**AUSTRALIAN NATIONAL UNIVERSITY**

**DEPARTMENT OF NUCLEAR PHYSICS**

# 14 UD TANK OPENING REPORT # 91

**26th JUNE to 3rd JULY 2001**

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## REASON FOR TANK OPENING

The Gas Stripper canal pressure was stuck at 4 to 6 mtorr since the removal of the Micromaze traps during the last opening. Therefore the main task for this opening was to reinstall these hydrocarbon traps in the turbo backing line.

Last opening, as the next shot in a campaign to improve beam transmission or, at least try to understand it better, the top 11-gap section of the accelerator tube was rotated 180 degrees. It was planned to check the geometry of the electrodes in this tube section and, based on findings, make some considered changes for evaluation during the next experimental period. Since the tube would be at air anyway, the opportunity to repopulate the foil changer was too good to pass up and so it was added to the short list of imposing tasks.

The Corona needle assembly had been cleverly (Weisser again!) isolated to be the source of some weird lost charge events we misidentified as "the poltergeist". There would be further investigation this opening.

**PUMP OUT 25-06-01**

Pump out tank, open doors and start ventilation system.

**SUMMARY OF WORK 26-06 to 3-07-01**

The initial cruise down the column found the machine clean, so clean in fact that the usual wipe down was foregone allowing immediate access to all the other fun stuff that was planned.

Some restraint was displayed however, allowing the somewhat disappointed crew sufficient time to perform the usual HV gap test.

Since the tube had been let up to $N_2$, during the latter stages of the pumpout, vacuum interlocks prevented the prefered early running and diagnosis of shafts and chains.

The terminal foil stripper was removed and a light source was set in its place to allow optical alignment work associated with the top accelerator tube section.

The bellows above the top tube section was removed and, using a Taylor Hobson telescope set above the machine and aligned on the stripper canal, the top tube position was sighted and recorded before anything was disturbed.

The top tube section was removed and taken to the workshop for geometric analysis.

The stripper canal turbo pump manifold was removed and taken out to have the Micromaze traps refitted.

**27-06-01**

The top tube section was found to have an intrinsic parallelogram misalignment of 1.93 mm. The only spare was measured and found to be only approximately half as bad and was fitted into the machine. The bellows was refitted after recording the tube alignment figures. Meanwhile the stripper manifold was reconfigured to include the traps and welded.

**28-06-01**

The top tube was outfitted with resistors and the entire area checked for any sign of disturbance that may have occurred during tube removal and reassembly.

The tank slit zeroes were reset.

The foil changer was reinstalled and the stripper manifold was trial fitted, removed and set to bake overnight. One bellows in the manifold, with a marginal seam weld, was damaged by overpressure while letting up to nitrogen during off line preparation.

**29-06-01**

The stripper manifold was reassembled with the damaged bellows replaced by a rigid tube and trial fitted before welding.

After welding the stripper manifold was again leak chased, baked and when cool removed from the bake set up and installed in the terminal.

The whole tube was pumped down while the terminal and charging system were being inspected and cleaned. Chain #3 inductor ground wire was found to be loose under its socket screw.

The top tube section was wrapped in heater tape and baked for 2 hours at 80 $^{o}$C.

**2-07-01**

The terminal and the top of the tube were Helium leak chased and no leaks were found. Shafts were run and computer functions were checked. Unit #26 was found to have a slight bearing noise but it was judged to be serviceable for now.

During the cleaning of Unit #16, a burnt resistor lead socket and plug were found and replaced. During the column blow down, using high-pressure nitrogen, Unit # 18 was found to have a loose stringer. The Triode assembly was removed for inspection and it was found not fully engaged with the conductor rod.

It was pushed fully home, a further 1.5 mm, and refitted. David had diagnosed this problem weeks earlier and made a makeshift adjustment outside the machine, which had permitted the system to function adequately for experiments to continue.

The usual four-person wipe down found only a few spark marks.

Meanwhile outside the tank, the shorting rod clutches were serviced and tested just prior to closing the tank doors. The terminal ion pumps were run, the HV gaps tested, charging tests and corona current checks were completed then the doors were closed.

**ACCELERATOR TUBE**

The top tube section was reoriented last opening (TOR 90) with no improvement in beam transmission although the beam spot position, measured with the tank slits, did move. The top accelerator tube section was checked and recorded prior to removal.

1. Using the new target engaged in the ceramic, South 0.038"/ East 0.016".
2. Using, as before, flange bolt pattern, South 0.015"/ East 0.007".

The tube bottom ceramic was spigotted onto a pre-made mandrel that had been set on centre in the milling machine.

The intention had been to use the mill digital cross slides to check and set the electrode axes as accurately as possible prior to reinstalling the tube section in the tube.

Once set in such an accurate environment it was immediately obvious that the tube section had a major alignment flaw. The section, sitting there on the mill table, looked like a parallelogram and was indeed found to be radially misaligned by 1.93 mm over its length, but the ends at least were square and parallel.

It was immediately obvious that chasing the last 1/4 mm in electrode alignment would be a total waste of time.

There was one new tube section in stock so that was subjected to the same checks as the old one and found to have about half the error (1.11 mm). It is not known for sure whether these two tubes are indicative of the entire inventory but it must be assumed that they are and that there may be even worse examples in the machine. Random assembly of the tube sections may result in an averaging effect. The tube, instead of being straight, in fact meanders through the column at plus or minus approximately 2mm from the intended alignment. Radial errors have a diminished transverse steering effect once the beam is in tube number two and negligible effects through the rest of the tubes if the errors are not accidentally coherent. . It would at the least be preferable to have an accurate tube section in the entrance position, tube number one, and this clearly is not the case.  If a new machine were being set up, or an old one reassembled, then the best tube should be

put in at the tube entrance and, for completeness, the rest selectively assembled to minimise possible cumulative deviation from the intended tube alignment. NEC reports that this is now standard procedure. The new tube was installed with the radial error of 1.11 mm aligned with the "Up" tank slit.  Using the target spigotted into the ceramic, the entrance of the top tube

was aligned on centre and so, the exit of the top tube and presumably the entrance of tube # 2, would be offset 1.11 mm toward the "Down" tank slit.

Knowing the position of the beam at the tank slits for maximum transmission to the HE cup is necessary to any program to improve transmission. Availability of an accurate tube section, if one exists, would greatly assist this study. There is also the ever-worsening question of funding such a noble quest. No doubt time will tell.

**FOIL CHANGER, TERMINAL**

The terminal foil changer was restocked with our usual inventory of repeated groups of foils comprised of; 5 Laser Ablated, 14 ANU, 1 Space.

**GAS STRIPPER**

The turbo pump manifold was measured and removed so that the Lesker Micromaze traps could be reinstalled.

The manifold was cleaned and set up with the traps in a jig made with matching flanges and prepared for welding. After tacking, the assembly was trial fitted and then welded. Initially no leaks were found but then a mistake during venting subjected the bellows to excessive internal pressure after which one of the bellows leaked. This bellows had a poorer seam weld than the one that survived. Since a spare bellows was not available the only option, in order to expedite completion of the assembly, was to replace the bellows with a piece of 1" OD SS tube. Trial fitting proved that the single bellows provided just adequate flexibility to allow assembly. The unit was then baked under vacuum on the leak chaser for two hours and allowed to cool while pumping until installation in the terminal next day. The manifold was the last item used in closing the tube and pumping was started the moment the tank crew signalled completion of the final joint.

With the backing line traps re-installed, the pressure at the center of the stripper canal stabilized at ~1 mtorr after several hours operation of the turbo pumps. This is a factor of ~5 better than the pressure without the traps and a factor of 3 higher than the minimum pressure required for thorium or uranium beams. The minimum pressure is limited by outgassing in the backing system for the pair of turbos.

**TRIODE NEEDLE ASSEMBLY**

The triode needles were replaced last opening using a spare assembly that is usually serviced between openings and kept in stock until required. The Triode and Lost Charge current readings had been unstable ever since the needles were changed and these changeable effects became confused with the "Poltergiest". The problem was finally traced to the conductor within the Triode support tube. David found that tightening the conductor tensioning nut outside the tank stopped the lost charge problem.

The conductor, between the needle assembly and the metering circuit outside the tank, is 1/8" diameter rod and passes through the triode support tube. Such a long slender conductor naturally deflects under its own weight towards the inside of the tube. A tensioning nut on the outside is used to pull the conductor straight onto the axis thus providing adequate clearance and so resistance to ground. The lost charge episode was caused when staff allowed the conductor to slacken and droop toward the tube wall while changing the Triode assembly within the tank. Whilst it did not touch, causing a complete short that would have made diagnosis much easier, it was close enough to allow varying degrees of discharge across the $SF_6$ gap to ground resulting in a "supernatural" effect that depended on the voltage on needles which in turn, depended on the distance of the needles from the terminal and terminal voltage.

Once a discharge ignited in the conductor to tube wall gap, it would continue even at lower needle voltage.

**SHORTING ROD CLUTCH**

The shorting rod clutches were designed in the mid 70's and apart from a few o-ring replacements over the years, and a sometimes annoying sensitivity to oil, have required no other service work.

Basically each clutch uses the axial force system to compress a series of o-rings contained between a series of nylon plates instead of the rubber block that was used originally. The units were disassembled with a view to replacing the o-rings yet again. The nylon plates though still serviceable appeared tired and as there was time available it was decided to make new ones. In the new version, the o-rings are squeezed in a triangular space instead of a truncated rectangular space. The new units were tested using oily steel and dryish nylon rods, more or less the worst conditions a clutch encounters, and found to be better than the older version. Only time will tell whether or not the newer design is as reliable as the older one had been and whether superior performance remains a feature as well.

**ITEMS REQUIRED FOR NEXT OPENING**

The platform Safety lights had not been attended to so still require work.

**INITIAL PERFORMANCE**

The machine conditioned to 13.5-13.8 MV with several sparks.