AUSTRALIAN NATIONAL UNIVERSITY

DEPARTMENT OF NUCLEAR PHYSICS

14 UD TANK OPENING REPORT # 101

9th to 20th December 2005

A.K.COOPER **D.C.WEISSER**

REASON FOR TANK OPENING

There would be an opportunity for a scheduled tank opening when major work on the laboratory chiller system was scheduled for approximately two weeks in December.
Chain #3 charging current had been behaving weirdly and there had been lost charge since the last opening in June so understanding the reason and rectifying the problem was of a high priority.
Fitting the new chain #1 to confirm that nylon powder was produced on the old blue rims and, if so, fitting the new black conductive rims were also important tasks.
The usual machinery and HV component checks were scheduled as well.
The terminal foil stripper was to be restocked and eight refurbished column posts fitted.

PUMP OUT 8-12-05

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

SUMMARY OF WORK 9-12-05 to 20-12-05
9-12-05

- 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 made serviceable just prior to entry.

- The initial cruise down the column found the machine was fairly clean.
- It was noticed that the dummy resistor across gap 5, tube 2 in U19 had stripped from its stud and fallen against the aluminium resistor housing. Sparking had caused erosion of the aluminium and a lot of breakdown products in the immediate area. Dummy resistors are used in unit 19, where the high-energy stripper is located, in order to match the tube gradient to the column gradient.

- Chain #3 was very dry and the inside edge of the shim stock had accumulated a small amount of white powder. Chains # 1 and 2 were slightly oily as usual and no white powder was evident.
- The Upper and Lower Rotating Shafts were run and no bearing problems were evident but it was noted that there was a slight vibration in the LE shaft. This was felt to be in the region of the motor. The HE shaft had a very slight noise between U17 and U18. No action was deemed necessary.
- The HV gap test found no problems.
- The terminal was opened and the foil changer removed for recharge.

  Chain # 3 drive pulley bearing block insulation sheets were found to have carbonised spark damage to ground and it was assumed, correctly, that the charging voltage anomalies resulted from current leakage through these spark holes. The bearing blocks had sharp edges touching the plastic insulating sheet and these were radiused using a die grinder. The smoother edges should protect the plastic insulation from spark damage. New Nylon insulating sheets were fitted and the pulley insulation was checked using a mega set at 1000V. Chain #3 was run and achieved 20 micro amps at 10 kV which was the same as Chains #1 and 2.
- The Chain # 1 drive motor was thought to be noisy and vibrating slightly. Thorough investigation of all three motor pulley sets allayed immediate

concern and it was decided that these would be checked over the next few openings. As a diagnostic, all three were timed from power off to stationary.

- The second stripper pneumatic drive, that had been a bit lazy of late, was removed for service and it was noted that the stripper was on foil #122.

12-12-05

- Old Chain #1 was removed and new Chain #1 fitted for an overnight run to see if it would again wear the pulley tyre.
- Casting covers were removed in preparation for opening the terminal.
- Reconditioned column posts were fitted in Units # 20 and 21.
- The foil changer pneumatic drive was reinstalled.

13-12-05

- Chain #1 was found have created a small amount of white powder after the overnight run so the new black rims were fitted for another overnight test. The oiler was disabled during the test.
- The terminal foil changer was removed for reloading.
- Stringer lugs were fitted to the reconditioned posts in Units 20 and 21.

14-12-05

- The post shorting wires in Unit #19 were checked and the following problems rectified.
  New post shorting wires made out of 1mm dia SS wire and fitted to all gaps.
  Insert nut replaced U 19, Post D, Ring 19.
  Tighten loose screws U 19, Post A, Ring 13.
  Replace lug rivets and tighten loose screw in U 19, Post B, Ring 13. This is the location of the stringer wire from the post to the tube flange.
  It was wondered if the drooped resistor was related to the many other problems in Unit #19.
- Chain #1 was turned on at 16.00 Hrs for another overnight run.

15-12-05

- The column post survey was done to set priorities for post refurbishment.
  Post Stress: The guidelines for the replacement of posts with reconditioned ones have now been clarified. There are three generations of posts:
  Original ones, that produce powder at the interface between the aluminium flanges and the last titanium spark-gap flange.
  Ones for which conducting Epoxy joined the two flanges. The Epoxy shows some browning which encouraged the next improvement.

The aluminium flanges were replaced with stainless steel ones and screws fastened the titanium spark-gap flanges to the stainless ones.

The priority is to first replace the original posts rather than the second generation ones.

- Four of the posts just installed were removed with understandable muttering. They will be re-installed in future to replace original ones identified in the survey.
- The terminal chain pulleys and associated equipment were checked and cleaned. The strobing of the DC idlers revealed that some bearings were wearing out. It was decided that new bearings and bearing blocks would be ordered for Chains #2 & 3.

16-12-05

- The Chain #2 up side DC idler was fitted with new bearings.
- Chain idlers were spun by hand and inspected. All were found to be serviceable.

19-12-05

- After the arrival of the new bearing blocks Chains #2 & 3 terminal pulley bearing blocks and bearings were replaced.
- The bearing block bottom edges were radiused using a die grinder just as those at the bottom of Chain #3 had been.
- The inductors were set using the NEC gauge device.
- The terminal and Unit #19 were closed.

20-12-05

- The column was blown down using compressed air and then wiped with RBS in water.
- The GVM was thought to be noisy so it was checked, by listening on the outside of the tank, and it was decided that it was OK.

- Unit #20, Post D, Gap 3 bottom resistor assembly was found to have a particle lodged at the nut so this was cleaned.
- 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

The chain pulley is supported between two spherical bearings mounted in self aligning bearing blocks. The bearing blocks are insulated from the chain wheel frame by Mylar, Teflon or Nylon sheets and plastic bolt shank tubes.
The lost charging current was found to be leaking through carbonized perforations in the Mylar shims. Whilst the perforations may be found anywhere on the shim surface, most tend to occur opposite the sharp relief on the underside or the edge of the bearing block base.
The edges and the relief were deburred using a die grinder.
New Nylon shim was fitted, the pulley was then reinstalled and the mounting checked for insulation from ground using a mega set at 1000V.
The motor was then test run and a charging test performed on all chains at 10 kV charging voltage resulting in currents of;

Chain #1, 27μA. Chain #2, 32μA. Chain #3, 28μA.

CHAIN #1
It was planned that new Chain #1 would be installed with the new conductive black nylon pulley rims but not without testing for the generation of dust at each stage.
Old Chain #1 had not generated white powder since being reinstalled last opening and run on old blue nylon rims.
It was decided to install new Chain #1 on the original blue pulley rims and run overnight.
The chain was lightly hand oiled, as has been the practice for many years.
There was a slight sign of powder or oil/powder slurry evident next day (photo, slurry on pellets) so the next step, to install the new black conducting pulley rims, was taken.
These were run overnight without oil and no white powder was found next day.

Heartened by the success the crew decided to run the chain for a few more hours, whenever there was a break in the work program, usually overnight. Chain #1 ran a total of 96 hours of which the initial 14 hours were with oiling. There were no signs of white powder and the charging test found that voltage and current were normal.

Conclusion: The new chain pellets are compatible with the conducting rims but not with the old blue nylon ones.

Once it was realised that the oiler could be left out, pressure to buy more black pulley rims, for Chains #2, 3, was immediate and forceful. Not forceful enough however to overcome a budget stressed administration. There was a commitment to purchase these within the next few tank openings.
Chain #1L accumulated 59370 hours at 1-12-05
Retired again 12-12-05
New Chain #1M restarts on 12-12-05 after clocking up 5219 hours before a trip back to NEC for checking.

CHAIN DRIVE MOTOR BEARINGS
The motor bearings, initially those of Chain #1, were thought to be noisy and a vibration seemed to be felt when the motor was run so the other motors were run for comparison. All motors vibrate slightly and it was difficult, in the absence of a bearing analyser, to find the degree of difference so the run down time was timed.
Chain #1 240 sec, Chain #2 194 sec, Chain #3 165 sec.
Whether or not this indicates bearing condition was not known but, at least, there was a number to compare with future results.
RECORDS
Machine meter hours as of 1- 12-05.
Chain #1, 39639. Chain #2, 39631. Chain #3, 39644.
LE Shaft, 52902. HE Shaft, 43786

Actual running time for each chain 10-07-05 to 1-12-05 was
Chain #1, 1364. Chain #2, 1364. Chain #3, 1344.

TERMINAL CHAIN PULLEY BEARINGS
Chains #2 & 3 were found to have noisy bearings so these were replaced, on new bearing blocks, using the alignment jig. These bearing blocks had been radiused in the same manner as those of the bottom set of Chain# 3. The jig

allowed the whole job to be done without removing the chains or needing to realign the pulleys.
The chains were supported using a slotted plate inserted through the pellet gap and resting on the casting. This was a new idea and worked brilliantly. The jig, along with the new slotted plates, turned out to be real time savers.

CHARGING CHAIN INDUCTORS

The nylon studs that hold the inductor assembly together had, on tightening of the nuts, been subjected to varying degrees of twist over the years. During subsequent machine operation the resultant stresses, on relaxation, were thought to have caused slight movement of the inductors bringing them too close to the chain.
Aligned slots were cut in the ends of the studs as an aid in retaining torsional alignment between the ends during tightening of the nuts.

SECOND STRIPPER

The second stripper pneumatic drive was removed for service. The gas cylinder and piston were cleaned, the o-ring replaced and lubricated with PBR rubber grease. The 360-degree drive helix was checked and found to be in good condition. The drive pin return gates were lubricated with Rocol A.S.P.
The unit was tested with shop air and returned to the 14 UD.
The unit runs on cylinder SF6 regulated to 5-6 atmospheres and exhausts into the machine.
It should be noted that as the lubrication on the piston o-ring diminishes and the o-ring loses some of its resilience then blow by begins to adversely effect performance.

The second stripper is to be computer controlled and electrically driven after the installation of a complete upgrade in the near future.
Many photographs and measurements were taken during this opening and will be used, as a design aid, to do as much of the work as possible outside while the machine is in operation. It is hoped that the upgrade will be installed during one 2 week tank opening in 2006.

SF6 INVENTORY

ANU GREEN monitors all potential sources of emissions and the Department has been requested to furnish records of SF6 inventory.
The 6 month, or at each opening, average mass of SF6 based on monthly temperature and pressure readings, will be recorded in each TOR along with the calculated loss.

SF6 in the system December 2005	21410 Kg.
Loss	25 Kg +- 50 Kg

SPARE PARTS

The following spares need to be ordered;

4 Black Pulley rims.

Shimstock contact bands

INITIAL PERFORMANCE

The machine was gassed up starting at 9 AM 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.