AUSTRALIAN NATIONAL UNIVERSITY

DEPARTMENT OF NUCLEAR PHYSICS

14UD TANK OPENING REPORT No. 35

Three openings.

25th to 28th May 1982

(4 days open.)

22nd to 24th June 1982

(3 days open.)

and

15th to 21st July 1982

(7 days open; 5 working days)

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

REASON FOR THE FIRST TANK OPENING

Scheduled opening for countdown chopper installation, SF_6 containment valve (hereinafter referred to as ball valve) renewal, chain replacement and the fact that the younger author was back from the U.S.A. and pining for a tank opening.

PREAMBLE

The 14UD was last closed on April 15th following a forced opening because the terminal stripper had jammed. Still having no chain to replace the one which broke on March 18th (34/1) the machine was closed with only Chains 1 and 3 in place. Though the tube had been let up to atmospheric pressure there was little trouble in getting the 14UD back to a respectable voltage, and it was soon conditioned up to 14.2 MV.

The machine continued to run well on only two chains and at no time was an experiment voltage limited, and there were long runs in the vicinity of 14MV.

After about three weeks we began to notice spasms of lost charge which did not appear to be correlated with anything in particular; for instance, reactivating the dryer and recirculating the gas did not improve the situation.

At one stage, when running at 13.75 MV, the machine would not hold volts when lost charge was high. The only procedure which cleared the effect was to stop the chains for a minute; on re-starting this allowed a new trouble-free spell which would last anything from 20 minutes to 10 hours.

OPERATIONAL TIME

During the 39 days since the last closure, the 14UD operated for 859 hours. This was 94% of elapsed time, excluding the days for gas transfer.

THE FIRST TANK OPENING

Exploratory tour.

We are now very sensitive to anything relating to the condition of our tank gas and as soon as the doors are opened, first one head, and then the other is inserted in the tank for a few good critical sniffs. Sometimes the atmosphere in the newly opened tank has been acrid and foul and at other times quite inoffensive. On this occasion the sulphurous smell was strong enough to make us apprehensive, yet it was not as bad as at the last tank opening, (smell not reported).

There was a lot of oil in the bottom of the tank; much more than could possibly be accounted for by the amount of chain oiling which had been carried out.

On the terminal, opposite the triode needles, the accumulation of brown material was similar to that of the first occasion of noticing such an effect in February (32/2). Instead of a smooth stain about a foot high and six inches wide, there was a patch of material flaking considerably, with small areas of clean terminal where sparks had blasted through the stain and left tiny craters on the terminal, (photograph). On the wall of the tank surrounding the stabilizing triode mushroom, and on the mushroom itself, were a lot of specks and small flakes of the material which had clearly flown across the tank (photograph). The effects were the same as we saw on the previous two tank openings and these photographs compare with those enclosed with Report 32.

Stain on the terminal opposite the triode needles always prompts us to take a look at the tube and column corona assemblies, and here was another surprise. The stain on the column assemblies was a rich chocolate brown similar to that on the terminal. The deposit on the tube assemblies was a bright, light green - pistachio, according to the younger and thus more colour-sensitive author, (photograph). We confirmed that the effect was the same throughout the machine. When the brown stain on the column assemblies was scraped lightly with a knife it came away easily and cleanly; however, the green stain on the tube points refused to budge with vigorous scraping and held fast, rather as baked enamel does. When touched with a drop of water both brown and green deposits dissolved readily.

In Unit 10, two consecutive column corona assemblies had drooped badly; the upper was resting on the lower, which, in turn, was very close to the one beneath it. In one or two units we found tube points with bad or missing needles.

One of the quarter inch aluminium rod column to tube "stringers" on the L.E. column was loose on the tube flange and sparking had eroded away part of the eyelet, (included in the photograph of the corona assemblies). We described (22/3) how we had earlier changed the original N.E.C. 0.04" stringers for 0.25" ones, then removed all the 0.25" ones from the H.E. column and replaced them with 0.0625" phosphor bronze wires because the rigid rods worked loose. We are now replacing the 0.25" rods with 0.0625" wires in all the L.E. units as they get opened up for one reason or another.

The 'down' d.c. idler on Chain 1 had seized. The tyre was badly damaged and sooty particles were spattered on the inductors and insulators in the vicinity. Two stabilizing idlers were found to have stiff bearings.

Robert Rathmell, of N.E.C., had recommended that we use the embrittlement of nylon cable ties as a harbinger of breakdown product induced chain damage (34/2). In the lower terminal about half a dozen large nylon cable ties still remained since their installation something between one and three years ago. One of them broke when its clamp lock was pushed hard; the others broke easily when their locks were twisted with pliers. The cable ties, put as monitors in the bottom of the tank at the last opening (34/6), were in good condition and resisted vigorous tugs.

Chains 1 and 3 were examined meticulously by the same observers who found the hairline cracks we reported earlier (34/1; 34/2; 34/6). No new cracks were found or other evidence of deterioration in the nylon links.

And so to work!

CHAINS: The new chains, which N.E.C. expedited, arrived in time for the tank opening. This meant that we were not spared the decision as to whether or not to put it in. We had to bear in mind not only N.E.C.'s parable of Sao Paulo (34/2) but also our own evidence of the unsatisfactory condition of our gas and the need for it to be clear of virulent properties before we put in the new chain. Unfortunatey there does not seem to be an instrument on the market into which we can put some of our gas and get an immediate digital readout in chain lifetime factors. The closest approximation to such a device, N.E.C's Cable Tie in The Window (34/3) has rather too long a time constant.

N.E.C. had advised that we should not put in a new chain until we were satisfied that we were in a better situaiton in regard to breakdown products. This advice, the smell in the tank and the stains on the terminal and corona assemblies were against putting a new chain in, whereas the fact that the condition of Chains 1 and 3 had not worsened detectably since the last tank opening and that tell-tale cable ties, installed in the middle of June (34/5), were still O.K., implied that the gas was not now all that bad.

The deciding factor was probably not so much caution as the remarkably good performance of the 14UD with only two chains. We elected to continue with two chains, and leave the new chain out of the machine for the present. We noted with interest that the plating on the two new chains was much more bright and shiny than on any supplied before; we assumed this was a good thing.

Foils.

No foils were changed in either stripper.

Points.

The various point assemblies referred to in the preamble were renewed.

Chains.

Three shimstock contact bands were renewed on the driving pulley of Chain 3.

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Chain stabilizing idlers.

It appears that, although we have mentioned alterations and problems with idlers over the last year or so, there exist gaps in the story that make some comments incomprehensible, even to us. For our records, and your information, we shall review the whole situation.

When installed, our machine was equippped with standard N.E.C. idlers. The assembly at each position comprises three wheels, each 2.75 inches in diameter. At that time spark shields had not been invented. Over the years we had consistent trouble with idler bearings due, we felt, to spark damage of the balls. In order to alleviate this problem we redesigned the idler assembly so that the inner race could be referenced to local ground through a carbon brush, (14/2), (see drawing enclosed). Unfortunately, this involves a press fit of the new steel idler shaft into the bearings. When our main machine shop was asked to manufacture 72 shafts, production run variations resulted in some tapered shafts. In cases where the shaft was looser than a press fit spark erosion of the shaft rapidly occurred. In an effort to salvage undersized shafts, we nickel plated them up to the specified dimension to plus or minus 0.0002 inches. However, as for most things for accelerators, this procedure was carried out under the time pressure of a tank opening. We reported details earlier (26/3).

In the short term, June 81 to September 81, plating seemed to be a successful solution. However, we soon discovered that, in pressing a shaft through the first bearing, the nickel plating was scraped off and was not present in the inner race of the second bearing. We had no way of knowing in how many cases this had occurred. Suffice it to say, we found spark eroded shafts where they contacted second bearing inner races. In November 81 we received from the workshop a new full set of properly machined idler shafts and, from then onwards, we have been installing them wherever replacements were necessary. Because of these confusing secondary failures due to dimensional quality control, we are unable to assert that the design using a carbon brush results in longer bearing lifetimes.

Chain oilers.

The considerable amount of oil found on the floor of the tank was explained when it was found that No. 1 oiler was leading constantly because of a defective solenoid valve. Because the SF_6 bottle, which supplies various actuators, is valved off when the tank is pumped out, the leak was not observed when we first went in the tank. When the oilers were tested the leak came to light and the defective valve was replaced with one borrowed from the No. 2 position, at present with no chain.

MISCELLANEOUS.

Cable tie indicators.

We renewed the cable ties kept under tension in the terminal, and dated them.

SF_6 Gas Handling.

Over the years we have been quite happy, and even smug, that the cheap gasket material used to assemble the SF_6 plumbing did not leak. Now, with the passage of time, and the improvements in SF_6 leak detectors, our plumbing shows that we have nothing to be happy about, let alone smug. Some of our leaks were attacked on this occasion.

The 8" ball valve in the suction side of the Kinney was dismantled completely. The fibre washer on the gland was replaced with an O-ring and the shaft was machined to provide sufficient compression on the O-ring. The equivalent valve under the tank was lowered and top and bottom gaskets were renewed, but not the gland seal as it didn't leak.

End plates on the recirculator pump were removed and gaskets replaced with new material. We confirmed that the blower was rotating in the correct direction. All threaded connections on the dryer safety valve, thermometer and thermostat were taken out, cleaned and remade. After the usual traumas with teflon tape, and then with various pipe sealants, the final seals were accomplished with Torrseal.

Pulser.

The latest stage of our pulser system, the countdown chopper, was installed. This meant that the tube had to be let up to atmospheric pressure because of a previous failure of the H.E. ball valve. We have now had to let the tube up during each of the past three tank openings whereas sometimes we survive years without it being necessary.

Vacuum system.

The H.E. ball valve was taken out and refurbished with aluminium-bronze links to stop stainless on stainless galling. The unsatisfactory home made L.E. gas containment valve was replaced with a ball valve also rebuilt with aluminium-bronze links.

Cleaning.

The triode stabilizing mushroom was not cleaned. Spattered with material from the terminal, it was left for photgraphy, and then forgotten. The older author, whose undeniable job it is to attend to such afflictions of critical parts of the machine, apologized humbly each time the blunder was again condemned by the younger author, who never seems to make such howling mistakes, (23/5).

Button-up.

Charging tests on the two chains went well. The 14UD was closed at 2 p.m. on Friday, and roughing began on the tank. Next morning the tank was down to about 2.5 mm, instead of the usual 300 microns. The 'gasser-up', early on Saturday morning, concluded that, since the tank had been roughed for longer than usual, there was probably a metering fault. He began to gas up at about 8 p.s.i.g. went to make the first checks for leaks with a halogen detector. On this occasion, because several flanges on the tank itself, and the dryer and recirculator had been opened, there would be more to check than the usual platform cable ports and the doors. Intending to start at the top

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of the tank, because SF_6 is a heavy gas, he found an immediate response when the detector was turned on in the tower. He hurried to the top of the tank, expecting to find a leak which he could hear at one of the cable ports. When he did not find one he raced down to the gas handling room and stopped the gas input. Returning to the top of the tank he soon concluded that the SF_6 was leaking lower down and rising up the tower in the convection currents. He went to the dryer and recirculator area on Level 3 and found nothing evident there. On Level 2, where all the plumbing for the pneumatic actuator system is installed, the leak could just be heard, and was quickly found. The pipe from which the No. 2 oiler solenoid valve had been borrowed had not been sealed off. Peter's revenge! This was promptly attended to, and the gassing up continued.

There were, of course, three consequences of the incident:

1. The tank was not pumped down to as low a pressure as desirable to enhance moisture removal. This could exacerbate an already grim breakdown product situation.

2. While SF_6 was being put into the tank, air was being sucked through the leak until the total pressure reached atmospheric and so the SF_6 was now contaminated with air.

3. A quantity of SF_6 was lost while the tank pressure increased from equilibrium to 8 p.s.i.g.

The time taken until equilibrium was reached was 45 minutes and from that point until the leak was capped was about 25 minutes.

In order to determine the degree to which our gas has been contaminated we immediately began to brush the dust off our residual gas analyzer. We spoke of reviving this in the last report (34/4) in regard to breakdown products; the last time we applied it to the 14UD tank gas was in January 1979 when we included with Report No. 14 plots of our gas analysis. We determined an air containment of 1.1% which compared very unfavourably with the value 0.1% in 1979.

Initial performance.

The effects reported in the preamble had all cleared and the machine went into use for about a week when there was a scheduled shutdown for a combined SF_6 inventory and examination of the storage vessel.

All the SF_6 was put into the 14UD. As usual, on these occasions, the accelerator was secured and left out of use in order to minimize all risks which could call for an emergency pump-out at a time when the storage was open and we had nowhere to dump the gas in a hurry.

The inside of the storage vessel looked remarkably clean and the paint was in excellent condition. The amount of brown, rusty material on the floor was small compared with the occasion when 8.5 kg were found (12/1). There was nothing to suggest that the storage veseel was being attacked by impurities in the gas; correspondingly it was clear that, since such attacks were not taking place, corrosive products which existed in the gas were not being depleted in virulence by having bare iron surfaces to operate on.

To serve the purpose of both an indicator and a small purifier a freshly shotblasted steel arrangement was created to stand in the tank in such a way as to have the lower part constantly in liquid and the upper in gas, varying as the liquid level.

After the gas inventory the 14UD behaved satisfactorily for another three weeks. Then Chain 1 broke, having operated for 2,875 hours. It had been in the tank for six months. In the worst light the new break was the sixth in seven months. In the best light only three of the six breaks were chains that had been installed new, one of which had been in for nearly three years. It was N.E.C.'s opinion, in March, that the chains remaining unbroken in the machine were already fatally compromised by the breakdown products which destroyed three others. From that point of view the use we have had from this chain, and the continued service of No. 3, are undeserved but welcome benefits.

During the 22 days since the last closure, the 14UD operated for 371 hours. This was 86% of elapsed time, excluding time for gas transfer for the tank opening, and also excluding the two days the machine was off to receive the full inventory of gas for the storage vessel to be opened.

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The second opening.

The smell in the newly opened tank was not bad and that, at least, was encouraging. There was little damage from the chain break but part of the nylon rim of the driving pulley had been broken off and we had to put in another pulley.

The broken chain was taken out of the tank and examined with great care. We have constructed a system consisting of an old pulley, lights and magnifiers and can inspect the nylon links easily and thoroughly. Two hair-line cracks were found, but nothing worse, and certainly no miracle links (33/2). Even these cracks were in nylon pellet necks, that is to say where pellets usually break by impact rather than by chemical attack.

We speculate that Chain 1 broke because of a transport failure induced by lack of oil. The open tube on oiler No. 2 already mentioned had the effect of dumping all the oil from Chains 1 and 3 on the floor of the tank making the act of oiling impotent.

Though Chain 3 was examined in situ at the last opening, it was again subjected to a long and careful inspection and no defects were noticed.

For the first time ever we specially prepared a brand new chain before installing it. On the assumption that breakdown products attack nylon more intensely in the presence of water we put the chain in a spare scattering chamber and pumped it with a vacsorb for a day and a half to remove as much water as possible from the nylon links.

A great deal of trouble was taken to ensure that the new chain ran perfectly. At first it exhibited gross oscillation parallel to the rivets. This was reduced, in large measure, by reshimming the drive motor to improve its alignment to the pulley. We parted the chain, allowed it to hang and determined that it did not have a significant twist. In spite of all this there remained a one inch oscillation just below the terminal. We eliminated this by reducing the chain tension by one 20 pound lead block. Once we were more or less satisfied we ran the chain for half an hour and then left it overnight to stretch. Next morning it was shortened by two links and then run again.

Along the column we found six shorting rod contact holders loose and were convinced that these could have accounted for some of the recent instabilities while using rods. These contacts are always checked in units which are opened but we don't open units especially to check them.

The mushroom of contention, not cleaned at the last opening, was apologized to and made to look like new.

In the lower terminal two of the nylon cable ties put in last time were deliberately twisted until they broke; they appeared to be somewhat brittle. New ones were put in at the same place under the same tension and one of them was immediately wrenched with pliers. It stood up to the test better than the ones which had been in the tank for three weeks. We had saved the brittle cable ties deliberately broken at the last opening, (Exploratory tour, this report), and discovered that after about a week in a normal atmosphere they had regained much of their flexibility and strength. If this was due to moisture takeup then, even though more susceptible to breakdown products, nylon is stronger when it contains normal water, then it dries in the tank and becomes more brittle. There's a hole in my bucket.....

Just for fun we might put some nylon cable ties under tension in a vacuum system where there are clearly no SF_6 breakdown products, and see what happens. Perhaps N.E.C. have done this, but they haven't mentioned it so far as we recall.

While the machine was off for the SF_6 storage vessel examination the sputter source was dismantled and the dilapidated perspex support structure, still scarred, distorted and part blackened from the ion source fire (25/2), was replaced with a new one. Then, because we propose to run the source at a higher pre-acceleration voltage, we did some tests to see how high we could go up in voltage without breakdown or significant corona. We should point out that the A.N.U. sputter source is not enclosed in an imposing metal box with large diameter pipe edges; it, and its associated electronics, merely sit unpretentiously on their perspex stands. This is because, years ago, we found the original N.E.C source very difficult to work on in its enclosure; also we frequently cracked our heads on its framework. Tormented by constant inaccessibility and unprovoked jabs of pain, bit by bit we whittled the enclosure away with a hacksaw. We discovered as we went that, no matter how much we removed, the source still stood up to 120 kV without corona. All that remains now is a pair of Pompeii-like pillars and two stumps which don't get in our way, (photograph on application). When we built the sputter source we saw no reason to enshrine it in an extravaganza of modern sculpture. It does get dusty, though!

We succeeded in getting the sputter source up to 175 kV after putting Q compound on a few edges and corners where we could see corona. Even this limitation was due to outgassing in the tube, and not structural. The outgassing cleared with conditioning and we achieved our goal of 200 kV. While Q compound is handy as a quick expedient we found that Plastibond (loaded epoxy resin) does a nice permanent job on troublesome surfaces, and it can be smoothed down very easily.

Breakdown products.

A very detailed response to our chain survey was received from Sao Paulo. In order to compile it they waded through various historical notebooks

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and gave us dates and lifetimes. They also gave us, in the column on the survey form headed "Cause of break if known/suspected" the unequivocal statement for each chain break: "SF_6 breakdown products".

We have just had a letter from Neil Burn, of Chalk River, concerning the way we reported purging our dryer with nitrogen (34/4). He pointed out that, at Chalk River, they simply take in room air, preheat it and circulate it through their dryers. He commented that possibly oxygen and/or moisture in the air reacts with the breakdown products absorbed on the surface of the alumina and added that the exhaust from their dryer smells awful! We are taking this suggestion seriously and will report on changes it leads us to make. The reason we purge with nitrogen is simply that it happened to be piped past the dryer when we needed a handy source of gas at convenient pressure.

The corona assemblies with brown and green stains were sent for analysis. Also flakes scraped from the terminal. The preliminary comments from the analyst so far do not lead us to anticipate a rapid major breakthrough; it was, however, confirmed that the stains were brown and green.

Initial performance.

The 14UD performed well at startup. Following some use at 12 MV it was used at 13 MV and then conditioned up to 13.6 MV. After about two weeks there were problems with stability when Chain 1 was in operation and we were convinced this was due to the new chain stretching and its motor "bottoming", giving rise to mechanical instability. Having no third chain in the machine we could not leave Chain 1 idle until the next opening, therefore we had no alternative but to go in the tank again.

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The third opening

Immediately we went in the tank we saw that the Chain 1 motor was nowhere near bottoming. The instability was clearly due to something else which we set out to determine before proceeding with other matters.

After turning the chain by hand to ensure that there was no obvious mechanical fault, we ran it under power and found no irregular behaviour. We then carried out the standard charging test which we apply to individual chains immediately prior to closing the tank. The charging system withstood 8 kV, with no chains running, until breakdown occurred. This value is acceptable in air, and we rarely exceed it. We then ran the chains and applied increasing voltages to observe charging currents. Breakdown occurred intermittently from the chain to the charging (negative) inductor at chain repetition frequency for something between 4 kV and 6 kV, in other words, significantly less that for the static test.

No failed idlers were found when the castings were opened. Searching the chain for irregularities we discovered a chain fault that was new to us. The rims of some pellets were badly spark damaged and were very rough to the touch. Close examination of the entire chain revealed that the damaged pellets were distributed over one section of the chain about 90 pellets long. There was severe spark damage to the ends of the pellets and microscopic examination revealed areas of melted plating, poorly adhered to the parent

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material. Although spark damage occurred with the non-shiny pellets of earlier chains they showed no large scale melting; this suggests that, with the new chains, there was poor thermal contact between the shiny plating and the substrate.

We put 10 kV from a resistance tester across the quarter inch gap between pairs of adjacent damaged pellets in order to detect the onset of corona on the meters, even if we could neither see nor hear it. In most cases there was very little indication. As we preceeded we came to a particular pair at which breakdown occurred at the onset voltage of 7 kV (in air). We found that the plating had lifted on the rim of one pellet and a sliver of it was projecting towards the other pellet. The sliver was fragile and broke when touched, leaving a patch of bare steel on the pellet rim.

The chain had been put in brand new at the last tank opening only three weeks before. We had commented, (this report, page 3) how bright and shiny the new chains were, and hoped it was a 'good thing'. The chain had operated for 400 hours.

Before being installed the chain had been placed in a vacuum chamber and pumped at the micron range, (this report, page 7) for a day and a half to remove moisture. Since all chains are in micron range vacuum when the tank is roughed overnight, there is no reason to suspect that this pre-treatment would have been any worse for the plating than the normal cycles of tank environment, to which chains are subjected many times.

Close inspection of the chain, when it was taken out, showed that the shape of its pellets was slightly different to standard chain. It appeared that the metal link was marginally larger in diameter, resulting in a dimension perpendicular to the pin of 1.253 inches, instead of 1.243 for standard chain. We noted that there were no 'proud rivets' (28/2; 28/5) and concluded that the distance across the pellet at the rivet was enforced to be 1.243 inches, thus stressing the pellet and perhaps making the chain stiffer. This stiffness might be what 'running in' overcomes, (this report, page 7). If the flexing in the bending direction is determined by the teflon bushes, however, this stiffness argument fails and another explanation for 'running in' must be sought.

We telexed N.E.C. and they replied by return that they were shipping us immediately a chain with old style plating. Grateful as we indeed were, the pressures of the experimental machine schedule persuaded us not to wait for the new chain, (it arrived in the lab 14 days after N.E.C.'s telex). We took 91 damaged links out of chain 1 and replaced them from a batch of 150 brand new ones which were also "shiny" and of the same vintage as the two new chains. From our point of view, if all the remainder of Chain 1, and the "shiny" spares, are to fail, then the sooner we know about it the better. All we have to lose is a tank opening.

Chain 3.

This old-timer, with nearly 2,400 hours to its credit, was examined once more with considerable care. One cracked link (photograph) was found and taken out, its removal accommodated by chain stretch.

Chain 2 position.

This position had been empty for four months and we now had a brand new chain (the second of the two shiny chains) to put in it and also had the time to put it in, but, in the light of experience with the first shiny chain, - To put, or not to put? That was the question.

We decided that we would put it in, and did so in the expectation that its lifetime would be plating-limited, rather than nylon-limited.

We found that all the mechanical oscillation phenomena seen on the first shiny chain, (this report, page 7) were repeated by the second shiny chain and seemed to add substance to our argument about stiffness mentioned above. In this case we did not waste time chasing the same red herrings, but relied on the running-in procedure.

We performed a charging test on this new No. 2 chain; it could sustain no more than 15 microamps at 3 kV charging volts. The current oscillated around and limited at 15 microamps, even at 6 kV, where Chain 3, old (relatively) but reliable, supplied 22 microamps. Trusting to the un-understood magic of running in we did no more to this chain before closing the tank.

Shimstock contact bands.

When testing Chain No. 1 in situ we came across one or two very fine steel 'hairs', half an inch to an inch long on the edges of the contact bands. We took a look at our spare new bands and found similar hairs on the edges, presumably caused by an imperfection in the die with which the bands are produced. In many cases the 'hairs' were still attached along the length by a most fragile amount of material. All that was necessary was to wipe the shimstock edges with emery paper. (Photograph of 'hair' on edge of new contact band.)

The stain on the terminal.

This was uncharacteristic. Usually there is a nebulous centre brown patch which is surrounded by an area which is much lighter brown. This time the surround was white with no detectable tint and in the central patch one could easily discern overlapping areas corresponding to each corona triode needles. We took a colour photograph which entirely failed to do the white justice, so we are not enclosing it.

Gas Dryer.

With the machine off the air, we took the opportunity to open up the recirculation dryer. All the alumina was taken out, and was good in appearance. We heat the alumina by electric elements buried in it and circulate nitrogen through the hot alumina. We are disenchanted with this method and, as mentioned on page 9, see much sense in what Neil Burn had to say. At all events, we took out the heater and established, as well as possible, that there was no uneven heating or other defect in the system, such as it is. The loading port at the top was improved by replacing the threaded plug with an O-ring sealing flange arrangement. A similar modification had been made long ago to the bottom flange.

After the dryer was reloaded, it was thumped vigorously with a soft-headed hammer to settle the pellets. Previously, the dryer felt much hotter at the centre than at the ends. After this massage the uniformity seemed better. As measured on the outside of the steel tower, it was 46° C at the top, 65° C at the centre and 58° C at the bottom.

Foils.

The foils in the terminal stripper were replaced.

Shaft bearings.

The shaft bearings were listened to individually. The only one to hint of impending trouble was in casting 28. The upper shaft bearings have run for 2,000 hours and the lower for 5,000.

Button-up.

While we have been cleaning regularly we came to the conclusion that the column is dirty - Filthy, one of us said. We shall have to do something about it.

Initial performance.

Conditioning began at 12.7 MV. On the second day the 14UD was in use at 13 MV.

OTHER MATTERS.

Chain survey.

We have received 10 completed questionnaires and a varied collection of relevant information which we have not had time to assess. The consequences of being our own best source of statistics give us little time for leisurely analysis.

Superconducting resonator.

The resonator (34/6) and associated peripherals arrived safely from Caltech.

And now we pause for a commercial:

We have been circulating these reports for six years, and, by request, three copies are sent to individuals at one of the largest and most famous laboratories in the U.S.A. (Near Chicago). During May one of our roving ambassadors visited the laboratory and was asked how the A.N.U. 14UD was going as no-one ever seemed to hear anything about it. The questioner went on to say that he had been overseas to another lab with a large N.E.C. accelerator (one of the oldest 14UD's on our circulation list) and they never seemed to hear anything about the A.N.U. machine either. Perhaps we should put the reports in a pretty cover, or run a centrefold of the second stripper.

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We regret that delays owing to a University industrial dispute, (not between the two authors), held up not only the report of the first opening but the second as well. We point this out because we are proud of the regular promptness with which we write and dispatch the Tank Opening Reports, if not their debilitating frequency. The third opening occurred just before the report went for printing, and so it was written up and tacked on the end.

D.C. Weisser

T.A. Brinkley

30 July, 1982

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 references to performance near the nominal voltage limit of the 14UD.

Drawing of stabilizing idler assembly.

Photographs:

1. Stains on tube and column corona assemblies.
   (The eroded end of the stringer mentioned was put in this photograph.)

2. Flaking deposit on the terminal spinning.

3. Deposits on the stabilizing triode mushroom.

4. Interior of SF_6 storage vessel, showing L shaped steel piece, shot-blasted clean.

5. Cracked nylon link.

6. Spark damage on pellet. sliver of plating is circled.

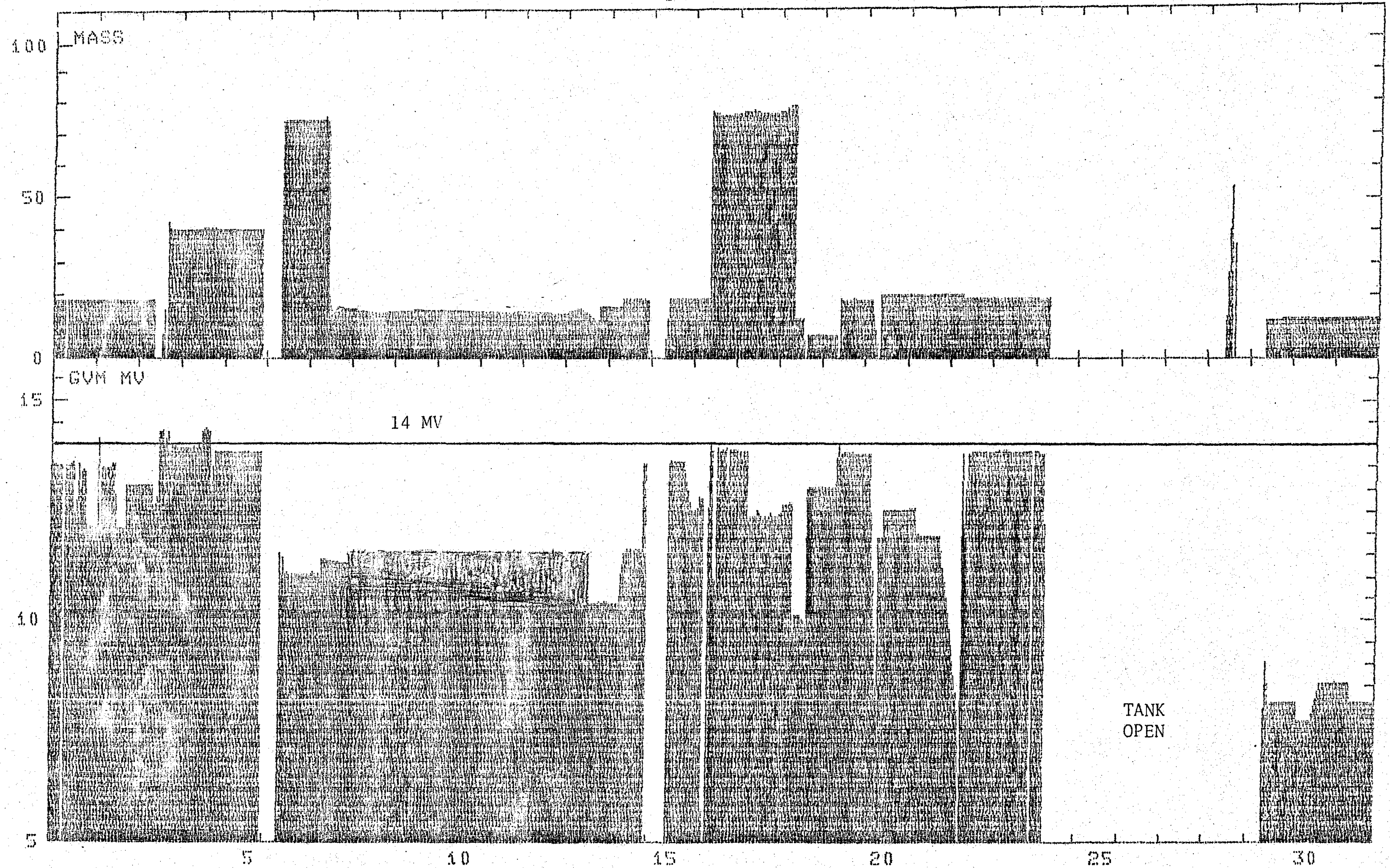
7. Complete rim of shiny pellet showing distribution of spark marks.

8. "Hair" on new contact shimstock.

LAST MINUTE ADDENDUM 4th. August 1982

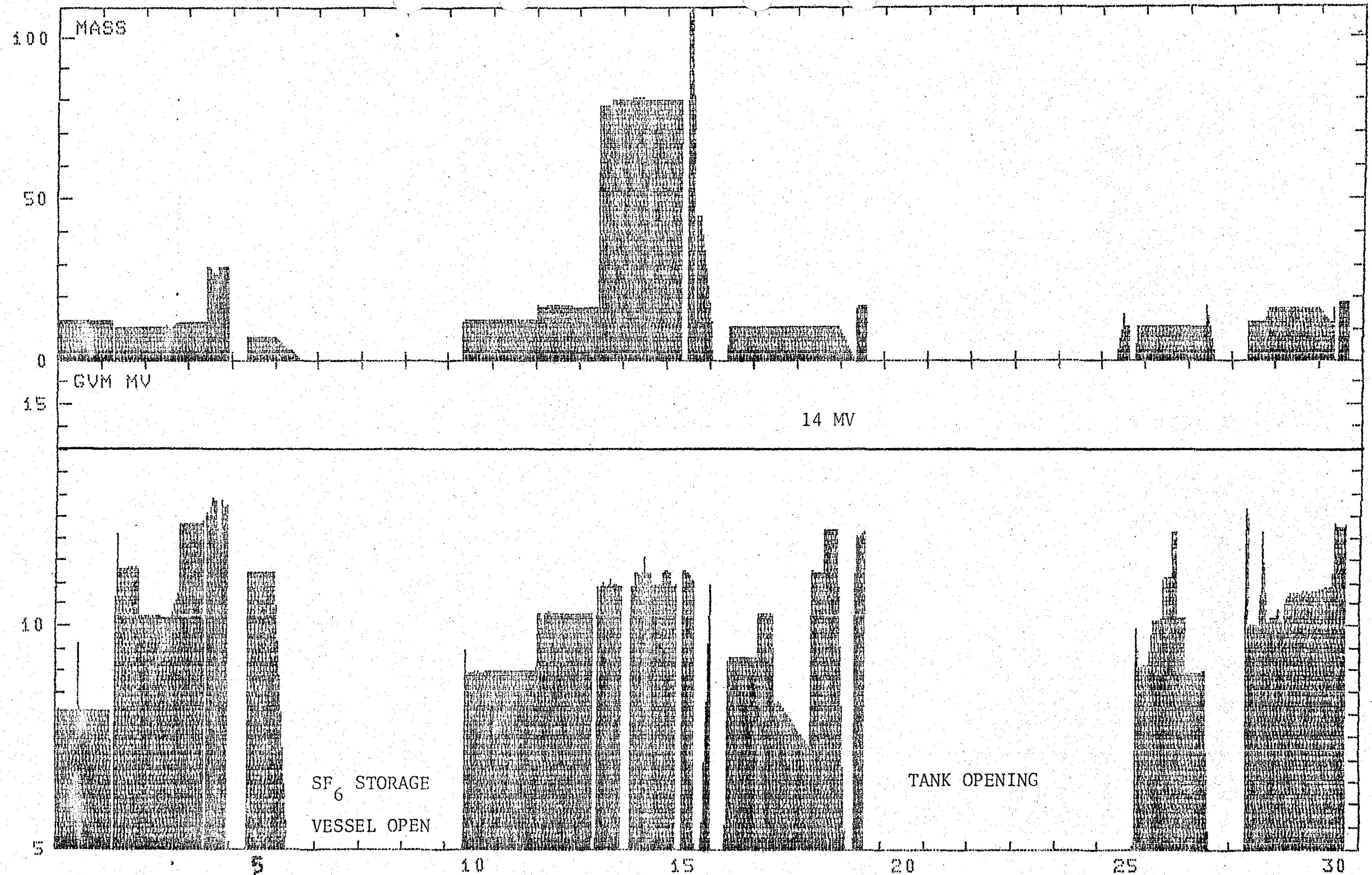
For the past two days the voltage performance of the 14UD has given rise to uncertainty. After problems last night, and first thing this morning, that uncertainty took a giant step towards undoubtedness. We believe the problems are chain-related and expect to be in the tank again soon. Rather than wait we are going to press before this report reverberates any longer.

14UD log MAY 1982

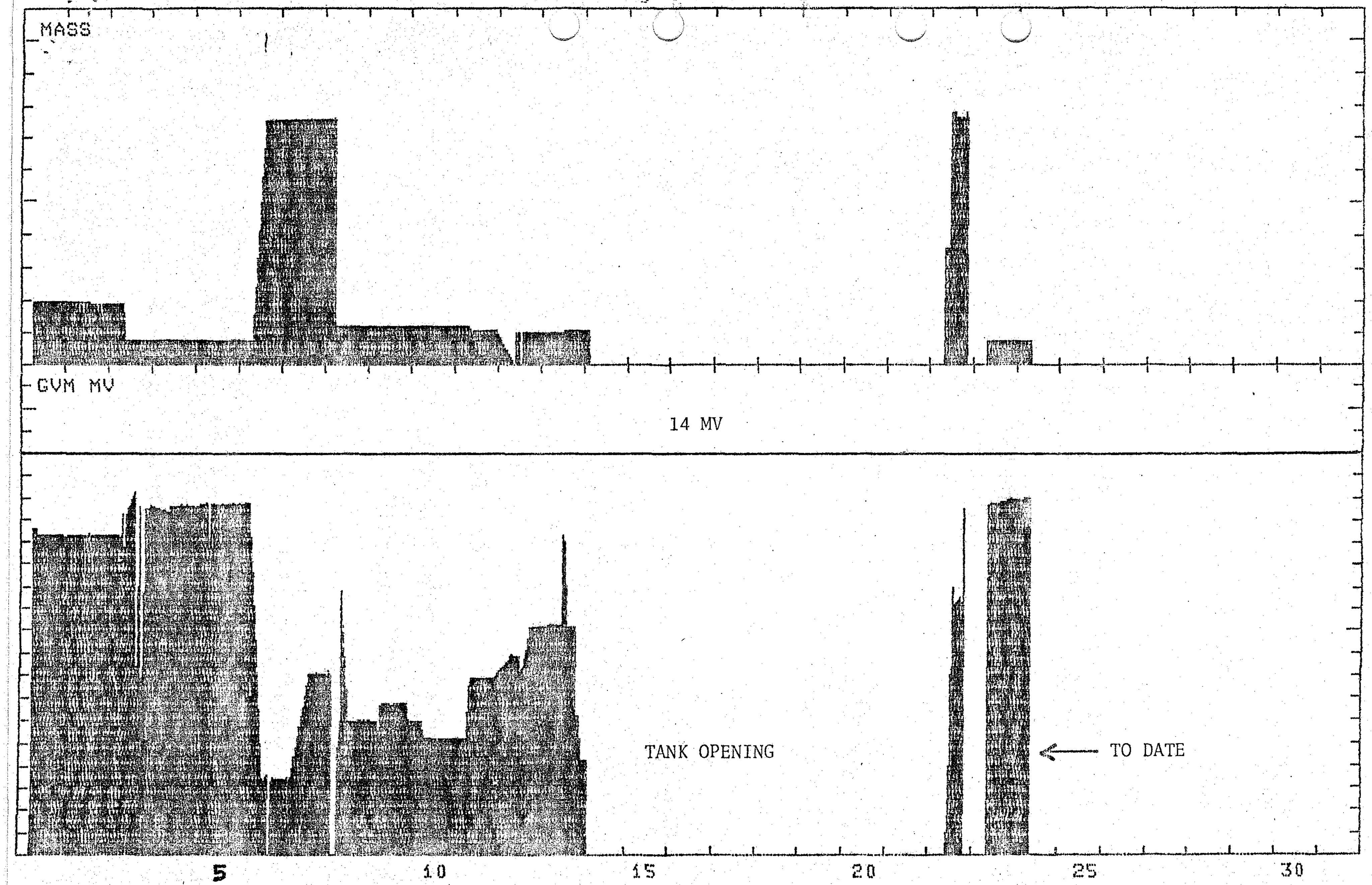


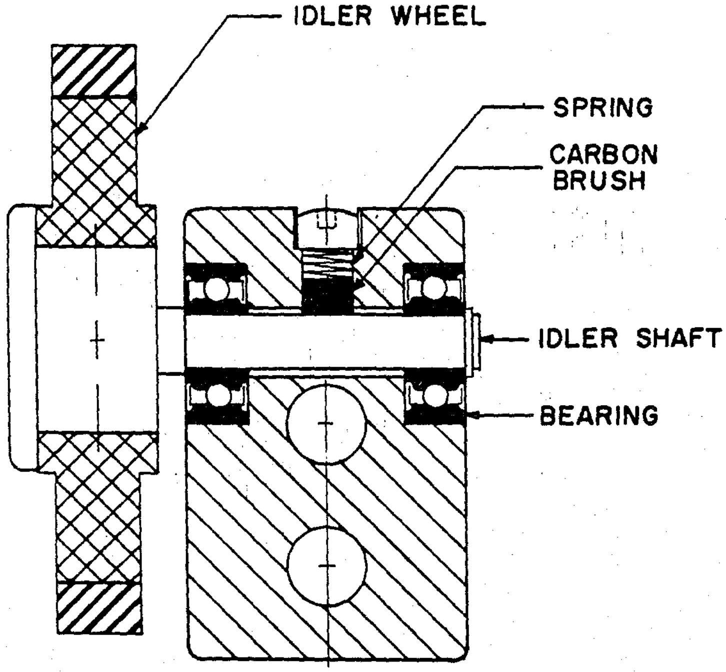
MASS .000 to 110.000
GVM MV 5.000 to 16.000

14UD log JU[illegible] 198[illegible]



14UD log JULY 1982





TOP VIEW A.N.U. DESIGNED
CASTING IDLER FOR 14UD