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Thu-Mo-Po4.03-03 [14]: Current Reset in Superconducting Devices

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Many superconducting devices operate in persistent mode. Heat losses from current leads are one of the major design challenges, especially when limited low-volume cryogen is available during normal operations. To reduce the heat losses, the current leads are either retracted after charging, or have permanent leads carrying smaller current when in a charging mode but have small heat load when in normal operating modes. The devices may require periodic current/magnetic field adjustment. It might be advantageous to ramp the unit to zero current when there is a long-time power outage or system malfunction. The ramp and re-calibration require engagement of the current leads and establishing high-current electrical path between components located outside of the cryogenic vessel and superconducting coils in the cryogenic vessel. Significant challenges need to be addressed including operation in automated, remotely-controlled mode, multiple engagements without performance degradation, operation in a high magnetic field and Lorentz force, need in multiple monitoring sensors and appropriate redundancy, long time in operation with minimum or no maintenance, and other factors. We evaluate several options of remotely-controlled retractable high-current leads that include several current reset options, fixed permanent leads with low heat load capable of carrying enough current to couple to a flux pump that periodically replenish and maintain the operating current, and system monitoring and methods that can either improve the engagement of retractable high-current leads, or precisely adjust the current in the superconducting device.

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