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X-point target divertor concept and the Alcator DX high power divertor test facility B. LABOMBARD, E. MARMAR, J. IRBY, R. VIERIA, S. WOLFE, P. BONOLI, C. FIORE, R. GRANETZ, M. GREENWALD, I. HUTCHINSON, A. HUBBARD, J. HUGHES, Y. LIN, B. LIPSCHULTZ, R. PARKER, M. PORKOLAB, M. REINKE, J. RICE, S. SHIRAIWA, J. TERRY, C. THEILER, G. WALLACE, A. WHITE, D. WHYTE, S. WUKITCH, Alcator DX Team — Three critical challenges must be met before a steady-state, power-producing fusion reactor can be realized: (1) safely handle extreme plasma exhaust power, (2) completely suppress material erosion at divertor targets and (3) do this while maintaining a burning plasma core. Advanced divertors such as 'Super X' and 'X-point target' have the potential to solve all three challenges by producing a stable, fully detached, low temperature plasma in the divertor while maintaining a hot boundary layer around a clean plasma core. The X-point target divertor may be particularly effective. It places a second X-point in the pathway of the peak parallel heat flux with the intention of forming an X-point MARFE in the divertor volume, well away from the primary X-point that defines the last closed flux surface and at larger major radius, providing detachment front stability. Divertor heat dissipation is via volumetric processes (radiation, ion-neutral collisions), virtually eliminating erosion by ion bombardment and reducing peak heat flux and neutron fluence on remote divertor target components. Alcator DX is conceived as a national facility to test these ideas. It employs the high magnetic field technology of Alcator combined with high-power ICRH to investigate advanced divertors at reactor-level parallel heat flux densities.

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