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FOLDERS ON SHELF

VARIOUS RQPE
ANNUAL REPORTS

1934-1935 Annual Report

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N. 374/14

D.O.F.,

I forward herewith the Annual Report on the Royal
Gunpowder Factory for the year 1934-35 (two copies).

R. C. BOWDEN

6. 6. 35.

Superintendent,
R.G.P. Factory.

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ANNUAL REPORT

OF THE

SUPERINTENDENT, ROYAL GUNPOWDER FACTORY, WALTHAM ABBEY.

FOR THE

YEAR 1934 - 35.

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ANNUAL REPORT
of the
SUPERINTENDENT, ROYAL GUNPOWDER FACTORY
for the Year 1934-35.

I. GENERAL SURVEY.

(a) Manufacture.

In spite of the serious delay during the first four months of the year, when manufacture of Cordite was suspended, 315 tons of Cordite have been issued as against the Programme quantity of 323 tons, viz. an increase of some 50 tons over last year's activities. The Annual Turnover is shown in Appendix I.

The following is a general survey of the manufacturing activities of the Factory.

(i) Acids Sections. The results obtained with the experimental denitration tower for the recovery of spent acid have indicated the reliability of silica-ware for use in the proposed large-scale scheme envisaged in last year's report.

The Calder-Fox Scrubber installed in the Guncotton Section in place of a coke condenser for purifying exhaust gases from sulphuric acid concentration is still on trial. It has not proved so immediately successful as was anticipated, and experiments are still in hand to test its suitability for use with the Bowden Tower.

(ii) Guncotton. Careful attention has been given to the cleaning of the cotton waste before nitration and of the guncotton produced, and a product is now being obtained containing an exceedingly small quantity of foreign matter.

Experiments on a new type of potcher, to be constructed of non-ferruginous material, are in progress with a view to modernisation of the older type and a consequent still further reduction in the amount of this foreign matter.

For any material increase of output the Ordnance Committee recommend the installation of 10 ton blending tanks (refce. O.C. minute B.28,116).

The production of Service guncotton has been seriously curtailed through non-availability of packages.

Reorganisation of Pulping and Moulding Room - The introduction of "dry moulding" of guncotton, that is, the removal of water from guncotton by hydro-extraction prior to moulding, has rendered some plant obsolete. A partial reorganisation, now nearing completion, of the plant in the Pulping and Moulding Room has been possible. Later, when Quinan driers are installed at the Nitroglycerine Section, more plant will become surplus and will be removed.

Quinan Stove for drying Guncotton - In view of the proposals to modernise the system of drying guncotton by the replacement of the existing guncotton stoves with Quinan driers, careful consideration has been given to the type of structure involved and a new and improved design has been formulated. It was considered desirable to erect a model section of the proposed new construction which, whilst being considered an improvement upon, also embodies the principles of past experience of the Factory in danger building construction.

Representatives from the Home Office, Research Department, Royal Naval Cordite Factory, Chief Superintendent of Ordnance Factories and the Imperial Chemical Industries were then invited to visit the Factory and criticise the scheme. The Chief Superintendent Research Department kindly arranged to test panels of the proposed construction to ascertain their behaviour when subjected to detonation. The constructive criticism and assistance which resulted from these visits were most valuable; from the discussions and subsequent reports which were received several changes were incorporated in the plans.

A full-sized stove is now in course of erection.

(iii) Cordite. The manufacture of the four principal propellants, viz. M.D.T., W., R.D.N./A. and Mark I has proceeded satisfactorily.

The manufacture of Cordite W., the new R.G.P.F. propellant which was started in 1933, is now well established and has proved

satisfactory, both in manufacture and in ballistics. This excellent result is due, primarily, to the thorough investigation of the conditions necessary for successful manufacture, and subsequently to the careful oversight of the various processes involved.

The policy of the use of diluted acetone in incorporation to overcome stickiness in the cords after pressing, which at first was considered might introduce the possibility of ungelatinised guncotton in the finished powder, with consequent danger of high pressures in the gun, has been clearly vindicated. Pressures in the gun with W. cordite are comparable with those of M.D.

The principles involved in the gelatinisation and extrusion of nitrocellulose propellants are being carefully investigated. Much enlightenment on this involved process is still necessary.

178 tons of Cordite W. were manufactured during the year, making a total of about 270 tons at R.G.P.F. since its introduction.

The manufacture of rifle cordite (M.D.T. 5-2) has proceeded satisfactorily, although at times some difficulty has been experienced due to the fact that during extrusion expansion has occurred at the die. By slight alteration in the conditions of manufacture this difficulty has been overcome but, owing to the variations that unavoidably occur in the guncotton, due partly to the cotton waste, a very careful watch has to be maintained so as to anticipate as far as possible these variations.

An investigation into the possible substitution of W.T. for M.D.T. 5-2 has been carried out. No great difficulty has been experienced in the manufacture of tubular W. cordite. The pressure of extrusion appears to be somewhat higher than for M.D., but this can be overcome by reducing the speed of extrusion if found necessary. The greatest difficulty has been in determining the size of cord and weight of charge to give correct ballistics. The matter has been under investigation by the Chief Superintendent Research Department and it is understood that these conditions have now been established.

(iv) Picrite and R.D.N./A. The manufacture of picrite and R.D.N./A. continues to be maintained at a development level only. About 14 tons of R.D.N./A. were made. The new methods for the manufacture of picrite introduced by the R.G.P.F., viz. water extraction and fusion, have continued to give very satisfactory results.

Difficulty in purification is still experienced with the spraying nozzles and a new type is now under trial.

(v) Tetryl. Repurification of material made during the War, together with the manufacture of new Tetryl and the subsequent operation of corning, have been carried out. Some difficulty has at times been experienced with the repurification of War-made Tetryl in producing from it material up to specification standard.

(vi) Composition R.D.202. The manufacture of this fuse powder has been carried out intermittently throughout the year. Failure at gun proof, after satisfactory rest proof results, has caused considerable delay in executing orders. The cause of this failure is still obscure. The process is being examined and the assistance of the Chief Superintendent Research Department on the proof side has been invited.

(vii) Gunpowder. A small amount of 63% charcoal has been made and the preparation of mill cake for the Royal Filling Factories has been carried out.

(viii) Main Laboratory. About 5000 samples, comprising raw materials, intermediate and finished products, have been analysed during the year.

Experimental work in connection with the general running of the Factory has been carried out, especially in connection with (a) solvents for the manufacture of cordite; (b) T.N.T. and its effluents; and (c) purification of tetryl.

(ix) Continuous Inspection of Cordite during Manufacture. In accordance with recommendations made by the Ordnance Committee, representatives of the Chief Inspector of Armaments have, during the year, been posted at the R.G.P.F. for inspection purposes.

(b) Services.

(i) Hydraulics. The hydraulic pumps, both at the Upper and Lower Works, are continuing to give good service with very little attention. Continuing the overhaul programme, further pipe lines and main valves have been put into a good state of repair during the year.

(ii) Compressed Air Plant. The compressed air plant at the Nitroglycerine Factory consists of four steam-driven sets. It is considered that the installation of a motor-driven set would result in considerable economy. Air receivers and mains are in good condition.

(iii) Refrigeration Plant. The condenser, previously reported as having developed serious leakages, has been retubed. The opportunity was taken while this set was out of commission to carry out repairs on the evaporator. The set has now been running satisfactorily for several weeks. The other sets are in fairly good order, but a sum of money has been taken up for the overhauling of the engines and compressors.

(iv) Air Heating (Guncotton Stoves). Air heaters and fans are now in running order for 14 stoves. Two fan engines have been replaced by electric motors. The new method of lagging the air pipes with glass silk, which is secured by wire netting and a final cover of zinc sheet, is very neat in appearance and highly efficient, and it is proposed to adopt this as standard for air pipe lines.

(v) Telephones. The proposal to instal the automatic telephone system at the R.G.F.F. and provide additional lines between this factory and the Royal Small Arms Factory has been held up pending a decision on the removal of the Factory.

The telephone service has been much interrupted by falling trees and branches, and the cost of maintenance for the year has been £171 as compared with the average of £115 for the last three years.

(vi) Transport. A new lorry has been purchased for the transport of gun-cotton from the Lower to the Upper Works.

The electric tractors, which have been in use for some 15 or 16 years, are showing signs of deterioration and new batteries will be required shortly. A sum of money for this replacement has been taken up in the year's services.

(vii) Machinery Shop. As previously reported, the Machinery Shop at the Upper Works is overcrowded, dark and inconveniently arranged. The scheme prepared for a new shop awaits a favourable opportunity for consideration.

(vii) Metropolitan Water Board Supplies. The consumption of water for the last five years has been as follows:-

<u>1930</u>	<u>1931</u>	<u>1932</u>	<u>1933</u>	<u>1934</u>
£131	£168	£182	£199	£192

(ix) Lee Conservancy Catchment Board. The agreement with this body dealing with the clearance of weeds etc. in waterways in and around the Factory, referred to in last year's report, has now been concluded, providing an annual maximum repayment to the Factory for services rendered in drainage matters of some £200.

The Board undertook the cutting and clearance of the Small River Lee for the War Department portion on repayment by the Factory.

The flow of water in the valley has fluctuated between a maximum of 9661 cu.ft. per minute in February 1935 and a minimum of 319 cu.ft. per minute in October 1934, and the daily averages over the last five years have been:-

<u>1930</u>	<u>1931</u>	<u>1932</u>	<u>1933</u>	<u>1934</u>
9987	9973	9675	2766	2405

Drought continued to have a serious effect on water-borne transport, alternative handling necessitating increased labour charges.

(x) Fire Brigade. During the year inspections have been made of all fire appliances and equipment; all were in good working condition.

Three fire calls were attended - (1) Cordite Dining Room (escape of gas), (2) Central Stores (spontaneous combustion of oily rags in iron bin) and (3) Composition Exploding Nitrating

House. In the latter case a hydrant was used to extinguish the fire; in the first two cases the damage was very slight.

The London County Council's bi-annual inspection of Fire Appliances and fire prevention arrangements took place on the 23rd May 1934. Tests were carried out in the Inspector's presence of the following fire appliances with satisfactory results:-

1 Petrol Fire Pump
1 Hydrant
4 lengths of Hose
1 Chemical Fire extinguisher.

The Inspector's recommendation that adaptor hose connections be added to the fire appliances has been adopted, five adaptors having been purchased. Four "Foamite Fire-foam" extinguishers have also been added to the Fire Brigade equipment during the year.

Fire rules and precautions have been well observed throughout the Factory generally, and the general condition of the Factory as regards fire risks has been improved by the cutting down and removal of undergrowth etc.

Two hydrants were renewed during the year as a result of half-yearly tests. Petrol fire pumps have been subjected to pumping tests and are in a satisfactory condition. All fire hose was tested - 15 lengths were condemned and renewed.

Fire squads attended regularly and carried out their drills with entire satisfaction.

An inspection of quarters, house and cottage property, as a precaution against fire risk from workshops etc., was carried out and all was found clean and in accordance with regulations.

(xi) Estate. The advice of the Forestry Commission has been sought on the subject of the best treatment of the woodlands with a view to (a) removing dangerous trees, (b) providing a suitable camouflage from the air and (c) retaining the best form of baffle for an explosion wave.

A representative (Mr. Felton) visited the Factory and, having regard to the necessities of (b) and (c), recommended a programme of work covering a period of ten years.

The Director of Forest Products Research visited the Factory and also kindly offered much valuable advice on the subject.

(c) Property.

The gross returns from all property attached to this Factory for the last five years are as follows:-

<u>1930</u>	<u>1931</u>	<u>1932</u>	<u>1933</u>	<u>1934</u>
£1,529	£1,537	£1,524	£1,434	£1,241

The expenditure on domestic property has amounted to £492 against an assessed annual value of £1,080. This does not include the special maintenance figure for rebuilding the kitchen wing of the Superintendent's quarter completed at the end of April. This quarter was also completely redecorated internally and externally and new fireplaces installed for the accommodation of the new Superintendent in August and September last.

II. TOTAL PRODUCTIONS.

(a) Guncotton Section.

(i) Manufacture of Nitric Acid.-

Nitrate of Soda charges	96 at 2 tons 28 at 1½ tons 8 at 1 ton	= 242 tons.
Total Nitrate of Soda charged	271.04 s/tons Crude 269.73 ,, Pure	
Equivalent HNO ₃	199.84 ,,	
Nitric Acid produced	217.85 ,, at 89.56% 195.12 ,, HNO ₃	
Loss	4.72 ,,	
Efficiency	97.63%	
Strong Sulphuric Acid used	260.11 s/tons at 93.36% 242.94 ,, H ₂ SO ₄	

(ii) Redistillation.-

Acid charged = 1443.75 s/tons containing	904.65 s/t H ₂ SO ₄ 263.96 " HNO ₃ 286.14 " H ₂ O
Strong Nitric Acid recovered	286.10 " at 90.2% 258.16 " HNO ₃
Loss	5.80 "
Efficiency	97.8%

Weak Sulphuric Acid recovered	1125.4 s/tons at 79.4%
	894.1 ,, H ₂ SO ₄
Loss	10.55 ,,
Efficiency	98.80%

(iii) Concentration of Weak Sulphuric Acid.-

Acid charged to concentrator	1007.36 s/tons at 81%
	815.28 ,, H ₂ SO ₄
Strong Sulphuric Acid produced	868.95 ,, at 92.6%
	804.37 ,, H ₂ SO ₄
Loss	10.91 ,,
Efficiency	98.70%

(iv) Nitration.-

No. of sets of Guncotton	2266
,, ,, Nitro Cotton	55
,, ,, Straw and Wood)	20½
Cellulose)	
Mixed Acid used	4130.38 s/tons
Cotton Waste used	130.52 ,,
Straw and Wood paper used	.83 ,,
Guncotton produced	219.30 ,,
Saveall	4.206 ,,

Yield - 167.3% (Available for Cordite 164.1%)

Ratio - Mixed Acid/Cotton Waste 31.46
Mixed Acid/Guncotton 18.89.

(v) Guncotton etc. issued to Services other than for Cordite manufacture.-

- 6200 - 1 lb. Guncotton Slabs, Wet, to C.O.O., Bramley
- 36 lb. Guncotton Dust to Messrs. Armstrong-Vickers
- 400 lb. Nitro-cotton to C.S.R.D., Woolwich
- 50 lb. Wood cellulose to C.S.R.D., Woolwich
- 215 lb. Straw paper to C.S.R.D., Woolwich
- 500 - 1 lb. Guncotton Slabs, Wet, to C.O.O., Bramley.

Total - 7401 lb. = 3.7005 s/tons.

(vi) Raw Materials.-

	T.	c.	lb.	
Oleum drawn from Store	354	4	82	= 396.75 s/tons
Difference in Stocks				83.30 ,,
Oleum consumed				313.45 ,,

= 1.429 per lb. of Guncotton.

Nitrate of Soda drawn from Store	242 T.	= 271.04 s/tons
Difference in Stocks		10.54 ,,
Nitrate of Soda consumed		260.50 ,,

= 1.188 per lb. of Guncotton.

	T. c. lb.	
Cotton Waste drawn from Store	129 15 80½	= 145.36 s/tons
Deduct oil and moisture (7.00%)		10.17 ,,
Deduct pickings and fly		4.665 ,,
Nett Cotton Waste used for nitration		130.525 ,,

Foreign matter removed from Cotton Waste in picking etc.-

Wood, string and metal	1067 lb.	=	.3945%
Grit	62 lb.	=	.0229%
Fly	8201 lb.	=	3.0330%

Cotton used per lb. of Guncotton	-	Gross	0.6630
		Nett	0.5948

(vii) Summary of Consumption and Losses of Acids.-

	<u>H2SO4</u>		<u>HNO3</u>	
	<u>Actual</u>	<u>Per ton</u>	<u>Actual</u>	<u>Per ton</u>
	s/tons	of G/C	s/tons	of G/C
Manufacture of Nitric Acid	242.94	1.108	4.72	.0215
Redistillation	10.55	.0492	5.80	.0264
Concentration	10.91	.0497	-	-
Nitration	43.95	.2005	181.57	.8282
Washing out Plant	20.75	.0965	-	-
Total	329.10	1.5039	192.09	.8761

(b) Nitroglycerine Section.

(i) Manufacture of Nitric Acid.-

Nitrate of Soda used	191.52	s/tons	at	99.40%	NaNO3
C.O.V. used	131.64	,,	at	88.3%	H2SO4
Oleum used	65.25	,,	at	20%	SO3
Strong Nitric Acid made	128.96	,,	at	91.2%	HNO3
Weak Nitric Acid made	28.49	,,	at	60.7%	HNO3

Efficiency Strong Acid - 85.8%

Total Efficiency - Process 96.0%

Overall 96.0%

(ii) Denitration of Waste Acid - Output.-

New Tower - Waste Acid denitrated	76.00	s/tons	
Weak Nitric Acid added	12.614	,,	at 66.1% HNO3
Denitrated Sulphuric Acid made	85.125	,,	at 63.9% H2SO4
Nitric Acid recovered	6.112	,,	at 83.1% HNO3
	17.570	,,	at 55.5% HNO3
Old Tower (No.1) - Waste Acid denitrated	91.50	,,	
Denitrated Sulphuric Acid made	93.827	,,	at 71.0% H2SO4
Nitric Acid recovered	14.932	,,	at 55.8% HNO3

Efficiencies - Sulphuric Acid 100%

Nitric Acid 86.0%

(iii) Concentration of Weak Sulphuric Acid - Output.-

Weak Acid concentrated	287.459 s/tons	at 64.4%
Strong Acid made	179.854	at 89.3%
Weak Acid made	45.000	at 42.8%

Efficiency - Strong Acid 85.2%
 Total - Process 97.0%
 Overall 95.8%

(iv) Redistillation of Weak Nitric Acid - Output.-

Weak Nitric Acid redistilled	37.216 s/tons	at 58.5%
Strong Sulphuric Acid used	50.025	at 92.8%
Strong Nitric Acid made	17.653	at 88.9%
Weak Nitric Acid made	8.990	at 57.8%
Sulphuric Acid recovered	65.170	at 70.8%

Efficiencies - Nitric Acid, strong - 72.5%
 Total, process - 96.0%
 Sulphuric Acid - 99.50%

(v) Acid Mixing - Output.-

Nitric Acid, new, mixed	112.959 s/tons	at 91.8%
Nitric Acid, redistilled, mixed	22.347	at 87.5%
Oleum 20% mixed	69.000	at 20% SO ₃
Oleum 65% mixed	64.500	at 65% SO ₃

Total Mixed Acid made - 268.806 s/tons.

(vi) Manufacture of Nitroglycerine.-

Materials and Output -

Glycerine nitrated	41.160 s/tons
Mixed Acid used	231.000
Waste Acid made	167.500
Soda Ash used	3.14
Nitroglycerine made	96.237

Yield - 233.81%

Summary of Tests -

	Maximum	Minimum	Average
Moisture	0.48%	0.22%	0.27%
Heat Test	13 min.	10 min.	11 min.
Alkalinity	All under 0.0005%		

Nitroglycerine was used as follows:-

For Cordite M.D.	35.197 s/tons
,, W.	55.641
,, Mark I	1.133
,, R.D.N./A.	3.279
For Dynamite	0.585
For various experiments	0.401

Summary of Consumption and Losses of Acids -

	H ₂ SO ₄		HNO ₃	
	Actual s/tons	Per ton N/G	Actual s/tons	Per ton N/G
Manufacture of Nitric Acid	151.2	1.363	-	-
Denitration	2.951	0.031	2.495	0.026
Redistillation	0.231	0.0024	0.872	0.0091
Concentration	7.681	0.080	-	-
Acid Mixing	6.48	0.067	10.49	0.109
Nitration	4.869	0.051	81.650	0.848
	<u>153.412</u>	<u>1.594</u>	<u>95.507</u>	<u>0.992</u>

(iii) Cordite Pressed.-

Small Screw Presses -

		lb.	lb.
Small Arms - M.D.T.	5-2	227,355	
	7-2	3,100	
		<hr/>	230,455
Mark I	1/.05	2,745	
	3	380	
	20/S.C.	771	
		<hr/>	3,896
Cannon - R.D.N./A.	.029	9,320	
	.042	9,403	
	.052	9,142	
		<hr/>	27,867
W.	.046	7,760	
	.036	69,000	
	.016	28,420	
	.154-.136	10,650	
		<hr/>	115,830
			<hr/>
			378,048

Experimental and Proof Samples -

R.D.B. Rework	93	
M.D. and M.D.T.	304	
M.C.T.	18	
R.D.N./A., B. and C.	1,853	
H.P.T.	156	
F.535/2	371	
W. and W.T.	1,250 ⁸ / ₁₆	
	<hr/>	4,045 ⁸ / ₁₆
		<hr/>
		382,093 ⁸ / ₁₆

Hydraulic Presses -

Cannon	.124	6,400	
	.098 and .093	24,975	
	.054 and .057	210,517	
		<hr/>	241,892
Experimental - R.D.B. Rework		160	
	M.D. Rework	5,745	
	W.	441	
		<hr/>	6,346
			<hr/>
			248,238
			<hr/>
			Grand Total - 630,331 ⁸ / ₁₆ lb.

(iv) Cordite Issued.-

		lb.	lb.
Small Arms - M.D.T.	5-2	242,392	
	7-2	7,800	
		<hr/>	250,192
Mark I	1/.05	2,745	
	3	380	
	20/S.C.	1,790	
		<hr/>	4,915
Cannon - R.D.N.A.	.029	9,020	
	.042	10,070 ⁸ / ₁₆	
	.052	9,142	
		<hr/>	28,232 ⁸ / ₁₆
W.	.124	6,400	
	.098	22,495	
	.054 & .057)	232,317	
	& .046)		
	.036	55,855	
	.016	21,035	
	.154-.136	5,214	
		<hr/>	343,516

Cordite Issued (Continued)

Brought forward 626,655 $\frac{8}{16}$ lb.

Experimental and Proof Samples - lb.
 R.D.B. Rework 93
 M.D. and M.D.T. 454
 M.C.T. 18
 R.D.N./A., B., and C. 1,868
 H.P.T. 156
 P.535/2 371
 W. and W.T. 1,691 $\frac{8}{16}$

Total

651,307

4,651 $\frac{8}{16}$

(v) Percentage Loss, etc.-

	<u>M.D.</u>	<u>W.</u>	<u>Mark I</u>	<u>R.D.N./A.</u>
	lb.	lb.	lb.	lb.
Paste Used	233,440	348,899 $\frac{5}{16}$	3,705	28,693 $\frac{8}{16}$
Minneral Jelly or Carbamite Added	11,649 $\frac{5}{16}$	22,051 $\frac{8}{16}$	195 $\frac{11}{16}$	2,354 $\frac{5}{16}$
Stock Rework 31.3.34	6,050	2,040	125	38
	<u>241,139 $\frac{5}{16}$</u>	<u>372,990 $\frac{13}{16}$</u>	<u>4,025 $\frac{11}{16}$</u>	<u>31,085 $\frac{13}{16}$</u>
Cordite Produced	230,735	358,060 $\frac{12}{16}$	3,896	29,497
Stock Rework 31.3.35	9,310	8,100	34 $\frac{15}{16}$	900
	<u>240,045</u>	<u>366,160 $\frac{12}{16}$</u>	<u>3,930 $\frac{15}{16}$</u>	<u>30,397</u>
Loss	<u>1,094 $\frac{5}{16}$</u>	<u>6,830 $\frac{1}{16}$</u>	<u>94 $\frac{12}{16}$</u>	<u>688 $\frac{13}{16}$</u>
Percentage Loss	0.47%	1.84%	2.43%	2.22%
Percentage Acetone Used	37.13%	35.46%	21.73%	17.98%
Percentage Minneral Jelly or Carbamite used	4.96%	5.94%	5.02%	7.58%

Note: The percentage loss on W. cordite is slightly higher than normal owing to the amount of work-up (800 lb.) burnt when manufacture was closed down at the beginning of the year. The amount of Rework arising during W. manufacture is high owing to the inclusion of 2,118 lb. picked out of rejected Lots W.A.C. 17 and 20.

(d) Tetryl.

Repurification of C.E. to Crystal C.E. -

Purified	7.149 s/tons	
Recovered	6.602	,,
Lost	0.547	,,
Stock	0.922	,, (0.150 s/tons Unfit (0.722 ,, Under test
Issued	5.680	,,
Acetone used (Trade)	4.437	,,

Repurification of C.E. to Corned C.E. -

Purified	12.685 s/tons
Corned	7.235
Issued	4.235
Acetone used (Trade)	12.804

Manufacture of New C.E. -

No. of Nitrations	28
Tar Oil used	1.392 s/tons
C.O.V. 96% used	21.750
Weight C.E. produced	2.520
Weight C.E. purified	1.710
Acetone used	2.100

(e) Picrite.

Raw Materials used -

Calcium Cyanamide	26.880 s/tons
Ammonium Nitrate	11.142
C.O.V. 98%	25.125
Picrite made	8.828

Raw Materials used per ton of Picrite -

Calcium Cyanamide	3.05 s/tons
Ammonium Nitrate	1.26
C.O.V. 98%	2.85

(f) T. N. T.

Materials used -

M.N.T.	30.381 s/tons
Nitric Acid 98%	50.207
C.O.V. 96%	106.761
Recovered Waste Acid) (about 91% H ₂ SO ₄)	37.185
Sodium Sulphite Crystals	6.742

Production -

T.N.T. (finished, sulphited product) - 43.427 s/tons.

(g) Composition R.D. 202.

Reblended	46 lb.
Manufactured	656½ lb.
Ammonium Perchlorate (Crude)	784 lb. (Refined)

III. MAIN PRODUCTIONS.

<u>Summary.-</u>	<u>Tons</u>
Cordite	
W.	178.9
M.D.	115.3
R.D.N./A.	13.9
Mark I	1.9
Experimental	5.2
	<hr/>
	315 tons
Composition R.D. 202	0.328 tons
Tetryl - Repurified	19.5 ,,
Corned	7.25 ,,
New manufacture	2.5 ,,

IV. NEW METHODS.

(a) Straining of Cordite. In July a new method of straining cordite during pressing was introduced. This was evolved in collaboration with Chief Superintendent Research Department. The new system is aimed at forming a seal between the vertical walls of the strainer and the vertical walls of the press cylinder. Sealing between horizontal faces of the strainer and plug under the old system was practically impossible owing to the very great pressure exerted during extrusion, with consequent stretching of the threads of the plug. The present method was gradually arrived at from the idea, once in use at R.G.P.F., of a cup-shaped copper ring soldered to the straining gauze.

All cordite is now strained through the new type of strainer both on the small screw and hydraulic presses.

A separate report has been furnished on this system.

(b) Solvent reduction. A reduction in the amount of solvent used for incorporation of cordite W. for use on the hydraulic presses has been introduced with very good results.

(c) Pulping of Guncotton. A relaxation in the time of pulping of guncotton from 2 hours to 1½ hours has been approved. (Refce. O.C. Minute B.28,895). As this time of pulping is still in excess of that in force during the War the effect upon emergency commitments is under consideration.

V. URGENT ORDERS.

An urgent order for the manufacture of 9 tons of R.D.N./A. for the Navy was executed.

An order for the reworking of 3 tons of M.D. cordite with the addition of 2% of Carbanite was executed for the Ordnance Committee.

VI. EXPERIMENTAL ORDERS.

A considerable number of experimental orders have been executed during the year.

In the Guncotton Section work on the nitration of straw-cellulose has been successfully carried out. At first a considerable proportion of the pans fired during displacement, but by modifying the acid composition this trouble was eliminated.

In the Cordite Section considerable experimental work has been carried out during the year, chiefly for Chief Superintendent Research Department and the Ordnance Committee. A summary of the quantities produced of each type of cordite is appended.

For Service of Ordnance Committee -

	Size	Pressed lb.	Issued lb.
R.D.B. reworked with Carbanite	8	93	93
" " "	8	145	-
M.D. reworked with Carbanite	8	5,745	150
M.D. and M.D.T. Straw-cellulose	16) 5-2)	24	24
W. various	15-13) 2 1/2) 4 1/2) 8) 15) .029)	301 8/16	301 8/16
W. Cotton) W. Wood) with impregnations W. Straw)	2 1/2) 16 (	123 114 8/16 138 16	123 114 8/16 138 16
W. Cotton) W. Wood) Various W. Straw)	2 1/2) 4 1/2) 8) 5-2) 5-2) Chopped	228 207 216 12/16 16	228 207 216 12/16 16
W. and W.T. Straw-cellulose	16) 5-2)	24	24
R.D.N./A Straw-cellulose	.042	15	15
F.535/2 Straw-cellulose	.045	15	15
		<u>7,389 12/16</u>	<u>1,649 12/16</u>

For Service of Small Arms Committee -

	Size	Pressed lb.	Issued lb.
M.D.	.048	<u>250</u>	<u>250</u>

For Service of Air Ministry -

H.P.T.	.091-.045	<u>156</u>	<u>156</u>
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For Service of Army -

M.D.T.	7-2	<u>10</u>	<u>10</u>
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For Service of Research Department -

M.D.T.	.047-.016) .050-.019)	20	20
M.C.T.	5-2	18	18
W.T. Various	5-2	10	10
	5-2	60 ¹² / ₁₆	60 ¹² / ₁₆
	5-2	25 ¹² / ₁₆	25 ¹² / ₁₆
W.	.054/9.75"	200	200
R.D.N./A.	.042/33"	500	500
	.042	500	500
	.042	75	75
R.D.N./B.	.042	75	75
R.D.N./C.	.042	73	73
R.D.N./A.	.040/10.5"	200	200
	.042/10.5"	200	200
F.535/2 Wood-cellulose Various	.022)	356	356
	.030)		
	.045)		
	.060)		
		<u>2,312¹²/₁₆</u>	<u>2,312¹²/₁₆</u>

Proof Samples -

W.	.046	23	23
	.054	20	20
R.D.N./A.	.029	90	90
	.052	140	140
		<u>273</u>	<u>273</u>

Total Experimental -

Authority	Pressed lb.	Issued lb.
Research Department	2,312 ¹² / ₁₆	2,312 ¹² / ₁₆
Air Ministry	156 ¹² / ₁₆	156 ¹² / ₁₆
Army	10	10
Small Arms Committee	250	250
Ordnance Committee	7,389 ¹² / ₁₆	1,649 ¹² / ₁₆
Proof Samples	273 ¹² / ₁₆	273 ¹² / ₁₆
	<u>10,391⁸/₁₆</u>	<u>4,651⁸/₁₆</u>
Total	<u>5.196 tons</u>	<u>2.326 tons</u>

T.N.T. - The pilot plant was closed down for a considerable part of the year owing to the drought and the difficulty in disposing of sulphite effluent. The plant was restarted in January and a total of 43½ tons of T.N.T. produced.

Some necessary experimental work has been carried out on the plant as regards the use of spent acid for nitration and the corrosion of various metals in contact with the acids used for this manufacture. A separate report, in conjunction with the Supply Board Technical Establishment, has been submitted.

VII. SERVICES.

(a) Steam. The overhaul of the Lower Works main boiler house and the erection of induced draught plant is almost complete. It is expected that this boiler house will shortly be available for steam raising.

Renewals and repairs at the Upper Works main boiler house, as foreshadowed in last year's report, have been somewhat costly during the year, the entire set of superheater tubes in two of the boilers having been renewed, and one of the feed pumps rebuilt with new parts. A CO₂ Recorder and Flue Gas Temperature Indicator have been added to the equipment of this boiler house.

The cost per 1000 lb. of steam, as compared with the two previous years, has been as follows:-

1932/33	96,156,000 lb.	@ 28.19d.	per 1000 lb.
1933/34	116,033,000 lb.	@ 30.09d.	per 1000 lb.
1934/35	130,312,000 lb.	@ 34.61d.	per 1000 lb.

The increase over the previous year is due to the extra cost of coal - 23/- per ton as compared with 19/6d. per ton - renewals and maintenance - 2.54d. as compared with 1.75d. per thousand - and maintenance of mains - 1.87d. as compared with 1.18d. per thousand.

Considerable progress has been made with the renewal, repair and relagging of steam mains, most of which are now in constant use. The total number of additional feet of steam mains thus brought into use during the year amounts to 4,100, while another 4,900 feet have been repaired but not lagged.

It is proposed to instal more steam meters in key positions for more accurate allocation to the different centres.

(b) Electricity. At the Upper Works minor repairs only have been necessary and the plant is in very fair running order.

The cost per unit, as compared with the two previous years, is as follows:-

1932/33	345,502 units	@	2.88d. per unit
1933/34	462,470 units	@	2.92d. per unit
1934/35	526,280 units	@	3.30d. per unit.

Developments at the northern end of the Factory, involving the use of electric motors, will necessitate the laying of another cable in the near future.

VIII. MAINTENANCE.

As indicated in previous annual reports, considerable attention has become necessary to the maintenance of buildings and estate. Many of the buildings erected in the War for temporary purposes are showing an accelerated rate of deterioration, and steps continue to be taken to overtake the work of maintenance. Due regard has been necessary to the possibility of a decision to remove the Factory.

The following major items of maintenance are worthy of mention:-

The modernisation of two Incorporating Houses is nearly complete. These houses were originally Gunpowder houses and the removable panels were open to objections from the point of view of grit being blown through and contaminating cordite paste. These panels have been replaced by "Insulwood" boarding rendered non-inflammable. The ceilings have been lined with the same material and the windows have been glazed with frosted "non-actinic" glass, recommended by Chief Superintendent Research Department, to eliminate from daylight the chemically active ultra-violet rays which have a detrimental effect upon the keeping qualities of cordite.

A major roof repair has been carried out at one Cordite Press House and three Incorporating Houses.

A new Dredger has been purchased, certain work upon waterways being essential for maintenance of output.

Some 4/5000 yards of pathway in the Nitroglycerine area have been renewed by contract, these paths, originally constructed of tarred ash, having become disintegrated. The immediate result will be a more scrupulous cleanliness of the clothing of explosives operatives, and the elimination to a considerable extent of the possibility of grit finding its way into danger buildings from the immediate vicinity.

Consideration has been given to the condition of a number of buildings upon which it is not economical to spend further money in maintenance. Chief amongst these are practically the whole of the buildings formerly used for the manufacture of Gunpowder. A scheme for demolition is in course of preparation. It will be necessary to include in this category a number of buildings formerly used for the manufacture of Nitroglycerine situated in the Lower Works.

IX. COST OF PRODUCTIONS.

The 1934-35 cost of M.D. 5-2 is expected to be 3/9d. per lb. This compares with 3/3½d. for last year. The cost of W.8 (a typical size) is expected to be 3/8d. per lb. against 3/3½d. for last year. The increased cost is attributable to the stoppage of manufacture in the early part of the year, together with the extra expenditure incurred on general maintenance.

X. FACTORY EXPENSE.

The total F.E., as shown in Appendix II, has increased by some £22,000 over last year. In the main, this is due to the accelerated maintenance programme.

The net effect of the decision to bring all Capital Assets, other than redundant items, under the usual depreciation rules, was an increase of some £2,400 under the depreciation heads.

XI. STORES.

The total value of stores held in stock on 31.3.35 was:-

Manufacturing Materials	£56,272
Other Items	16,360
Total	<u>£72,632</u>

This compares with the value of 31.3.34 as follows:-

Manufacturing Materials	£55,603
Other Items	13,907
Total	<u>£69,510</u>

Appendix III shows comparative prices paid for various items as between 1933-34 and 1934-35, also the result of Stocktaking and the sale of Surplus Stores.

During the year the post of Storeholder became vacant owing to the retirement, on account of age, of Mr. Gibbs, and Mr. Chaplin, who has had valuable technical experience in the Laboratory, was promoted to fill the vacancy.

As part of the overhaul of manufacturing conditions for Gun-cotton, the top floor of the building in which initial manufacturing operations are carried out has been specially equipped for the storing of Cotton waste.

Included in this equipment is a special rubber tyred weighing machine, a bale lifter and also an electric hoist which permits unloading direct from the lorry which brings the material straight from the works.

Special arrangements have been made during the year for the inspection of Cotton waste during manufacture by a member of the R.G. P.F. technical staff in conjunction with Chief Inspector of Armaments.

Arrangements are being made for establishing a central dump where all surplus scrap material can be deposited for sale.

Arrangements have been made for requirements for Carbamite to be covered by contracts placed by the Admiralty. The price paid in 1934-35 was £235.2.1d. against £265.0.0d. in 1933-34.

XII. IMPERIAL RESERVE STOCKS.

The stock of Glycerine at the end of the year amounted to some 488 tons, of which 450 tons represents Imperial Reserve.

XIII. GENERAL WAGES QUESTIONS.

The outstanding events of the year were the partial restoration of the Morris Award to Industrial employees and the "half-consolidated" of Civil Service Bonus to Non-industrials, both with effect from 1st July.

The increased activities foreshadowed for the Factory led to a conference with the local Labour Exchange officials, when satisfactory arrangements were arrived at with regard to the supply of labour as and when required.

XIV. AGES OF EMPLOYEES.

The numbers and average ages of employees on 1st April 1934 and 31st March 1935 are given in Appendix IV.

XV. ESTABLISHMENT.

(a) Staff. The Superintendent R.G.P.F. (Colonel P.H. Evans R.A.) retired on 12th July 1934, and I was appointed in succession to him as from that date.

Mr. H.A. Phillips (Managing Chemist) was appointed to the position of Chemical Engineer to the Director of Ordnance Factories in October, the consequential vacancies being filled by the promotion of Mr. P.G. Knapman to Managing Chemist and the appointment of Mr. W.H. Simmons to that of Grade I Chemist.

Two additional Grade II Chemists have also been appointed during the year, namely, Mr. H. Lewis and Mr. S.P. Roach.

(b) Strength. The total strength of the Factory on 31st March 1935 is shown in Appendix V, together with record of ages giving an average of 42.46. This compares favourably with last year's figure of 44.05.

(c) Personnel. Appendix VI gives details of personnel on 31st March 1935 as compared with last year.

XVI. WAR EMERGENCY ACTIVITIES.

As indicated under "Maintenance" above, many war-time buildings are showing an enhanced rate of deterioration, and steps are being taken to overtake the maintenance, subject to the overriding consideration of the possibility of removal of the Factory. Nevertheless, much work has been possible, particularly in maintenance of plant.

The following are amongst the matters on which action is

suspended pending a decision as to the removal of the Factory:-

Provision of Vat House for stabilising Guncotton
(Refce. O.C. Minute B.28,369).
Extra Buildings, Machinery and Plant required
for amendment of maximum commitment
from 240 tons R.D.B. to 240 tons W.
New lay-out for Tetryl manufacture.
Restoration of two Cordite Stoves.
Further progress with Quinan Driers.
Denitration Towers for Spent Acid.
Automatic Telephone System.
New Machinery Shop.

Collaboration with the Supply Board Technical Establishment has been effected continuously, particularly in connection with the T.N.T. Pilot Plant.

The scheme for the emergency supply of electricity at the Lower Works is nearing completion after which overhaul of the existing steam plant will proceed.

XVII. CONCLUDING REMARKS.

The relations with labour continue to be satisfactory. Meetings with the Shop Stewards have been held when considered necessary for the discussion of questions affecting local conditions and employment.

The appointment of two additional Chemists has been recorded under "Maintenance". A departure was made from the normal method of recruitment with a view to obtaining older men with works experience, capable of assuming on shorter training positions in charge of manufacturing sections. It was a matter of difficulty to find suitable candidates and, having regard to the necessity for a knowledge of Danger Building technique, it is felt that reversion should be made as soon as possible to the former method of recruitment for higher posts by training young entrants possessing a University degree or its equivalent. The increase in the scientific staff will be of value in the event of emergency. The experience of the last war showed the dearth of properly trained Chemists for the control of explosives manufacturing operations.

It is gratifying to record that the output programme for the year ending March 31st 1936 will permit a more regular and continuous working of the plant, particularly in the manufacture of Guncotton and ancillary operations.

1934 - 35.

ANNUAL TURNOVER

ROYAL GUNPOWDER FACTORY, WALTHAM ABBEY.

	Parliamentary Estimate	Latest Forecast
	£	£
A. Establishments	4,436	4,260
B. Wages	68,300	70,215
C. Materials	52,376	57,000
D. Machinery, Contract	8,450	5,290
E. Works, Contract	3,038	2,855
F. Miscellaneous	6,200	6,300
G. Non-effective	8,740	8,500
	<u>151,540</u>	<u>154,420</u>
Add - Net effect of Materials on I.D.D.'s	1,490	1,730
	<u>153,030</u>	<u>156,150</u>
H. Productions for Army, Navy, etc.	144,820	157,500
Miscellaneous Receipts	2,400	2,000
Sale of Scrap, Old Stores, and Stores issued on Repayment	1,600	1,400
	<u>148,820</u>	<u>160,900</u>
Less - Net effect of I.D. Services	5,790	6,720
	<u>143,030</u>	<u>154,180</u>
Balance as shown below	10,000	1,970

<u>Incomings</u>	Parly. Est.	Latest F'cast	<u>Outgoings</u>	Parly. Est.	Latest F'cast
Estimated amounts recoverable in respect of:-	£	£	Estimated Expend- iture on New Capital:-	£	£
Depreciation of			Buildings -		
Buildings	2520	3230	Contract	1610	69
Machinery	1575	3245	Departmental	6250	1676
Mains	205	260	Machinery -		
Write Offs -			Contract	6950	2810
Machinery	250	175	Departmental	2225	1000
Decrease of			Mains -		
Stores in Stock	2985	-	Contract	476	-
Transfer from			Departmental	24	125
Supplies Suspense			Land	-	-
Account	10000	1970	Increase of		
			Stores in Stock	-	3200
	<u>17535</u>	<u>8880</u>		<u>17535</u>	<u>8880</u>

R.G.F.F. WALTHAM ABBEY.

FACTORY EXPENSES.

<u>Description</u>	<u>1934-35</u> <u>Amount</u>	<u>1933-34</u> <u>Amount</u>
	£	£
<u>Process Expenses.</u>		
Foremen, Asst. Foremen, etc.	2220	2172
Miscellaneous Labour	1134	779
Consumable Stores	708	654
Gas	21	12
Water	21	20
Steam (Process)	6937	4318
Power	4995	3881
Refrigeration	3749	2328
Compressed Air	3097	2418
Maintenance of Plant	15589	9884
Maintenance of Buildings	4461	2825
Depreciation	1394	827
Rates	192	182
Internal Transport	990	895
Balance of Process Expenses	2537	1595
 <u>Sectional Expenses.</u>		
Management	2735	2696
Electric Light	628	371
Gas	74	68
Steam for heating	2540	3007
Maintenance Services	2065	1665
Miscellaneous Labour	560	349
Laboratory Testing	3085	3033
Care and Custody of Departmental Stores	205	190
Allowances	2193	1761
Overtime and Night Shift Bonus	190	177
Balance of Sectional Expenses	1772	1413
Credit for Materials returned to store	490	324
 <u>General Expenses.</u>		
Superintendence	546	580
Registry, Pay and Order Branches	353	284
Worktakers, Wages and Accounts	829	739
Central Stores	3010	2015
Police, Fire Brigade and Warders	4205	4173
Maintenance of Grounds, Mains, Canal, Permanent Way, etc.	9712	5311
Non-effective Charges	5493	4988
Balance of General Expenses	20138	20261
	<hr/>	<hr/>
Total	107888	85547
Less Subsidy	14873	14150
	<hr/>	<hr/>
Total Factory Expenses	93015	71397
Percentage to Direct Labour	641.70	661.39
	<hr/>	<hr/>
Direct Labour	£ 14495	£10795
	<hr/> <hr/>	<hr/> <hr/>

R.G.P.F. WALTHAM ABBEY.

MATERIALS.

Price per ton of Main Items (Average Prices given
if more than one Contract).

<u>Material</u>	<u>1933-34</u>			<u>1934-35</u>		
	£	s.	d.	£	s.	d.
Acetone	56	8	0	58	8	0
Cotton Waste	51	7	6	56	14	0
Glycerine	46	0	0	50	0	0
Mineral Jelly	11	10	0	10	7	6
Sodium Nitrate	7	15	0	7	15	0
Ammonium Nitrate *	18	0	0	17	18	6
Carbamite	265	0	0	235	2	1 [¢]
Sodium Sulphite	9	10	0	9	2	6
Calcium Cyanamide	9	0	0	9	0	0
Mono-Nitro-Toluene	54	0	0	45	0	0
Acid Sulphuric - 20%	6	1	0	6	1	0
65%	8	11	0	8	11	0
98%	6	1	0	6	1	0
96%	6	1	0	5	19	9
Acid Nitric 98%	20	2	6	19	10	0
Lead Chemical - Sheet	18	10	0	16	16	8
Pipe	19	0	0	15	10	6
Coal, Mechanical Stoker	18	10 ^½		1	0	10 ^½

*Supply from Army Stocks.

[¢]Supply arranged by Director, Navy Contracts.

STOCKTAKING.

<u>Value of Stock</u>		<u>Value of Stock Checked</u>		<u>Nett Surplus</u>
<u>This Year</u>	<u>Last Year</u>	<u>This Year</u>	<u>Last Year</u>	
£	£	£	£	£
72,632	69,510	61,311	13,576	37

The surplus of £37 revealed in Stocktaking
is equivalent to .06% of the value of stock taken.

SALE OF SURPLUS STORES.

<u>Total Amount Realised</u>	<u>Nett Loss</u>
£	£
1,645	1,084 *

*This loss is largely accounted for by loss on
sale of Dimethylaniline.

APPENDIX IV.

<u>Age</u>	<u>Nos. on 1.4.34</u>	<u>Nos. on 31.3.35</u>	<u>Age</u>	<u>Nos. on 1.4.34</u>	<u>Nos. on 31.3.35</u>
65	-	-	39	6	14
64	12	4	38	10	13
63	9	8	37	5	8
62	8	12	36	8	8
61	12	11	35	2	8
60	15	12	34	4	9
59	14	13	33	4	11
58	13	14	32	9	11
57	12	11	31	10	13
56	21	26	30	7	12
55	17	9	29	13	14
54	9	14	28	7	14
53	16	9	27	10	10
52	13	18	26	10	14
51	16	13	25	11	15
50	7	7	24	12	7
49	9	6	23	5	11
48	4	7	22	8	11
47	4	6	21	9	4
46	6	13	20	3	4
45	10	10	19	3	5
44	8	10	18	2	2
43	5	7	17	1	3
42	4	8	16	-	3
41	7	8	15	1	1
40	3	6	14	1	1
				<u>415</u>	<u>488</u>
			<u>Average Age</u>	<u>44.05</u>	<u>42.46</u>

APPENDIX V.

H.G.F.F. WALTHAM ABBEY.

TOTAL STRENGTH on 31.3.35.

	<u>Nos.</u>	<u>Percentage</u>
60 and over	51	10.45
Over 50 and under 60	133	27.25
Over 40 and under 50	81	16.60
Over 30 and under 40	110	22.54
Over 21 and under 30	96	19.68
Under 21	17	3.48
	<u>488</u>	<u>100.</u>

APPENDIX VI.

R.G.F.F. WALTHAM ABBEY.

PERSONNEL - 31.3.35.

	<u>Total this Year</u>	<u>Total last Year</u>
Supervisory, etc.	49	45
Skilled	66	78
Semi Skilled	79	81
Unskilled	279	202
Women and Girls	-	-
Boys	15	9
	<hr/>	<hr/>
	488	415
	<hr/>	<hr/>
Highest	488	415
Lowest	398	291
Average	441	354
Entries during the year	133	131
Discharges during the year	63	5
Transfers during the year	23	17

(Transfers "In" - 13
"Out" - 10).

W32A/14

22nd July, 35.

Dear Phillips,

The following are, I think, the main points of the Annual Report which deserve stressing:-

1. Establishment of the manufacture of Cordite W.
2. New method for straining Cordite.
3. Increase of 50 tons production over last year's activities.
4. Experiments on a new type of potcher.
5. Attention to foreign matter in Guncotton.
6. Development of a Quinan stove for drying Guncotton.
7. Investigations into possible substitution of tubular "W" Cordite for M.D.T. 5-2.
8. Establishment of methods introduced in the manufacture of Picrite at R.G.F.F.
9. Decision to instal continuous inspection of Cordite: installation of C.I.A.'s examiners.
10. Accelerated rate of deterioration of buildings.
11. Development of programme for the best treatment of woodlands.
12. Modernisation of Incorporating houses with use of "Insulwood" boarding rendered non-inflammable: use of non-actinic glass.
13. Inability to take decisions as to emergency commitments pending decision on the removal of the factory - see for example list on page 24 of the report.
14. Satisfactory to note output programme for next year will permit of more regular working of the plant.

I am afraid this is rather a big bunch, but I have no doubt that you will be able to make a satisfactory selection.

*Note also connection
to pipid with installation
of Rotary bonnets.*

Yours sincerely,

P. H. Bowden

H. A. Phillips, Esq.,
Room 401, War Office.

ANNUAL REPORT - GUNCOTTON SECTION - 1934-35.

ACIDS.

Following the programme of plant repairs mentioned in last year's report, a scheme has been prepared for the denitration of the whole of the weak waste acid produced from an emergency output. The recovery capacity of the existing acid factories was found to be so low that the opportunity of replacing stills by a more modern process could not be overlooked. Accordingly detailed plans for plant and buildings costing some £10,000 have been evolved for a tower system. In view of this change, acid storage tanks used as charge tanks for stills have been abandoned, and all waste acid from the nitrating house, together with all weak nitric acid from the acid factory, are passed into the main storage tank on ground level.

In No.1 Nitric Acid Factory the framework supporting acid pipes leading from the retorts to the coolers has been repaired throughout, using an improved system of "T" irons resting on timber joists. The fan difficulty reported to have arisen in connection with the Calder-Fox Scrubber was investigated by one of the patentees and it was stated that the use of the scrubber with a concentrator built on a transverse barrier saturex departed so far from the conditions originally observed, i.e. longitudinal barriers, that the character of the acid mist had changed profoundly and could no longer be easily removed. The scrubber has been reconnected to the original type of plant and an investigation of its efficiency is proceeding.

There has been unusually heavy expenditure on stoneware receivers for waste acid at the nitrating house. During experimental nitrations for C.S.R.D. "fires" occurred twice and the hot acid split the receiver. Their replacement required an extremely awkward lift, and as the house was in need of extensive repair the front was renewed in removable panels.

GUNCOTTON.

Attention has been focussed on the failure of the idle vat houses to comply with specification conditions in so far as they do not contain separate loading and unloading platforms. Conversion to the required lay-out could not be effected with any degree of success, and a new vat house has been designed to hold 70 vats, the estimated cost being about £50,000. This house would replace the three existing houses and be of modern construction, and erected on a more convenient site. A new pattern Guncotton truck has been evolved to meet criticism of danger from wood splinters. It consists of an aluminium body fitted with a brass fender and mounted on an oak bogie. No woodwork extends above the bogie so that there is now no possibility of contamination from this source.

Following C.I.A.'s recommendation that a certain amount of blending should be carried out, it was realised that the largest convenient blend for a peace-time output would be 2 tons, and it was decided to combine the operation of potching and blending in one vessel. The first attempts to devise a 2-ton potcher on a laboratory scale followed established practice, employing a pump to circulate around an elliptical vessel. The capacity of the pump would need to be impracticably larger to ensure proper mixing in this type of vessel, and after a detailed investigation into the properties of Guncotton suspensions, a new type of potcher is under consideration in which a high circulating velocity is achieved by injecting the pump discharge tangentially into a circular vessel.

During the year the inspection of cotton waste manufacture has been carried out at contractors' premises. Certain improvements were recommended by C.I.A. at Spencer & Curedale's works and the satisfactory observance of specified conditions was ascertained at this factory and at the Cotton Cellulose Co.'s works. Incidentally it became apparent that raw cotton could be processed at the R.G.P.F. with a substantial saving on contractors' prices.

Particulars of Manufacture.

<u>Nitric Acid.</u>	Soda Nitrate charges	96 at 2 tons	
	,,	28 at 1½ ,,	
	,,	8 at 1 ton	= 240 tons
	Total Soda Nitrate charged	271.04 S/Tons Crude	
		269.73 ,,	Pure
	Equivalent HNO ₃	199.84 ,,	
	Nitric Acid produced	217.85 ,,	at 89.56%
		195.12 ,,	HNO ₃
	Loss	4.72 ,,	
	Efficiency	97.63%	
	Strong Sulphuric Acid used	260.11 S/Tons at 93.36%	
		242.94 ,,	H ₂ SO ₄

Redistillation.

	Acid charged = 1443.75 S/Tons containing -	
		904.65 S/Tons H ₂ SO ₄
		263.96 ,, HNO ₃
		286.14 ,, H ₂ O
	Strong Nitric Acid recovered	286.10 ,, at 90.2%
		258.16 ,, HNO ₃
	Loss	5.80 ,,
	Efficiency	97.8%
	Weak Sulphuric Acid recovered	1125.4 S/Tons at 79.4%
		894.1 ,, H ₂ SO ₄
	Loss	10.55 ,,
	Efficiency	98.80%

Concentration of Weak Sulphuric Acid.

	Acid charged to Concentrator	1007.36 S/Tons at 81%
		815.28 ,, H ₂ SO ₄
	Strong Sulphuric Acid produced	868.95 ,, at 92.6%
		804.37 ,, H ₂ SO ₄
	Loss	10.91 ,,
	Efficiency	98.70%

Nitration.

No. of Sets of Guncotton	2266	
,, Nitro Cotton	55	
,, Straw and Wood Cellulose	20 $\frac{3}{4}$	
Mixed Acid used	4130.38	S/Tons
Cotton Waste used	130.52	,,
Straw and Wood Paper used	.83	,,
Guncotton produced	219.30	,,
Saveall	4.206	,,
Yield	167.3%	Available for Cordite 164.1%
Ratio Mixed Acid/Cotton Waste	31.46	
Mixed Acid/Guncotton	18.89	

Guncotton, etc., issued to Services other than for Cordite

Manufacture.

6200	1 lb. Guncotton Slabs Wet to C.O.O., Bramley
	36 lb. Guncotton Dust to Armstrong-Vickers
	400 lb. Nitro Cotton to C.S.R.D., Woolwich
	50 lb. Wood Cellulose ,,
	215 lb. Straw Paper ,,
500	1 lb. Guncotton Slabs, Wet, to C.O.O., Bramley
	<u>Total - 7401 lb. = 3.7005 S/Tons.</u>

Fuze Powder R.D. .202.

Reblended	46 lb.
Manufactured	656 $\frac{1}{2}$ lb.
Ammonium Perchlorate (Crude)	784 lb. (Refined)

Raw Materials.

Oleum drawn from Store t. c. lb. = 396.75 S/Tons
 354 4 82
 Difference in Stocks 83.30 ,,
 Oleum consumed 313.45 ,,
= 1.429 per lb. of Guncotton.

Nitrate of Soda drawn from Store 242 T. = 271.04 S/Tons
 Difference in Stocks 10.54 ,,
 Nitrate of Soda consumed 260.50 ,,
= 1.188 per lb. of Guncotton.

Cotton Waste drawn from Store t. c. lb. = 145.36 S/Tons
 129 15 80½
 Deduct Oil and Moisture (7.00%) 10.17 ,,
 ,, Pickings and Fly 4.665 ,,
 Nett Cotton Waste used for Nitration 130.525 ,,

Foreign Matter Removed in Picking, etc.

Wood, String and Metal 1067 lb. = .3945%
 Grit 62 lb. = .0229%
 Fly 8201 lb. = 3.0330%
 Cotton used per lb. of Guncotton (0.6630 Gross
 (0.5948 Nett

	H ₂ SO ₄		HNO ₃	
	Actual	Per ton of G/C	Actual	Per ton of G/C
Manufacture of Nitric Acid	S/Tons 242.94	S/Tons 1.108	S/Tons 4.72	S/Tons .0215
Redistillation	10.55	.0492	5.80	.0264
Concentration	10.91	.0497	-	-
Nitration	43.95	.2005	181.57	.8282
Washing out Plant	20.75	.0965	-	
	329.10	1.5039	192.09	.8761

*W. Kellieck
 30.4.75.*

R.G.P. Annual Report

Departmental Memo. No. *W 324/14.*

Minutes to be numbered consecutively.

Sheet No.

M.B.,

ANNUAL REPORT - FIRE BRIGADE - 1934-35.

I have to report that during the year ending 31st March 1935, inspections have been made of all fire appliances and equipment, and I certify them to be in good working condition.

Three fire calls have been attended during the year comprising Cordite Dining Room (escape of gas), Central Stores (spontaneous combustion of oily rags in iron bin) and C.E. Nitrating House; in the latter case a hydrant was used to extinguish the fire, in the former cases the damage was very slight.

The London County Council's Bi-annual inspection of Fire Appliances and Fire Prevention of the Factory took place on the 23rd May 1934. The following tests of fire appliances were carried out in the Inspector's presence with satisfactory results:- 1 Petrol Fire Pump, 1 Hydrant, 4 lengths of Hose and 1 Chemical Fire Extinguisher. His recommendation that adaptor hose connections be added to the fire appliances has been complied with, five adaptors having been purchased. Also four "Foamite Fire-foam" extinguishers have been added to the Fire Brigade equipment during the year.

Generally throughout the factory Fire Rules and precautions are well observed and the general condition of the Factory as regards fire risks has been improved by the cutting down of undergrowth etc.

All fire hydrants are tested half-yearly; two have been renewed during the year. Petrol Fire Pumps have been subjected to pumping tests and are in a satisfactory condition. All fire hose has been tested; 15 lengths were condemned and renewed.

Fire squads have attended regularly and carried out their drills with entire satisfaction.

An inspection as regards fire risk from workshops etc. in Quarters, House and Cottage property was carried out and all was found clean in accordance with the regulations.

P. H. Poole
A. J. B.O.
11/4/35

A.F.B.O.

Notes. file. May 1935

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ANNUAL REPORT ON THE MANUFACTURE OF CORDITE

1934 - 35.

The output of Cordite from the presses during the year has been approximately 310 tons (2000 lb.), an increase of 25 tons over last year's production.

Of this output, 61% has been pressed on the small screw presses and 39% on the hydraulics. Last year the ratio was 49% small screw and 51% hydraulics.

In addition to normal manufacture 5.2 tons of Experimental Cordite has been produced.

The number of men employed has varied between 61 and 110, the average being 86.3.

It is to be noted that 36 of these men have been taken on during the year and 34 during 1933-34 and, in consequence of this large proportion of new labour, the output per man-hour has been slightly less than normal.

The number of lads on the section has been increased from 5 to 10.

Sickness has been about normal at 1.9%.

The labour recruited from the Labour Exchange has not been very satisfactory; two men have had to be discharged and one severely cautioned for unsatisfactory work. The type of man supplied is far from ideal for explosives work; on the other hand the lads taken on have proved to be very satisfactory.

The following buildings have been in use during the year and are in the stated state of repair

<u>Buildings.</u>	<u>State of Repair.</u>
<u>Paste Stores</u> Nos. 3, 4, 5 and 6	Good, except for No.3, the surrounds and approach require tar paving, general condition very fair.
<u>Incorporating Houses</u> Nos. 7, 8 and 2	Nos.7 and 8 are under re-construction. No.2 has been overhauled completely during the year but is not yet reconstructed.
<u>Dough Stores</u> Nos. 1, 2, 3 and 4	Nos. 1, 2 and 3 in good repair, except for platforms and rails. No.4 requires overhauling.

<u>Buildings.</u>	<u>State of Repair.</u>
<u>Acetone and Jelly Store</u> No.2	In good repair. Drum handling area requires concreting - this was requisitioned on 22.8.34 but has not yet been done.
<u>Press Houses</u> No.3 - Bays 1,2,4,5, 6 and 7.	In good repair. <i>Bay 3 is also in good repair but has not been used.</i>
No.10 - Bays 2,3,4 & 5	In fair repair. Roof requires overhaul.
No.6 - Bay 6 (Carbamite) Bays 1,2 and 3 (Experimental)	In good repair. In poor condition.
<u>Reel Stoves</u> Nos. 1 and 2	In good repair; have been thoroughly overhauled during the year.
<u>Reel Store</u>	In good repair, but traverse low.
<u>Tray Stoves</u> Nos. 5,6,7,8,9,10,11, 12,13,14,15 & 16	In fair condition.
<u>Box House</u>	In fair condition.
<u>Blending Houses</u> Nos. 1,2,3,4 and 7	In good repair, except for No.4, this requires thorough overhaul. The approach to No.3 is bad.
<u>Magazines</u> Nos. 1 and 3	In good repair; rails and approach to No. 3 bad.
<u>Reeling House</u>	A thorough overhaul of this building has been carried out during the year. In good repair.

In general the Upper Works is in fair repair, but at the Lower Works the connecting paths and railway system are still in a poor state of repair, the towing paths are especially bad, no repairs to these paths having been carried out during the year. The Black Ditch requires dredging near Stoves 5 - 8.

Boat No. 3 has been taken into use. Nos. 14 and 15 which have been condemned are still in use.

The following accidents to plant, etc. have been recorded during the year:-

- (1) Two large tray trucks containing W. 15 and 4 $\frac{1}{2}$ derailed and overturned near No.1 Blending House, 29.8.34.

- (2) Truck containing cases of M.D.T. 5-2 derailed and fell on its side just south of Lower Island Lock, 15.11.34.
- (3) Dough truck derailed and fell into plantation near No. 1 Solvent Store, 1.1.35.
- (4) Tray truck containing W. 2 $\frac{1}{4}$ and 4 $\frac{1}{4}$ derailed and overturned near No.1 \odot Press House, 16.1.35.
- (5) Bolt of safety catch of Incorporating Machine No.373, Bay 6 No.7 House, fractured, 20.2.35.
- (6) Plunger jammed of No. 121 Small Screw Press, Bay 3 No.10 Press House, 16.3.35.

No ignitions were recorded.

MANUFACTURE.

M.D. Cordite. The manufacture of M.D.T. has progressed quite normally, except for one period during July and August when very heavy weights per 100" combined with an extremely sticky cord reduced the output of the Reeling House very considerably and gave increased waste and irregular cords.

Several lots had to be 43 stranded.

W. Cordite. A new system of filtering cordite has been successfully ~~int~~roduced this year for hydraulic and small screw presses, all W. output since the closed period has been pressed through the new system. A separate report on this system has been issued. P-16

Experiments have been successfully concluded in reducing the quantity of solvent required by W. cordite and a 33% solvent can be introduced for the hydraulic presses instead of the normal 36%. The small screw presses would not take the extra pressure required for extrusion and 36% will have to be retained for these presses.

A temperature of 35 $^{\circ}$ for incorporation has been used throughout the year.

New packing tables designed to reduce the amount of cordite getting on to the floor have been introduced at No.3 Press House and have proved very satisfactory for size 8.

Two lots have been rejected for oversized sticks, WAC 17 W. size 15, and WAC 20 W, size 8, and one lot has had 3 lb. of

heavy sticks rejected and the remainder accepted, WAC 28, W.054.

Lots WAC 17 and 20 were returned and resubmitted after oversized sticks had been eliminated.

Mark I and R.D.N./A. Normal manufacture.

Considerable experimental work has been carried out during the year, chiefly for C.S.R.D. and the Ordnance Committee; a summary of the quantities produced of each type of cordite is appended.

Experimental Batches 1934-35.

For Service of Ordnance Committee.-

	Size	Pressed lb.	Issued lb.
R.D.B. reworked with Carbamite	8	93	93
" "	"	145	-
M.D. reworked with Carbamite	8	5,745	150
M.D. and M.D.T. Straw Cellulose	16) 5-2)	24	24
W. Various	15-13) 2 1/4) 4 1/4) 8) 15) .029)	301 8/16	301 8/16
W. Cotton) Wood) with impregnations Straw)	2 1/4 () 16 ()	123 114 8/16 138 16/16	123 114 8/16 138 16/16
W. Cotton) Wood) Various Straw)	2 1/4) 4 1/4) 8) 5-2) chopped 5-2)	228 207 12/16 216 16/16	228 207 12/16 216 16/16
W. and W.T. Straw Cellulose	16) 5-2)	24	24
R.D.N./A. Straw Cellulose	.042	15	15
F.535/2 Straw Cellulose	.045	15	15
		<u>7,389 12/16</u>	<u>1,649 12/16</u>

For Service of Small Arms Committee.-

M.D.	.048	<u>250</u>	<u>250</u>
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For Service of Research Department.-

	<u>Size</u>	<u>Pressed lb.</u>	<u>Issued lb.</u>
M.D.T.	.047-.016)	20	20
M.D.T.	.050-.019)		
M.C.T.	5-2	18	18
W.T. Various	5-2	10	10
W.T. ,,	5-2	60	60
W.T. ,,	5-2	25 $\frac{12}{16}$	25 $\frac{12}{16}$
W.	.054/9.75	200 $\frac{12}{16}$	200 $\frac{12}{16}$
R.D.N./A.	.042/33	500	500
R.D.N./A.	.042	500	500
R.D.N./A.	.042	75	75
R.D.N./B.	.042	75	75
R.D.N./C.	.042	73	73
R.D.N./A.	.040/10.5	200	200
R.D.N./A.	.042/10.5	200	200
F.535/2 Wood Cellulose	.022)		
Various	.030)	356	356
	.045)		
	.060)		
		<u>2,312$\frac{12}{16}$</u>	<u>2,312$\frac{12}{16}$</u>

For Service of Air Ministry.-

H.P.T.	.091-.045	<u>156</u>	<u>156</u>
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For Service of Army.-

M.D.T.	7-2	<u>10</u>	<u>10</u>
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Proof Samples.-

W.	.046	23	23
W.	.054	20	20
R.D.N./A.	.029	90	90
R.D.N./A.	.052	140	140
		<u>273</u>	<u>273</u>

Total Experimental.-

<u>Authority</u>	<u>Pressed lb.</u>	<u>Issued lb.</u>
C.S.R.D.	2,312 $\frac{12}{16}$	2,312 $\frac{12}{16}$
Air Ministry	156	156
Army	10	10
Proof Samples	273	273
Small Arms Committee	250 $\frac{12}{16}$	250 $\frac{12}{16}$
Ordnance Committee	7,389 $\frac{12}{16}$	1,649 $\frac{12}{16}$
Total	<u>10,391$\frac{8}{16}$</u>	<u>14,651$\frac{8}{16}$</u>
TOTAL	<u>5.196 tons</u>	<u>2,326 tons.</u>

A summary of the Raw Materials used, and the Cordite and sizes produced, issued, etc., follows:-

Table I - Raw Materials.-

	<u>W.</u>	<u>M.D.</u>	<u>Mk.I</u>	<u>RDN/A</u>	<u>Exptl.</u>	<u>Total</u>
Acetone	131,599	87,285	920	5,583	3,189	228,576
Min. Jelly	-	11,649 $\frac{13}{16}$	195 $\frac{11}{16}$	-	1 $\frac{8}{16}$	11,847
Carbamite	22,051 $\frac{8}{16}$	-	-	2,354 $\frac{5}{16}$	295 $\frac{3}{16}$	24,701
Paste	348,899 $\frac{5}{16}$	223,440	3,705	28,693 $\frac{8}{16}$	2,687 $\frac{5}{16}$	607,425 $\frac{2}{16}$
Rework	-	-	333 $\frac{1}{16}$	-	6,364 $\frac{4}{16}$	6,697 $\frac{5}{16}$
	502,549 $\frac{13}{16}$	322,374 $\frac{13}{16}$	5,153 $\frac{12}{16}$	36,630 $\frac{13}{16}$	12,537 $\frac{4}{16}$	879,246 $\frac{7}{16}$
				Less Acetone		228,576
				Total Incorporated Material (not including Acetone)		650,670 $\frac{7}{16}$

Table I-A.

Nitro-Glycerine Charge Nos.	680 - 738
Guncotton Batches	1469 - 1675
Nitro-Cotton Batches	25 - 28
Picrite Batches	348 - 418
Acetone Consignment Nos.	2423 - 2425
Mineral Jelly Consignment Nos.	187 - 189
Carbamite Consignment Nos.	9 - 14

Table II - Material Incorporated.-

M.D. Dough	235,089.13/16 lb.
Rework	-
Mark I Dough	3,900.11/16
Rework	333.1/16
R.D.N./A. Dough	31,047.13/16
Rework	-
W. Dough	370,950.13/16
Rework	-
Exptl. Dough	2,857.8/16
Rework (various)	6,490.12/16
Total	650,670.7/16 lb.

Table III (A) - Cordite Pressed - Small Screw Presses.-

<u>Small Arms</u>	<u>lb.</u>	<u>lb.</u>
M.D.T. 5-2	227,355	
7-2	3,100	230,455
Mark I 1/.05	2,745	
3	380	
20/S.C.	771	3,896
<u>Cannon.</u>		
R.D.N./A. .029	9,320	
.042	9,405	
.052	9,142	27,867
W. .046	7,760	
.036	69,000	
.016	28,420	
.154-.136	10,650	115,830
		<u>378,048</u>

Experimental and Proof Samples

R.D.B. Rework	93	
M.D. and M.D.T.	304	
M.C.T.	18	
R.D.N./A., B. and C	1,853	
H.P.T.	156	
F.535/2	371	
W. and W.T.	1,250 ⁸ / ₁₆	4,045 ⁸ / ₁₆
		<u>382,093⁸/₁₆</u>

Table III (B) - Cordite Pressed - Hydraulics.

<u>Cannon.</u>	<u>lb.</u>	<u>lb.</u>
W. .124	6,400	
.098 and .093	24,975	
.054 and .057	210,517	
	<hr/>	241,892
<u>Experimental.</u>		
R.D.B. Rework	160	
M.D. Rework	5,745	
W.	441	
	<hr/>	6,346
		<hr/> 248,238
		<hr/>
	Grand Total	630,331 $\frac{8}{16}$

ef

Table IV - Cordite Issued.

<u>Small Arms</u>	<u>lb.</u>	<u>lb.</u>
M.D.T. 5-2	242,392	
7-2	7,800	
	<hr/>	250,192
Mark I 1/.05	2,745	
3	380	
20/S.C.	1,790	
	<hr/>	4,915
<u>Cannon.</u>		
R.D.N./A. .029	9,020	
.042	10,070 $\frac{8}{16}$	
.052	9,142 $\frac{8}{16}$	
	<hr/>	28,232 $\frac{8}{16}$
W. .124	6,400	
.098	22,495	
.054 & .057 & .046	232,317	
.036	55,855	
.016	21,035	
.154-.136	5,214	
	<hr/>	343,316
<u>Experimental and Proof Samples.</u>		
R.D.B. Rework	93	
M.D. and M.D.T.	454	
M.C.T.	18	
R.D.N./A., B. & C.	1,868	
H.P.T.	156	
F.535/2	371	
W. and W.T.	1,691 $\frac{8}{16}$	
	<hr/>	4,651 $\frac{8}{16}$
	Total	631,307

Table V - Percentage Loss, etc.

	<u>M.D.</u>	<u>W.</u>	<u>Mark I</u>	<u>R.D.N./A.</u>
Paste Used	223,440	348,899 $\frac{5}{16}$	3,705	28,693 $\frac{8}{16}$
Mineral Jelly or Carbamate added	11,649 $\frac{5}{16}$	22,051 $\frac{8}{16}$	195 $\frac{11}{16}$	2,354 $\frac{5}{16}$
Stock Rework, 31.3.34	6,050	2,040	125	38
	<u>241,139$\frac{5}{16}$</u>	<u>372,990$\frac{13}{16}$</u>	<u>4,025$\frac{11}{16}$</u>	<u>31,085$\frac{13}{16}$</u>
Cordite Produced	230,735	358,060 $\frac{12}{16}$	3,896	29,497
Stock Rework, 31.3.35	9,310	8,100 $\frac{12}{16}$	34 $\frac{15}{16}$	900
	<u>240,045</u>	<u>366,160$\frac{12}{16}$</u>	<u>3,930$\frac{15}{16}$</u>	<u>30,397</u>
Loss	<u>1,094$\frac{5}{16}$</u>	<u>6,830$\frac{1}{16}$</u>	<u>94$\frac{12}{16}$</u>	<u>688$\frac{13}{16}$</u>
Percentage Loss	0.47%	1.84%	2.43%	2.22%
Percentage Azetone Used	37.13%	35.46%	21.73%	17.98%
Percentage Mineral Jelly) or Carbamate Used)	4.96%	5.94%	5.02%	7.58%

NOTE: The percentage loss on W. Cordite is slightly higher than normal owing to the amount of work-up (800 lb.) burnt when manufacture was closed down at the beginning of the year. The amount of Rework arising during W. manufacture is high owing to 2,118 lb. included which was picked out of the rejected lots WAC 17 and 20.

QWR 11/4/35

ANNUAL REPORT - 1934 - 35.

NITROGLYCERINE SECTION.

Manufacture of nitroglycerine, stoving of guncotton and paste mixing has proceeded throughout the year without any difficulty.

The use of the new large silica denitration tower was suspended in the middle of the year. It had served for the examination of the suitability of silica as constructional material but was not large enough for rapid denitration of waste acid.

During the year much work has been carried out on getting buildings, plant and paths into a good condition. The erection of a Quinan guncotton stove is proceeding.

Repurification of Tetryl to Crystal and Corned C.E. has been carried out, and in the latter part of the year nitration of tar oil to fresh C.E. has recommenced.

Picrite manufacture has proceeded satisfactorily.

During the year manufacture of T.N.T. in the experimental "pilot" continuous plant has continued and valuable information has been gained respecting the running of this process.

The following is a record of the year's work in the individual processes.

A. Manufacture of Nitric Acid.

Retorts used were -

No.10 - 57 runs at 30 cwts. of Nitrate of Soda
No.11 - 57 runs at 30 cwts. " " "
Average time of distillation - 14 hours.

Materials and Results -

✓ Nitrate of Soda used	- 191.52 Sh.tons	at 99.40% NaNO ₃
✓ C.O.V. used	- 131.64 ,,	at 88.3% H ₂ SO ₄
✓ Oleum used	- 65.25 ,,	at 20% SO ₃
Coke	- 31.79 ,,	
N.A.issued to C.E.) Nitration)	- 11.152 ,,	(9.635 s/tons HNO ₃)
✓ Strong Nitric Acid made	128.96 ,,	at 91.2% HNO ₃
✓ Weak " " "	28.49 ,,	at 60.7% " "
Nitre Cake produced	230.0 ,,	at 33.19% H ₂ SO ₄
✓ Efficiency Strong Acid	- 85.8%	
✓ Total Efficiency - Process	- 96.0%	
Overall	- 96.0%	

B. Denitration of Waste Acid.

30 charges were denitrated in Nos. 1 and 2 Towers
26 charges with 12.614 tons weak Nitric Acid were denitrated
in the new silica Tower.

Output.

New Tower - Waste Acid denitrated	76.00 s/tons		
Weak Nitric Acid Added	12.614	,,	at 66.1% HNO ₃
Denitrated Sulphuric Acid made	85.125	,,	at 63.9% H ₂ SO ₄
Nitric Acid recovered	6.112	,,	at 83.1% HNO ₃
	17.570	,,	at 55.5% HNO ₃
Old Tower - Waste Acid denitrated	91.50	,,	
No. 1 Denitrated Sulphuric Acid made	93.827	,,	at 71.0% H ₂ SO ₄
Nitric Acid recovered	14.932	,,	at 55.8% HNO ₃

Efficiencies - Sulphuric Acid 100%
Nitric Acid 86.0%

C. Concentration of Weak Sulphuric Acid.

Nos. 2 and 3 Concentrators were used.

Output.

Weak Acid concentrated	-	287.459 s/tons	at 64.4%
Strong Acid made	-	179.854	,, at 89.3%
Weak Acid made	-	45.000	,, at 42.8%
Coke used	-	35.42	,,

Efficiency - Strong Acid 85.2%
Total - Process 97.00%
Overall 95.8%

D. Redistillation of Weak Nitric Acid.

The concentration of weak Nitric Acid by adding it to Waste Acid before denitrating in the new large tower ceased in the middle of the year and redistillations recommenced, using Still No. 4 (14 hours average time of Distillation).

Output.

Weak Nitric Acid redistilled	-	37.216 s/tons	at 58.5%
Strong Sulphuric Acid used	-	50.025	,, at 92.8%
Strong Nitric Acid made	-	17.653	,, at 88.9%
Weak Nitric Acid made	-	8.990	,, at 57.8%
Sulphuric Acid recovered	-	65.170	,, at 70.8%
Coke used	-	6.608	,,

Efficiencies - Nitric Acid, strong, 72.5%
Total, Process 96.0%
Sulphuric Acid 99.50%

E. Acid Mixing.

Output.

Nitric Acid, New, Mixed	112.959 s/tons	at 91.8%
Nitric Acid, Redistilled, Mixed	22.347	at 87.5%
Oleum 20% mixed	69.000	at 20% SO ₃
Oleum 65% mixed	64.500	at 65% SO ₃
Total mixed Acid made	268.806	

F. Manufacture of Nitroglycerine.

56 Charges of 1470 lb. Glycerine each were nitrated. Average time of nitration was 71 minutes, of separation 178 minutes and temperature of brine-11.5° C.

Materials and Output.

Glycerine nitrated	41.160 s/tons
Mixed Acid used	231.000
Waste Acid made	167.500
Soda Ash used	3.14
Nitroglycerine made	96.237

Yield - 233.81%

Summary of Tests.

	<u>Maximum</u>	<u>Minimum</u>	<u>Average</u>
Moisture	0.48%	0.22%	0.27%
Heat Test	13 mn	10 mn	11 mn
Alkalinity	All under 0.0005%		

Nitroglycerine was used as follows:-

For Cordite M.D.	35.197 s/tons
" W.	55.641
" Mark I	1.133
" R.D.N./A.	3.279
For Dynamite	0.585
For various experiments	0.401

Summary of Consumption and Losses of Acids.

	<u>H₂SO₄</u>		<u>HNO₃</u>	
	<u>Actual s/tons</u>	<u>Per ton N/G</u>	<u>Actual s/tons</u>	<u>Per ton N/G</u>
Manufacture of Nitric Acid	131.2	1.363	-	-
Denitration	2.951	0.031	2.495	0.026
Redistillation	0.231	0.0024	0.872	0.0091
Concentration	7.681	0.080	-	-
Acid Mixing	6.48	0.067	10.49	0.109
Nitration	4.869	0.051	81.650	0.848
	<u>153.412</u>	<u>1.594</u>	<u>95.51</u>	<u>0.992</u>

Raw Materials used.

Nitrate of Soda used	1.409 per ton Nitroglycerine
Oleum 20%	0.890
Oleum 65%	0.577
Glycerine	0.427
Soda Ash	0.0326

G. Drying and Weighing Guncotton and Nitrocotton.

82 Stovings of Guncotton and 2 stovings of Nitrocotton were dried. Average time of drying 67 hours.

Moistures at the end of drying were - Max. 0.84%; Min. 0.38%; Average 0.55%.

The total amount dried was -

Guncotton	206.040 s/tons
Nitrocotton	1.878 ,,

The Guncotton was used for -

M.D.	)	193.863 s/tons
Cordite W.)	
Mark I		0.715 ,,
Experiments		0.509 ,,

The Nitrocotton used was 2.172 ,,

H. Mixing Paste.

The Paste mixed was -

M.D.	113.715 s/tons
Cordite W.	175.902 ,,
Mark I	1.826 ,,
R.D.N./A.	14.458 ,,

I. Tetryl.

During this year both corning and manufacture of fresh C.E. recommenced. Conditions were found for satisfactory corning of dry C.E. Crystals since, before the change of specification, wet C.E. from purification had been used for this process instead of, as at present, after drying and sieving. Nitration of tar oil to fresh C.E. also recommenced.

Repurification of C.E. to Crystal C.E.

Purified	7.149 s/tons	
Recovered	6.602 ,,	
Lost	0.547 ,,	
Stock left	0.922 ,,	(0.150 s/tons unfit (0.722 ,, under)
Issued	5.680 ,,	test.)
Acetone used (Trade)	4.437 ,,	

Repurification of C.E. to Corned C.E.

Purified	12.685 s/tons
Corned	7.235 ,,
Issued	4.235 ,,
Acetone used (Trade)	12.804 ,,

Manufacture of New C.E.

No. of Nitrations	28
Tar Oil used	1.392 s/tons
C.O.V. 96% used	21.750 ,,
Weight C.E. produced	2.520 ,,
Weight C.E. purified	1.710 ,,
Acetone used	2.100 ,,

J. Picrite Manufacture.

There have been no further developments in the process of manufacture, which has proceeded satisfactorily.

Raw Materials.

Calcium Cyanamide	26.880 s/tons
Ammonium Nitrate	11.142 ,,
C.O.V. 98%	25.125 ,,
Picrite made	8.828 ,,

Raw Materials used per ton of Picrite.

Calcium Cyanamide	3.05
Ammonium Nitrate	1.26
C.O.V. 98%	2.85

K. T.N.T. Manufacture.

T.N.T. manufacture in the "pilot" continuous plant was carried out during seven periods of the year, and during the course of this work valuable experience was gained in the running of this experimental plant.

Materials.

M.N.T. used	30.381 s/tons
Nitric Acid (98%) used	50.207 ,,
C.O.V. (96%) used	106.761 ,,
Recovered Waste Acid used (about 91% H ₂ SO ₄)	37.185 ,,
Sodium Sulphite Crystals used	6.742 ,,

Production.

T.N.T. (Finished, Sulphited Product) - 43.427 s/tons.

Am
2/5/35

MAIN LABORATORY SECTION 1934-35.

Inspection of Raw Materials, intermediate and finished products, etc.

The following raw materials supplied by outside contractors have been inspected:-

Cotton Waste	...	...	...	164 tons
Glycerine	...	...	...	50 ,,
Acetone	...	...	...	140 ,,
Mineral Jelly	...	...	...	3 ,,
Nitrate of Soda	...	...	...	520 ,,
Soda Ash	...	...	...	12 ,,
Chemical Lead	...	...	...	68 ,,
Calcium Cyanamide	...	...	...	25 ,,
Carbamite	...	...	...	15 ,,
C.O.V.	...	...	...	133 ,,
N.O.V.	...	...	...	520 ,,
Nitric Acid	...	...	...	70 ,,
M.N.T.	...	...	...	30 ,,
Cpke	...	...	...	236 ,,
Petrol	...	...	...	360 Galls.
Sodium Sulphite	...	...	...	14 tons
Ammonium Nitrate	...	...	...	10 ,,

Intermediate products inspected included:-

N.G. 54 Nitrations = 162 Washings =	92 tons
G/C 201 Batches	) 219.5 tons
84 Stovings	
12 Service Batches and N/C	
Product "C" - 67 Batches	8.5 tons

Finished products inspected included:-

452 Samples representing -			
Cordite M.D.	102 Lots	) 115 tons	
,,	15 Batches		
,,	Mark I 24 Lots	2 ,,	
,,	W. 47 Lots	179 ,,	
,,	R.D.N. 9 Lots	) 19 ,,	
,,	11 Batches		
C.E.	187 Batches	16.5 tons	
T.N.T.	128 Batches	43.5 ,,	
R.D. 202	14 Batches	490 lb.	
610 Cordite Batch Samples			
392 Cordite W. Batch Samples			
226 Blend and Stove Samples			
147 R.D.N. Samples.			

Routine inspection for the purpose of process control included the following:-

C.O.V. from N.G. manufacture	63 Samples
,, ,, G.C. ,,	100 ,,
Denitrated Acid for N.G. manfre.	95 ,,
,, ,, ,, G.C. ,,	92 ,,
Nitric Acid for N.G. manufacture	123 ,,
,, ,, ,, G.C. ,,	120 ,,
Mixed Acid for N.G.	33 ,,
,, ,, ,, G.C. ,,	35 ,,
Waste Acid from N.G.	34 ,,
,, ,, ,, G.C. ,,	55 ,,

Condensate Acid manufacture	122	Samples
Nitre Cake from N.G. manufacture	23	,,
,, ,, ,, G.C. ,,	16	,,
Soda Nitrate for N.G. ,,	23	,,
,, ,, ,, G.C. ,,	20	,,
Cotton Waste	464	,,
Acetone	319	,,
Mineral Jelly	36	,,
Glycerine	42	,,
Filter Bed Waters	444	,,
Vat Boiling Waters	1624	,,
G/C from Stoves and Weighing House	358	,,
Product "AM	233	,,
,, "B"	115	,,
,, "C"	70	,,
Sludge	58	,,
Milled Picrite	70	,,
R.D.N./A.	46	,,
Recovered Petrolite Acids	5	,,
T.N.T. Acids	64	,,
R.D. 202 and Ingredients	52	,,
Lime Water	10	,,

Fuze Powder:-

520 lb. of 63% carbon content Dogwood Charcoal were manufactured for R.F.F. and 100 lb. of experimental Fuze Powder Mill Cake were manufactured for finishing by R.F.F.

Departmental Memo. No.

Minutes to be numbered consecutively.

Sheet No.

M.S.,

I have not yet received your notes for my Annual Report for 1934-35. Will you please arrange to forward these to my office not later than Saturday the 11th instant.

Supt.

Report h/w.

L.G. 10/5/35.

[Signature]
2. 5. 35.

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See

As soon as the
information is received
will you please fill in the
gaps & revise as
required. This report
has been re-typed with copy
& pass to Supt.

City
17/4

ANNUAL REPORT FOR 1934-35.

MACHINERY SECTION.

ORGANIZATION.

The only change in the staff attached to the Section has been the replacement of a Young Journeyman by a Junior Draughtsman. The increasing amount of work renders it desirable to appoint a Book-keeper for the assistance of the Shop Manager in the near future.

SERVICES.

*Put in
out-x-x*

Production Machinery. The overhauling of spare plant initiated in 1933-34 has continued throughout the year under review. The plant in two Incorporating Houses has been completed, including the rewiring of the electric lighting system, ~~and~~ the hydraulic presses, valves and service mains have been overhauled in one of the spare Press Houses. A set of rope mantlets has been supplied for one of these houses, *of the steam heating services to a number of buildings have been overhauled*. In connection with Cordite pressing the introduction of copper sieves has involved a good deal of work which had not been contemplated and ^{which} has, to some extent, retarded progress in other directions. With the present output it may not be profitable to make these sieves by large scale production methods, but steps are being taken to provide the necessary tools for this purpose.

Other work includes the repair of a number of reeling machines, C.E. nitrating plant, the renewal of the gearing and bearings of 4 Potchers, a special jig having been designed and made at R.G.P.F. for truing up the journals of the potcher shafts in situ.

New Machinery purchased includes 3 Hydro Extractors for Guncotton, a combined motor and reduction gear unit for stirring Guncotton, a dredger for the waterways, a capstan lathe for the rapid production of cordite dies, a screwing machine for steam and hydraulic tubing, and an electric hoist for Guncotton bales.

overhaul of one of the

Steam Raising Plant and Mains. The completion of No. ⁵ Boiler House and erection of the Induced draft plant has been somewhat delayed by calls on labour elsewhere. It is expected, however, that this Boiler House will shortly be available for steam raising. ~~as foreshadowed in last year's report.~~

Renewals and repairs at No. 5 Boiler House as foreshadowed in last year's report have been somewhat costly during the year, The entire set of Superheater tubes in two of the boilers having been renewed, and one of the feed pumps rebuilt with new parts. A CO₂ Recorder and Flue Gas Temperature Indicator have been added to the equipment at this boiler house. There has not, however, been the necessary technical staff available to utilise the records with a view to improving the efficiency of these boilers which, considering the increased output during the year, has not come up to expectation.

Requirements made to me by J. G. H. H. H.

The cost of steam as compared with the two previous years has been as follows:-

<i>1932/3</i>	<i>1933/4</i>	<i>1934/5</i>
96,156,000	116,033,000	130,312,000
at 28.19 pence per 1000 lbs	" " " "	" " " "

The increase over the previous year is due to the extra cost of coal - ^{per ton} 23/- 8. as compared with ^{per ton} 19/6 8., renewals and maintenance - 2.54 d. as compared with 1.75 d. per thousand, and ^{maintenance of mains} ~~share of general charges~~ 1.87 d. as compared with 1.18 d. per thousand.

Considerable progress has been made with the renewal, repair and relagging of steam mains, most of which are now in constant use. The total number of additional feet of steam mains thus brought into use during the year amounts to 4,100, while another 4,900 feet have been repaired but not lagged. During the present year other mains, nnt required for immediate use, will also be repaired and coated with preservative, but not lagged.

It is proposed to instal more steam meters in key positions for more accurate allocation to the different centres, although the subsequent splitting of the consumption into sub-divisions of power, process and heating, as has been done in the past, renders accuracy ^{absolute}

impossible, and a modification of this principle is being introduced in the case of some centres.

An adequate supply of steam and electricity in emergency for both the Upper and Lower Works has been fully considered in the past and estimates given for cost of putting spare boiler plant into thorough working order, nevertheless expenditure of a large sum of money on plant which is some 35 years old does not appear altogether desirable, and I propose to put forward a scheme for modernising the plant at Upper Works and increasing the efficiency without the necessity of bringing into use obsolescent plant.

✓
Improvement

The installation of water softeners, without which no modern boiler house is complete, I regard as essential for the continuous and economical operation of boilers. I propose, therefore, to include this in the scheme mentioned above.

Electricity. The scheme for the emergency supply at the Lower Works is nearing completion. The new switchgear has been installed, together with the plant from the R.S.A.F. Part of the North Metropolitan Co.'s cable and overhead line have been laid and erected but unfortunate delay has occurred in the obtaining of a necessary wayleave for the remainder of the overhead line. It is understood the difficulty has now been surmounted and that a supply of current will shortly be available for trying out the plant. Overhaul of the existing steam plant will then proceed.

✓
Improvement

At the Upper Works minor repairs only have been necessary and the plant is in very fair running order.

The cost per unit as compared with the two previous years is as follows:-

	1932/3	1933/4	1934/5
	345,502	462,470	526,280
	2.88 d	2.92 d	3.30 d

Handwritten notes: 1932/3 has '3/3' written below it. 1933/4 has 'AM' written to its left. 1934/5 has 'AM' written to its left. The unit 'units at' is written between the first two columns. The unit 'per unit' is written at the end of the third row.

Developments at the northern end of the factory, involving the use of electric motors, will necessitate the laying of another cable in the near future.

Hydraulics. The hydraulic pumps, both at the Upper and Lower Works, are continuing to give good service with very little

✓

attention. Continuing the overhaul programme further pipe lines and main valves have been put into a good state of repair during the year.

Compressed Air Plant. The compressed air plant at the Nitro-Glycerine Factory consists of four steam driven sets. It is considered that the installation of a motor driven set would result in considerable economy. Air receivers and mains are in good condition.

Refrigeration Plant. The condenser previously reported as having developed serious leakages has been re-tubed. The opportunity was taken while this set was out of commission to carry out repairs on the evaporator. The set has now been running satisfactorily for several weeks. ^{other} The sets are in fairly good order, but a sum of money has been taken up for the overhauling of the engines and compressors. Air Heating - Guncotton Stoves. Air heaters and fans are now in running order for 14 stoves. Two fan engines have been replaced by electric motors. The new method of lagging the air pipes with glass silk, which is secured by wire netting and a final cover of zinc sheet, is very neat in appearance and highly efficient, and it is proposed to adopt this as standard for air pipe lines.

Telephones. The proposal to instal the Automatic telephone system at the R.G.P.F. and provide additional lines between this factory and the R.S.A.F. has been postponed ^{W.C.} for reasons indicated below under P on account of the cost. The telephone service has been much interrupted by falling trees and branches, and the cost of maintenance for the year has been £ 171 as compared with the average of £115 for the last 3 years.

Transport. A new lorry has been purchased for the transport of Guncotton from the Lower to the Upper Works.

The electric tractors, which have been in use for some 15 or 16 years, are showing signs of deterioration, and new batteries will be required shortly. A sum of money for this replacement has been taken up in the year's services.

Machinery Shop. As previously reported, the Machinery Shop

at the Upper Works is overcrowded, dark and inconveniently arranged. The scheme prepared for a new shop awaits a favourable opportunity for ~~discussion~~. *Consideration (see also* ✓

Departmental Memo. No.

Minutes to be numbered consecutively.

Sheet No.

M.B.,

I have not yet received your notes for my Annual Report for 1934-35. Will you please arrange to forward these to my office not later than Saturday the 11th instant.

AMB

2. 5. 35.

Supt. *Herewith and last year's are returned.*
P.D.W.
10/5/35.

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ANNUAL REPORT - 1934-35 - BUILDING WORKS DEPT., R.G.P.F.

Property.

The gross returns from all property attached to this Factory for the last five years are as follows:-

<u>1930</u>	<u>1931</u>	<u>1932</u>	<u>1933</u>	<u>1934</u>
£1,529	£1,537	£1,524	£1,434	£1,241

The expenditure on domestic property has amounted to £492 against an assessed annual value of £1,080. This does not include the special Maintenance figure for rebuilding the Kitchen wing of the Superintendent's Quarter completed at the end of April. This Quarter was also completely redecorated internally and externally and new fireplaces installed for the accommodation of the new Superintendent in August and September last.

M.W.B. Supplies.

Consumption of water for the last five years has been as follows:-

<u>1930</u>	<u>1931</u>	<u>1932</u>	<u>1933</u>	<u>1934</u>
£131	£168	£182	£199	£192

Lee Conservancy Catchment Board.

The agreement with this body, referred to in last year's report, has now been concluded, providing an annual maximum repayment to the Factory for services rendered in drainage matters of some £200.

The Board undertook the cutting and clearance of the Small River Lee for the W.D. portion on repayment by the Factory.

The flow of water in the valley has fluctuated between a maximum of 9661 cu.ft. per min. in February 1935 and a minimum of 319 cu.ft. per min. in October 1934 and the daily averages over the last five years have been:-

<u>1930</u>	<u>1931</u>	<u>1932</u>	<u>1933</u>	<u>1934</u>
9987	9973	8675	2766	2405

Departmental Work.

Following the approval of a model building erected in the B.W.D. yard in September in a new type of construction, considerable progress was made by the end of the financial year in the erection of a Quinan Stove to this design.

Nos. 7 and 8 Incorporating Houses were completely renovated.

A new sample type of pavement for explosives workers was laid down in Powder Mill Lane and it was decided to replace tar mac construction with this new type. A contract was made for some 4000 - 5000 yards and one section carried out in the N.G. area.

A major roof repair has been carried out to No. 5 Press House and Nos. 1, 4 and 5 Incorporating Houses - R.O.K. felt roofing being replaced in zinc.

Considerable reconstruction has been carried out in the P. & M. Room, including removal of potchers and provision of new save-all.

Owing to the fact that we were purchasing a new dredger only a minimum of dredging work was carried out last year.

An estate gang has been engaged on cutting and clearance of undergrowth.

An installation of hot water supply has been provided to Nos. 2, 3, 4 and 5 Incorporating Houses.

Fire Brigade.

During the year inspections have been made of all fire appliances and equipment; all were in good working condition.

Three fire calls were attended (1) Cordite Dining Room (escape of gas), (2) Central Stores (spontaneous combustion of oily rags in iron bin) and (3) C.E. Nitrating House. In the latter case a hydrant was used to extinguish the fire; in the first two cases the damage was very slight.

The London County Council's bi-annual inspection of Fire

appliances and fire prevention arrangements took place on 23rd May 1934. Tests were carried out in the Inspector's presence of the following fire appliances with satisfactory results:-

1 Petrol Fire Pump
1 Hydrant
4 lengths of Hose
1 Chemical Fire Extinguisher.

The Inspector's recommendation that adaptor hose connections be added to the fire appliances has been adopted, five adaptors having been purchased. Four "Foamite Fire-foam" extinguishers have also been added to the Fire Brigade equipment during the year.

Fire rules and precautions have been well observed throughout the factory generally and the general condition of the factory as regards fire risks has been improved by the cutting ^{and the removal of} down of undergrowth etc.

Two hydrants were renewed during the year as a result of half-yearly tests. Petrol fire pumps have been subjected to pumping tests and are in a satisfactory condition. All fire hose was tested - 15 lengths were condemned and renewed.

Fire squads attended regularly and carried out their drills with entire satisfaction.

An inspection of Quarters, House and Cottage property as a precaution against fire risk from workshops etc. was carried out and all was found clean and in accordance with regulations.

A. W. G.
10.5.35

W. 324/14

REPORT ON THE ADMINISTRATION & ACTIVITIES OF THE
ROYAL ORDNANCE AND NATIONAL FACTORIES. 1933/34.

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Supplementary Reports:

Report by Chief Supt., Ordnance Factories, Woolwich.	Appendix I.
" " Supt. Royal Small Arms Factory, Enfield.	" II.
" " Supt. Royal Gunpowder Factory, Waltham.	" III.

W324/14

C.S.O.F.,
S.R.S.A.F.,
S.R.G.P.F.,

The attached statement shews the order of subject matters normally followed in my annual report on the R.O. Factories, the compilation of which would be greatly facilitated if your report followed the same order.

I would therefore be glad if you would draw up your report in that order as far as conveniently possible.

(Sgd.) R. TOWNSEND

17.4.35.

D.O.F.

D.O.F.,

Noted.

This will be arranged.

(Sgd.) F. CARNEGIE

23.4.35.

C.S.O.F.

D.O.F.,

Noted and arranged.

(Sgd.) F.E.ROBINSON.

(undated)

Supt., R.S.A.F.

D.O.F.,

Noted and arranged.

(Sgd.) R.C.BOWDEN

2.5.35.

Supt., R.G.P.F.

Departmental Memo. No. W 324/14

Minutes to be numbered consecutively.

Sheet No. 1

①
DOF. min of 17.4.35

P.C. P. 3/5
M.C. M.S. M.M.
M.M. / T.G.
M.M. 30/4/35

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