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**Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830**

**Pacific Northwest Laboratory
Operated for the U.S. Department of Energy
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August 29, 1947

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100 AREAS TECHNICAL ACTIVITIES REPORT - ENGINEERING

JULY, 1947

**300 AREA
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CORROSION AND BLISTERING - W. K. Alexander, C. F. Cabell, R. A. Rohrbacher

SUMMARY

The slugs from Tube 4392-F, which stuck in the tube during discharge, were examined for blistering and distortion. The surface of the slug which caused the binding was only slightly blistered, but the slug had an overall warp which made it bind in the tube.

Further comparison between rolled and extruded slugs by visual inspection shows no apparent difference.

Three rear Van Stone flanges were inspected in the D File on tubes which have replaced the original tubes. One tube, 3396-D, replaced on 4/15/47 with a 28 aluminum tube, showed traces of etch and some very small pits. There were no visible signs of any corrosion or pitting on the other two.

The front and rear Van Stone flanges of eight process tubes in the D File were removed for critical examination. The Metallurgical Group in 300 Area is now examining these flanges. Upon visual inspection of Tube 1293-B, 0.140" orifice zone, both front and rear flanges appeared to be badly corroded. The front flange of this tube was the only front flange in this group which was badly corroded.

Eighty-five rear Van Stone flanges were examined in the D File to see if they were corroded or ruptured to such an extent to cause a leak. Although thirty-two flanges were badly corroded, none showed any evidence of leaking.

Construction of the Van Stone test units is complete except for final hook-up of the water lines on the discharge face.

No signs of chattering were found in the long-term test in the flow laboratory tube which contained aluminum slugs of various diameters.

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Details

Comparison of rolled and extruded slugs, as well as other metal examined during the month, is listed below:

Tube #	Type	ID	Exposure Days	OK	Blistered		
					Sl.	Mod.	Ext.
2484-U	Regular	25	154	6	24	0	0
4374-F	Corr.	25	287	2	29	1	0
4392-F	Regular	25	350	7	26	1	1
1557-U	Regular	24.5	217	3	29	0	0
1674-U	Papoose	52.7	339	1	24	7	0
2473-U	Papoose	56	339	2	24	6	0
1260-F	R	26	209	4	56	1	0
2482-F	R	26.6	209				
1270-F	UR	26.1	209				
1482-F	UR	26.1	209	4	111	13	0
1684-F	UR	26.1	209				
2062-F	UR	26.1	209				
2160-F	R	26.6	209	1	26	2	0

In the above table "UR" refers to bonded slugs which were previously unbanded and which are believed to consist of rolled metal; and "R" refers to slugs of extruded metal (virgin) from billets which were companion billets to those used for "R" slugs.

Corrosion Tube 4374-F had an average penetration rate of 0.03 mils per month and a maximum of 0.04 mils per month.

The "stuck" slugs from Tube 4392-F were inspected this month. Borescoping of the tube on 6-25-47 showed that one slug 19-1/2 feet from the upstream nozzle stuck in the tube. Upon inspection the slug was found to be warped over its entire length but only slightly blistered on the surface.

Inspection of Van Stone Flanges

The Van Stone flanges of three tubes which were replaced at the D Pile were inspected this month. Tube 2692-D, which was replaced on 6-19-46 with an "Alclad" tube, showed no visible sign of any corrosion or pitting. Tube 3396-U, which was replaced on 4-15-47 with a 2S Aluminum tube showed traces of etch and some very small pits. Tube 3188-D, replaced on 6-17-47 with a 2S Aluminum tube, showed no visible sign of corrosion or pitting. Tube 1982-U, which was an original tube, was in very good condition. The flange showed little corrosion.

Under Production Test 105-110-F eight process tubes were removed from the D Pile in order to examine critically the Van Stone flanges. Two tubes were removed from each orifice zone, and all tubes were chosen from the lower half of the unit to facilitate tube replacement. The Van Stone flanges of these tubes were removed and sent to the Metallurgical Group in 300 Area for an accurate determination of corrosion effects. Upon visual examination of these flanges the following results were obtained:

Tube No.	Orifice Zone	Front Van Stone	Rear Van Stone
0657-D	0.140"	Two moderate pits.	Few pits shallow corr.
1292-U	0.140"	Endly corr. malformed.	Large corr. area - bad.
1856-B	0.175"	Shallow corr.	Some mod. pits - fair.

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<u>Tube No.</u>	<u>Orifice Zone</u>	<u>Front Van Stone</u>	<u>Rear Van Stone</u>
1159-B	0.175"	Shallow corr. no pits.	Few small pits - fair.
1163-B	0.200"	Few mod. pits.	Few mod. pits.
0672-B	0.200"	Few shallow pits.	Few mod. pits.
2357-B	0.240"	Few mod. pits.	Few mod. pits.
2178-B	0.240"	Shallow corr.	Two shallow pits - good.

In an attempt to locate the leak in the process water system in the D Pile, eighty-five rear nozzles were removed and the Van Stone flanges examined to see if they were corroded or ruptured to such an extent as to cause a leak. A tabular summary showing the general condition of these flanges is given below:

<u>Tube #</u>	<u>Orifice</u>	<u>Condi.</u>	<u>Tube #</u>	<u>Orifice</u>	<u>Condi.</u>	<u>Tube #</u>	<u>Orifice</u>	<u>Condi.</u>
4660	0.140	bad	4580	0.140	bad	4362	0.175	fair
4661	0.140	bad	4581	0.140	bad	4363	0.175	fair
4662	0.140	bad	4582	0.140	bad	4364	0.175	fair
4663	0.140	fair	4583	0.140	bad	4365	0.175	good
4664	0.140	bad	4584	0.140	bad	4366	0.175	fair
4665	0.140	fair	4585	0.140	bad	4367	0.175	fair
4666	0.140	fair	4586	0.140	bad	4368	0.175	fair
4667	0.140	fair	4587	0.140	bad	4379	0.175	fair
4668	0.140	fair	4460	0.140	fair	4380	0.175	fair
4679	0.140	bad	4461	0.140	bad	4381	0.175	fair
4680	0.140	bad	4462	0.140	bad	4382	0.175	fair
4681	0.140	bad	4463	0.140	fair	4383	0.175	fair
4682	0.140	bad	4464	0.140	fair	4384	0.175	fair
4683	0.140	bad	4465	0.140	fair	4385	0.175	fair
4684	0.140	bad	4466	0.140	fair	4386	0.140	fair
4685	0.140	bad	4467	0.140	good	4387	0.140	fair
4686	0.140	bad	4468	0.175	fair	4265	0.175	fair
4687	0.140	bad	4479	0.175	fair	4266	0.175	fair
4560	0.140	bad	4480	0.140	fair	4267	0.175	fair
4561	0.140	bad	4481	0.140	fair	4268	0.175	fair
4562	0.140	bad	4482	0.140	fair	4279	0.175	fair
4563	0.140	fair	4483	0.140	fair	4280	0.175	fair
4564	0.140	fair	4484	0.140	fair	4281	0.175	fair
4565	0.140	fair	4485	0.140	bad	4282	0.175	fair
4566	0.140	fair	4486	0.140	bad	4283	0.175	fair
4567	0.140	bad	4487	0.140	bad	4284	0.175	fair
4568	0.140	fair	4360	0.140	bad	4285	0.175	fair
4579	0.140	bad	4361	0.140	fair	4286	0.175	fair
						4287	0.175	fair

All the flanges above listed as "bad" are from the 0.140" orifice zone.

Photographs were taken of a number of Van Stone Flanges on the discharge face of 105-B and issued with previous photographs taken at 105-D and 105-F in Document IEW-7199, 7-29-47. The tubes photographed at 105-B were 3693, 4600, 2496, 1175, and 1191.

Van Stone Flange Test Units

The construction of the hot flow laboratory in the riser room at 105-D was completed

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during the month, except for final hook-up of the water lines on the discharge face. This hook-up was not made because of the higher priority leak-detection problem which required use of the discharge elevator. It is expected that the hook-up will be completed in August, as soon as the leaking tube is replaced.

The excess "line-feed line" from 108 Building was converted into a steam line to feed the test units. It was given a 250 pound hydrostatic test and also a thorough inspection before being accepted.

It was decided to begin the tests on Van Stone Flanges by a study of the possibilities of preferential corrosion of replaceable washers of cathodic metals. The metals selected and obtained for the test are 52-S aluminum (containing 2.5% magnesium), 72-S aluminum (containing 1% zinc) and dead-soft 2-S aluminum. These washers are to be mounted in such a manner that they will be in good electrical contact with the stainless steel nozzles.

Discharge of Stuck Slugs - Problem Assignment No. 7-P

Only a limited amount of time was spent on this Problem Assignment during the month. Design was completed on the expanding mandrel for reinforcement of front-face Van Stone Flanges during discharge of slugs requiring excessively high pushing forces.

Chattering - Problem Assignment No. 5-P

The long-term chattering test evaluating chattering tendencies of aluminum dummies of various diameters and lengths in a flow laboratory tube was shut down for inspection on July 15. This test had been in operation since April 16, drawing water from the "C" riser at 105-D at 20 gpm. Inspection of the slugs and borescoping of the tube showed no signs of chattering. The tube was reloaded and the test continued at 17 gpm (on August 1).

The loading of this tube is as follows, beginning at the upstream end:

Lead slugs	1.44" O.D.	6 1/2" long	2
Aluminum slugs	1.46" O.D.	8 " long	6
Aluminum slugs	1.29" O.D.	8 " long	4
Aluminum slugs	1.45" O.D.	8 " long	4
Aluminum slugs	1.34" O.D.	4 " long	6
Aluminum slugs	1.44" O.D.	8 " long	4
Aluminum slugs	1.34" O.D.	8 " long	4
Aluminum slugs	1.43" O.D.	8 " long	4
Aluminum slugs	1.39" O.D.	8 " long	4
Aluminum slugs	1.42" O.D.	8 " long	4
Aluminum slugs	1.40" O.D.	8 " long	4
Aluminum slugs	1.41" O.D.	8 " long	4

It will be observed that the tube is charged in such a manner that maximum differences in diameter are obtained between adjacent slugs.

Tube Leak at 105-D

Considerable time was spent assisting the "P" Department process group in their study of the process tube leak at 105-D. In the isolation of the leak, a number of calculations were made for them on techniques of introducing various tracer compounds into

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the water system.

In the course of analyzing the leak the group found it necessary to measure the water being removed from the helium in the dryers in the 115 Building. We analyzed their data and offered the opinion that the results indicated faulty sampling technique, and recommended that the sampling system be disassembled and examined. This recommendation was accepted and put into practice, and it was found that the sampling lines were plugged so badly that relatively enormous amounts of water were being held in the dryers and condensers. The lines were cleaned out and significant results were then obtained from the dryers.

Much of our effort, however, was directed toward improving the method of testing individual tubes for leaks. A test run with the "P" Department group showed that the leak tester could be used with low pressure (55 - 100 psi) water to detect leaks as low as 1/3 pound per hour. This eliminated the use of 200 psi water, and thus speeded up the test considerably, since it now can be run at normal 100 psi shut-down header pressure.

Calculations were made on the expansion effect to be expected when using the leak tester under such conditions that it would take 10 minutes to adjust the tester and 2 minutes to run the test. The expansion effect was found to be only 0.15 pound/hour of water, which would not mask any leak as large as that at 105-D.

The original procedure for using the leak tester called for loosening the end caps to permit flushing of air from the tube. The "P" Department questioned the safety of this procedure, and asked if 100 psi header pressure would not be enough to discharge some of the dummy slugs. We reviewed our calculations and data, and reported that such pressure would move dummies and thus possibly cause discharge of radioactive dummies. It was then decided to make up a special end cap with a discharge opening for removal of the air. We supplied the "P" Department with a design for this device, and a number were made up and used.

A suggestion was then made by one of the maintenance mechanics that we use hydrostatic pressure test methods on our leak testing procedure. A simplified leak tester was made up, consisting merely of a double valve assembly and a pressure gage, and was tested in the flow laboratory. It was found that for low water pressures (50 - 60 psi) the simplified tester would detect a leak as small as one pound of water per hour. Its use was recommended for the leak testing program at 105-D, since it offered a very rapid method of leak detection. Several units were made up, and were used with success in locating the leak in the 105-D pile.

This simplified leak tester is satisfactory for locating leaks of one pound per hour, but is not sensitive enough to detect leaks under about one pound per hour. The use of the standard leak tester is recommended for detection of smaller leaks.

Miscellaneous

A literature survey indicated that there was no particular technical reason for establishing the length of the discharge tip-off fixtures at precisely their present dimensions. The possibility of changing the length of the fixtures slightly is now being considered by the "P" Department in order to speed up discharge operations by discharging from more than one row for each setting of the tip-off fixtures.

Tube Traverses

Tube 4674-D was traversed on July 8 to measure vertical bowing. The maximum difference

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in elevation was 47 sixteenths inches.

GRAPHITE EXPANSION - W. H. Lewis, J. T. Carleton

Summary

Previously reported galling of process tubes during their replacement may be reduced by coating the tube with "Aquadag." The neutron absorption and corrosion effects should be determined before its use is recommended.

Corroded rear Van Stone flanges of process tubes may be corrected without tube replacement or loss of metal by shortening the rear gun barrel and reflanging the tube.

Resistance wire strain gauges are suggested as a means of prediction of failure of the biological shields caused by bowing under the influence of graphite expansion.

Details

Process Tube Replacement

A replacement tube that had been inserted in 4365-B was found to be galled to a depth of 0.009 inches. This is just within Specification No. 2031 as the defects were on the top of the tube where the wall thickness is a maximum. Similar defects on the bottom of the tube would be a cause for rejection.

To eliminate this galling a thin coating of "Aquadag" was tried as a lubricant. It was found to prevent galling when a short piece of tubing was inserted through the front gun barrel of 4365-B about two feet into the graphite. Lock-up tests also indicated that it was beneficial during tube replacement. Before it is used on the unit tests are planned to determine the neutron absorption and corrosion effects.

Renewing Van Stone Flanges

The feasibility of renewing the rear Van Stone flange after shortening the rear gun barrel was demonstrated on Tube 0904-B. The water flow was cut off and both nozzles removed. The rear Van Stone was cut off and the tube pushed about six inches toward the front face. Then 3/8 inch was cut off the rear gun barrel and it was refaced to duplicate the original end. The tube was then pushed back in place and a new Van Stone flange formed.

The tools used were satisfactory for the demonstration. Further development of tools and methods is being carried out by the Maintenance Department.

Stresses in Biological Shields

Mr. D. K. Miller of the General Engineering and Consulting Laboratory is visiting Hanford Engineer Works to advise about possible failure of the pile shielding due to graphite expansion. His rough calculations of stresses produced by bowing of the biological shields indicate the advisability of measuring the actual stress of the outer surfaces. These stresses cannot be calculated with confidence because of the complexity of the structure. He has suggested that resistance wire strain gauges may be used to measure the stress at various points on the outer surface. The gauges would be mounted on the unit and a base reading taken. The stress at the gauge would

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then be relieved by drilling 1/2" deep holes near the gauge and a second reading taken. The difference between the two readings would be the strain in the shield. This method was tried on a test bar. The test encountered some difficulty with stresses introduced in drilling and/or residual stresses due to forming of the bar. These factors will be investigated more fully by use of annealed test specimen. Since the stresses set up by drilling are far below the yield point of steel, they will not seriously affect the accuracy of measurement of stresses in the biological shield if the latter are near the yield point.

RADIATION STUDIES - S. S. Jones and J. C. Chatten

SUMMARY

There were no appreciable changes in the slug axial temperatures during the month. After the purge of the pile process tubes on July 2 there was a decrease in the equilibrium slug axial temperatures of 2°C. for 1367-F (0.175 orifice) and 6°C. for 2679-F (0.240 orifice) but this change is the same order of magnitude as changes caused by normal deviations in rod configuration and poison pattern.

The heat generation in a "E" tube has been found experimentally to be 4.7% of the heat generated by Active Metal.

No significant differences have as yet been found between the operational aspects of lead and steel dummy shielding slugs. The radiation effects outside of the pile front nozzle end caps, and the thermal neutron flux in the outer front perforate section have been found to be essentially the same in each case.

The metal storage basin, Building 212-N, 200 north, has been de-watered and flushed to prepare for erection of steel framework for the Underwater Physical Testing Laboratory.

The facilities for opening receptacle slugs are to be located in the transfer area of Building 105-D. It is planned to have these facilities ready for operation by October 1, 1947.

Details

Measurement of Slug Axial Temperature (Production Test 105-30-F)

There was no significant change in R, the ratio of the slug axial temperature above local water temperature to the increase in the local water temperature. The temperature data at equilibrium conditions on July 1 and 8 show the effect of purging the tubes of film. It is evident from Table I that this effect is of the same order of magnitude as the normal variations due to changes in rod configuration, poison pattern, etc.

A decrease in the pile power output of 14.4% produced a decrease in the slug axial temperature (above local water) of 16.6% for Tube 1367-F and 15.6% for Tube 2679-F. This small difference between the overall power decrease and the local effects is attributed to changes in rod configuration and flattening.

The #2 tube at the 105-F Flow Laboratory contains a charge simulating the thermocouple slug charge in 2679-F. This has had a water flow of about 21 g.p.m. since May 1. On July 22 chattering was observed near the down stream gun-barrel. It appears to be much different in amplitude and frequency from that observed in the 1367 Thermocouple slug mock-up.

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TABLE I

SLUG AXIAL TEMPERATURE

Tube No.	1367	2679	1367	2679	1367	2679	1367	2679	1367	2679
Date	July 1		July 8*		July 15		July 21		July 29	
Exposure Mon. to Days Adj. ton	263	130	273	140	265	152	294	161	305	172
Test Duration - Weeks	24.9	12.3	25.9	13.3	26.9	14.3	27.9	15.3	28.9	16.3
Slug Axial Temp. °C.	134.5		134		136		132		130.5	
Inlet Water Temp. °C.	16.5		17.7		18.3		19.0		18.5	
Local Water Temp. °C.										
from adj. tubes	36.3	29.5	37.3	30.1	30.0	30.6	39.0	31.9	37.8	31.9
from test tube	40.2	33.2	41.3	33.9	42.0	34.2	43.3	35.5	41.0	35.0
Slug Temp. above Local Water Temp. (Δt_s)										
based on adj. tubes	98.2	85.5	96.3	78.9	96.0	79.4	91.0	74.5	92.7	84.6
based on test tube	94.3	80.8	92.7	75.1	94.0	75.8	88.7	79.5	89.5	81.5
Local Water Temp. above Inlet Water (Δt_w)										
based on adj. tubes	19.8	13.0	19.6	12.4	19.7	12.3	20.0	12.9	19.3	13.4
based on test tube	23.7	16.7	23.6	16.2	23.7	15.9	24.3	16.5	21.5	16.5
Ratio ($\Delta t_s / \Delta t_w$) = R										
adj. tubes	4.96	6.59	4.91	6.36	4.97	6.46	4.55	6.13	4.80	6.31
test tube	3.98	4.84	3.93	4.64	3.96	4.77	3.65	4.81	4.16	4.51

*Unit was purged during the Shut-down on July 2.

A calculation of the heating effects in a submerged central slug after shut-down, using the Borst-Weiler curves, indicates that the following temperatures would be observed in a pile that had been operating at a power level of 200 mw.

TABLE II

HEATING EFFECTS AFTER SHUTDOWN
WITH NO WATER FLOW IN TUBE

Time After Shutdown*	Rate of Temperature Increase, Initial °C./min	Equilibrium Temperature** °C.
0 hrs.	515	---
0.5	7.6	110
1.0	6.5	98
5	4	68
10	3.3	60
1 day	2.9	55
5	2.3	48
10	2.0	43

*Represents time from completion of shutdown to instant of turning off the water in a central tube.

**Assumes 20°C. inlet water temperature

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Heat Generation in the Graphite (Production Test 105-104-P)

With the F File at equilibrium the water flow was decreased in a Bismuth tube in the 0.240 orifice zone until its outlet water temperature was equal to that of the eight surrounding tubes. Under these conditions there was a water flow of 0.60 gpm through the tube corresponding to a heat generation of 4.7% of that of an active tube.

Steel Shielding Slugs (Production Test 105-104-P)

Three special 1/8" O.D. aluminum tubing assemblies, containing copper wire, were charged into the outer perforate section on the front side of the active metal in Tubes 3167-F, 3173-F, and 3181-F. These tubes contained respectively 2 lead, 2 steel, and 3 steel, shielding slugs in the thermal block zone of the process tube. After one week of exposure the special tubes were removed, cut into one inch segments and measured for radiation intensity. There was no significant difference in the thermal neutron flux intensity outside of these shielding slugs between the two lead and the two steel. The difference between the two lead and the three steel could be accounted for by the displacement of the test tubing because of the additional solid slug.

The aluminum tubing activity was expected to serve as a measure of the fast neutron flux but the tubing was too low in activity and too variable as a function of position to interpret.

Film exposed outside the front end caps of these tubes showed no significant change in intensity for:

- 1 - Two lead, 6 perf., one lead
- 2 - Two steel, 6 perf., one lead
- 3 - Three steel, 5 perf., one lead
- 4 - Two lead, 6 perf., one solid aluminum

Building 212 H

During the month of July 1947 the Basin of Building 212 H, 200 north area, was dewatered and flushed to prepare for erection of steel framework for the Underwater Hot Laboratory. The first 10 feet of water removed from the Basin was discharged through the existing weir sump and drain line underground to the existing open drainage ditch. The rate of pumping was low enough so that only a limited amount of water was standing above ground at any time. At no time did water flow above ground more than 25 feet from the open end of the discharge pipe. H. I. reports on radiation from the dry ditch during this period increased from 10 mrep/hr to 29 mrep/hr at 4 inches. Because of this increase in radiation level it was decided that the last 18 inches of water in the Basin should be pumped into a separate drainage ditch within the 212 H fenced area and back filled and barricaded at completion of work. This decision was made to preclude any possibility of depositing active sludge in the existing drainage ditch during flushing operations.

Flushing of the Basin area at completion of dewatering was successfully completed following this plan. Radiation levels on the floor, columns, and walls of the Basin in the area where erection will take place are reported by H. I. as not over 3 mrep/hr at 4 inches.

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At no time during the dewatering did the radiation at deck level exceed 1 mrep/hr. The General Building Background was lowered by removal of the water from 400 c/n to less than 100 c/n. Active sludge was encountered in the Basin since one spot adjacent to the transfer pits over which all the flushing water passed is now reported to have a radiation level of 3000 mrep/hr at surface and less than 5 mrep/hr at 2 inches. The General Background in vicinity of transfer pits is less than 6 mrep/hr. This area need not be entered during erection of equipment and was not flushed clean.

Air samples taken during dewatering at deck level are reported as less than 1.0×10^{-7} $\mu\text{c/l}$. Smears from dry walls and columns were reported to be less than 100 c/n and less than 100 d/n.

Tensile and Bend Testing Machine

The status of design for the combination Tensile and Bend Testing Machine has not changed during the month. No word has been received to date from Dehenectady on the status of their design of stress-strain (load-deflection) gages. Meanwhile fabrication of component parts of this machine as designed here has been proceeding and installation should be complete by the end of August 1947.

Dr. W. I. Patnode and Colonel H. H. Zorrig, on their visit to Dehenectady during first week of August, will again investigate the status of this problem.

Hardness Machine

All design work and tracings have been completed for the fabrication of the equipment necessary to adapt the Universal Testing Unit (Rockwell Hardness) to underwater work. No further information has been received on the shipping date of the Universal Testing Unit. It was reported last month that a tentative shipping date of August 1, 1947, had been set by the Wilson Mechanical Instrument Company. It seems likely that the design of the adaptation will be approved during the first week of August 1947, and that installation of the machine will follow promptly.

Jacket Dissolving Equipment

Equipment for chemical stripping of canned, exposed, slugs in Building 221 T dissolver cell, in lots of 25 per operation has been fabricated and tested on dry runs. It is reported by W. G. Browne that this equipment performs satisfactorily and is ready for use when required.

Profilometer

No progress has been made during the month on this machine design. The Instrument Development group is waiting receipt of a small Atlas Bench Lathe before proceeding further.

Can Opener for Recaptacile Slugs

It has been decided to locate this equipment in the southeast corner of the transfer area of Building 105 D. Can manipulations will be handled by the existing Lifting Crane. It will be necessary to remove approximately 20 feet of the east end of the

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steel grating balcony to permit crane access to the concrete floor for tank spotting. Design of these facilities is well under way and it seems possible to put the equipment in operation October 1, 1947 as planned.

W. R. Woods
W. R. Woods
Technical Department

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END