HEALTH PHYSICS MANUAL

DAVISON CHEMICAL CO.

POMPTON PLAINS

NEW JERSEY

JANUARY 1, 1960

PREPARED BY

PETER J. GARINO

TABLE OF CONTENTS

INTRODUCTION

It is important for any organization using radioactive materials to establish a program that will insure the safety of its personnel and the inhabitants of the surrounding area, and compliance with local, state and federal regulations. The Pompton Plains Plant of the Davison Chemical Company has established the radiological safety program described below. Its success depends upon the cooperation of each individual.

The Health-Physics Department has three areas of prime responsibility. They are: the day-to-day evaluation of radiation exposure; the reduction of exposure by any applicable control measures; and, the monitoring of all materials and effluents discharged from the plant site. The fact that all exposure levels are maintained below maximum permissible levels is an indication that the control procedures are working, but since any unwarranted exposure is foolish, the efforts to maintain radiation levels as low as possible in these three areas of responsibility should be paramount.

A prime factor in the control of radiation exposure is the proper training of operating personnel. It is a part of the Health-Physics Department's responsibility to see that every individual knows what he is working with, what the hazards are, and what measures are being taken to insure his safety. The employee must be trained in safe techniques and know what to do in case of accident. Finally he must be made to realize that observance of safety rules and personnel monitoring requirements are just as much a part of the job as the actual operation performed.

Thorium, small amounts of uranium and their compounds occur naturally in monazite or thorite. Chemical separation produces a mixture of thorium ^{232} and thorium ^{288} plus the uranium disintegration products in radioactive equilibrium, and may drive off the active daughter creating an airborne hazard. Thorium decays slowly to form thoron gas which then decays to form stable lead, with the emission of alpha and beta activity.

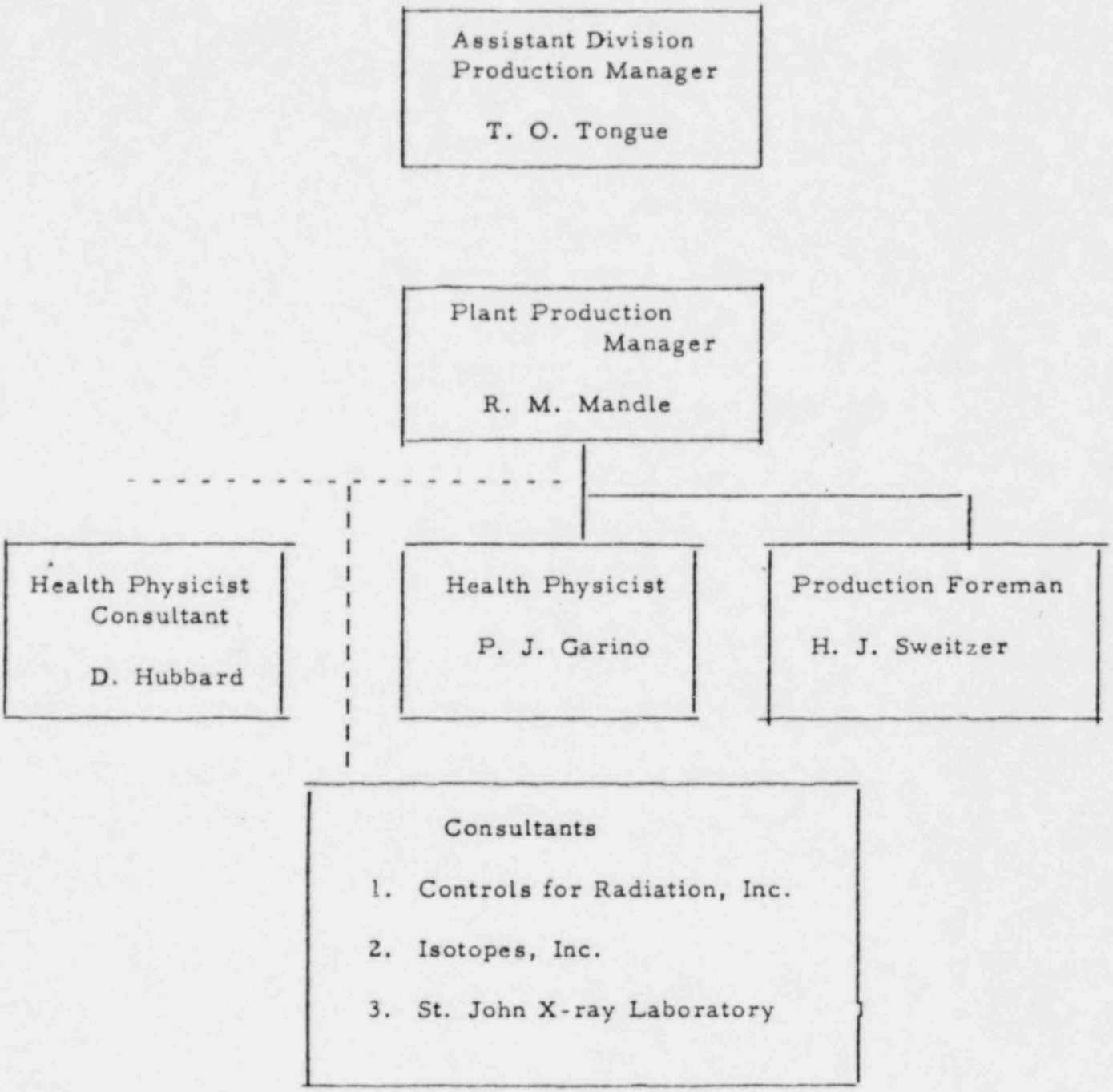
Fifty to seventy-five years of experience in refining thoria from monazite has produced no noticeable evidence of radiation injury or chemical toxicity. Industrial exposure averaged 10^{-10} uc/cc during this period.

Certain recent animal toxicity data indicates radiation dosage from thorium might better be compared to that of plutonium than to uranium. Calculations based on these and other animal data suggest that permissible occupational exposure to thorium should be reduced to 2×10^{-12} uc/cc for 40 hours per week. However, the most recent review on the subject strongly supports the uranium comparison and retention of the present limits. The National Committee on Radiation Protection has recognized this disparity and has proposed 3×10^{-11} uc/cc as a temporary permissible level with the recommendation that exposure levels be kept as low as operationally possible.

This manual contains general safety procedures and rules which must be followed by all employees, methods of analysis, administrative forms, and diagrams of the plant and surrounding area.

The basic purpose of these safety procedures is to prevent entry of radioactive material into the body by ingestion, inhalation, or other modes, to minimize exposure of personnel to external radiation, and to limit the cross contamination of areas and equipment.

RADIOLOGICAL SAFETY ORGANIZATION



DEFINITION OF TERMS

Controlled area	Any area, access to which is controlled by the licensee.
Spreadable activity	Airborne activity or activity on any object which may be transferred to a piece of filter paper which is lightly rubbed on the surface.
Non-spreadable activity	Fixed contamination which cannot be transferred to the smear paper.
Maximum permissable dose (MPD)	That amount of ionizing radiation, which in the light of present knowledge, is not expected to cause appreciable bodily injury to a person at any time during his lifetime.
Maximum permissable concentration(MPC)	In restricted areas this is limited to 5×10^{-11} microcuries per milliliter of air. This is equivalent to 110 alpha disintegrations per minute per cubic meter of air.
Roentgen	The quantity of X or gamma-radiation such that the associated corpuscular emmission per 0.001293 gram of air (1cc of dry air at standard conditions) produce, in air, ions, carrying one electro-static unit or quantity of electricity of either sign.
Roentgen Equivalent Man (REM)	The amount of ionizing radiation that will produce the same biological effect as that produced by one roentgen of high voltage X radiation.
Radioactivity	Process whereby certain nuclides undergo spontaneous disintegration, liberating energy through alpha or beta particles or gamma Photons or a combination of these.
Radiological Safety Officer (RSO)	A person trained in that branch of radiological science dealing with the protection of personnel from the harmful effects of ionizing radiation.

MAXIMUM PERMISSIBLE LEVELS AND CONCENTRATIONS

PERMISSIBLE WEEKLY DOSE

Conditions of exposure		Dose in critical organs (mrem)			
Parts of body	Radiation	Skin, at basal layer of epidermis	Blood forming organs	Gonads	Lens of eye
Whole body - - - - - - - -	Any radiation with half-value-layer greater than 1 mm of soft tissue.	[1]600	[1]300	[1]300	[1]300
Whole body - - - - - - - -	Any radiation with half-value layer less than 1 mm of soft tissue.	1,500	300	300	300
Hands and forearms or feet and ankles or head and neck.	Any radiation - - - - - - - -	[2]1,500	- - - - -	- - - -	- - - -

[1] For exposures of the whole body to X or gamma rays up to 3 mev, this condition may be assumed to be met if the "air dose" does not exceed 300 mr, provided the dose to the gonads does not exceed 300 mrem. "Air dose" means that the dose is measured by an appropriate instrument in air in the region of highest dosage rate to be occupied by an individual, without the presence of the human body or other absorbing and scattering material.

[2] Exposure of these limited portions of the body under these conditions does not alter the total weekly dose of 300 mrem permitted to the bloodforming organs in the main portion of the body, to the gonads, or to the lens of the eye.

MAXIMUM PERMISSIBLE LEVELS AND CONCENTRATIONS (cont.)

PERMISSIBLE CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND

Material	Table I [4]		Table II [4]	
	Column 1[1] Air (2)	Column 2[2] Water (3)	Column 1[1] Air (2)	Column 2[2] Water (3)
Te^{127}	3×10^{-7}	8×10^{-2}	1×10^{-8}	3×10^{-3}
Te^{129}	1.2×10^{-7}	3.3×10^{-2}	4×10^{-9}	1.1×10^{-3}
Th^{234}	2×10^{-6}	10	6×10^{-8}	3×10^{-1}
Th-natural (soluble)	5×10^{-11}	1.5×10^{-6}	1.7×10^{-12}	5×10^{-8}
Th-natural (unsoluble)	5×10^{-11}	- - - -	1.7×10^{-12}	- - - -
Tm^{170}	1.5×10^{-7}	8×10^{-1}	5×10^{-9}	2.5×10^{-3}
U-natural (soluble)[3]	5×10^{-11}	2×10^{-4}	1.7×10^{-12}	7×10^{-6}
U-natural (unsoluble)[3]	5×10^{-11}	- - - -	1.7×10^{-12}	- - - -
U^{233} (soluble)	4×10^{-10}	4.5×10^{-4}	1×10^{-11}	1.5×10^{-5}
U^{233} (unsoluble)	5×10^{-11}	- - - -	1.6×10^{-12}	- - - -
Y^{48}	3×10^{-6}	1.5	1×10^{-7}	5×10^{-2}
Xe^{133}	1.3×10^{-5}	1.3×10^{-2}	4×10^{-7}	4×10^{-4}
Xe^{135}	5×10^{-6}	4×10^{-3}	1.7×10^{-7}	1.4×10^{-4}
Y^{91}	1.2×10^{-7}	6×10^{-1}	4×10^{-9}	2×10^{-2}
Zn^{65}	6×10^{-6}	2×10^{-1}	2×10^{-7}	6×10^{-3}
Unidentified beta or gamma emitters of any undetermined mixtures of beta or gamma emitters	- - - -	- - - -	1×10^{-9}	1×10^{-7}
Unidentified alpha emitters or any undetermined mixtures of alpha emitters	- - - -	- - - -	5×10^{-12}	1×10^{-7}

[1]Air concentrations are given in microcuries per milliliter of air.

[2]Water concentrations are given in microcuries per milliliter of water. These figures also apply to foodstuffs in microcuries per gram (wet-weight).

[3]For enriched uranium the same radioactivities per unit volume as those for natural uranium are applicable. It should be noted that the contribution of U-234 to the gross activity of enriched uranium is 20-40 times that of the U-235.

[4]Table I applies to restricted areas, Table II to unrestricted areas.

CONTAMINATION CONTROL

The processing of monazite ores results in potential health hazards to both the employees and to the plant community. The control of in-plant hazards require the evaluation of employees' exposures. The sources of the exposures are external radiation from thorium and its daughter products and small amounts of uranium, taken into the body by inhalation or ingestion of airborne activity or surface contamination. To control the potential hazards to the plant community it is necessary to determine and control the quantity of uranium and thorium with its daughter products released from the plant. This includes liquid and gaseous effluents, solid waste material and contamination on material or personnel leaving the plant area.

In the interest of general personal protection, all personnel working in the vicinity of operations in which a potential dust hazard exists are required to wear respirators.

All personnel working in the plant processing areas are required to undergo a clothing change prior to reporting to their work areas. On arrival at the plant, operators enter the clean area (west side of the locker room), undress and place their street clothes in their assigned lockers. They then pass into the process area (east side of the locker room) and put on their process clothing and safety shoes. At the end of their shift, operators return their process clothing to their lockers in the east locker room and pass into the west locker room.

Supervisory personnel and those individuals who have occasion to visit the processing areas are issued smocks and overshoes. These are worn at all times while the individual is in the processing area. They are maintained on hangers immediately adjacent to the chemical control laboratory. Plant visitors follow the same procedure described for supervisory personnel.

Controls have been established to insure that equipment and materials leaving the plant are not significantly contaminated. Prior to the release of any material, written approval must be obtained from the Health Physics office. All radioactive material brought onto the plant site will be monitored by the Health Physics department to insure that maximum permissable concentrations of radioactivity are not exceeded. Records of incoming and outgoing materials are maintained in the office.

RADIATION SURVEYS

1. Air Samples

The extent of airborne contamination in the Rare Earth Processing Plant site is monitored by sampling the air in different parts of the plant with a Staplex Hi-Volume Air Sampler, equipped with a T.F.A. #41 filter, and determining the radioactive content of the dust accumulated on the filter. The procedure employed consists of sampling the air in a particular locality at the rate of 20 cu. ft. per minute for a period of 5 minutes, allowing the collected dust to age 48 hours to permit the decay of radon and thoron, counting the sample in a proportional counter-scaler arrangement and converting the resulting reading to uc/ml.

Air samples are taken by each of two different schemes. In the first instance, each of the positions designated as air sampling stations in exhibit #1 are monitored at least once each month while other areas are monitored once every two months. In the second scheme, each operator station is monitored during a period of production. In the latter case a complete survey is conducted at least once every two months. In addition to these two systematic sampling methods, the Health Physicist makes a number of spot checks of the air count when he, during the course of his daily routine health inspection, feels that a particular operation or area requires such attention.

In the event that it is found that the air count in a particular area exceeds the following tolerance limits, the Health Physicist has the authority to cause a cessation of the applicable operation (s) until correctional measures have been taken.

TOLERANCE LIMITS FOR RESTRICTED AREAS

Thorium	5×10^{-11} uc/ml
Uranium	5×10^{-11} uc/ml

Reports of the surveys of airborne contamination are prepared by the Health Physicist and distributed to the plant manager and department heads.

LOCATIONS OF AIR SAMPLING STATIONS

1. Restricted Areas

   a) Shipping Room - in the center of the room, five feet from the east wall.

   b) Pulverizing Room - in the center of the room.

   c) Calcining Furnace - midway between press number 4 and the furnace.

   d) Thorium Refining - in the hallway near the rear south side entrance.

   e) Thorium Crystallization Unit - in the center of the room.

   f) Process storage - in the center of the room.

   g) Ball Mill - in the center of the room.

   h) Monazite Storage Area - three feet from the center of the south wall.

   i) Lunch Room - in the center of the room.

   j) Thorium Hydroxide Storage - on the south side of barrels.

   k) Development Laboratory - in the center of the room.

   l) Sulfonation Kettle Area - midway along the south wall of the room.

2. Unrestricted Areas

   a) North west corner of property line.

   b) Midway along south property line.

   c) Southwest corner of property line.

Z. Liquid Waste - Plant Effluent

The waste treatment plant treats all liquid wastes issuing from the plant. The waste involved consists of wash water, floor washings and surface run-off from the adjacent plant property.

The process involves the use of an average of 18,000 gallons of water per day. All of the washes are discharged into a common 1,000 gallon sump equipped with two automatically controlled force pumps which pump the waste to a retention tank. Each pump has capacity to handle the peak load and is installed so that the second pump starts in case of extreme demand or failure of the first. Signals are installed in a control house to indicate the proper function of the pumps.

The retention tank has a capacity of 50,000 gallons which provides a minimum of 48 hours average retention of the wastes. In addition to the purpose of acting as a reservoir, or constant head installation, the tank provides means of blending effluents of widely varying pH so that the automatic pH controlling equipment may function more efficiently. The incoming wastes flow through a distributing channel in the tank and effluent, after initial settling, is removed from the midpoint of the tank and flows by gravity to a mixing tank. A draw-off is provided at the bottom of the tank to pump accumulated solids to the sludge filter press.

An 8,000 gallon mixing tank, equipped with a gate agitator receives effluent from the retention tank at its midpoint. A pH electrode assembly is in circuit with the mixing tank and electrically connected to a mechanically operated diaphragm valve. Two storage tanks are provided to feed either 50% sulphuric acid or 50% caustic soda solution through the automatic diaphragm valve to the mixing tank as called for by the pH controller. Again signals are

provided to indicate proper functioning of the valve and chemical supply tanks as well as a recording chart which indicates the pH of the mixing tank. The mixing tank effluent is piped to a 2,000 gallon Hardinge thickener at pH 5.8 - 6.2.

The Hardinge thickener provides a clear overflow to a final clarification tank and adjusted to give a 20% solids underflow which is pumped to a sludge filter press in the control house.

The final clarification tank of 50,000 gallon capacity provides an average 48 hours of retention time for the effluent before discharge from the system. The main function of this tank is to provide sufficient time for post precipitation of solids after pH adjustment. A draw off is provided at the bottom of the tank to pump accumulated solids to the sludge filter press.

The sludge filter is of the plate and frame type with a capacity of 6 cubic ft. of cake. Approximately 60 cubic feet of sludges, or 3,500 lbs. are removed weekly. These sludges are hauled to a dump on the property.

The system was designed to operate automatically. Twelve man hours per day are devoted to the maintenance, cleaning and control of the operation. The entire operation is under the supervision of the plant chemist who checks the performance of the equipment, and samples prepared by the shift operator.

A log is maintained which indicates satisfactory operation of the system for pH and turbidity control. The pH of the effluent is maintained between 5.0 and 8.0 according to the permit granted by the New Jersey State Department of Health who have approved the design and mode of operation of the system. We have found through experience that the system operates more satisfactorily at lower pH values since the precipitate formed by neutralization settles more rapidly assuring a clearer effluent.

The effluent is sampled daily at the overflow of the Hardinge thickener and at the Weir in the control house. Sampling at the Hardinge thickener in the system provides an average 48 hour retention time before discharge and will indicate the quality of the effluent entering the final clarification tank. Sampling at the Weir provides a check on the amount of contamination which has settled out of the effluent in the final clarification tank or if there is any additional contamination being added to the effluent through the accumulation of sludges in the clarification tank.

The samples are immediately taken to the laboratory together with the completed "plant effluent form". Upon completion of analysis of the sample the Health Physicist reviews the analytical results and compares them with the maximum permissable concentration. The effluent is then graded according to the following standards.

PLANT EFFLUENT STANDARDS

Grade of Effluent	Sample Position and % Hardinge Overflow		M.P.C. Weir	Disposition
A	33	=	33	Excellent effluent
B	33-66	=	33-66	Satisfactory effluent
C	0-66	=	33-66	Possible contamination from final effluent tank
D	33-66	=	33-66	Indicates buildup of contamination. Notify Plant Manager.
E	66-100	=	66-100	Continued contamination. Notify Plant Manager
E	66-100	=	66-100	Further build up from final effluent tank.
F	66-100	=	66-100	Increasing contamination from plant process. Alert Plant Manager. Additional analysis.

(continued)

Grade of Effluent	Sample Position and % Hardinge Overflow		M. P. C. Weir	Disposition
F	/ 100	=	66-100	Shut down departments discharging effluents.
F	/ 100	=	/ 100	Shut down departments discharging effluents and hold up effluent.

Copies of analysis of effluent grade D or lower must be immediately presented to the Plant Manager

On the final day of each month the Health Physicist prepares a "Monthly Report of Material Discharged into the Pompton River" in which he presents the high, low and average amounts of process effluent discharged during the preceding month and the high, low and average concentrates expressed as a percentage of the maximum permissible concentration. The original and two copies of the report will be sent to the Plant Manager and one copy retained by the originator.

All effluent and river samples are monitored with a Proportional counter, decade scaler circuit by methods outlined in Appendix B.

3. Personnel Monitoring

All employees who have reason to enter the processing areas are required to wear film badges. These badges, supplied by the St. John X-Ray Laboratory, are read every week and a report of the readings by name and badge number if furnished the health physicist. The health physicist prepares a report of the exposure readings which is sent to the plant manager.

New film badges are issued by the health physics office each week. Film badges are not carried home or left in process areas but are hung in their assigned spaces on film badge racks.

Individual work activities are so scheduled that an operator is not subject to radiation in excess of 300 mr/week. In the event of a reading exceeding 150 mr/week as shown by a film badge report, the area supervisor is notified, the individual's work program reviewed and the results of the review filed with the weekly film badge report.

4. External Radiation Surveys

A radiological survey of the entire Rare Earths Processing Plant is made by the health physicist once each month. To facilitate such surveys, the plant has been subdivided into a series of monitoring areas. A diagram of these areas is shown in Exhibit #2 (Appendix). Each area is surveyed carefully and the highest radiation level in the area is recorded. In the event that the radiation level in any part of a given area exceeds 5 mr/hr the portion of the area indicating such a level is posted with a radiation sign. Any area with a radiation level in excess of 10/mr/hr is so enclosed that only limited access to authorized personnel is available.

A report describing the results of each radiological survey is prepared by the health physicist and is forwarded to the plant manager. Such surveys are conducted using a Geiger counter manufactured by the Anton Electronic Laboratories, Inc., Brooklyn, New York, Model #5.

DECONTAMINATION PROCEDURES

Personal decontamination methods to be used are dependent upon the contaminating material and the area of the person contaminated. Generally the following procedure is to be used immediately.

First notify Health Physics; specific measures will then be carried out by this office. Thorough washing with soap and water and then rinsing off with large quantities of water is the best general decontamination method for the hands and other parts of the body. For well localized contamination, however, it is recommended that the area be washed off and cleansed with swabs and later, if necessary, by using a general washing. This avoids the dangerous procedure of spreading the contamination needlessly.

The following specific measures should be followed with the guidance of Health Physics:

(a) For general hand washing: the hands should be washed two to three minutes in tepid water using mild soap. Rinse thoroughly and repeat a maximum of four times. If the required degree of decontamination is not then reached, proceed with (b).

(b) Using a soft brush, wash and rinse three times in 8 minutes of which no less than 6 minutes should be spent in scrubbing. Use only light pressure so as not to abrade the skin. Rinse thoroughly and monitor.

Generally, persons with any wounds or cuts will not be permitted to work in a radioactive area, unless specific approval is obtained from Health Physics. Any wounds, cuts or bruises received while working with, in or near radioactive materials should be flushed with water immediately and must be referred to the Health Physics Department immediately so that more specific measures can be taken.

Equipment may be decontaminated by washing with detergent and water until the desired permissible level of activity is obtained. Other chemicals which may be used include ammonium citrate, trisodium phosphate and ammonium bi-fluoride. Equipment once contaminated, must be treated in the exact same method as other primary radioactive materials. Health Physics will supervise the decontamination of this material and equipment.

Health Physics will also monitor contaminated areas and determine the most practical method decontamination. The method used will include those mentioned under equipment and personal decontamination in addition to washing, surface stripping and repainting.

WASTE DISPOSAL

Waste materials are a natural result of the manufacturing process at the Rare Earth Processing Plant. Procedures have been established to collect, handle and dispose of the material. The general methods of waste disposal are:

(a) Transfer - This must be to an authorized recipient, whether he be a licensee, a commercial disposal facility or the Atomic Energy Commission.

(b) Burial - Is at a minimum depth of four feet, successive burials are separated by distance of at least six feet and not more than twelve burials are made in any year. Finally the total quantity of licensed material buried at any one location and times does not exceed, at the time of burial, 50,000 microcurai of natural thorium or uranium. The contractor or licensee must own the land used for these burials and must limit access to this property to prevent hazard to casual personnel.

(c) Discharge - Concentrations of licensed or other radioactive material released as an effluent into an unrestricted area must not exceed specifications set forth in AEC Regulations Title 10, Part 20. The amendment of a license will be issued if the applicant demonstrates that it is not likely that any individual will be exposed to concentrations in excess of those set forth in the regulation. Concentrations in effluents may be averaged over periods not greater than one year. The established procedure for effluent retention and disposal is outlined under Radiation Surveys, Plant Effluent.

MEDICAL EXAMINATIONS

The Rare Earth Processing Plant has a medical protection program and maintains medical records and radiation exposure records of each employee. This medical program in itself can only be an added precaution for radiation control and will be most valuable in maintaining the general health of the workers. The clinical systems of radiation damage occur only with a considerable over-exposure therefore the responsibility for prevention of radiation damage rests entirely on the personnel monitoring and control systems.

At the present time there are only a limited number of medical tests available for radiation protection. Most exposure information is still obtained from personnel and area monitoring. Any radiation program is a failure if clinical evidence of radiation damage appears. Thus medical tests are not as much a part of a protection program as they are a confirmation that some acute over-exposure has occurred.

Semi-annually each employee of the Rare Earth Processing Plant receives a complete blood count. Annually each employee receives a full chest x-ray. Additional examinations are performed at the termination of any employment or where candidates for employment exhibit or make known symptoms of normal disease which may also be attributed later to radiation exposure.

ADMINISTRATIVE FORMS

RARE EARTH DIVISION

DAVISON CHEMICAL COMPANY

POMPTON PLAINS, NEW JERSEY

HEALTH PHYSICS DEPARTMENT

AREA MONITORING SURVEY DATA SHEET

R.E:P.P WAYNE TWP., NEW JERSEY

DATE _____

BUILDING OR AREA _____

NATURE OF SUSPECTED ACTIVITY _____

MONITORED BY _____

INSTRUMENT USED _____

LOCATION	Distance From Source	Radiation Level	REMARKS

SURVEY OF RADIOLOGICAL AIR-BORNE CONTAMINATION

Location	Date	Time	Type of Survey	Results

Date _____

_____

INCINERATION PER T

Date _____

THIS FORM UPON COMPLETION, SURVEY AND SIGNATURE OF THE HEALTH-PHYSICS OFFICER AUTHORIZES THE FOLLOWING ITEM (S) TO BE BURNED IN THE TRASH BURNING AREA:

ITEMS

(1) _____

(2) _____

(3) _____

(4) _____

DATE TO BE INCINERATED _____

APPROVED B' _____
Department Manager

MONITORED BY _____
Health-Physics Department

RARE EARTH DIVISI

PROPERTY PASS

Date _____

THIS AUTHORIZES (Name) _____ TO REMOVE THE FOLLOWING ITEM (S) OF COMPANY PROPERTY FROM THE PLANT:

ITEMS AND NUMBER OF EACH

(1) _____

(2) _____

(3) _____

( ) PERMANENT REMOVAL

( ) TEMPORARY REMOVAL

DATE TO BE RETURNED _____

DATE RETURNED _____

APPROVED BY _____

MONITORED BY _____
Health Physics Dept.

HEALTH PHYSICS DEPARTMENT
RARE EARTH DIVISION

DUST RESPIRATOR INSPECTION REPORT

DATE OF INSPECTION _____

OPERATOR	CLASS	CONDITION OF RESPIRATOR		
		GOOD	FAIR	UNSATISFACTORY

By _____
Health Physics Department

R.E.P.P WAYNE TWP., NEW JERSEY

RECORD OF DISCHARGE OF PROCESS EFFLUENTS TO THE POMPTON RIVER

Date	Volume	Plant Sample No.	Lab. Sample No.	Percent MPC	pH	Remarks

HEALTH AND SAFETY DEPT

R.E.P.P., WAYNE TWP., N.J.

Operator _____ _____ Shift

Job Description _____

TIME	OPERATION OR OPERATING AREA	$d/m/m^3$ CONCENTRATION (L) (H) (AVG)
8:00		
:10		
:20		
:30		
:40		
:50		
9:00		
:10		
:20		
:30		
:40		
:50		
10:00		
:10		
:20		
:30		
:40		
:50		
11:00		
:10		
:20		
:30		
:40		
:50		
12:00	LUNCH	
1:00		
1:00		
:10		
:20		
:30		
:40		
:50		
2:00		
:10		
:20		
:30		
:40		
:50		
3:00		
:10		
:20		
:30		
:40		
:50		
4:00		
:10		
:20		
:30		
:40		
:50		
5:00		

JOB ANALYSIS SHEET

OPERATOR _____ ____MEN/SHIFT ____SHIFTS/DAY

Operation or Operating Area	Time per Oper.	Oper. per Shift	Time per, Shift (min)	No. of slps.	CONCENTRATION M^3	AVGE CONC X TOTAL TIME

(TXC) / (T) _____ d/m/M^3 _____ times max. per. conc.

CONTACTS FOR EMERGENCY USE

OPERATIONS SUPERVISOR

R. M. Mandle

Home Phone TE 5-3189

OPERATIONS ASSISTANT

H. J. Sweitzer

Home Phone TE 5-5119

HEALTH PHYSICS

P. J. Garino

Home Phone OX 4-0877

MEDICAL OFFICER

Dr. S. T. Bernson

Office Phone TE 5-2400

PLANT AREA FIRE

(1) Report fire alarm.
(2) Use fire extinguisher.
(3) Notify Operations Supervisors and Health Physicist.