# Superconducting Magnets for JHF-SK Nu Proton Beam Line

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☞Radiation Damage

☞Heat Load

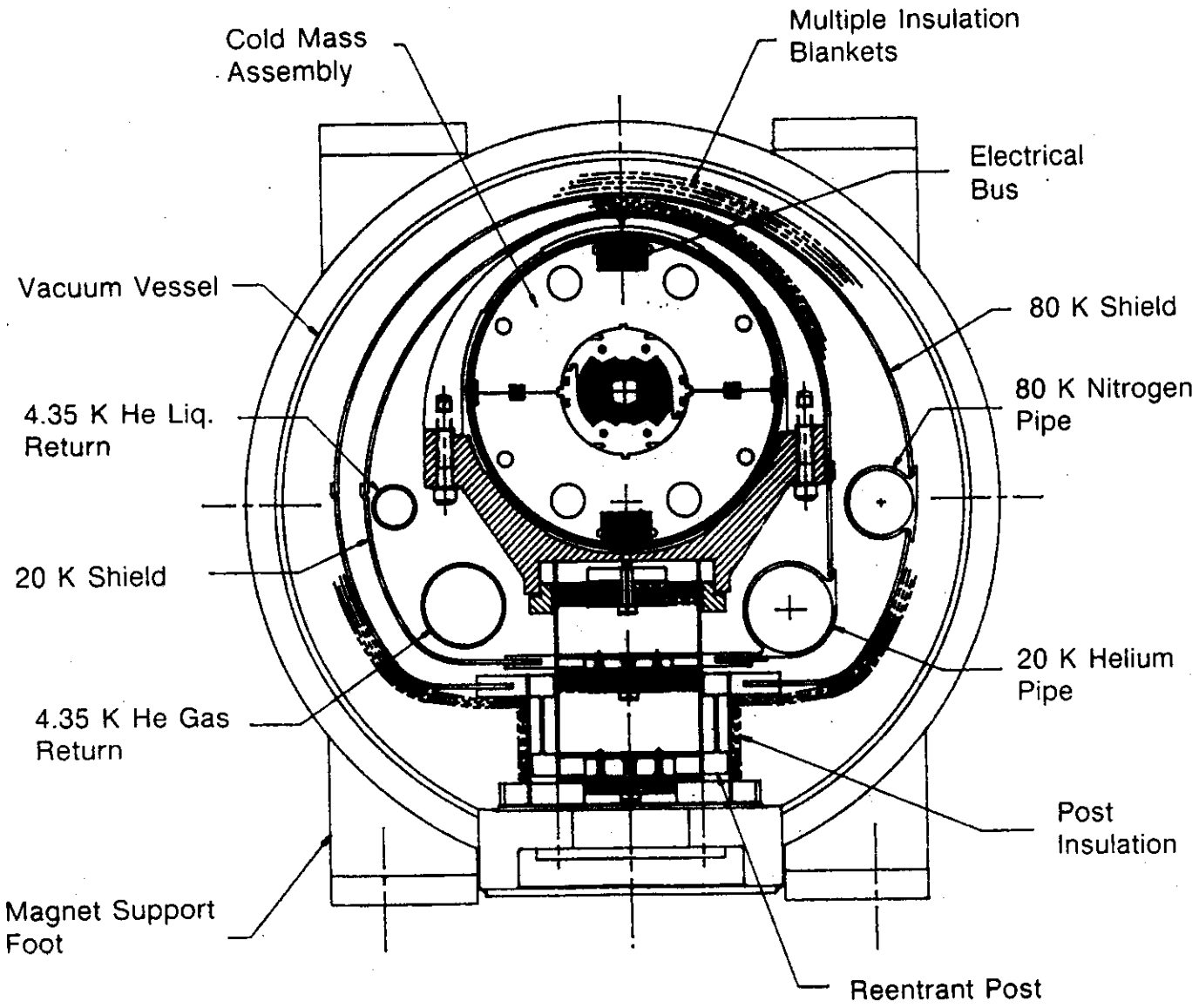
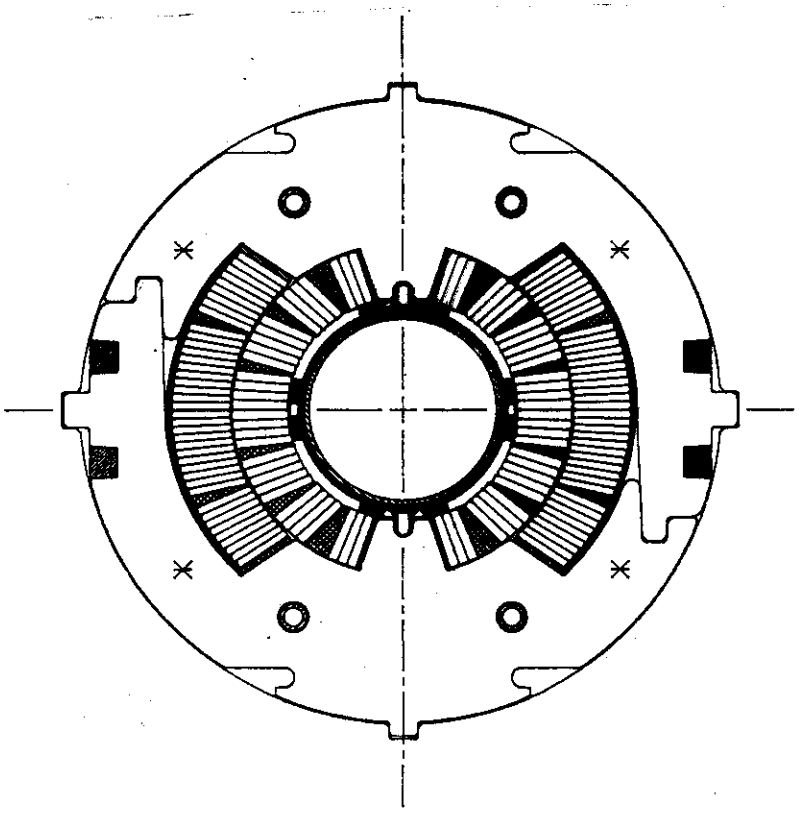



Figure 4. Dipole magnet cross section.



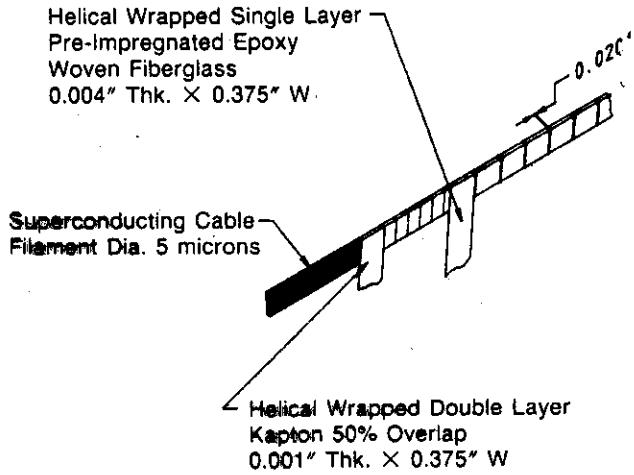



Figure 7. Cable and insulation.

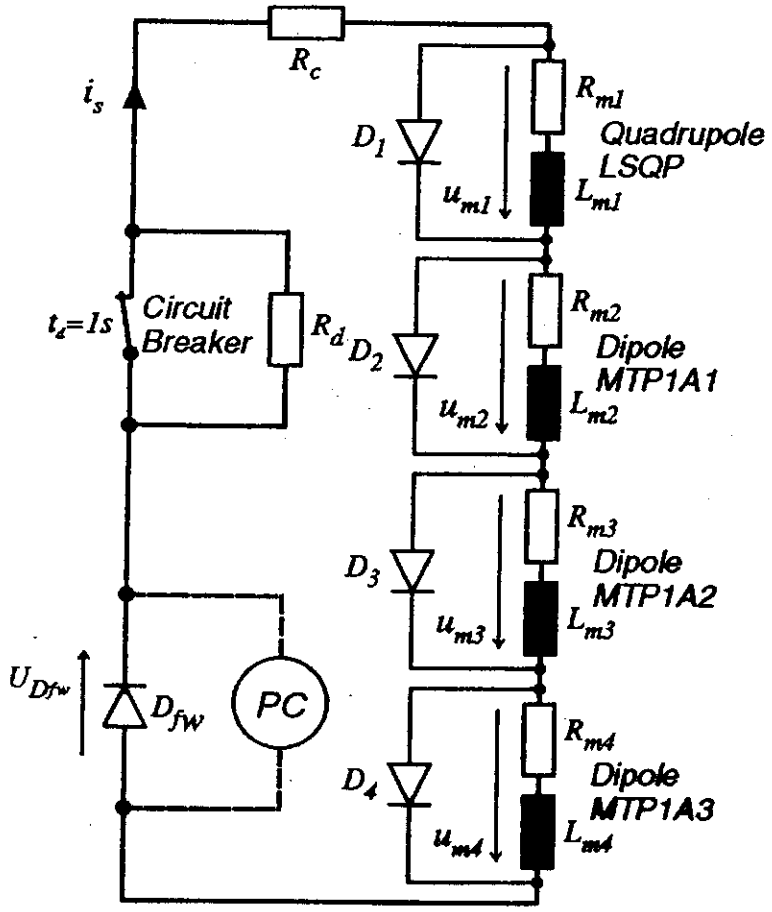



Figure 1: Electric scheme of the superconducting magnet string configuration

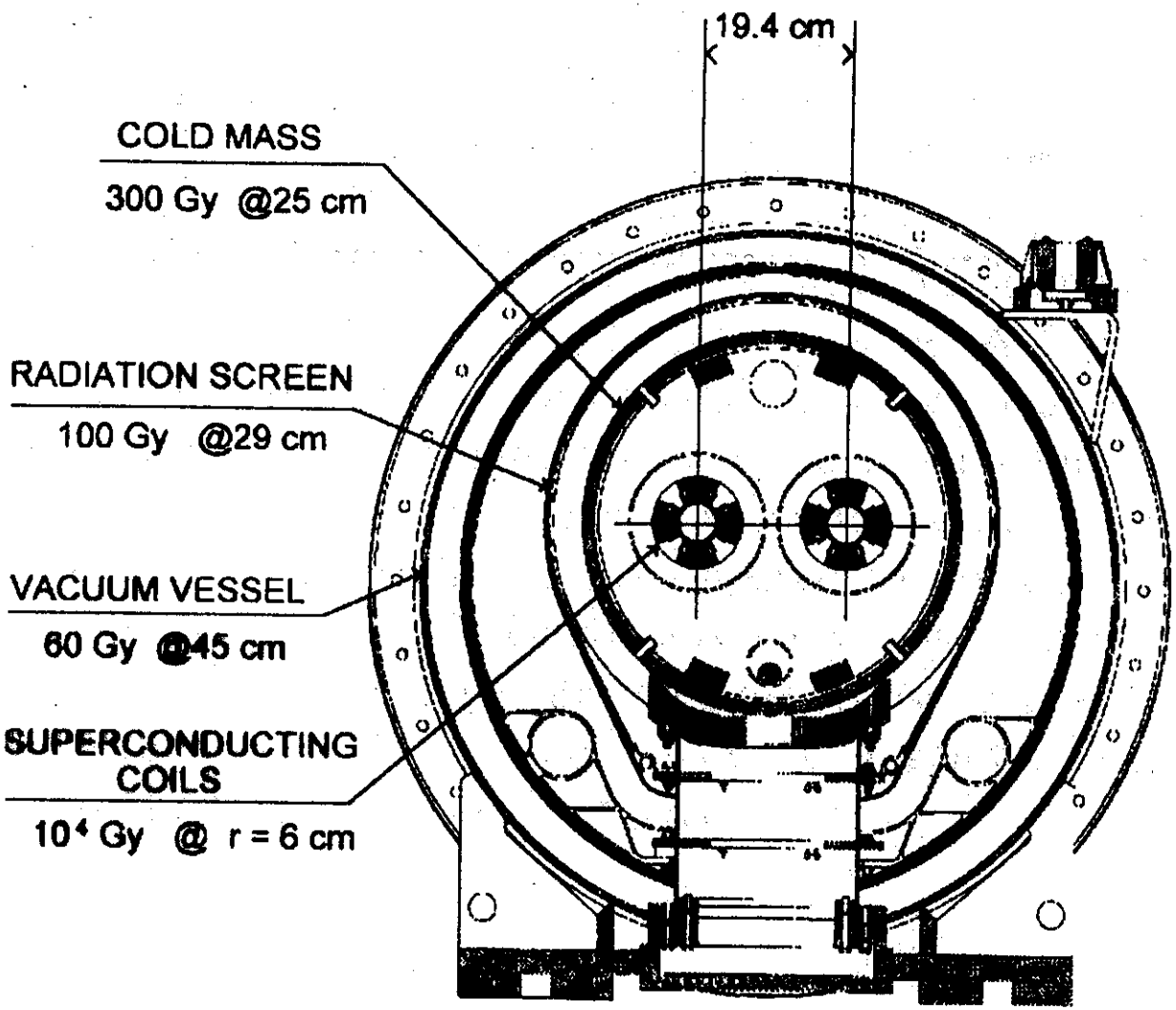



**Figure1.** Cross-section of a LHC magnet, the doses correspond to 10 years at nominal beam intensity.

Radiation Resistance of Some Materials for Superconducting Magnet

| Material | Expected Dose / 10 Years Operation at LHC (Gy) | Radiation Resistance (Gy) |
|---|---|---|
| Insulation of Superconducting Magnet / Polyimide | ~$10^4$ | ~$10^7$ |
| End Spacer / GFRP | ~$10^4$ | ~$10^7$ |
| Cold Diode | 200 | > $1*10^3$ |
| Cryogenic Sensors / Cernox, Carbon, Platinum | 100-1000 | > $2*10^4$ |

Table 3
Main parameters of the superconducting septum magnet

| | |
|---|---|
| Maximum magnetic field | 2 T |
| Magnetic aperture ($h \times w$) | $140 \times 160$ mm$^2$ |
| Cold bore aperture | $134 \times 154$ mm$^2$ |
| Magnetic length | 1.27 m |
| Septum coil thickness | 6.4 mm |
| Coil current | 2220 A |
| Ampere-turns | $2.22 \times 10^5$ AT |
| Current density | 280 A/mm$^2$ |
| Inductance | 21 mH |
| Stored energy | 52 kJ |
| Bursting force | 22.7 tonf/m |
| Cold mass (coil and yoke) | 2 ton |
| Superconductor | |
| Material | Nb–Ti/Cu |
| Type | Compacted strand cable |
| Cable size ($h \times w$) | $1.27 \times 6.23$ mm$^2$ |
| Number of wires | 19 |
| C/S ratio | 1.8/1 |
| Critical current (at 4 T, 4.2 K) | 4700 A |
| Cable insulation | 3 layers of Kapton (25 $\mu$m) |
| Total cable length | 400 m |

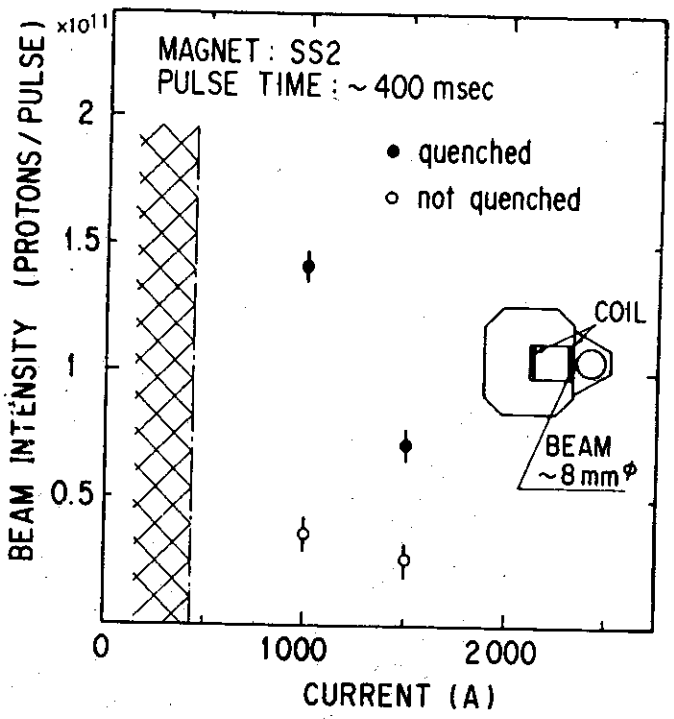



Fig. 6. Beam induced quench level as a function of the coil current. The septum coil was directly irradiated with a beam of primary protons of about 8 mm diameter during about 400 ms. The cross-hatched area below the coil current of 450 A indicates the fully stabilized region in which the normal zone recovered to the superconducting state after the irradiation.

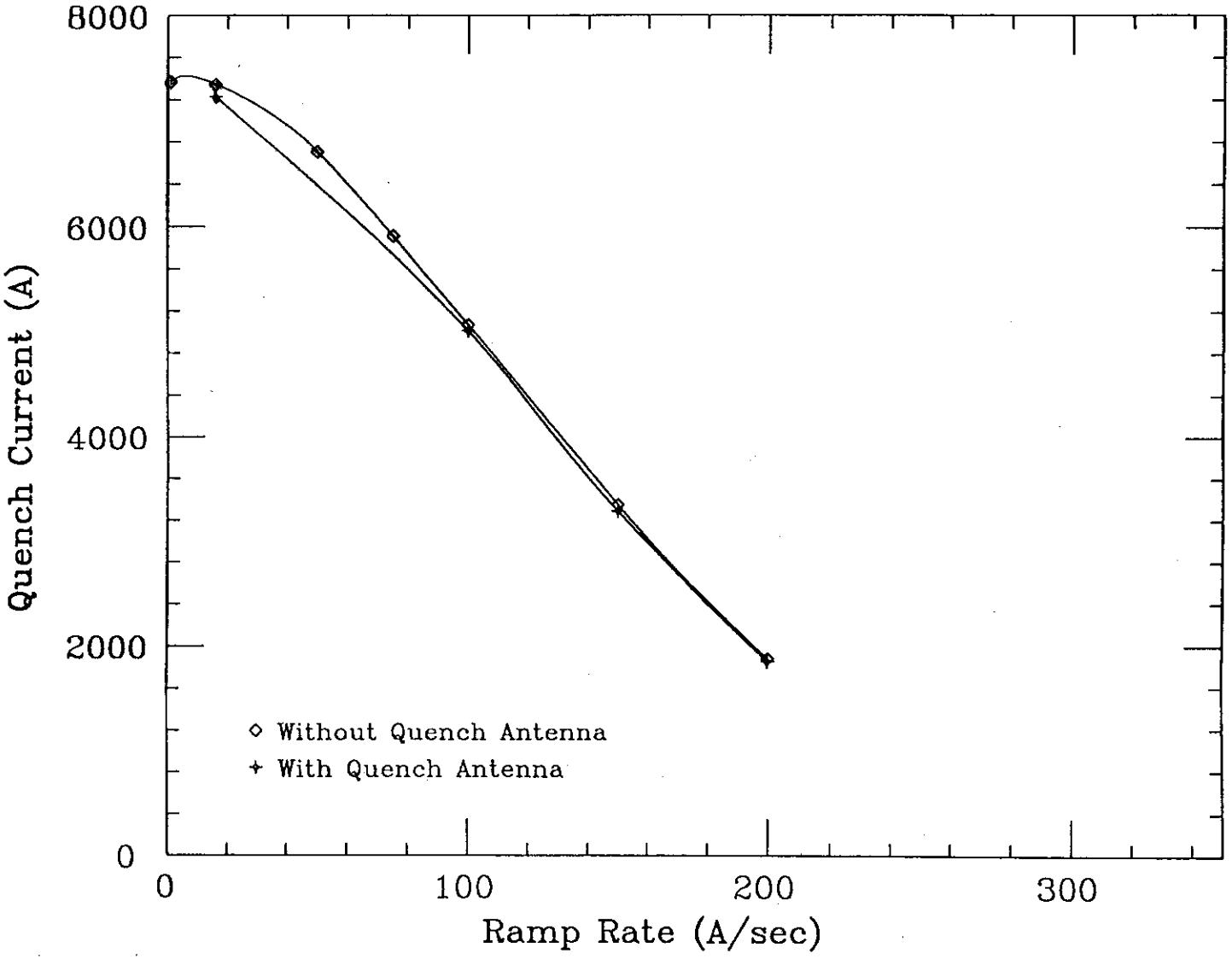



Figure 4-21 Ramp Rate Dependence of Quench Current with Quench Antenna

AC-Loss P-1 100 A/s

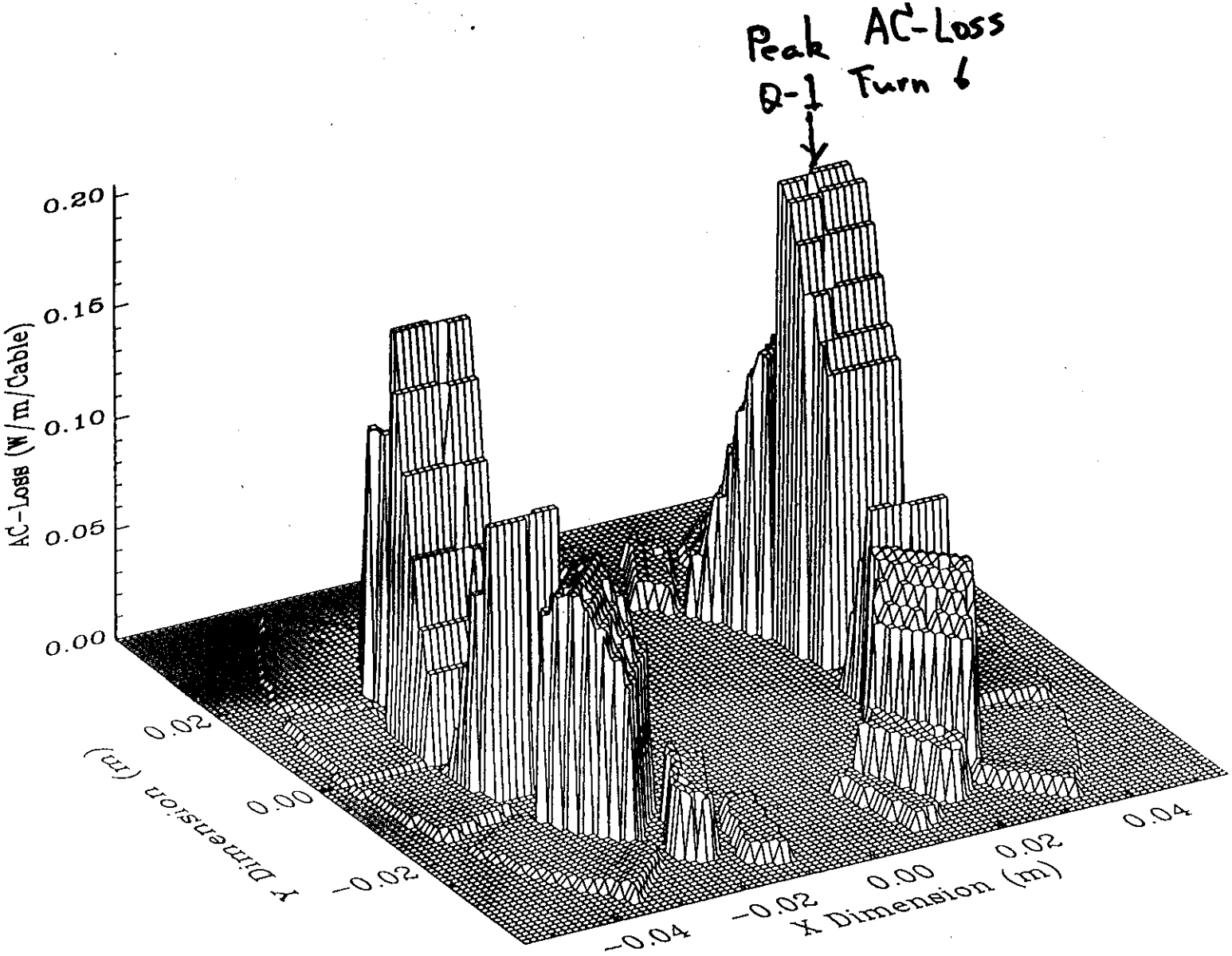



Figure 5-15(b) AC-loss Distribution at Position-1

Mole Position 5~ 6m