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MINIMARS CENTER CELL MAGNET DESIGN OPTIONS

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at

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CENTER CELL MAGNET REQUIREMENTS

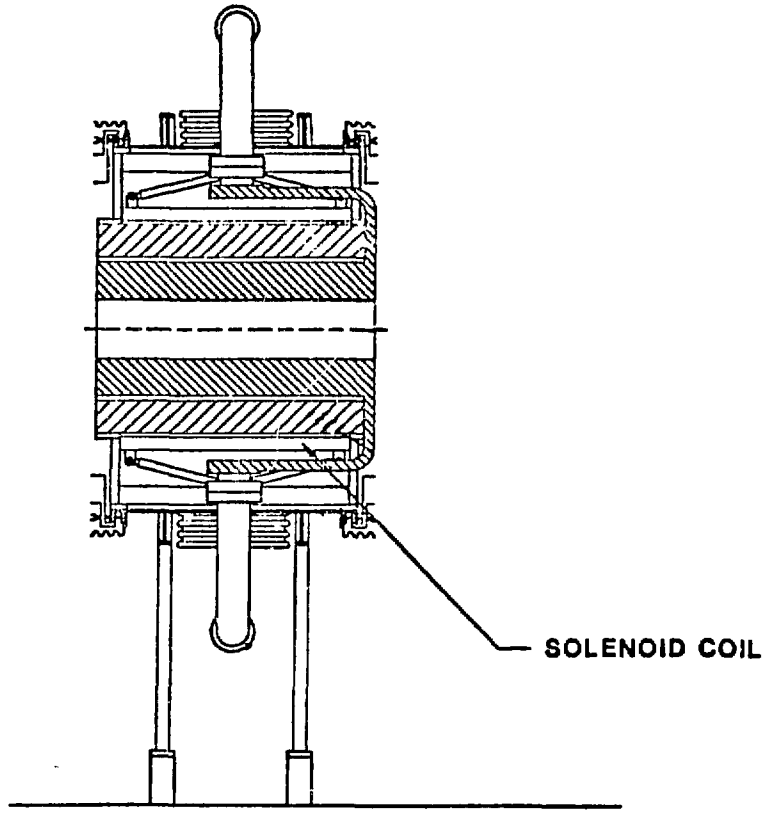
MEAN RADIUS	2 m
AXIAL LENGTH	2-8 m
FIELD ON AXIS	3 T

PRESENT BASELINE ASSUMES FORCED-FLOW COOLING

POTENTIAL COMPLEXITY OF MANIFOLDING REQUIRES RE-EVALUATION OF DESIGN OPTIONS

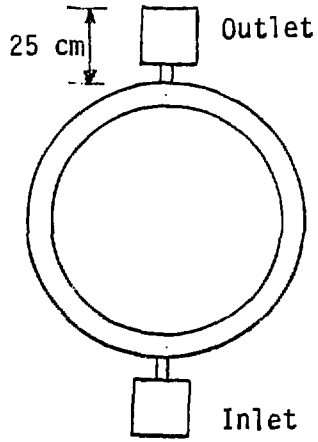
DESIGN OPTIONS ARE:

- WINDING COOLED WITH FORCED-FLOW HELIUM
- WINDING COOLED WITH POOL BOILING HELIUM



CENTER CELL COIL DESIGN COOLED WITH FORCED-FLOW HELIUM

- EMPLOY LCP-TYPE Nb_3Sn CABLE-IN-CONDUIT CONDUCTOR COOLED WITH FORCED-FLOW HELIUM
- CONDUCTOR CURRENT 60 kA
- NUMBER OF TURNS/m LENGTH OF COIL 40
- PEAK NUCLEAR HEATING AT WINDING 0.1 mW/cm^3
- NO. OF TURNS IN A COOLED LOOP 10
- HELIUM TEMP. AT INLET 4.2 K
  AT OUTLET 5.5 K
- HELIUM INLET PRESSURE 15 atm
  PRESSURE DROP 0.25 atm
- HELIUM MASS FLOW 1 g/s
- RADIAL SPACE REQUIRED FOR HELIUM MANIFOLDING 25 cm



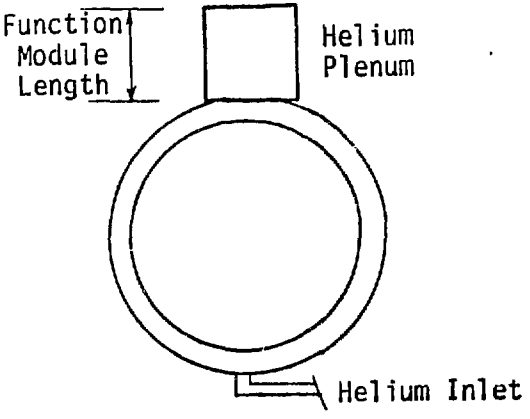
OBSERVATIONS

- THIS DESIGN HAS MANY HYDRAULIC JOINTS, MAKING AN UNFAVORABLE IMPACT ON THE AVAILABILITY.
- HELIUM LINES TO A MODULE MUST BE DISCONNECTED BEFORE REMOVING A CENTER CELL MODULE.
- RADIAL SPACE OCCUPIED BY HELIUM INLET AND OUTLET MANIFOLD WILL LEAD TO A LARGER OVERALL MODULE DIAMETER.

CENTER CELL COIL DESIGN COOLED WITH POOL BOILING HELIUM

- EMPLOY LCP-GD TYPE NbTi CONDUCTOR COOLED WITH POOL BOILING HELIUM
- CONDUCTOR CURRENT 10 kA
- PEAK NUCLEAR HEATING AT WINDING 0.1 mW/cm^3
- HELIUM BATH TEMPERATURE 4.2 K
- RADIAL SPACE REQUIRED FOR HELIUM PLENUM (ONLY ON TOP)

FOR MODULE LENGTH	
2 m	0.25 m
4 m	0.45 m
6 m	0.65 m



OBSERVATIONS

- DESIGN REQUIRES TALLER (RADIALLY) HELIUM PLENUM AND WILL LEAD TO LARGER OVERALL MODULE DIAMETER
- WINDING RADIAL BUILD IS LARGER BECAUSE POOL BOILING CONDUCTORS OPERATE AT LOWER CURRENT DENSITY
- FEWER HELIUM SUPPLY/DISCHARGE LINES TO BE DISCONNECTED BEFORE REMOVING A MODULE

CONCLUSIONS

- CHOICE BETWEEN POOL-BOILING AND FORCE-COOLED WINDING APPROACHES IS NOT CLEAR
- MAGNET CONFIGURATION SHOULD BE DEVELOPED FOR THE TWO OPTIONS BEFORE MAKING A SELECTION