MUON DESIGN NOTE 22

SUBSYSTEM: [X] CCM [ ] CVM [ ] Cryoplant

TITLE: Current-on Access to CCM Aperture

AUTHOR: R.I. Dachniwskyj MD

DATE: April 23, 1986

OBJECTIVE

To determine a current at which the experimenters and Fermilab employees may access the CCM aperture using the heat transfer criterion suggested by the Muon Cryogenic Safety Review Panel on April 11, 1986 (0.1 W/cm^2).

CALCULATIONS Using a heat flux criterion of 0.1 W/cm^2.

The heat flux required to cause a transition from nucleate and film boiling in helium is approximately 0.8 to 1 W/cm^2. A generally used design criteria for cryostable pool boiling magnet is a heat flux of approximately 0.4 to 0.5 W/cm^2 with the superconductor at 10 K. The heat flux of the CCM conductor at 10 K is determined as follows:

Operating current = 875 A

Resistance at 10 K and 2.85 T = 4.58×10^{-7} Ω/cm

Distance between spacers = 6.67 cm

Energy dissipated by conductor between spacers at 10 K and 2.85 T = $(875)^2(6.67)(4.58 \times 10^{-7})$ = 2.34 W

Wire area exposed between spacers = 3.24 cm^2

∴ Heat flux for the CCM conductor at 875 A = 2.34/3.24 = 0.72 W/cm^2

Operating current for heat flux of 0.1 W/cm^2 = $875\ (0.1/0.72)^{0.5}$ = (875)(0.373) = 326 A

CONCLUSION & RECOMMENDATION

It has been shown that an operating current of 326 A is consistent with the heat flux criterion suggested by the Cryosafety Review Panel (0.1 W/cm^2).

It is recommended that when it is necessary for a person, outside experimenter or Fermilab employee, to enter the CCM aperture, a cylindrical volume defined by the major diameter of the upper vacuum vessel and the iron poles, that the magnet be deenergized to a maximum current of 326 A before entering the aperture.

A controlled access procedure will be prepared for this situation.

REVIEWED

R. C. Fast 4/23/86

D. P. Hunt 4-23-86