SSC DETECTOR SOLENOID DESIGN NOTE #21

TITLE: Weight of 8-m Assembly

AUTHOR: R.W. Fast

DATE: May 12, 1988

I. 2-m cold mass

A. Conductor

Avg diameter = 950 + 15.85 cm = 966 cm
Avg circumference = 3035 cm

Area of conductor
$= (651 \text{ turns})(1.6 \times 1.8 \text{ cm}^2/\text{turn})$
$= 1875 \text{ cm}^2$

Volume of conductor $= (1875 \text{ cm}^2)(3035 \text{ cm})$
$= 5.69 \times 10^6 \text{ cm}^3$

Mass of conductor $= (5.69 \times 10^6 \text{ cm}^3)(8.9 \text{ g/cm}^3)$
$= 50.6$ Mg (tonnes)

B. LHe vessel inner shell

$\Delta r = 5$ cm, $r = 470.5$ cm, $l = 195$ cm

Volume of metal $= 2\pi(470.5)(5)(195) \text{ cm}^3$
$= 2.88 \times 10^6 \text{ cm}^3$

Mass of shell $= (2.88 \times 10^6 \text{ cm}^3)(7.6 \text{ g/cm}^3)$
$= 21.9$ tonnes

C. LHe vessel outer shell

$\Delta r = 4$ cm, $r = 490$ cm, $l = 195$ cm

Mass of shell = 22.8 tonnes

D. G-10 insulation

Coil area = $185 \times 15.85\ cm^2 = 2932\ cm^2$

Area of G-10 + Lite = $1057\ cm^2$

Area of G-10 = $1057/2 = 530\ cm^2$

Mass of G-10 = $(1.8\ g/cm^3)(3035 \times 530\ cm^3)$
= 2.9 tonnes

E. Flat heads

$\Delta r = 15.85$, $\Delta z = 3.5$ cm, Circ = 3025 cm

Mass of two heads = $(2)(7.6\ g/cm^3)(15.85 \times 3.5 \times 3025)$
= 2.6 tonnes

F. Approximate cold mass

Conductor	50.6 tonnes (10^3 kg)
G-10	2.9
Inner shell	21.9
Outer "	22.8
Flat heads	2.6
Total	100.8

Does not include: (1) Connection plenums
(2) Supports
(3) Chimney
(4) Supply pipes

II. 8-m cold mass

4 (100.8 tonnes) ~ 400 tonnes.

III. Vacuum vessel

A. Inner shell

$\Delta r = 3$, $l = 800$, $r = 456.5$ cm

$$\text{mass} = (7.6\ g/cm^3)(2\pi)(456.5)(800)(3)$$
$$= 52.3 \text{ tonnes}$$

B. Outer shell

$\Delta r = 3$, $l = 800$, $r = 503.5$ cm

Mass = 57.7 tonnes

C. Flat heads

$\Delta r = 65$ cm, $l = 3.5$ cm, Circ = 5035 cm

Mass of two = 10.5 tonnes

D. Total mass

= 120.5 tonnes

IV. Total mass of 8-m assembly

~ 500 tonnes