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C2Or4B-05: Replacement and expansion of the cryogenic control system for the Electron Ion Collider at Brookhaven National Laboratory

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The Electron Ion Collider (EIC) at Brookhaven National Laboratory represents a major advancement in particle physics, requiring sophisticated cryogenic infrastructure to support its superconducting elements. This effort involves the conversion of the existing cryogenic control system, originally developed for the Relativistic Heavy Ion Collider (RHIC), to meet the specific demands of the EIC. The cryogenic control system will coordinate cooling for components operating at various temperatures, including superconducting magnets at 4.6K, 1.92 K and Superconducting Radio Frequency (SRF) cavities at 2.0 K.

Key to this transition is the integration of 2K satellite cryogenic systems distributed around the Collider ring. These systems will function in tandem with the existing central plant and the existing 4K distribution system. The central plant will provide supplemental capacity to the 2K satellites and ensure seamless operation across diverse cooling loads. Upgrades to the control system architecture will focus on enabling precise management of expanders, heat exchangers streams, and supply and return flow streams from the various loads to accommodate the expanded functionality. The cryogenic control system also interfaces to other Collider systems such as the magnet system, SRF systems, vacuum systems, beam permit/abort system, VODH system, and utilities systems for controls and interlocks.

This effort is a cooperative endeavor between Brookhaven National Laboratory (BNL) and Thomas Jefferson National Accelerator Facility (JLAB). The collaboration leverages the expertise and resources of both institutions, ensuring the cryogenic control system meets the stringent performance and reliability requirements of the EIC. By working together, BNL and JLAB aim to deliver a state-of-the-art cryogenic solution that supports the groundbreaking scientific goals of the EIC.

This paper outlines the strategy for transitioning the RHIC cryogenic control system to the EIC, detailing the architectural modifications, operational protocols, and enhanced monitoring required to support EIC's advanced scientific objectives. By leveraging the existing infrastructure while introducing targeted enhancements, the cryogenic control system will play a critical role in achieving reliable, efficient, and scalable performance for the EIC.

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Author: TALTY, Patrick (Brookhaven National Laboratory)

Co-authors: Mr ZARCONE, Adam (Brookhaven National Laboratory); VAN KUIK, Brian (Brookhaven National Laboratory); CREEL, Jonathan (Thomas Jefferson National Accelerator Facility); Mr MASI, Len (Brookhaven National Laboratory); MICHNOFF, Rob (Brookhaven National Laboratory); NORTON, Robert (Thomas Jefferson National Accelerator Facility); THAN, Roberto (Brookhaven National Laboratory); FEDER, Russell (Brookhaven National Laboratory)

Presenter: TALTY, Patrick (Brookhaven National Laboratory)

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