MO. 2

DISPOSAL OF DESTREHAN STREET FACILITIES AND RESTORATION OF SITE

ST. LOUIS, MISSOURI

Note: Based on blanks, corrections and handwritten diagrams, this copy is a draft of the final report. CBParmele SAIC 3-8-00

REPORT OF SERVICE PROVIDED BY

MALLINCKRODT CHEMICAL WORKS, URANIUM DIVISION

HEALTH AND SAFETY DEPARTMENT

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INTRODUCTION

The Destrehan Plant facility was operated for the AEC by the Uranium Division of the Mallinckrodt Chemical Works from the early days of the Manhattan Project to 1958. Uranium ore concentrates and pitchblende ores were refined and further processed to produce highly purified uranium oxides, uranium fluoride salts, and uranium metal. A pilot plant process for refining of Ionium from uranium wastes was also operated for a short period of time at the site. The facility was shut down in 1958 and placed in a standby condition. Decision was then made by the AEC to dispose of the facility and restore the site for public use. Contracts for the "Disposal of the Destrehan Facility and Restoration of Site" were entered into by the AEC and several construction and demolition companies. These contracts were conducted as "prime contracts" with the AEC.

The AEC required its prime operating contractor, MCW Uranium Division, to provide certain personnel and services during the disposal and restoration operations, this request included Industrial Health-Hygiene assistance and surveillance, hereafter referred to as Health Services, which consisted of the following:

1. The providing of monitoring surveys before, during, and after decontamination, equipment removal, and demolition operations to include:

   a. Separating of equipment facilities and materials utilizing radioactivity monitoring techniques into salvageable, nonsalvageable, and contaminated waste classifications.

   b. Checking of commercial carrier shipments leaving the site for compliance with AEC and ICC regulations.

   c. Contamination surveys during and subsequent to disposal and restoration activities for final evaluation of residual radioactivity levels in comparison with AEC prescribed standards.

   d. Monitoring of tools and equipment used by contractor personnel during the operations to insure established contamination control practices were operated consistent with AEC prescribed standards.

2. The providing of the following specific health surveillance services:

   a. Medical review of contractor personnel prior to their working at the Destrehan site and at their termination of employment.

   b. Establishment and operation of adequate protective equipment programs.

   c. Special monitoring services including:

      (1) Public Environs (neighboring Destrehan Site)

         (a) Air testing for uranium and radioactivity bearing contamination.

         (b) Water testing for uranium and radioactivity bearing contamination.

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(2) Personal Health (Contractor)

(a) External radiation exposure (film dosimeters).

(b) Internal exposure to uranium-bearing materials (bioassay - urinary uranium, and in-plant uranium-in-air concentration tests).

3. Provide technically qualified service as follows:

a. Special risk analysis

b. Supply and maintain first aid fire extinguishers.

The MCW uranium Division, in carrying out its contractual responsibilities, assigned to the Destrehan facility full-time personnel for industrial hygiene, and radiation monitoring and protection, who were thoroughly knowledgeable concerning the history of Destrehan operations. Additional advisory, administrative and laboratory supporting services were supplied on a part-time basis from the Operating Contractor's base at Weldon Spring, Missouri.

The Health Service also supplied technical assistance in the establishing of certain decontamination procedures and practices.

Approximately 6,000 hrs. ~~manda~~ys were devoted to this activity with one qualified person being available at the site as a minimum at all times. Additionally, 500 manhours were expended in support of services provided, i.e., analytical instrument maintenance, technical assistance, etc.

SUMMARY

Contamination surveys and monitoring were conducted and specified health surveillance services were supplied by the Uranium Division Health/Safety Department during the equipment removal, decontamination, and demolition of the Destrehan site in accordance with AEC Prime Contract AT-23-2-44.

Contamination surveys and monitoring efforts using the criteria established by the AEC (AEC Manual Chapters and AEC specified guides for the Destrehan retirement operation) were performed as directed. Salvageable and nonsalvageable materials, debris, and rubble were classified using standard radiation monitoring techniques. Decontamination and demolition activities were evaluated from the standpoint of personal hazards and effect of the operations on the public environs. Recommendations for personal protection for particularly hazardous operations were provided, assistance was given for procurement and issue of such equipment. Technical aid was rendered in the establishing of several highly successful techniques of decontamination which resulted in conversion of a sizable percentage of nonsalvageable classed equipment, metal, and other materials into salvageable items.

Shipments of equipment, salvageable materials, scrap, debris, and rubble generated at and leaving the Destrehan Plant site met radioactive material contamination control criteria per ICC regulations.

Residual contamination on the plant properties and those buildings left standing was tested and found to be below prescribed residual contamination levels.

Contamination control on-site during decontamination and demolition activities was operated satisfactorily. Loss of uranium and radioactivity-bearing materials to the public environs was maintained at or below AEC established maximum permissible concentrations.

Fire extinguishers were provided, serviced, and maintained per contract.

Contractor personnel participating in the operation received pre-employment and termination physicals. No permanent change or disability in the personal health of the individuals was noted. The effectiveness of personal protection practices established to cope with the hazards encountered, particularly radioactive materials, was substantiated through bioassay and film dosimeter monitoring techniques. No individual received external radiation exposure greater than the AEC prescribed limits. Actual exposure to external radiation was a fraction of the permissible. Uranium uptake by individuals during all phases of the operation was minimal and a fraction of the permissible amount.

Personal health, contamination control, monitoring, and survey records generated during the providing of the required monitoring and health surveillance services are on file in the Uranium Division Health/Safety Department.

PART I

MONITORING AND SURVEYING ACTIVITIES

EQUIPMENT FACILITIES AND MATERIALS MONITORING SERVICES

Removal and Transfer of Equipment Phase

Monitoring services in this phase included evaluation of the health problems involved in removal, and the determination of contamination levels of items to be removed in accordance with AEC Manual Chapters covering transfer of equipment from one government installation to another. Approximately 20% of the Destrehan Plant equipment was classed as salvageable and handled under this criteria.

Demolition and Disposal Phase

Equipment, facilities, and materials monitoring and surveying were performed according to the criteria stipulated in the AEC contract for demolition. Items were segregated according to this criteria for disposal according to specified methods set forth for each of three major disposal categories, i.e., salvageable material, nonsalvageable material, and debris and rubble.

Scrap monitoring functions were performed in the following manner:

1. Appraisal accomplished by inspection and by sampling of surface contamination to evaluate the type and extent of contamination and the likelihood of success in cleaning by specified methods.

2. Monitoring to establish and identify disposal classification per established criteria.

3. Reinspection of classified items located in specified hold areas to insure that further reclassification due to possible recontamination during the demolition operations was not necessary.

The specific hold areas were set up to permit control of classified items during the period from equipment appraisal through intermediate decontamination steps, reclassification, and finally to each item's ultimate disposal.

The initial inspection served a dual purpose:

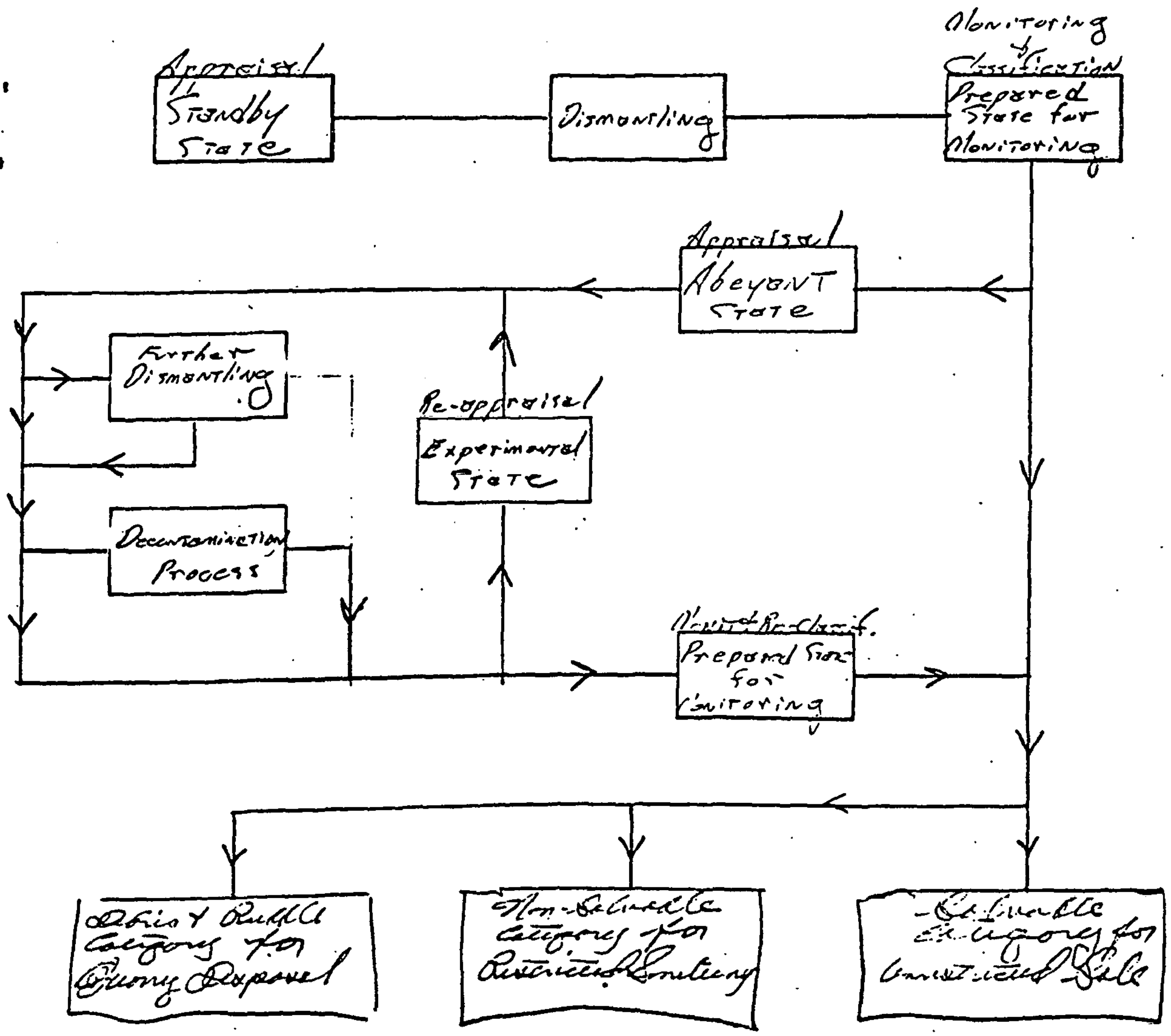
a. Permitted evaluation of potential hazards which would be involved in removal and decontamination. Control practices were set up as required.

b. Permitted appraisal for most desirable decontamination or cleaning methods (this function contributed to monitoring efficiency by minimizing the potential number of remonitoring operations).

Specific Methods of Operation

Materials were appraised, dismantled, and set up in interim hold areas for monitoring and classification. At this point, materials were either assigned directly to a particular disposal method or were held in abeyant state for further consideration as a nonsalvageable material. From this latter nonsalvageable state, the items were generally further dismantled, reappraised, reclassified, and decontaminated. Subsequently, a final monitoring and classification stage was reached and the materials were disposed of into one of the three major disposal categories. Approximately 80% of the available equipment was handled in the demolition phase.

The following flow chart represents a summary of the material flow described above.



All monitoring was performed according to techniques outlined in the attached Appendix 1, Standards for Monitoring, and Appendix 2, Techniques for Monitoring Pipe.

For both the salvageable and nonsalvageable classed items, disassembly was accomplished prior to the final classification. Disassembly efforts were directed to the extent that all points subject to contamination were exposed. Contaminated items were disassembled so that it could be determined that no gross quantities of materials were entrapped. For specific items which were to undergo decontamination operations or cleaning for purposes of reclassification to a salvageable material or when a direct classification to a salvageable material was desired, the items were completely disassembled so that all points subject to contamination could be made available for representative radiation monitoring. Each such item destined for possible reuse in the major assembly was monitored individually before reassembly.

During cleaning operations to provide an efficient means of identifying classified items and to assist in speeding the decontamination process steps, a marking system was established to permit quick visual segregation of classified items. Items were color coded with aerosol spray paints in addition to the durable color coded classification tags which were affixed, and specific storage areas for each type were established.

The processing of nonsalvageable materials from an intermediate abeyant state often involved experimentation and reappraisal. Of the many techniques applied to decontamination of such items, the two most successful employed were sandblasting, and paint stripping coupled with steam cleaning.

A summary of cleaning applications is presented in the following chart:

REFERENCE GUIDE TO CLEANING METHODS EMPLOYED ON NONSALVAGEABLE MATERIALS

FUNCTIONS SERVED

Examples of Items	Removal of loose, dry particles	Removal of readily soluble foreign mat'ls	Removal of layers of paint	Removal of relatively insoluble fixed materials	Penetration and removal of part of surface [illegible] metal
Stainless steel vessels; aluminum plate				Dry sand-blast	Dry sand-blast
Nickel-bearing steel valves, centrifugal pumps, water-seal compressors	Steam-detergent	Solvent (mixture including Stoddard solvent)		Dry sand-blast	Dry sand-blast
Nickel-bearing steel pipe and plate	Steam-detergent			Acid-detergent, wire brush and steam	
Electric Control Boxes and Open Shell Motors	Solvent (mixture)	Solvent (mixture)			
Closed Shell and Explosion-proof electric motors; gear-reducers and drives; deckplate; structurals	Steam-detergent	Solvent (mixture) and steam	Paint stripper and steam	Dry sand-blast	Dry sand-blast
Light fixtures	Steam-detergent	Solvent (mixture) and steam			
Insulated Electric Cable			[illegible]	Burning	

A discussion of specific cleaning methods and their application at the Destrehan disposal site is given in Appendix 4.

CONTAMINATION SURVEY SERVICES

A final survey was made of the Destrehan site subsequent to the completion of decontamination and demolition activities. This survey was performed to provide assurance that contamination had been reduced to the lowest practical level and that any remaining uranium or radioactive contamination was fixed and nonremovable and met the residual radiation contamination criteria agreed to by the AEC. These criteria (Table I) were considered as being reasonable levels of contamination which could be obtained and which would not present significant health hazards by currently recognized standards for radiation protection.

TABLE I

Type of Activity	Maximum Overall Average	Maximum Spot Contamination
Surface alpha activity	1000 d/m/100 cm^2	5000 d/m/100 cm^2
Beta + Gamma Activity	0.1 mrep/hr	1.0 mrep/hr

The survey techniques employed by Uranium Division personnel are shown in Appendix ___ to this report. Survey personnel were trained and experienced in performance of such studies. Their knowledge of the history of the operations at the Destrehan facility, the types of materials processed and handled, the production area sites involved, and actual experience gathered during the extensive survey made prior to the demolition activities to define contamination levels (survey made by MCW personnel and reported previously to the AEC) permitted the final survey to be accomplished expeditiously and with a high degree of assurance as to the reliability of the resultant measurements.

The final survey results demonstrated that the Destrehan site and remaining buildings had been decontaminated to prescribed surface contamination levels. In fact, surface alpha activity averages much lower than the 1000 d/m/100 cm^2 limit were noted. Averages generally range from 250 to 500 d/m/100 cm^2. Beta plus gamma activity on floors averaged slightly above 0.1 mrep/hr but walls and structural steel were well below the 0.1 mrep/hr. Spot contamination was equal to or less than 5000 d/m/100 cm^2 alpha, or 1.0 mrep/hr beta plus gamma activity.

Experience noted during the demolition operations and confirmed by the final survey showed that some amount of residual contamination is buried at the Destrehan Plant site. This contamination is generally located adjacent to foundations, between joints and concrete floors, under storage pads, and between joints and structural steel members. In its final condition this residual contamination is judged to be fixed and should not present a problem.

From the viewpoint of the public, the residual contamination and radiation levels present at the Destrehan site do not present health hazards. The residual contamination and radiation levels present may be likened to a radioactivity level range from 1 to 3 times the normal natural background radioactivity found in the Metropolitan St. Louis area with spots measuring up to 20 times background.

Table II depicts final contamination survey measurements for typical areas of the Destrehan site and remaining buildings.

TABLE II

TYPICAL FINAL CONTAMINATION SURVEY MEASUREMENTS

		Spot Radioactivity Measurements			
		Alpha d/m/100 cm^2		Beta + Gamma mrep/hr	
Area/Site	Type Surface	Average	High	Average	High
Former Production Buildings (left standing)	Columns & Beams	1200	5000	0.3	1.0
"	Roof Beams & Slabs	700	5000	0.3	1.0
"	Floor	300	900	0.4	1.0
"	Walls	800	5000	0.2	1.0
"	Roof		ND		ND
ServiceBuilding (Laundry, Clothes Change, Cafeteria, Dispensary) (left standing)	Floor	800	2800	0.3	1.0
"	Roof		ND		ND
Storeroom Building (left standing)	Floors	1400	7500	0.2	1.0
"	Roof		ND		ND
Site of Razed Refinery	Ground		ND		ND

COMMERCIAL CARRIER MONITORING SERVICES

Commercial carriers utilized at the Destrehan demolition operation were monitored for compliance with ICC and AEC regulations concerning shipments of radioactive materials.

The major activity in this area centered about the monitoring of empty carriers at the point of release and the monitoring of railway gondola cars containing non-salvageable scrap material being shipped to the restricted smelter. The empty carriers were monitored as they left the plant site for conformance with the criteria specified in ICC regulations as follows:

> Any motor vehicle which, after use of transportation of radioactive materials in truckload lots, shall be thoroughly cleaned in such a manner that the interior surfaces show the contamination levels to be below 10 mrep in 24 hours, and the average alpha contamination is less than 500 d/m/100 cm^2.

Each empty carrier was so monitored, cleaned, and recleaned as necessary and the measured radiation levels were certified as being less than the prescribed criteria.

Nonsalvageable scrap materials shipped by railroad gondola cars were monitored for compliance with AEC Manual Chapter 5182, Section 09, which provides that the gamma radiation measured above background should not exceed 10 milliroentgens per 24 hours at any outside surface of the car. Railroad gondola cars containing shipments met this criteria.

TOOL AND EQUIPMENT RADIATION MONITORING SERVICE

Contractor tools and equipment employed in the Destrehan operations were monitored for radioactive contamination prior to release. Criteria given in AEC Manual Chapter 5170 was used as the guide. Indication of compliance with criteria was noted by approval on property release passes which were collected at the point of release.

PART II

PERSONAL HEALTH SURVEILLANCE ACTIVITIES

MEDICAL SERVICES

The mere fact of demolition of an Atomic Energy Plant has a unique psychological impact. The publicity given to radiation has caused many people to automatically associate an Atomic Energy site with radiation danger. Workmen coming on this job could be expected to have some fears and some reservation arising from the fact that it was an Atomic Energy site.

It was deemed prudent to establish good medical rapport with these workmen and to secure a satisfactory medical reference so as to avoid placing some individual at undue risk relative to a personal susceptability. In cooperation with AEC and the prime contractor, the health service established procedures to secure specific clinical data and secure medical examination for workmen as they came on the site. The transient nature of the work force made it impractical to review every new workman before he came on the job. There was no unique health risk in the demolition to require the establishing of rigid pre-employment medical examination requirements.

Medical service was provided to screen for anomalies which would render a workman unsuitable. Pre-planning this service included decisions that the screening would not attempt an evaluation of the full medical capability (injury risk), but that the doctor would note observed physical defects and that he would advise both the workman and the contractor when, in his opinion, there was a defect which was judged to represent a high risk of trauma. The thorough medical examination did concentrate on history taking and on evaluating the condition of the respiratory, blood, and urine systems.

Chest X-rays (PA and lateral) were taken on nearby equipment which was formerly located on the Destrehan site. Full size films (14 x 17) were interpreted by a radiologist who had been closely associated with the medical program of the site when it was in operation. The radiologist's reports were forwarded to the examining physician.

Samples of blood and urine were secured and analyzed by registered medical technicians from the AEC Weldon Spring plant. Results were forwarded to the examining physician who also guided the work of the technicians.

The examining physician made scheduled visits to the site to interview new and prospective workmen who were referred to the health service by the prime contractor. He also saw workmen in his private office in St. Louis by appointment made for the prime contractor.

The physician's conclusions as to suitability were forwarded to the contractor through the health service. There was no transmittal to the contractor of medical files or privileged medical information.

In the course of this medical screening process, some medical irregularities were noted by the physician. In some cases, these irregularities were not previously known to the workman. Some of these workmen came from areas and population groups in which personal hygiene and personal medical care are possibly below the general population norm. All such findings were discussed with the workmen by the doctor. One of the side benefits was the gratitude of some people who learned of problems and received assistance in securing medical help where needed.

The examining physician, a doctor of internal medicine, was well informed about the Destrehan site, having been one of the experienced physicians who provided medical guidance for the management of the site while in operation. During his interviews, the doctor answered all questions the workmen had concerning the health problems related to the demolition work and especially any questions concerning radiation. Pre-planning for this medical service focused on allaying the fears a workman might have about health risks in relation to this being an Atomic Energy Commission site. Throughout the entire demolition program, good medical rapport was maintained with the workmen. There were no psychological problems and no instance of any adverse effect upon the health of workmen.

Approximately 125 workmen were processed and cleared by this medical program. Some of these workmen also received examination upon termination. However, the highly transient nature of this work force made it impractical to provide termination examination for all people.

PROTECTIVE EQUIPMENT

Pre-planning the health service for the demolition work included decisions that this service would provide protective equipment and ordinary work clothing appropriate to the work. Information sessions were held with the prime contractor supervision to acquaint them with the kind of protection which would be needed and the conditions under which it would be required. It is understood that the health service would not be an enforcement agency, but would advise and counsel and provide reliable equipment.

From the health protection viewpoint, the principal need was for respiratory protection. The following types were provided:

1. High efficiency, mechanical dust respirators.
2. Canister masks suitable to low concentrations of acid fumes which might be encountered.
3. Bottled air-supplied masks for short duration entry into high concentration atmosphere and/or for emergency use.
4. Airline-supplied masks and hoods suitable for tank entry and for sandblasting operations.

This equipment was issued to the prime contractor through the health services which also made periodical inspection of equipment in use to assure satisfactory quality. There was no case of defective equipment in use noted. In general, the contractor personnel complied effectively with the use requirements laid down by the contractor.

Clothing

Because small quantities of radioactive material remained at the site and could contaminate the clothing of workmen, it was decided to provide coveralls and safety shoes to the workmen which clothing would be restricted to the site. Locker and shower facilities were provided so that the workmen could change from street clothing to work clothing and could wash themselves free of any material before leaving the site. Clothing was supplied from the Weldon Spring laundry and clothing facility. Periodic monitoring of the clothing disclosed no important contamination, and there were no incidents which presented particular problems.

Special Protection Equipment

Unusual problems calling for special protective equipment needs were experienced during the development and application of sandblasting techniques as applied to heavily contaminated tanks, pumps, valves, etc.

Experiments with sandblasting proved this to be an effective method for removing the surface contamination from items of hardware and equipment which had been in contact with uranium. Experiments and experience with sandblasting showed that many items which had previously been considered to be not salvable could possibly be cleaned to acceptable levels for uncontrolled release. However, satisfactory sandblasting procedures would require control of the dust generated by this cleaning method.

Sandblasting of many classes of items caused air contamination which grossly exceeded acceptable levels. Methods were developed which secured acceptable control while permitting the flexibility needed to accommodate the wide range of size and shape of items to be cleaned.

A large walk-in hood was reactivated in Building 116. A high efficiency bag filter type of dust collector was relocated and connected in a manner to exhaust the hood and to clean the exhausted air. Extensions for the hood and partial closure for the hood face was provided by tarpaulins. This gave the size flexibility required and, at the same time, reduced the open face so as to secure good control of the dust without requiring an excessive volume of ventilation air. The workmen who did the sandblasting were provided with full respiratory protection by positive air-supplied hood and jacket.

The airline hoods and jackets were checked at least daily and the men were supplied with clean work clothing at least daily. A specific urine sampling program was set up for workmen assigned to this job.

Hundred of items were successfully cleaned in this setup with no significant exposure to workmen, and no objectionable increase in air contamination within the general demolition area or to the general atmosphere. The cumulative daily exposure of sandblasters and helpers to airborne materials did not exceed 25 percent of the AEC guide rates for the 40-hour workweek.

For items which could not be easily taken to the fixed hood, an alternate arrangement was utilized. This consisted of a portable canvas hood which was set up around the item and inside of which the sandblaster worked with full protective equipment. Exposure of these workmen by inhalation was also well below the AEC guide levels. Zone air contamination was higher than at the large hood, but still within guide levels.

Sandblasting equipment of a specific design which surrounds the nozzle with high velocity suction air filtered back through bag filters proved effective on some items.

Respiratory protection was provided for the sandblaster in all cases, even though in some cases it might not have been necessary.

ENVIRONMENTAL AIR TESTING

Generation of dust during the demolition was at or near ground level; there were no stacks or other sources of discharge to the upper atmosphere. Dust sampling stations were established at or adjacent to the property boundry and so dispersed as to always have one or more operating stations downwind of the site of demolition.

Analysis specific for uranium activity from all sampling points during the demolition period resulted in average uranium-in-air concentration of 4×10^{-13} μc/cc, or approximately one-tenth the MPC_a established by the AEC (AEC Manual Chapter 0524, Annex 1, Table II). Gross alpha activity concentrations determined from these samples were not significantly different from the uranium activity; hence, for purposes of evaluation, the concentrations present in air of other radionuclides were not considered present in significant quantities. Gross beta activity concentrations determined from these samples resulted in a concentration in the range of 3×10^{-12} μc/cc; this level reflects the beta background existing during the period due primarily to nuclear weapons testing, especially those conducted at that time by the Soviet Union.

All the monthly averages for uranium activity were below the MPC_a concentrations established by the AEC for release to uncontrolled areas.

The primary method of sampling was with 110-volt AEC powered high volume samplers by Gelman Hurricane, Staplex Type TF1A, or equal. Collected media was Whatman 41 or HV-70. Sampling rates averaged approximately five liters of air per cm^2 of filter media. Samples were taken routinely during the workshift; filters were changed at the end of each daily sampling period.

Analyses of samples for beta and alpha activity were on standard low level counting equipment by direct count of the sample. Analysis for uranium was by acid leach of the filter followed by photo fluorometric analysis of the aliquot.

Environmental air sampling results during demolition and decontamination phases are given in the following table:

Date	Airborne Activity - μc/cc of Air			No. Samples
	Uranium	Gross Alpha	Gross Beta	
12/60	4.0×10^{-13}	6.8×10^{-13}	45.0×10^{-13}	16
1/61	7.4×10^{-13}	6.5×10^{-13}	13.0×10^{-13}	48
2/61	1.1×10^{-13}	1.6×10^{-13}	5.8×10^{-13}	104
3/61	1.4×10^{-13}	1.7×10^{-13}	6.4×10^{-13}	141
4/61	2.0×10^{-13}	6.9×10^{-13}	9.4×10^{-13}	115
5/61	2.0×10^{-13}	4.0×10^{-13}	6.2×10^{-13}	97
6/61	3.3×10^{-13}	5.6×10^{-13}	10.0×10^{-13}	69
7/61	1.6×10^{-13}	2.8×10^{-13}	4.8×10^{-13}	48
8/61	1.9×10^{-13}	4.1×10^{-13}	7.2×10^{-13}	77
9/61	2.2×10^{-13}	2.9×10^{-13}	182.0×10^{-13}	83
10/61	3.8×10^{-13}	5.0×10^{-13}	54.4×10^{-13}	77
11/61	12.0×10^{-13}	6.7×10^{-13}	61.2×10^{-13}	21

ENVIRONMENTAL WATER TESTING

Sampling of water effluents from the Destrehan facility during equipment removal, decontamination, and demolition operations were collected and analyzed periodically.

Surface waters and water effluent generated in specific decontamination and cleaning operations flow from the Destrehan plant via trunk sewers which feed into a main sewer coming from the Mallinckrodt Chemical Works Main Plant area immediately west and north of the Destrehan site. This main sewer flows at a rate of approximately 1,000,000 gallons per day. The Destrehan site water effluent component to this sewer represented only a small additional fraction. The sewer has a single outlet which discharges into the Mississippi River immediately west of the Destrehan site.

The periodic samples collected from the sewer were analyzed for uranium concentration and for alpha and beta radioactivity. Analyses were performed in the Uranium Division Health/Safety Laboratory at the Weldon Spring plant. Determination of uranium content of the water samples was accomplished using the standard fluorometric technique of analysis which is specific for uranium. Gross alpha and beta radioactivity analyses were performed after chemical treatment and concentration of the sample and preparation of suitable radiation counting planchets. Alpha and beta radioactivity analysis was then accomplished by the use of standard radiation counting equipment with scintillation type detectors specific for each type radiation.

During the Destrehan decontamination and demolition operation, no sewer sample taken was found to have uranium concentration in excess of the maximum permissible concentrations for nonoccupational noncontrolled areas as defined by the AEC in Manual Chapter 0524 (Standards for Radiation Protection). Alpha activity minus that component from the natural uranium and beta activity of the sewer water averaged less than 1×10^{-8} μc/cc.

Table I summarizes the analysis data for water effluent samples collected in the MCW main sewer which received the Destrehan water effluents. It is to be emphasized that the samples taken for analysis were obtained in the sewer itself and prior to entry into and before subsequent dilution in the Mississippi River.

TABLE I

Uranium Concentration in the MCW Sewer			
	Average	High	Low
Uranium Concentration in μc/cc	0.6×10^{-7}	2×10^{-7}	0.3×10^{-7}
Uranium Concentration in % of MPC_w	0.3	1.0	0.15

In addition to water samples taken from the sewer, source water samples were obtained at a number of special decontamination operations which resulted in water effluent. These samples were collected prior to entry into the sewer and represent the maximum uranium concentrations available to the MCW sewer from the Destrehan plant via water effluent generated from decontamination and demolition operations. The uranium concentrations found in these source water samples from special operations did not exceed the AEC described MPC_w for nonoccupational, noncontrolled areas. Table II summaries these results.

TABLE II

Source of Sample	Average Uranium Concentration μc/cc	% of MPC_w
Plant 4 - Surface Runoff Waters	0.12×10^{-6}	0.6
Water Effluent from Steam Cleaning Operations at Plant 7	8.3×10^{-6}	42
Water Effluent from Steam Cleaning Operations at Plant 6-E	1.1×10^{-5}	55
Composite Surface Runoff from Equipment Washing Area	1.7×10^{-5}	85
Surface Water from Hosing Down of Production Area Beams & Floors	1.0×10^{-5}	50

FILM BADGE SERVICE

Personal film dosimeters (film badges) were issued to all personnel working in or visiting in the Destrehan Plant during all phases of the equipment removal, decontamination, and demolition operations. The processed dosimeter provided measurement and permanent record of each wearer's film badge exposure. The film badge exposure was evaluated and converted to the radiation dose received by the individual from external radiation, specifically, beta and gamma radiation.

The film badge data indicated that no person working or visiting the plant during the operations received exposure in excess of the AEC Standards for Radiation Protection (Manual Chapter 0524) for quarterly or thirteen consecutive week periods, nor did any person receive exposure to penetrating radiation in excess of the permissible rate for cumulative lifetime radiation dose.

The film badge dosimeters were processed monthly. The type film badge used was that employed throughout the MCW Uranium Division operations, i.e., the A. M. Samples stainless steel badge holder with open-window and cadmium filters permitting beta and gamma differentiation and measurement. DuPont Type 552 dosimeter film was used in the badge. The film was processed by techniques calibrated and standardized with film exposed to standard gamma and beta radiation sources. Gamma standards were obtained by exposing film to a platinum encapsulated radium needle. Beta standards were obtained using an aged, natural uranium block as a source.

During the Destrehan Plant removal of equipment, decontamination, and demolition operations, an average of 104 film badges were supplied to contractor employees and visitors and processed monthly, ranging from a low of 80 to a high of 124. MCW employees and AEC personnel associated with the operation utilize film badges provided them at the Weldon Spring facility.

For the entire period of the operation, extending from the latter part of '59 through '61, the average monthly film badge exposure for all contractor personnel working in or visiting the plant was less than 50 mrem gamma and 50 mrem beta. During the entire period, only 7 film badges showed gamma exposure exceeding 50 mrem in any one month, the high being 80 mrem. The highest cumulative gamma film badge exposure for any one quarter was 150 mrem. The cumulative yearly and high film badge exposure data is shown in the following tables:

TABLE I

Badge User	Average Year - Cumulative Film Badge Exposure Beta (rem)	Gamma (rem)
Contractor Employees	0.3	0.04
AEC	0.6	0.1
MCW	0.8	0.2
Visitors	No visitor badges received more than 0.05 rem during any one monthly period.	

TABLE II

	Highest Film Badge Exposure/Month Contractor Employees	AEC/MCW
Beta - rem	0.29	0.15
Gamma - rem	0.08	0.14

BIOASSAY SERVICE - THE URANIUM-IN-URINE ANALYSIS

Urine specimens were obtained from contractor personnel who participated in the equipment removal, decontamination, and demolition of the Destrehan facility. Samples were collected prior to exposure in the facility, during the operation, and upon termination of the individual with the project. Special urine samples were obtained from personnel working in high dust exposure areas or participating in a unique or special design operation such as sandblasting of contaminated tanks.

All urine samples collected at the Destrehan facilities were submitted to bioassay techniques of analysis for specific determination of uranium content. Analyses were performed in the Uranium Division's Health/Safety Laboratory located at the Weldon Spring Plant. The technique of analysis employed utilized the fluorescence properties of uranium when dissolved in a sodium fluoride molten salt matrix. The analysis followed standard and published uranium-in-urine fluorometric procedure. Equipment used was the Jarrell-Ash fluorimeter. Pure NaF was used as the fluxing agent with a small platinum dish (3/4 inch in diameter) as the sample holder. The fluorimeter was standardized against known uranium solutions. Each urine sample was analyzed in triplicate; a 0.1 milliliter allocate utilized for each individual analysis.
aliquot was

The contractor employee urinary uranium data was evaluated on the basis of criteria developed in the Uranium Division during its many years operating experience in the processing of uranium materials. MCW experience at the Destrehan Plant indicated that a before work urine sample collected on a Monday morning after a 48-hour period of no exposure would be expected to contain 0.025 to 0.030 ml U/l of urine for an individual with a daily integrated exposure to a uranium-in-air concentration of the order of 50 mg U/M^3 of air. The after work sample collected on Friday at the end of the shift would, at the same integrated exposure concentration, be expected to range from 0.050 to 0.060 mg U/l of urine.

The contractor personnel were scheduled to participate in urine sampling at six-week intervals. A Friday after work and a Monday before work was collected during each sampling interval. The uranium-in-urine samples for all contractor personnel corroborated the success of personnel exposure control programs operated at the Destrehan Plant, and aimed at keeping the individual exposure to airborne uranium concentration below the maximum permissible concentration prescribed by the AEC in Manual Chapter 0524 (Standards for Radiation Protection). Urine samples taken when the contractor employees terminated verified that in each instance the individual's uranium uptake was substantially below the permissible guide level.

Table I summarizes the uranium-in-urine data for contractor personnel working during the equipment removal phase of the Destrehan demolition operation:

TABLE I

Type of Sample	Average U Conc. in Urine - mg/l	Range in mg/l
Pre-Exposure Sample	0.007	0.002 to 0.013
Monday before Work Samples	0.010	0.005 to 0.008
Friday after Work Samples	0.025	0.003 to 0.078

MCW experience indicates average exposure of personnel during this phase of the operation was at a uranium-in-air concentration less than 15% of the maximum permissible concentration level established by the AEC.

Table II summarizes urinary uranium data for contractor employees working during the decontamination and demolition phases of the Destrehan disposal operation:

TABLE II

Type of Sample	Average U Conc. in Urine - mg/l	Range in mg/l
Pre-Exposure Sample	0.005	0.001 to 0.014
Monday before Work Samples	0.019	0.003 to 0.058
Friday after Work Samples	0.036	0.006 to 0.271
Termination Sample	0.017	0.006 to 0.027

MCW experience indicates that the average exposure of personnel during this phase of the operation was at a uranium-in-air concentration less than 20% of the maximum permissible concentration established by the AEC.

Special urine samples were collected from contractor personnel assigned to special problem areas or unique operations in which uranium dust concentration generations were estimated to be significant. Table III shows several of these operations with the average urinary uranium concentration found in operator subsequent to the day in which the operation occurred.

TABLE III

Operation	Average U Conc. in Urine - mg/l	Range in mg/l
Sandblasting of Contaminated Equipment	0.031	0.007 to 0.080
Cutting Contaminated Stainless Steel by Torch	0.032	-
Cutting and Wrecking of a Uranium-Contaminated Rod Mill	0.098	0.061 to 0.135
Dismantling of a Contaminated Vacuum Producer & Dust Collector	0.065	-
Pulling Electrical Wiring and Stripping Metal from Contaminated Buildings	0.045	0.007 to 0.158

IN-PLANT AIR SAMPLING AND APPRAISAL

In the range of one percent of the effort during phases of equipment removal, demolition, and decontamination of the Destrehan facility is estimated to have been spent in areas where the airborne uranium concentration was to the order of 10 to 100 times the MPC_a given in AEC Manual Chapter 0524, and for which full-flow, air-supply masks for respiratory protection were provided. In the range of ten percent of the effort is estimated to have been spent in areas where the dust concentration was to the order of 1 to 10 times the MPC_a, and for which personal half-face, dust-type respiratory protection was provided. The remaining effort, then, is estimated to have been spent in areas of dust concentrations in a range from background to 1 x MPC_a.

Test samples were collected from the primary dust-producing operations to aid in the appraisal of dust control provisions.

Samples were taken with both battery-powered sampling pumps and 110-volt AC powered samplers. Collection media was both Whatman 41 paper and Gelman AM-4 Membrane filters. Sampling rate averaged approximately 5 liters of air per minute per cm^2 of filter area. Sample analysis was by direct alpha counting of samples with standard low level counting equipment.

The basic areas where airborne uranium was generated were:

1. Scrap Removal - Methods employed during dismantling to minimize dust generation were as follows:

    a. Inspection of areas prior to and during operations to assure that gross amounts of radioactive materials were not present; or to plan means of containment, i.e., removal to containers or sealing of units.

    b. Wetting surfaces by means of high pressure fog or spray.

c. Lowering of removed materials with hoists.

d. Washing with water hose and retaining runoff in areas to be excavated.

Personnel protection for anticipated dusty conditions was employed in specific instances; for these operations, this was primarily half-face dust respirators (Dustfoe 66, MSA).

Dust from process plants was considered to be contaminated with uranium without specific testing for the case; therefore, masks were designated for use in local areas of activity where handling was likely to generate dust. Cutting torch operators, "burners," were instructed especially to use masks for torch use around any dust.

2. Decontamination of Buildings - Structure cleaning inside of buildings by dry sandblasting was a major source of dust generation. Breathing air was supplied by airlines, full-face type, for personnel protection from dust for all building inhabitants during sandblasting operations. Discipline and guarding of conditions were necessary to maintain the location of air supply pumping units upwind of sandblasting operations and/or in dust-free areas.

Uranium dust generation was minimized by washing loose particles to sump and recovering residues both before and after sandblasting. Air changes in buildings were limited by controlling outside openings. The minimum number were left over open which would permit adequate visibility for operations. This procedure would tend to increase the airborne dust concentration inside, but decrease the amount of dust escape to outside areas in the plant by permitting more residence time for particles to settle, and by decreasing velocity of air currents.

3. Decontamination of Yard Slabs - Concrete slab cleaning by dry sandblast outside of buildings, also, was a major source of dust generation.

Control provisions for the operation were as follows:

a. A canvas covered booth, which structure was mounted on wheels and could readily be moved by two men. The operator inside the booth was supplied air by airline; attendant outside the booth was provided half-face dust respiratory protection.

b. Accessories to the booth were an electric generator for lighting and a ventilated fan for dust removal, both mounted on a light trailer. Attached to the fan outlet was a typical furnace cleaning bag, approximately 50' x 6' when inflated, used for dust collection. A flexible length of ducting was used between the booth and the fan to permit greater mobility of the booth. At each move of the filter bag, collected materials were dumped into containers for disposal.

Radiation levels of the finer particles collected in the filter bag were significantly higher than those from the coarser particles which remained on the surface being cleaned.

Test samples were collected from the above-described operations and, in addition, specific process of scrap cleaning. Sample locations were in the general work area and/or downwind. A breakdown by general types of work and the resulting estimated average activity level are presented in the following table:

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TABLE I

Description	Airborne Alpha Activity μc/cc Average	High
Cutting down and removing iron: structure, framing, equipment	8.7×10^{-11}	7.7×10^{-10}
Loading out iron and equipment by hand and mechanical lifts	8.7×10^{-11}	5.3×10^{-10}
Demolishing wood, concrete, or masonary	2.7×10^{-11}	9.2×10^{-11}
Mechanical loading of debris and rubble	1.8×10^{-11}	1.1×10^{-10}
Removal of tar and gravel roofs	6.6 $\cancel{2.5} \times 10^{-11}$	1.5×10^{-11}
Dry sandblast inside of buildings	3.6×10^{-10}	7.4×10^{-10}
General area outside of buildings during sandblasting inside	2.7×10^{-11}	9.5×10^{-11}
Dry sandblast of outside surfaces	4.2×10^{-11}	1.1×10^{-10}
Shoveling residues in small quarters	2.4×10^{-10}	-
Jackhammering "Gunite" from tanks	8.2×10^{-10}	1.8×10^{-9}
Location outside of hood during removal of "Gunite" inside of hood	3.4×10^{-12}	-
Cleaning sand and residues from inside of vessel after sandblasting	6.4×10^{-11}	-
Steam cleaning of nonsalvable materials	2.0×10^{-12}	-
Source sample using electric wire brush on interior of pipe after solvent soaking	8.8×10^{-10}	-
Area of stack exhaust from dust collector-hood setup	3.3×10^{-11}	-
General air in building during period of inactivity	1.4×10^{-11}	-

PART III

RISK EVALUATION AND FIRST AID FIRE EXTINGUISHMENT SERVICE

RISK EVALUATION

The demolition contractor was assumed to be qualified to accommodate the risk normally encountered in demolition work and to meet his contractual obligation concerning the AEC's "Minimum Safety Requirements." He was not, however, equipped to evaluate risk connected with the properties of chemicals which had been handled and processed at the site. It is for this risk that hazard-type analysis service was provided.

The Destrehan Plant had contained many chemicals representing many kinds and degrees of risk. For example, one section had used many thousands of gallons of highly flammable ether as a process reagent. In another part of the plant, large volume usage of nitric acid had caused the nitration of some cellulose materials. The plant had been modified many times, to the end that in some parts of the plant historical knowledge of the use of an area was important in judging type and magnitude of risk which might be encountered in demolishing that area.

The principal risks were those of fire or explosion, and trauma to workmen from contact with strong chemicals. The possibility that some remaining uranium would be lost or released to the environs was a risk of a different order involving mainly control over disposal of classified materials.

The prime contractor for the demolition work had no intimate knowledge of the area use during operations and was not in a good position to evaluate the risks which might be encountered in removing a particular tank or pipeline or other piece of production equipment. Although the process equipment had been thoroughly cleaned by the operating contractor prior to going into standby, the possibility did exist that materials and chemicals could still be present in significant quantity.

One of the important assignments to the health services was assistance to the AEC in planning successive phases and steps of demolition. This was accomplished mainly in pre-work planning discussions between engineering, health services, and the on-site AEC representative. This planning included estimation of risk which might be present, and a selection of measurements or observations to secure adequate identification of the magnitude of risk. A second level effort then occurred as the work began in a particular area. This involved visual observations as pipelines were dismantled, tankage was removed, and similar actions took place. These observations were particularly attentive to unexpected presence of materials which might fall into one of the risk categories. Where such materials were observed, decisions were then made as to the most suitable way for handling that particular problem.

FIRE PROTECTION EQUIPMENT

When the plant was placed in standby, the first aid fire extinguishers were left in place and were still there when demolition work began. The Fire Marshal from the Weldon Spring Plant made an inspection of all equipment to assure its reliability.

Meetings were held between the Weldon Spring Fire Marshal and the prime contractor's supervisory personnel to acquaint them with unusual fire problems which might arise due to nitrated materials at the site. He also advised them about locations where highly flammable materials were present during operations and might still be present in some quantity.

During the demolition work, fire extinguishers were supplied through the site health service from the AEC's stock at Weldon Spring. The general rule was to provide separate extinguishers for welding and other flame-producing work so as to not render useless the installed fire extinguishers which might be needed for protection of the properties.

As buildings were dismantled, the extinguishers were collected at a central location which then became the source from which job extinguishers were issued. Approximately 50 first aid extinguishers were in place at the start of demolition. During demolition, approximately 30 were used to extinguish small fires which, almost without exception, were started by gas torch cutting work. These small fires in paint and insulation did not result in any appreciable fire loss.

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APPENDIX 1

STANDARD MONITORING TECHNIQUES

1. GENERAL

1.1 Alpha contamination is measured with an alpha survey meter calibrated in d/m/100 cm^2 against normal uranium. Survey meters may be of the air ionization, proportional, or scintillation type, sufficiently sensitive to detect alpha contamination in the range from 500 to 50,000 d/m/100 cm^2.

1.2 Beta-gamma contamination is measured with a survey meter calibrated in millirad/hr or millirep/hr against normal uranium. The unshielded probe should have a minimum face area of approximately 2 square inches. Meters may be of the geiger tube, air ionization, or scintillation type sufficiently sensitive to measure beta-gamma activity in the range from 0.3 mrad/hr to >1.0 mrad/hr.

1.3 Removable contamination, as used in this instruction, is measured as follows:

a. Alpha Activity

Using 1/2 of a 4" disc of Whatman filter paper, wipe an area of approximately 100 cm^2 of the surface of the item to be measured. Two (2) wipe passes over the area is sufficient. Place the filter paper under the alpha probe and measure the activity on the paper. Call this measurement "removable."

b. Beta-Gamma Activity

Follow the same wipe procedure as above. Place the unshielded probe of the beta-gamma survey meter in the center of the filter paper and measure the activity on the paper. Call this measurement "removable."

A clean piece of filter paper is used for each 100 cm^2 area monitored.

1.4 All equipment items (Class V material) are monitored individually.

1.5 All material items, any class, exceeding 50 pounds are monitored individually.

1.6 Material items weighing less than 50 pounds each are monitored as a lot using a 20% random sample, providing the material is from the same plant source, and the material is destined for controlled or uncontrolled smelting. Samples are considered representative of the entire lot.

1.7 Material items weighing less than 50 pounds each destined for purposes other than smelting are monitored individually as if they weighed in excess of 50 pounds.

1.8 When monitoring any item of material, an equal number of measurements are made on inside and outside surfaces to determine averages except for wipe tests.

2. BETA-GAMMA MONITORING

2.1 Monitor for beta-gamma contamination.

2.2 Scan the material item being monitored to locate spots of highest contamination. Record the measurements and mark the spots with a grease pencil. If any one of the measurements exceed 1.0 mrep/hr, the item is "contaminated" and no further monitoring is required. Mark Form 7374 for disposition in accordance with appropriate category.

2.2 If none of the measurements exceed 1.0 mrep/hr but do exceed 0.3 mrep/hr, dry wipe a representative number of high spots as described in Section 1.3(b) of this appendix and measure the filter paper for "removable" beta-gamma contamination. If any one of the wipe test measurements exceeds 0.3 mrep/hr, the item is "contaminated" and no further monitoring is necessary. Mark the form for disposition as above.

2.3 If none of the surface beta-gamma measurements exceed 0.3 mrep/hr, no wipe test is required. Enter the measurements on Form 7374 and proceed with alpha monitoring.

3. ALPHA MONITORING

3.1 Monitor for alpha contamination after beta-gamma monitoring.

3.2 Measure alpha contamination at the highest spot of beta-gamma activity; then make additional random measurements to provide a representative measurement for each 10 square feet of surface area. Record the measurements. If any one of the measurements exceeds 25,000 d/m/100 cm^2, the item is "contaminated" and no further monitoring is required. Mark Form 7374 for disposition according to appropriate category.

3.3 If no measurement exceeds 25,000 d/m/100 cm^2, sum up all alpha measurements and calculate the arithmetic average. If the average exceeds 5,000 d/m/100 cm^2, the item is "contaminated" and no further monitoring is required. Mark the form for disposition as above.

3.4 If the average alpha contamination is less than 5,000 d/m/100 cm^2 and no spot exceeds 25,000 d/m/100 cm^2, dry wipe those spots exceeding 2,000 d/m/100 cm^2 as described in Section 1.3(a) of this appendix and measure the filter paper for "removable" alpha contamination. If any one spot exceeds 2,000 d/m/100 cm^2, the item is "contaminated;" proceed for disposition as above.

3.5 If none of the wipe test measurements exceed 2,000 d/m/100 cm^2, the item is noncontaminated and is disposed of as salvable material.

3.6 If none of the surface measurements exceed 2,000 d/m/100 cm^2, the wipe test is not necessary. The item is "noncontaminated" and may be disposed of as salvable material.

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Form 7374

Report No. ______

CLASSIFICATION AND MONITORING REPORT

Item ______ Property No. ______

______ Identification No. ______

CLASS I II III IV V VI VII VIII IX (Circle appropriate class)

DISPOSITION ☐ Salvable ☐ Nonsalvable ☐ Debris and Rubble

TAGGED ☐ Green ☐ Yellow ☐ Red ☐ White

AEC Approval ______

Date ______

MONITORING DATA

Beta-Gamma mrad/hr		Alpha d/m/100 cm^2		REMARKS
Surface	Removable	Surface	Removable	☐ Contaminated ☐ Noncontaminated
		Σ		Meter No. α
		Avg.		β

Monitored by ______

Reference Reports ______ Date ______

______

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APPENDIX 2

TECHNIQUE FOR MONITORING PIPE CONTAMINATED WITH URANIUM

INTRODUCTION

At the present time, there is no acceptable method for monitoring the inside surface of small diameter pipe to quantitatively determine alpha activity other than by destructive sampling and laboratory analysis. Existing alpha survey instrument probes are too large to be inserted into pipe. Geiger tubes are sufficiently small for this type of monitoring, but are ineffective for alpha monitoring. If beta and/or gamma activity are associated with the radioactive decay of an alpha emitter, however, a geiger tube can give a qualitative indication as to whether or not radioactive material is present. Since normal uranium daughters are Th_{234} and Pa_{234}, both beta emitters, which reach equilibrium with uranium in approximately 250 days, measurement of the beta activity should give a reasonable measurement of the uranium present. It must be recognized, however, that nonequilibrium conditions and/or the presence of other beta and gamma emitting isotopes would significantly affect the accuracy of uranium measurement.

PREPARATION OF PIPE FOR MONITORING

Prior to monitoring pipe, all bends, kinks, or crushed sections must be removed. Visible, loose material must also be removed from the pipe. Maximum length of pipe should be 20 feet. The pipe must be removed from the plant area to a monitoring area where the probability of recontamination after monitoring is minimized. Curved pipe cannot be monitored.

MONITORING PROCEDURE

1. Inspect the pipe visually for interior and exterior deposits of uranium. The presence of visible material classifies the pipe as "contaminated."
2. Inspect the pipe for bends, elbows, valves, fittings, and crushed sections. This type of pipe cannot be monitored and must be considered "contaminated."
3. Monitor the exterior surface in accordance with the standard monitoring procedure. If the exterior exceeds the established activity levels, the pipe is contaminated and no further monitoring is required.
4. Slowly move the Thyac meter ten-foot probe through the pipe. If the survey instrument shows radioactivity in excess of background, the pipe should be considered contaminated.
5. Pipe lengths greater than ten feet must be monitored from both ends.
6. Record the c/m of contaminated pipe.
7. Each individual piece of pipe must be monitored. Pipe cannot be sampled as a lot.
8. Mark pipe by using spray paint in accordance with the color code used in the standard monitoring procedure.

APPENDIX 3

FINAL SURVEY CONTAMINATION MONITORING TECHNIQUES

1. Instruments Used

a. Alpha Activity - Gas proportional alpha counter. Eberline Instrument Corporation PAC-3G, 150 d/m/100 cm^2 per graduation, and alpha survey meter (ionization chamber type), Victoreen Instrument Company Model 356, 400 d/m/100 cm^2 per graduation.

b. Beta-Gamma Activity: Geiger-Mueller type survey meter, Victoreen Instrument Company Model 389C - Thyac survey meter, background in the range of 0.1 mrep/hr.

c. Instrument calibrations for alpha and beta radiation were made with the use of aged natural uranium sources. Gamma calibrations were made with platinum capsulated radium needles.

2. Survey Methods

Two techniques were applied to estimate the surface uranium contamination levels, a spot sampling method and a path scanning method. The spot sampling method was used for such surfaces as walls, ceilings, and beams. The number of readings per unit area depended upon judgment based on knowledge of the history of the location, the variety of the surface types and initial survey measurements. The path scanning method was used for large areas that could be traversed, such as yards, pads, floors, and roofs. This latter method resulted in a continuous reading of beta-gamma activity ranges, highs and lows, and spot readings for alpha contamination.

APPENDIX 4

CLEANING METHODS EMPLOYED DURING DESTREHAN DEMOLITION

A. Decontamination of Equipment

1. Dry Sandblast - Of approximately sixty vessels cleaned by this method, the average number of cleanings required per vessel was approximately 1 1/3, with a maximum of 7. Approximately 5% of those tried could not be cleaned to specified levels after intensive effort; these were surfaces exposed to process materials in the pitchblende digestion and radium extraction operations.

   Items were prepared for cleaning by stripping them of all excess parts; and by providing access to all points.

   Cleaning of material surfaces was conducted in a ventilated enclosure with dust collection facilities, and positive air supply masks for operators.

2. Steam Cleaning - Caustic-detergent additives were used with the steam cleaning equipment. Grossly contaminated items were cleaned on grating placed over a vat which served to retain residues. Overflow was permitted to escape through a weir to the sewer. This process was frequently used in conjunction with paint strippers. A significant number of items were cleaned by this process; items were contaminated to levels ranging to approximately twice the criteria limits, or in the case of beta intensity, specifically, to approximately 5 times the criteria limits.

   Operation was conducted in the open air; half-face dust respirators and face shields were provided; periodically, the vat was cleaned by transferring contents to be disposed of with rubble.

3. Paint Strippers - This step was followed by flushing with a steam gun (refer to 2 above). Stripper was applied by dipping or brushing.

4. Acid-Detergents - Nickel-bearing steel pieces and pipe were cleaned by this method. Pipe was lowered into a vat and allowed to soak for several hours. An electric powered rotary wire brush was worked through the pipe until scale was loosened. Residues were rinsed away by a wet steam wash.

   Approximately 55% of pipe tried was cleaned to specified radiation levels for release. An estimated 2 to 3 cleaning cycles were required to reach this level. Once the cleaning solution became sufficiently contaminated, there was a tendency toward recontamination.

   Operations were conducted in the open air. Splash protection was provided the operators.

5. Solvents (Chlorinated Hydrocarbons) - Items of low contamination level, ranging to approximately 1 1/2 times the criteria limits, were cleaned to specified levels by this method. Those which remained contaminated after a run through the process were not generally improved by further solvent cleaning. The method received limited use and is considered to have been successful only on items with contamination not firmly fixed in the surface.

Two solvent vats were used, one for heavy soil removal, and the second for rinsing. Solvent was continuously recirculated through a 50 micron Cuno filter; pump outlet lines were used for flushing. Drained items were dryed by forced air.

Operations were performed in open air; rubber gloves and face shields were utilized for personnel protection; area was set up with controls designed to avoid explosion of fire; contaminated liquids and filters were disposed of with rubble.

6. Burning - Insulation was burned from cable by providing fuel other than the insulation itself. Sampling of remaining metal after a water rinse indicated that it complied with criteria for clean scrap.

B. Decontamination of Property

The process of decontamination of structures, like that of nonsalvable scrap, was one of experimentation and reappraisal. The methods most successfully used were dry sandblast and water blast.

A brief discussion of the applications for various cleaning methods is given in the following paragraphs:

1. Pickup - Removal of gross quantities of contaminated materials commonly involved sweeping and shoveling; respiratory protection for dust was prescribed. Vacuum cleaning is a desirable method when it is compatible to the conditions.

2. Water Blast - This was successfully applied for removal of loose particles from roof structurals and beams. It was applied also to remove loose particles from all surfaces before and after dry sandblasting.

3. Pressurized Steam - This method is applicable to cleaning low levels of semifixed surface particles in the range of 1.5 times criteria limits. Application of detergent-brush scrubbing techniques gave similar results.

4. Dry Sandblast - This method is applicable to removal in depth of masonary materials and paint, as well as encrusted layers of surface contamination. The primary limitation on this technique is the depth of penetration on masonary materials, especially porous concrete.

5. Wet Sandblast - This method was not as effective in cleaning as dry sandblasting; removal of wet sand is more difficult and delays the cleaning effort.

6. Vacu-Blast - This method utilizing steel shot, with vacuum pickup and recirculation of shot, may readily be applied to floor surfaces; however, preliminary tests indicated that it was more time-consuming than dry sandblast. Shot remaining on surface made footing hazardous. Techniques were not fully developed to fully evaluate this method.

7. Mechanical Scratcher - This method is applicable to removal of embedded gravel and dust particles from tar and gravel roofs when the contamination level is in the range of 1.5 times the limited criteria.

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