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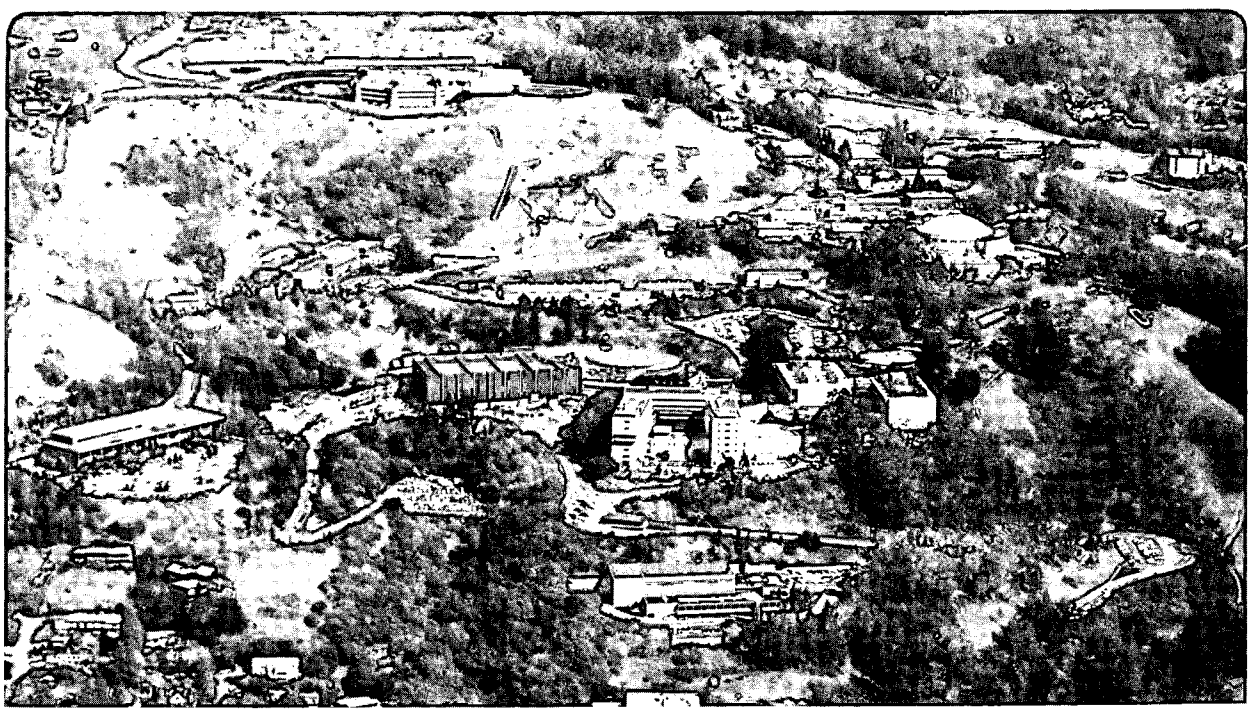

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ENGINEERING NOTE

CODE	SERIAL	PAGE
HF0401	M5250	1 of 4

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PROGRAM — PROJECT — JOB
HIF-HIDE

CONCEPTUAL DESIGN - INDUCTION LINAC

TITLE
SUMMARY OF INDUCTION LINAC COST FACTORS

A. Technical Components

1. Accelerating Modules

1.1 Core Unit Costs:

ferrite	3.00 ($/#)
nickel steel	11.28 ($/#)
laminated iron	1.33 ($/#)
metallic glass	0.97 ($/#)

1.2 Insulator Unit Cost:

porcelain (UPC) 7.20 ($/#)

1.3 Structure Costs:

for ferrite cores

$$CS = 2.4 + n[3.35 + 2.81\ (UPC)(rins)^2 lins] \quad (K\$)$$

Where:

n = no. of cores

rins = insulator radius (m)

lins = graded insulator length (m)

UPC = unit insulator cost

for iron cores -

a) type 1 cavity -

$$CS = 2.4 + n[3.35 + 2.81\ (UPC)(rins)^2 lins] \quad (K\$)$$

b) types 2 & 3 cavities -

$$CS = 1.35 + n[2.00 + 2.81\ (UPC)(rins)^2 lins] \quad (K\$)$$

2. Pulsers

2.1 Ferrite Core Pulsers:

$$CP = 13.3 + 2.2\ (VI) + 0.00250\ (USF) \quad (K\$)$$

Where:

VI = incremental voltage (MV)

USF = stored energy (J)

2.2 Iron Core Pulsers:

$$CP = 5.2 + 3.0\ (VI) + 0.00250\ (USF) \quad (K\$)$$

3. Vacuum System

3.1 Ferrite Core Structure

Cost per unit length 1.9 (K$/m)

3.2 Iron Core Structure

a) type 1 cavity

cost per unit length 1.9 (K$/m)

b) type 2 & 3 cavities

cost per unit length 1.0 (K$/m)

4. Support and Alignment

4.1 Monuments and Fixtures 0.5 (K$/half period)

4.2 Support, Installation and Alignment 3.0 (K$/module)

5. Control Room

Includes consoles, racks, raised floor, air conditioning, fire control, installation 0.144 (K$/m)

6. Computer System

Includes central computer, peripheral equipment, remote computers, clusters, digital and analog equipment, links, installation and software 0.424 (K$/m)

7. Beam Monitoring and Control

Includes profile monitors, electronics, trimming windings, power supplies and installation 0.140 (K$/m)

8. Superconducting Quadrupoles

8.1 Quadrupole Cost

$$CQ = (8.0 + 76.8\ r + 114.7\ rB)(.285\ell + .430)\ .475 \qquad (K\$)$$

Where:

r = Bore Radius (m)

B = Field at Bore Radius (Teslas)

ℓ = Quadrupole Length (m)

8.2 Refrigeration Cost

$$CR = .8[5 + 66.7\ r + \frac{9\ell}{\eta}] \qquad (K\$)$$

Where:

η = Packing Fraction

8.3 Cryo Distribution Costs

$$CC = \frac{.78\ell}{\eta} \qquad (K\$)$$

8.4 Magnet Costs

Includes power supplies dc wiring, magnet monitoring and control, magnetic measurements and installation 5.1 (K$/Magnet)

8.5 Support and Alignment

Includes support, installation and alignment 3.1 (K$/Magnet)

B. Conventional Facilities

1. Site Work:

Includes road with paving, drainage, excavation and grading, and site lighting — 0.364 (K$/m)

2. Accelerator Housing;

Includes a 25' wide structure with an 8' wide - 2' thick reinforced concrete floor — 4.663 (K$/m)

3. Control Room:

a 30' x 80' building for a 5000 m long accelerator — 0.060 (K$/m)

4. Mechanical Facilities

Includes primary and secondary cooling systems with distribution, LCW makeup, domestic water, compressed air, fire protection, heating and ventilating, building drainage, temporary utilities, sanitary sewers, etc. — 0.145 (K$/kW)

5. Electrical Facilities

Includes a-c service to cooling systems, primary power distribution, cable trays, fire protection detection system, lighting — 0.125 (K$/kW)

6. Safety

Includes personnel protection system, electrical system safety, paging system — 0.182 (K$/m)

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