AUSTRALIAN NATIONAL UNIVERSITY

DEPARTMENT OF NUCLEAR PHYSICS

14 UD TANK OPENING REPORT # 96

23 Nov to 2 Dec 2004

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REASON FOR TANK OPENING

The machine had been closed for a year and, although it was still meeting experimental requirements, was due for regular maintenance. Further, the schedule for early 2005 included some overseas groups so having a freshly serviced machine for these users was seen as desirable.

It had been planned for some time to install a 60 l/s Ion pump in the LE mid section to replace the original Sublimer. The pump would be controlled from the terminal through an extended fibre optic link.

One new and seven reconditioned column posts were on hand and it was intended that these be installed.

During this opening major upgrades to equipment outside the accelerator will be performed.

Firstly, the 2 old pre-acceleration tube of the McSNICS ion source on level 5 will be replaced with 3 new ones and secondly. On level 4 ½, the Gridded Buncher will be up-graded to function at three frequencies for double the capture efficiency.

PUMP OUT 22-11-04

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

SUMMARY OF WORK 23-11 to 2-12-04, Photos in main body of report.

- 23-11-04

- The initial cruise down the column found the top half of the machine was very clean with only a very light dusting of breakdown products.
- Surprisingly the HE end again had thick deposits of particulates on the castings around Chain #1. These were not nearly as bad as last time (TOR 95). We took these deposits to be breakdown products and proceeded accordingly. You will read in (TOR 99), that this assumption was wrong.
- The column was wiped down with RBS and water and the HV gap test found there to be no problems with the rings and resistors.
- The Shafts were run and whilst the LE shaft was quiet the HE shaft had slight dry bearing noise at the casting between U17 and 18.
- The Chains were run. Chain #1 had noise at idlers U22, U25. Chain #2 was fine. Chain #3 had noise at idlers U19 and U 25.
- The charging system under the platform was inspected next. “Breakdown products” adhered to the up side pick off and lower casting of chain #1. The “breakdown products” were distributed up to the next few castings and there was a light dusting in the whole HE end.
- It was obvious that quite a clean up was required and that would entail the removal of all Chain #1 idler sets.
- The LE mid section was stripped in preparation for the new pump and control box installation.
- Measurements were taken and manufacture of the LE mid section shielding box was commenced outside the tank.
- PFA tube was removed from the HE end and fitted to the LE end to house the fibre optic of the LE mid section pump read out.

24-11-04

- During the initial inspection and clean up under the platform investigation of the inductor frame revealed that its support bearing did not turn freely. The inductor frame was not returning to its running position after the initial motor starting torque displaced it. This was demonstrated while displacing the frame repeatedly by hand. The resultant position placed the pick off electrode too close to the chain and would have caused the generation of breakdown products in the decreased gap.

25-11-04

- The terminal stripper was removed for refilling.

- The new shielding box was brought in for a location check and for planning cable routing.
- The new ion pump was positioned to check fit and the length of the previously prepared nipple confirmed.
- The terminal stripper was refitted.
- The ion pump and nipple were installed on the tube tee bellows.

26-11-04

- The ion pump was mainly supported by its vacuum flange but the outer end required a small support bracket.
- The ion pump magnets were fitted and a blanking flange was fitted to blank off the now unnecessary gauge port in the manifold.
- Chain #1 idlers and petals were removed for cleaning and to facilitate the cleaning of the castings.

29-11-04

- The HE column and the bottom of the tank were vacuumed as a preliminary clean to remove most of the “breakdown products” before removing chain #1 for cleaning.
- Chain #1 was removed to the clean room and washed using the high pressure water spray and alcohol rinse
- The castings of the HE end were cleaned using water and RBS and then blown off with compressed air.
- The Chain #1 inductor frame was removed and the pivot pin inspected. No damage was found but the bush and pin were dry of lubricant. The frame assembly was cleaned, the pivot lubricated with moly grease and reinstalled.
- Chain #1 was reinstalled.

30-11-04

- The idlers and petals were refitted.
- The rings and casting covers were refitted.
- Stringer #1 was found to be loose at the column post end and was tightened.

1-12-04

- The optical fibre terminations were attached and both shafts were run.
- The redundant control rod box was removed from the top of the terminal.
- Two resistor leads and one shorting loop were replaced in U19.

2-12-04

- Casting covers were refitted and the LE mid section was closed.
- The terminal was blown out and the HE castings wiped for a final time.
- The HE end was re-ringed and wiped down with RBS and water.
- The metering wires above the column were left unsupported by the removal of the rod box so a post was made and fitted in its place.
- Charging and metering tests were done and the machine closed.

MORE “BREAKDOWN PRODUCTS”

The last opening, November 2003, saw the crew cleaning up after a severe bout of “break down product” accumulation. (TOR 95)

This opening found “breakdown products” again, although thankfully much less than last tank opening, but distributed in a similar pattern to last time. Chain # 1 was again the subject of anguished inspection.

After no other problem could be found it was noticed that the inductor support frame was not returning to the horizontal after the motor starting torque had been applied. This left the pick off horseshoe closer to the chain. It was assumed that a discharge, across the reduced gap, between the horseshoe and the running chain allowed the generation of breakdown products.

Photographs were taken before the clean up of the whole machine.

PICTURES

CHARGING CHAIN # 1

The chain was removed to the clean room, pressure washed with deionized water, rinsed in a bath of alcohol and left to dry out.

The pair of chain inductors and the pick off horseshoes are mounted on a pivoted 2*2 RHS frame that mounts to the inner side of the chain motor support arm. The pivot centre is concentric with the motor and chain pulley shaft and close behind the chain metering brush assembly. The assembly has a weighted pendulum beneath the pivot that returns the frame assembly to the horizontal after motor starting torque momentarily displaces it.

After checking all the wires and other mechanical connections that may limit free movement of the inductor frame it was decided that the inductor frame pivot pin was the most likely source of friction that resisted the righting moment of the pendulum.

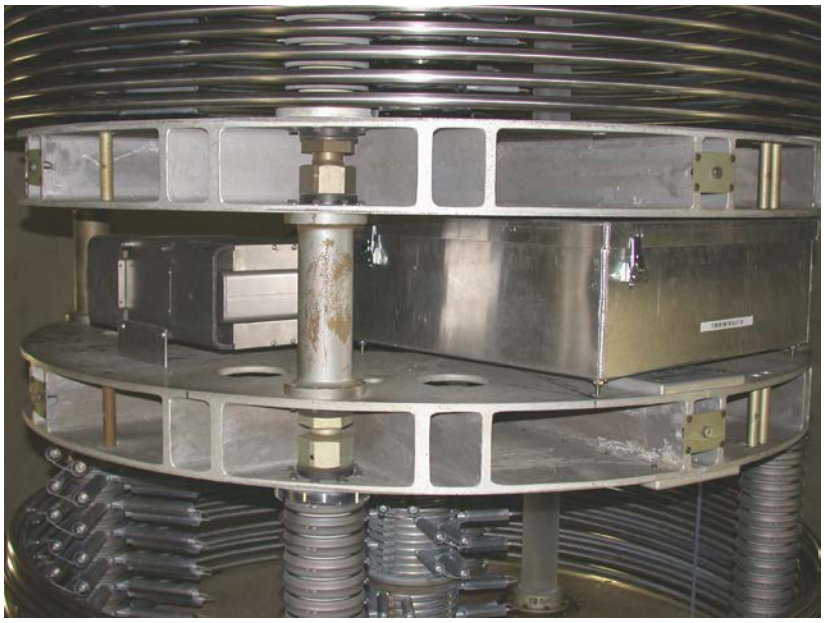
The whole assembly was removed and taken to the workshop for inspection.
The pivot pin and bush were found to be in good condition but the working surfaces were totally dry of lubricant.
The assembly was cleaned and the pin lubricated with moly-grease.
The assembly rotated to centre freely under the force of the pendulum.

IDLERS

The Chain #1 idlers and petal assemblies were removed for a thorough clean with RBS and water.
All idlers were in good condition so were reinstalled after the castings were cleaned and blown off with compressed air.

LE MID SECTION PUMP REPLACEMENT

The accelerator tube was let up to dry nitrogen and the mid section sublimer pump was removed along with all associated hardware.
The 8 l/s ion pump was removed and the port in tube blanked off.
The new shielding box was designed and its construction was begun in parallel with the new pump installation inside.
The new 60 l/s ion pump was bolted to the tube tee using a previously made adaptor nipple 75mm in length. The outer end of the pump was supported on an aluminium plate bolted the pump but simply resting on the casting surface.
The new shield box was trial fitted in place. Shielded cable, optical fibre routing and grounding attachments were planned. These items were installed in the mid section while the box was finished off and the control equipment fitted to it in the workshop.



New pump to left. Control box to right.

The pump was warm after a few hours and the current was 7.4μA.
The pump magnets were checked to confirm that the polarities were the same. In this standard configuration the field at the beam line was 1.6 Gauss. In order to

minimise stray magnetic field on the beam axis, one of the magnets was flipped over so that the stray field from the pair of magnets cancelled on the beam line. After the magnet was flipped over, the pump still read 7.5μA, ie; no change.

OLD MECHANICAL ROD BOX

The old mechanical rod box was now totally redundant since the sublimer was its last remaining customer.
There was time to remove the remaining acrylic drive rods, bearings and motors as well as the box itself.
The column and tube metering wires ran on the side of the box so a new wire support post was made and installed.

TERMINAL FOIL STRIPPER

The terminal foil stripper was removed for repopulation with the usual mix of foils. The pattern of 14 ANU, 5 ablation and 1 blank is repeated throughout the 280-foil position chain.

INITIAL PERFORMANCE

Because the entire accelerator tube had been vented and the long time it was open to install the LE mid section pump, we anticipated that the conditioning threshold would be low. The 14UD didn't disappoint. First x-ray bursts were at 8.9 MV and the first spark at 10.2 MV. The lessons are: close the Weisser valve to keep vacuum in the HE tube and thoroughly prepare the new equipment to minimise the time that the tube is at atmospheric pressure. In spite of the less than best care in this case, the machine went to 14 MV the next day.

It was soon noticed that the 20 l/s ion pump in the gas stripper was reading high and that turning it on or off didn't affect the stripper gas pressure or the pressures in the two ion pumps that deal with gas coming through the impedances. The loss of the gas stripper ion pump only meant that the response time of the gas pressure was very long for pressure reduction. We could live with it if we were careful.

On 10 Dec, we discovered that the LE shorting rods could not pass through the LE mid section. Oh $#!+. This AMS could not live with. The installation of the pump and/or its electronics was blocking the path of the rods.

The machine was once again scheduled to be opened a.s.a.p.

Nature, through the auspices of accelerators, has the knack of teaching us humility. One only has to gloat, even in private that we need to open the 14UD only once or twice a year to have our noses rubbed in $#!+. Unfortunately, the half life of learnt humility is humiliatingly short.