AUSTRALIAN NATIONAL UNIVERSITY

DEPARTMENT OF NUCLEAR PHYSICS

14UD TANK OPENING REPORT NO.12

Three openings: July 3rd to July 11th 1978 (9 days; 7 working days).
July 20th to July 21st 1978 (1½ days)
July 26th (1 day)

PREAMBLE:

The 14UD was last closed on May 10th following a long shutdown during which the gas handling system was found to be contaminated with oil. Considerable work was carried out on the Kinney and compressor and extensive analysis was made of the gas at various places and times (Report No. 11). It was assumed that the oil contamination was the cause of high lost charge which had plagued the accelerator for about two years.

Since Report No. 11 was sent out all the gas was taken from the storage vessel by means of the compressor and put into the accelerator. When the storage vessel was opened rust was found as powdery dust over the walls and lying, in places, half an inch deep on the floor. There was no obvious sign of oil. Residual gas analysis of scrapings of rusty material showed definite signs of oil with the largest concentration in a "bathtub ring" at the initial liquid level. This distribution was the result expected following the technique of slow evaporation of the SF_6. The rust was collected and the walls swept down. In all about 8.5 kg of rust was removed. A pressure vessel inspector was asked to look at the tank and he stated that the rusting was quite superficial and there was no scaling or pitting of the vessel. The Danboline paint put on the walls had failed probably because the initial sandblasting had not been vigorous enough to remove the mill scale. Arrangements were made for the vessel to be properly cleaned and sprayed with an epoxy paint. The total quantity of SF_6 was kept in the accelerator vessel, though the storage vessel was closed again in order to be able to transfer the gas to safety in the event of a large leak occurring; before closing the storage vessel its walls were wiped with rags dipped in alcohol after which, beneath the surface dust, distinct traces of oil were found on the walls. A time was chosen for the storage tank to be cleaned and the accelerator was scheduled to be out of use during the period.

In spite of the meticulous way in which the tank had been gassed up, excluding any oil we soon found, to our considerable disappointment, that the reappearance after four weeks of excessive lost charge was almost entirely unaffected by having oil-free gas. The experimental groups requiring $>$ 12 MV found it impossible to maintain this voltage, in fact the lost charge of more than 200 microamps was limiting the upcharge capability for tolerable inductor voltages.

After a large tank spark at 11.8 MV on 1st June, all terminal power was lost, though both shafts continued to operate. The L.E. midsection pumps, illumination and metering were working and the same applied at the H.E. stripper. In the terminal both pumps and lens were out of action and there was no illumination for the terminal foil counter. Since the pneumatic foil changer continued to operate we continued running the machine.

In order to see if the charging system was causing the lost charge, the terminal was shorted from the high energy end. It was found that all charge to the terminal was accounted for.

Though the gas was demonstrably oil-free the possibility of breakdown products in sufficient concentration to give rise to lost charge led us to reactivate the alumina in the dryer; this was carried out in the usual way. When the gas was again put through the dryer the lost charge was reduced from 110 microamps to 71 microamps at 11 MV in 6 hours. The lost charge remained stable at 55 microamps after 45 hours, implying the alumina was saturated. The dryer was reactivated again and, on this occasion, it was noticed that the thermostat was cutting out at 190 degrees F, whereas the appropriate temperature is 300 to about 350 F. There seemed little doubt that reactivation had never taken place at anything like the correct temperature since installation of the accelerator. The thermostat was adjusted and the dryer reactivated at about 350 F.

When the dryer was cool it was evacuated with a rotary pump; the exhaust from which had a sulphurous odour suggesting that even this vigorous reactivation left breakdown products behind. The SF6 was recirculated for 17 hours and further measurements were made. The lost charge had dropped to 16 microamps at 11 MV; the reduction at 12MV was from 180 to 42 microamps. This was remarkably encouraging and the scheduled runs continued.

Then, unfortunately, the day before work was to start on the storage vessel, Chain 3 broke! It was very wet weather, and most unsuitable conditions for opening the storage vessel; also a visitor, who was shortly to depart, badly needed more machine time in his last week; accordingly we decided to go into the accelerator at the cost of putting the gas into a mildly rusty, but essentially uncontaminated tank (besides oil is not critical).

The gas was taken out by the compressor to ⅓ atmosphere, absolute, at which point the Kinney was used to scavenge the last of the SF6.

****

<u>THE FIRST TANK OPENING:</u>

Chain 3, or most of it, was in a heap on the floor of the tank, crowned by the suppressor inductor. All three chains, and the pulley rims, were very dry.

The column points, removed and washed at the last opening because of their oily condition, (Report No. 11, page 4), were no longer moist but had on them dusty deposits which adhered to the surfaces and could not be blown or brushed off; more significantly, where the point assembly bracket joined the post bracket there was, in most cases, a build-up of irregular powdery appearance strongly resembling the corrosion which builds up on the terminals of a car battery (see photograph). This effect was only on the column points; however, the tube points, which were not touched last time, were now very dirty and speckled with small particles which also adhered firmly to the assemblies. Around the bases of the needles on many of the tube points in the region of the terminal there was a buildup of the same white material. On the floors of H.E. castings near the terminal thin "needles" which could barely be seen, were growing vertically upwards' one, at least, was nearly half an inch long, but most were possibly an eighth of an inch or so. Nearly all were near the outer edges of the castings. Could such needles contribute to lost charge? None were noticed on the floors of the L.E. castings but, because of the different polarity, they might have been on the ceilings of the L.E. units.

On the terminal where, for the last few openings, a heavy deposit of moist brown substance was seen, there was a misty deposit much less severe than before, but nevertheless quite moist. (Even near the end of this tank opening the deposit had not dried out).

When the terminal was raised the general loss of power was explained by the burn out of much of the wiring in the terminal connection box. The two terminal alternators have one side in common, and almost all this wiring was burnt. It was found that a pyrotenax feed from the upper alternator had its 'live' shorted to ground in such a way that return currents had destroyed the common wiring. Two other pyrotenax runs had low resistance to ground; one was the feed to the 10 litre/sec pump and the other the feed to the upper terminal heater plate transformer. The thermal overloads relevant to the feeds had welded contacts. Our impression is that the failure was caused by a breakdown in the connection box and the pyrotenax failure came as a result of overloading rather than being the cause of the problem.

POINTS:

It was decided to remove every point assembly in the machine, clean it and put it back. Alcohol removed the surface mess but on the rivets which held the disc of the assembly to the bracket a rough deposit obstinately resisted alcohol. This deposit rapidly dissolved in water, as did all the other mess on the points, also the material of "battery corrosion" appearance on the column brackets. (See photograph).

Every assembly was taken off, scrubbed with a pink nylon toothbrush dipped in cold water, and then with a blue one dipped in alcohol. The water produced a mild froth on the assembly. The assemblies were not dipped in the liquids in order to minimize the amount which entered their volume by way of the pumping holes. The "battery corrosion" effect on the column brackets responded readily to a wet synthetic sponge.

Since SF6 breakdown products are readily soluble in water we assume they were a large component of the deposit on the point assemblies. Hitherto water has been taboo in the tank but, intrigued by the response on the points, the brown patch on the terminal was, for the first time, wiped with a sponge dipped in water and squeezed somewhat, but not too much, the stain dissolved very readily.

Apart from the cleaning treatment we report that the needles on both tube and column assemblies were in good condition; a little rusty, a little dull, but acceptable and no needle missing in the entire tank.

CHAINS:

As usual, bits of the broken chain were on various parts of the column, but very little damage was done. Only one stabilizing idler needed replacing and this was because of bearings, not breakage. In the terminal the regular crop of d.c. idlers needed replacement contact springs.

A chain was made up out of lengths from earlier chain breaks after carefully studying all pellets. Shimstock contact rims were renewed and idlers replaced as necessary. Another pellet was removed from Chain 3 (the new one), after it had stretched and a pellet was taken out of Chain 2. When tested Chain 1 was seen to be running immaculately, but there was a slight wobble in the stiff direction on Chain 3. The oilers were put back and tested since clearly we can no longer afford to run without them. Even so, the chains were oiled by hand, likewise the rims of the driving pulleys, before button-up.

The life of the chain which broke was 7,155 hours.

SHAFT BEARINGS:

Both bearings in casting No. 2 were changed because of excessive noise at 3850 hours. The alternator in casting 27 was opened to observe the condition after 4780 hours of the carbon brush fitted in the hope that it might reduce spark damage to the bearings (Report No. 9, page 4). A good deal of powdered carbon was found in the housing and the bearings appeared to be no quieter than any others. The brushes were removed.

ELECTRON SUPPRESSION EXPERIMENT:

In Report No. 11, page 6, we reported that a positive bias supply was connected to the mid-section sublimer; this was in addition to the reintroduction of a solid optical baffle and grounded grid between the sublimer pellets and the accelerator tube pumping manifold. With the bias off, the baffle and grid prevented electrons from the pellets from entering the tube and producing x-rays at the 330 cycle alternator frequency. The bias supply was superfluous and the geometric solution used by N.E.C. was adequate. There was still evidence of 330 cycle x-rays from the L.E. shaft. Reducing the heater plate current did not eliminate this effect as we had hoped it would.

HIGH ENERGY STRIPPER:

The H.E. stripper was used with a 100MeV ^{16}O beam. The additional loading in this configuration more than negated the advantage of running at lower terminal volts and lower lost charge than when using the 7+ state without the second stripper. So far the new stripper has not been used deliberately though, on several occasions, tank sparks have got back into the electronic control of the stripper and evoked considerable confusion by putting in a foil instead of a blank. thereby generating beams of much higher energy which would not analyze.

****

THE SECOND TANK OPENING:

After the 14UD was gassed up on July 12th it ran for 8 days. It conditioned easily to 12.3 MV and operated beams up to 10.7 MV, the highest voltage required so far by the experimenters. The machine stability was absolutely superb; the analyzing slit amplifier had practically nothing to do and the beam just sat at full intensity for days on end. There was no lost charge.

At the height of this idyllic performance Chain 3 broke again entirely without warning. This occurred on starting the chain motor and presumably was due to a weak link and an insufficiently gentle starting sequence.

On entering the tank the chain was found partly on the floor with one end quite high up on the column. We soon found that this was an entirely uncharacteristic breakage: there were no short lengths distributed on the castings. The breakage was the result of a link pin tearing through the back of a nylon link at start-up, and the chain had merely slid to the bottom without slamming into castings, idlers or inductors. The only damage was bent shimstock and one bent pellet.

The nylon links on each side of the break were dye checked and are shown in a photograph. Cracks appeared on the ends of the links along the crude machining marks where the links were chamfered. These marks vary considerably; at times quite a good finish has been achieved. The failed link broke along a deep tool mark.

Breakdown products alone cannot explain the cracking. Chains 1 and 2 have been exposed to about a year's more breakdown products than the replacement for Chain 3. The important difference, we assume, is that the chain with cracks on the links had been subjected to breakdown products in the accelerator and was then exposed to ambient humidity for about a year; this could well increase the virulence of the break down products which are hygroscopic.

The fact that all the cracks are only along machining marks cannot be ignored. These stress lines are possibly more sensitive to attack by the hydrolized breakdown products. The other chains, with equally rough tool marks, but kept in the dry accelerator environment, did not break.

Since the chamfers are not needed in the 14UD, because of its large pulleys, we shall order replacement chains without them.

The above observations and tests were, unfortunately, not made until the machine was once again running with this "tainted" chain. Its subsequent failure presented an opportunity to test our hypothesis. The chain broke at speed, as had the original Chain 3. The nylon link damage was substantially different on the tainted chain: 8 pellets broke on the chamfers and only 2 at the neck. The original Chain 3, which rose up its pulley because of lack of oil, had only 3 chamfer breaks and 10 nech breaks. Such neck breaks are characteristic of high speed damage. We take the chamfer breaks, together with the dye checking, to imply weakening of nylon links by breakdown products, aggravated by exposure to humidity.

Both contact springs were off on the down d.c. idler on Chain 1. All contact springs were in place for Chain 3, the one that broke. Clearly such statistics for only a week's running give a sad picture of the contact springs. We believe that, under centrifugal force, the springs may move out too far and now and then enter a gap between pellets at precisely the moment when the relative positions are such that the spring is caught and nipped off. We propose to change the shape of the spring which has remained the same since installation.

Entering the tank again so soon gave us the opportunity to observe the onset of characteristic staining on the column point assemblies and the terminal. Three faint patches of stain existed on all the assemblies, and there was a distinct stain on the terminal; however, it was not moist, as usual, and did not easily wipe, yet it was hygroscopic.

The same chain was put back in after removal of a number of links each side of the break. Replacements were from the stock of broken lengths after checking. New shimstock was fitted on both pulleys.

The only service on the column was opening up idler castings to inspect all idlers. One needed to be replaced on Chain 3 because the pully had moved on its bearing.

The chain was replaced and the machine buttoned up in 1½ days, a record, we believe, for the southern hemisphere, and possibly due to our increasing expertise.

After gassing up the machine went up to 13MV though the stability was not quite so good as before on the first day.

THE THIRD TANK OPENING:

The 14UD ran for 2½ days on Chains 1 and 2 because we had a timorous disinclination to turn on Chain 3. However, on the third day it was turned on and broke again in about an hour.

In the terminal we found that the clamping screws on the down (positive) inductor were loose and the inductor had clearly been hit by the chain; whether it had dropped onto the moving chain, causing it to break, or had been hit by the flying chain after it had broken, we are not prepared to assert. The fact that the shimstock and pulley rims were not damaged argues against the possibility.

The contact springs on the d.c. idlers for Chain 3 were intact, but both were missing from the down idler of Chain 2 and one was missing from the down idler of Chain 1 - these instances after only 3 days.

Because the tank was to be roughed all night there was no point in closing up early in the afternoon when the few hours could well be spent on jobs which could be fitted in. The temptation to reduce, by an order of magnitude, the Southern Hemisphere Tank Closing Record was staunchly resisted and new shaped casting covers which we have bought were hurriedly adapted and a pair fitted at the 15 MeV casting. Modified contact springs for the A.N.U. type shorting rod contacts had been made and these were fitted throughout the H.E. column and as far as the midsection on the L.E. column. The coils in the prototype version had 23 turns and the new ones have about 68 turns, providing about three times the number of contact points which we hope will help them to survive considerabl longer. The ones removed had suffered from sparking at the contact surfaces and were damaged to varying degrees.

The column had not been cleaned during the brief opening of a day or so before, and the stability had not been so good as before. On this third occasion the surfaces between rings were cleaned by inserting a folded Tac-Rag between adjacent pairs and walking round the column. (The 14UD later went up to 12.8 MV before the onset of any conditioning and the subsequent stability was once more back in the "superb" bracket).

The machine was buttoned up in one day, breaking our own recent record for the southern hemisphere.

COMMENTS ON SF6 CONTAMINATION:

At present we have pure SF6 with no breakdown products and no oil. First it should be affirmed that oil, and now the demonstrable lack of it in the gas, plays an insignificant role in limiting the performance of the 14UD. The removal of breakdown products proceeds via a more arguable mechanism and therefore needs more explanation.

The fact that the activated alumina has never been heated enough to properly reactivate it was not discovered until recently because the transfer of gas to storage probably both reactivated the dryer and purified the gas, somewhat obscuring lack of heating. Evacuating the dryer during a pumpout probably removed volatile breakdown products; the sulphurous odours from the vacuum pump exhausting the dryer, even after high temperature reactivation, suggest this. In addition the mild bakeouts of the dryer which accompanied tank openings did somewhat reduce the burden of breakdown products in the alumina. This is coupled with the fact that the alumina, in the early days, was fresh and perhaps more effective than it is now. The manufacturers suggest a lifetime of about 3 years, though our application is certainly not what they had in mind. The final, and probably most important factor, is that, in the early days, some 2½ years ago, the tank was frequently opened to rectify failures. It is the improved reliability of the machine which has resulted in 8 to 12 week periods without a tank opening.

It was only after about 4 weeks that the lost charge problem would become apparent. We have the question of how gas contaminated by breakdown products becomes purified simply by transferring it into liquid storage. Where do the breakdown products go? We speculate that the bare steel surfaces of the gas handling system, e.g. heat exchangers, storage vessels etc, provided a surface upon which the chemically active components react with the residual (about 0.1%) air in the SF6, resulting in rust. A stainless steel gas handling system, or one with a well-protected storage vessel surface would not be as effective a purifier. Perhaps the slight coating of oil in our storage vessel reduced the effectiveness of this putative purifying mechanism.

Further support for the idea that lost charge is caused by breakdown products is obtained by observation of the substantial increase in lost charge following hard conditioning of subsections of the machine. With 14 units live at each end the lost charge was 150 microamps at 12.3MV. There was evidence of conditioning at this voltage. Using various combinations of shorting rods, each unit of the machine was brought up to a gradient in excess of 13/14 of an MV. After removing all the rods the lost charge had increased to 195 microamps at 12.3 MV. This episode took place over about 8 hours.

Why the presence of breakdown products causes lost charge is not explained. One would think that the whiskers on the casting would corona onto the structure and not be affected by reactivating the alumina. The fact that the largest accumulation of residue, assumed to be related to the breakdown products and lost charge, appears as brownish hygroscopic deposits on the terminal and tank wall around the triode stabilizing needle port, suggests that charge transport via mass transport to the tank wall is probably involved.

Possibly the most speculative suggestion is coupling the breakdown products with mechanical stability of the chains. Certainly the removal of breakdown products exactly coincided with the sudden appearance of negative self-charge on all three chains. At least one previous chain breakage was preceded by just such negative selfcharge and, in the recent case, we turned off the chain with the largest negative self-charge, about 20 microamps. This partial prediction of a chain break was followed, within 36 hours,by a break of the chain which had had 5 microamps negative self-charge. Perhaps after a couple of months of running the oil put on the chains by hand is consumed and the breakdown products act instead of oil to affect the surface conditions of the pulleys. With the more effective dryer reactivation, the breakdown products were removed, allowing the pellet/pulley interface to revert to the dry, high friction condition. There is evidence that on the first chain breakage, the chain rode up one side of its grooved terminal pulley and this led to the breakage.

It should be noted that there was no evidence prior to the second breakage, to suggest that a break was about to occur. This is to be expected since the chains and pulley rims had not dried out, and the break was link failure believed to have occurred at startup.

Our plans to cope with the breakdown product problem include:

(1) Replacing our much-used alumina with new material.

(2) High temperature, 300-350 F reactivation of the activated alumina.

(3) Evacuation of the dryer to good vacuum before refilling with SF6.

(4) Monthly reactivation expedited by a small compressor to transfer the SF6 in the dryer into the accelerator vessel (instead of dumping it).

There is sound evidence that the lost charge problem can be kept under control by the use of good alumina.

SLOW START ON CHAIN MOTORS:

In the belief that the second chain break occurred at startup, when the surge stretches the chain so significantly, a trial was made of a device to limit startup speed while watching the effect in the bottom of the tank. Instead of dipping steeply down, then rising again to running position, the pivot system barely dipped at all and the start was very smooth. We propose to introduce the measure on all motors and it will be reported later.

MISCELLANEOUS:

Entry into the tank:

The news from Los Alamos that two people had become unconscious when entering the tank after the SF6 had been taken out, and the backfill of nitrogen purged, caused us to investigate the atmosphere in our own tank. We do not backfill with nitrogen and have always entered the tank at the top, in order to prepare the platform for use, some minutes after letting in ambient air.

At the first of these three openings, before the upper door was opened, or ventilation started, one of the authors went cautiously into the bottom of the tank immediately the lower door was opened. The atmosphere was very warm but did not seem to be troublesome. After a minute or so the broken chain was collected from the bottom and taken outside. Once the top door was opened, and forced ventilation started, it soon became normal "tank atmosphere".

After the second and third breakages entry into the bottom of the tank was made at about the same time as the top door was being opened, and the situation inside investigated without discomfort.

MINOR ACCIDENT:

When the platform was at the top of the column, and men were working in the bottom of the tank, the bell of the internal phone system was knocked off its support and fell to the bottom; it struck the curved bottom of the tank and flew sideways, striking a technician on the shoulder, causing pain and bruising. This is the first time anyone has been hit by an object falling in the tank. We were concerned, especially since the bell had been travelling horizontally when it caused the injury, meaning that a helmet would have been no protection. We have instigated a rule that no-one is to work in the bottom of the tank when there are workers on the platform unless a task such as a chain installation absolutely requires it; clearly this will waste time and we are compensating as much as possible by rostering lunch breaks etc.

Safety devices:

A device sensing a light beam has been fixed to the platform where it passes the doors; in the event of a head, or any object being inserted through the door when the platform is about to pass, the control trips and stops the platform. A type of curtain is hung above the top door and will intercept the beam when the platform is driven above a chosen height, thereby preventing a mishap through accidentally driving too high. When necessary the curtain can be held aside and the platform driven higher up while taking care.

BERYLLIUM CONTAMINATION:

Beryllium cones are used in the sputter source and we decided to try to estimate the levels of residual beryllium because of its potential hazard. The Australian Atomic Energy Commission sent information together with instructions for making "swab" tests inside the source. Results from the swabs have been received and the levels reported are as follows:

Area smeared	Total Be on smear (micrograms)	Be on area (No. of max.permissible levels)
Control sample	0.005	
In and around extractor	18	180
Inside source body	9	90
Behind cone wheel	18	180

The A.A.E.C. sent us instructions for waste disposal, personal hygiene and decontamination. (Ref. WHITTEM, R.M. "A direct reading spectrometer for the determination of beryllium in filter paper samples". A.A.E.C./M63, June 1962.

D.C. Weisser.

T.A. Brinkley.

30th July, 1978.

Enclosures:

Photograph of column point assemblies showing stains, buildup of deposit on rivets and buildup on post brackets.

Photograph of tube point assemblies showing concentration of deposit and particles adhering to it.

Photograph of stain on terminal.

Photograph of stain around stabilizing needles port.

Photo of dye checked nylon links.

14UD SCHEDULE - 27 JUNE - 15 AUGUST 1978

MONTH	DATE	DAY	GROUP	LINE	
JUNE	26	MON			
	27	TUES	DRACOULIS, YEE, WALKER	1	^{9}Be, 48 MeV
	28	WED			^{13}C
	29	THURS	ZABEL, SPEAR, ET AL	5	^{16}O, ^{18}O
	30	FRI			^{24}Mg, ^{28}Si
JULY	1	SAT			^{32}S
	2	SUN	Chain broke		
JULY	3	MON	TANK OPEN		
	11	TUES			
	12	WED	NEWTON, CONLEY, EVANS, SIE	1	^{16}O 96 MeV
	13	THURS			
	14	FRI			
	15	SAT			
	16	SUN	DRACOULIS, YEE, WALKER	1	^{9}Be, 50 MeV
	17	MON			and ^{16}O ^{13}
	18	TUES			
	19	WED	chain broke 8 PM		
	20	THURS	~~BAXTER ET AL~~ TANK OPEN	~~6~~	~~α, 27 MeV~~
	21	FRI			
	22	SAT	Baxter ET Al.	6	α, 27 MeV
	23	SUN			
	24	MON	ZELLER, OPHEL, WEISSER, CLARK, HEBBARD	5	14N, 70 M
	25	TUES	Chain #3 broke 12 noon		
	26	WED	LEIGH, SIE, NEWTON	6	p, α, ^{12}C,
	27	THURS			^{19}F, 94 M
	28	FRI	ZELLER, ET AL	5	^{7}Li, 48 MeV
	29	SAT			
	30	SUN			^{7}Li, 52 MeV
	31	MON			

SPUTTER

LITHEX

AUG 1 TUES SF6 STORAGE VESSEL DUE FOR CLEANING AND SEALING

14UD SCHEDULE - 15 May - 31 June 1978.

MONTH	DATE	DAY	GROUP	LINE		
MAY	15	MON	GAS TRANSFER			SPUTTER
	16	TUES	CONLEY, EVANS, NEWTON, SIE	1	60 MeV ^{16}O	
	17	WED				
	18	THURS				
	19	FRI	GAS TRANSFER			
	20	SAT	ZELLER, WEISSER, HEBBARD, OPHEL, CLARK	5	48 MeV ^{7}Li	
	21	SUN				
	22	MON	FEWELL, KEAN, SPEAR, BAXTER, HINDS, ZABEL	6	70 MeV ^{18}O ^{16}O	
	23	TUES				
	24	WED				
	25	THURS				
	26	FRI				
	27	SAT				
	28	SUN	DRACOULIS, YEE, WALKER	1	^{16}O 95 MeV	
	29	MON				
	30	TUES				
	31	WED	GAS TRANSFER COMPLETED			LITHEX
JUNE	1	THURS	ZELLER, WEISSER, OPHEL, HEBBARD, CLARK	5	70 MeV ^{14}N	
	2	FRI				
	3	SAT	MATTISKE, BAXTER	6	27 MeV ^{4}He	
	4	SUN				
	5	MON				
	6	TUES	GAS ~~TRANSFER~~ MACHINE OFF			SPUTTER
	7	WED	NURZYNSKI, RAVI, HEBBARD, WEISSER, ZELLER, OPHEL	5	56 MeV ^{16}O ^{12}C	
	8	THURS				
	9	FRI	LEIGH, SIE, NEWTON	6	^{19}F 94 MeV ^{16}O 84 MeV	
	10	SAT				
	11	SUN				
	12	MON	DRACOULIS, YEE, WALKER	1	^{16}O 105 MeV ^{9}Be ^{12}C	
	13	TUES				
	14	WED				
	15	THURS	ZELLER, WEISSER, OPHEL, HEBBARD, CLARK	5	~~52~~ 48 MeV ^{7}Li	
	16	FRI				
	17	SAT	DRACOULIS, YEE, WALKER	1	^{9}Be ^{16}O 48 MeV 105 MeV	
	18	SUN				
	19	MON				
	20	TUES	WEISSER, ZELLER, OPHEL, HEBBARD	5	~~^{11}B~~ ^{16}O ~~65~~ MeV 100	
	21	WED				
	22	THURS	CONLEY, EVANS, NEWTON, SIE	1	85 MeV ^{16}O	
	23	FRI				
	24	SAT				
	25	SUN	NURZYNSKI, HEBBARD, RAVI, et al	5	^{16}O	