

AUSTRALIAN NATIONAL UNIVERSITY

DEPARTMENT OF NUCLEAR PHYSICS

14UD TANK OPENING REPORT No. 29

Two openings:

October 13th to 16th 1981 (4 days open).

October 23rd to 28th 1981 (6 days open; 4 working days).

REFERENCES: Earlier Tank Opening Reports are referred to by the notation (12/4) etc.

REASON FOR THE FIRST TANK OPENING

To renew terminal foils, (which were not changed at the last opening), and to attend to the H.E. stripper malfunction.

PREAMBLE

The 14UD was last closed on August 28th. Initial performance was quite satisfactory and it was used to 14.4 MV two days after gassing up. After only a few days it was discovered that the second stripper was not operating. The foil counter was changing in the forward direction, but not in reverse. Since no foil operations affected the beam, it was concluded that the changing system had jammed.

Apart from the foils, the machine itself was trouble-free. It was used below 8 MV for some lengthy runs and for a significant fraction of the time at 14 MV.

There was a major vacuum failure when the beam burnt a hole in a bellows immediately after the analyzing magnet. The accelerator tube, which was saved from going to atmospheric pressure by fast acting valves, nevertheless went up to 10^{-5} torr. At the time we were running 12 microamps of 180 in order to meet the needs of experimenters from Birmingham and Daresbury, who had only two days remaining. During a lunchtime barbecue for their farewell, the machine, which was not at the barbecue, went out of energy lock and scanned the bellows. Unfortunately there was not protection aperture. A new bellows and tantalum aperture were installed. Late that night, after the farewell conference in the darkroom for our ever-welcome friends from Birmingham and Daresbury, the vacuum began to worsen. An acquaintance from Birmingham went to work with a spanner and sheared a bolt. A telephone call, replacement of the bolt and "whomping" the sublimers, restored the vacuum, if not dignity. A few hours later the run was completed with flying colours.

Protruding rivets on the chain removed at the last opening.

The discovery at the last tank opening that a large number of drive screws (we referred to them as rivets) were protruding on Chain 3 led us to replace the chain (28/2; 28/3; 28/5). We wrote to N.E.C. questioning whether the

screws had ever been driven in properly, or were working out, and expressed our concern that the effect could lead to a chain break. N.E.C. replied that the rivets are put in with a press employing a torque wrench set to a value low enough to prevent bending pins, and that usually only about 1% of pellets end up with protruding rivets. (The fraction on our chain was nearer 50%). The N.E.C. letter continued with the statement that they will make a die to pull future assembled chains through to detect protruding drive screws. We inferred from the confident tone of the letter that such screws constitute no risk to mechanical reliability. We shall use this chain again when the need arises.

OPERATIONAL TIME.

During the 45 days since the last closure, the 14UD operated for 921 hours. This was 89% of elapsed time, excluding the days of gas transfer.

THE FIRST TANK OPENING.

Exploratory tour.

When the tank doors were first opened, there was a much more acrid smell than we found at the three tank openings since the alumina was renewed. Nevertheless, there were no lost charge symptoms. Presumably the odour precedes the onset of bad gas problems. The large amount of 14 MV operation, with occasional sparks, probably contributed to the breakdown product production.

The second stripper had failed because of a loose grub screw.

The new chain, put in position 3 at the last opening, had stretched to the point that the motor was bottoming.

The stabilizing idlers, which have given so much trouble, (26/3; 27/2; 28/2) were generally in good condition. This result seemed to justify the resetting of the idlers by wise old hands (27/3) and also arranging that chain rivets do not touch the tyres (28/3). However, one tyre, in unit 19, was just touching the rivets and had been abraded slightly.

On one of the rings was a stalactite/stalagmite pair (27/2; 28/2) which may have arisen from this tyre or from tyre dust not completely removed last time. Another tyre, in unit 16, seemed to have lost chunks from its surface. No tyres were changed because of their acceptable condition and the fact that we had no spare idler shafts. All the idler shafts and bearings were excellent.

And so to work!

Foils.

Since the second stripper failure was external there was no reason to suspect the foils themselves, or the internal mechanism. The tube was therefore not let up to atmospheric pressure.

The terminal foils were renewed. Remembering the triumph of the last occasion (27/3) when, for the first time in recent history, zero on the foil counter corresponded to the blank foil position, we zeroed the counter and closed the Weisser valve. Withdrawing the foil assembly we found that we had knocked off two foil frames. This provoked a thorough examination of the foil counter and it was found that the tens number wheel occasionally failed to move on appropriately with the units wheel. The counter was stripped and a new wheel put in. An exhaustive test produced no further failure. Time will tell whether we shall knock off any more foil frames when closing the Weisser valve.

Points.

There was no recurrence of failure in the region of the second stripper (27/2; 28/2). No points were changed.

Chains.

Chain 3 was shortened by 4 pellets. The metering insulator on charging pulley No. 1 was removed following our failure to measure charging current last time (28/3; 28/4). The insulator was in good condition and with some puzzlement it was cleaned and put back. The chains were cleaned and oiled by hand.

Main alternators.

Vibration in the L.E. midsection alternator led us to remove and examine it. There was evidence that spots on the rotor were touching the stator. The rotor was replaced with one from an almost identical spare. We did not fit the entire spare because this would have entailed machining off the mounting feet in order to fit it in the restricted space. However, the replacement rotor also caused vibration, though no poling. We shall not use the upper shaft before the next tank opening when the problem of rotor imbalance will be pursued.

Miscellaneous.

Over a year ago a power blackout left one of the authors stranded on the platform in pitch darkness. Emergency lights, which operate from trickle charged batteries and come on at power failure, were bought. We put them in this time, and, when tested, a brilliant light lasted for one second. We had been furnished with a 12 volt supply and 6 volt lights. The matter will be rectified.

Button-up.

After the usual cleaning, with nitrogen and tacrags, the charging tests were carried out. While metering tests for all chains were normal, charging current under running conditions for Chain 1 again gave trouble. Insulation of the leads, and the carbon metering brush, were checked. Eventually we found that the pulley support system, and the inductors, had a low amplitude vibration which the other chains did not have. It being late on Friday afternoon there was no time to dismantle the motor and pulley to look for wear. Schedule commitments for the coming week led us to button up with Chain 1 kept isolated unless desperation compels its use.

Initial performance.

On Saturday the tank was gassed up to 60 s.p.i.a. because only a low voltage run was required over the weekend. Machine performance was troublefree.

After three days of low voltage running the 14UD was gassed up to 110 p.s.i.a. instead of our usual 90. This was done to reduce drain from corona currents because we were restricted to two chains. At 110 p.s.i.a. the machine went into operation at 14 MV which was achieved by the two chains at a charging voltage of 20 kV. Corona currents were about 25 microamps for each tube and about 15 microamps for each column. Lost charge was almost zero.

The troublesome second stripper was tested and worked promptly each time. All this, and eerie stability too!

The Second Opening.

On Trafalgar Day, not long after the foregoing part of this report was finished, and those tranquil words immediately above were written, Chain 2 broke after 16,666 hours of operation, having been installed four years and one month ago. The gas was taken out on October 22nd and the doors were opened at about 6 p.m. to reveal the forlorn, shiny heap in the bottom of the tank. The pungent smell encountered when we opened ten days earlier was not present, though, after ten minutes or so of forced air through the tank, there was a distinct smell in the tower.

Next day, Friday, most of the units were opened in order to remove short lengths of broken chain which were lying on most castings. We found no damage to any idlers, though one of the spark shield units was loose. Since it had not been damaged in any way it was clear that the chain had not hit the spark shield. Later, when assembling the lengths of chain, we found that only one nylon link had torn where the pin goes through, suggesting failure due to fatigued nylon. All other broken links were a direct shear on the neck of the nylon links.

Because Chain 1 was out of operation, (Button-up paragraph above) it was decided to keep the tank open long enough not only to replace Chain 2 but to attend to Chain 1 and a few other matters.

The charging pulley of Chain 1 was taken out and we found the cause of the vibration which had led us to button up without the use of this chain. The self-aligning bearings on the pulley had siezed in their spherical housings. While this was being worked on outside the tank the L.E. midsection alternator was taken out and sent for dynamic balancing in order to eliminate the vibration mentioned earlier.

Since everything else in the machine had recently been attended to there was time for some of the general housekeeping which gets bypassed because of the demands on platform time. We have long promised ourselves to re-route the metering leads for H.E. tube and column corona currents, and also those for the three charging currents. Accordingly the old leads were removed from the tank feedthrough box, so inaccessible that students gathered in awe to observe the older author, force-fitted under two charging motors, fighting bifocals to

attend to a few simple wires and dispensing acquired wisdom to the inexperienced. The new wiring was run using the coiled steel strengthening wire of narrow gauge pressure tubing used by N.E.C. for internal metering leads. The leads were run beneath the bottom casting by the supple younger author who interspersed himself among the charging pulleys, inductors and various distributing wires with great agility, but nevertheless played to an empty house.

As with the modified L.E. corona metering leads on top of the column. (21/7; 23/4), the new wires were suspended on devices made from old N.E.C. Type 3 corona assembly domes.

The broken Chain 2 was replaced by the chain with protruding rivets which we had earlier taken out of No. 3 position. As mentioned in the preamble, N.E.C. visualized no mechanical problem with this chain. Alas, too late, we received a further letter from N.E.C. when they came to realize how high a fraction of protruding rivets we had in this chain. They expressed surprise and suggested that we return the chain for inspection.

The midsection alternator came back from its dynamic balance and was put back and tested. It sounded exactly the same.

The shafts of two stabilizing idlers were renewed. The wear of the shafts had escaped earlier inspection. The failures occurred because plating peeled off the shaft when it was pushed through the first bearing, thus leaving insufficient contact in the second bearing. Eventually all plated shafts will need to be replaced with shafts ground accurately to the correct size. The extravagant claim, by wise old hands, (page 2), for perfect shafts and no loose spark shields, also needs revising.

Button-up tests:

All chains were run without volts while the column was toured, looking and listening for any kind of trouble. The usual charging tests were carried out and there still appeared a slight anomaly with the charging current on Chain 1. Having checked out all the metering leads we concluded the fault might be in the terminal and associated with the cross-over wiring. Since the terminal was already closed, and the problem not severe, the machine was closed with no further action taken.

There was, of course, the usual cleaning with nitrogen and tacrags. For once we did not hand oil the chains; they, and the pulley rims, appeared to be moist enough.

The doors were closed at 6.30 p.m. and early next morning the machine was gassed up to only 85 p.s.i.a. since we now had all chains operating again.

The column went to 12 MV easily and the accelerator went into use at 12.4 MV.

D.C. WEISSER

T.A. BRINKLEY

13th November, 1981.

