ENTRY NO. 59

NAME OF MACHINE Harwell Variable Energy Cyclotron - VEC DATE July 78
INSTITUTION Atomic Energy Research Establishment
ADDRESS Harwell, Nr. Didcot, Oxon, OX11 ORA, England

IN CHARGE R. W. McIlroy REPORTED by E. J. Jones

HISTORY AND STATUS

DESIGN, date 1961-62 MODEL tests 1961-63
ENG. DESIGN, date 1962-64
CONSTRUCTION, date 1962-65
FIRST BEAM date (or goal) int.1965 : ext.1966
MAJOR ALTERATIONS None

OPERATION, 120 hr/wk; On Target 77 hr/wk
TIME DIST., in house 79 %, outside 21 %
USERS' SCHEDULING CYCLE 2 weeks
COST, ACCELERATOR £1.2 x 10^6
COST, FACILITY, total £1.6 x 10^6
FUNDED BY U.K.A.E.A.

ACCELERATOR STAFF, OPERATION and DEVELOPMENT

SCIENTISTS 3 ENGINEERS 1
TECHNICIANS 9 CRAFTS 10
GRAD STUDENTS involved during year -
OPERATED BY Res staff or X Operators
BUDGET, op & dev £600K
FUNDED BY U.K.A.E.A.

RESEARCH STAFF, not included above

USERS, in house 13 outside 20
GRAD STUDENTS involved during year 10
RES. BUDGET, in house -
FUNDED BY U.K.A.E.A.

FACILITIES FOR RESEARCH

SHIELDED AREA, fixed 360 m^2
movable 0 m^2
TARGET STATIONS 7 in 3 rooms
STATIONS served at same time, max 1
MAG SPECTROGRAPH, type -
COMPUTER, model PDP8
OTHER FACILITIES 1. Isotope Production Rig with variable target assemblies.
2. Irradiation facility for damage studies - programmed beam scanning and target rocking.

REFERENCES/NOTES

RHEL report NIRL/R/85.
Harwell Report - R5744 (pp 5-9).
Proc. Fifth Int.Cycl.Conf., 200, 318 (1969).
IEEE Trans. Nucl. Sci. NS-19, no. 2, 101 (1972).

MAGNET

POLE FACE diameter 178 cm; R extraction 80 cm
GAP, min 19 cm; Field 21.6 kG } at 0.55x 10^6 ampere turns
max 43 cm; Field 13.1 kG
AVERAGE FIELD at R ext 17 kG
CURRENT STABILITY 100 parts/10^6; $B_{max}/\langle B \rangle$ 1.3
NUMBER OF SECTORS 3 ; SPIRAL, max 48 deg
POLE FACE COIL PAIRS: AVF Nil /sec;
Harmonic correction 3 per sector
Rad grad Nil /sec or Circ coils 12
WEIGHT: Fe 170 tons; Coils 10 tons
CONDUCTOR, Material and type Copper
STORED ENERGY 2 MJ
COOLING SYSTEM Demineralised water
POWER: Main coils 300 max, kW
Trimming coils 650 max, kW
YOKE/POLE AREA 120 %
SECTOR ANGLE (Sep Sec) - deg
ION ENERGY (Bending limit) E/A = 86 q^2/A^2 MeV
(Focusing limit) E/A = ~ 65 q/A MeV

ACCELERATION SYSTEM

DEES, number 1 angle 180 deg
BEAM APERTURE 4.5 cm; DC BIAS 0 kV
TUNED by, coarse Short Pl. fine Trim. Cap.
RF 7.5 to 23 mHz, stable ± 0.01 /10^6
Orb F 1.1 to mHz; GAIN, max 160 kV/turn
HARMONICS, RF/Orb F, used 1, 3, 5, 7, 9
DEE-Gnd, max 80 kV, min gap 0.7 cm
STABILITY, (pk-pk noise)/(pk RF volt) 0.001
RF PHASE stable to ± - deg
RF POWER input, max 200 kW
RF PROTECT circuit, speed - μsec
Type Reflectometer
FREQUENCY MODULATION, rate - /sec
MODULATOR, type -
BEAM PULSE, width -

VACUUM SYSTEM

PUMPS, No., Type, Size 3 Diffusion pumps (one 60 cm, two 76 cm): Liq. N_2 cryopanels
OPERATING PRESSURE 1.2 μTorr,
PUMPDOWN TIME 6 hrs

ION SOURCES/INJECTION SYSTEM

Internal Penning

EXTRACTION SYSTEM

Electrostatic deflector + mag.channel

CONTROL SYSTEM

Conventional

ENTRY NO. 59 (cont.)

CHARACTERISTIC BEAMS

	Particle	Goal (MeV)	Achieved (MeV)
ENERGY	p		59
	$^{6}Li^{3+}$		80
	$^{20}Ne^{6+,7+}$		150, 202
	$^{58}Ni^{6+,10+}$		48, 150
CURRENT		(μA)	(μA)
Internal			
External	p		25
	$^{6}Li^{3+}$		1
	$^{20}Ne^{6+,7+}$		2, .3
	$^{58}Ni^{6+,10+}$		30, .04
		(part/s)	(part/s)
Secondary			

BEAM PROPERTIES

	Measured	Conditions		
Pulse Width	20–40 RF deg	μA of	MeV	
Phase Exc, max	RF deg	μA of	MeV	
Extract Eff	75 %	10 μA of	48 MeV	p
Res, ΔE/E	0.35 %	20 μA of	27 MeV	p
Emittance (mm-mrad)	20 axial, 20 radial	10 μA of	59 MeV	p

OPERATING PROGRAMS, time dist

Program	%
Basic Nuclear Physics	27 %
Solid State Physics — Metallurgy	37 %
Bio-Medical Applications / Isotope Production	16 %
Development	20 %
	%
	%

PLAN VIEW OF FACILITY, NOTEWORTHY FEATURES, OPERATION SUMMARY, ADDITIONAL REFERENCES

Despite a reduction over the past two years in the machine time required by users, beam requirements are still very varied, ranging from light ions for isotope production, medium heavy ions such as Li, B, C, O, N and Ne for nuclear physics and the heavier metal ions Co, Cr, Fe and Ni for radiation damage work.

Diversification into the nuclear medicine field has been increasing and has now reached the stage where (a) production of the medical isotope ^{123}I is now on a routine basis and (b) plans are being prepared for the establishment of a limited neutron therapy facility.