AUSTRALIAN NATIONAL UNIVERSITY

DEPARTMENT OF NUCLEAR PHYSICS

14UD TANK OPENING REPORT NO.15

March 28th to April 10th 1979 (13 days open; 9 working days).

PREAMBLE:

The tank was last closed on January 4th and the performance of the 14UD during the 83 days until this opening is briefly summarized as follows:

After the last button-up the machine went immediately to 13MV and in a couple of days was conditioned to 14.28MV and was in use at 14MV. By the middle of March the machine had conditioned to 14.85MV and an experiment had been run at 14.33.

After a week or so it was found that operating the chain oilers cleared negative self-charge for Chains 1 and 2 but had no effect on Chain 3, and the situation did not improve with time.

In the first week of March it was clear that two things were at fault on the column. The charging supply broke down now and then at 20kV if the chains were running. Terminal instability was associated with interference appearing on the NMR display and was traced to Unit 19; these effects ceased when the unit was shorted out.

The operation of both foil changers became unreliable without the reason being clear.

A tank opening was scheduled to investigate the problems and carry out such other work as time permitted.

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EXAMINATION:

The failure in Unit 19 was due to a column corona point assembly drooping, disrupting the terminal to ground current path. The assembly was at the level of the deck covering the HE stripper. Copper shorting straps had been fitted to the column posts in the stripper region and, although these had been screwed firmly onto the post electrodes using shakeproof washers, two of the screws had vanished. The point assembly was refitted using a nut and bolt rather than the original captive nut in the post electrode. In order to tie the stripper deck more effectively to the posts and casting wide copper strips were fitted from the deck directly to the posts; also a strap was put between the deck and the tube.

The inductors of Chain 2 were loose, and clearly the cause of charging voltage breakdown. It is assumed that the inductors were taken off when Chain 2 was last shortened. On that occasion it is known that one of the authors, (the usual one), only checked inductor alignment, and not screw removal, unable to believe that anyone else would remove an inductor.

The uncertain operation of the foil changers was traced, in the case of the terminal changer, to a loose grub screw (last set by the other author). The HE foil changer was found to need a stronger return spring and both actuators were, in fact, so fitted.

CHAINS:

The motor of Chain 1 was bottoming and the chain was shortened by 3 pellets. The other 2 chains were each shortened by 2 pellets. The tyres on 8 stabilizing idlers were in bad condition, some having a burnt appearance, and the pulleys of 2 idlers had moved on their bearings. The idlers modified by ANU (Report 14,page2)

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were in good condition and needed no attention. More stabilizing idlers will be modified in the same way and fitted. Both contact springs on the down d.c. idlers for Chains 2 and 3 were missing; two were found on the floor of the lower terminal. All chains were cleaned, and then oiled manually. The oilers were tested.

SHAFTS:

All bearings were listened to with a stethoscope. The LE set, which have operated for nearly 8,000 hours, and are due for change, sounded to be in acceptable condition. If other matters, which were to delay button-up, could have been anticipated the LE shaft bearings would have been changed, but it was decided to leave them in as a test of ultimate bearing life rather than change them as a discipline.

ALTERNATOR:

Vibration in the upper main alternator led to the discovery that its bearings were in very bad condition. They were replaced.

BEAM TRANSPORT:

At the LE end of the machine the NEC fast valve was removed from below the inflection magnet and replaced by an ANU hand valve; fast protection now relies on the ANU ball valve installed about a year ago, (Report No.11,page 5). The NEC scanner was also taken out and an ANU einzel was installed in the space which became available.

An iris, controllable from the main console, was fitted above the LE ball valve for the purpose of reducing intensity without varying beam parameters.

VACUUM:

Unfortunately the ball valve had a leak, and when the volume above it was opened to air the entire tube went very slowly to 50 microns; it was then let up to nitrogen over a period of 45 minutes to minimize turbulence and remained at atmospheric pressure for several days. When it was pumped out, the pressure was reduced to 50 mm over 45 minutes. This time coincided with the carbon vane motor overheating. The efficacy of these pains was seen during reconditioning of the machine. (See "Machine Conditioning")

Measurements, and other preparations, were made in regard to the installation of a 300 litre/sec ion pump inside the tank at the top of the LE column.

MISCELLANEOUS:

The ANU valves, which protect against a mishap if the last shorting rod is withdrawn, were modified to avoid spark damage at the sealing surface. The NEC method for clamping the shorting rods was replaced by an ANU design which consists of a series of O-rings compressed by nylon bushes.

A simple test arrangement was put in the terminal to determine the suitability of power breakers being reset by pneumatic means. A 1 amp breaker was arranged to switch a 0.9 amp resistive load and a LED was fitted across the breaker so that, when it tripped, there would be an indication on terminal TV which would also apply to resetting. To date, in the presence of 13.6MV sparks, the breaker has not tripped.

90 DEGREE ANALYZING MAGNET:

Troubles with the magnet were described in Report No.14. Since then, in the last week of January, insulation problems worsened and some coils were shorted out on one side of the magnet. About two weeks later poor transmission round the magnet led to the suggestion that, because the windings on each side of the magnet were unbalanced, irregular fringe fields were producing focusing effects which degraded

the beam. When corresponding coils on the good side of the magnet were likewise shorted out, transmission immediately improved by a factor of three. At an appropriate time the magnet will be dismantled and replacement coils fitted.

ION SOURCES:

Failing beam from the sputter source provoked us into changing the ionizer assembly, including cesium reservoir, which was last renewed 50 weeks ago and had clocked 4,360 hours actual operating time. The cesium which remained in the reservoir was melted and measured to be 1 cc, or one fifth of the load. However, molybdenum sputtered from the suppressor electrode had collected on the frit and was substantially blocking it. The ionizer heater was siezed onto the ion gun and, in removing it, not only did the frit get broken but a brazed joint came apart.

Following success with lithium and a variety of other beams from the sputter source, the lithium exchange source is now only used for helium beams. For experimenters who require brief changes to alpha particles in the middle of their runs it is common to swing the inflection magnet to the lithex source for as little as half a day, and then back again. Leaks, and consequent lost time, were only avoided with extreme care in the days of the indium seal, but with the installation of the ferrofluidic seal, the operation has been reduced to only a mild inconvenience.

BUTTON-UP:

The chains were run without volts and found to have excellent mechanical stability after slight adjustment by means of the moveable lead weights. Final charging tests went well. The column was cleaned as usual by blowing nitrogen and all open units were tac-ragged on floors and ceilings. Rings and spinnings were all gladly tac-ragged with the vigour necessary for best results.

MACHINE CONDITIONING:

One hypothesis holds that the voltage to which the machine will condition is determined by whether dust, or other particulate matter in the accelerator tube, is lying in critical places or has been physically displaced to regions where it has little or no effect. Turbulence in the tube will disturb the particles and many will settle back in the critical places, reducing the conditioned level. The idea is substantiated by the fact that, after tank openings during which the tube had not been let up to atmosphere, the machine would immediately achieve 12MV and condition up to 14MV easily.

In order to preserve hard-won conditioning the tube, on this occasion, was let up to atmosphere and roughed down again much more slowly than in the past - the usual 10 minutes being extended to about 45 minutes in each case. The result was that the first spark occurred at 7MV and vigorous conditioning commenced at 10.8MV. Subsections of the machine, groups of 6 or 8 units, were then conditioned up to 1MV/unit over about 8 hours. When the entire column was stressed it achieved 13.48MV before conditioning recommenced. Subsequently 6 units at each end were conditioned to 1.05MV/unit. As opportunities occur, the remaining units will be conditioned to this value as well. Prior to the tank opening all units had been conditioned to between 1.10 and 1.15MV/unit. The speed with which the 14UD reconditioned justified the time and care taken in minimizing turbulence in the tube.

When the machine was back in use again it was clear that "eerie stability" had returned; its departure has always been associated with something coming adrift in the machine, usually in Unit 19.

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IRIS:

The iris behaves well, reducing beam to 5% of its maximum without recourse to defocusing.

MACHINE ALIGNMENT AND TRANSMISSION:

The work carried out on the LE beam transport concentrated our attention on troubles with alignment and transmission which have been slowly creeping up on us. So far as sputter source beams are concerned transmission from the LE cup, which is above the lens, to the tank cup at the accelerator entrance waist has improved to the extent that the previous value of 40 to 60% has risen to 80 to 100%. Transmission through the machine is however, disappointing. For 13MV on terminal, and using ^{7}Li from the sputter source, with a year-old cone, the intensities in charge microamps are:

LE	1.75	μA
Tank	1.5	μA
HE	1.1	μA
Anal	0.7	μA
Tgt.	0.35	μA

The rather large, and irreducible LE steering required suggests that a major ion source to analyzing magnet realignment is necessary. This was last carried out in December 1974.

D.C. Weisser

T.A. Brinkley

April 23rd, 1979.

David Weisser will be in the USA from May until December, 1979. Most of the time will be spent at Oak Ridge.

14UD SCHEDULE - 25th DEC. 1978 - 2nd Feb. 1979

MONTH	DATE	DAY	GROUP	LINE	
DEC.	25	MON			
	26	TUES			
	27	WED			
	28	THURS			
	29	FRI			
	30	SAT			
	31	SUN			
1979 JAN	1	MON			
	2	TUES	SIE, NEWTON, HINDE 11.45 chain break. CHAIN BREAK	1	160 MeV ^{32}S
	3	WED			
	4	THURS			
	5	FRI	ECK et al.	5	^{9}Be
	6	SAT			
	7	SUN	S-D SHELL	6	
	8	MON			
	9	TUES			
	10	WED			
	11	THURS	WEISSER, OPHEL	5	^{18}O
	12	FRI			120 MeV
	13	SAT	DRACOULIS, FEWELL	1	^{24}Mg 160
	14	SUN			^{13}C 100 MeV
	15	MON			
	16	TUES	WEISSER, OPHEL, et al.	5	^{16}O
	17	WED			120 MeV
	18	THURS	DRACOULIS	1	^{13}C, ^{12}C
	19	FRI	LEIGH, SIE, NEWTON	5	^{16}O
	20	SAT	(Enge 150°)		^{24}Mg
	21	SUN			
	22	MON	WEISSER, ~~OPHEL, et al~~ Conditioning Bend. Mag. Main.	5	^{18}O
	23	TUES			120 MeV
	24	WED			
	25	THURS	~~ECK~~ LEIGH, DRACOULIS, WEISSER	5	~~^{24}Mg, 150 MeV~~
	26	FRI	LEIGH, DRACOULIS, WEISSER	5	^{28}Si
	27	SAT	ECK		^{32}S 240 MeV
	28	SUN			138 MeV
	29	MON	CONLEY, SIE, NEWTON, HINDE	1	75 MeV
	30	TUES			^{13}C
	31	WED			
FEB.	1	THURS	LEIGH, OPHEL	6	
	2	FRI			
		SAT			

14UD SCHEDULE - 12/3/79 - 18/4/79

MONTH	DATE	DAY	GROUP	LINE	
ANBERRA	DAY 12	MON			
MAR.	13	TUES	OPHEL, LEIGH	6	^{16}O
	14	WED	HAY ET AL.	7	80 MeV ^{16}O
	15	THURS			
	16	FRI	OPHEL, WEISSER	5	100 MeV ^{18}O
	17	SAT			
	18	SUN			
	19	MON	RENNIE, BAXTER	5	27 MeV
	20	TUES			α
	21	WED			
	22	THURS	SIE, NEWTON, ET AL.	1	168 MeV ^{34}S
	23	FRI			
	24	SAT			
	25	SUN	NURZYNSKI	5	70 MeV ^{16}O
	26	MON			
	27	TUES			
	28	WED	Interface work		
	29	THURS	Repair unit 19		
	30	FRI	TANK OPEN — Repair foil changer		
	31	SAT	Fix chains		
APR	1	SUN	Install extra LE lens		
	2	MON	Install iris		
	3	TUES	~~SPEAR ET AL~~	~~6~~	~~110 MeV ^{30}Si~~
	4	WED			
	5	THURS			
	6	FRI			
	7	SAT			
	8	SUN			
	9	MON			
	10	TUES	~~CLARK~~	5	^{7}Li 52 MeV
	11	WED			
	12	THURS			
	13	FRI			
	14	SAT			
	15	SUN	EASTER		
	16	MON			
	17	TUES	ECK, OPHEL, LEIGH	6	^{9}Be 45 MeV
	18	WED			
		THURS			
		FRI			
		SAT			
		SUN			

14UD SCHEDULE - 5 FEB - 13 MAR, 1979

MONTH	DATE	DAY	GROUP	LINE	
FEB	5	MON	SIE, NEWTON, CONLEY, HINDE	1	^{32}S
	6	TUES			140 MeV
	7	WED			160 MeV
	8	THURS	ECK, OPHEL, CLARK, WEISSER	5	^{24}Mg 145 MeV
	9	FRI	ENGE WINDOW	5	
	10	SAT			
	11	SUN			
	12	MON	DRACOULIS	1	^{16}O 100 MeV
	13	TUES			
	14	WED			
	15	THURS	OPHEL, WEISSER	5	^{16}O
	16	FRI			^{18}O
	17	SAT			
	18	SUN			
	19	MON	DRACOULIS, FEWELL	1	^{16}O
	20	TUES			
	21	WED			
	22	THURS	SPEAR ET AL	6	^{30}Si
	23	FRI			100 MeV
	24	SAT			^{32}Si
	25	SUN	Sputter		100 MeV
	26	MON			
	27	TUES	α from Lithex Source // Reload Cs reservoir		
	28	WED	Back to Sputter		
MAR	1	THURS	CONLEY, NEWTON, SIE, HINDE	1	^{13}C
	2	FRI			59 MeV
	3	SAT			
	4	SUN			
	5	MON	ECK, OPHEL, WEISSER, CLARK	5	45 MeV
	6	TUES			^{9}Be
	7	WED			45 MeV ^{7}Li
	8	THURS	MACHINE CONDITIONING		2100/MX
	9	FRI			changeover
	10	SAT			
	11	SUN			
	12	MON	OPHEL, LEIGH	5	^{16}O
	13	TUES			