AUSTRALIAN NATIONAL UNIVERSITY

DEPARTMENT OF NUCLEAR PHYSICS

14UD TANK OPENING REPORT No.45

14th to 18th May 1984
(5 days open.)

REFERENCES: Earlier Tank Opening Reports are referred to by the notation (38/4) etc, meaning Report No.38, page 4.

REASON FOR TANK OPENING

The opening was scheduled to change shaft bearings. No operational faults had appeared up until the time of this opening.

PREAMBLE

The 14UD was last closed on 29th March. The machine operated cheerfully at 13.8 MV a day or so after closure. It was used at high voltage for most of April and ran just below 14MV for the first week of May.

OPERATIONAL TIME

During the 46 days since the last closure, the 14UD operated for 841 hours. This was 79% of elapsed time, excluding the days for gas transfer.

THE TANK OPENING

Exploratory tour.

When the first door was opened, a good sniff established that the air in the tank was what we call 'pleasant'. We have come to take this as an additional sign that nothing is very wrong with the gas.

The stain on the terminal was, once again, dry to the point of being dusty. We first noticed this condition in the tank opening immediately after the larger recirculator and purifier came into operation (42/3) and again at the next opening (44/3). It would appear that dry stain is now characteristic of our purification.

No rings were off and no corona assemblies had drooped onto the ones below them. We found a tube point assembly in a column position and presume it was put there last September when the new (Type 4) corona assemblies were fitted throughout, though it might have been wrongly put in as a replacement. Not long ago we found a column point assembly on the tube, so it was only fair.

Two shorting rod contact housings were loose; one contact coil was rough and appeared to be spark damaged.

The stabilizing idlers were examined at all positions. There were no faulty tyres or bearings. This means that we have had no idler problems at all since last December when we took out our own versions and put back the N.E.C. ones (42/4,5).

We noticed that the brown stain which forms on the backs of our column point assemblies (photograph with Report 35), had changed in appearance along the column. In units between the input and output parts of the new recirculator (units 7 to 21) there was almost none of the usual brown deposit on the assemblies immediately opposite the needles. Only a narrow ring of deposit remained around each of the three relatively clean patches. In the units at the extreme ends of the column, which are outside the gas flow path, the stain was uniformly brown over the three corona patches. These effects are attributed to the larger gas velocity past the points between the inlet and outlet of the gas recirculator, which includes the middle half of the accelerator. Though effective gas mixing has been demonstrated, a reduced velocity of gas presumably occurs at the ends of the tank. The baffles installed at the last opening (44/3) can probably be modified to produce a more uniform flow of the entire gas volume than is presently the case.

In the bottom of the tank chains, pulleys and inductors were all faultless. On the whole, the entire situation inside the machine was consistent with the excellent way it had performed.

And so to work!

Shaft bearings.

Two shaft bearings were changed at the last tank opening; all the remainder were taken out this time and replaced. It is recorded in earlier reports that we experienced a great deal of trouble with shaft bearings during the first years of the machine's operation, but unfortunately no systematic records were kept before 1976; between then and 1981 there were five complete changes, also a full change for the lower shaft, plus changes of individual bearings. Our efforts to improve bearing lifetimes (3/1; 5/3; 18/1; 26/8; 28/2,4,5; 39/3) finally led us to success with the 1981 set which we have just removed after 15,700 hours for the lower shaft and an estimated 11,500 (more likely 13,000) for the upper shaft.

Recently we had discussions with a bearing engineer who suggested that we might further improve lifetimes if we moved to bearings with marginally larger clearance in order to take up slight misalignments which inevitably occur. Accordingly, the bearings we have just put in were half a point looser than new ones put in previously. They are FAG.6010.2ZR.C3. We were interested to find that many of the bearings removed seemed to be still in good condition. This applied just as much to the bearings from the lower shaft, which had run longer, as to those from the upper.

With two teams functioning, one removing casting alternators and the other renewing bearings outside the tank, we had expected to complete the entire operation in less than three days. This estimate was sadly out because the drive coupling flange on the L.E. midsection alternator had seized so badly that an entire day was wasted trying to remove it; eventually the flange had to be flame-cut in order to get it out. Cumulative hold-ups dragged the tank opening on for five full days.

Chains:

Because we were pressed for platform time, the ritual inspection of all nylon links of the chains was curtailed and we examined only about a quarter of each chain, though with the same care. No cracks were seen and we accepted this as an indication that all was well.

Foils.

The terminal foils were changed. Though the Weisser valve leaked last time, on this occasion it held perfectly.

Insulating gas.

Moisture measurements throughout the operating period indicated that the moisture content was well below 10 p.p.m.

Periodic sampling of the gas was carried out using the conductivity cell. The small responses obtained, (less than 20 kilohms/hour), were consistent with effective purification by the Vivalyme and the gas cycle time of 2 hours provided by the new recirculating system.

Cleaning.

Taking advantage of the fact that all units were opened to change bearings, we tacragged inside them: floors, ceilings and any furniture that could harbour dust.

Button-up.

The charging tests were copybook and the new insulators put in the crossover system in the terminal last time (44/4) were obviously well worth the effort. As mentioned earlier, the bearing change dragged out longer than expected and the doors were not closed until 5 p.m. on the fifth day.

Initial performance

The first run after button-up, alpha particles from the lithium exchange source, quickly came to grief when a massive spark somewhere on the source found its way into peripheral electronics and blew up some protection circuits, together with the controller for the 200 kV box voltage supply. It was a weekend and, while makeshift efforts got the lithex to work again, too much was involved in regard to the box supply over which two days were lost at the start of the next week. In parallel with this work, a disaster struck the sputter source. A valve system which enables us to use a nitrogen line to blow water out of the source cooling pipes was left in the wrong configuration, letting water into the nitrogen line. One consequence of this was that the various pneumatic actuators on the gate valves emitted fountains of water; these were quite relaxing to watch and didn't seem to do any harm. Less conducive to relaxation was the fact that the sputter source turbomolecular pump, which automatically vents to nitrogen when it goes off, tripped and vented to its own private fountain. After two days of dehydration procedures, one of which was to take off a 4 inch valve and pour out the water trapped in it, the sputter source went resentfully back on the air after mustering good enough vacuum to make a start.

The 14UD ran at 12.8 MV and conditioned up to 13.8 before sparking. From then on it ran at whatever voltage was required of it, including some spells at

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13.98 MV. We haven't mentioned 'eerie stability' for a long while; this is because we have become accustomed to having it much of the time.

Ion source stability monitor.

When the 14UD is used for pulsed beam work, instabilities on the ion source potentials have drastic effects which have been ignored for d.c. operation.

A cheap dual input oscilloscope has been installed on the ion source deck so that it can be seen with the T.V. camera which views the ion source meters. One trace looks across a portion of the top resistor on the pre-acceleration tube. Any voltage fluctuations in the pre-accelerator supply are easily observed. Similarly, a signal is tapped off the voltage metering chain for the extractor supply. The experimenters can now easily and unambiguously identify the location of instabilities and turn down, or ask for repair of the appropriate supply.

One of the first coups of the system occurred when instabilities on the pre-accelerator were seen above 80 kV. Sophisticated investigation revealed the presence of a wooden stepladder next to the source across the pre-acceleration insulator. Rule No. 1: if the source is unstable at 80 kV, use teflon step-ladders.

INTRODUCING A LADY

SHEBA - Superconducting Heavy ion Booster Accelerator.

The Department has submitted a proposal to upgrade the 14UD by the addition of a superconducting linac booster. It is hoped that funding will become available in 1986.

In brief, it is proposed to construct a linac with 40 resonators to provide acceleration of about 20 MeV/charge to beams from the 14UD.

At present, quarter-wave resonators are favoured. In collaboration with the Weizmann, a module of four such resonators is being built to evaluate both the resonators and our ability to fabricate them. Jerzy Sokolowski has spent nearly a year in the laboratory providing invaluable assistance.

A souvenir poster, illustrating the photogenic qualities of the first resonator electrode, is enclosed.

T.R. Ophel

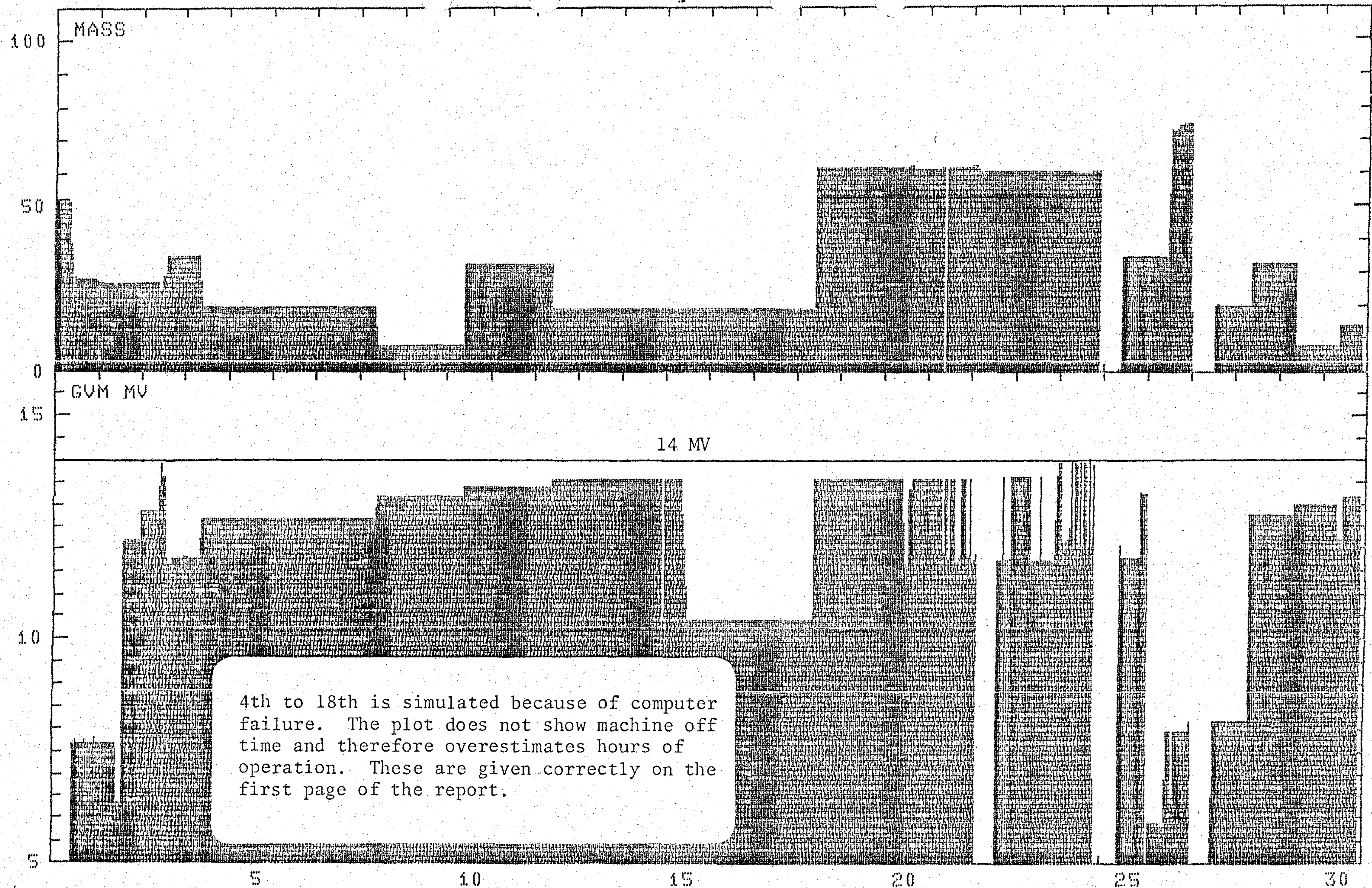
T.A. Brinkley

22 June, 1984

Enclosures:

Plots of particle masses accelerated, and operating terminal voltages.

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



4th to 18th is simulated because of computer failure. The plot does not show machine off time and therefore overestimates hours of operation. These are given correctly on the first page of the report.

14UD log MAY 1984