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PROCUREMENT OF ARTILLERY AMMUNITION
IN THE
PITTSBURGH ORDNANCE DISTRICT.

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During the last emergency, the Pittsburgh Ordnance District was essentially a sub-contract rather than a prime contract District. With reference to the production of artillery ammunition, a great number of components were produced as rough forgings to be machined in other Districts or as machined shell to be loaded in other Districts. No shell loading was performed here.

The production of military explosives was limited to a relatively small quantity of ammonium nitrate and trinitrotoluol used for loading shell, and smokeless powder for propellant charges. Several of the by-product coke plants, which were built during the war at Government expense for production of toluol, were completed too late to assist materially in the production of trinitrotoluol.

Practically all of the shell machining previously done in the District was performed by a half dozen companies with well established organizations, several of which had acquired experience in machining artillery ammunition for the British and French governments prior to 1917. Booster casing blanks and cold drawn steel for adapters were produced here in great quantities but were shipped to other Districts for machining, loading and assembling. The burden placed upon the transportation facilities of the District was tremendous, as large tonnages of shell forgings had to be transported by rail for considerable distances and Pittsburgh became the choke point for railroad transportation.

In the present development of War Plans for Pittsburgh, particular attention has been given to the question of rail and water transportation, so that advantage might be taken of the natural facilities afforded and precautions taken to avoid unnecessary congestion due to routing and re-routing of material over main trunk lines passing through the heart of this great steel producing District.

The industrial survey of the Pittsburgh District was started in September 1922, before allocation of plant facilities had been made by the War Department. Preparatory to making the survey, a classified list was prepared of the various plants which were previously operated on

Ordnance contracts. Information was available from the list of contracts prepared by the Production division of the Ordnance Department, and from the History of the Pittsburgh District prepared by Mr. R. M. Dravo, Ordnance District Chief.

Classification of Facilities.

With the assistance of these records, facilities were divided into groups, classified as follows:-

Group A. Blast furnaces, open hearths, billet and bar mills, wire mills, plate and sheet mills, and cold drawn steel mills. A large number of the plants in this group would be utilized in production of common steel billets required for forging various types of shell bodies. Strip steel, cold-drawn free cutting steel, and steel wire would be utilized for producing booster casing blanks, shell adapters, and steel parts for fuzes.

Group B. Forging plants, equipped with hydraulic press equipment for producing shell forgings of various types or power driven press equipment suitable for forging shell not larger than 3-inch.

Group C. Facilities for machining common steel shell and its components, including adapters, booster casings and metal parts of fuzes.

Group D. Commercial high explosive facilities consisting particularly of organizations, experienced in wartime production of military explosives, which could be depended upon to construct and operate new facilities for production of trinitrotoluol, in addition to shell loading and bag loading plants, for assembling of ammunition.

Group E. Facilities for production of ammunition accessories, including organizations experienced in production of booster casing blanks, brass cartridge cases, cartridge storage cases for powder charges, wooden packing boxes, etc.

Group F. By-product coke plants now equipped for commercial recovery of benzol which could be utilized for emergency production of toluol for military purposes.

A more intimate knowledge of the production of steel was acquired through preliminary visits to representative plants in the District which might be required for Ordnance production. As a result of these visits, a more accurate classification of plants was made than

would otherwise have been possible.

Method of Survey.

The survey of the larger facilities, following the preliminary visits of inspection, involved the preparation of a complete record of ammunition production from each plant, covering the entire period from 1914 until after the Armistice. These records were prepared at the expense of the individual companies concerned. The information also included, in most cases, a schedule of machine tools which it was necessary to install to obtain this production, together with a list of the machinery which would be still available for similar work should the occasion arise. Estimates were also obtained, pertaining to plant capacities, and the number of months necessary to obtain initial production and maximum production at each plant, for certain types of ammunition. All of the data so obtained was tabulated from commercial records, and is now a part of the permanent record of the District Office.

Allocation of District War Orders.

After a preliminary estimate of the resources of the District had been obtained, initial allocation of War Orders for artillery ammunition was made by the Chief of Ordnance in September 1923, and included high explosive shell to be produced in maximum monthly quantities as shown on Chart I:-

<u>Pittsburgh District War Orders</u>		<u>Artillery Ammunition (Complete Rounds)</u>
MA-43	75 m/m H. E. Shell	300,000 per month
MA-96	75 m/m H. E. Shell	150,000 per month
MA-78)	155 m/m H. E. Shell for	
MA-79)	Howitzer and Gun	437,750 per month
MA-66	12" H. E. Shell for	
	R.R. Gun	1,840 per month.

This paper will deal with the procurement problem concerned with placing these War Orders with individual plants in the District.

It will be noted that all War Orders for artillery ammunition were allocated to the District on the basis of complete rounds, which would involve procurement of raw material, steel forgings, machined shell, high explosive and loading, propellant charges, fuzes, and primers. The preferred method of solving the problem would be to allocate as large a quantity as possible to one or more firms

who would be willing and able to undertake the manufacture of complete rounds. This would relieve the District Office of a large part of the burden incidental to obtaining balanced production of the various components.

Westinghouse Air-Brake Company.

The company, in the Pittsburgh District, which had the most varied experience in obtaining mass production of artillery ammunition, including loading and assembling of ammunition and production of fuzes, was the Westinghouse Air-Brake Company, Wilmerding, Pa. This company, in April 1915, accepted an order from the British government for eighteen-pound (three inch) shrapnel, complete rounds, except propellant powder, delivery to begin in four months and to be completed in fourteen months. The factor that chiefly influenced the management in deciding to undertake this special line of work was the unfavorable outlook of the railway supply business in general, and its desire to retain, if possible, a highly trained organization and provide employment for its men. Their contract was for 1,250,000 British shrapnel which was 25% of the total order for 3 inch shell and shrapnel contracted for by a combination of manufacturing interests, including the American Locomotive Company, the New York Air-Brake Company, and the Westinghouse Air-Brake Company. Not one of the three companies mentioned had had any previous experience whatever, in the manufacture of artillery ammunition. They did, however, have superior types of organizations. Necessary new facilities, including forge and machine shops were constructed at Wilmerding and initial production of shrapnel was obtained in four months after signing the contract. Facilities for loading and assembling were provided on the Atlantic seaboard by associated companies. Production was completed six weeks ahead of the schedule guaranteed.

Ammunition procured as Complete Rounds.

In the present development of War Plans, the Westinghouse Air-Brake Company has accepted an allocation of 75 mm H. E. shell, complete rounds, to be produced at the rate of 300,000 per month, and has guaranteed a schedule of delivery of complete rounds as indicated on Chart II. Initial production would be obtained in four months time and over 1,280,000 rounds would be available for issue within 12 months after receipt of "go ahead" orders.

War plans of the Westinghouse Air-Brake Company include the construction of new facilities for forging and machining shell and adapters, drawing and machining brass

cartridge cases, and machining metal components of fuzes, all of which facilities will be constructed on ground now available at Swissvale, Pa. Shell loading, fuze loading, and assembling facilities will be provided near Trafford City, Pa., at a point located just outside of the crowded industrial area and about ten miles distant from the proposed forging and machining plant at Swissvale. A nucleus of 500 trained men experienced in war-time production of ammunition, are now available from the plants of the Westinghouse Air-Brake Company, and the Union Switch and Signal Company, both of which are under the same management.

Ammunition procured as separate components.

The remainder of the artillery ammunition of various types is to be procured as separate components from individual plants, the machined components to be loaded and assembled at central loading plants to be constructed in the District. This involves the selection of existing facilities and planning of new facilities to be located at points readily accessible both to the sources of the raw material and to the proposed sites for loading and assembling plants. Complete units for the combined operations of forging and machining are the features of the present War Plan; these are indicated on the industrial map of the District.

To continue the discussion of ammunition to be procured as separate components from individual facilities, as contrasted to complete rounds from individual contractors, a careful survey was made of plants coming under the following classification:-

- (a) Forging plants,
- (b) Machining plants,
- (c) Accessory plants,
- (d) Explosive plants.

Forging and machining unit for 75 m/m shell.

Forgings for 75 m/m shell were produced during the war in large quantities at the Christy Park Works of the National Tube Company, McKeesport, Pa. This plant was considerably enlarged during the war for production of forgings for Army and Navy Ordnance. Most of the original hydraulic equipment used for shell forgings is now available and is used for commercial production of 4-inch couplings. The processes used are almost identical with those required for shell forging. With necessary re-arrangement, this plant could, in three months' time, be

producing large quantities of 75 m/m shell forgings. Peace time development of other specialties such as torpedo flasks and demolition bombs, is now being conducted at this plant for both the Army and Navy. Allocation has been made to this plant of all 75 m/m shell forgings required for War Order MA-96 and tentative agreement made with the company to provide facilities for machining these forgings on ground adjoining the present forge plant. The principal advantage of completing these plans at this time lies in the fact that present peace-time development of this plant is being coordinated with the possible war-time development of this same plant for production of ammunition, including 75 m/m shell, torpedo flasks, and bombs. Plant layout for shell forging and machining has been practically completed, ready for actual construction to be started should an emergency arise.

75 m/m machined shell, including adapter-booster assembly, may be shipped from the Christy Park Works directly to the proposed loading and assembling plant near Beaver, Pa. Estimated schedules of production for machining, also for loading and assembling are shown on Chart III.

Miscellaneous components of 75 m/m shell.

With reference to War Order MA-96, for complete rounds of 75 m/m shell, allocation has been made to ~~other~~ companies of components to be produced in the District, as follows:-

Brass cartridge cases	-	Allegheny Steel Company
Booster casing blanks	-	National Metal Molding Co.
(not machined)		
Brass fuze sockets	-	Aluminum Co. of America
Packing boxes	-	F. J. Kress Box Co.

Articles to be obtained from other Districts include:-

- Copper rotating bands
- Brass discs for cartridge cases
- Loaded fuzes
- Loaded primers.

Procurement of 155 m/m shell.

With reference to the procurement of 155 m/m shell, no individual contractor has been selected to undertake the manufacture of the complete round. Components will be procured from individual plants and assembled at central loading plants.

Forging presses for 155 m/m shell purchased and used for this purpose during the war, are being retained in storage by several of the companies who formerly did this work. New facilities, however, are being planned to meet the additional requirements. These will all be constructed and operated by companies experienced in production of ammunition.

Shell machining facilities used during the war at various plants in the District, have since been scrapped or otherwise disposed of, with the exception of certain buildings which could again be used for this purpose. Several large commercial organizations experienced in this work, have agreed to again undertake this production on pre-arranged schedules of delivery, based on the probable schedule of delivery of shell forgings, and have each furnished an estimate of the machine tools required.

Forging and machining units for 155 m/m shell.

Since new facilities for shell machining must be provided, the sites for proposed machining plants have been selected at points as close as possible to the proposed forging plants, in order to utilize the natural advantages afforded by rail or water transportation. A careful analysis was made of the labor situation, so that an adequate supply of the required class of labor might be housed in the vicinity of each of these proposed munition centers without requiring the building of villages.

At the time we entered the last war, most of the shell machining facilities were already being operated on contracts for the allied governments and many of these plants were taken over for our needs, wherever they could be utilized. As a result of this condition, forging plants and machining plants were often separated by considerable distances and transportation delays were thereby unavoidable.

With only partial facilities now available for forging and machining shell, it is considered advisable to plan a consolidation of forging and machining activities at individual plants or at combinations of plants located in the same vicinity. This will facilitate a close control over inspection and production of munitions and also tend to overcome the delays incidental to routing material between widely separated plants, which have no community of interest.

Conferences with some of the larger companies formerly engaged in ammunition production, have resulted in the

development of a complete plan for forging and machining units to be located at important industrial centers, which will also provide for an equitable distribution of labor supply. The ideal arrangement of contracting for complete rounds of ammunition has been approximated in contracting for raw material, forgings and machined shell, with an individual contractor, or group of contractors, as provided for in this plan, the outline of which can best be seen by referring to the geographical arrangement of the several industrial units concerned, and which will be discussed in sequence.

DISCUSSION OF INDUSTRIAL UNITS.

155 m/m Shell forging and machining units.

Butler, Pa. 40 miles north of Pittsburgh by rail, was a shell forging and machining center during the last war. Forgings to be produced by the Standard Steel Car Company and Spang and Company; to be machined by these two companies at the combined maximum rate of 140,000 machined shell per month. Steel billets will be shipped from Pittsburgh.

Ellwood City, Pa. 40 miles northwest of Pittsburgh, by rail, was a shell forging center during the emergency. Forgings and machined shell will be produced here by the National Tube Company on ground adjoining their present seamless steel tubing works. Anticipated schedule of delivery, 95,644 machined shell per month.

New Castle, Pa. The forging plant of the Standard Steel Car Company will forge 25,000 shell per month, to be machined by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., 60 miles distant.

McKees Rocks, Pa. and North Side Pittsburgh, Pa. The two large car plants of the Pressed Steel Car Company, on opposite banks of the Ohio River, will, together, produce 140,000 shell forgings per month, using hydraulic forging equipment now in storage in addition to equipment already installed. A railroad bridge in the vicinity connects the two plants. Fifty thousand forgings per month will be machined nearby at the Northside Plant of the Standard Sanitary Manufacturing Company, who will utilize their present power plant and buildings, with installation of new machinery. Thirteen hundred employees at the latter plant are available. The remaining 90,000 forgings per month will be machined at new facilities to be installed by the Westinghouse Electric and Manufacturing Company, location of plant

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dependent upon buildings which could be acquired at the time.

E. Steubenville, W. Va. The Wheeling Steel Corporation is designing a plant layout for forging 150,000 155 m/m forgings per month, to meet the combined requirements of the Pittsburgh and Cincinnati Ordnance Districts. A private railroad bridge already connects the site of the proposed forging plant with the furnaces and rolling mills at Steubenville, Ohio. One hundred thousand forgings per month will be shipped to the Cincinnati District to apply on their War Order. The remaining forgings, 50,000 per month, will be machined at new facilities to be built and operated by the Wheeling Mold and Foundry Company, on ground adjacent to the proposed forging unit. With the exception of the forgings for Cincinnati, the unit will be complete from the raw material to the machined shell, which may be shipped directly to the loading plant by rail or water, about 35 miles distant (near Beaver, Pa.).

155 m/m Ammunition Accessories.

Follansbee, W. Va. Cartridge storage cases for 155 m/m Howitzer propellant charges will be produced by the Sheet Metal Specialty Company at the rate of 154,000 per month. Raw material will be procured from the sheet mill of the Follansbee Brothers Company, immediately adjoining.

Wheeling, W. Va. Cartridge storage cases for 155 m/m Gun propellant charges will be produced by the Wheeling Steel Corporation at facilities now used for manufacture of portable ovens. The sheet steel for these cases will be manufactured directly across the river, by the same company at their plant at Martins Ferry, Ohio. The finished cases may be shipped all the way by rail or water directly to the loading plant, west of Beaver, Pa. Requirements for this company are 138,000 cases per month.

Beaver Falls, Pa. The largest producing center for cold drawn steel suitable for machining adapters. Tentative plans now being developed will provide for machining all adapter-booster assemblies for shell not otherwise allocated. A considerable battery of automatic screw machines will necessarily be installed for this purpose in buildings which may be used, adjoining the cold drawn steel mills of the Union Drawn Steel Company.

Ambridge, Pa. Booster casing blanks for all 75 m/m and 155 m/m shell to be produced in the District, will be manufactured by the National Metal Molding Company by

facilities formerly used for this purpose. This company was very successful during the last emergency in producing booster casing blanks. Over 900,000 per month will be required.

New Kensington, Pa. Brass fuze sockets, over 900,000 per month, for various types of shell will be produced by the Aluminum Company of America, by use of a small portion of their facilities now used for production of aluminum cooking utensils.

12" H. E. Shell forging and machining units.

McKees Rocks, Pa. Existing forging unit of the Schoen Steel Wheel Works will be used for this purpose by curtailing present production of railroad car wheels. This plant is operated by the Carnegie Steel Company. Necessary facilities for machining shell bodies and all steel components will be installed by this company immediately adjoining the forging plant. Either rail or water transportation will be available from the machining plant to the loading plant, west of Beaver, Pa. This plant was very successful in forging large caliber shell including 15" British Navy Shell during the last emergency. Only about 10% of the capacity of this forging unit is at present required for Ordnance production. Requirements - 1,858 forgings and machined shell per month.

Explosive Plants.

Two sites have been tentatively selected for proposed trinitrotoluol plants, one near New Castle, to be constructed and operated by the Grasselli Powder Company, on the site of a former T.N.T. plant operated by them for the French Government during the last war; required capacity of proposed plant about three million pounds per month. A partially completed T.N.T. plant at Mount Union, Pa., abandoned after the Armistice, and now owned by the Hercules Powder Company, could be constructed on acreage now available; required capacity, approximately five million pounds per month. Black powder will be available from facilities at Fairchance, Pa., operated by the duPont Co. Smokeless powder for propellant charges will be delivered from government smokeless powder plants located outside of the District. With reference to production of trinitrotoluol, practically all of the toluol required may be obtained from facilities now used for recovery of benzol from by-product coke plants. Seven of these plants are indicated on the industrial map of the District. A deficit of toluol may be overcome by completion of facilities now being operated by the Carnegie Steel Company at

Clairton, Pa.

Loading Plants.

Plans are being developed for three shell loading plants to be constructed in the District in the event of an emergency. These will be built and operated by commercial companies.

Loading Plant A, is to be located near Coverts Station, Pa., on the Bessemer Branch of the Pennsylvania Railroad, about 10 miles west of New Castle, on property adjoining the proposed T.N.T. plant of the Grasselli Powder Company. Loading facilities to be constructed and operated by this same company will consist of a bag loading plant and shell loading and assembling plant, capacity about 5,500 complete rounds per day, except fuzes and primers. Source of machined shell, Butler, Pa., about 50 miles distant. Necessary labor will be available from New Castle, Pa., and Youngstown, Ohio. Complete rounds of ammunition may be transported over three main lines of railroad extending northwest to Cleveland, Ohio; southeast to Pittsburgh and Philadelphia, southwest to Cincinnati, Memphis or St. Louis, by the use of all rail or of combined rail and water transportation.

Loading Plant B, to be located on the north bank of the Ohio River and Pennsylvania Railroad, between Beaver and Smith's Ferry, Pa. Daily capacity, 6,000 - 75 m/m shell, 13,000 - 155 m/m shell, 75 - 12" shell, and 25 - 1100-lb. bombs, including bag loading for propellant charges and shell loading with T.N.T.; loaded fuzes and primers to be obtained elsewhere. Plant will probably be constructed and operated by the duPont Company. Sources of labor supply, Beaver Falls, New Brighton, Rochester and Beaver, Pa. Sources of machined shell, Ellwood City, Pittsburgh, East Pittsburgh, Pa., and East Steubenville, W.Va. Complete rounds may be shipped to the west or southwest all the way by water to Memphis or New Orleans, or by rail in any direction as required over main lines of transportation. This site has been selected as particularly favorable from a transportation standpoint and is, furthermore, centrally located to all of the proposed shell machining plants.

Loading Plant C, to be constructed and operated near Trafford City, Pa., by the Westinghouse Air-Brake Company, for loading and assembling complete rounds and fuzes. Daily capacity, 13,000 - 75 m/m H. E. shell. Source of machined shell, Swissvale, Pa., about ten miles distant, on the main line of the Pennsylvania Railroad. Complete rounds may be shipped to any desired point over main lines of the Pennsylvania and connecting railroads.

Detail requirements for each of the above loading plants are being determined by Picatinny Arsenal with reference to,

- (a) acreage,
- (b) labor supply,
- (c) power and water supply,
- (d) plant equipment.

These are based on the requirements for typical units for shell loading plants now being designed at Picatinny for various types of ammunition.

Proving Grounds.

A tentative site for a government proving ground has been selected in Erie and Crawford Counties, Pa., in the Cleveland Ordnance District. About 22,000 acres with a maximum range of 20,000 yards will be required. (See map) The proving ground may be reached from any of the three loading plants, by either rail or motor transportation. By the use of light motor trucks, ballistic samples may be conveyed from loading plant A in four hours, from loading plant B in six hours, and from loading plant C in eight hours. Excellent concrete highways are available over practically the entire distance. This proving ground could be utilized for proof firing all ammunition not larger than 155 m/m, to be produced in the Cleveland, Pittsburgh, and Buffalo Ordnance Districts, it being centrally located to these three Districts. A large scale map of this site has been prepared from aerial photographs taken recently by the Army Air Service.

Material from other Districts, 75 m/m, 155 m/m, and 12" Ammunition.

Loaded Fuzes and Primers for 75 m/m, 155 m/m and 12" H. E. Shell (in addition to loaded fuzes to be manufactured by the Westinghouse Air-Brake Co.) will be procured as follows:-

- Cleveland District - Point Detonating Fuzes, from American Multigraph Co., Cleveland, Ohio.
- Boston District - 49-grain Primers for 75 m.m Shell, from U. S. Cartridge Co., Lowell, Mass.
- Bridgeport District - Friction Primers for 12" Ammunition, 21-grain Primers for 155 m/m Ammunition, Drawn Copper Parts and Forged Brass Parts

- Bridgeport District - (Cont' d)
for Fuzes, Brass Discs for
75 m/m Cartridge Cases, and
Rough Copper Rotating Bands.
- Buffalo District - Brass Rod for Fuzes (Sub-
contract for Westinghouse
Air-Brake Co.)
- Baltimore District - Brass Discs for 75 m/m
Cartridge Cases.

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