AUSTRALIAN NATIONAL UNIVERSITY

DEPARTMENT OF NUCLEAR PHYSICS

14UD TANK OPENING REPORT NO. ~~11~~ 13

August 29th and 30th, 1978 (2 days).

PREAMBLE:

The 14UD was last closed on July 26th and during the 34 days until this opening it ran satisfactorily, but with some problems. Prior to the opening the machine had been running with thirteen and two thirds units and it was conditioned to 13.9 MV. The experimenters ran at 13.5 MV following which there was a run with double stripping at 13 MV with 13 live units.

This opening was forced by the need to change terminal foils which were last replaced during the long April/May tank opening when the tube was opened to install the H.E. stripper. After over 100 days, during which time the foils had cycled four times, with users hunting for a prolific one, it was concluded that there wasn't a single good foil left in the terminal stripper. In the latter stages of operation with a nickel beam some bit of conjecture arose as to why, during a terminal foil change, the beam doubled for a moment, then fell back to its original value. It was believed that the foils were passing through their correct position, then stopping at an angled position at which part of the foil frame was intercepting the beam and the beam passed through two foils. By external manipulation of our pneumatic system it was arranged for the foils to stop at what we believed was sufficiently offset to present the foils normal to the beam; the beam doubled in this position.

The ^{58}Ni run required a terminal voltage of 13 MV for 13 H.E. units. In order to attain this voltage, a variety of shorting rod configurations were employed to identify poorly conditioned units and to condition these separately. Unit 22 required repeated attention, as did units 26, 27 and 28.

Though use was made of the H.E. stripper (Report No.12, p.4), the H.E. foils were used for the first time in hot blood when an ^{58}Ni run was scheduled. Considerable loading occurred and was attributed to electrons emitted from the H.E. stripper entering the more positive tube section above the stripper and being accelerated back towards the terminal. After some bit of discussion a solution was finally suggested that evening in the darkroom when it was proposed that a shorting rod be put in Unit 19, where the H.E. stripper occupies the final (highest energy) third of the unit, thereby connecting together the first two thirds of the unit to the stripper assembly in order to minimize electron acceleration from the foil region. Next morning Unit 19 was shorted out and all loading vanished immediately; the run was continued.

In addition to the foil problems we had experienced some unsettling behaviour from Chain 2 which exhibited a readiness to run into negative self-charge, in spite of increased frequency of oiling. In Report No.12, p.7, we suggested that high negative self-charge was a pointer to an impending chain break; consequently Chain 2 was rested whenever Chain 1 could handle the conditions required by the experimenters.

It was clear by Friday, August 25th, that the foils in the terminal stripper were useless and therefore a brief tank opening was scheduled for the following Monday and Tuesday during the International Conference on Nuclear Interactions, hosted at the A.N.U.

A new 270 position foil changer, similar to that fitted in the H.E. position in April/May (Report No.11, p.6) was loaded on Saturday. The doors were opened at 8 a.m. on Tuesday and the usual exploratory cruise was made first thing. The column was quite

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clean and the stains on tube and column corona assemblies were slight, and definitely dry. On the terminal opposite the stabilizing triode needles the invariable stain was also slight, and quite dry.

Unit 22, which had resisted conditioning, appeared at first examination to have nothing wrong with it and we then saw that its rotating shaft had "riverlike" tracks in the dusty deposit on its surface which roughly corresponded to tracks on shafts which we have seen before, suspecting them to be related to voltage breakdown. Shafts are susceptible to tracking problems (Report No.11, p.6).

To deal with the loading of the machine by electrons from the H.E. stripper, we had intended to bias an insulated collimator in the stripper by tying it to the voltage supplying the ion pump, but found that the collimator insulation was leaky. Therefore the darkroom idea of connecting together the entire unit was modified by connecting the centre tube section of the unit to the stripper assembly and leaving only the first tube section in the unit live. While this measure would mean a permanent sacrifice of 300 kV for the next closure it also left a useful 300 kV live in the unit and also eliminated the inconvenience of shorting rod manipulations whenever a few rods had to be put in for low voltage running. This solution has now proved to be satisfactory.

CHAINS:

All casting idlers for Chains 1 and 2 (Chain 3 is still out), were checked for damage or bad bearings and all three in the up position of the 25 MeV casting were replaced because of bearing trouble.

The rims of the driving pulleys had a faint film of oil and were in good condition. The chains were sticky, but not moist, and they were cleaned with alcohol, then oiled by hand in the usual way. The A.N.U. oilers, put back last time, were checked, and one on Chain 2 needed to be replaced to give it the same flow rate as Chain 1.

STRIPPERS:

The old 115 position foil unit in the terminal was removed and the new 270 position one installed. There was no detectable change in tube pressure during the foil change and the re-seating of the A.N.U. tube isolating valve did not require further adjustment.

When the foils were examined to determine the cause of beam doubling referred to on page 1, there appeared at first to be nothing wrong with the foil alignment; however, a beam shadow was seen on the top end of several foil holders. We concluded that the mechanical indexing was at fault. The 270 position foil holder was carefully positioned and full transmission was re-established with no momentary increase during foil changes.

MISCELLANEOUS:

All N.E.C. porthole flanges were removed because of hissing SF_6 leaks in them. They were replaced with view ports designed at A.N.U. The threaded joints on the safety valve and signal feedthrough fittings were re-sealed with Loctite Instant Seal No.70-31.

Following the discovery of surface rust in the SF_6 storage vessel (Report No.12, p.1), all the gas was put in the accelerator early in August and the storage vessel was opened again, heavily shot blasted and then coated with an epoxy paint. Three weeks later the vessel was opened again and the seal was examined and found to be hard and apparently very successful.

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The column, which continues to remain free of sand particles since phasing out the N.E.C. mines, (Report No.9, p.2), was cleaned as usual by blowing nitrogen from a fine jet and then thoroughly tac-ragging, paying meticulous attention to surfaces between the rings. We regard tac-ragging column surfaces as nothing less than innovative. (For this occasion only we are enclosing a piece of tac-rag free with every report.)

We have heard from Israel that our discovery of mines led them to be sufficiently concerned to investigate the depths of their own castings where they found, to their delight, that mines had not been a special N.E.C. concession to A.N.U., but existed in satisfactory profusion in their own machine. We wonder if the Israel people, with their great archaeological inheritance, instinctively approached the excavations with more hope and delicacy than our own pragmatic interest in the resources themselves.

After gassing up we found that the expedient of shorting out the centre tube section of Unit 19 had been adequate, and there was now no loading when the H.E. stripper was used.

The first experimental run was ^{58}Ni. The 14UD conditioned fairly easily to 13.3 MV with only thirteen and one third units live in the H.E. end. The run required 13 MV on terminal for 220 MeV, using 12^+ from the terminal stripper and 18^+ from the H.E. stripper. Intensities were about 260 nA on the tank cup and 46 nA analysed on stop; a log sheet is appended. The run continued non-stop for 3 days and the accelerator was remarkably stable. So far as the ^{58}Ni run is concerned, the peak L.E. cup intensity was 2.5 microamps and the peak analysed current 200 nA; this had to be cut back because of counting rate limitation set by the experimenters. It was noticeable that only at L.E. cup intensities above 1.2 microamps, loading resulting in lost charge occurred. Below 1.2 microamps the lost charge was apparently attributable to measured beam currents on the H.E. cup. At currents greater than 1.2 microamps the lost charge loading increased to about 50 microamps, well within even the two chain ability of the machine. L.E. pressure would start to rise at this threshold. We shall, at the next opportunity, install a pump at the entrance to the L.E. tube (inside the tank); the present pump suffers from the pumping impedance of 1) the tank cup; 2) the entrance slits; 3) the beam profile monitor; 4) the L.E. triplet and 5) the ball valve. The beam loading threshold current appears to be independent of particle type. The loading due to carbon beams is comparable to that with nickel.

It was also noted that, when a terminal foil broke during double stripper operation the loading on the machine would increase to about 50 microamps; this is presumably due to the negative beam in the H.E. tube. The foil life for the Ni beam was about 1 hour per foil.

The 14UD is now fully coming into its own and consistently and reliably operates at voltage gradients at and above 1 MV per unit. While we do not hesitate to claim some credit for the success it is very clear that we have not created a silk purse out of a sow's ear: the inherent strength of the N.E.C. design is now having an opportunity to express itself.

D.C. WEISSER

T.A. BRINKLEY

September 14th, 1978.
(The 60th birthday of one of the authors)

Date: 6/9/78 Group: [illegible] Line: 1

~~Lithex Source~~

Sputter Source Particle: ^{58}Ni Charge State: 12+ 18+ Energy 220 MeV

VACUUM					
Source	x 10⁻	L.E.	x 10⁻	H.E.	x 10⁻
3.7	7	3.7	8	1.3	7

Image slits (.04 / .04)

Object slits (.100 / .100)

CHARGING SYSTEM

Chg.I (1)	Chg.I (2)	Chg.I (3)	Lost Charge	Triode Current	Chg. kV	Terminal MV	Shorting Rods
70	70	70	13	29	17	13.04	None/~~as list~~

Corona Currents				Analyzing magnet	
L.E.		H.E.			
Tube	Col.	Tube	Col.	Amps	N.M.R. Gauss
8	15	17	12		7106.

MAGNET SELECTION HALL PROBE		
Inflection	90 deg.	Switching
~~8.177~~ 7.0[illegible]	7,005	8.720

WHEN H.E. FOIL WAS IN USE:

TERMINAL MV: 13.04

Charge states

Terminal to H.E. Foil: 12

After H.E. Foil: 18

QUADRUPOLE CURRENT MONITOR

Low Energy	13.1	14.3
High Energy	10.1	9.2
Switching	4.8	5.5
Line A	16.3	15.4
Line B	—	—

TANK PRESSURE

75.5

BEAM CURRENT						
L.E. cup	Tank cup	H.E. cup	Obj QTZ	Stop	Line cup	Target
720	200	4.3μ		46		66

X-ray rate > 1 MeV at the terminal seen by a 5x4" NaI 3K0+ counts/sec.

Date: 8/9/78 Group: [illegible] Line: 5

Lithex ~~Source~~

Sputter Source Particle: 12C Charge State: 6 Energy 78 MeV

VACUUM					
Source	x 10⁻	L.E.	x 10⁻	H.E.	x 10⁻
.5	7	3.2	8	1.5	9

Image slits (.035 / .03)

Object slits (/)

CHARGING SYSTEM

Chg.I (1)	Chg.I (2)	Chg.I (3)	Lost Charge	Triode Current	Chg. kV	Terminal MV	Shorting Rods
51	50	5	0	30	4	13.07	None/~~as list~~

Corona Currents				Analyzing magnet	
L.E. Tube	L.E. Col.	H.E. Tube	H.E. Col.	Amps	N.M.R. Gauss
6	18	18	10	87	6245

MAGNET SELECTION HALL PROBE		
Inflection	90 deg.	Switching
35	6217	2050

QUADRUPOLE CURRENT MONITOR

Low Energy	5.8	5.5
High Energy	7	6.1
Switching	7.5	7.1
Line A	7.5	7.5
Line B	5.1	6.0

WHEN H.E. FOIL WAS IN USE:

TERMINAL MV:

Charge states

Terminal to H.E. Foil:

After H.E. Foil:

TANK PRESSURE

95

BEAM CURRENT

L.E. cup	Tank cup	H.E. cup	Obj QTZ	Stop	Line cup	Target
1.35	.850	3.2	2.1	~~.450~~		450

5.2 .570

[illegible]

22	SAT	Barker ET AL.	6	α, 2 MeV	LITHEX
23	SUN				
24	MON	ZELLER, OPHEL, WEISSER, CLARK, HEBBARD TAPE	5	14N, 70 MeV	
25	TUES	Chain #3 broke 12 noon OFF			
26	WED	LEIGH, SIE, NEWTON	6	p, α, ^{12}C, ^{19}F, 94 MeV	
27	THURS				
28	FRI	ZELLER, ET AL	5	^{7}Li, 48 MeV	
29	SAT				
30	SUN			^{7}Li, 52 MeV	
31	MON				
1	TUES	PAINT STORAGE VESSEL			SPUTTER
2	WED				
3	THURS				
4	FRI				
5	SAT	~~OPHEL ET AL~~	5	^{6}Li, 40-48 MeV	
6	SUN				
7	MON	~~NURZYNSKI, RAVI~~	5	~~^{6}O~~, ~~60 MeV~~	
8	TUES	OPHEL, ET AL			
9	WED	~~CLARK ET AL~~	5	~~^{19}F~~, ~~60 MeV~~	
10	THURS	NURZYNSI, RAVI			
11	FRI	~~LEIGH~~, SIE, NEWTON, CONLEY	1	α, 39 MeV	LITH
12	SAT				
13	SUN	~~NURZYNSKI, RAVI ET AL~~	5	~~^{16}O~~ ^{7}Li	
14	MON	Ark, Ophel, Weiss, Zeller.			
16	WED	HAY - NEWTON	7	112 MeV Si	
17	THURS				
18	FRI	SPEAR - ZABEL	5	^{16}O, ^{18}O	SPUTTER
19	SAT			^{24}Mg,	
20	SUN			^{28}Si,	
21	MON			50-100 MeV	
22	TUES	SOURCE MAINTENANCE			
23	WED	CLINE COMMITTEE	1	Ni	
24	THURS			230 MeV	
25	FRI				
26	SAT				
27	SUN				
28	MON	INTERNATIONAL CONFERENCE			
29	TUES	TANK OPEN FOIL CHANGE			
30	WED				
31	THURS				

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