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REPORT

OF THE

COMMITTEE

ON THE

**MANUFACTURE OF GUNPOWDER
AT THE ROYAL GUNPOWDER
FACTORY, WALTHAM ABBEY**

APPOINTED ON 70/Explosives/8

REPORTED ON 70/Explosives/64

The War Office

[A 2757]

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CONSTITUTION OF THE COMMITTEE

Chairman

Mr. G. S. WHITHAM, Factories Directorate.

Members

Mr. E. J. R. EDWARDS (M.G.O.F. (A)).
Lieut.-Colonel G. A. FULCHER, O.B.E., R.A. (A. 2 (c)).
Mr. H. WILSON (D.C. 1).

Secretary

Mr. J. H. HODGE (C.O., W. & E. Factories).

TERMS OF REFERENCE

To advise as to whether it is essential to retain capacity at the Royal Gunpowder Factory, Waltham Abbey, for the manufacture of Gunpowder.

In carrying out their inquiry the Committee will investigate :—

(i) The capacity of the Trade to meet the demands based on requirements both in peace and war of the Service Departments and the Indian and Colonial Governments.

(ii) Whether the Trade can manufacture gunpowder of quality suitable for blending as fuze powders.

(iii) Where, in the event of the Trade being able to supply suitable blending powder, the operation of blending can most efficiently and economically be effected.

The War Office
[537]

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REPORT

1. In pursuing its inquiries the Committee has visited the Royal Gunpowder Factory, Waltham Abbey, and the Royal Filling Factories, Woolwich Arsenal, to see the plant, and as far as practicable the processes, and has obtained evidence on the spot from the responsible technical authorities. The Committee has also consulted other responsible authorities such as Major T. H. Crozier, His Majesty's Inspector of Explosives, Home Office (regarding the activities of the Trade), the Armament Supply Department of the Admiralty (regarding Naval requirements), Messrs. Nobel Industries, Ltd. (regarding their capacity for manufacture of gunpowder) and the Chief Inspector of Armaments (regarding his experience of the Trade in relation to fuze powders).

PEACE AND WAR REQUIREMENTS OF SERVICE GUNPOWDER

2. The use of gunpowder in the Service is confined to bursting charges for shell, igniters, primers, friction tubes, blank ammunition, and fuzes. During the years 1911-12, 1912-13, 1913-14 and 1914-15 provision was made in Army Estimates for the supply of 55, 85, 80 and 85 tons respectively, and the average post war peace requirements of the Army up to date have been stated to the Committee as 50 tons per annum.

3. Admiralty requirements have been stated to the Committee as 5 tons per annum in 1924-25 and 1925-26, subsequently rising to 50 tons per annum.

4. Indian and Colonial orders amounted to 80, 58 and 103 tons for the years 1922-23, 1923-24 and 1924-25 respectively.

While it appears unlikely that the above rate of demand for India and the Colonies will be maintained, it is appreciated that as a basis for estimating future requirements the figure of 50 tons per annum for the Army may be on the low side. On the whole the Committee consider that the total peace requirements should be put at not less than 150 tons per annum.

5. The Committee has been informed that the requirements of the Army for a great war have not yet been formulated, but that for a small war of one cavalry and five infantry divisions requirements would be approximately 250 tons per annum, half this quantity being required in the second six months of the first year of war.

6. It has been stated to the Committee that Naval requirements for the first year of war would not exceed 150 tons.

In the circumstances the Committee has assumed a figure of 1,500 to 2,000 tons per annum as covering the requirements for a great war of the Army, of the Colonial forces forming part of the expanded Expeditionary Force, and of the Navy.

CAPACITY OF THE ROYAL GUNPOWDER FACTORY, WALTHAM ABBEY, FOR THE MANUFACTURE OF GUNPOWDER

7. The activities of the Royal Gunpowder Factory, so far as gunpowder is concerned, are at present practically confined to the manufacture of experimental powders for the Ordnance Committee and to the blending of fuze powders drawn from stock (which are subsequently again blended at the Royal Filling Factories, Woolwich Arsenal). The existing stock of calibrated fuze powders is estimated to be sufficient for some years to come in the case of most natures of fuzes, but this estimate is subject to confirmation of the recorded times of burning, which are based on tests taken some time ago.

8. The plant maintained at the Royal Gunpowder Factory, Waltham Abbey, is capable of producing 260 tons of R.F.G.² (long milled) powder or 520 tons of S.M.¹ (short milled) powder per annum; but this rate of production is liable to be reduced owing to deficiency of water for power, as 5 out of 9 processes involved in the manufacture are carried out on plant run by water power only. This question of water supply has been under consideration by the Controller of Lands, War Department, and it appears that the War Department cannot rely on getting a sufficiency of water in the future, *vide* War Office file 74/Gen. No./4433. This has been exemplified in recent years inasmuch as the capacity for production of gunpowder was nullified in 1921 and 1922, and seriously impaired in 1923, by shortage of water in the River Lee and the associated streams.

9. The plant could be mechanicalised, to make it independent of water power, at a cost which has been estimated at £4,000, and it appears that if this work were carried out the Royal Gunpowder Factory, Waltham Abbey, would be in a position to meet requirements as estimated for a small war, but not to cope unaided with requirements for a great war.

10. The lay-out of the buildings is by no means ideal (owing to the age of the factory), the buildings being very much scattered. At the same time the position and construction of certain of the buildings is such that it would not be practicable, while manufacture was being carried on, to comply with Magazine or Home Office regulations in regard to distances.

11. It should be mentioned that the saltpetre refining plant is capable of dealing with 50 tons per week of saltpetre, of which only 7½ tons would be required for the above-mentioned output of gunpowder, the balance being available in war time for smoke boxes, &c.

CAPACITY OF THE TRADE FOR THE MANUFACTURE OF GUNPOWDER

12. The whole of the manufacture of gunpowder in this country, other than that at the Royal Gunpowder Factory, Waltham Abbey, is in the hands of one firm, namely, Messrs. Nobel Industries, Ltd., which has control of about a dozen factories in various parts of the country. A list of these factories is attached (Appendix I).

13. In normal peace time the staple item of gunpowder manufacture is short milled blasting powder for use in mines and quarries. It is believed that Messrs. Nobel Industries, Ltd., make practically the whole quantity consumed in this country, which amounted in 1923 to about 6,000 tons.

14. Messrs. Nobel Industries, Ltd., have stated to the Committee that for a mixed requirement of gunpowders such as fuze powder, ordinary powders of small and large grain, and a proportion of short milled powder such as would presumably be admitted to service in time of war, their capacity at present is approximately 2,000 tons per annum over and above the estimated requirements of blasting powder for use in mines and quarries.

15. It appears, therefore, that Messrs. Nobel Industries, Ltd., would, if the above-mentioned excess capacity were maintained at the disposal of the Government, be in a position to produce without difficulty the 2,000 tons of gunpowder per annum which the Committee has assumed to represent the probable requirements for a great war.

FUZE POWDER

16. The production of fuze powder requires no special plant beyond that required for the manufacture of ordinary service gunpowder; it requires the exercise of great care in the manufacturing processes, and the production of powder to burn for a specified time is a process of trial and error. Such a powder is not normally produced directly from manufacture, but by blending powders selected from a stock of calibrated lots.

Messrs. Nobels Industries, Ltd., have assured the Committee of their ability to supply fuze powders, and have shown themselves ready to co-operate with the War Department in meeting requirements. In the past the trade has been successful in the supply of fuze powders and the Committee has no doubt that Messrs. Nobels Industries, Ltd., could manufacture gunpowder of quality suitable for blending as fuze powder.

EXPERIMENTAL MANUFACTURE

17. As regards the manufacture of experimental powders, the Committee is of opinion that there would be no difficulty in arranging for this to be carried out by Messrs. Nobel Industries, Ltd., with the co-operation of the War Department.

18. The Committee has been informed that to maintain capacity for this work at the Royal Gunpowder Factory, Waltham Abbey, practically the whole of the existing plant would be required.

CONCLUSIONS

19. The opinion of the Committee is that it is not essential to retain capacity at the Royal Gunpowder Factory, Waltham Abbey, for the manufacture of gunpowder, provided that arrangements are made to ensure the availability of the service by Messrs. Nobel Industries, Ltd., in the future at a reasonable cost.

20. At the same time, the Committee desires to point out that the maintenance of capacity at the Royal Gunpowder Factory, Waltham Abbey, might be advantageous from the point of view of insuring against unduly high prices being charged by the firm if the firm were in possession of a complete monopoly.

There is, however, in existence an agreement under which the Board of Trade have power to intervene in respect of the prices charged by the firm. The clause in the agreement is to the effect that—

“If at any time the price at which the company is supplying or is proposing to supply any of its products is, in the opinion of the President of the Board of Trade, unreasonable, the said President may from time to time fix the maximum price of such product, due regard being had to the cost of manufacture, a reasonable profit to the company and any other relevant circumstances; and if and so long as the maximum price of any product is so fixed, the price at which the company shall supply that product shall not exceed such maximum price.”

This clause was forced on the firm at the time of the formation of the Combine in 1918 as a condition of Treasury assent to the issue of new capital. It does not in terms give the Board of Trade any power to investigate costs, but it might, in the opinion of the Committee, be of use as a lever for securing a reduction in prices for gunpowder supplied to the Department should the firm at any time show a tendency to make excessive charges.

21. The Committee is informed that the estimated price for the supply of gunpowder to the Services, India, Colonies and the Crown Agents, would be 103s. 8d. per 100 lb. on the average for a mixed programme of blank and R.F.G.², and 120s. 4d. per 100 lb. for fuze powder, including, in both cases, delivery to Purfleet, but not the cost of packages.

Appendix II indicates how these figures are built up.

In addition to the above, expenditure estimated at £2,500 would be necessary for immediate reparations to the gunpowder buildings and plant. The estimated average annual cost of maintenance of the buildings and plant thereafter is £500, which is a normal factory expense charge and therefore included in the prices quoted above.

A further item of expenditure would be the renewal of the tubes in the evaporator used for purifying potassium nitrate, but no estimate is available for this service.

The trade price of gunpowder at the present time, including delivery to Purfleet, but not the cost of packages, has been stated to the Committee to be 83s. per 100 lb. for blank and R.F.G.², and 105s. per 100 lb. for fuze powder.

22. The Committee is of opinion that any necessary blending of powders taken from stock for the filling of fuzes should be carried out at the Royal Filling Factories, Woolwich Arsenal. As gunpowder suffers in the course of time a change in regard to rapidity of burning, it is invariably necessary for the Royal Filling Factories

to blend powders in small quantities for current needs. The process of blending and the plant required therefor are very simple, and the plant is available.

23. The cessation of blending at the Royal Gunpowder Factory, Waltham Abbey, would leave no justification for keeping fuze powders there, and the Committee recommends that the whole of the stock of fuze powders now lying at the Royal Gunpowder Factory, Waltham Abbey, be removed to an R.A.O.C. magazine.

24. The Committee desire to draw attention to the fact that there are at the Royal Gunpowder Factory, Waltham Abbey, certain Imperial stocks of raw materials for gunpowder manufacture, also a plant for charcoal manufacture. The latter might be of interest to the Chemical Warfare Committee.

25. In conclusion the Committee desire to express their appreciation for the services rendered by the Secretary, Mr. J. H. Hodge.

G. S. WHITHAM,
Chairman.

E. J. R. EDWARDS.

G. A. FULCHER,
Lieut.-Colonel.

H. WILSON.

J. H. HODGE,
Secretary.

30th July, 1925.

APPENDICES

Appendix I.—List of Gunpowder Factories in the United Kingdom.

Appendix II.—Estimates for expenditure and charge against services in connection with the manufacture of Gunpowder at the Royal Gunpowder Factory, Waltham Abbey.

APPENDIX I

GUNPOWDER FACTORIES

Edinburgh.

Camilty Mill, West Calder ...	...	}	Curtis's and Harvey, Ltd.,
Roslin ... ..	...	}	2, Buckingham Gate, S.W. 1.

Westmorland.

Gatebeck, near Kendal ...	...	}	W. H. Wakefield & Co., Ltd., Gatebeck Gunpowder Mills, Kendal, Westmorland.
Sedgwick, near Kendal ...	...	}	The Sedgwick Gunpowder Company, Ltd., Gatebeck, Kendal.
Elterwater, near Ambleside ...	...	}	The Elterwater Gunpowder Company, Gatebeck, Kendal.

Lancashire.

Low-wood, near Haverthwaite ...	...	}	W. H. Wakefield & Co., Ltd., Gatebeck Gunpowder Mills, Kendal.
Blackbeck, near Haverthwaite ...	...	}

Kent.

Marsh and Oare Works, Faversham...	...	}	Curtis's and Harvey, Ltd., 2, Buckingham Gate, S.W. 1.
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Glamorgan.

Glyn-neath	}	Curtis's and Harvey, Ltd., 2, Buckingham Gate, S.W. 1.
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Middlesex.

Hounslow	}	Curtis's and Harvey, Ltd.,
Bedfont	}	2, Buckingham Gate, S.W. 1.

All the above are in the "Combine."

All the Westmorland and Lancashire factories are really worked by Wakefield's organization at Gatebeck. It is possible that the Hounslow and Bedfont factories may go out of use in the near future as work is being concentrated at Faversham.

APPENDIX II

STATEMENT 1

(a) Extra expenditure, over and above charges essential for maintenance without manufacture, for manufacture of 71,000 lb. of gunpowder in one year, viz., 55,000 lb. blank L.G., 15,000 lb. R.F.G.² and 1,000 lb. fuze powder.

	£	s.	d.
Raw materials	805	14	0
Direct wages	821	7	9
Factory expense	559	6	6
	<u>2,186</u>	<u>8</u>	<u>3</u>

Equivalent to 61s. 7d. per 100 lb. on the average.

(b) To complete an additional 2 tons of fuze powder with the same staff the extra expenditure would be as follows :—

	£	s.	d.
Raw materials	46	3	3
Direct wages	55	11	5
Factory expense	36	12	2
	<u>138</u>	<u>6</u>	<u>10</u>

Equivalent to 69s. 2d. per 100 lb.

Note 1.—The above estimate for 2 tons of fuze powder is based on the assumption that the powder as manufactured would comply with specification requirements in regard to time of burning. If this were not so, and blending were required, the extra cost would be about 1s. per 100 lb. of gunpowder for each blending operation.

Note 2.—Raw materials have been taken at replacement values. The details are as follows :—

	(a) For 71,000 lb. mixed natures.	(b) For 2 tons of fuze powder.
	£ s. d.	£ s. d.
Saltpetre, grough, at £26 per ton ...	64,534 lb.—749 1 1	3,733 lb.—43 6 7
Wood, alder, at £2 per ton ...	34,020 lb.—30 7 6	...
Wood, dogwood, at £2 per ton ...	7,920 lb.—7 1 5	1,935 lb.—1 14 6
Sulphur, grough, at £5 10s. per ton	7,820 lb.—19 4 0	451 lb.—1 2 2
	<u>805 14 0</u>	<u>46 3 3</u>

Note 3.—Factory expense includes only those items which result directly from manufacture, e.g., foreman's wages, walking, changing and meal times, consumable stores, clothing, coal.

STATEMENT 2

(a) Estimated charge against services for manufacture of 71,000 lb. of gunpowder in one year, viz., 55,000 lb. blank L.G., 15,000 lb. R.F.G.² and 1,000 lb. fuze powder.

	£	s.	d.
Raw materials	805	14	0
Direct wages	821	7	9
Factory expense	2,053	9	4
	<u>3,680</u>	<u>11</u>	<u>1</u>

Equivalent to 103s. 8d. per 100 lb. on the average.

(b) For an additional 2 tons of fuze powder made by the same staff the estimated charge against the services is:—

	£	s.	d.
Raw materials	46	3	3
Direct wages	55	11	5
Factory expense	138	18	6
	240	13	2

Equivalent to 120s. 4d. per 100 lb.

Note 1.—The estimated charge for an extra blending operation, if required, is 3s. 6d. per 100 lb. of gunpowder.

Note 2.—To facilitate comparison, raw materials have been taken at replacement values, as in Statement 1, though such values would not operate until existing stocks were used up. Market prices have fallen since stocks were revalued in 1922.

Note 3.—Factory expense is included at full rate, but the figure is given with reserve owing to the impossibility of forecasting with accuracy the factory expense chargeable on gunpowder work without a knowledge not only of the prospective gunpowder output but of the prospective cordite output as well.

Note 1.—The above estimate for 2 tons of fuze powder is based on the assumption that the powder as manufactured would comply with specification requirements in regard to time of burning. It is not to be taken as a forecast of the extra cost which would be incurred in the event of a blending operation. The details are as follows:—

(a) For 2 tons of fuze powder	(b) For 21,000 lb. mixed nitrate
£ 46 3 3	£ 46 3 3
s. 55 11 5	s. 55 11 5
d. 138 18 6	d. 138 18 6
240 13 2	240 13 2

Note 3.—Factory expense includes only those items which are directly from manufacture, e.g. tonnage's wages, waiting, changing and meal times, consumable stores, clothing, coal.

STATEMENT 2

(a) Estimated charge against services for manufacture of 1,000 lb. of gunpowder in one year, viz. 4,000 lb. blank I.G. 13,000 lb. R.G. and 1,000 lb. fuze powder.

Raw materials	805	14	0
Direct wages	831	7	8
Factory expense	2,033	9	4
	3,680	11	1

Equivalent to 103s. 8d. per 100 lb. on the average.