CRITERIA FOR OPTIMIZING SCS

GENERAL CRITERIA (PRIORITY ORDER)

- GRADIENT

  $\Delta E = 283.5$ MeV

  $\Delta L = \underset{\text{AVAIL}}{66} \underset{\text{TR. SECT.}}{-7} \underset{\text{400 MeV LINE}}{-2} = 57\,m$

  $\Delta E/\Delta L = 4.97$ MV/m

- RELIABILITY

  $E_m < b\,E_K$

  $E_K = 26$ MV/m

  $b = 1.7$ (C.D. REV 1; HOW ABOUT $b = 1.5$?)

  $E_m = \alpha E_0$

  $\alpha = 5.25 - 5.75$ (C.D. REV 1; HOW ABOUT $\alpha = 4.5$?)

- COST

  MAX $ZT^2 \longrightarrow$ MIN POWER COST

  MAX $E_0 T \longrightarrow$ MIN STRUCTURE COST

  $C_L = \dfrac{\$5.31 \cdot 10^6}{57\,m} = 9.32 \cdot 10^4$ \$/m

  $C_P = \dfrac{\$5.14 \cdot 10^6}{8.4 \cdot 10^7\,W} = 6.12 \cdot 10^{-2}$ \$/W

FACTORS IN $\frac{\Delta E}{\Delta L}$

- $\frac{\Delta E}{\Delta L} = \eta E_0 \overline{\cos\varphi} T$

  $\eta = \frac{\Delta L_{RF}}{\Delta L} = 0.824$ (C.D. REV 1)

  $\varphi_s = -32°$

  $\cos\varphi_s = 0.848$

  $\overline{\cos\varphi} \approx 0.86$

  $T = 0.83 - 0.86 \approx 0.85$

- REQUIRED E_0

  $E_0 \approx \frac{\Delta E}{\Delta L} / (\eta \overline{\cos\varphi} T) = 8.25\ MV/m$

- COST OPTIMUM E_0

  $$E_0^{op} = \sqrt{\frac{Z C_L}{k C_p}}$$

  $$k = (\underset{100\%}{1} - \underset{\text{COUPLING}}{.125} \underset{\text{SURFACE}}{-.02})^{-1} = 1.145$$

  $Z \approx 67.3\ M\Omega/m$

  $$E_0^{op} = \sqrt{\frac{6.73 \cdot 10^7 \times 9.32 \cdot 10^4}{1.145 \times 6.12 \cdot 10^{-2}}} = 9.46\ MV/m$$

  ($E_0^{op} = 8.91\ MV/m$ FOR $k = 1.29$)

  $b = 1.64$ ($b = 1.52$)

How Brave Must We Be?

- Assume

$$E_0 = 8.25 \text{ MV/m}$$
$$T = 0.85$$
$$ZT^2 = \frac{47.5 \text{ M}\Omega/\text{m}}{1.145} = 40.6 \text{ MV/m}$$
$$\alpha = 4.5$$

- E_m

$$E_m = \alpha E_0 = 323 \text{ MV/m} = 1.44 E_K$$

- Beam Power

$$P_B = I_B \frac{\Delta E}{e} = 0.05 \text{A} \times 2.83 \times 10^8 \text{V} = 14.2 \cdot 10^6 \text{W}$$

- Structure Power

$$P_{Cu} = \frac{(E_0 T)^2}{ZT^2} = 1.21 \times 10^6 \text{ W/m}$$

- Total Power

$$P = P_B + L_{RF} \cdot P_{Cu} = 74.9 \text{ MW}$$

(INCLUDES BRIDGE COUPLERS x 1 CELL)

- Reserve

$$P_{RES} = \frac{9.1}{74.9} = 12.1\%$$

- Bravery

$$\underline{b = 1.43}$$ ← BOTTOM LINE