ENTRY No. 93

NAME OF MACHINE Cleveland Clinic Fast Neutron Therapy Facility

INSTITUTION ... National Aeronautics & 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 } at .....

max ....41... cm, Field .....8.8.. kG } Ampere turns

AVERAGE FIELD at R ext ..... kG

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 H_2O 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 ...deionized water.....

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

(focusing limit) E/A = ...45... q^2/a^2 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.....

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CHARACTERISTIC BEAMS

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

SECONDARY (part/s)

neutrons from 43 MeV p on Be yields 20 rad/min

125 cm $90

BEAM PROPERTIES

	MEASURED	CONDITIONS
PULSE WIDTH	RF deg	pμ A of .... MeV ... ions
PHASE EXC, max ...	RF deg	pμ A of .... MeV ... ions
EXTRACT eff ...60..	% ..30..	pμ A of 43.. MeV p.. ions
RESOL ΔE/E	%	pμ A of .... MeV ... ions

EMITTANCE

(π mm. mrad) { ... axial / .... rad } ..... pμA of ..... MeV ... ions

OPERATING PROGRAMS, time distribution

BASIC NUCLEAR PHYSICS .. SOLID STATES PHYSICS ....

BIOMEDICAL APPLICAT. .95% ISOTOPE PRODUCTIONS 1.%

RADIATION DAMAGE .....4%.....

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REFERENCES/NOTES

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

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, COMMENTS