AUSTRALIAN NATIONAL UNIVERSITY

DEPARTMENT OF NUCLEAR PHYSICS

14 UD TANK OPENING REPORT # 92

7th MAY to 9th MAY 2002

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REASON FOR TANK OPENING

The machine had been operating reliably since it was closed July 2001, a trouble free run of 10 months.
Planned maintenance and other items were;

Replenish the terminal stripper foils.

General inspection and electrical tests.

Test run all machinery for mechanical diagnostics.

Check chain oilers.

Replace the triode points.

Replace eight column posts using refurbished ones.

Test and record numbers for the terminal 20l/s pump readout calibration.

Check that the casualty evacuation stretcher fits through the tank entry ports.

Check the long ignored Platform safety lights.

PUMP OUT 6-05-02
Pump out tank, open doors and start ventilation system.
The ventilation system ran overnight for 14 hours prior to staff entering the top port.

SUMMARY OF WORK 7-05 to 9-05-02

The initial cruise down the column found the machine very clean with only a light dusting of break-down products on the terminal and adjacent units.
The HV gap test found no problems.
The upper and lower rotating shafts were run and a slightly noisy bearing was found at the bottom of Unit #7.
The charging chains were stable and quiet running.
The column was wiped down with RBS and water.
The terminal foilchanger was removed and taken to Bob Turkentine for foil replenishment.
The Casualty evacuation stretcher was passed through the tank port.
The noisy bearing in unit #7 was replaced.
Four refurbished column posts were fitted to Unit #7

8-05-02

One resistor on post B Unit #7 was found to have a loose terminal nut and this was tightened. Unit #7 was re-ringed using new long support screws.
Four refurbished column posts were fitted to Unit #8.
The terminal foilchanger was refitted to the machine.
David Anderson recorded the necessary readings for the recalibration of the terminal 20l/s ion pump.
New stringer brackets were riveted onto post C Unit #8.

9-05-02

Unit #8 was reringed using new short support screws.
The Upper Rotating Shaft was run to confirm that the noisy bearing in Unit #7 was rectified.
The terminal inspection included Chain Pulleys, DC idlers, Inductors, Associated electrical connections and Charging Chains.
The DC idler on the up side of chain #2 was found to have a slight bearing fault and the bearings were changed.
Charging chain #1 was found to have some faults and, after some debate, was accepted for further use.
Computer controlled equipment was tested prior to closing the terminal.
The change-over assembly of new Triode needles was fitted.
The column was blown down with nitrogen gas, while outside, the shorting rod clutch O-rings were renewed.
The Charging Chain motors and associated equipment in the bottom of the machine were checked and the area cleaned.
The column was wiped down using RBS and water.

The HV gap test found no problems and the charging tests confirmed that all was well.
The tube and column current circuits were checked and the machine was closed.

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 and 1 space.

CASUALTY EVACUATION EXERCISE

The recent official classification of the 14 UD tank as a confined work space heralded the need for compliance with AS 2865, the relevant Australian code. Whilst most safety concerns were addressed in the early 70s none of the methods employed then needed to be vetted by authorities. The ANU is determined to have all work places comply with current codes and best practice. The possible need to remove a prone casualty is one area that requires the tank to be open for development of appropriate procedures. This opening was an opportunity to demonstrate, to interested parties, that the casualty stretcher actually fits through the tank port.
The stretcher fitted easily and even appeared to have enough room above it for a casualty.
One outcome of the test was that the decision was made to store the stretcher in the tower near the bottom port of the machine rather than in the first aid locker in the link building.
The fire department is the primary resource for rescue operations and an exercise, with a live "casualty" or a dummy will be arranged for next opening. This is only one aspect of the code compliance effort that will be necessary in the near future. Aspects of progress toward full compliance will be recorded elsewhere but, since some of these topics may be of interest to our readers, mention will be made in future TORs.
The group of visitors, comprised of RSPhysS&E First Aiders and an Occupational Safety official, were shown the platform "emergency manual operation setup". It was embarrassing but helpful to discover, before need in an emergency, that the motor shaft to handle drive key was missing. The key will now be permanently fixed in the shaft so that an operator need only slip the handle onto the shaft before manual operation. This incidence demonstrates the value of actually exercising safety operations regularly instead of simply assuming all is well.

UPPER ROTATING SHAFT

The running tests led to the discovery of a noisy bearing in the bottom casting of Unit #7, ie. The top of Unit #8.
The offending alternator housing (formerly tube heater alternators) was removed and both bearings were replaced. The two old bearings were spun by hand and the lower one felt and sounded dry. There was expelled grease about the area. The upper bearing felt normal but was routinely discarded.
Interestingly these bearings were renewed during Tank Opening #90(TOR90) so, this location will be given more than a cursory check in the future.

SHORTING ROD CLUTCHES
These were worked on last opening after many years of somewhat checkered service (TOR91).
The younger author, and father of the clutch packs, discovered quite a pool of pent up emotion when, just before the opening and with a cavalier air, he inquired how the clutches had been performing. Well, it seems that the usual users had been swearing under and over their breath each time the shorting rods were changed but, had always cooled down sufficiently to forget to report the tribulations, associated with the task, by the time they had regained the ground floor.
The immediate and thorough investigation that followed quickly found the, somewhat, embarrassing truth.
The Stainless Steel rods actually measure 0.735" in diameter, whereas, the Nylon rods are typically 0.750" to 0.755" in diameter.
The Nylon rods have always required a wipe with an oily rag to allow them to be pushed through the clutch o-ring pack. The residual oil, within the clutch pack would then prevent the clutch from gripping the Stainless rods properly, and often, the operator would need to wipe oil away to restore grip.
It had been assumed from the beginning of time that this problem was due to different materials but is now understood to be due to the different diameters between the two materials. The minimum and maximum operating diameter range of the clutch pack had been barely coping with the large range of the rod diameters.
Four Nylon rods were machined down to between 0.733" to 0.738". During a test, before the tank opening, the newly machined Nylon rods were pushed into the machine with the same ease as the Stainless ones.
The entire inventory awaits machining, after which, the clutch diameter will be optimised downward to suit the uniform diameter rods. This should allow easy rod entry when the clutch is relaxed and good grip on the rod when the clutch is tightened.

COLUMN POST REFURBISHMENT

The column posts degrade in two main areas during their working life.
Firstly, electrical contact between the old style aluminium end caps and the titanium electrodes deteriorate over time due to electrical breakdown forming contaminants between the two surfaces. Secondly, electrical breakdown erodes the titanium electrodes at ring screw location and it has long been recognised that maintaining tight contact here virtually eliminates this problem.
Post refurbishment includes renewal of the surfaces and fitment procedures ensure that the problems do not recur.
The aluminium end caps are replaced with stainless steel and, to further improve bonding, are screwed to the adjoining titanium electrode using six 4/40 button head screws.
The ring screw locations are, either, remachined to clean up the eroded surface or the post is rotated to present an unused part of the electrode circumference for use as a ring screw location. The new location must be one that has location rivets so there are limited opportunities to use the second method.

The workshop prepared eight reconditioned posts prior to the opening.
The four posts used in Unit #7 had remachined ring screw location and, therefore, required the longer ring screws (0.417") in order to maintain firm ring to post electrode contact.

Post #s	A, 241.	B, 251.	C, 310.	D, 229.

The four posts used in Unit #8 were rotated to present a different quadrant of electrode edge to the ring screws. This meant that new standard length ring screws (0.375") were adequate to maintain firm ring to post electrode contact.

Post #s	A, 283.	B, 690.	C,351.	D, 299.

Post C in Unit #8 required three new stringer brackets riveted in place as the old ones were in a different quadrant.
Ever since the post refurbishment program was begun great care has been taken to ensure that ring screw to electrode contact is checked at every opportunity and maintained, by renewing any screws that are found to be loose. Sometimes the equipotential ring requires resetting in shape to restore firm contact with new screws.
However achieved, the maintenance of firm contact is crucial to long post electrode service life.

DC IDLER BEARING

The DC idler on Chain #2, up side, was judged to have a slightly dry bearing when spun by hand during the terminal inspection.

The bearings were replaced even though they may well have had plenty of life left in them.

CHARGING CHAINS

The charging chains are visually inspected during routine terminal maintenance at each opening.
Charging chain #1 had been noted, last opening, as having two links with elongated pin holes and these were marked with ink for monitoring even though a rust like stain was evident around the pin. Close inspection this time did not confirm further degradation although it was assumed wear must have taken place.
Usually such a find would see the crew changing out links but another discovery overshadowed the pin problem and rendered complete repair impossible during this opening.
Good eyesight and care allowed Alistair Muirhead to spot some faint anomalies in a nylon link. Closer inspection, using a magnifying glass, confirmed the presence of faults in a total of 11 nylon links distributed randomly through a section of 185 links. The same section contained the loose pins.
The cracks or imperfections are of a type not previously seen at the ANU. They run parallel to the link axis and are confined to the waist of the link.
The chain had run for over 50K hours.
Even if spare parts had been available the repair would be an onerous undertaking due to the wide spread of bad links through such a long length of chain.
Had these faults not been discovered the machine would have been closed and expected to run for a further 6 months so, the decision was taken to do just that and to buy a new chain for the next opening.
Ideally charging chains would be regarded as routinely expendable items and replaced at certain hours or when early signs of wear are found but, the replacement cost, in light of an ever shrinking budget, dictates that they be run to destruction or at best very close to.

TRIODE POINTS

The triode point needles were replaced routinely by changing out the old set for a reconditioned set. New needles were soldered into the holder prior to the opening.

TERMINAL ION PUMP

David Anderson recorded recalibration numbers, across terminals A1 and A2, for the 20l/s ion pump as follows.

ADC input 3.85v @ 10mA
ADC input 0.038v @ 100uA

PLATFORM SAFETY LIGHTS

The platform safety lights cunningly avoided work this opening by operating faultlessly until the last afternoon when, realising that over pressed staff were engrossed trying to close the tank, they felt comfortable with reminding staff that there was still a problem.

EMERGENCY LIGHTS

The machine has emergency lights that are supposed to light in the event of a power outage. Operation was tested and the lights failed to come on.
The problem was traced to the rechargeable battery on Level 4.
The battery has been replaced and operation will be checked next opening when their battery endurance will be tested also.

INITIAL PERFORMANCE

The machine ran up to 11 MV with no sparking, however, it recently sparked twice on the way up to 14.5 MV.
No other problems have been reported by May 23rd.