AUSTRALIAN NATIONAL UNIVERSITY

DEPARTMENT OF NUCLEAR PHYSICS

14 UD TANK OPENING REPORT # 100

28th to 30th June 2005

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CELEBRATING TANK OPENING #100

This is a bit like celebrating ones 100th trip to the dentist, root canal even sometimes, but a milestone never the less.

The 100th opening caused reflection on the people and events of over 30 years of high performance operation interspersed with the seemingly obligatory periods of confusion, reasoning, frustration and satisfaction but also those of just plain hard work.

Thank you to all who have over the years and still do contribute to this effort especially to Bob Turkentine who contributed to the first 76 tank openings and was senior accelerator technician following Tony Brinkley's retirement.

Many thanks to the staff of the Electronics Unit and the School Workshop who have usually been involved in both maintenance and upgrade work.

Beer, wine and nibbles greeted a significant gathering of staff on Friday afternoon 1st July.

REASON FOR TANK OPENING

Breakdowns to Chain #3 were seen so it had been turned off on 24-06-05. In the days preceding this, the current on # 3 was 30% higher than for the other chains which is also consistent with the inductor being too close to the chain. A final experiment, at 8MV, was run using only two chains.

The chance to check how old Chain #1was travelling, particularly, white powder generation was also welcomed.
The usual machinery and column checks would be performed.
Pump out was scheduled for Monday 27-06-05.

PUMP OUT 27-06-05

- Pump out tank, open doors and start ventilation system.
- The ventilation system ran overnight.

SUMMARY OF WORK 28-06-05 to 30-06-05, Photos in main body of report.
28-06-05

- The Oxygen monitor was used to check the atmosphere within the tank prior to entry.
- The service platform and equipment were deployed. Note that the emergency lights were unserviceable.
- The initial cruise down the column found the machine was fairly clean.
- It was noticed that the shorting rods were still in the LE end and during removal it was also noticed, from within the machine, that the last rod had unscrewed several turns. This would not be discovered normally unless the last rod was partially drawn out for checking at shorting rod changes. It was decided that inspection should be made at every shorting rod change. Losing a rod would be bad enough but the second last rod, on removal, would open the shorting rod port to atmosphere. Whilst there is a flow limiting emergency valve in place it would still expose the operator to a burst of SF6 at 100 PSIA and require rapid fitment of the plug before control was restored. This type of heart stress testing should be avoided.
- The HV gap test was performed and nothing unusual came to light.
- It was noted that Chains 2 and 3 were as oily as expected but that Chain 1 felt and looked dry and that there was no white powder on the charging system.
- It was noted that the pickoff electrodes on chain #3 had moved approximately 5mm off centre. The inductors, being on the same stud, had moved with them so the gap between the chain pulley and inductor was also reduced. Charging tests were performed and this confirmed that the reduced gap between the inductor and the pulley was found to be breaking down at about 3kV rather than the normal ~ 9 kV.
- During the charging tests it was discovered that the inner bearing on the Chain #3 pulley was very rough. The pulley was taken from the machine and the two bearings, inner and outer, were changed in the workshop.

- The Upper and Lower Rotating Shafts were run and no bearing problems were evident but it was found that the flexible coupling beneath the URS motor was fractured. This was the one replaced under two years ago (TOR95) so a reason for these failures needs to be found and rectified.
- The terminal was opened and the foil changer removed for recharge.

29-06-05

- The terminal chain pulleys and associated equipment were checked and cleaned.
- The Chain #3 pulley bearings were replaced and the pulley reinstalled.
- The pulley insulation was checked using a mega set at 1000V.
- Chain #3 was then checked at charging volts and attained 9.5kV both static and running.
- The foil changer motor housing was opened and a drop of oil applied to the bronze bushes of the mechanism.
- The foil changer was reinstalled.
- The terminal was cleaned, the inductors given a final check and then it was closed.

30-06-05

- First thing today it was remembered, thanks to the team approach on the platform, that the foil changer motor housing had not been refitted prior to closing the terminal.
  The lower terminal spinning was dropped and, fortunately, the motor housing was just in reach. It was screwed on and the lower terminal spinning was closed again.
- Attention turned to the URS motor coupling at the top of the column. It was noticed that the coupling cracks opened and closed as the shaft was rotated. The motor was found to be about 1 mm off axis. The motor position was not adjustable and had been in this position since day one. The mountings were modified and the motor positioned, using a dial indicator and depth micrometer, then a new coupling was installed.
- The URS was tested and ran smoothly.
- The metering wires at the top of the column had been fitted to an aluminium strap, when the old rod box was removed, last opening. The strap vibrated excessively when the shaft ran so an extra support was fitted.
- The clean down with RBS and water was combined with the blow down this time. Each unit was blown using breathable compressed air then the

outside wiped and so on to the bottom of the column. This was fairly efficient and may be done this way again.

- During the clean up a small amount of white powder was found on casting surface around a Chain #1 upside idler set. It was wiped and is noted here for future reference and checking next opening.
- The HV gap test found no problems.
- The charging and metering tests were completed and the machine closed.

FOIL CHANGER

The foil changer was reloaded with a mix of foils as follows.
#1 blank, 13 ANU, 5 Ablation.
#20 blank, 14 ANU, 5 Ablation. This group repeats after each blank at;
#40 blank, #60 …#80 and so on up to 280 in total.

CHAIN #3

Although the failure of chain #3 to sustain voltage was the reason for this opening there were other problems found that may have led to failure within months.

The chain pulley is supported between two spherical bearings and the inner one was found to be quite noisy. The motor and even the support structure had a perceivable vibration. Once the chain load was removed then play could be felt and the unit was removed to the workshop.

New bearings were fitted. One shim stock contact band had a raised end, which was reshaped.

The pulley was then reinstalled and the mounting checked for insulation from ground using a mega set at 1000V.
The motor was then run and a charging test performed achieving ~9.5 kV.

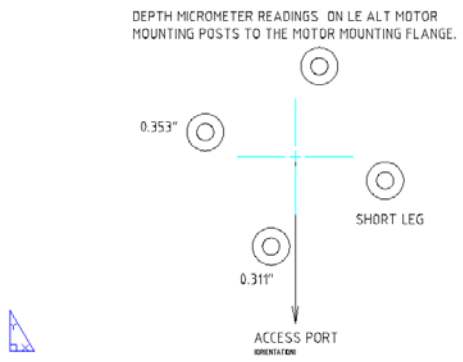
INDUCTORS

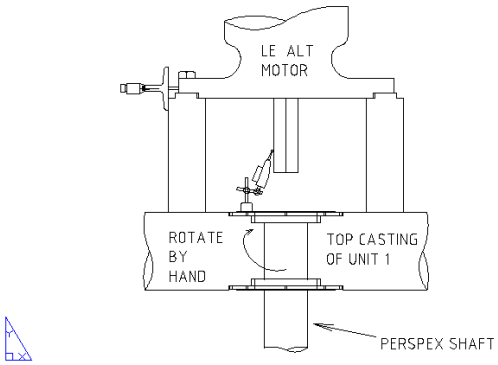
The inductors are secured by a ½" nylon stud which can harbour an unresolved twist when the inductor is positioned. Vibration during subsequent operation may allow this twist to relax shifting the inductor closer to the chain. The extra vibration from the failing bearing may well have precipitated this rotation. The nylon studs will be replaced with longer ones that will allow room for a couple of lock-nuts at the top. These shall be held motionless while the inductors are positioned and tightened.

TERMINAL SHORTING STRAP
The shorting strap was installed and removed several times this opening and points to the importance of remembering, in spite of all the other activities going on, to refit it before running machinery.

UPPER ROTATING SHAFT COUPLING
The same situation was seen less than 2 years ago (TOR95) so the collective eyes were wide open this time round.
Rotation of the shaft system by hand led to noticing that the coupling fracture opened and closed according to rotational position. This condition indicated that the motor was off axis approximately 1mm.
The motor mountings were installed during machine installation and were not adjustable so repeated installations, down the years, have been similarly off axis within some small tolerance.
Modifications were made to the aluminium stands and bolts that allow the motor to be moved up to 1.5mm. A dial indicator was mounted on the casting alternator top face, with the coupling removed, and run around the motor shaft. The run out was less than 0.004” when finished.

The fitting of the coupling required that the set up be moved so a depth micrometer was used to measure the position of the motor in relation to the aluminium stands. The drawings show which stands and the measurement in thousandths of an inch.





The coupling was installed to the motor shaft and then the micrometer was used to reposition the motor and the aluminium stand bolts were tightened. The coupling flange was then bolted to the casting alternator flange.
The reason that there have been two failures within two years remains puzzling since the misalignment appears to have been there since day one. It may be that the particular batch of rubber be it age or manufacture is less tolerant of the misalignment than previous ones.

The URS was run and all present felt that the shaft system was much quieter than it has ever been. The coupling should now have a good long life irrespective of rubber quality.

The younger author does not remember a similar failure at the LRS motor.

CHAIN #1
Old Chain #1 had not generated white powder since being reinstalled last opening. See the photos below and compare with those in (TOR99) (TOR97) (TOR95).
Note, however, that a small amount of white powder was found during the clean of the column prior to closing the machine. It was on the casting surface at an idler set on the upside direction of chain #1 and was dismissed as insignificant during the run down to tank closure. Next opening this will be checked again.

New Chain #1 was shipped back from NEC and was available for reinstallation but the crew were not quite yet ready for another white powder experiment. Time was needed to think about what to do next. Whether to repeat the white powder check or change to current NEC pulleys with the newer chain was still under discussion so old chain #1 got the Guernsey this time.

SPARE PARTS
The following spares need to be ordered;
24 chain idler wheels.
2 DC idlers wheels.

INITIAL PERFORMANCE

The machine was gassed up to 103.5 psia on Friday and went to 14.1 MV at 14:00. There were three sparks over the next few hours at ~ 14 MV and then the normal quietude.