ENTRY NO. 89

NAME OF MACHINE: Cleveland Clinic Fast Neutron Therapy Facility

INSTITUTION: National Aeronautics & Space Administrations Lewis Research Center

ADDRESS: M.S. 49-2 21000 Brookpark Rd. Cleveland, OH 44135

TEL: (216) 433-6379 TELEX:

IN CHARGE: James Blue REPORTED BY: James Blue

HISTORY AND STATUS

DESIGN, date: Ref. 1 Model tests:

ENG DESIGN, date: 1968-69

CONSTRUCTION, date: 1970

FIRST BEAM, date (or goal): 1972

MAJOR ALTERATIONS: Vertical and horizontal beams of fast neutrons for cancer therapy.

COST, ACCELERATOR: $1.5 M

COST, FACILITY, total: $2.0 M

FUNDED BY: NASA, Cleveland Clinic, NCI

ACCELERATOR STAFF, OPERATION AND DEVELOPMENT

SCIENTISTS: 0 ENGINEERS: 1

TECHNICIANS: 1 CRAFTS: 1

GRAD STUDENTS involved during year: 0

OPERATED BY: Research staff or 1 Operators

OPERATION: 30 hr/wk. On target: hr/wk

TIME DISTR. in house: 90 %, outside: 10 %

BUDGET, op & dev: $75,000

FUNDED BY: NCI

RESEARCH STAFF, not included above

USERS, in house: 2 outside: 10

GRAD STUDENTS involved during year: 0

RESEARCH BUDGET, in house: $25,000

FUNDED BY: NCI, NASA

MAGNET

POLE FACE, diameter (compact): 175 cm, R-extraction: 73.5 cm

R injection: 1.5 cm

GAP, min: 17. cm, Field: 19.2 kG

max: 41. cm, Field: 8.8 kG } at

AVERAGE FIELD at R ext: kG } Ampere turns

B max/<B>:

NUMBER OF SECTORS: compact 3 / separated: Spiral, max: deg

SECTOR ANGLE (SSC): deg

TRIMMING COILS: 8 pair

CONDUCTOR, material and type: copper-hollow H20 cooled

STORED ENERGY (cryogenic): MJ

POWER: main coils 250 max kW: current stability .10

trimming coils .10 max kW: current stability .100

WEIGHT: Fe 206 tons: coils .28 tons

COOLING system: deiolzed water

ION ENERGY (Bending limit) E/A = .55 q^2/A^2 MeV/amu

(Focusing limit) E/A = .45 q/A MeV/amu

ACCELERATION SYSTEM

DEES, number: 2 angle: 134 deg

BEAM APERTURE: 2.5 cm; DC Bias: 0 kV

TUNED by, coarse: panels fine: panels

RF: 13.5 to 23 MHz, stable ± 10^{-8}

Orb F: 6.7 to 23 MHz

HARMONICS, RF/Orb F, used: 1 & 2

DEE–Gnd, max: 70 kV, min gap: 5 cm

STABILITY, (pk-pk noise)/(pk RF volt):

ENERGY GAIN, max: 220 kV/turn

RF PHASE, stable to ±: 2 deg

RF POWER input, max.: 200 kW

FREQUENCY MODULATION, rate: /s

modulator, type:

beam pulse, width:

VACUUM SYSTEM

OPERATING PRESSURE: 10^{-5} Torr or mbar

PUMPS, No, Type, Size: two 40 cm diam. diffusion pumps with freon baffles.

ION SOURCES

Internal, hooded, hot filament

INJECTION SYSTEM

EXTRACTION SYSTEM

Electrostatic deflector and magnetic channel

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed: m^2; movable: m^2

TARGET STATIONS: 3 in two rooms

STATIONS served at same time, max: 1

MAG SPECTROGRAPH, type: none

COMPUTER model: two IBM-PC

OTHER FACILITIES: Cobalt-60 teletheapy unit

CHARACTERISTIC BEAMS

PARTICLE	ENERGY (MeV) Goal	Achieved	CURRENT (pμA) Internal	External
p	50	46		50
d	26	26		50
^{3}He	80	80		5
^{4}He	52	52		5

SECONDARY (part/s)

neutrons from 43 MeV p on Be yields 20 rad/min @ 125 cm SSD

BEAM PROPERTIES

MEASURED		CONDITIONS			
PULSE WIDTH	RF deg	pμA of	MeV	ions	
PHASE EXC. max	RF deg	pμA of	MeV	ions	
EXTRACT eff. 60	% .30.	pμA of .43	MeV	protons	
RESOL ΔE/E	%	pμA of	MeV	ions	
EMITTANCE (π mm-mrad)	axial	pμA of	MeV		
	rad				

OPERATING PROGRAMS, time distribution

BASIC NUCLEAR PHYSICS: SOLID STATES PHYSICS:

BIOMEDICAL APPLICAT.: 95% ISOTOPE PRODUCTIONS: 1%

4% radiation damage

REFERENCES/NOTES

1) Modified 60" fixed freq. cycl. to MSU magnetic
2) field and dee design with redesigned rf system.

PLAN VIEW OF FACILITY, COMMENTS, ETC.

VERTICAL CROSS SECTION OF BEAM TRANSPORT SYSTEM