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ARMY INDUSTRIAL COLLEGE
WASHINGTON, D. C.

CONSTRUCTION AND OPERATION OF A.E.F. COLD STORAGE PLANTS.

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February 19, 1926.

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COLD STORAGE PLANTS

The subject for this talk might well have been taken as "Frozen Meat Supply for the A.E.F.", as it is the intention to treat the subject as a whole, of which the construction and operation of 27 cold storage projects was an essential part. This discussion at the present time is, I believe, entirely justified as we are all probably more than ever concerned with the problem of preparedness, of which the experiences of a previous campaign are the best guides. This is true whether the particular experiences in question were of a successful or unsuccessful nature. The attitude to be taken toward methods previously followed naturally depends upon the measure of success which attended such methods.

In the case of the frozen meat supply for the A.E.F. we are dealing with an undertaking that met with signal success. After the armistice the Commander in Chief, on request of the Commanding General, Services of Supply, ordered that a board be appointed in each division to investigate thoroughly all matters pertaining to the supply of the division during its service in Europe, this board to consist of line officers. Beef supply was one subject on which report was ordered. I did not see reports as submitted from all divisions but did have access to the reports from 6 Divisions of the 3rd Army, extracts from which are as follows:

"2nd Div Experience during the last two years has demonstrated that frozen carcass beef, wrapped in burlap, has reached the troops in excellent condition in practically all cases. In this division there have been very few cases in which beef was found to be tainted or spoiled when received. A few quarters have been condemned at times, but there has been no real trouble in getting beef in excellent condition. In the Verdun sector in May, 1918, the beef for three days was delivered to troops in poor condition and considerable quantities had to be trimmed and partially condemned, this condition was due to the fact that for several days the beef was shipped to railhead in improperly refrigerated cars

3rd Div Experience of this division during the entire campaign has been of such satisfactory nature, that it is believed little improvement can be made on the present method of delivery of fresh meat.

4th Div. No suggestions as to possible methods of delivering fresh beef in better condition.

32nd Div Fresh beef has been always received and no improvement in method of delivery is suggested.

42nd Div. Present method of delivering frozen beef securely wrapped in burlap is satisfactory.

90th Div. The present method of delivering carcass beef in refrigerator cars is entirely satisfactory and all beef shipped to this organization, without exception, has been received in excellent condition. The present protective wrapping for this class of fresh meat should not be changed."

To discuss the almost innumerable steps taken to make possible these results would take far more time than we have for this conference, but I will attempt a brief resumé of this work. It was an established policy that all personnel, equipment and supplies would be sent to France only upon request for same by the Commander in Chief, A E F, and cablegram was received from Paris on June 22, 1917, requesting "Plans, specifications, superintendent and personnel for construction of ice plant for 500 tons capacity per day and refrigerating plant capacity 5000 tons of beef." By July 7, just two weeks later, personnel to handle this work had been procured from the principal Chicago packers, preliminary drawings made, and all equipment for these two projects had been contracted for at a fixed price on the basis of competitive bids covering same. No contract was placed for construction of the buildings or erection of the refrigerating machinery. Instead necessary construction tools were purchased and shipped to France and some 275 civilian carpenters and other mechanics, together with a superintendent of erection and a foreman, were employed direct by the Quartermaster Corps on special contract form originated to cover this case. Later a military unit designated Ice Plant Company No. 301, consisting of about 350 officers and men was recruited for this particular work and sent to France to assist in the completion of and to operate this plant. Certain additional labor consisting of Chinese and Spaniards were also used on this job, the total man-days being as follows

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American civilian	- - -	41,280	man days
Soldiers	- - -	29,115	" "
Chinese	- - -	17,475	" "
Spaniards	- - -	4,602	" "
Total	- - -	92,472	" "

On May 2, 1918, just about 10 months after the start of the work in Washington this plant was placed in operation with a storage capacity for 16,000,000 lbs. frozen carcass meat. It was located about 200 miles from either the ports of St. Nazaire or Bordeaux, near the village of Gievres.

Until the Gievres plant was placed in operation on May 2, 1918, the only cold storage facilities available for use of the A.E.F. consisted of the S.S. McClellan at St. Nazaire and certain space in the French Government cold storage plant at Dijon. The old transport McClellan had arrived at the port of St. Nazaire in July, 1917, with a cargo of frozen meat. It was found that the vessel was in bad condition and after inspection was condemned as unfit for ocean-going service. It was accordingly decided to retain this vessel in the basin at St. Nazaire as a permanent cold storage plant. The capacity of this ship was originally 1250 tons meat which was later increased to 1500 tons.

The arrangement with the French for use of space in their plant at Dijon was made after arrival of the S.S. McClellan with the first cargo of frozen meat for the A.E.F. The space originally available at Dijon for use by the A.E.F. had capacity for storing 300 tons frozen beef. This was an almost negligible quantity and besides the temperature maintained in this plant was not low enough for good results.

The authorized ration was 1 lb. frozen beef per day for 7 days out of each 10 day period, so that 2,000,000 men would require 700 tons beef daily. Considering irregularity of arrival of beef carrying vessels and the difficulties involved in distribution, the minimum storage facilities required for regular supply should be equivalent to 30 days requirements. On this basis it is seen that supply for 2,000,000 men would require facilities for storage of 21,000 tons. The Gievres plant had a nominal rating of 5000 tons but, by eliminating certain passageways and piling meat right up to the overhead ammonia piping it could be loaded to a total of 8,000 tons, and in fact did at one time contain that amount of meat.

Steps taken to meet the requirements as above calculated for 2,000,000 and later for the proposed army of 4,000,000 men make a long story and will not be discussed in detail at this time. The following list gives location and

capacity of the refrigerating plants in A.E.F. service just before the armistice with notes as to method of obtaining these facilities

St. Nazaire	1500 tons	- S.S. McClellen
Gievres	8000 "	- Built by A.E.F.
Eninal	1800 "	- Leased from French Govt.
Toul	400 "	- " " " "
Belfort	400 "	- " " " "
Brest	500 "	- Plant built by A.E.F., refrigerating equipment leased from French company.
10 Base Hospitals, 25 tons each	250 "	- Built by A.E.F.
Le Havre	120 "	- Leased from French Co
Tours	200 "	- French plant rebuilt by A.E.F.
Arcachon	150 "	- Leased from French Company
Angers	10 "	- " " " "
Blois	100 "	- " " " "
Vittel	30 "	- " " " "
Bordeaux	100 "	- " " " "
La Rochelle	30 "	- " " " "
Vichy	30 "	- " " " "
Bassens	6000 "	- Built by A.E.F.
La Pallice	4000 "	- Built by French Co. with assistance of A.E.F.
27 Plants	<u>23620 tons</u>	

In addition work was either under way or approved for the following additional facilities.

Marseilles	400 tons	- Being built by A.E.F.
St. Nazaire	4000 "	- Being built by French Co. for A.E.F.
Gievres Addition	8000 "	- Being built by A.E.F.
Advance Section	3000 "	- Approved to be built by A.E.F.
Total	<u>15400 tons</u>	
Total 31 plants -	39,020 tons.	

This total storage capacity would supply the regular meat ration to an Army of 4,000,000 men for a period of 28 days.

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The actual quantities of frozen meat unloaded at ports were as follows:

February 1918	655 tons
March	2362 tons
April	3828 tons
May	4085 tons
June	10,104 tons
July	10,184 tons
August	6,106 tons
September	12,535 tons
October	21,223 tons
November	26,384 tons.

The average daily consumption per man of American fresh meat increased from .34 lbs. at the time of placing the Gievres plant in operation to .73 lbs. at the time of the armistice.

The distribution of the large amount of meat with negligible loss required a proper organization and very close supervision. Control was exercised by the Cold Storage Branch, O.C.Q.M., Tours. In view of the perishable nature of the material handled, all reports were received and instructions given by telegraph or telephone, usually the latter. In this manner close contact was maintained with all cold storage plants.

The first step was, of course, preparation of requisition for frozen meat, this being included in cablegram to Washington. Shipments were not always made as ordered. There was a great scarcity of refrigerated vessels. A program was prepared for construction of such vessels in sufficient number to supply requirements, but this program was not maintained and it was only due to use of vessels loaned by the British that anything like an adequate supply of meat was furnished.

When a vessel with a cargo of frozen meat was several days off France, the Cold Storage Branch would be advised and would be required to state immediately at what port it was desired to have such vessel dock. The ports available were St. Nazaire, La Pallice, and Bassens, although small shipments were handled at Brest and later vessels as required were routed to Hook of Holland for supply of the 3rd Army. In deciding upon what port to route ships as well as for assistance in making the subsequent disposal of the meat, use was made of a large map showing all cold storage plants by circles colored blue, the area of these circles representing the capacity of the plants. A circular disk colored red of corresponding size was mounted so as to rotate over the blue circle so as to show any desired portion of the circle as blue and the remainder red. Position of

these circular disks was adjusted at 10 00 o'clock each morning, based on the telephone or telegraph report received the first thing every morning from each plant. The entire situation respecting beef supply and distribution could then be seen by a glance at this map.

Upon arrival at the designated port, the frozen meat was unloaded as rapidly as possible so as to avoid delaying the return of the much needed refrigerated vessel. The unloading rate would vary from about 400 to 1500 tons in 24 hours. So far as space at Gievres and transportation facilities would permit this meat was shipped direct to that plant, the plant at the port taking care of any excess which could not be shipped direct to Gievres. Of course, a sufficient amount was always retained at the port plants to supply the troops in that base section.

For making frozen meat shipments a few French insulated cars were at first used, then 10 American box cars which were insulated at Gievres. But starting June 22, 1918 American refrigerator cars were being turned out from the American car shops at La Rochelle. By July 1st, these were being made available at the rate of 25 a day until a total of 950 refrigerator cars were in this service.

All shipments, except the small amounts distributed direct by so-called "peddler" cars, were made entirely without the use of ice. As stated previously, the Gievres plant had ice making facilities for 500 tons a day, at that time I believe the largest ice plant in the world. But no ice was ever made at Gievres.

Instead of maintaining a temperature of about 15° F. in the Gievres plant, as is the common practice in the United States for freezer storage plants, it was found that particularly good results were secured by maintaining the temperature in the Gievres Plant at 0° F. Beef at this low temperature introduced into insulated cars served effectively to cool the cars to a point below freezing without the defrosting of any of the meat. The results obtained by this method are well known by certain tests made on shipments from Gievres to Is-sur-Tille, for example, two cars were en route 57 hours from Gievres to Is-sur-Tille, car temperatures at loading being 73° F. and 68° F., and car temperatures when opened 36° F. and 30° F. respectively, the average outside temperatures during the time of shipment being 66° F. and the meat being loaded from a storage room at Gievres of which the temperature was -2° F. It is estimated that during the summer, the maintenance of this low temperature in the Gievres plant did not increase the coal consumption for the operation of the plant more than about 15%, whereas to have manufactured sufficient ice for the icing of outgoing carload shipments would have at least doubled the coal consumption. It has been calculated on a theoretical basis

that the sensible heat represented by a difference of 15° F. in the temperature of a carload of beef is equal to the sensible heat which must be abstracted to reduce the car temperature 40° and overcome heat conduction for a period of three days.

Another condition which contributed to render it satisfactory to make shipments in refrigerator cars without ice, is the comparatively low mean temperatures in France. As an illustration mean temperatures in degrees fahrenheit taken from records of the French Government for Bordeaux, were as follows.

January	41.
February	43.
March	47.
April	52.
May	58.
June	63.
July	68.
August	68.
September	63.
October	55.
November	47.
December	41.
Year	<u>54.</u>

During the early part of the summer, before it was realized how thoroughly satisfactory frozen beef could be transported in the manner above described, consideration was at one time given to the proposition of using refrigerated motor trucks for distribution from railheads. However, investigation during June, 1918, of the condition in which frozen beef was being received by organizations occupying advanced positions developed that the use of these refrigerated motor trucks was unnecessary.

Before an adequate number of refrigerator cars became available, thus making it necessary to ship a considerable amount of beef in box cars, the hazards incurred in making such shipments were great. To reduce this hazard, one of the first steps taken by the Cold Storage Branch was to arrange for the convoy of every beef shipment. It is believed that this convoy system prevented many losses. As it was, the losses suffered were entirely negligible. Great stress was laid by the Cold Storage Branch on this convoy system. In general, the convoyers were obtained from Ice Plant Company #301 or from some of the Butchery Companies, these latter organizations having been placed at the disposal of the Cold Storage Branch. It was the intention to pick the best men from these organizations for convoy duty and in general the same men were continued on that duty.

It was endeavored to educate these men as to the importance of their work. As an illustration of this effort, the following is quoted from "Instructions to Convoyers of Meat Shipments" -

"Delivering beef to the troops in good condition depends largely upon prompt and proper handling in transit.

The convoy is responsible for every part of the movement of a car of beef, from the loading dock to the spotting of the car for discharge, for the prompt return of the empty refrigerator cars to original points unless otherwise specially instructed, for the prompt rendition of all required reports.

Initiative and attention are the factors which contribute to the value of the convoys. Such habits and conduct as will make for alertness must be cultivated.

Acquire enough French to be able to ask for necessary information from train crews and Chefs de Gare.

Telephonic and telegraphic accommodations will be secured through the Cold Storage Branch representative or, if there be no such representative, through the R.T.O.; in the absence of both, convoy will utilize such other means of securing this accommodation as may be available.

To wire the Cold Storage Branch address "C.Q.M , Tours". To telephone the Cold Storage Branch call #341, Tours."

The following reports are required to be made to the Cold Storage Branch by wire or telephone.

1. Report of whereabouts at end of each twelve-hour period after leaving loading track.
2. Report of anticipated or encountered delay.
3. Report of arrival at unloading point, giving destination, time of arrival, car initials and numbers.
4. Report of departure on return trip with empty refrigerator cars, giving station, time, car initials and numbers.
5. Report of arrival at reloading point with empty refrigerator cars, giving station, time, car initials and numbers.

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"Immediately on return trip, convoy will submit in duplicate to his commanding officer, the prescribed form report giving precise answers to all questions

If possible, convoy will report his shipping point, destination, car initials and numbers to the R.T.O.'s at passing point when his cars are not a part of a solid American train.

When side-tracked in railroad yards, convoy will report to the R.T.O., giving his car initials, car numbers, destination and the number of the track on which his cars are set, and will ask for such movement as is desired. This report to the R.T.O. does not relieve the necessity for wiring the reports required by the Cold Storage Branch.

Immediately after having so reported to the R.T.O., convoy will return to his cars, and will stay close enough to them as to prevent their being lost track of by switching, etc.

Upon arrival at a destination at which there is a Cold Storage Branch representative, report immediately to him. At other destinations report to the consignee.

Before starting on a trip, ascertain if there is a Cold Storage Branch representative at your destination and if not be sure that you know the name of the consignee, that you may find him promptly.

A convoy will stay with his cars from the loading dock to the point at which they are spotted for unloading. The nearest freight yard is not considered a destination. Securing prompt switching service is a part of the convoy's duty. Before starting on return trip, convoy will remove all pasters from his cars

If delays are encountered en route first, report to the Cold Storage Branch as outlined in these instructions, second, try to get action through the R.T.O., train crew or the Chef de Gare.

If car trouble is encountered, making it necessary to transfer meat from one car to another, inspect all cars to make sure that

1. The cars are tight.
2. The running gears are well oiled.
3. There is no accumulation of materials which will stick to the beef and put it in bad condition at destination.

Report numbers of seals removed from original cars and numbers of seals attached to resultant car.

Before opening the original car have the details so arranged that the transfer can be made as quickly as possible."

As a further means of controlling and expediting beef shipments, the Cold Storage Branch made considerable use of the long distance telephone and telegraph. On account of the perishable nature of the product, letter writing in regard to shipments was in general entirely out of the question. Numerous instances occurred when on account of "hot boxes" or for other causes, railroad cars loaded with beef became unserviceable in transit. Report of such condition being received by telephone from the convoyer, it was possible in numerous instances to arrange for quick disposition of the product before loss occurred.

Orders for beef requirements were also placed by telegraph and telephone and report of shipments and receipts forwarded to the Cold Storage Branch by the same means. It was in this manner possible to keep close touch upon the entire beef situation and to detect and take steps to expedite any delay in movements. In addition to the essential reports by telegraph and telephone, certain reports by letter were also required.

"Peddler" cars made it possible to supply small detachments located in towns where it would have been necessary to have purchased their requirements locally and to which it was impossible to make full carload shipments. One of these "peddler" cars was placed in operation out of La Rochelle on the 22nd of July. This car left La Rochelle under convoy every other day and moved on the following schedule

Lv. La Rochelle	7 57 AM
Ar. Niort	11 20 AM
Lv. Niort	6 00 PM
Ar. Thouars	8 20 PM
Lv. Thouars	9 07 PM
Ar. Sumur	10 06 PM
Lv. Sumur	9 16 AM Following day
Ar. Angers	11 00 AM

This schedule being definitely established the car was met at each point by a detachment of the organization for which the beef was intended. Another peddler car was established from Bordeaux traveling daily via Libourne, Montpont, Perigueux, Limoges, Montmorillon, arriving at Poitiers the second morning, beef being delivered to each

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of these places with entirely satisfactory results. Also the practice of making shipments via Grand Vitesse was extended thus supplying numerous organizations who could not handle full carload shipments and whom it was impossible to supply by peddler car

It was early thought advisable to use boneless beef and numerous tests were made with the result that this was finally requested as regular method of supply. The boned beef as finally shipped made it possible to store $2\frac{1}{2}$ times as much in a given space as with carcass beef. It was found that it was not so satisfactory to pack the deboned beef in boxes as to freeze in blocks of about 100 lbs. each, wrapped in cheese cloth and sewed in burlap. Contrary to what might be at first thought, this package stood shipment better than the meat packed in boxes, due probably to elimination of the voids in the boxes. Also hind-quarter and fore-quarter meat was packed separately and marked accordingly so that equitable distribution could be made to organizations.

As an illustration of actual distribution to troops, the following is taken from report which was made on visit to the Toul sector in June, 1918

"A car of beef, which left Is-sur-Tille 7.00 PM on June 17th, arrived at Toul 2 00 AM on the 18th, was transferred there during the day and shipped at 5 o'clock the morning of the 19th, arriving at Menil-la-Tour at 7 00 AM that day. A portion of this beef was again transferred and sent by narrow gauge railroad to the regimental dump at Corneville, arrived there in time for issue that same afternoon, the last quarter leaving for the mess halls at 3 00 PM. This quarter was found to be almost defrosted but in the best of condition. The bulk of the balance of the shipment to Menil-la-Tour was taken from the cars in wagons to the division dump, not far from the railroad yards, where it was loaded into ration wagons during the day. Two quarters sent from there to a mess hall near the front lines, where they arrived during the night, and were cut and used for supper the following day. This beef was entirely defrosted on arrival at the mess hall but in perfect condition."

Means taken to improve the meat ration was the decision to obtain sufficient frozen pork from the United States to issue same to all organizations once each month, in accordance with which cablegram was sent under date of 19 September, 1918, requesting that there be shipped monthly in lieu of equal quantity of frozen beef, 1,000 tons Boston Butts and Boneless Loins. A sufficient

quantity of pork, received in response to this cablegram, was shipped to the 3rd Army in time to enable same to be issued to the troops of that Arm on Christmas Day.

After the armistice and upon entry of the 3rd Army into Germany, it was decided to supply beef to these troops by rail through Holland. Space for storage of 3000 tons was contracted for in a plant owned by a Dutch concern at the Hook of Holland, near Rotterdam. Storage in the 3rd Army Area was provided by building at Bendorf, on the Rhine, near Coblenz a cold storage plant with capacity for 500 tons frozen meat. This plant was installed in an old building in the railroad yard at that point, this building being insulated and partly rebuilt for the purpose. Pipe, refrigerating machines, and other equipment were supplied from Gievres, and the plant was placed in operation within 3 weeks after work was started.