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FEED MATERIALS PRODUCTION CENTER

NATIONAL LEAD COMPANY OF OHIO

NLCO-733  
SPECIAL

THE HISTORY OF THE MIDDLESEX SAMPLING PLANT

BY

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NATIONAL LEAD COMPANY OF OHIO  
CINCINNATI, OHIO

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INTRODUCTION

The role played by the Middlesex Sampling Plant of the USAEC is of historical significance in the development of the Atomic Energy program in the United States.

The Middlesex Sampling Plant was established in October, 1943 at the request of the Manhattan Engineering District and was operated until February 18, 1955. At this time the duties and responsibilities were completely transferred to the Sampling Plant at the Feed Materials Production Center (FMPC) at Fernald, Ohio. Prior to the closing date the work at Middlesex was tapered off. The last few months of its existence were spent in disposing of material and equipment and preparing the buildings for permanent closure.

In its period of existence the plant and its crew had performed creditably the duties which were required and in addition had made valuable contributions in the development of sampling techniques.

The Middlesex Sampling Plant was located in the Borough of Middlesex, New Jersey. It was surrounded by important industrial and commercial centers such as Plainfield in Union County, Bound Brook in Somerset County, and New Brunswick in Middlesex County. The plant was in close proximity to the New Jersey State Highway 22.

Locally, the Middlesex Sampling Plant was situated on Mountain Avenue just east of the Lehigh Valley and New Jersey Central Railroad rights of way in Lincoln. The Middlesex Sampling Plant was served by a siding of the Lehigh Valley Railroad.

The function of the Middlesex Sampling Plant was to thaw, crush, dry, screen, store, sample, weigh and/or ship various types of ores from both foreign and domestic sources. After the ores were processed through the sampling operation they were packaged in airtight drums, weighed and stored for shipment or shipped to the Mallinckrodt Chemical Works in St. Louis, the Brush Beryllium Company at Luckey, Ohio and other locations. The ores processed contained uranium, thorium, and beryllium.

An additional function of the Middlesex Sampling Plant was to prepare contaminated wastes for shipment and disposal at sea. The dumping at sea was done by personnel of the U. S. Navy Depot, Earle, New Jersey.

There were two distinct historical periods in the existence of the Middlesex Sampling Plant. The distinction between the two periods is the manner in which the functions of the plant were administered. In the first period, November, 1943 to November, 1950, the AEC handled the administrative duties, Lucius Pitkin, Inc. performed the preparation and technical aspects of sampling, and the Perry Warehouse Corporation supplied the labor.

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In the second period, November, 1950 to February 18, 1955, an AEC representative acted as an advisor and liaison agent for AEC to the contract operator, The United Lead Company. The latter had charge of all administrative duties, the technical aspects of sampling, and furnishing of supervision and labor for operation. Lucius Pitkin, Inc. represented the AEC and the United Lead Company in the weighing, sampling, and sample preparation operations.

THE ACQUIREMENT OF THE MIDDLESEX SAMPLING PLANT

On October 27, 1943, the Manhattan Engineering District requested that the North Atlantic Division of Engineers lease this property. The property was taken by right of entry on this date. On November 1, 1943 a lease was signed with the owners, the American Marietta Corporation, for 2.42 acres of land with 35,500 square feet of floor space in the buildings contained thereon.

On May, 1945 supplement No. 1 was added to the lease and the total area was increased by 2.7 acres. The additional acreage was required for storage space. Supplement No. 2 was added to the lease on June 27, 1945 and the total area was increased by 3.6 acres.

The Manhattan District Engineers on March 8, 1946 requested that the property at the Middlesex Sampling Plant be purchased. On June 20, 1946 the Secretary of War authorized the purchase of the property at the Middlesex Sampling Plant. The owners, the American Marietta Corporation, refused to sell the property and condemnation proceedings were initiated on September 12, 1946. The U. S. Government won the verdict and was awarded the property by condemnation and the American Marietta Corporation was paid \$197,000 for the property and buildings thereon.

Later, additional property which was necessary for a drainage ditch was purchased from private individuals. The area of this addition was 0.23 of an acre.

ADMINISTRATION OF OPERATIONS FROM NOVEMBER, 1943. TO NOVEMBER, 1950

CONTRACT ARRANGEMENT

After the property had been acquired the AEC entered into a contract with the Perry Warehouse Corporation for the operation of the Sampling Plant. Under the terms of this contract each party was delegated certain definite responsibilities.

AEC assumed the responsibility of the administrative functions at the Middlesex Sampling Plant with a staff that consisted of a Plant Supervisor, a Storekeeper, a Health & Safety Technician, a Security Force of twelve Security Police, and four clerk typists. AEC was responsible for administering the following operations and duties:

1. Planning and scheduling all work for plant operations.
2. Maintaining all accountability records.
3. Maintaining an adequate security force.
4. Administering the Health and Safety program.
5. Purchasing all materials required for plant operations.

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The Perry Warehouse Corporation assumed the responsibility of supplying a labor force with a foreman to direct and to perform the operations of crushing, weighing, and handling the processed materials. The labor force was not fixed numerically but could be varied to meet the needs of the operating load.

Lucius Pitkin, Inc. was engaged by AEC to represent the US Government in the technical aspects of sampling and weighing, and to furnish the labor and services to supervise and control these operations. This labor force consisted of two supervisors who were skilled in sampling and weighing and two technicians to perform the sampling. On July 1, 1948 a supplement agreement to the contract added responsibilities to Lucius Pitkin, Inc. as follows:

1. Technical Details

Assume the responsibility of the technical aspects of the mill operation, sampling, drying, size reduction and sample preparation on the behalf of the AEC.

2. Material Handling

Inspect all the materials received and supervise the drying operations.

3. Mechanical Operations

Check the machinery and equipment for proper operation, damage and wear, and initiate action to correct any operational defects.

4. Weighing Operations

Perform the weighing functions with the LeDoux Co. representatives as official observers for the vendor.

5. Health and Safety

Closely supervise the dust control operations from a Health and Safety viewpoint to maintain the AEC standards for Health and Safety.

6. Laboratory Security

Maintain complete control of the approval for admission of visitors to the laboratory premises including representatives of AEC, LeDoux Co., and the Perry Warehouse employees.

7. Co-ordination of Changes

Coordinate changes in equipment and process by obtaining

joint approvals of the AEC and the LeDoux Co., and keep a permanent log of all pertinent information.

EARLY PROCESSING METHODS AND DEVELOPMENTS AT MIDDLESEX  
(Period of Oct., 1943 to Nov., 1950)

The primary function of the Middlesex Plant was the sampling and weighing of ores received from various vendors. The methods and equipment available at first were crude and usually inadequate. There was a need to develop better methods and yet at the same time to consider the health and safety of personnel and the economics of the operation. One of the early attempts made toward improving the sampling method was the sampling of one lot by three methods and the comparison of the results.

SAMPLING Q-11 ORE

Manual Screening and Sampling

The first sampling operations of the Middlesex Sampling Plant were performed manually. Most of the ore being received was packaged in heavy paper bags. These bags of ore were conveyed to the second floor of the warehouse and dumped on framed screens which were supported by wooden horses. Then the ore was manually worked through the screens and dropped on the floor. Blending was accomplished by shoveling and reshoveling of the ore. A grab sample was taken and processed for analysis.

Sampling by Cascading

The second method to be tried was cascading. The cascades consisted of a series of four inch riffles which extended from the second floor of the warehouse to the first floor. The ore was dumped onto the riffles and worked through the riffles by hand. On the first floor the sample was taken and the ore was drummed for shipment.

The Pipe Sampling Method

Twenty percent of each lot was screened through a three-quarter (3/4") inch vibrating screen. The oversized lumps were by-passed to the grinding mill and then recycled through the vibrating screen. The entire sample was drummed and three pipe samples were taken from each drum. The completed sample was dried for 48 hours in five flat pans.

The entire completed sample was ground in a bell grinder to the required mesh size and the sample was then cut in half on small riffles and one-half of the sample was reserved. The remaining half went to

the rough grinder to be ground to 20 mesh size. This material was again riffled down to the required size, and this portion then taken as the final sample was pulverized in a Braun pulverizer, passed through an 80 mesh screen and blended thoroughly. After compositing the samples from five cars, the samples were blended in a ball mill overnight, dried for two hours and packed in nine (9) bottles for distribution.

Determination of the Best Method for Sampling

At this time these three methods were considered for sampling ores. To determine the best method to use for accuracy, health and safety, and economics an experiment was set up to prepare three samples from the same lot by three different sampling methods.

Comparison of the Three Methods

The cascade method was used as a control medium. The pipe sampling method was used on twenty percent (20%) of the drums after the material was ground and riffled. The crude moisture grab sample was worked up as a final sample for analysis. The analytical results obtained were as follows:

<u>Cascade (Riffled)</u>	<u>20% Pipe Sample</u>	<u>Moisture Grab Sample</u>
11.0%	10.93%	11.07%
11.7%	11.0%	11.36%

Comparison of the Economics

<u>Method</u>	<u>No. Men Required</u>	<u>No. Hours Per Man</u>	<u>Total Man-hours</u>	<u>No. Lots Per Week</u>
Riffled	8	12	96	4
Hand Sampled	12	8	96	6
Pipe Sample	8	6	48	8

Disadvantages of Hand Sampling

There were numerous disadvantages to the hand sampling that far outweighed any advantages of this method:

1. The labor cost was high.
2. The manual operation consumed too much time, thus limiting plant capacity.
3. The dust control was difficult and inadequate. The exposure of personnel to airborne dust was much higher than the standard maximum allowable.
4. The material moisture pickup could not be eliminated and the consequent resultant errors could not be controlled.

Method of Sampling Adopted

From the test results obtained regarding economics and health and safety the pipe sampling method was obviously the best and was adopted at this time.

Sampling Problems

Several problems were encountered in the sampling process that were of considerable concern but which were eliminated after investigation and the application of new methods.

Moisture Pickup By Q-11 Samples

Some experiments that were performed on Q-11 samples indicated that the material picked up 0.50% water from the time it was placed in the drum just before milling until it was weighed immediately after milling.

The observations on a sample ground in an Abbe Pebble mill for 18.0 hours were as follows:

1. The material adhered to the sides of the jug.
2. The material adhered to the pebbles.
3. The loose material in the mill was in the form of small cakes.

These experiments were conducted under the following conditions:

1. All the equipment as well as the sample was dried thoroughly.
2. It was noted that caking was not dependent on the nature of the material since 55% material behaved the same as 35% material.

The conclusion was that the moisture was picked up by dried Q-11 samples from either or both sources; (1) The moisture in the air trapped in the pebble mill or (2) The moisture picked up in the time interval between the removal from the drier and sealing the sample in the pebble mill.

Processing Wet Ores

Another problem was the considerable difficulty experienced in the processing of wet Q-11 ores. The frequent caking and gumming up of the wet ore necessitated a shutdown of the processing equipment to clean out the caked ore resulting in a considerable amount of downtime. It was obvious that some method was needed to dry the ore before it entered the processing equipment. Two methods of drying were tested:

1. The first method tried consisted of a series of propane gas burners mounted over the belt conveyor that carried the ore to the processing equipment from the dumping station. At first a rubber belt was used but it quickly failed because of the heat. Next, a woven metal belt was tested, but it was not usable because the ore caked on it. This method was tried because it offered the possibility of a quick solution to the problem.

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2. Secondly, an oil-fired rotary kiln drier was tested. It was immediately successful and eliminated the ore drying problem.

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PROCESSING Q-11 ORES WITH MECHANICAL EQUIPMENT

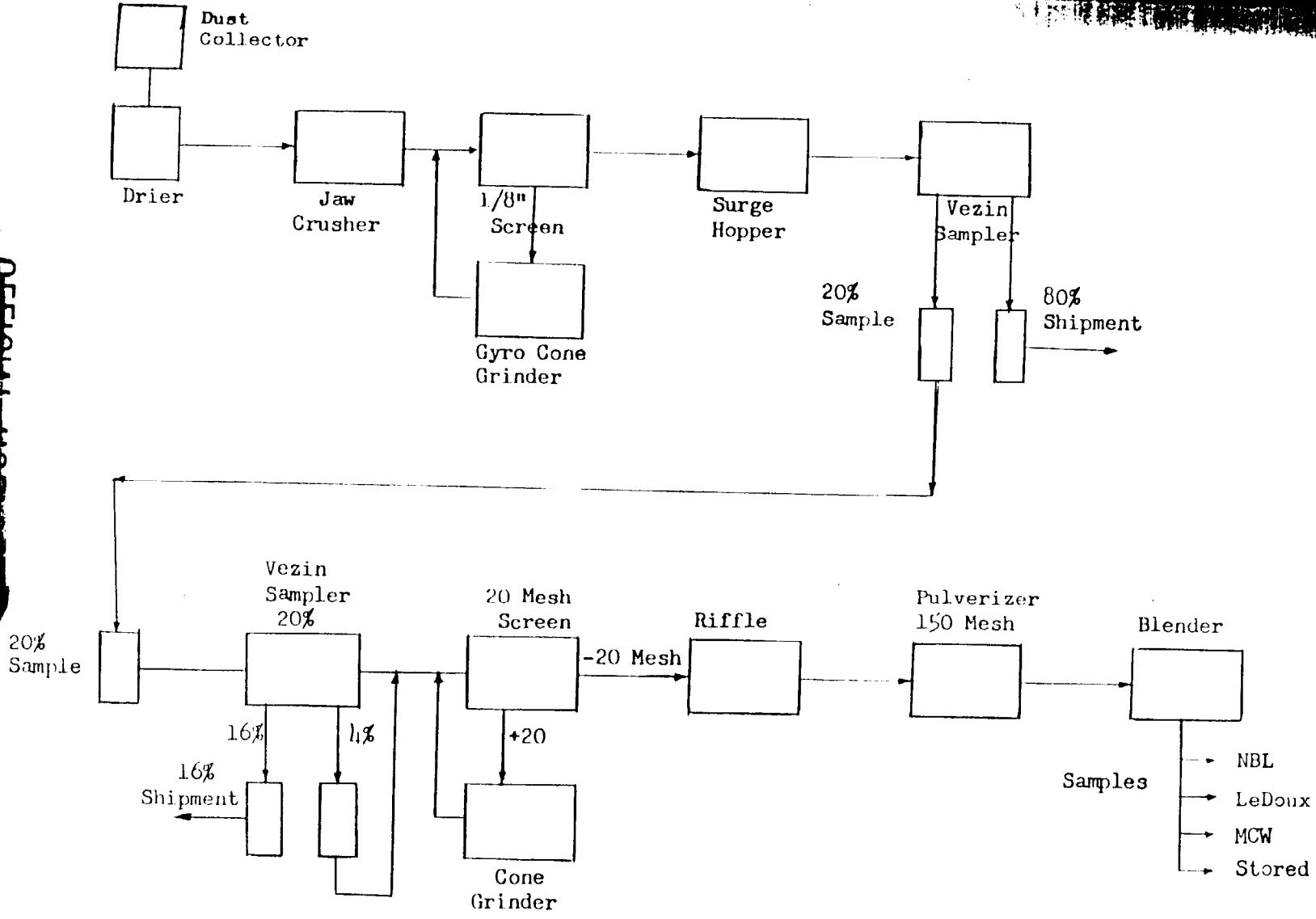
The shipment of ore was received and separated into lots. When the lots were completed the number of drums were checked by the LeDoux representative for the vendor and the L. Pitkin representative for AEC.

The drum lids were cut-off in preparation for dumping and in cold weather the drums were kept in the thaw house 24 hours before being dumped. The drums were dumped on the conveyor and the material carried to the rotary drier and after passing through the drier the material was conveyed to the jaw crusher, a 19 x 24 Telesmith crusher. A bucket elevator carried the ore to a 4 x 8 Tyler Niagara vibrating screen of 1/8" mesh. The oversized lumps were diverted to a secondary crusher, a Symons cone grinder, while the smaller particles passed through to the large surge hopper. The material leaving the Symons cone grinder was conveyed to the bucket elevator for recycle through the Tyler screen.

From the large surge hopper the material was conveyed to the Vezin sampler by a Hardinge constant weight feeder. The sample cut of 20% of the material processed was caught in special drums which were designed to be mounted on a feed inlet to the bucket elevator and reprocessed through the Tyler screen, surge hopper and Vezin sampler. Twenty percent of the original sample (or 4.0% of the total lot) was obtained to be processed and bottled for the samples. The discard from the sample was collected in 30 gallon drums, sealed, weighed and shipped with the lot.

The 4.0% sample of the lot was conveyed to the laboratory in covered hoppers or drums mounted on carts. This material was processed through a 10% vezin sampler to obtain a 0.4% of the original lot. The sample obtained was spread in pans for a drying period of 48 hours @ 110°C prior to determining the moisture content.

After the moisture determination the sample was crushed, riffled and pulverized to 150 mesh and screened. The final sample was then blended and re-dried, and nine sealed samples were bottled for storage and distribution.



STATISTICS CONCERNING PROPERTY AND BUILDINGS

Property

The total area enclosed with a cyclone fence was 9.61 acres and of this acreage eight (8) acres were paved with asphalt to provide a drum storage area.

Buildings

- Building No. 1 - The main building was a two story brick warehouse with dimensions of 60' by 257'. A concrete dock extended along the entire east side of the building to facilitate the loading and unloading of railroad cars. The building was approximately 50 years old.
- Building No. 2 - This building of concrete block construction measured 43' by 38' and was used as a thaw house for frozen ores in the winter time.
- Building No. 3 - The boiler house and maintenance shop was constructed of brick and measured 50' by 35'. It had to be remodeled and two new low pressure boilers had to be installed.
- Building No. 4 - This quonset hut used for enclosed storage extended along the eastern edge of the property with the dimensions of 24' by 256'. It was constructed of steel and galvanized corrugated sheet metal.
- Building No. 5 - A six car garage was located north of the quonset hut and was constructed of wood and galvanized corrugated sheet metal. A five foot wide concrete apron extended along the entire front of the building.
- Building No. 6 - The administration building was a one story "L" shaped building constructed of concrete block and housed the offices, laundry, lunchroom, lockerroom, health and safety dispensary and waste disposal unit.
- Building No. 7 - This building of concrete block construction was used as a dumping station for Q-11 onto the conveyor for processing.



Area of Buildings and Land

Buildings

Administration Building		311 square yards
Closed Storage Areas:		
Quonset Hut	1213 sq. yds.	
Storage House	<u>223 sq. yds.</u>	
		1436 square yards
Operation Areas:		
Garage	320 sq. yds.	
Boiler House	195	
Thaw House	220	
Loading Dock	511	
Track Siding	314	
Oil Tank	43	
Paint Shed	15	
Dust Collectors	178	
Miscellaneous	<u>23</u>	
	1819	
		1819 square yards
Open Storage Areas:		33824 square yards
Total Area:		37390 square yards

REPAIRS AND REVISIONS TO BUILDING AND EQUIPMENT

In February of 1947 a list of repairs and revisions to buildings and equipment required for the operations was submitted to the AEC by the Perry Warehouse Corporation.

In the Fall of 1947 the AEC Staff of Engineering Division made the following recommendations:

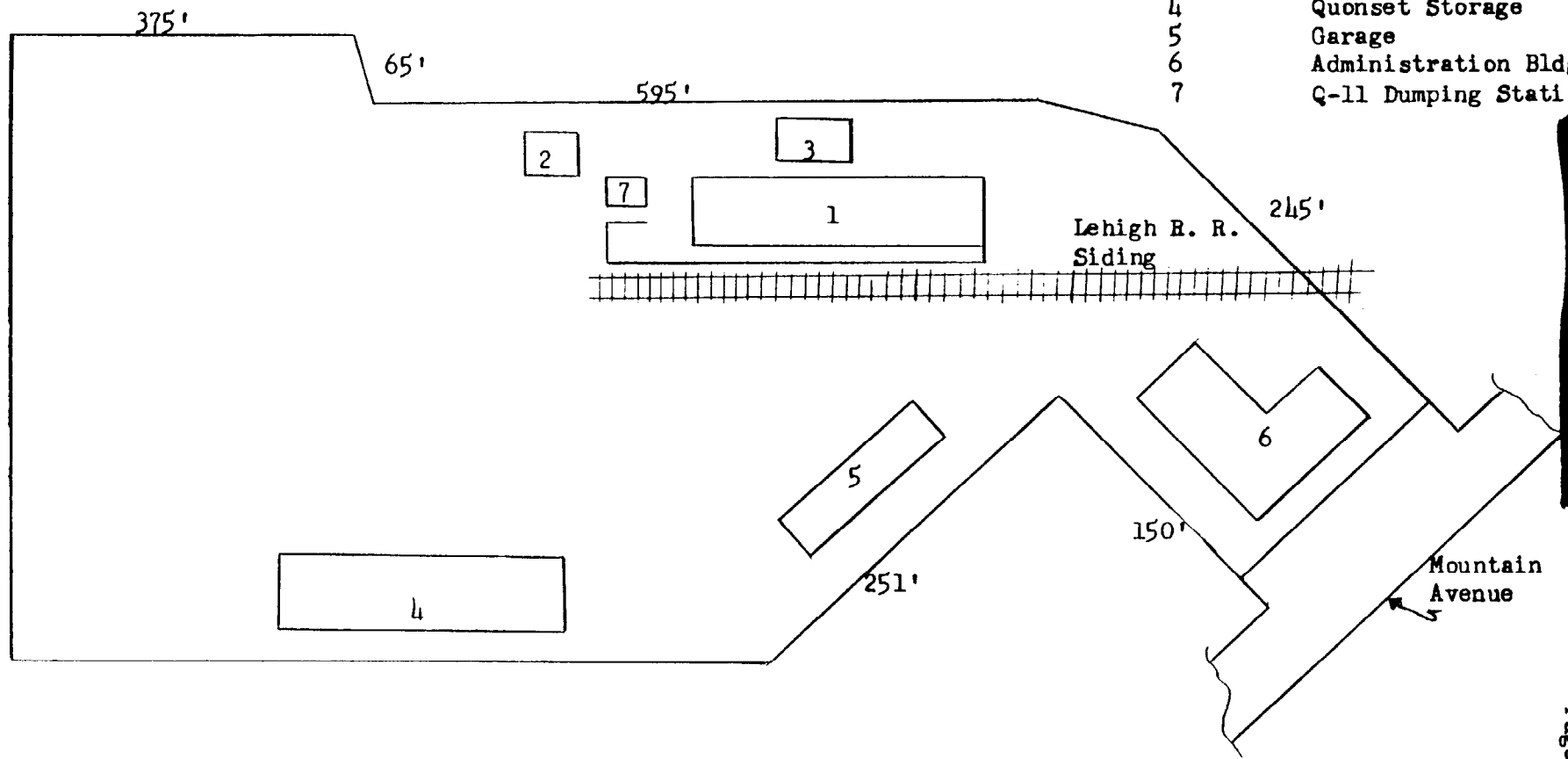
1. Administration Building - It was proposed to build a new building to replace the temporary office building. This new building housed the laundry, lunchroom, health and safety facilities, shower and lockerooms, and all the offices. This project was carried to completion.
2. Laundry Waste Water Disposal - In order to filter the solids from the laundry waste water and to allow the clear filtrate to be sent to the drainage ditch, it was proposed to build and equip a waste disposal unit. This project was completed.
3. New Floor in South End of the Warehouse - The wooden floor in the south end of the warehouse was to be replaced by a concrete floor with the proper drainage system. The new floor covered 9480 square feet and was completed in July, 1948.

4. Concrete Dock on the East Side of the Warehouse - It was recommended that a concrete dock replace the original wooden structure. This project was completed.
5. Settling Tank - A concrete settling tank of 500 cubic feet capacity to receive the drainage from the warehouse concrete floor was installed. Purpose of the tank was to remove the solids from the drain water and allow the clear effluent to go to the drainage ditch.
6. Two New Boilers - The original boilers were old and beyond repair. A new boiler house equipped with two new boilers was built.
7. New Sampling Equipment - New sampling equipment was installed to get a more representative sample. This equipment included a ball mill, a Vezin Sampler, and a blender. The Middlesex Sampling Plant was down in the fall of 1947 for these revisions. The new equipment would not process frozen material so it was necessary to build a thaw house with the government labor available.

In addition to the above list of improvements the Cottrell precipitator on the Q-11 system was installed in December of 1947; the outside storage area was paved and modifications made to the jaw crusher in September, 1948.

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Bldg. No.	Name
1	Brick Warehouse
2	Thaw House
3	Boiler House
4	Quonset Storage
5	Garage
6	Administration Bldg.
7	Q-11 Dumping Station



MIDDLESEX SAMPLING PLANT  
GENERAL LAYOUT

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ADMINISTRATION OF OPERATIONS - PERIOD OF NOVEMBER, 1950 TO FEBRUARY, 1955

In May, 1950 it was noted by AEC representatives that the operations at Middlesex lacked speed and coordination in the administration of the smaller programs such as enforcement of health and safety regulations, the adherence to procedures in sampling and testing, and the accurate recording of information for accountability purposes. Programs such as these had to be put into effect on a day to day basis to obtain the required results.

Selection of a Contract-Operator

In order to gain unified control of operations and of the administration of various programs and to have a capable technical man as plant manager it was suggested that a contract operator should be engaged. The benefits to be gained by such a move were as follows:

1. Better all-around operation of the processes and attainment of greater flexibility to handle new jobs that might be assigned to the Middlesex Plant.
2. The improvement of sampling techniques and weighing procedures.
3. Purchase orders that were being processed at the NYO Office could be handled at Middlesex at a considerable savings.

After it had been decided by the AEC to engage a contract operator a plan was devised to make the selection. Thirteen firms which had had a diversified experience in mining and chemical processing operations were contacted by the AEC and each firm was requested to submit information as outlined below if they were interested in the proposition:

1. A description of how the firm would organize and operate the plant.
2. Furnish a complete resume' of the background and experience of the firm in similar operations.
3. Supply a listing of the past accomplishments of the firm in related fields.
4. Estimate the amount of the fee and the cost of operations for one year.
5. List the qualifications and experience of the man to be appointed plant manager. AEC made it very clear that the man selected for plant manager must be the best obtainable.

Nine of the thirteen firms contacted declined the proposition for various reasons. Each firm that was interested was invited to meet representatives of AEC for a discussion of the problems and operations involved.

On September 18, 1950, such a meeting was held between the AEC and the National Lead Company representatives. AEC representatives were Mr. R. J. Smith, Production Manager and Mr. J. T. Consiglio, AEC representative at Middlesex; National Lead Company was represented by Mr. E. R. Rowley, Mr. P. C. Mucilli and Mr. J. F. Harper. Among the many problems discussed are the major items listed below:

1. The requirements and attainment of security clearances for the National Lead Company personnel.
2. The plan for organizing the Middlesex Plant staff by the contract operator.
3. The qualifications of the Plant Manager, in a very detailed resume' of his technical background and experience.
4. The required cooperation between the AEC and the contract operator in the operations at Middlesex. The proposition was that the contract operator would operate the plant with an AEC representative at the site to assist as an adviser and liaison between the AEC and the contract operator.
5. The amount of fee to be charged to cover any major engineering work that might be done by the contract operator.

#### National Lead Company Selected as Contract Operator

After the completion of the meetings between AEC and the prospective contract operators each firm was asked to submit bids estimating the cost for operating the plant for one year. After considering the bids received and the data obtained in the meetings the AEC selected the National Lead Company as the contract operator for the reasons listed below:

1. The National Lead Company was well rounded in experience and well established in the field of Industrial Management.
2. The company had a staff of capable and experienced technical and administrative personnel who were readily available if needed.
3. The company had a wealth of up-to-date experience in handling similar materials.
4. The company had considerable experience in sampling and weighing operations of similar materials.

THE CONTRACT ARRANGEMENT OF AEC AND UNITED LEAD COMPANY

In November, 1950 a cost type integrated contract with a stipulated fixed fee on a yearly basis was negotiated between AEC and National Lead Company. The fixed fee was included to cover any administrative assistance received from the parent company.

The responsibility of operating the Middlesex Sampling Plant was assumed in November, 1950 by the United Lead Company, a subsidiary of the National Lead Company. By the terms of the contract the United Lead Company was the administrator of the program outlined below:

1. The company was to administer all phases of the contract - namely, to control the sampling procedures, supervise the proper processing of ores and special materials, and to enforce and augment the established Health and Safety program.
2. The company was to exercise the proper administrative supervision for efficient operation and maintenance of the plant, the storage of materials, recording property records, and to supervise the receipts, weighing, checking and shipment of materials.
3. The company was to work in conjunction with the Records and Miscellaneous Source Branch of the AEC to administer the following program:
  - a. Receive the information covering the vendor's preliminary weight, lot number, drum number, and type of materials.
  - b. In accordance with AEC instructions, re-lot the materials to United States lots.
  - c. Prepare the necessary documents for accountability and the Washington reports, and prepare the final weight statements and sample analysis reports.
  - d. Distribute the samples to the contractor involved, to the AEC Lab in New Brunswick, New Jersey, and also to the National Bureau of Standards if an umpire analysis was required.
  - e. Report any discrepancies in the receipt of materials, and arrange for the shipment of the processed materials.
  - f. Procure material and equipment required for the plant operations.
  - g. Protect the plant warehouse and storage areas by an adequate force of security police.

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- h. Supervise and rigidly enforce safety regulations and precautions.
- i. Estimate the cost of any subcontracts.
- j. Direct and lay out plant operations, and schedule the work to be performed by professional, technical and hourly employees.

Staff of United Lead Company

There were fifty-four (54) employees on the staff of the United Lead Company.

Distribution and organization in the various job categories was as follows:

Plant Manager	
Office Manager	
Plant Engineer	
Business Staff	5
Security Police	11
Operators (Skilled and semi-skilled)	- 34
Health - Physicist	1

PROCESSING METHODS AND DEVELOPMENTS

Processing MgX and INX:

In 1950 the Middlesex plant began to receive, process and sample MgX. Since little was known about the handling of this material the first sampling was done by pipe sampling as a temporary means until a system could be installed for the processing.

There were several problems connected with the handling of MgX. The material was fine, creating a dust problem, the radiation of alpha rays required careful handling of the material to prevent over-exposure of personnel, and the material was hygroscopic.

AEC decided that a "stop-gap" method for sampling must be devised and no time could be spared for a design study. A system was devised consisting of the components listed below, some of which were available on the site with the remaining items obtainable in the area:

- |                    |                               |
|--------------------|-------------------------------|
| 1. Bucket Elevator | 5. Ice Crusher (lump breaker) |
| 2. Dust Collector  | 6. Barrel Vibrator            |
| 3. Drum Dumper     | 7. Vezin Sampler              |
| 4. Surge Hopper    |                               |

The equipment was installed and the African Metals Corporation accepted Vezin sampling of MgX on March 9, 1951.

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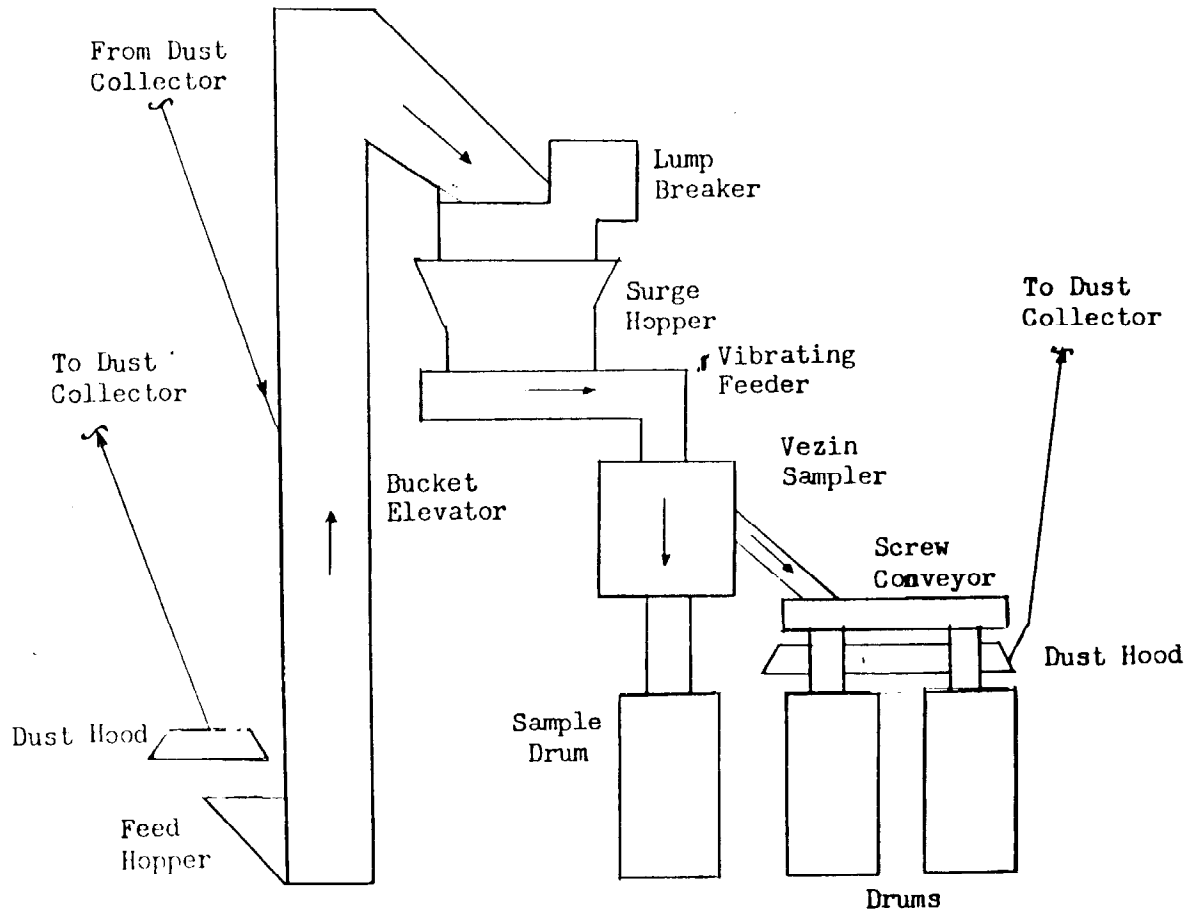
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The chemical precipitate called MgX was received in drums. When packed it had the tendency to form balls or clots which had to be broken prior to sampling. The drum lids were cut off and the drums dumped by the drum dumper at the bucket elevator feed station. The bucket elevator conveyed the material to the lump breaker from which it dropped into a surge hopper. A feed screw conveyed the material to a Vezin sampler unit where a 10% cut was taken for a sample. This 10% sample was directed to a second Vezin sampler which took a 10% cut to make a final sample of 1% of the total lot.

This final sample was taken to the Laboratory where it was mixed, coned, and quartered successively. Two quarters were placed in the oven for drying and after drying it was riffled, ground and screened through an 80 mesh screen. This sample was bottled for distribution.

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MIDDLESEX SAMPLING PLANT  
MEX SAMPLING SYSTEM

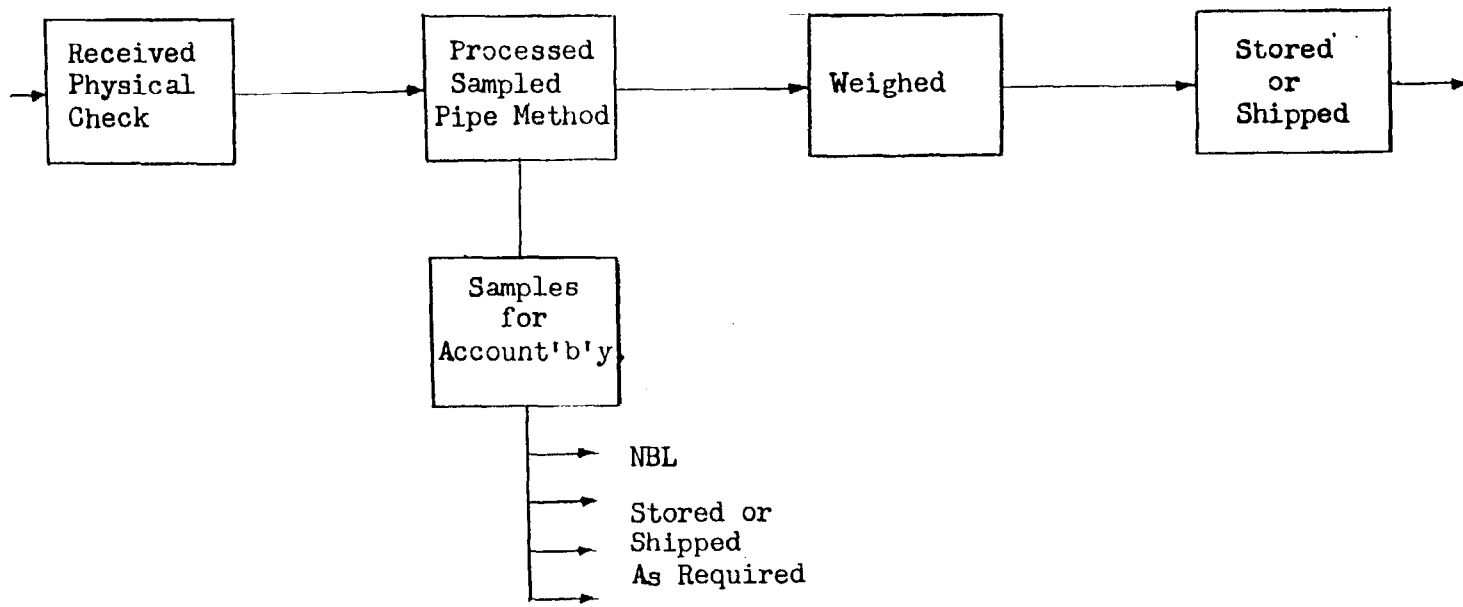
Processing Beryl Ore:

Beryl ore from either India or South America was received in carload lots. For the processing of the ore two vendor lots were combined to form one U. S. lot. In June, 1951, the sampling frequency was changed to one lot sampled out of every five lots processed.

When received the ore was packed one-hundred (100) pounds in each burlap bag. Bags, of the two lots, were dumped alternately so that there would be a thorough mixing. The same equipment that was used for processing Q-11 material was used to handle beryl ore. However, the system had to be thoroughly cleaned before changing from one type of material to the other. No thawing and drying of the ore was required but beryl ore was brittle and abrasive causing considerable wear on the processing equipment. The ore was crushed in the jaw crusher, passed through a 5/8 screen, and then packaged in 55 gallon drums for weighing and shipment to the Brush Beryllium Company. The final sample consisted of about eight pounds of ore which was ground to 20 mesh and poured into four bottles with one sample bottle being sent to the New Brunswick Laboratory and the remaining bottles stored.

FIGURE 2

MISCELLANEOUS MATERIAL FLOW DIAGRAM



SUMMARY OF THE EVALUATION AND IMPROVEMENT OF THE Q-11 SYSTEM

This report summarizes, chronologically, the work done on the evaluation and improvement of the Q-11 sampling system at Middlesex from June, 1949 to October, 1952. The original sampling system and all changes incorporated into it had the mutual approval and consent of both the buyer and seller of the material processed.

Study of Particle Size Distribution

The study of the effect of the particle size on sampling was started in June, 1949. At that time a  $\frac{1}{4}$ " screen was being used for screening prior to sampling. The most noteworthy effect in this study was the determination of the particle size distribution in the 300 pound sample as it was obtained from the mill prior to being ground for sample preparation.

Screen analysis were made on several portions of one mill sample. The analysis of the samples on the  $U_3O_8$  basis revealed that the different particle sizes have different assay values; the general trend was that the larger particle sizes had higher assay values.

From the data available it was determined statistically that the random fluctuation of particle size within each 300 pound sample created a standard deviation of 0.18%. In 5% of the time the assay variations in a 300 pound sample would be more than 0.35% of the true value. These results indicate the need for a change.

Change in Mill Crushing to 1/8" Size

According to results obtained it was decided to change the mill grinding so that all material should have to pass through a 1/8" screen. Thus, with a smaller particle size, the same size sample would be more representative. A smaller particle size was desirable but such a change would have required major equipment revisions.

Coordination of Laboratory Technique

In order to reduce possible errors in the chemical analysis of samples, standard samples have been employed. In 1948 the National Bureau of Standards prepared a standard sample of Q-11 known as MSOR. This standard sample was sent to those laboratories involved in the Q-11 assay determination - namely - L. Pitkin, Inc., LeDoux and the Mallinckrodt Chemical Works.

The purpose of this sample was to provide a standard against which these laboratories could check the results of their methods.

Quality Control Program for Laboratories

In the summer of 1950 a program was established whereby the New Brunswick Laboratory and MCW would be placed under a Quality Control Program with regard to Q-11 and MgX assay determination.

Standard samples of Q-11 and MgX, for which the assays would be known as accurately as possible, were prepared at Middlesex. The program consisted of sending of these samples to NBL and MCW in a disguised form at periodic intervals distributed among the regular samples; thus, the accuracy of the technician could be checked to determine if a bias was being developed.

Mechanical Changes in the Q-11 Sampling System

In November, 1951 a new feeder and a new type of Vezin sampler were installed primarily because they were dust tight and the original equipment could not be made dust tight.

In February and March of 1952 further modifications were made to the Q-11 system in the nature of improved ventilation and dust collection at the vibrating screen, drum filling and drum sealing locations. The flow of material was not affected by these changes.

Sample Preparation by the Ball Mill

In 1947 and 1948 the use of a ball mill in the preparation of the Q-11 sample was discussed. The idea was to perform the preparation of the sample in one complete step, thus reduce handling and dust hazard. Lucius Pitkin, Inc. conducted laboratory scale experiments and obtained favorable results.

In June, 1951 the first official tests were conducted on the new equipment. The preparation of the sample through the ball mill consisted of ball milling the sample for four (4) hours, blending the charge in a blender for two (2) hours, and final riffing through a cascade of four (4) Jones riffles to obtain the required sample.

The assays of the resultant samples, when compared with those of the regular official sample showed the ball mill valve to be consistently higher. No suitable explanation could be developed for this apparently consistent discrepancy. A decision was made to investigate the accuracy of the official sample procedure.

Proving the Sample Preparation Procedure

In October, 1951, an experiment was formulated to determine the efficiency of the sample reduction and preparation procedure. It was planned to prepare duplicate samples at each step where a reduction in quantity of samples took place. The resultant data was considered very good.

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At the first step the two percent (2%) mill sample was reduced to 0.4% by passing it through a laboratory Vezin sampler. Such reduction without prior mixing or particle size reduction was questionable.

Proving the First Sample Reduction - 20% Laboratory Vezin

In November, 1951 an experiment consisting of taking two duplicate samples out of the rejects of the mill samples which had been ground to pass a 10 mesh screen, one duplicate sample was prepared in the ball mill and the second sample similar to the official sample. The three samples for each lot were to be taken in this order - official, ball mill and duplicate.

The assays of the resultant samples revealed that the two duplicates differed greatly from the official sample. This difference was plus for two lots and minus for the third lot. The variation ranged from -2.25% to +2.83%.

It was noted that the difference between the second and third samples was less than between the first and second samples. It was concluded that blending was caused by the passage of the material through the Vezin for the withdrawal of each subsequent sample. This indicated that the mill sample should be blended before removing the sample.

Checking the Mill Sample Blending

A series of check tests were conducted to prove the efficiency of the blending operation. Five lots were checked using a large mixing barrel constructed to enable blending to take place. The difference between assays of the duplicate and official sample was much smaller ranging from 0.12% to 0.13%. The results of the moisture checks were remarkably close also.

Performance of the New Vezin Sampler

Early in January, 1952, the percent of sample cut throughout each lot began to vary slightly more and at times was as much as 1.0%. At the installation of the New Vezin Sampler November 15, 1951, the initial sample cut was approximately 4.0%. Adjustments were made in order to bring the sample size down to about 2.0%.

It was observed that this size could be kept uniform if a bed was maintained in the surge hopper above the Vezin. In February, 1952, a "Bindicator" was installed to maintain this bed. Uniform sample cuts were then obtained.

In May, 1952 it was noted that the difference between the African metals assays and the final assays for each lot of Q-11 were becoming larger. The African Metals assay tended to be higher. As a result a sampling efficiency experiment was developed and conducted at Middlesex.

Sampling Efficiency Experiments

In June, 1952 a revised sampling efficiency experiment was formulated to test the accuracy of the mill sampling of Q-11 ores. This experiment consisted of testing three (3) lots of Q-11 by sampling each with three distinctively independent methods:

1. The Vezin sampler
2. Riffle sampling of the entire lot
3. The Auger of thief sampling of each drum

The results of this experiment, completed in September, 1952, were too varied to provide any definite conclusions.

In October, 1952, another experiment was formulated. Six vendor lots were selected in pairs of two (2), representing high and low assay material for fines, coarse, and hand-picked types of Q-11. Each lot was sampled by two methods - namely - the official Vezin sampler method, and by the coning and quartering of each drum and forming a composite for the lot. In addition, for the "fine" type of material only, a thief sample was taken prior to the above two methods. Each sample taken was divided into three portions, an original, a duplicate, and the third portion for screen analysis. The low assay lots were sampled prior to the high assay lots.

The United Lead Company and the AEC had the overall responsibility for the execution of these tests. The LeDoux Company was invited to participate fully in all aspects. Lucius Pitkin, Inc. was responsible for the supervision of all operations concerning these tests.

Additional Tests

Since the results of the efficiency tests did reveal that a difference was present a "location" test was immediately put into effect. The test was started in December 4, 1952.

The location test was so designed that sample and reject stream were isolated for each portion of the mill Vezin sampler. A comparison of the assay of each stream should indicate whether the sample was or was not representative of the reject stream. The 80% reject stream from the first Vezin sampler was rerun through the Vezin to determine if the first Vezin was biased. If the first Vezin was biased in the low direction then the second run sample should be richer than the first.

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PROCEDURE FOR DETERMINING OF BIAS IN MILL VEZIN Q-11 EFFICIENCY TESTS

Phase II

In order to obtain additional data in evaluating the performance of the mill Vezin, the following step-wise procedure was followed in the reprocessing of Q-11 lots C-139B and C-141A. As closely as possible all material belonging to each lot was re-processed, retaining in the laboratory only those sample discards as might have been necessary to prepare additional samples for Phase I evaluation tests. Original dust from the Multiclone, Cottrel and Pangborn dust collectors was omitted. Second run dust from the Pangborn and the Sly dust collectors was included.

Procedure

Lot C-139B

Run 1

- (1) Rerun lot through mill and Vezin
- (2) Collect 3 separate streams
  - (a) 2% sample stream
  - (b) 18% reject stream
  - (c) 80% reject stream
- (3) 2% sample stream  
Sample was cut down by means of the laboratory Vezin, following procedures established in Phase I. Only the original and duplicate samples were obtained.
- (4) 18% reject streams  
Coned and quartered to approximately 2%, then further cut the sample down according to step (3).

Run 2

- (5) 80% stream  
Rerun through mill and Vezin as above collecting again three separate streams as follows:
  - (a) 1.6% sample stream
  - (b) 14.4% reject stream
  - (c) 64.0% reject stream

Dust

- (6) Disposition of dust
  - (a) Pangborn dust (Run 1) - Compositied by weight in each sample for Run 1 balanced reprocessed



- (b) Pangborn dust (Run 2) - Composited by weight in each sample for Run 2 only.
- (c) Sly collector (Run 1) - Composited by weight into 18% sample of Step (4). The balance was re-run.
- (d) Sly collector (Run 2) - Composited by weight into sample from 14.4% reject.
- (e) Portable collector (Run 1) - Reprocess

Lot C-141A

Repeat steps (1) to (6) of above procedure.

Comparative Analysis of H, C, and F Material

In order to determine the effect of each different type of Q-11 material on the differences encountered between the African metals U<sub>3</sub>O<sub>8</sub> content and the final accepted U<sub>3</sub>O<sub>8</sub> content for each lot of material, a tabulation was made as follows, covering the material processed at Middlesex during the period January, 1950 to August, 1952. (Lots A-135 through A-312, B-1 through B-74, and C-1 through C-101).

Part A - Using only those lots which consist of 100% of each of the "H", "C", or "F" type material, a breakdown was made showing this difference for each type of material. Together with this, the total amount of U<sub>3</sub>O<sub>8</sub> (as determined by Jadotville) representing all these lots was also tabulated.

Part B - Using only those USA lots made up of two types of material, a breakdown was made according to the predominant type, showing this difference. Together with this, the total amount of U<sub>3</sub>O<sub>8</sub> (as determined by Jadotville) representing all these lots was also tabulated.

Part C - Parts "A" and "B" were combined to show totals for the time period under consideration.

The obvious conclusion that can be made from the analysis of this data is that of the total difference in U<sub>3</sub>O<sub>8</sub> of 382, 141 pounds, about one-half of this is attributable to "H" type material. Slightly less is attributable to "C" type material and only 9% is caused by "F" type material.

Summary of Parts A and B

1. Total summation of differences in U<sub>3</sub>O<sub>8</sub> content

	<u>Totals</u>	<u>H</u>	<u>C</u>	<u>F</u>
	-271,450#	-162,094	-89,707	-19,658
	<u>-110,691</u>	<u>- 38,005</u>	<u>-57,107</u>	<u>-15,579</u>
Difference	-383,141	-200,099	-146,814	-35,237
%		- 52.3%	-38.5%	-9.2%

2. Total Summation of U<sub>3</sub>O<sub>8</sub> content for lots used above.

<u>Totals</u>	<u>H</u>	<u>C</u>	<u>F</u>
5,513,261	2,425,284	1,079,432	2,008,545
<u>3,138,309</u>	<u>816,586</u>	<u>1,006,774</u>	<u>1,314,949</u>
Total U <sub>3</sub> O <sub>8</sub>			
8,651,570	3,241,870	2,086,206	3,323,494
%	37.5	24.1	38.4

Correction of the Bias

The Vezin Sampler which was installed in November, 1951, was a two stage sampler with the first stage taking its cut from the main ore stream and directing this sample cut to the second stage. The second stage took a sample cut from this stream for the preparation of the final sample by the Laboratory. The reject stream from both sample stages was drummed for shipment. The results of the bias location tests revealed that the second stage sample cut was not taking a representative sample. To correct the bias the second stage was blanked off and the first stage sample cut was recycled through the first stage to obtain a sample for laboratory preparation.

IMPROVEMENTS AND REVISIONS MADE IN PERIOD NOVEMBER, 1950 TO APRIL 30, 1953

Many revisions and improvements were accomplished during this period through the efforts of the personnel of the United Lead Company and the complete cooperation of the representatives of AEC. New sampling equipment was installed, improvements were made in dust control methods, equipment was revised and improvised to improve methods and realize savings, and plant security was made more effective.

The MgX System

In 1950 the Middlesex Sampling Plant began receiving, processing and sampling MgX, a magnesium precipitate. Initially no equipment was available for handling this material, so pipe sampling was used to sample the MgX. AEC requested that a processing and sampling system be installed as quickly as possible. Some of the equipment was installed by the plant maintenance crew. The system, thus improvised, did a very creditable job and was accepted as the official sampling station for MgX.

After the installation and initial operations several improvements were made to the system including installation of a permanent magnet to remove tramp iron, complete enclosure of the MgX packaging station to improve dust control, and revisions to the conveyor feed system.

The Q-11 System

A considerable number of revisions were made to the Q-11 processing and sampling system to improve the processing and working conditions.

From the results of the sampling evaluation program, it was determined that variation of particle size affected the reliability of the sample, so in order to keep the particle size more uniform the Tyler screen was changed from 1/4" to 1/8" to get a more representative sample.

The United Lead Company made constant efforts toward improving the methods of minimizing the quantity of airborne dust. The major improvements among the many accomplished are listed:

1. The method of emptying the dust from the hoppers of the Pangborn dust collector and the Cottrell precipitator was changed from manual to mechanical. The manual method consisted of dropping the collected dust into unvented drums resulting in a major dust problem. To eliminate this problem the dust from the Cottrell precipitator was discharged to a dust tight screw conveyor which in turn discharged to a drum located in an enclosure vented to the Pangborn collector.

The collected dust in the Pangborn collector was discharged into a dust tight screw conveyor and returned to the Q-11 bucket elevator.

2. A new sly dust collector and a new dust hood were installed to provide for better dust control and to increase the ventilating capacity for the Q-11 system.

To prevent damage to equipment and to remove tramp iron in the ore an Alnico permanent magnet was installed in the Q-11 system.

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To obtain more accurate weighing of material the beam type scale was replaced by a Toledo dial scale, model 66-1521, with a printweigh mechanism.

Improvements were made to the sampling apparatus by installing a Witte tubular feeder and a Denver Duplex Vezin Sampler which increased system capacity to twelve (12) tons per hour.

#### Drum Reconditioning Equipment

A considerable number of drums were required for the plant operation, since all materials were received and shipped in drums. Many of the drums in which materials were received had the lids welded on and/or were damaged. These drums could not be re-used, but had to be replaced. In order to reduce costs incurred by the purchase of drums, a drum reconditioning unit including a chime machine, bender machine, and a body roller machine was installed. Considerable savings were realized by being able to recondition drums in which materials were received and re-use them for materials being shipped.

#### Other Improvements and Additions

Originally the heads of drums which were welded had to be cut out by the use of an acetylene torch. This method was hazardous because of the exposure of personnel to dust and radiation and a drum deheader was installed.

To improve the materials handling more dock space for loading and unloading was provided by the addition of a wooden ramp on the south end of the warehouse. Several roller conveyors were added as needed and a Hyster Model 40 fork truck was purchased.

To supply compressed air for use in operating plant equipment and instrumentation an air compressor was installed.

#### Baling Scrap Drums

One of the problems was the baling of scrapped drums. Some local firms were contacted for estimated of the cost for baling drums. For the large number of drums to be baled, the cost was considerable. However, through the ingenuity of the supervisors and the maintenance crew a drum crusher was improvised from materials at hand. The drums were flattened under the crusher, and bound in bundles. A considerable savings was realized from this operation. The AEC in a letter specified that the drums be transferred to a scrap dealer who, in turn, was instructed by the AEC to credit the scrap value to the ore vendor's account.

#### Security Program

Early in 1951 the AEC indicated that the area was not as secure as it should have been and requested the United Lead Company to take steps to improve the situation. Several recommendations were made by AEC and were promptly put into effect. Listed are AEC recommendations that were fulfilled:

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1. The guard tower was relocated for a more commanding view of the operating area and buildings.
2. A sufficient number of qualified men were employed to occupy the guard tower from 4:00 PM to 8:00 AM.
3. Thirteen additional floodlights were installed to light the area.
4. A master station of the two-way executive intercommunication system was installed in the guard tower.
5. Telephone connections were tied in at both the main entrance and the guard tower.
6. Connections were established with the ADT service so that guards on night duty could call ADT on a regular schedule. Arrangements were established for action to be taken by ADT if a scheduled call was missed.

#### Resolving the Stores Inventory Situation

The inventory and organization of stores items was completed in December, 1952. Prior to that date it was normal procedure at Middlesex to store in what was designated as the store-room non-stores expensed items, such as tools. The AEC requested that a physical separation of stores items from non-stores items be effected, so that a more efficient control of inventory of those materials could be maintained. To accomplish this goal the following program was put into effect:

1. Segregate and relocate all stores items.
2. Segregate all stores inventory scrap items.
3. Segregate all stores inventory salvage items.
4. Regroup all new or usable clothing.
5. Segregate equipment items of a fixed asset nature in two groups:
  - a. Serviceable items - needed on the project or declared excess.
  - b. Unserviceable items - listed on retirement notice as scrap or salvage.

When this program was completed each item of equipment found was tentatively unitized in accordance with AEC procedures for property units.

IMPROVEMENT IN DIRECT COSTS

One of the prime objectives of any industrial organization is the reduction of operating costs per unit of production. The United Lead Company was no exception as indicated by their record of direct costs for the period of operations.

For the period of January to December, 1950, the period immediately preceding United Lead Company tour of administrative operations, the direct cost per ton of ore processed was \$58.00. For the period of January to July, 1951, the direct cost per ton of ore processed was \$31.10. For the period of January to November, 1952, the direct cost per ton was \$29.75. For the month of August, 1953, costs were reduced to \$19.74 per ton of ore processed.

Such a reduction in costs was made difficult because ore receipts were not of a steady flow, and smooth even flow of production is a requisite for low costs.

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HEALTH AND SAFETY PROGRAM

Since methods and the equipment used in the early existence of the Middlesex Sampling Plant were crude, it follows that health and safety hazards peculiar to the material being handled were very much in evidence. The lack of understanding of the hazards involved by the production workers increased the seriousness of the situation. The solution to these problems was the improvement of methods for processing material with better dust control together with the education of the worker to recognize the consequences of exposure and to wear the protective equipment available.

From the crude manual methods used at first, the sampling and handling of materials was gradually improved to a mechanized process constructed as dust tight as possible and with dust control maintained by modern dust collectors.

These improvements were supplemented by radiation monitoring, air sampling, and the furnishing of protective equipment to the operators.

In order to protect the health of the personnel, the United Lead Company employed a Health-Physicist to administer the standards specified by the AEC. Health and Safety problems peculiar to the materials handled were the prime consideration but hazards normal to all industrial operations were not overlooked.

The duties of the Health-Physicist included the following:

1. Maintain the standards established by AEC.
2. Make recommendations for health and safety improvements from this daily observations.
3. Collect breath and urine samples on a periodic schedule.
4. Monitor working areas and shipments for radiation.

Listed below are some of the problems encountered and the method used in an attempt to rectify these conditions:

Radiation

The possibility of exposure of personnel to alpha, beta and gamma rays was recognized. The degree of radiation was checked daily in working areas by dosimeters. The Health-Physicist of the United Lead Company checked the dosimeters. The employees were required to wear film badges which were changed weekly and sent to New York operations office to be developed. All shipments from the plant were monitored by United Lead Company personnel before leaving the area. Monthly monitoring surveys were made by an AEC representative from the New York operations office.

Toxicity of Dusts

One of the major problems was the elimination and control of airborne radioactive dusts. To avoid inhalation of dusts, employees were furnished respirators to be worn in dusty working areas. Air samples were taken throughout the plant periodically by an AEC representative. The results of these surveys indicated the location of areas requiring improvement in dust control methods.

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To minimize the quantity of airborne dusts, the United Lead Company was constantly improving the methods of handling materials and dust control with the existing facilities. Through these efforts the exposure rate was decreased almost 50% by revising and utilizing the equipment available.

One notable example was the reduction of the dust concentration to 600 d/m/m<sup>3</sup> from an average of 78,700 d/m/m<sup>3</sup> at the Cottrell precipitator and the Pangborn dust collector by the installation of mechanical dumping facilities and the utilization of existing ventilating equipment, as described on page 34.

Waste Waters

The waste waters from outdoor and plant storage areas were sent to a settling tank and the liquor decanted.

The waste waters from the laundry and showers were sent to special treatment tanks and the filtrate passed on to the main drainage system. The collected sludge residue was dumped at sea.

The waste water was sampled weekly, and the soil was sampled yearly by the United Lead Company. These samples were forwarded to the New York operations office for analysis.

Solid Waste Disposal

All solid wastes were monitored with the combustible materials being burnt and the non-combustible wastes being dumped at sea.

Fire and Accidents

This hazard was ordinary with the exception of that of handling uranium turnings since these turnings ignite readily when exposed to air.

In addition to the listed precautions each employee was given a thorough physical examination at the time he was employed. This examination was repeated annually. Each employee engaged in plant operation was furnished all his work clothing including shoes and a clean change of clothing was provided daily. Two locker rooms were provided - one room for work clothing and one room for street clothing with a shower room situated between the locker rooms.

Results of Airborne Dust Survey

	8/50	4/52	1/53
No. of Workers Studied	58	51	46
Average exposure in d/m/m <sup>3</sup>	755	685	520
Highest exposure in d/m/m <sup>3</sup>	5250	8900	5750
% of employees exposed to 70 d/m/m <sup>3</sup> or less	10	18	35
70-210	42	45	26
210-350	7	14	7
350-700	21	8	7
700-1750	7	2	22
over 1750	14	14	4



TERMINATION OF OPERATIONS AT MIDDLESEX

Before operations at the Middlesex Sampling Plant could be completely terminated many problems had to be resolved. These concerned the disposal of stored ores, of excess and contaminated equipment, the storage of records, the AEC audits, the termination of sub-contracts, the clean-up and decontamination of building and equipment, and the preparation of buildings and equipment for the shutdown.

The termination date was also dependent upon the successful conclusion of the sample evaluation program at Fernald, and the acceptance of the techniques and procedures for processing and sampling of pitchblende (Q-11) and magnesium di-uranate precipitate (MGX) by the U. S. Atomic Energy Commission, National Lead Company and the vendor.

Sampling

The sampling of INX material had been transferred to Fernald on July 23, 1954 upon acceptance of the FMPC system by all parties concerned.

All sampling of uranium was completed in the last week of November, 1954 with the exception of a few miscellaneous lots consisting of stored samples and dead-bed materials.

Plan for Termination

A meeting attended by representatives of the United Lead Company, AEC, and the National Lead Company was held in October, 1954 at the AEC Oak Ridge Office for the purpose of outlining the procedures for the termination of activities at the Middlesex Sampling Plant. The discussion of requirements to be met included the following items:

1. Cessation of sampling and weighing operations.
2. Reconsignment of shipments and storage to Fernald or other sites.
3. Disposal of excess equipment.
4. Preparation of process and heating equipment for standby operations.
5. Cleaning all areas for dead-bed material and decontamination of all areas.
6. Inventory of fixed assets for the AEC in detail.

7. Audits to be made by the AEC.
8. Inventory of all classified documents.
9. Disposal and storage of all other government documents.
10. Disposal of stored materials and scrap metal.
11. Fire protection for property after shutdown.

From this meeting a plan of action was developed and was carried to completion by the personnel of the United Lead Company.

Shipments and Stored Materials

The thorium residues (hydroxides, oxides and oxalates) were consigned to the Mound Laboratory to be shipped at the rate of four or five freight cars per day. These residues had to be re-drummed, using polyethylene drum liners.

The thorium nitrate stored at Middlesex was consigned to Fernald along with the small miscellaneous lots of uranium bearing materials. The monazite and amang sand, and thorium tetrafluoride were left in storage at Middlesex in accordance with AEC directives.

The shipments were made as listed below:

<u>Consignee</u>	<u>No. of Drums</u>	<u>No. of Cars</u>	<u>Completion Date</u>
Mound Laboratory	5895	68 (5 per day)	12/24/54
EMPC	120	2	12/31/54
MCW	40	1	12/31/54

The materials left in storage at Middlesex were transferred by the Company to the Raw Materials Division of AEC.

Termination of Subcontracts

Letters of termination were written to the sub-contractors, Lucius Pitkin, Inc., and the American District Telegraph (ADT) terminating the contracts as of 12/31/54.

Personnel

All personnel were terminated as of 12/31/54 with the exception of four guards, a senior accountant, a general foreman and the maintenance men. Before being released all personnel were given a final physical examination.

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Disposition of Non-Contaminated Equipment and Stores

All non-contaminated equipment and stores items were inventoried and listed for public sale. The listings were completed prior to the end of the year and forwarded to prospective purchasers during the first week of January, 1955. All items were sold by sealed bids at a public sale during the first week of February, 1955.

Among the stores items that were excess property were clothing and shoes which had been furnished to the production workers. Items that had been worn and were no longer fit for use were burned. The new clothing and used clothing in good condition was declared excess and placed on the administrative control list for shipment to other AEC installations.

Disposal of Excess Equipment

Much of the excess equipment could be used at Fernald and AEC agreed to give National Lead Co. of Ohio first selection. In October, 1954, a list of 79 items of excess equipment to be transferred to NLCO was submitted to AEC. This list included laboratory size jaw crushers, pulverizers, rotap screens, drying ovens, dust collectors, machine tools and industrial trucks.

The remaining items of excess equipment were listed and the list was distributed to local plants with an invitation to bid on the items.

Equipment that was no longer serviceable was stripped of all useable parts and sold as salvaged material by sealed bid. All salvage material was listed on retirement forms and the AEC approved the removal of these items from the records.

Disposal of Scrap Metal

There were two basic types of scrap metal - contaminated radioactive materials and decontaminated or non-radioactive materials. If it were economically feasible the materials were decontaminated.

Contaminated scrap materials consisting mostly of drums were baled and prepared for disposal at sea.

Decontaminated or non-radioactive scrap was segregated into classes and advertised for sale under sealed bids. Scrap sales were held periodically from December, 1952 until termination as sufficient scrap was accumulated.

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Accountability Audit and Final Accounting Statements

The United Lead Company requested an accountability audit of the Middlesex books and records by the Finance Division of the Oak Ridge Office. At the same time the Property Division of AEC was requested to verify fixed assets and the remaining stores items. These audits were requested to prevent any future liability to the United Lead Company.

On February 1, 1955 the final and closing statements were submitted to the AEC Finance Division of the Oak Ridge Office. All government funds in the United Lead Company account at the Peoples National Bank, New Brunswick, New Jersey, were transferred to the AEC Oak Ridge Office.

Transfer and Storage of Records

AEC required that all records be stored by the company for at least three years. With the able assistance of NLO's Records Management Group the records were listed, boxed and sent to NLO for storage.

Radiation Survey

As a measure of protection against any personal liability AEC requested that a radiation survey be conducted around the outer perimeter of the cyclone fence. A total of 745 readings were taken at various distances from the fence at 60' intervals. About 97% of the readings were within the allowable limits for Beta, Gamma and Alpha values.

The high readings were obtained in areas adjacent to the thaw house, quonset hut, and drum storage, and resulted from material still stored in these areas.

Recovery of Dead-Bed Material

It was realized that in processing material a very small amount is lost or held up in the equipment and cannot be economically recovered. However, since this shutdown was final, the equipment and buildings had to be thoroughly cleaned to recover the material and to decontaminate the area.

A considerable amount of dead-bed material was recovered from the equipment and building. In all, 16,743 pounds of material were recovered and rightfully credited to the vendor since it had never been weighed. The sources of dead-bed material are listed as follows:

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- The MgX drum reconditioning equipment
- The MgX in returned samples
- The INX mill clean-up
- The Q-11 drum dumping house and dryer conveyor
- The Q-11 dust collectors, dust collector bags and stored samples
- The room enclosing the Q-11 equipment
- The main sump pit

In addition, during a radiation monitoring survey it was discovered that the ground beneath the "L" shaped wooden dock at the south end of the brick warehouse contained a considerable quantity of radioactive material. Samples of the ground were taken at regular intervals, at the surface, at a depth of 3", and at a depth of 6". Samples were taken by the United Lead Company primarily for the recovery of SS material which had to be credited to the vendor's account. The results obtained on samples which were sent to the New Brunswick Laboratory are listed as follows:

Location of Sample	Percent U <sub>3</sub> O <sub>8</sub>
Surface	8.0 to 7.2%
3" depth	7.7 to 6.0%
6" depth	5.5 to 4.3%

The earth beneath the loading dock (3136 square feet) was removed in sections to a depth of one (1) foot by hand shoveling with each section kept separate and screened through a 1/4" screen before being drummed. A total gross weight of 173,427 pounds in 248 drums was shipped to FMPC at Fernald for sampling.

Preparation of Buildings and Equipment for Termination

In the meeting at Oak Ridge, AEC had specified that the following operations on buildings and equipment be completed before all operations ceased. These preparations were carried out to the letter.

1. The fire sprinkler system lines were drained and the water shut off to prevent freezing in cold weather.
2. All unprotected exterior wall openings were boarded.
3. Any fire wall openings were closed with a fireproof refractory.
4. The existing carbon dioxide extinguishers were left in place but all water type extinguishers were removed and drained.
5. All movable process equipment was removed from the brick warehouse and stored in other buildings.
6. A physical inventory of property, buildings, and equipment was taken.

7. Excess equipment that was not sold was preserved with rust preventative. Among this equipment were motors, Simonds Cone crusher, air compressor, elevator and scales.
8. At regular intervals on the exterior side of the cyclone fence signs were posted "US Government Property - No Trespassing".
9. At the final shutdown all windows and doors were locked.
10. The boilers were placed in a standby condition. This job was on bid and was completed on February 17, 1955, and it was the very last to be performed because the boilers were needed to supply heat.

On February 18, 1955 the keys to the plant were officially returned to the AEC representative, signifying the termination of the responsibilities of the United Lead Co. in the operations of the Middlesex Sampling Plant.