.</i>
ELMs & Disruptions Off-normal heat flux Energetic electrons Dust production Impurity injection	<i>3-D MHD, two-fluid, & kinetic models including runaways. Control techniques such as edge ergodicity, stimulated edge transport and small ELMs</i>	<i>Tests of impacts of Demo-relevant off-normal events. Tests on neutron-irradiated materials.</i>	<i>Tests of advanced models and control techniques. Scenario development with focus on stability.</i>	<i>Demonstration of high accumulated run time without large off-normal events. Test of effects of many small off-normal events.</i>
Tritium Retention Safety	<i>Improved theory for tritium trapping in materials.</i>	<i>Tests of tritium diffusion/permeation and trapping on neutron irradiated materials at high temperature.</i>	<i>Tests of deuterium retention in high-temperature refractory metals.</i>	<i>Deuterium, trace tritium retention with long pulse, Demo-relevant power & hot walls. Tests on neutron irradiated coupons.</i>
Innovations High radiation frac'n Flux expansion Stellarator edge Material development Liquid surfaces Active coating	<i>Modeling and design of new divertor concepts. Multi-scale materials modeling and development of new materials. Modeling of liquid surfaces and flows. Modeling of techniques for coating and removal.</i>	<i>Tests of new solid materials and of liquid surfaces under plasma bombardment. Tests of coating techniques, advanced refractory alloys and metal doping.</i>	<i>Tests of innovative approaches to power and particle handling, including self-consistency of He pumping.</i>	<i>Integrated long pulse, Demo-relevant power, hot-wall tests of innovative approaches to power and particle handling, including self-consistency of He pumping.</i>