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Extrapolation of the Runaway Electron Benign Termination Scenario to ITER

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D2 injection into mature runaway electron (RE) beams is found to enable access to a benign termination scenario that can mitigate MA-level RE currents without measurable wall heating. This result is enabled by the excitation of large and sudden MHD events (dB/B ~ 5%) that are found to promptly disperse the entire RE population over a large wetted area, with MHD accelerated by a recombined background plasma [1,2]. Fast RE loss timescales (« ms) also prevent magnetic to kinetic energy conversion. We review benign termination phenomenology with supporting published data and focus on extrapolation to ITER, specifically: 1) the required D2 or H2 injection to recombine the background plasma, 2) vertical displacement event evolution and MHD instability access; 3) the required wetted area enhancement to disperse the kinetic energy; 4) the impact of the increased avalanche gain. Using the DINA code, we find that high current ITER RE beams should robustly access edge q of 3 & 2, where instability is expected. Using the MARS-F code, we find that the large-scale dispersal of RE kinetic energy is expected if dB/B is large, as was found in existing experiments [3]. The large avalanche gain in ITER poses a severe challenge, likely requiring multiple cycles of the benign loss to fully terminate a high current RE beam. [1] C. Paz-Soldan et al PPCF 2019 & NF 2021 [2] C. Reux et al PRL 2021, [3] Y. Liu et al, NF 2022

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