AUSTRALIAN NATIONAL UNIVERSITY

DEPARTMENT OF NUCLEAR PHYSICS

14UD TANK OPENING REPORT No.31

15th December 1981

(1 day open.)

REFERENCES: Earlier Tank Opening Reports are referred to by the notation (12/4) etc, meaning Report No. 12, page 4.

REASON FOR TANK OPENING

Problems with the tank cup.

PREAMBLE

The 14UD was last closed on 3rd December. It easily achieved over 13 MV on the first day, after which it was used for two days at 11.3 MV. There was then a period of 14 MV followed by another at 14.5 MV. There were few sparks, and voltage stability was excellent. For about a week the experimenters were happy with beam intensities. There was a switch to the lithex source for a helium beam and problems with intensitites led to the discovery that transmission was poor from the L.E.. cup to the tank cup. This was not characteristic for the lithex source and we concluded that the source itself was out of alignment. It was opened up and a misalignment corrected, but this led to no improvement.

The younger and brighter author, who had fought opposition to putting in the buncher during the last tank opening, (30/3), and had done a significant amount of the work himself, came to the conclusion that perhaps the buncher was the cause of the poor transmission, either because it was incorrectly lined up, or its grids were affecting the beam. Before diving into the almost unthinkable procedure of "beam aligning" the buncher to observe effects on transmission, the section of tube above the L.E. ball valve was let up to atmospheric pressure and the buncher system was removed from its housing.

Lying on the upper grid was a piece of one of the aluminium tapes used to locate aluminium wire gaskets. Although the area of grid obscured was only about half a square centimetre. It was possible for the piece of foil to intercept a large fraction of the beam because the lithex source beam is smaller than that of the sputter source for that position. The foil was removed, the grids left in, and when the tube was pumped down again the transmission was the same. We took out the grids, pumped down again and the transmission was the same.

As we feared, the remaining possible location for the problem was the tank cup, which is inside the machine. Some more tests with beam established that the tank cup, a rotary device, appeared to be operating

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about a half-in position. At 4.45 p.m. we began to pump out the SF_6; this was completed by 1 a.m. when air was let in and the machine left until next morning.

OPERATIONAL TIME.

During the 11 days since the last closure, the 14UD operated for 202 hours. This was 76% of elapsed time, excluding the days for gas transfer. Of the 11 days, 2 were spent chasing the transmission problem. This reduced our proud 80 to 95% operational time given in the last four reports.

THE TANK OPENING.

Exploratory tour.

An examination in the bottom of the tank before the platform was lowered revealed that everything was well, but the standby chain put in position 1 at the last opening (30/2; 30/4), had stretched and clearly needed shortening.

On the column, 3 tube point assemblies needed changing and 2 tube-to-post stringers were loose on the posts. Below the main patch of stain on the terminal was a curious secondary patch which we have never noticed before.

And so to work!

Chain 1 was parted in preparation for shortening it. We are abidingly grateful to Alan Cooper who noticed an irregularity in the appearance of the chain near where he had opened it. He studied the relevant links and discovered that a nylon link had parted on one side of the head through which the pin passes. The chain was being held together not by a complete eyelet, but effectively a nylon hook, (photograph), with all the strain on its spine. That the link had not broken is only less remarkable than the probability of the chain stopping in the position it did so the failed link could be discovered.

A brand new chain was attached to the good side of the defective chain and shepherded into position without the necessity of lowering the terminal.

When the defective chain was examined another identically parted link was found on the next pellet but one, and our gratitude knew even less bounds.

We have a premise that something is always about to go wrong in an accelerator, and that there are signs, if only one pokes and pries assiduously enough. The younger author proclaimed the discovery as the result of diligent, systematic routine; the older author regarded the affair in a more mystic way, contending that the outcome was the benediction of humble faith in magic.

The most effective way to examine the tank cup is to remove the entrance slits immediately above it. This would mean a full optical alignment through the machine in order to relocate them, entailing opening the vacuum system at various places for telescopes and targets. Since the 300 litre/sec ion pump is attached to the body of the tank cup, and the pump could be removed without disturbing the slits, by this means at least a examination was possible and simple repair feasible. In any case, the entire accelerator tube had to be let up to atmospheric pressure. We began this with the sacramental slowness which is our inviolable procedure in order to minimize turbulence and its consequent loss of conditioning, (15/3); (24/3, table of pumping times).

When the 300 litre/sec pump was removed it could be seen that the cup had got out of correct register with the driving magnet and had settled at a position in which the coiled spring carrying cup current was in the beam path. By inserting a rod into the 3 inch pumping tube it was possible to manipulate the cup to a different position on the multipole magnet and return it to the "out" position with the spring clear of the beam.

The movable element of the "cup" is a cylinder with a hole normal to its axis through which beam passes. To intercept beam the cylinder is rotated about its axis by the magnets. The cylinder is fixed to the magnet rod by an axial screw and two extremely fragile ceramic insulating washers. It appears that one of these washers had broken so that the coupling of the cylinder to the magnet rod was very loose. Each time the cup was actuated the force of the current pick-off wire spring disoriented the cylinder from the magnets. It was estimated that, in the present condition, the cup could be actuated about 20 times before the cylinder would be sufficiently diassociated from the magnet shaft to affect beam transmission. Because replacement of the ceramic washers could well result in bits dropping into the accelerator tube, the cup was set in its "out" position and we do not intend to use it if at all possible. There might already be chunks of broken insulator washer from the initial failure on some tube electrodes.

"Sand" in the 300 litre/sec pump. Another unwelcome surprise of this tank opening was the discovery of granulated material in the manifold leading to the 300 litre/sec pump at the entrance to the accelerator tube. There was a continuous dune of the material from the pump mouth to the precipice into the beam tube. The material was removed with its origin still not clear. The destination of those particles which fell into the tube does not bear thinking about.

Points.

Three tube point assemblies were replaced.

Miscellaneous

The chain with two parted links just removed was examined for further such failures, but none were found. A dozen randomly chosen links were dye-checked for cracks with a negative result. In addition the chains from the two earlier breakages were dye-checked, but no cracks were found.

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Two new chains were received from N.E.C. this month and were checked for "proud rivets" (28/2; 28/5; 29/1). There were virtually none, and N.E.C.'s figure of not more than 1% is realistic for these new chains. In any case, apart from the "proud rivet" chain, the new ones resemble all other chains we have had. The "proud rivet" chain was put into No. 2 position 7 weeks ago and has operated for 715 hours since then. Adding its earlier life in No. 3 position this chain has now done almost 4,000 hours. The rivets were inspected cursorily at the previous tank opening, but a more thorough exmaination is needed.

Cleaning.

Even though the 14UD had been open less than two weeks ago there was no excuse for not cleaning as well as possible. Dust gets in to some degree whenever the doors are open. In addition, the effect of water vapour on the breakdown products on the rings requires that they be cleaned. Cleaning is mandatory, no matter how time might be running out. The column was blown with nitrogen and tacragging carried out with cheeriness in proportion to a nice, midafternoon button-up.

Button-up.

All chains were run and studied for mechanical stability. Charging tests were quite satisfactory. The doors were closed at 3.45 p.m. The time from when we began to take out the gas until we started pumping air out of the closed machine was less than 24 hours, and this was yet another record for the southern hemisphere. We would all appreciate fewer opportunities to attack such records.

Initial performance.

The first experimental run was for two days at 5 to 7 MV. Immediately after this the machine went to 13.8 MV virtually with no effort at conditioning and was used for a non-stop run of 5 days at 13.84 MV. We were pleased with this, considering that the tube had just been let up and opened.

The recent deluge of tank openings heightened our paranoia and convinced us that the machine must have been opened extraordinarily frequently. A check of recent history, recorded below, assured us that we were merely suffering the revenge of statistics for times when they have favoured us.

TABLE OF TIME IN THE TANK DURING THE PAST THREE YEARS.

Year	Number of tank Openings	Working days in the tank.
1979	6	24
1980	7	45
1981	10	29

(The 45 days in 1980 include one period of 33 working days when the terminal spinnings were changed and major work on the vacuum system and internal wiring was carried out, together with full alignment.)

D.C. Weisser

T.A. Brinkley

24th December, 1981

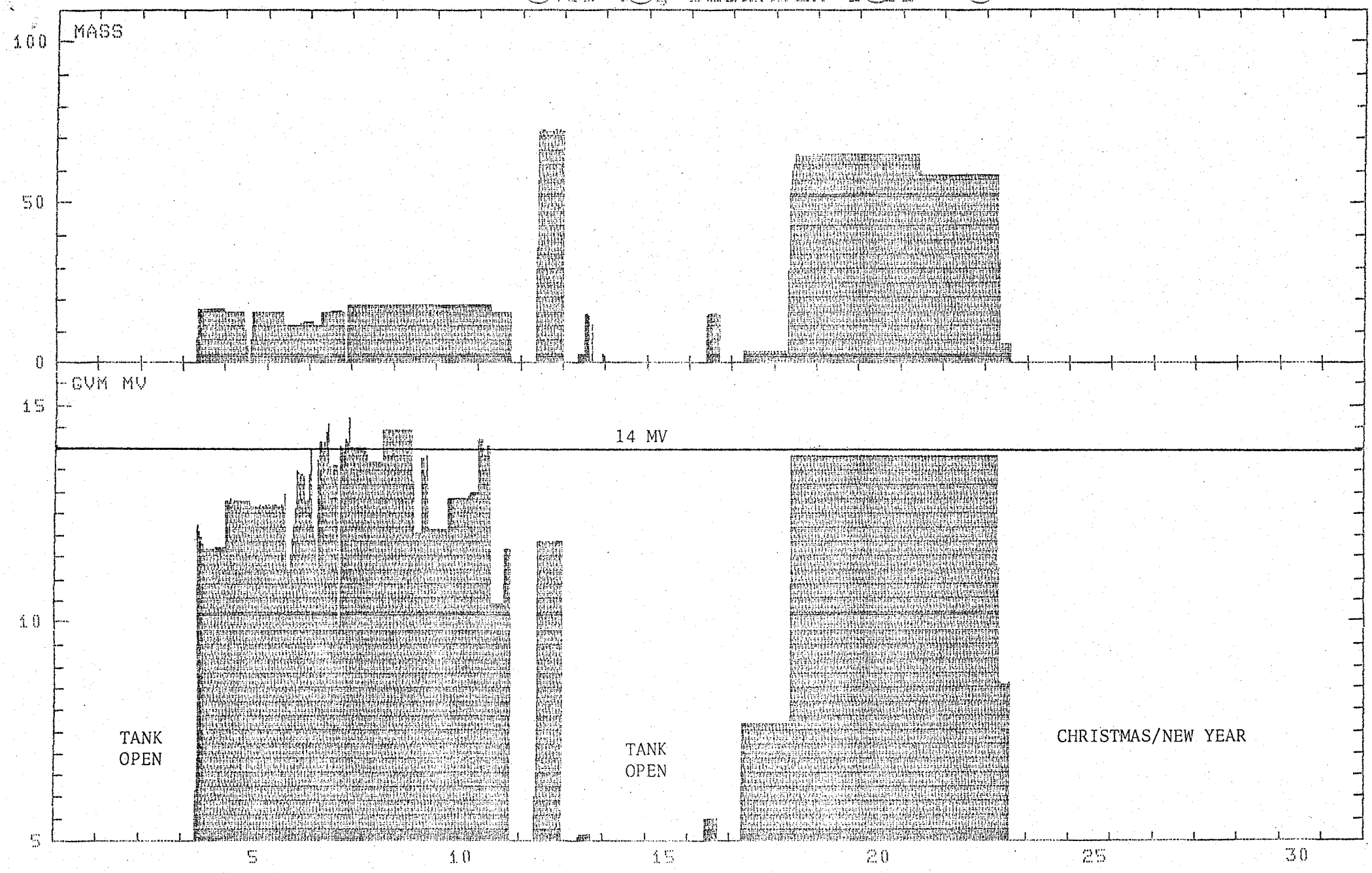
Enclosures:

Plots of particle masses accelerated, and operating terminal voltages.

NOTE: On the plot of terminal voltages we have drawn a horizontal line at 14 MV for easy reference to performance near the machine's nominal voltage limit.

Photographs:

The nylon link failure. The shell of the pellet has been cut away in order to show the full link.


AUD 1◯q DECEMBER 1◯31
MASS
100
50
0
GVM MV
15
14 MV
10
5
TANK
OPEN
TANK
OPEN
CHRISTMAS/NEW YEAR
5
10
15
20
25
30