AUSTRALIAN NATIONAL UNIVERSITY

DEPARTMENT OF NUCLEAR PHYSICS

14UD TANK OPENING REPORT No. 28

25th to 28th August 1981

(4 days 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

Scheduled opening for column cleaning and bearing changes.

PREAMBLE

The 14UD was last closed on July 31st after we had carried out a major cleanup inside to remove rubber "dust" eroded from stabilizing idlers. We predicted in the last report that more cleaning would be needed.

First tests after the last closure were acceptable. There was eerie stability at 7.5 MV for 47 p.s.i.a. SF_6 (no rods), then the machine was fully gassed up and continued in use.

On August 14th, after only two weeks operation, sparking at 14 MV caused gross regression to 12.7 MV without our being able to relate the fault to a given chain. The sparking was not preceded by conditioning symptoms; this is a classic indication of dirt-induced sparking.

A series of diagnostic tests with rods indicated no localization, as was the case before the last tank opening. Various rod configurations allowed 1.1 MV/unit almost throughout. Problems continued above 13.5 MV, though the machine operated at 14 MV during the weekend of August 16th. The opening scheduled for 14th September was advanced in order to pump out on August 24th.

OPERATIONAL TIME.

During the 22 days since the last closure, the 14UD operated for 418 hours. This was 79% of elapsed time, excluding gas transfer.

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THE TANK OPENING.

Exploratory tour.

On the floor of the tank there were a few flecks of white material resembling the idler tyre dust seen at the last opening. Once on the platform we found fine particles on the floors of all castings. There were further instances of the stalagmites on rings and in one case a fine example of a stalactite/stalagmite pair. (Photograph.)

When the idler castings were opened six tyres were found to have on their rims white deposit formed as a narrow belt. On a down idler of Chain 3 was an accumulation of white powder in the casting, and on the tyre itself. We suspected that this position might have been the origin from which the stuff was distributed. (Photograph.)

On Chain 3, which we examined in order to determine whether there were any fragments adhering to pellet screws or rivets, we discovered that quite a lot of the rivets protruded more from the surfaces of the pellets than others, and that fragments of tyre were caught under some of them, indicating that the rivets had been ploughing the tyres. None of the idlers was siezed, or even stiff on its bearings.

Examining the corona points we found several cases in which an individual needle of the trio on tube point assemblies had melted. These instances appeared to be random, apart from the case of the upper tube in Unit 17 where five consecutive assemblies had a melted needle; these were directly below an idler casting. (Photograph.)

The shafts were run and the oldest bearings on the upper shaft all sounded bad. The bearings on the lower shaft left a lot to be desired and it was decided to change every shaft bearing in the machine. During the examination, the rubber flexible coupling between the L.E. midsection alternator and shaft section below, was found to be cracked at its screw holes, and needed replacement. (Photograph.)

And so to work!

Foils.

No foils were changed at this tank opening.

Shaft bearings.

Every shaft bearing in the machine was changed. That such an undertaking could be completed within the available four days, in competition with other work, was due to a marathon performance by Alan Cooper and Howard Wallace, who were give first priority on the platform.

We had insufficient NSK DDU (brown seal) bearings for the entire machine. Bearings from another manufacturer, (RHP 6010 2RS), said to be identical, were put in castings 20 to 28 inclusive. NSK VVC (black seal) were avoided. (Refer to 18/2 for reason.)

The oldest bearings in the upper shaft had served 6,090 hours and those of the lower shaft 5,920 hours.

The cracked flexible coupling, below the L.E. midsection alternator, was replaced.

Idlers.

At each stabilizing position there are three idler pulleys which touch the chain 120 degrees apart; it is therefore possible to set the idlers in such a way that their tyres are not touched by the rivets on the chain pellets. While much care was taken at the last tank opening to set the idlers freely enough for them to function without them being loaded unnecessarily (27/2; 27/3), we found that in two cases the chain rivets had been passing over idler tyres. One of the cases was for Chain 3 with "prouder" rivets.

The idler tyres with an accumulation of white material on them, but not damaged, were cleaned and put back. Two tyres were renewed. One shaft was found to be bent, probably during assembly, and was replaced.

Points.

The corona assemblies with melted points were replaced; as on the last occasion all failures were on the tube. In all, 8 assemblies were replaced.

Chains.

Following the discovery that many rivets on Chain 3 were protruding more than those in the other chains, the chain was replaced by a new one. The chain taken out had operated for 3,300 hours and had been in for 10 months. Comments following the examination of the chain are given at the end of this report.

Cleaning.

Because rings were shifted in all units for the shaft bearing changes, the upper and lower casting surfaces in all units were washed with alcohol. After blowing the tube and posts with nitrogen, the castings rings and surfaces in the terminal were tacragged.

The terminal inductors were taken off, cleaned with chlorothene, and any detectable roughness smoothed with emery paper. The inductors in the bottom of the tank were put in the degreaser, smoothed, and then sand-blasted.

Button-up.

When carrying out the usual metering charging tests we were unable to simulate charging current on Chain 1 and attributed this to a short circuit at the mylar insulator which isolates the pulley from local ground.

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This was discovered approaching midnight after a long, hard day, bereft of an evening meal, and even the comforts of the Friday conference. Repair would have meant the two authors taking out the charging pulley and renewing the mylar, so instead some chlorothene was sloshed over the offending region in the hope of dissolving or dislodging the short circuit. It did not, and the chain current parameter was abandoned with such gay insouciance as could be mustered.

The doors were closed well after midnight and there was no enthusiasm for an apres button-up discussion.

Initial performance.

The next day a few MV were put on in the early stages of gassing up and all appeared to be well, except that there was no charging current on Chain 1 because of the short circuit mentioned above; correspondingly the lost charge meter read negative. While we were misguidedly devising a simple way of reconnecting the meters involved, the fault disappeared and Chain 1 charging current and lost charge returned to normal. This was presumably because of SF_6 overcame the insulation problem.

The first spark occurred at 13.4 MV for 65 p.s.i.a. SF_6 and gassing up continued to 90 p.s.i.a.

At mid morning on Saturday the 14UD went into operation for four days at voltages between 13.5 and 14.4 MV, at the experimenters' choice.

Examination of bearings just removed.

We reported (18/2) the difference in performance between black sealed and brown sealed NSK bearings removed at the last complete bearing change in August 1979. The black sealed ones, (VVC), were in distinctly poorer condition than the brown (DDU). As many brown as we could obtain were put in at that time, and black were fitted in the remaining places. In order to make a direct comparison, one black and one brown were put in the two bearing positions of the same casting alternator in units 22, 24 and 26. This was done to eliminate the difference in running conditions of the bearings for those locations. Several individual bearing changes were made on both shafts since the 1979 complete change, but the majority of those just taken out were 1979 bearings.

The survivors of all these bearings have been examined and the result is heavily in favour of the brown (DDU) bearings. In both black and brown bearings the grease appeared to be in good condition with none lost.

The bearing cages of the black units examined varied in condition from bad to disintegrating. The entire bearing system, cages, balls and grooves, of all the brown bearings examined were in excellent condition and there was every indication that their lifetime would have extended well beyond the 6,000 hours they had operated.

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VVC and DDU bearings compared.

A few years ago, when we tried to find more reliable bearings, we were never given a satisfactory explanation as to the fundamental difference between the black sealed and brown sealed bearings. Recent enquiries have at last unearthed the information.

VVC are high speed bearings in which the seals contact only the outer race. DDU are low speed bearings and the seals rub on both races. Our application is low speed, and while it could be expected that high speed should perform when underrrun, the penetration of SF_6 breakdown products through the gap has a deleterious effect on the bearings. We were also told that the appearance of the grease in the VVC was no indication as to its quality. At least our findings are in the right direction.

Examination of Chain 3, just removed.

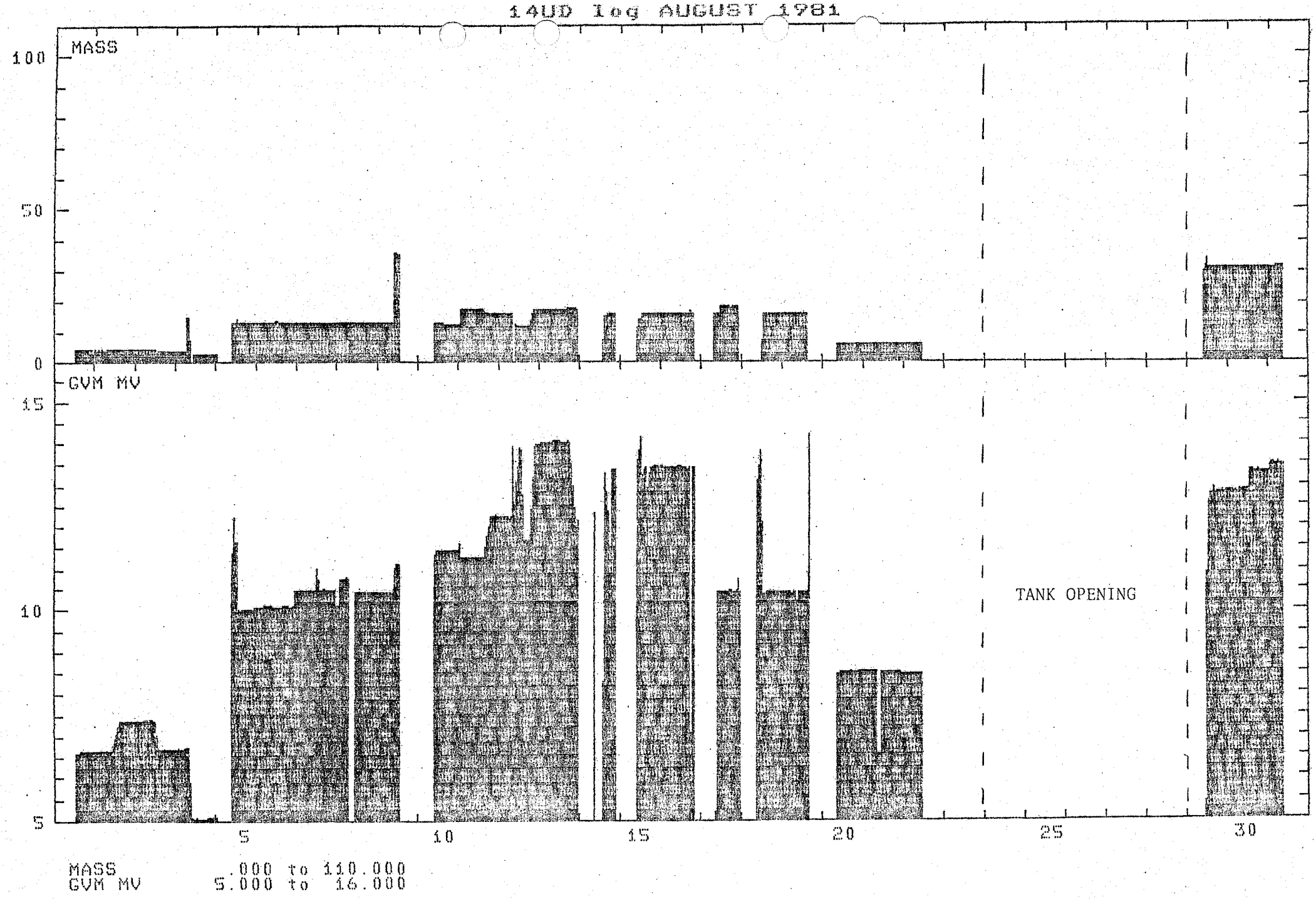
In the worst cases, rivets protruded about 0.015 inches more than rivets accepted to be normal. Comparisons were made with lengths of chain removed after chain breaks a long time ago. Also a length of 50 new pellets was examined. The rivets on these samples were as we remember "good" rivets to be, apart from the occasional one which would now be called a proud rivet. It will be remembered that, when the protruding rivets were first noticed, they were compared with Chains 1 and 2 in the machine, and each of these appeared to be better than Chain 3.

The above general observations led us to examine the rivets more thoroughly with a low power microscope. We are confident that many of the rivets had never been driven fully home.

D.C. WEISSER.

T.A. BRINKLEY.

9th. September, 1981.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TANK OPENING
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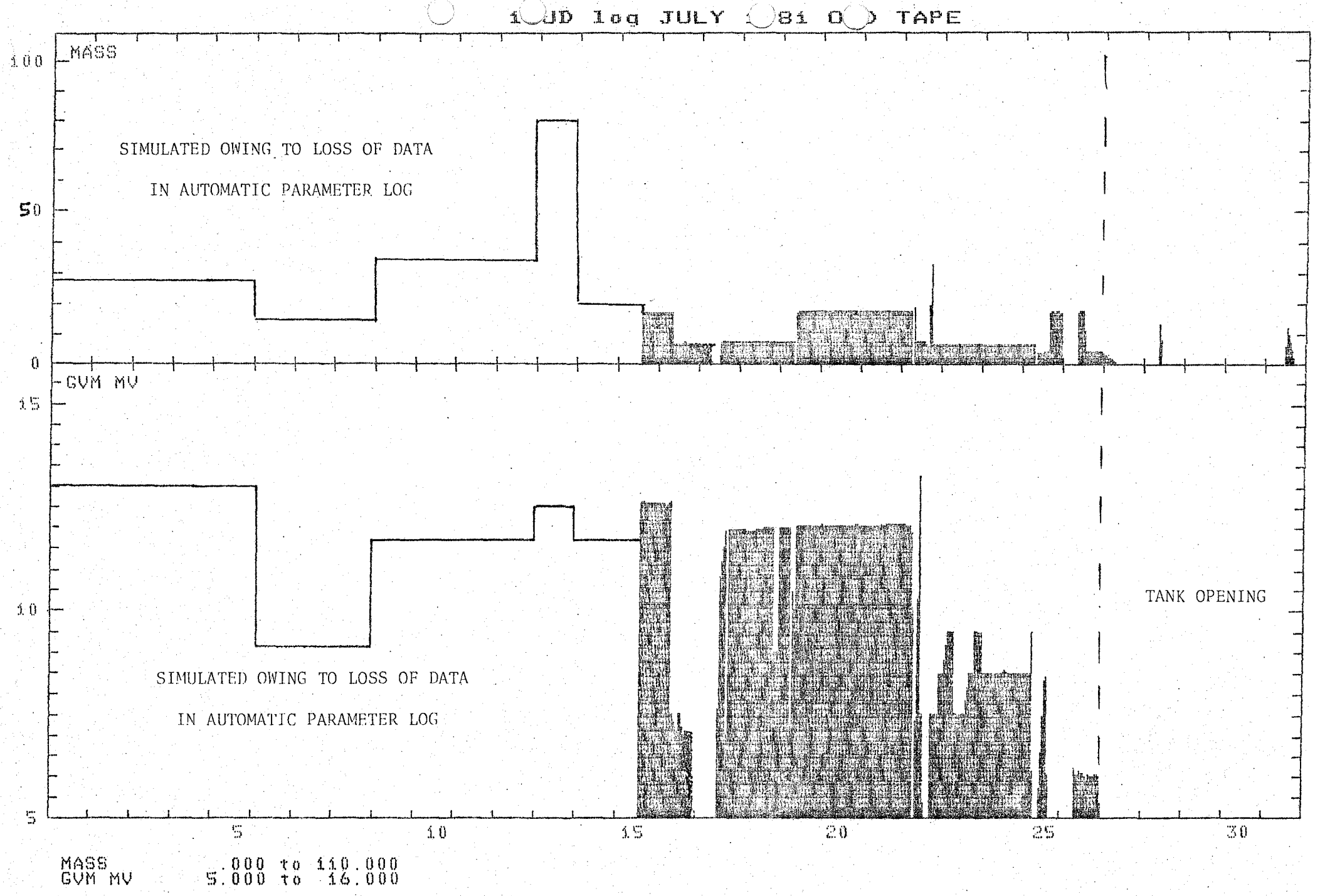
GVM MV 5.000 to 16.000

TAB 14.9.61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MASS .000 to 110.000
GVM MV 5.000 to 16.000