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C3Or4B-01: Nitrogen Precooling Heat Exchanger replacement and control system upgrade in Superfluid Cryoplant at CMTF

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Liquid Nitrogen precooling is used in most Cryoplants to achieve cooldown to 80 K temperature range. In one such system at Fermilab's CMTF Superfluid Cryoplant, where the Helium supply directly exchanges heat with liquid Nitrogen, freezing of Nitrogen occurred inside the heat exchanger due to heat exchanger imbalance during a Cryoplant trip. Trapped vapor pockets of N₂ within the frozen heat exchanger channels were formed while warming up the heat exchanger, creating high localized pressure and subsequent damage/rupture of the heat exchanger. Replacement of the heat exchanger was done, and modifications were made in the system to rectify future occurrences. The control system was updated to bypass the heat exchanger entirely if the incoming Helium stream temperature drops below 76 K. This was done by repurposing two control valves as heat exchanger bypass valves that were previously used for a redundant 80 K adsorber in the coldbox. Additional modifications were made to further prevent return of large amount of cold Helium gas from cold end during abrupt Cryoplant shutdown. This modification has ensured high reliability of heat exchanger with prevention of freezing of Nitrogen which can damage to the heat exchanger.

Authors: HANSEN, Benjamin (Fermi National Accelerator Laboratory); SUBEDI, Jeewan (Fermi National Accelerator Laboratory); WHITE, Michael (Fermi National Accelerator Laboratory); PATEL, Vrushank (Fermi National Accelerator Laboratory)

Co-authors: JOHNSON, Gregory (Fermi National Accelerator Laboratory); MAKARA, Jerry (Fermi National Accelerator Laboratory); AL ATASSI, Omar (Fermi National Accelerator Laboratory)

Presenter: SUBEDI, Jeewan (Fermi National Accelerator Laboratory)

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