

APPLICATION FOR AEC LICENSE TO  
RECEIVE, POSSESS, USE AND TRANSFER  
SPECIAL NUCLEAR MATERIAL

Pursuant to Code of Federal Regulations,  
Title 10 - Atomic Energy, Part 70 -  
Special Nuclear Material

TO: United States Atomic Energy Commission  
Washington 25, D.C.  
Attn: Division of Licensing and Regulations

Note: Item numbers and principal terminology agrees directly with  
pertinent item numbers of paragraph 70.22 of the subject  
Federal Regulations.

(1) Description of Applicant:

Name Coors Porcelain Company

Address 600 Ninth Street  
Golden, Colorado

Incorporated in the State of Colorado

Principal Office is 600 Ninth Street, Golden, Colorado

Principal Officers:

President: Joseph Coors



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Executive Vice President:

William K. Coors  
c/o Adolph Coors Company  
Golden, Colorado  
[REDACTED]

Secretary: Ray V. Frost  
[REDACTED]

Assistant Secretary:

Morris B. Hecox  
[REDACTED]

Treasurer: Adolph Coors, Jr.  
c/o Adolph Coors Company  
Golden, Colorado  
[REDACTED]

There is no control or ownership exercised over Coors Porcelain Company by any alien, foreign corporation, or foreign government.

- (2) The general activity, for which special nuclear material will be requested is the development and manufacture of reactor fuel in various forms and configurations.

This application is made for licensing of this facility on a capability basis rather than for a particular activity.

For the purpose of clarification, one type of activity, to which the contemplated license would apply, may be the manufacture of fuel rods

for use in the Special Power Excursion Reactor Test (SPERT) facility, which is operated for the Commission by Phillips Petroleum Company. A proposal for this work is presently being submitted by Coors Porcelain Company to Phillips Petroleum Company.

The place at which all contemplated activity will be performed, to the extent that the handling of special nuclear material is directly involved (See Note 2), is the Energy Products Division, located in the Fuel Element Building (SS Station CPC), at the firm's principal address.

The exact physical location of the Fuel Element Building (at 7th and Ford Streets in Golden, Colorado) is clarified by the following engineering drawings which are included in License Application Supplement No. 1, which is submitted with this application:

Coors Porcelain Company Drawing No. 45-0022-23

Adolph Coors Company Drawing No. 44-0039-7

Adolph Coors Company Drawing No. 44-0039-34

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Note 2: It is possible that unfueled mechanical parts of fuel element assemblies (such as vessels, brackets, etc.) may be partly or completely fabricated in locations other than the one described in this application, when such manufacturing steps can be completed prior to contact with special nuclear material.

(3) The period of time for which the license is requested begins immediately and extends until December 31, 1969.

(4) The name, amount, and specifications of the special nuclear material which Coors Porcelain Company proposes to use are as follows:

Name - Contained U-235

Amount - The total quantity of contained U-235 on the property at any one time will not exceed 1,000 kilograms (contained in  $UO_2$  and  $U_3O_8$ ).

Specifications - The material may be mixed with a 95%  $ThO_2$ -5%  $UO_2$  combination or may be processed as  $UO_2$  alone.

The chemical form will be  $UO_2$  and/or  $U_3O_8$  in one or more of the following physical forms during processing:

Powder  
Slurry  
Mixed with organic wax or binder  
Pressed into pellets  
Calcined  
Sintered in hydrogen atmosphere  
Grinding sludge

(5) The estimated date on which Coors Porcelain Company desires to receive the first shipment of special nuclear material is (on or before) January 2, 1964.



Subsequent receipts of special nuclear material, for the uses presently anticipated, are estimated to occur within the calendar years of 1964, 1965, 1966, 1967 and 1968.

- (511) A schedule, by years, showing estimated consumption and operating losses of special nuclear material can not be projected beyond 1964, except to suggest that the example used for 1964 is generally typical of a part of the work anticipated for this facility.

Again referring to the Special Power Excursion Reactor Test (SPERT) facility, it is estimated that 200 to 500 kilograms of contained U-235 will be consumed<sup>(1)</sup> during the calendar year 1964, and that operating losses are not estimated not to exceed 5 kilograms of contained U-235 during the same period.

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(1) The terms "consumed" or "consumption" include the reduction in value of material due to blending of different assays of special nuclear material, or other alternation of the isotopic ratio, and the disposition of material in such manner that it cannot be economically recovered for further use.



B. L. MORNIN, DIVISION MANAGER

Education: B. S. and M. S. degrees in Ceramic Engineering from Missouri School of Mines.

Special Training: Criticality Theory and Practice Course at the University of California, Berkeley.

Experience: Research Engineer and Production Superintendent at Electric Auto Lite Company Spark Plug Division; Research Engineer for Aluminum Company of America on manufacture of ceramic grade alumina materials; introduced the dry press forming method to the ceramic seal industry; 9 years at Coors Porcelain Company - 4 years as Plant Production Superintendent, formed Energy Products Division in 1960.

KEN G. WASSON, DIVISION SUPERINTENDENT

Education: B. S. degree in Mechanical Engineering from the University of Wisconsin.

Special Training: Special Weapons, U.S.A.F., Pilot, U.S.A.F., various management and technical courses, University of Colorado and U.S.A.F.

Experience: Design Engineer, Research Test Engineer, Caterpillar Tractor Company; Special Weapons Accountable Officer, U.S.A.F.; Pilot U.S.A.F.; Test Facilities Engineer, Sundstrand Turbo (Missile Application Work); Design Engineer, Production Supervisor, Production

Superintendent, Coors Porcelain Company. Developed and designed most of the production equipment used to manufacture the fuel elements used in the Tory II-C reactor core.

C. E. NORDQUIST, SUPERVISOR  
PRODUCT DEVELOPMENT, PROCESS CONTROL

Education: B. S. degree in Ceramic Engineering, University of Washington, M. B. A. degree in Management, University of Denver.

Experience: 3 years in the U.S. Air Force working on development of ceramic materials and processes for radar nose cones (Radomes) to be used in advanced vehicles (directed Air Force efforts in this area for 1-1/2 years); six (6) months in New Products Division of Coors Porcelain Company, 2 years in production trouble shooting of alumina materials; with Energy Products Division since November 1962.

R. D. SMITH, HEALTH PHYSICIST

Education: B.A. degree (1950) in Chemistry and Biology from the University of Colorado.

Special Training: Additional academic training in nuclear radiation physics, industrial toxicology, industrial ventilation and electronic instrumentation. A two month training period with the Los Alamos Scientific Laboratories in radiation monitoring procedures, conducted by the USAEC. Industrial Ventilation Conference, Michigan State University.

Experience: 8-3/4 years in Health Physics as a Radiation Engineer with the Dow Chemical Company, Rocky Flats Plant. Areas of responsibility included supervision of all Health Physics activities in facilities processing uranium, plutonium and americium, as well as conducting environmental site surveys. Team Captain of Radiological Assistance Plan Emergency Monitoring Team while at Rocky Flats. 3 years with Coors Porcelain Company in charge of health physics and nuclear safety functions, assisting in design of the Coors Energy Products facility and directing health physics functions during Lawrence Radiation Laboratory Subcontract 165 for the production of beryllia-uranium fuel elements.

GEORGE BIDINGER, NUCLEAR PHYSICIST

Education: B. S. (1957) and M. S. (1958) in Physics from John Carroll University, Cleveland, Ohio.

Special Training: 20 week course in Dynamics of Supervision.

Experience: 3-1/2 years at the Dow Chemical Company's Rocky Flats Division in the Nuclear Safety Group. Functions were nuclear safety evaluations of processes and equipment in the storage, transportation, processing and fabrication of highly enriched uranium and plutonium, and critical mass surveys using transport (DSN) and diffusion theory computation codes. 1 year at the Coors Porcelain Company's Energy Products Division in charge of nuclear safety for the production of beryllia-uranium fuel elements for the Tory II-C reactor.

C. R. McMULLEN, CHIEF CHEMIST

Education: B. Ed degree in Chemistry from Eastern Illinois State College.

Special Training: 5 years training on the Linde Air Products Company Chem and Met Program.

Experience: 3 years as Analytical Chemist on the Manhattan Project for Linde Air Products Company in Tonawanda, New York. One year as Analytical Chemist in the Schenectady Works Laboratory, and three years as Research Chemist at the General Electric Hanford Works. 2 years for Phillips Petroleum Company at the National Reactor Testing Station as Research Chemist in the Chemical Development Laboratory. 4 years with Sundstrand Corporation, three years as Chief Chemist, and one year as Supervisor of the Chemical and Metallurgical Laboratories at the Denver Plant; 3-1/2 years at Energy Products Division.

FRANCIS S. DeROSE  
ASSISTANT CHIEF CHEMIST

Education: B. S. degree (1937) in Chemistry from Regis College, Denver, Colorado. Graduate work in Chemistry and Chemical Engineering at the University of Colorado and Ohio State University.

Experience: Quality control studies at Remington Arms Ballistic Laboratory; 3 years on Manhattan Project at University of Chicago, Analytic Chemistry of Isotopes; 9 years as Professional Chemist for Dow Chemical Company, including 5 years in charge of Rocky Flats



Plant Spectrographic Laboratory; 3 years at Coors Porcelain Company, Energy Products Division as Director of Spectro-Chemistry.

T. J. LAROCO, CHIEF INSPECTOR  
ENERGY PRODUCTS DIVISION

Education: Petroleum Engineering degree from Colorado School of Mines, 1947.

Special Training: U. S. Navy Electronics School, and U. S. Navy School for Encoding and Decoding Equipment.

Experience: 10 years as Design Engineer for Stearns-Roger Manufacturing Company, designing metal reduction, chemical and cement plants. Supervised design and development of all manual inspection equipment used for Tory II-C reactor core. Member of Coors Porcelain Company staff for 3 years as director of all inspection operations related to production of urania-beryllia fuel elements.

GEORGE F. KNOWLES, PROJECT ENGINEER

Special Training: Machine Tool Operation and Toolmaking (1938)

Experience: 4 years as Manufacturing Process Engineer for Alpha Engineering Company (Mt. Prospect, Illinois) as a contractor to Ford Motor Company for design of production lines; 3 years at Sundstrand Corporation, Machine Tool Division (Belvedere, Illinois) as transfer line specialist (Ford, Chrysler, Peugeot projects); 3 years



at Coors Porcelain Company as Design Engineer, designed the Automatic Trimming Machine and Internal Drying Oven for the Coors Automated Aluminum Can Plant, supervised construction of the present (second) aluminum can production line. Currently directing all Energy Product Division technical supporting services.

In addition to the Division staff listed, technically qualified ceramic, stainless steel, aluminum and metallizing experts are available from other Coors Divisions.

- (7) Descriptions of the equipment and facilities which will be used by Coors Porcelain Company to protect health and minimum danger to life or property, are furnished in License Application Supplements Nos. 3, 4 and 8, which are submitted with this application.

Supplement Number 3 is the Health Physics Guide.

Supplement Number 4, entitled "Health and Safety Procedures" also includes some references to equipment.

Monitoring equipment is discussed in License Application Supplement No. 8.

- (8) The proposed procedures to protect health and minimize danger to life or property, including procedures to avoid accidental conditions of

criticality and procedures for personnel monitoring and waste disposal, are furnished in License Application Supplements Nos. 3 and 4.

Supplement Numbers 5 and 6, "Nuclear Safety Considerations" and "A Typical Ceramic Production Process" will provide helpful background information for clarifying many of the health protection measures.

The probability of special nuclear materials being involved in a fire in this facility are very remote. The building structure is generally of a fire-proof nature, and process materials at all times, are in a non-combustible state and no unusual fire hazards are believed to exist.

One area which does present unusual potential hazards is the high temperature, hydrogen atmosphere furnaces used for sintering. These furnaces have been in operation on almost a continual basis for nearly two years and have not given any indication of malfunction which would create a fire or explosion. Entrance and exit of materials is accomplished by automated inter-locked controls which purge the entrance and exit chambers with nitrogen gas thereby preventing the mixture of outside air with the hydrogen atmosphere inside of the furnace. Frequent surveys are made for leakage of hydrogen gas or any malfunction.

Water?

Nearly all of the air exhausted from the building is exhausted through our process equipment ventilation system. This air is passed through absolute type filters before being released to the outside atmosphere. Should an incident occur within the building causing the release of radioactive material into the atmosphere within the building, this air would not represent a serious potential release to the outside environment.

It is highly improbable that any incident occurring within the confines of the Fuel Element Building would cause a significant release of radioactive atmosphere to the outside environment.

Regarding financial responsibility, the Coors Porcelain Company was incorporated in 1911 in Colorado and has continued in business up to the present time.

In the three fields of ceramic manufacturing;

Chemical and Scientific Ware,

Grinding (ceramic) Media, and

Industrial Alumina parts,

Coors is considered as the leader in this country.

Since this is a family owned corporation, and financial statements are not published, the rating given by Dun and Bradstreet is (1). This indicates net worth of \$125,000 to \$1,000,000. Annual sales approximate 10 million dollars. We refer you to the First National Banks of both Golden and Denver, Colorado for verifying this Company's integrity and ability to adequately finance the license requested.

Coors recently completed an A.E.C. contract which totaled approximately \$5,200,000. This also, we believe, will evidence our ability to handle and finance the license applied for.

Note: The following item numbers agree directly with pertinent item numbers of paragraph 70.24 of the subject Federal Regulations.

(a1) The radiation monitoring system is discussed in License Application Supplement No. 8.

(a2) Emergency Procedures are discussed in License Application Supplement No. 3 on page 20, 45 through 51, and in Supplement No. 4 on pages 45 through 51.

(b) Plans for compliance by Coors Porcelain Company with the requirements of this section (Reference: paragraph 70.24, "Additional Requirements") are considered to be in effect as of the date of this application.

A complete statement of these plans is deemed to be included as part of License Application Supplements Nos. 3, 4 and 8.

CERTIFICATE

(This item must be completed by applicant)

The applicant, and any official executing this certificate on behalf of the applicant named in Item 1, certify that this application is prepared in conformity with Title 10, Code of Federal Regulations, Part 40, and that all information contained herein, including any supplements attached hereto, is true and correct to the best of our knowledge and belief.

Dated November 14, 1963

COORS PORCELAIN COMPANY

BY: *Joseph Coors*

PRESIDENT

(Title)

UNITED STATES ATOMIC ENERGY COMMISSION

APPLICATION FOR SOURCE MATERIAL LICENSE

Pursuant to the regulations in Title 10, Code of Federal Regulations, Chapter 1, Part 40, application is hereby made for a license to receive, possess, use, transfer, deliver or import into the United States, source material for the activity or activities described.

1. (Check one) <input checked="" type="checkbox"/> (a) New license <input type="checkbox"/> (b) Amendment to License No. _____ <input type="checkbox"/> (c) Renewal of License No. _____ <input type="checkbox"/> (d) Previous License No. _____		2. NAME OF APPLICANT Coors Porcelain Company	
3. PRINCIPAL BUSINESS ADDRESS 600 Ninth Street Golden, Colorado		4. STATE THE ADDRESS(ES) AT WHICH SOURCE MATERIAL WILL BE POSSESSED OR USED Fuel Element Building (SS Station CPC) 7th and Ford St., Golden, Colorado	
5. BUSINESS OR OCCUPATION Industrial Ceramics		6. (a) IF APPLICANT IS AN INDIVIDUAL, STATE CITIZENSHIP Colorado Corporation	
7. DESCRIBE PURPOSE FOR WHICH SOURCE MATERIAL WILL BE USED See: Application for AEC License to Receive, Possess, Use and Transfer Special Nuclear Material, Paragraph (2)			
8. STATE THE TYPE OR TYPES, CHEMICAL FORM OR FORMS, AND QUANTITIES OF SOURCE MATERIAL YOU PROPOSE TO RECEIVE, POSSESS, USE, OR TRANSFER UNDER THE LICENSE			
(a) TYPE	(b) CHEMICAL FORM	(c) PHYSICAL FORM (Including % U or Th.)	(d) MAXIMUM AMOUNT AT ANY ONE TIME (in pounds)
NORMAL URANIUM	UNH	Crystals 55.3% U	660 lbs.
URANIUM DEPLETED IN THE U-235 ISOTOPE	U <sub>3</sub> O <sub>8</sub>	Powder 84.7% U	10,000 lbs.
	UO <sub>2</sub>	Powder 88.1% U	15,000 lbs.
THORIUM	ThO <sub>2</sub>	Powder 87.8% Th	13,000 lbs.
(e) MAXIMUM TOTAL QUANTITY OF SOURCE MATERIAL YOU WILL HAVE ON HAND AT ANY TIME (in pounds) 30,000 lbs.			
9. DESCRIBE THE CHEMICAL, PHYSICAL, METALLURGICAL, OR NUCLEAR PROCESS OR PROCESSES IN WHICH THE SOURCE MATERIAL WILL BE USED, INDICATING THE MAXIMUM AMOUNT OF SOURCE MATERIAL INVOLVED IN EACH PROCESS AT ANY ONE TIME, AND PROVIDING A THOROUGH EVALUATION OF THE POTENTIAL HAZARDS ASSOCIATED WITH EACH STEP OF THOSE OPERATIONS. See License Application Supplements Nos. 3 through 6.			
10. DESCRIBE THE MINIMUM TECHNICAL QUALIFICATIONS INCLUDING TRAINING AND EXPERIENCE THAT WILL BE REQUIRED OF APPLICANT'S SUPERVISORY PERSONNEL INCLUDING PERSON RESPONSIBLE FOR RADIATION SAFETY PROGRAM (OR OF APPLICANT IF APPLICANT IS AN INDIVIDUAL). Refer to Application for AEC License To Receive, Possess, Use and Transfer Special Nuclear Material, Paragraph (6). Also see License Application Supplement No. 13, Statement No. 1.			
11. DESCRIBE THE EQUIPMENT AND FACILITIES WHICH WILL BE USED TO PROTECT HEALTH AND MINIMIZE DANGER TO LIFE OR PROPERTY AND RELATE THE USE OF THE EQUIPMENT AND FACILITIES TO THE OPERATIONS LISTED IN ITEM 9; INCLUDE: (a) RADIATION DETECTION AND RELATED INSTRUMENTS (including film badges, dosimeters, counters, air-monitoring and other survey equipment as appropriate. The description of radiation detection instruments should include the type of radiation detected and the range(s) of each instrument.) Refer to Application for AEC License to Receive, Possess, Use and Transfer Special Nuclear Material, Paragraph (7).			
(b) METHOD, FREQUENCY, AND STANDARDS USED IN CALIBRATING INSTRUMENTS LISTED IN (a) ABOVE (for film badges, specify method of calibrating and processing, or name supplier.) Refer to License Application Supplement No. 4			



LICENSE APPLICATION SUPPLEMENT NO. 5  
November 14, 1963

Nuclear Safety Considerations

This material is furnished for reference use  
as a supplement to Coors Porcelain Company  
applications for AEC licenses.



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## NUCLEAR SAFETY CONSIDERATIONS

### I. Introduction

In the many operations associated with the development and production of fuel components and assemblies, the hazards of a criticality accident are some of the more important considerations. This guide summarizes the limitations and operating techniques which will be in effect for the prevention of this type of accident. It is being prepared primarily for the benefit of the nuclear safety control group; however, it may also assist management in the safe operation of development and production facilities.

The criteria are generally consistent with the nuclear safety standards of the Nuclear Safety Guide.<sup>(1)</sup> Data from other critical mass experiments may be used with caution.

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(1) Nuclear Safety Guide, Rev. 1, TID-7016, 1961 revised by the Subcommittee 8 of the American Standards Association Sectional Committee W6 and Project 8 of the American Nuclear Society Standards Committee.

## II. Philosophy of Nuclear Safety Control

### A. General

1. Nuclear Safety Control is basically concerned with the protection of Energy Products Division personnel, plant facilities, and the surrounding communities from the hazards of radiation and contamination associated with a criticality accident.
2. Maximum effort is directed to the prevention of criticality accidents. However, such accidents are possible and consequently the protection includes plans for handling an accident of this type.

### B. Responsibilities

Nuclear safety is a line responsibility; that is, each supervisor is responsible for the practices of his subordinate supervisions and reporting personnel as well as the mechanical aspects of each area.

1. Process supervision has the following responsibilities:
  - a. To be adequately acquainted with all aspects of operations which involve nuclear safety and to assure that all operations are carried out according to approved procedures.

- b. To request the advice of Nuclear Safety personnel concerning any unusual circumstance or condition which might affect nuclear safety.
  - c. To request the advice of Nuclear Safety personnel concerning contemplated changes in equipment or operating procedures.
2. Nuclear Safety personnel have the following responsibilities:
- a. From a nuclear safety point of view, to advise process supervision on the design, installation, alteration and operation of equipment and facilities for processing, storing and transporting U-235.
  - b. To assist in the investigation of non-routine incidents such as infractions and near-misses of nuclear safety rules, and to suggest possible methods of eliminating such incident in the future.
  - c. To assist supervision in the design and layout of instrumentation for the detection of radiation from a critical mass accident, should one occur.
  - d. To provide a program of nuclear safety lectures and demonstrations to those groups requesting such service and to new personnel.

C. Criteria

- Prim  
appr. each  
case*
1. Criteria for nuclear safety control are based on the results of criticality experimentation. In the absence of such experimentation, conservative reductions of existing criteria are made.
  2. Calculations in conjunction with experimental data may be used to bridge the gap between experimental points. Criteria are not based on calculations alone, but may be used as a back-up verification.
  3. Nuclear safe geometry is preferred for nuclear safety control over the other methods of control.
  4. Administrative control on a nuclear safe mass basis will be used for safe operation of non-geometrically safe equipment in most cases where nuclear safe geometry is impractical.
  5. Fixed neutron poisons (Pyrex glass, Cadmium foil, etc.) may be used as a primary means of control in some circumstances.
  6. An operation is considered safe if it requires the simultaneous failure of two independent safeguards for the establishment of an unsafe uranium configuration. Sabotage is not considered a factor in establishing criteria for a nuclearly safe operation.
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D. Emergency Planning

1. Radiation detection instruments with automatic alarms for the detection of any criticality are installed at intervals within the department where fissionable material is handled. For further description of this system see License Application Supplement No. 4, page 45.
2. A comprehensive plan of action is maintained in order to cope with a criticality accident. This plan is explained in detail in License Application Supplement No. 4, page 45.

III. Nuclear Safety Criteria

For U-235 Moderated with Hydrogenous Materials and for Unmoderated U-235

A. Basic Criteria

The criteria in Table I are recommended as being nuclearly safe for U-235 when moderated and reflected with light water.<sup>(1)</sup>

TABLE I

	<u>Recommended Nuclearly Safe for Solutions</u>
Mass-Kg: (H/U $\leq$ 2)	2.0
Mass-Kg: (H/U $>$ 2)	0.35
Diameter of Infinite Cylinder - inches:	5.0
Thickness of Infinite Slab - inches:	1.5
Solution Volume - liters	4.8

B. Handling Rules

The following handling rules are applicable for:

1. Non-moderated uranium ( $H/U-235 \leq 2$ ): *(not done)*
  - a. Individual batches of U-235 are  $\leq 2000$  g.
  - b. The minimum separation between batches, which is maintained by physical spacers, is 1 foot edge to edge.
  - c. Positive controls are in effect to prevent water and other moderating materials from being mixed with the fuel.
2. Moderated uranium ( $H/U-235 > 2$ ) or where No. 1. c. above does not apply:

- a. Individual batch sizes are  $\leq 350$  g.
- b. The limitation in No. 1. b. above is in effect.

C. In-Process Storage Rules

The following precautions for storage are nuclearly safe for non-moderated and moderated U-235 batches in planar arrays.

Although water flooding is not credible, the separation between batches is safe for flooded or unflooded conditions.



1. Individual containers are covered and essentially water tight.
2. Individual containers are in fixed positions while in storage.
3. Individual containers are physically separated by a minimum of 12 inches edge to edge.
4. Individual containers are on minimum center to center spacing of 16 inches.

GHB:br

LICENSE APPLICATION SUPPLEMENT NO. 6

A Typical Ceramic Production Process

This material is furnished for reference use  
as a supplement to Coors Porcelain Company  
applications for AEC licenses.

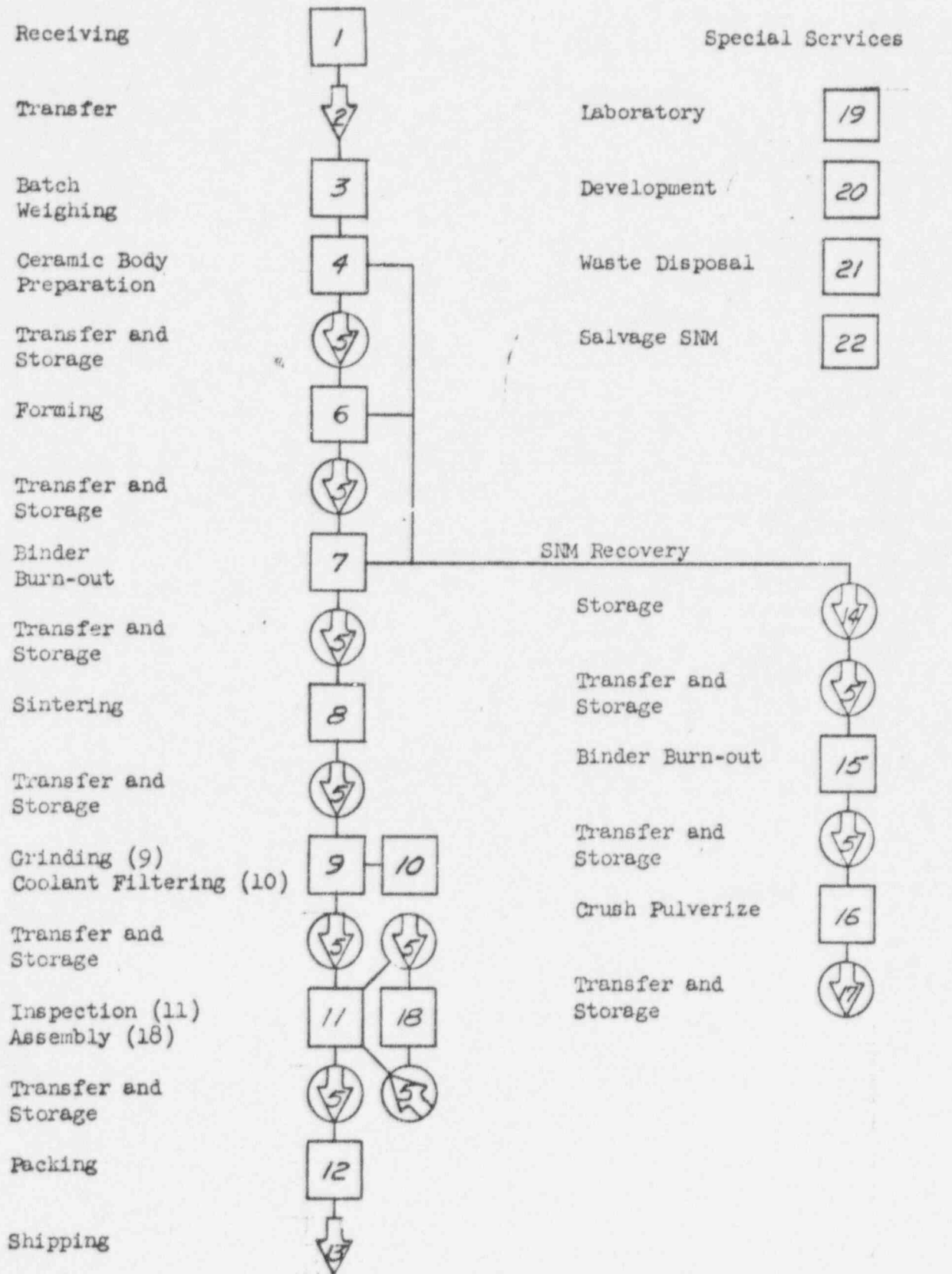


FIGURE 1 - TYPICAL PROCESS FLOW DIAGRAM

### Introduction

This facility has been operating under a more detailed Nuclear Safety Guide for the production of urania-beryllia fuel elements under subcontract to the University of California. The more detailed plan, as approved by AEC-SAN and UCLRL, is documented as CPC-68, classified Secret - Restricted Data. Copies of this document are available at AEC-SAN, UCLRL, and Coors Porcelain Company. Because of the security restrictions, it is not intended to license the classified equipment, which is used exclusively for our present subcontract work for LRL.

### Layout of Production Equipment

Coors Porcelain Company Engineering Drawing No. AE-4-581-1, Revision 5 (1) shows the first floor layout of production equipment. This level is above ground and flooding is not credible.

At the west end of the building is a section known as the Depressed Area. This area is below grade and could be flooded. Waste disposal equipment (See Paragraph 21 below) is located in this area.

Drawing No. AE-4-528-2, Revision 1 shows the second floor layout of production equipment and the laboratory equipment.

### Typical Process

The process flow diagram in Figure 1 depicts a typical ceramic production process to be performed in the Energy Products Division facility. This

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(1) Prints of applicable engineering drawings are included in License Application Supplement No. 1.

diagram is used for illustrative purposes and is not intended to represent the only capability of this facility.

The numbers on the flow diagram refer to the paragraph numbers in the following text in which the respective operations are described.

1. Receiving

The SNM is received from the commercial carrier at the dock area by a member of the accountability staff. The material in the shipping birdcages is either moved into vault storage or stored in nuclear safe protected arrays in the dock area. The size and shape of the array depends upon the chemical and physical forms of the SNM and on the number and size of the shipping birdcages.

The material is then taken to the sampling station where the material is weighed and a sample is withdrawn. The SNM is then returned to the vault to await transfer to the Production Department.

The sample is taken to the laboratory to check for uranium content, impurities, moderation, assay, etc.

2. Transfer

A the need for more SNM arises in the Production Department, a member of the accountability staff transfers the material (still in the shipping birdcage) to the Production Department.

Nuclear safety is assured by using the birdcage as a transport medium and by limiting the amount of material being transferred to that quantity which is in one birdcage.

### 3. Batch Weighing

The SNM is weighed into batch quantities. The maximum size batch which is independent of enrichment or moderation is 350 grams of U-235. For low enrichments and low well-controlled moderation, the batch size can be increased to a maximum of 2000 grams of U-235. This increase would be done in accord with criteria and curves in Figure 1, Figure 2, Figure 3, Figure 4, Figure 20, and Figure 21 in the Nuclear Safety Guide (1a).

Nuclear safety is controlled by:

- a. Placing the batch in a restricted use container.
- b. Identifying the SNM with a batch card.
- c. Moving the batch to an approved storage location.
- d. Limit of contained U-235.
- e. Geometry of process equipment.

In addition to the batch processing, process control samples are withdrawn from various stages of the operation which are limited in any collection of samples to the weights allowed for one batch. Personal conveyance inside the facility of up to 20% of a batch limit is allowed without further nuclear safety restriction.

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(1a) Nuclear Safety Guide, Revision 1, TID-7016, 1961 revised by the Subcommittee 8 of the American Standards Association Sectional Committee W6 and Project 8 of the American Nuclear Society Standards Committee.

4. Ceramic Body Preparation (2)

The SNM batch is mixed with binder, water, lubricant, additives, etc. in blenders, mixers, or roller mills. This mixing equipment, by design, is good for batch operation only. The batch size as measured above in Paragraph 3 is determined by the amount of moderation added at this process step.

Administrative control is used to insure that only one batch is at a mixing station at one time.

5. Transfer and Storage (3)

Hand carrying of batches is generally avoided. The batch in a proper container is wheeled in a transport cart to a storage rack designed for that container. The cart is designed to keep the batch 6 inches from the edge of the cart. The batch card remains with the batch to identify the quantity and type of material in the container.

Nuclear safety is enhanced by using a "safe" transport cart and properly identifying the contents of the batch with the batch card.

For batch size, see Paragraph 3 above.

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(2) For additional information on this step, see Photograph Number 22-5 in License Application Supplement No. 2.

(3) For photographs which help to illustrate these operations, see Photographs Numbers 22-3, 22-4, 22-6, 22-8, 22-13 and 22-14 in License Application Supplement No. 2.



5. Transfer and Storage continued

Storage racks are constructed to maintain minimum 12-inch edge to edge and 16-inch center to center spacings between batches. Physical barriers fill the spaces between the "pigeonholes." Guard rails are erected a minimum of 6-inches in front of pigeonholes.

Six inch spacing is used on the carts and on the storage rack guard rail so that 12-inch separation is maintained between batches on carts and in storage racks.

Piping is being considered as a mode of transport for SNM in a fluidized medium-air or liquid. All pipe line and pipe connections will be nuclear safe by geometry. This geometry includes pipe connections, interconnections, and SNM fluidized medium separators.

6. Forming (Extrusion)

Forming can be done by the extrusion method. Two large extruders are used for production and two additional small extruders are used for pre-extrusion testing.

The pre-extruders have bore sizes of not greater than 2-inches in diameter. These extruder stations are limited to one batch each.

The two production extruders have 4.8-inch diameter by 2-foot long bores. These are nuclear safe for more than one batch. The material is split into batch size or smaller quantities and the extruded parts are placed on saggers for Binder-Burn-Out (See Paragraph 7 below).

### Forming (Dry Press)

A mechanical press can be used to form parts from "dry" ceramic SNM. The ceramic material is described as being "dry" because of its appearance; however, the binder will usually be a hydrogen compound.

A glove box for loading and unloading the press tools will also be employed. (This box does not yet exist.) Two nuclear safety controls will be used for this semi-automatic process - batch control and safe geometry.

The parts as pressed will be loaded on saggars for firing as mentioned in Paragraphs 7 and 8 below. The height of the material on the saggars will be limited so that only a safe array can be formed in the furnaces.

### 7. Binder Burn-Out

A Hevi-Duty electric furnace is used to remove all binder products. The ceramic parts are placed on saggars after forming. The saggars enter a heated zone with a cross-sectional opening  $6\frac{1}{2}$ -inches by  $13\frac{1}{2}$ -inches. However, the current saggars can hold material in a  $1\frac{3}{4}$ -inch by 11-inch cross-sectional area. The saggars are butted together to form essentially a  $1\frac{3}{4}$  by 11-inch infinite array in the furnace. Different saggars could be used for different products. The height of the array for different enrichments or assays could also change.

Binder Burn-Out continued

Geometry is used to control nuclear safety. The furnace is an open air furnace which permits visual inspection for administrative control.

8. Sintering

The ceramic parts are sintered in electrically heated hydrogen atmosphere furnaces. The chamber is approximately 6-inches high by  $7\frac{1}{4}$ -inches wide. Saggars are butted together to form essentially an infinitely long array. The height of the ceramic material is controlled by administrative control to form a safe planar array. The height of the array is a function of the assay and moderation of the SNM.

9. Grinding (4)

Each grinding station consists of a grinder, a work table, and a coolant cart.

Actual fuel grinding operations are conducted inside of dry boxes. The grinding coolant returns to the coolant cart by gravity.

Each work table is a two-level table with a one foot thick physical barrier between levels. A well is located in the centers of each of the two levels so that a batch cannot come within one foot of the edge of the table or each other.

---

(4) Also see Photograph Number 22-7 in License Application Supplement No. 2.

The coolant carts are approximately 13 gallon capacity, three inch thick annulli. The 14-inch diameter inner cylinder is cadmium lined and water filled.

The well in the top level of the work table and the grinder is considered a station for one batch. A second batch may be in the well on the lower level of the work table.

10. Coolant Filtering (5)

The coolant carts are nuclear safe cylindrical annulli. The outside of the cylinder is 12-inches from the edge of the cart; the 14-inch diameter inside cylinder is cadmium lined and water filled. The annulus is 3-inches thick and has a 13 gallon capacity.

The coolant and grinding sludge is dropped through the floor in the grinding department to a 21-inch diameter by 3-inch high filter pan. The filtrate is collected in pyrex pipe filled holding tanks until the filtrate is analyzed. The filtrate is dumped to the sewer if Health Physics requirements are met. If the filtrate cannot be dumped to the sewer, it is refiltered until requirements are met.

The sludge is calcined in batch quantities or less as described in Paragraph 15 below. The sludge is disposed in the manner described in Paragraph 22 below.

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(5) Also see Photograph Number 22-9 in License Application Supplement No. 2.

11. Inspection

The inspection department has cleaning, dimensional check, zygo check, X-ray check, and gamma scanning equipment. Each individual piece of inspection equipment is designated as a station. Only one batch is permitted at a station. Where more than one station occupies the same table or work bench, a one foot thick barrier separates the work stations.

Administrative control is used to limit the station to one batch. See Paragraph 3 above for batch size.

12. Packing

The Special Nuclear Material products are packaged in shipping containers which are water tight and nuclearly safe when water reflected. Bird cages are used to maintain a minimum of twelve inches, edge to edge, between shipping containers. Design of shipping containers will be approved by Bureau of Explosives prior to usage.

13. Transfer

The birdcages are stored in the dock area for transfer to a commercial carrier, generally an exclusive-use vehicle.

14. Special Nuclear Material Recovery Storage

In each process area, some Special Nuclear Material from each batch, which can be recovered and reprocessed, is scrapped. This material is composited into a recovery batch under carefully controlled conditions. Chemical analysis, total weight, and/or volume are used to determine the composite batch limit.

15. Special Nuclear Material Recovery Binder Burn-Out

Batches of Special Nuclear Material for recovery are placed in 9-inch pans for removal of all binder products. The batch material is limited to an approximate depth of 2-inches, which is necessary for good binder burn-out. These pans are placed edge to edge and run through the furnace described in Paragraph 7 above. The pans in effect form a 2-inch by 9-inch by infinite array of Special Nuclear Material.

A small batch type furnace is also available for binder burn-out.

16. Special Nuclear Material Recovery Crush and Pulverize

This operation is a four step operation in a recovery "silo" dry box. The Special Nuclear Material to be recovered is gravity fed through a jaw crusher, down through a pulverizer, down through a dry ferro filter, and into a chute for bag-out. This is a batch type operation



with only one batch allowed in the dry box which houses all of this equipment. Each batch is weighed in and out of the silo to prevent any unknown buildup of material in the silo.

17. Special Nuclear Material Recovery Transfer and Storage

The batch is ready for operations described in Paragraph 3 above. See Paragraph 5 for Transfer and Storage procedures.

18. Assembly

Assembly of ceramic parts will be with batch quantities or less Special Nuclear Material unless the material is placed in a geometrically safe shape. The assembly will be handled in a birdcage except for certain inspection operations which prohibit the use of the birdcage.

19. Laboratory

The analytical equipment available includes two Arc-Spark Emission Spectrograph (3 meter and 1-1/2 meter), a 50KV X-ray Fluorescent Emission Spectrograph, and a wet chemistry laboratory.

This equipment is sufficient for purity analysis, assay analysis, and some isotope analysis ( $\pm 1\%$  between 5% and 95% U-235 enrichment).

The nuclear safety limits for the laboratory are one batch equivalent in the Arc-Spark area, one batch equivalent in the X-ray area,



and one batch equivalent in the wet chemistry area (three batch equivalents total). A batch equivalent is defined as the number of batch samples which, if combined, would be equal to one batch. See Paragraph 3 for batch size.

20. Development

One end of the wet chemistry laboratory has been designated as the process development area.

One batch equivalent of material is allowed in this area. See Paragraph 3 for batch size.

21. Waste Disposal<sup>(6)</sup>

Contaminated liquids ( 20 ppm uranium) are collected in two 1000-gallon tanks located in the Depressed Area. When a tank is full of liquid, it is flocculated, filtered, sampled, and dumped to the sewer if permitted by Health Physics regulations. If dumping is not permitted, it is again flocculated, filtered, etc., until it can be dumped to the sewer. The sludge is collected for burial in 30-gallon drums.

Contaminated solids (-20 ppm uranium) are collected in 55-gallon drums for burial.

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(6) Also see Photograph Number 1-12 in License Application Supplement No. 2.

22. Salvage Special Nuclear Material

All Special Nuclear Material which can be salvaged is stored in 5-inch cylinders in birdcages. This material includes laboratory samples, grinding sludge and sintered scrap. A maximum of 1 Kg of U-235 will be collected in any cylinder.

The 5-inch cylinders in birdcages (55-gallon drums) will be stored in one of the following arrays prior to shipment for recovery:

- a. A group of 50 in any pattern. Each group will be separated by 12-feet from other Special Nuclear Material.
- b. A group 2 wide, one high and infinitely long. Each group will be separated 12-feet from other Special Nuclear Material.

LICENSE APPLICATION SUPPLEMENT NO. 7  
November 14, 1963

Statement of Combined Operation

Approximately 110 Kg of uranium enriched in U-235 is accounted for at CPC under subcontract to LRL. The nuclear safety plan for this material is documented in the CPC Nuclear Safety Guide, CPC-68. It has been approved by AEC-SAN and the LRL Nuclear Safety Committee. This material would at no time be mixed with any licensed material which would come into the CPC facility. This non-mixing includes all production, inspection, and storage areas.

CPC - Coors Porcelain Company  
LRL - Lawrence Radiation Laboratory

LICENSE APPLICATION SUPPLEMENT NO. 8  
November 14, 1963

Radiation Monitoring System

A five channel remote area radiation monitor monitoring system is currently in operation at the Energy Products Division facility. This system was installed and approved as part of Coors Porcelain Company's subcontract work for the Lawrence Radiation Laboratory.

At this time, the system is being re-evaluated in the light of the requirements set forth in paragraph 70.24 of CFR 70. In consideration of the many new pieces of equipment and re-arrangement of the production area, which may be needed in conjunction with activities carried out under this license, it is necessary to re-consider the radiation sensitivity of each detector at its present location.

Rather than delay the submission of license applications while these calculations are made, it is intended to submit the applications without the detailed description of our Gamma Monitoring System while the above calculations are completed.

*E. J. [Signature]*

LICENSE APPLICATION SUPPLEMENT NO. 13  
November 14, 1963

Miscellaneous Supporting Statements

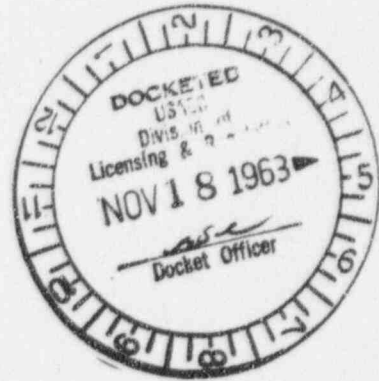
1. In lieu of a description of minimum technical qualifications, the actual backgrounds of responsible supervisory personnel are stated.
2. Discussion of the quantity of radioactive waste that will be generated is limited by the intent to license the capability of the Energy Products Division facility, as explained in Application for AEC License to Receive, Possess, Use and Transfer Special Nuclear Material, Paragraph (2).
3. See License Application Supplement No. 6, Figure 1 and Paragraph No. 21.

DOCKET NO. 70-814-  
40-7096

L&R File CORR

TRANS. w/11-14-63 etc.

LICENSE APPLICATION SUPPLEMENT NO. 4  
November 14, 1963



Health and Safety Procedures

This material is furnished for reference use  
as a supplement to Coors Porcelain Company  
applications for AEC licenses.



ALZ

7666

#### 4.2.1.3

#### HEALTH AND SAFETY PROCESS

##### 4.2.1.3.1

##### AIR SAMPLING

##### General Air Samples

The Giraffe portable air samplers (Gast Pump Model 0521) are located with respect to the operation, air currents, and personnel and can be moved to any location. Air samples are collected on 5.4 cm diameter Millipore paper backed by a 5.4 cm diameter Whatman #41 filter paper by placing the plastic sample head, containing the Millipore and Whatman #41 filter paper, into the connector on the neck of the pump. An air sample is collected for 24 hours at the breathing level of the workmen. Before turning the pump on, an elapsed time and clock time reading is taken and recorded on the air sample record. The air sample record card is attached to the pump.

##### Data Gathering

At the completion of the sampling period, the pump is turned off and the sample number, location, date, time on, time off and personnel present are recorded on the air sample record card.

Total time is calculated by subtracting the elapsed time readings giving the time to the nearest tenth of an hour. Multiply by sixty to obtain time in minutes. This is converted to minutes and entered on the total time line.

To obtain the volume in  $M^3$ , multiply the flow rate (normally 2 cfm) by 0.0283 and the result by the total time in minutes.

##### Duct Samples

There are eight permanent duct air sampling stations located throughout the building. Main exhaust duct sample is located behind the Mechanical Technician's shop in the M & E room; pump is between fan motor and duct-work. Fuel tower exhaust duct is located at the top of the stairs on the second level of the Fuel Tower. Laboratory Hood numbers 1, 2, 3 and 4 are located above the laboratory area in the first fan complex. Laboratory glove box numbers 5 and 6 are located above the laboratory area in second fan complex.



Gast rotary air pumps (Model 0521) are used and samples collected on 5.4 diameter Millipore paper backed by a 5.4 cm diameter Whatman #41 filter paper.

The two filter papers are placed in the double air sample head so that the Millipore paper is facing the duct. The air sample is collected for seven days and is usually changed every Friday morning about 10:00 a.m.

Before turning the Gast pump on, an elapsed time and clock time reading is taken and recorded on the air sample record card which is retained by the Technician taking the sample. At the completion of the sampling period, the sample number, location, remarks, date, time on, and time off are recorded on the sample record card. Calculate the total time by subtracting the elapsed time meter readings. This gives the times in tenths of minutes. Multiply by sixty to obtain the time in minutes. Enter this figure on the total time line. The volume, in  $M^3$  is obtained by multiplying the flow rate (normally 2 cfm) by 0.0283 and the result by the total time in minutes.

#### High Volume Samples - In-Plant

The Staplex Hi-volume air sampler (Model TFA41) used for sampling large volumes of air employs a turbine type blower and permits the use of 4-inch diameter filter papers. The filter paper must be placed evenly over the 4-inch opening and secured with the aluminum filter holder. The removable cross-grid is then inserted behind the filter paper and the sampler turned on. The sampler may be located wherever a sample is required. The sample number, location, date, time on, time off, and personnel present are recorded on the sample record card.

The flow rate is measured by means of an indirect orifice meter located on the back of the Staplex Hi-volume sampler which indicates the pressure drop across an orifice in the housing and is calibrated against a standard orifice on the intake. Total volume, in  $M^3$  is found by multiplying the average flow rate, in cfm by 0.0283 and the result by total time in minutes.

#### Permanent Off-Site Sampling Stations

The sampling equipment for the three off-site stations consists of Gelman Nuclear Air Samplers #26001, with 5.4 cm filter holders, elapsed time meter and flow rate meter. The original Gelman Nuclear Air Sampler pumps have been replaced by Gast Rotary Air Pumps model 0521.

The three permanent off-site sampling stations are located from 100 meters to 1600 meters from the plant. Number one sampler is located on the north east corner of the Porcelain Plant roof. Number two sampler is located on the west outside wall of the Brewery Garage. Number three sampler is located on the south east corner of the Sewage Plant roof. Continuous off-site air samples from the permanent stations are collected weekly on a 5.4 cm diameter Millipore paper backed by a 5.4 cm diameter Whatman #41.

Prior to departing for the sites, the following materials must be assembled: Three air sample record cards, three air sample heads with filter papers inserted in proper order, three glassine envelopes, a dark color marking pen, 1 quart 10 SAE motor oil, (non-detergent) and the site survey books including combination to off-site locks.

At each site, the following operations must be performed: Change the air sample heads, check motor oil level in oil reservoir. To add oil, run pump while filling and leave cap off the oil reservoir for a few minutes. Check Norgren trap located behind Gast pump in housing unit. If oil has collected in the trap, drain and keep a written record in the site-survey book. Lock housing unit with combination lock. Record the sample number, location, date, time on, time off, elapsed time meter readings, flow rate meter readings weather, and approximate temperature on the air sample card and in the site-survey log book. Calculate volume of air sampled by subtracting the flow rate meter readings at start and finish of sampling period. The value in cubic feet is converted to cubic meters by multiplying by 0.0283.

#### High Volume Samples - Off-Site

The following equipment and supplies are required for collecting high volume off-site samples:

- Hi-volume air sampler in wooden case.
- Gasoline powered electric generator.
- Gas can and gasoline.
- Whatman #41 filter paper.
- Glassine envelopes.

The following steps are carried out at each site:

- Place one piece of filter paper in sample head.
- Start generator and sampler.

Adjust generator power level to give a flow of about 20 cfm.  
Run sampler sixty minutes.  
Record weather conditions.  
Record start/stop time and sampler flow volume in log book.  
Place completed sample in glassine envelope for submission to  
Counting Technician.

#### 4.2.1.3.2

#### RADIATION DETECTION

##### Alpha Monitoring

The Nuclear Chicago P-2112 portable alpha particle counter is used with an attached air proportional alpha probe. As Alpha particles have a very short traveling distance in air, it is necessary to hold the sensitive area of the probe as close as possible (within 1/8 inch) to the surface being monitored.

The process stations where high alpha contamination is most likely to occur should be monitored at least once per shift. These areas include:

- P-10 Primary bottle weigh station
- P-20 Primary bottle supply station
- P-40 Fuel weigh out
- All other stations where fuel is processed

At least twice per shift, the counter should be checked for calibration by removing the calibration standard from the clips on the end of the case and holding it on the center of the face of the probe. After allowing sufficient time for the needle to stabilize, the needle should read the count written on the back of the standard. If not, the instrument is calibrated by turning the "calibrate" screw very slowly until the meter reads correctly.

When necessary, the Probe window may be replaced in the following manner:

Stretch a piece of aluminized mylar smoothly over a felt faced block of wood about 7" x 10". Tape the mylar to the block, clean the brass window frame and put a light coat of rubber cement on one side. Lay the cemented side of the frame on the stretched mylar very carefully. Allow time for the cement to dry.

Take a sharp knife and cut, very carefully, around the outside of the frame. The window is ready for use and the probe may be re-assembled.

The Nuclear Chicago P-2112 counter is used primarily to indicate that a hazardous contamination condition exists and vigorous clean-up is required. The meter reading is usually relayed verbally to the operator concerned.

The actual count observed at a station is not recorded unless unusually high. However, the record of having conducted a survey is reported on the Nuclear Safety Monitoring Report form for that shift.

#### Beta-Gamma Surveys

Nuclear Measurements Corp. GS-3 is used to monitor:

Sludge buildup in the SS waste tanks.

Sludge buildup in the tank truck.

U-235 indication in pure BeO storage places.

The Victoreen AGB-50B-SR is intended primarily as a re-entry survey instrument in the event of a nuclear excursion. Neither the NMC GS-3 or the Victoreen AGB-50B-SR are used for specific data gathering but as indicators of a need for more accurate investigation. It is expected that the results from these surveys be negative, therefore, they are reported only on the Nuclear Safety Monitoring Report form as having been conducted.

#### 4.2.1.3.3

#### AREA SURVEYING

#### Contamination Surveys

A daily survey should be made in and around all stations processing fueled material. An alpha survey with a portable alpha survey instrument and/or a smear survey should be made in addition to the routine housekeeping smear survey. All dry box gloves, the work bench tops, machine controls, floors, and other areas of suspected contamination should be monitored.



Routine housekeeping smear surveys should be counted for alpha activity before being submitted to the laboratory for beryllium analysis.

Contamination should be reported to the area supervisor immediately and a written record of the survey made turned into the H.P. office. A contaminated incident (accident) report should be filled out when necessary. The contaminated area should be checked after decontamination to assure that proper clean-up was completed.

### Nuclear Safety Surveying

At least once per shift, the following nuclear safety surveys should be made:

- Check all production stations to see that no limits are being exceeded.

- Check the uranium inventory in the laboratory and development area to assure that the amount of fuel present is less than the area limits.

- Check all storage racks for proper material storage.

- Inspect all coolant carts at the beginning of the shift to assure that there is less than the allowable amount of sludge in them. Initial the coolant log sheet only if you are sure that the limit will not be exceeded during your shift.

- Check the ultrasonic water, 1000 gallon waste tanks, zygl solutions, degreaser and tank truck with the Beta-Gamma counter. Report any readings above background.

- Observe that personnel do not violate nuclear safety rules as posted by sign limits or as stated in CPC-68. Stop violations before they start. If need be, fill out a nuclear safety infraction report.

### Industrial Safety Surveying

Monitor all areas to assure proper use of safety equipment and the wearing of proper safety clothing such as glasses, face shields, etc.

Make certain that all walk ways and exits are kept clear in the event that they must be used for an emergency evacuation.

Make weekly surveys of the H<sub>2</sub> furnaces for H<sub>2</sub> leaks.

Make sure that there are sufficient respirators in all areas.

#### Record Keeping and Reporting

Contaminated incident reports and nuclear safety infraction reports are to be completed and sent to supervision.

Routine smears, water, and soil samples are to be sent to the Counting Technician with a Chemistry Laboratory Request for Analysis.

#### 4.2.1.3.4

#### RADIOMETRIC ANALYSIS

##### Alpha Air Samples

A SAC-2 Eberline instrument with a PC6-1 pulse counter is used for this analysis.

At the beginning of each day a geometry and background determination must be made. The pre-determined source is placed in the counting chamber, and the timer is set for ten minutes. To obtain the percentage of geometry (on the SAC-2, it should be between 39.5% and 40.5%) the total count is divided by the time, and the resultant then divided by the known number of disintegrations of the source. To raise the geometry, the bottom of the chamber is raised by rotating it counter-clockwise. To lower the geometry, the bottom is rotated clockwise.

To determine the background, a clean filter paper is placed in the chamber, and the timer set for ten minutes. The total count is divided by the time counted to get the background. If the background exceeds 0.9 cpm, the chamber is washed with water or alcohol until the count is down to an acceptable level.

The air sample to be counted must be handled very carefully with forceps to avoid smudging. Care should be taken that the paper is below the level of the chamber so there is no chance of it catching on the edge when the drawer is closed. After the sample has been counted, it is placed in a glassine envelope and attached to the Air Sample Record sheet.

Routine air samples are held for a 24 hour period before counting, and are counted once for a time of ten minutes. Off-site samples are held for a 24 hour period and are counted for 20 minutes. After a minimum 4 hour interval, preferably close to 24 hours, the samples are counted a second time for 20 minutes.

To calculate the routine samples which have been counted only once, the resultant cpm is entered as cpm (LL) on the Air Sample Record form. This figure is then divided by the geometry (0.40) to yield disintegrations per minute. This figure is then divided by the volume in cubic meters as obtained from the record form. The resulting value is entered on the form as dpm/M<sup>3</sup>, the dpm/M<sup>3</sup> are divided by 220, the MPC, and the resulting figure is multiplied by 100 to obtain percent MPC.

To calculate samples which have been counted two times, the Koval formula for radioactive decay correction is applied. This formula is stated as:

$$\text{cpm(LL)} = \frac{C_2 - C_1 K}{1 - K}$$

where cpm(LL) are the counts per minute due to long lived isotopes,  
C<sub>2</sub> is the value in cpm for the second count  
C<sub>1</sub> is the value in cpm for the first count  
K is a decay constant dependent on the time interval between counts and is determined from the following graph:

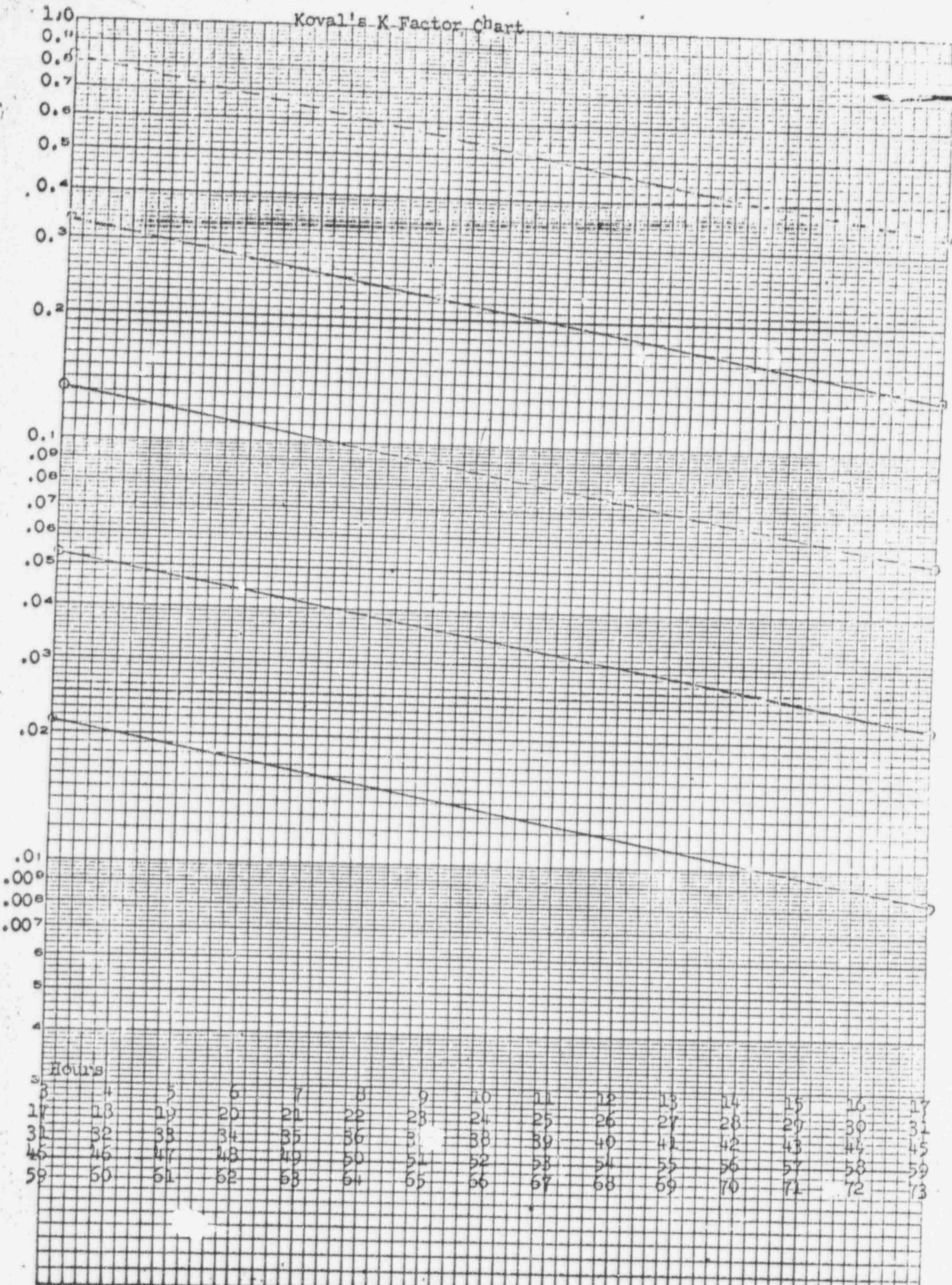
After the value for cpm(LL) has been obtained, it is entered on the Air Sample Record form. This figure is then divided by the geometry of the counter (0.40), to yield disintegrations per minute which is then divided by the volume in cubic meters. This value is entered in the form as dpm/M<sup>3</sup>.



# Koval's K-Factor Chart

EUGENE DIETZGEN CO.  
MADE IN U.S.A.

RU. 350W L310 DIETZGEN GRAPH PAPER  
SEMI-LOGARITHMIC  
3 CYCLES X 10 DIVISIONS PER INCH



To obtain an answer in terms of percentage of Maximum Permissible Concentration for inplant samples counted in this manner, divide the dpm/M<sup>3</sup> value by 220, the MPC, and multiply the result by 100 to obtain %MPC.

To obtain an answer in terms of percentage of allowable concentrations for ducts and offsite locations, the dpm/M<sup>3</sup> value is divided by  $2.2 \times 10^{-12}$  which yields the concentration in microcuries per cubic centimeter. This value is entered in the form in parentheses on the same line as the dpm/M<sup>3</sup>. The uc/cc value is then divided by the maximum allowable concentration of  $4 \times 10^{-12}$  uc/cc, the result multiplied by 100 and the resultant value entered as %MPC.

After alpha determination, the sample is sent to the laboratory for beryllium determination and the carbon copy of the Air Sample Record is retained in the laboratory. The original record is returned to Health Physics and is kept on file.

All in-plant, duct, and off-site samples are reported on a weekly basis to Fuel Element Supervision, CPC Engineering, and CPC Research.

#### Alpha Smears

The same counting equipment and methods for determining geometry and background are used as described in the preceding section.

Whatman #41, 2.8 cm paper is used for smears and must be handled very carefully to avoid rubbing off any contamination that may be present. A small paper booklet rather than a glassine envelope is used to hold the smears.

The smear paper is placed very carefully in the center of the chamber, making sure the contaminated side is up and it is below the level of the chamber so that the drawer will close without catching the smear paper. All smears are counted for alpha determination immediately for at least 30 seconds to obtain CPM, which is multiplied by 2.5 to obtain DPM.

A complete record is kept on all smears. A Request for Analysis form is completed describing the origin of the smear and the type of analysis desired. If alpha only is requested, the person submitting the smear is notified immediately of any contamination present.

**AIR SAMPLE RECORD**

SAMPLE NO _____	DATE _____
LOCATION _____	TIME ON _____
_____	TIME OFF _____
REMARKS _____	TOTAL TIME _____
_____	FLOW RATE _____ cfm
_____	VOLUME _____ M <sup>3</sup>

**ALPHA DETERMINATION**

	FIRST COUNT	SECOND COUNT
DATE		
TIME		
GEOMETRY		
TOTAL COUNT		
COUNTING TIME		
GROSS CPM		
BACKGROUND		
NET CPM		
TECHNICIAN		

**BERYLLIUM DETERMINATION**

DATE _____
LAB IDENTIFICATION _____
MICROGRAMS Be _____
TECHNICIAN _____

**CONCENTRATIONS**

ALPHA	BERYLLIUM
CPM (LL) _____	MICROGRAMS/M <sup>3</sup> _____
CPM/M <sup>3</sup> _____	
%MPC _____	%MPC _____



If a beryllium analysis is requested, the smear is returned to its booklet, attached to the Request for Analysis form and submitted to the Laboratory. When the Laboratory results are received, a report is then made to the person submitting the smear.

#### Alpha Water

The same counting equipment and methods for determining geometry and background are used as described in the preceding section.

When a water sample is submitted for analysis, a 1 ml sample is taken using a pipette, placed in a 1" planchet, and set under the heat lamp to evaporate. The planchet is placed in the counting chamber, with a clean filter paper beneath it to eliminate any chamber contamination, and counted for ten minutes. The total count is divided by the time, the background is subtracted and the result is Net CPM. This is then divided by the geometry (40%) and the result is DPM/ml. DPM/ml is divided by  $2.2 \times 10^{-6}$  to obtain the uc/ml.

All water samples, laundry rinse water and waste disposal water are entered in the waste water log book. The alpha results are reported on a Request for Analysis form and returned to the person submitting the sample.

#### Gamma Water

The counting system used for gamma analysis is a Gamma Spectrometer, consisting of a RIDL-49-55 Scaler, a Victoreen-695 Single Channel Differential Analyzer, and a Linear Pulse Amplifier-LE-1023.

At the beginning of each day a background determination must be made. A standardized vial of de-ionized water is placed in the counting chamber, and counted for ten minutes. This total count is divided by the time to obtain the background. A standard solution of known value is then placed in the chamber and counted for ten minutes to determine the accuracy of the machine. All liquids, filtrates, zyglo solutions, ultrasonic, coolant solutions are submitted for gamma analysis in a standard 60 ml polyethylene mixing vial.

Samples are normally counted for ten minutes and the total count divided by the time and the background subtracted. The Net CPM are compared to a graph made up from known standards and the proper PPM figure determined. A second procedure, to be followed when a more accurate determination is desired, or when counting anything other than a liquid, is described on the attached form.

All samples, with the exception of waste water, are entered in the Gamma Log Book. The person submitting the sample is notified of the results as soon as they are available.

#### 4.2.1.3.5

#### SITE SURVEY

##### Water Samples

One liter water samples will be collected on a weekly basis and submitted to the laboratory for a beryllium and uranium analysis. Sample locations are shown on the accompanying map. Each week the sample is taken at a point nearest the air sample location for the week. The bottle is dated and marked with the sample location. Beryllium analysis is requested in terms of ug/liter.

##### Soil Samples

Seventy five cc soil samples are collected weekly at the location of the water samples and submitted to the laboratory in 100 cc plastic cold cream jars for beryllium and uranium analysis. Beryllium analysis is requested in terms of ug/gram. The jars are dated and marked with the sample location. Sample locations are indicated on the accompanying map.

##### Air Samples

Samples are collected from the following three permanent stations weekly:

Northeast corner of Porcelain Plant roof.

West outside wall of the Brewery Garage.

Southeast corner of the Sewage Plant roof.

Standards and unknown must be same size, shape, and concentration.  
Obtain net cpm (2,4) for standards above (1) and below (3) net cpm for sample (8).

Obtain difference between concentrations (5) and net cpm (6) for standards.

Divide net cpm difference (6) by concentration difference (5) to determine ratio (7).

Subtract low standard cpm (4) from sample cpm (8).

Divide answer (9) by ratio (7) to give result (10).

Add low standard concentration (3) to result (10) to obtain Sample Concentration (11).

	conc.	units	net cpm	
High Standard (1)	<input type="text"/>	<input type="text"/>	<input type="text"/>	(2)

Low standard (3)	<input type="text"/>	<input type="text"/>	<input type="text"/>	(4)
------------------	----------------------	----------------------	----------------------	-----

(1) - (3) = (5)	<input type="text"/>	<input type="text"/>	<input type="text"/>	(6) = (2) - (4)
-----------------	----------------------	----------------------	----------------------	-----------------

(6)	<input type="text"/>	$\div$	<input type="text"/>	(7)
(5)	<input type="text"/>			

Sample net cpm(8)	<input type="text"/>
-------------------	----------------------

-(4)	<input type="text"/>
------	----------------------

(9)	<input type="text"/>	=	<input type="text"/>	(10)
-----	----------------------	---	----------------------	------

(7)	<input type="text"/>	+	<input type="text"/>	(3)
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High volume air samples are collected weekly at three of the pre-determined locations off-site. The locations are shown on the accompanying map. The locations are numbered from 1 - 23 and are described by their UTM grid locations. Samples are collected at locations in numerical sequence, requiring approximately eight weeks to complete the sequence of sampling locations.

Each Hi-Vol sample is collected for a period of one hour at a flow rate of approximately 20 cfm. The sample is submitted for alpha analysis and beryllium determination.

#### Grid System

The Universal Transverse Mercator grid system has been selected as the most clear and precise method of locating soil, water and air sample points. This system, based on 1000 meter grids is shown in the following maps.

A reference coordinate of 99-79 was chosen and the grids continue from there north and east in 1000 meter increments. Sample points for the most part were located radially at 100, 500, 1000 and 2000 meters from the plant.

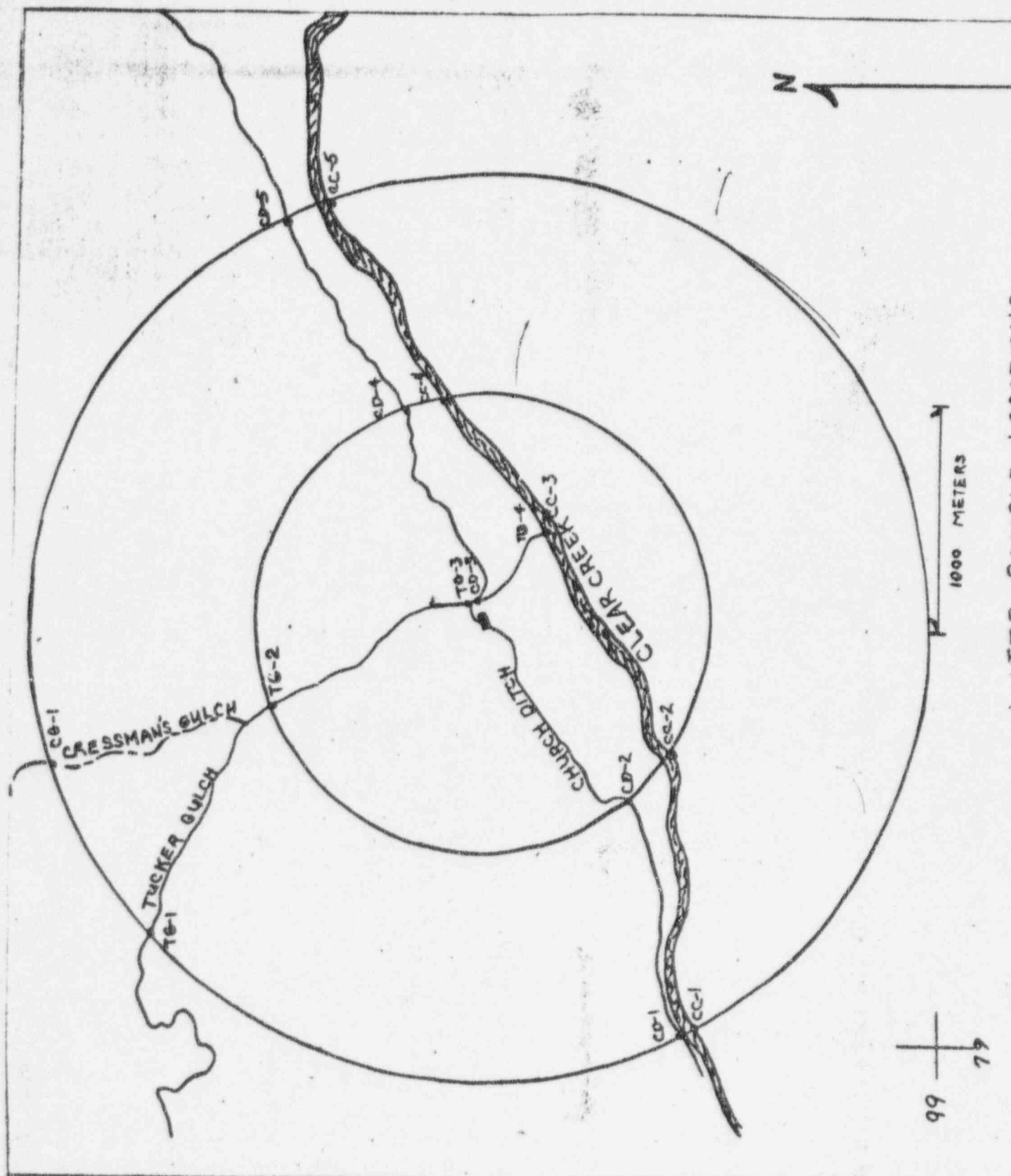
Each sample point was given a number and assigned geographical coordinates. These coordinates are based on the UTM projection.

The coordinates were scaled from the U. S. Geologic Survey Maps of the area and are reported to the nearest 10 meters east and north of the grid corner. To properly locate points using this grid system, it is necessary to have a USGS map of this area with the UTM 1000 meter grid system superimposed. Referenced coordinates can then be scaled from the 1000 meter grid lines and the point identified by its location relative to surrounding landmarks.

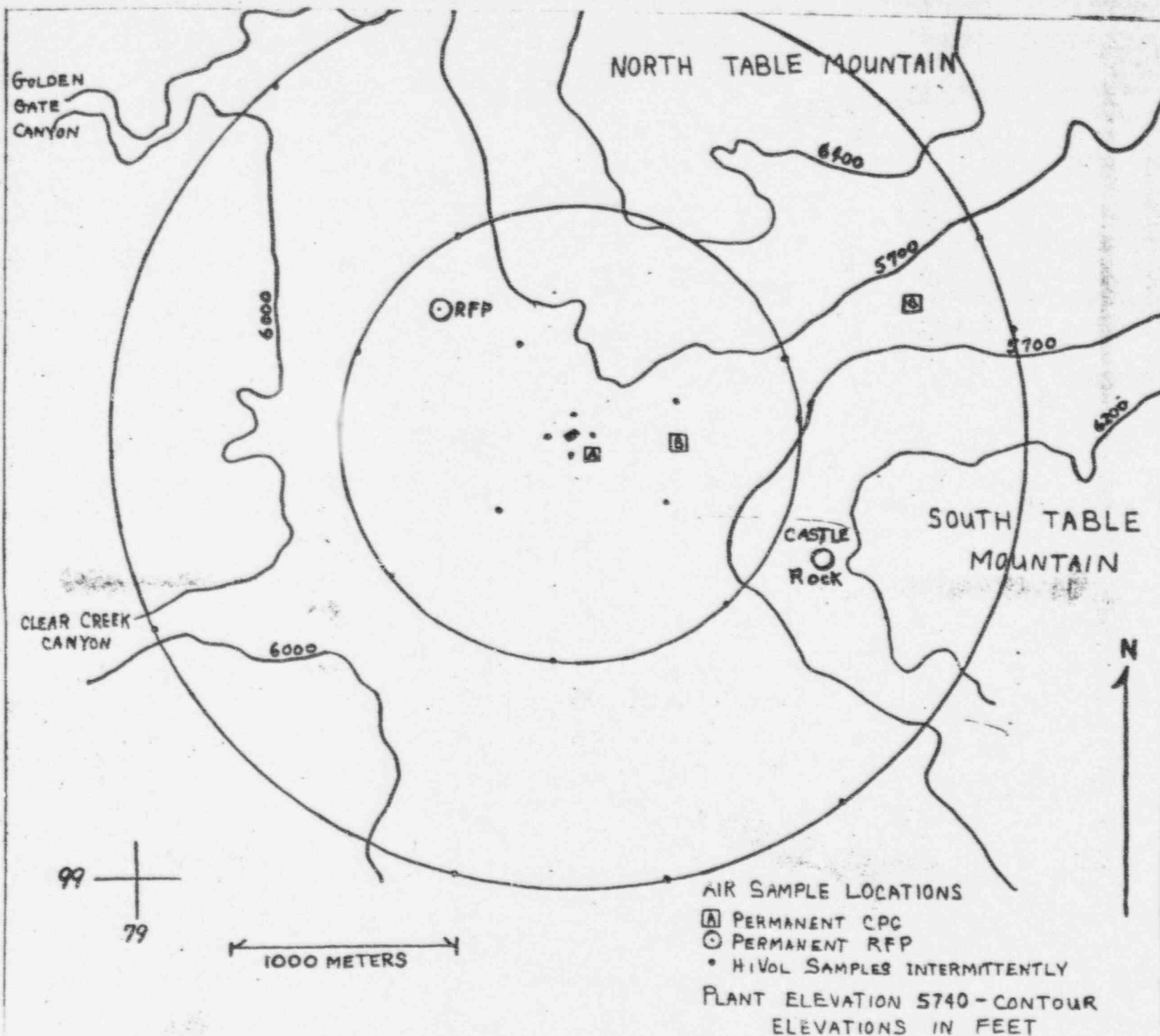
For example, sample point 4, coordinates 8267, 0185 is located 670 meters east and 850 meters north of the corner of grid square 82-01.

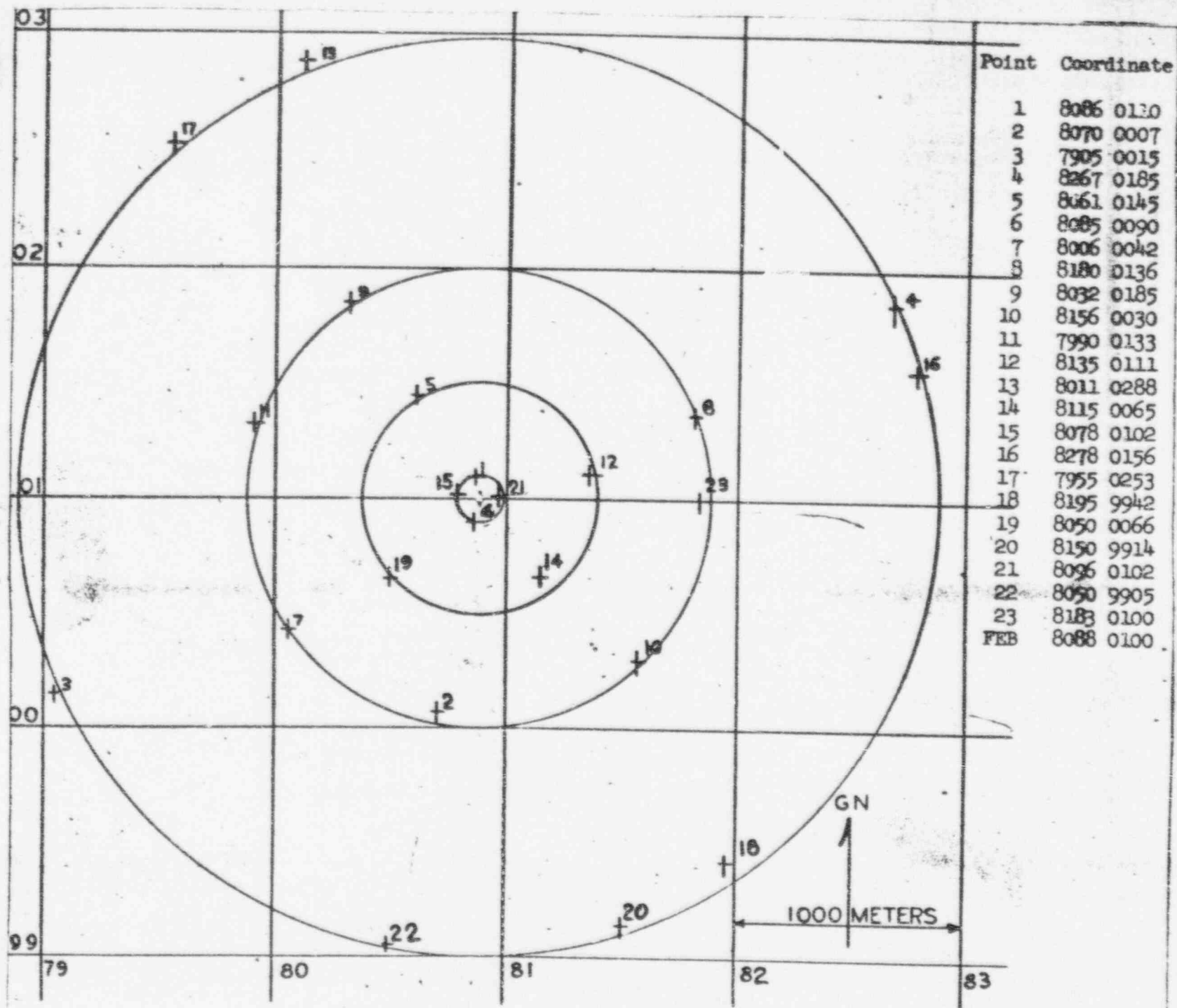
This system insures relocation of the sample point.





WATER SAMPLE LOCATIONS





#### 4.2.1.3.6

#### RESPIRATORY PROTECTION

##### Half Mask Respirators

The Willson respirator, model 809 is equipped with two model R520 filters and is used when airborne contamination is suspected or known to exist in a particular area. This respirator provides effective filtration of toxic aerosols and extremely fine particles, including radioactive dust, and BeO particulates.

When required, the half mask respirator is used in the following manner:

Check to be sure the mask contains 2 filter cartridges securely in place.

Place the mask to your face, molding the rubber nose piece to the contour of the face.

Secure head straps.

Place palms over the two filter air inlets securely, and attempt to breathe. If mask is correctly in place it will not be possible to inhale.

After use, the respirators must be collected, washed, disinfected, inspected and reassembled for use. They are to be placed in a sealed paper bag and distributed in strategic locations.

##### Self Contained Breathing Apparatus

The Scott Air-Pak (Model 6000-A2 MSP) is provided for emergency use where a worker might be exposed to an environmental concentration exceeding ten times the MPC, not to exceed a period of thirty minutes of heavy exertion. The equipment is to be used in the following manner.

Connect breast strap buckle, leaving the side strap unhooked, then swing the harness over the head, snap the side strap in place, fasten the waist belt and adjust the harness to suit the user.

Check regulator hose nut at cylinder valve for tightness, open cylinder valve three full turns, snap safety chain into valve hand wheel. Check pressure indicated on regulator gauge. Adjust all of the head harness straps on the mask assembly full out. Put mask on chin first, adjust the chin straps, then temple and forehead straps last. Test the mask and hose for leaks and tightness to the face by closing the mask hose quick-connect fitting with the thumb and inhaling. The mask should collapse to the face with no air leakage. Test the exhalation valve by exhaling with the hose still closed off. During normal operation, the red knob should be fully closed, and the yellow knob fully open.

After each use, inspect equipment, scrub mask with a warm soapy solution, rinse with warm water and disinfect with a solution of 70% Ethyl Alcohol in water.

Replace used cylinder with a freshly charged one.

Store flat, preferably in a cool dry place.

#### 4.2.1.3.7

#### PERSONNEL DOSIMETRY

##### Personal badges

The film badge program has been provided as one of the elements of a program for safe-guarding personnel against the harmful effect of ionizing radiation. It provides a periodic and permanent record of the accumulated radiation dosage. The badge is made up of a film packet designed to detect X or Beta & Gamma radiation within the 5 mrem to 550,000 mrem range and a series of silver, cadmium and aluminum foil filters to differentiate the various energy levels of radiation such as hard and soft Gamma or X-rays. The film badges are worn by all employees and visitors within the confines of the building.

##### Threshold Detectors

Several modifications to the standard personal film badges are made for use as area survey badges.



These badges are primarily constructed to monitor nuclear excursions, in which a high level neutron flux would be present. For this purpose an additional neutron film has been provided plus an additional series of gold, cadmium covered gold, indium and aluminum foils. These materials when irradiated with neutrons become radioactive. The degree of induced radioactivity is a function of the energy and intensity of the neutron irradiation.

The threshold detectors are located throughout the plant at strategic points. The following charts show these locations.

Films are changed monthly at which time the badges are closely inspected for damage and loose metal foils are replaced. An electromagnetic opener is provided for changing the film. The film packets are packed in a plastic bag before being placed in the shipping container, to insure un-damaged arrival. A letter is enclosed listing all terminations and new assignments during the previous month. All exposure results are kept on file and as each employee terminates, he is given an Exposure Summary, listing his external radiation exposure during his term of employment.

### Urinalysis

Urinalysis is used to determine the initial background uranium content in the system and to have a periodic check on any additional uranium in the system. The frequency of collection during employment depends on the individuals work area and contact with the enriched uranium. Urine samples are collected during the first week of employment, (prior to any possible exposure), and at 3 months, 6 months, or 12 month intervals and at termination.

Two 32-ounce wide mouth "Nalgene" polyethylene bottles are packaged in a standard cardboard container and accompanied by the standard instruction form(attached). Routinely, sample bottles are distributed on Monday and collected on Wednesday. Thursday morning the samples are prepared for shipment by adding concentrated nitric acid as a preservative for each quart of sample, or fraction thereof.

Bottles are resealed and arrangements made for shipment.



A letter listing all names and sample numbers is enclosed in the shipment. A file card is maintained on each employee, listing date of sample and results. A log book is also kept, so it is possible to find the desired information either by name or by sample number. Bioassay information is also included in the employee's Exposure Summary which he receives upon termination.

#### 4.2.1.3.8

#### VENTILATION SURVEYS

##### Instrument Calibration

The following procedure is used for calibrating the Anemotherm air meter:

Plug in air probe in 7-hole socket.

Place probe in air shield.

Depress "Velocity and S.P." button.

Depress "0-100" fpm selector button.

Depress and hold "Check" button.

Adjust indicator to red line on 0-100 fpm scale by use of the "Velocity-S.P." current adjustment knob.

Repeat similarly for 100-1000 and 1000-8000 fpm scales.

##### Measuring Velocity at Fixed Opening Hoods

After calibrating the instrument, locate the probe directly in the hood opening. Select the most likely scale and place the probe in the line of air movement with the red indicator dot facing the air source. Read the flow from the appropriate scale. Make necessary adjustments with the duct damper to achieve the desired velocity through the hood opening.

### Measuring Velocity at Variable Opening Hoods

After calibrating the instrument, locate the probe directly in the hood opening. Operation of the instrument to determine flow rates is the same as in the preceding paragraph. Velocity measurements are made by varying the size of the hood opening to determine the maximum size of hood opening which will still produce the desired minimum velocity. The size of the opening must not be less than that normally used during operation of the hood. Necessary adjustments are made in the duct damper to achieve the desired velocity.

### Static Pressure Measurements

Static pressure differentials across exhaust filters are measured at the main exhaust plenum, the P-30 filters, the mix line filters, the laboratory hood filters, and the laboratory dry box filters.

### Equipment and its Use

Either the C-2 or O-6 inches of H<sub>2</sub>O Magnehelic static pressure gauge may be used. Each gauge has two tygon tubes, a yellow one for use on the higher pressure or atmospheric side.

All static pressure measurement locations have two nipples, one of which is yellow.

Connect both tubes to the nipples matching yellow for yellow. Hold gauge upright and take reading.

### Duct Surveys

The measurement locations are located strategically throughout the plant. Ducts are labeled A through I.

The Anemotherm Air Meter used in this operation is equipped with a ruled 36" probe extension for greater reach.

The air meter is operated as previously described and the probe inserted a specific distance to achieve a uniform air velocity profile of the duct. Six readings are taken horizontally and 6 vertically at different distances through the access holes.

### Collection, Processing and Reading

Velocity measurements of all glove boxes are taken and recorded on a standard form and remarks made as to unusual conditions and damper positions. Static pressure measurements are recorded on a standard form accompanied by location, date and remarks.

Hood opening data, date taken, location and all remarks are noted on a standard form.

Duct survey data is recorded on standard forms, indicating insertion distances ( $R_1, R_2, R_3$ , etc.) sample points, (A, B, C, etc), duct diameters and duct areas. Duct survey data is processed in the following manner:

Average the 12 readings to find the average velocity in fpm.

Calculate flow rate as follows:

$$\text{average velocity (fpm)} \times \text{duct area (ft}^2\text{)} = \text{flowrate } \frac{\text{(ft}^3\text{)}}{\text{min}}$$

Correct flow rate to this altitude by multiplying by 1.275.

The rated values are:

<u>Area</u>	<u>Flow Rate</u>
I	1700 fpm
II	1000 fpm
III	3800 fpm
IV	4760 fpm
V	1950 fpm
VI	3550 fpm
VII	540 fpm
VIII	7850 fpm
IX	400 fpm

The actual values are calculated as follows:

I	=	reading at A in cfm
II	=	B-A
III	=	C-B
IV	=	D

V = E-F  
 VI = F-E  
 VII = G (I + II + III + IV + V + VI)  
 VIII = H  
 IX = I  
 Total to Fan = G + H + I

The entire ventilation survey is reported weekly so correct ventilation requirement and conditions can be maintained. Copies of reports are kept as a permanent record.

#### 4.2.1.3.9

#### SPECIAL HAZARDS EVALUATION

##### Carbon Monoxide

The "Bacharach Monoxor" carbon monoxide indicator model CDE is used where carbon monoxide fumes are suspected or known to be present.

The following steps should be followed for successful operation of this device:

Unfold scale frame and scale from bottom of indicator sampler and swivel forward until it locks in place.

Slide metal tip breaker on the bottom of the indicator sampler back to open the tube breaker hole.

Insert indicator tube tip in exposed hole and break off tips to open both ends of tube. Push slide forward to close tip breaker hole.

Slide either open end of indicator tube through wire loop under scale and insert tube tip snugly into rubber tube connector of indicator sampler.

Depress push button to bottom of travel and hold down for several seconds. Release push button quickly. Allow push button to return to its original position. This will be shown by appearance of red line on push button.

When red line on pushbutton is visible, wait 15 seconds before examining the indicator tube for brownish stain in yellow colored gel. If stain appears, carbon monoxide is present in test area.

Move scale right until only unstained yellow colored gel appears in the window (A) to the left of scale's zero bar (B) and stained gel appears on the other side. Read scale at junction (c) of stained gel and white guard gel.

Carbon monoxide present is reported as % CO in the air or as ppm CO. A permanent record is kept of any unusual carbon monoxide concentrations. Area supervisors are notified when carbon monoxide is found in the area.

#### Hydrogen Gas

The MSA Explosimeter (model 3) is used to quickly and conveniently test an atmosphere for concentrations of flammable gases and vapors.

The following procedure should be used:

Lift the left end of the rheostat knob "on-off" bar and turn the rheostat knob one quarter turn clockwise.

Flush fresh air through the explosimeter.

Adjust rheostat knob until meter pointer rests at zero.

Place end of sampling line at, or transport the explosimeter to the point where the sample is to be taken.

Read just meter pointer to zero if necessary.

Aspirate sample through explosimeter until highest reading is obtained.

To turn off instrument rotate rheostat knob counter-clockwise until arrow on knob points to "off" position.

Report hydrogen concentration as a percent of the lower explosive limit.



Ordinarily the explosimeter is primarily used as a leak detection device and any irregularities are brought to the attention of the responsible supervisor.

A permanent record is kept of any abnormal amounts of explosive vapor found.

#### Microwave radiation

The "Ramcor" model 1200 Densimeter is used in the following manner:

Before connecting the antenna, set the "on-off" switch to the "off" position. Set the selector switch to "Bat" position and press the red button. The meter needle should read at or above the red dot, if it is below the red dot, replace batteries.

Select the proper antenna to operate in the frequency range to be measured. Set the "Selector Switch" to the proper band, turn the "on-off" switch to "on" and balance the meter with the balance control. Proper balance is obtained when the needle is at the extreme left of the meter.

Caution: Do not turn the instrument "on" when the selector switch is in the battery check position.

Connect the antenna to the meter and scan the desired area. The meter is calibrated in "DB" above and below 10 MW/CM<sup>2</sup>. The 10 MW/CM<sup>2</sup> is the "0" db mark at the center of the scale.

If using one of the horn antennas and the polarization of the transmitting source is unknown, readings should be taken by rotating the unit until the "E" field is horizontal.

The instrument must be in "off" position when not in use.

Caution: Do not use the antenna head as a handle for removing it from the meter.

Microwave density is reported in db.

A permanent record is filed of any excess microwave radiation, and a report submitted to the supervisor to correct the situation.



4.2.1.3.10

SHIPMENT OF RADIOACTIVE AND TOXIC MATERIALS

REGULATIONS COVERING THE TRANSPORTATION OF URANIUM AND BERYLLIUM COMPOUNDS PERTAINING TO THE COORS PORCELAIN COMPANY.

SHIPPING PROCEDURES FOR BERYLLIUM OXIDE

General Information

This procedure is intended as a guide for the preparation of shipments of Beryllium Oxide by common carrier, parcel post, express, or courier.

Packaging

All Beryllium Oxide material will be packaged in double internal containers which will completely contain the contents under all normal shipping conditions. This double container may consist of two plastic bags separately sealed, or a combination of the following types of containers:

1. Metal can
2. Plastic bottle
3. Plastic carton
4. Cardboard carton
5. Plastic bag

Both containers shall be sealed to prevent leakage of the contents. The choice of containers will be dictated by the characteristics of the contents.

Sharp or heavy objects should be put in rigid containers, liquids in plastic bottles, etc.

The double inner container will be packed in a suitable outer container with sufficient packing material to adequately protect the contents from damage.

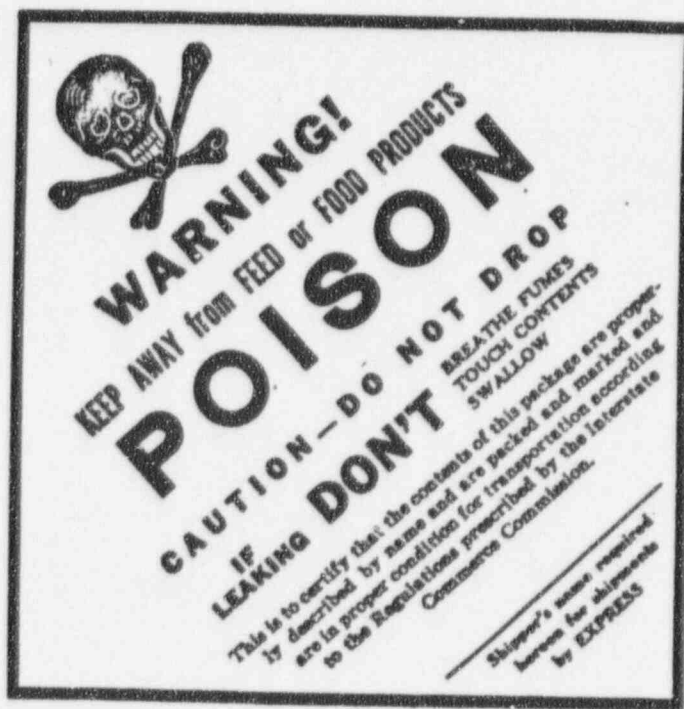
For packaging liquids the outer container shall be of a material chemically resistant to the liquid and sufficient absorbent packing material will be placed between the inner and outer containers to absorb the liquid in the event that the inner container should break or leak for any reason.

For packaging solids or semi-solids, the outer container shall be rigid enough to withstand the type of handling encountered in normal shipment.

### Labeling

Each double inner container shall be plainly marked with a tag, label, sticker, or a felt pen in the event that none of the other three are available, with the word BERYLLIUM in such a manner as to be visible to the recipient before the double inner container is opened.

The outer container will bear in a conspicuous place the I.C.C. Class B poison label shown below:



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### Monitoring

Each package containing beryllium shall be monitored by Health Physics before shipping. The maximum allowable contamination level shall be 0.01 ug/cm<sup>2</sup> Be removable by smearing.

### SHIPPING PROCEDURES FOR URANIUM COMPOUNDS IN COMPLIANCE WITH I.C.C. REGULATIONS.

### General Information

As stated by the I.C.C. Bureau of Explosives, radioactive materials are a Class D poison. Radioactive material is defined as any material or combination of materials that spontaneously emit ionizing radiation. The I.C.C. has divided radioactive materials into three groups according to the type of radiation emitted at any time during the transportation of such a material, as follows:

- |           |   |
|-----------|---|
| Group I   | Radioactive materials that emit gamma radiation only or both gamma radiation and electrically charged corpuscular rays, better known as alpha and beta radiation.   |
| Group II  | Radioactive materials that emit neutrons and either/or both types of radiation characteristic of Group I materials.   |
| Group III | Radioactive materials that emit electrically charged corpuscular rays only, i.e. alpha or beta radiation, or any other material that is so shielded that the gamma radiation at the surface of the package does not exceed 10 milliroentgens for 24 hours at any time during the transportation of said material. |

The radioactive material used and shipped by the Coors Porcelain Company, Fuel Element Department is principally an alpha emitter. Hence it is classified a Class D, Group III poison and must bear an appropriate label stating such. See Section 73.391 of the I.C.C. Regulations for specific details.

### Packaging

It is necessary to exercise special care in packaging Uranium compounds. Below are listed in brief form the I.C.C. Regulations pertaining to our product.

The design and preparation of the package must be such that there will be no significant radioactive surface contamination of any kind on the outside of the container. See Section II D for maximum acceptable levels of radiation.

The smallest dimension of any outside shipping container for radioactive materials must be not less than 4 inches. Thus any package containing U-235 in any form must be at least 4 inches x 4 inches x 4 inches.

All outside shipping containers must be of such design that the gamma radiation will not exceed 200 mr/hr or equivalent at any point of readily accessible surface.

The outside shipping container for any radioactive material other than exempt quantities, (See Section II E for exempt quantities) shall be wooden boxes, fiberboard boxes, fiber drums or metal drums. Any container used for shipping radioactive materials must be constructed so as to withstand conditions incidental to shipping.

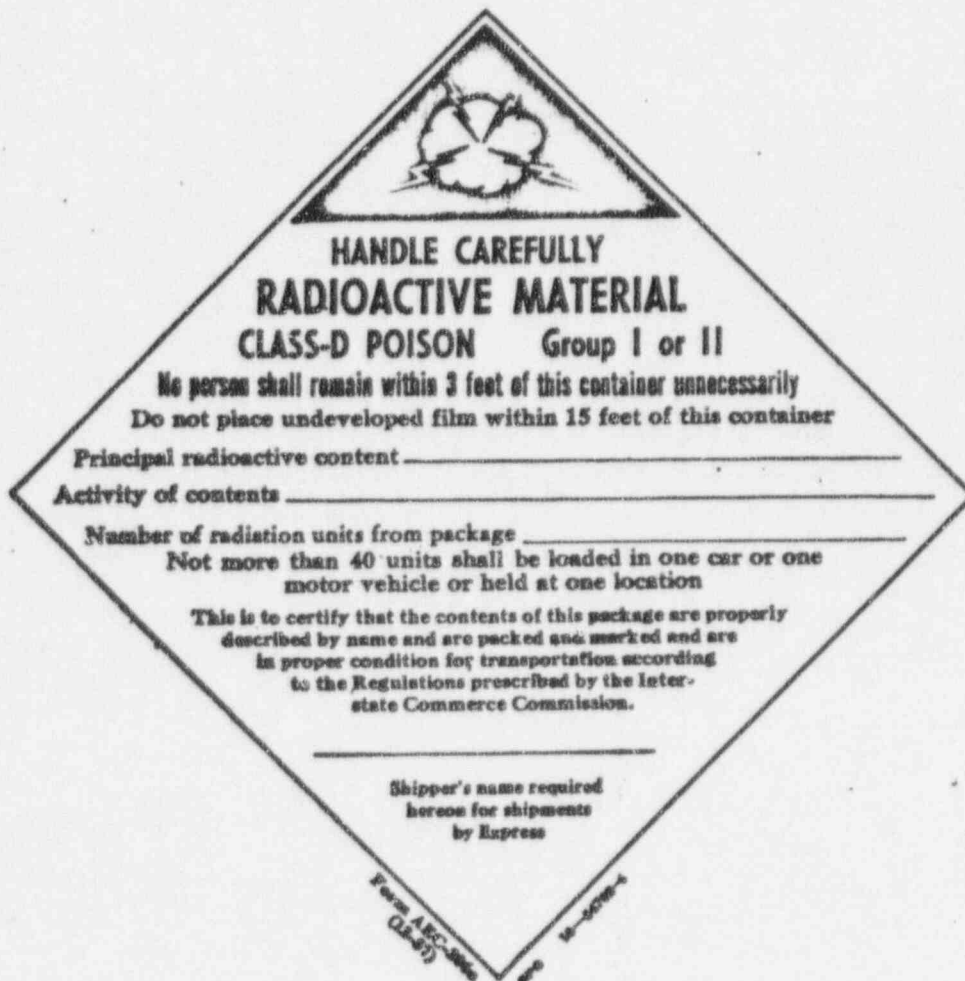
Radioactive materials Group I liquid or solid must be packaged in such a manner that no alpha nor beta radiation is allowed to escape to the exterior surface of the outside container and the gamma radiation may not exceed ten milliroentgens at one meter from any surface of the radioactive source.

Liquid radioactive materials must be packed in tight containers, chemically compatible with the contents and must be surrounded with sufficient absorbent material to entirely absorb the contents in the event the container should leak for any reason. Absorbent packing material must be such that its efficiency is not impaired by chemical reaction with the contents of the container.


Labeling

Outside containers containing Group I or II radioactive materials must bear an appropriate red label as described in paragraph 73.414 a of the I.C.C. Regulations.

For rail, truck, or express shipment



A diamond-shaped label template for radioactive materials. At the top is a triangular warning symbol containing a stylized atomic symbol. Below the symbol, the text reads: "HANDLE CAREFULLY", "RADIOACTIVE MATERIAL", "CLASS-D POISON", and "Group I or II". This is followed by two lines of instructions: "No person shall remain within 3 feet of this container unnecessarily" and "Do not place undeveloped film within 15 feet of this container". Then are two lines for "Principal radioactive content" and "Activity of contents". Next is a line for "Number of radiation units from package" followed by the instruction "Not more than 40 units shall be loaded in one car or one motor vehicle or held at one location". A paragraph states: "This is to certify that the contents of this package are properly described by name and are packed and marked and are in proper condition for transportation according to the Regulations prescribed by the Interstate Commerce Commission." Below this is a line for "Shipper's name required hereon for shipments by Express". At the bottom left, it says "Form AEC-3000 (12-57)" and at the bottom right, "12-5000-1".



**HANDLE CAREFULLY**  
**RADIOACTIVE MATERIAL**  
**CLASS-D POISON      Group I or II**

No person shall remain within 3 feet of this container unnecessarily  
Do not place undeveloped film within 15 feet of this container

Principal radioactive content \_\_\_\_\_  
Activity of contents \_\_\_\_\_

Number of radiation units from package \_\_\_\_\_  
Not more than 40 units shall be loaded in one car or one motor vehicle or held at one location

This is to certify that the contents of this package are properly described by name and are packed and marked and are in proper condition for transportation according to the Regulations prescribed by the Interstate Commerce Commission.

\_\_\_\_\_  
Shipper's name required hereon for shipments by Express

Form AEC-3000 (12-57)      12-5000-1



For air shipments





The radioactive materials shipped from Ocora Porcelain Company, Fuel Element Department being a Class D Group III poison must bear a 4 in. x 4 in. blue and white label.



For air shipments

For rail, truck, or express shipment



Form AEC-207  
(8-57)

15-73455-1  
8-0

Inner containers shall bear a sticker, label, or tag in such a place that it will be easily noticed by persons opening these containers. See Section 73.393 and 73.414 of the I.C.C. Regulations for specific details.

It is unlawful to label packages with Class D poison labels if the packages do not contain such. It is also unlawful to leave a Class D poison label affixed to any vehicle after it has been unloaded of radioactive contents or to ship emptied containers with Class D poison label affixed.

All radioactive material shipments which contain Beryllium Oxide will display the Class B poison label in addition to the appropriate Class D label.

#### Monitoring

In brief the following conditions must be met before a shipment of radioactive material may safely leave the Fuel Element Department:

There may not be more than 50 dpm surface contamination removable by smearing on any outer or inner container.

Gamma radiation may not exceed 200 milliroentgens per hour at any readily accessible surface nor may it exceed 10 mr/hr at one meter from any point on the radioactive source.

Packages must be put together in such a manner that their contents will not spill or in any way cause undue exposure to personnel involved in handling the shipment. Packages must be able to withstand conditions incidental to shipping.

All packages must bear in a conspicuous place appropriate labels denoting the nature of the contents.

The Health Physics Department will monitor packaging procedures periodically to make certain that all rules are being followed.

### Exempt Quantities

The I.C.C. Regulations allow for unmarked shipments providing that the quantity being shipped meets the following requirements:

The package must be such that there can be no leakage of the contents under conditions normally incident to transportation.

The package may not contain more than 19 grams of Enriched Uranium or 2000 grams of Natural Uranium.

Surface contamination may not exceed 50 dpm/ft<sup>2</sup> removable by smearing and gamma radiation from within the package may not exceed 10 milliroentgens per 24 hours at any readily accessible surface.

Shipments of low level waste may be made in car load lots providing gamma radiation does not exceed 10 milliroentgens per hour 12 ft from any surface or 5 ft from either end. Material must be packed in strong tight containers braced in the vehicle with no loose material in the vehicle. Shipments must be loaded by consignor and unloaded by consignee and the vehicle must bear a 10-3/4 in. x 10-3/4 inc. label as described in Section 74.553 of the I.C.C. Regulations. See Section 73.392 of the I.C.C. Regulations for specific details.

## POSTAL REGULATIONS COVERING THE TRANSPORTATION OF RADIOACTIVE MATERIALS

### General

Quantities that may be shipped via Parcel Post are those that may be shipped via R.E.A. or common carrier as exempt quantities. There are some differences however in the labeling requirements. Below are listed the requirements in brief.

### Packaging

Packages must be put together as outlined in Section II, B, 6 of this paper and must be able to withstand conditions normal to shipment via Parcel Post. No shipment may contain more than 19 grams of Enriched Uranium or 2000 grams of Natural Uranium.

### Labeling

Packages must be labeled as follows:

"Radioactive material, gamma radiation at surface of parcel less than 10 mr/24 hr. No significant alpha, beta or neutron radiation".

The contents must comply with the specifications designated on the label.

### Monitoring

Monitoring will be carried out as outlined in Section II D, 1, 3 and 4.

### Exempt Quantities

There are no exempt quantities for shipment via Parcel Post. Any and all packages containing radioactive materials must be labeled.

## REGULATIONS COVERING AIR SHIPMENTS

Shipments made by air must meet all requirements of the I.C.C. plus those listed below.

Packages must bear a label reading as follows:

"Do not place in same compartment with undeveloped film or mail".

No more than 40 units of Group I and II materials may be shipped on one air craft. This will necessitate marking the contents of each package providing the total shipment contains more than 40 units (1 unit-1 mr/hr at one meter distance of hard gamma).

Compensation should be made for differences in air pressure during flight, i.e. caps on air tight containers should be secured to withstand pressure from within the container.

#### 4.2.1.3.11

#### MEDICAL PROGRAM

##### Schedules

A pre-employment physical examination is required of all employees. Routine physical examinations are scheduled for either 6 months or 12 months intervals, depending upon the person's work area or job duties. A terminal physical examination is required of all employees just prior to termination. All employees are checked for weight change, vital capacity change, any chest, throat, skin complaints on either a monthly, bi-monthly or tri-monthly basis. The same system, to determine frequency of visits, is used for the routine medical visits and the scheduling of routine physical examinations.

Any employee with a suspected exposure or occupational illness is sent immediately to Dr. Wright for examination. Any severe change in weight, or vital capacity is brought to the Doctor's attention so that he may evaluate the situation and decide what action should be taken.

Several of the A. Coors construction workers are included in the medical program, since their job duties in this division bring them into close contact with possible contamination.

All employees are required to have ten weekly checks of weight and vital capacity, which are used as a background, to determine any abnormal change.

A Medical Record form is kept on all employees, listing their starting date, their pre-employment physical date, any routine physical examinations and routine medical visits. A file card system also lists weight and vital capacity and the dates of routine medical visits for each employee. A list of physical examinations and routine medical visits is included in the Exposure Summary which each employee receives upon termination.

A copy of the Maternity Leave form is attached. This form, when signed, is placed in the employee's file in the Personnel Department.



Maternity Leave Form to be Signed by All Female Employees:

TO: All Female Employees

SUBJECT: Maternity Leave

The Company policy regarding maternity leave for women in the Fuel Element Department is as follows:

1. It is the employee's responsibility to notify the Company at the first knowledge of pregnancy and to request maternity leave at that time.
2. Maternity leave will be granted immediately for a period not to exceed two months beyond the termination of pregnancy.

To be signed by the employee:

I understand the foregoing statement of policy and agree to assume the responsibility for notifying the Company at the earliest possible knowledge of pregnancy and to accept immediate maternity leave.

---

Date

---

Employee's signature



#### 4.2.1.3.12

#### PERSONNEL INDOCTRINATION

##### Health Physics Lectures

The Health Physicist meets with all new employees to discuss the health physics safety program. The contents of the Health Physics Guide are covered with the new employee. Special emphasis is placed on proper usage of respirators, contamination enclosures, and protective clothing.

##### Nuclear Safety Lectures

The Nuclear Physicist meets with each new employee who will be working in uranium processing areas. The major provisions in the Nuclear Safety Guide, CPC-68 are covered with the new employee. The emergency evacuation procedure is also covered in detail.

##### Films

The film "Living with Radiation" is shown to all new employees. The film "Criticality" is shown to all new employees who will be handling uranium.

##### On the Job Training

It is the primary responsibility of a supervisor to train a new employee for his job. This training is to include the health and nuclear safety aspects of a particular job.

Nuclear Safety Inspectors and Health Physics Technicians have the responsibility to monitor all production areas to see that all aspects of safety are complying with rules and regulations.

#### 4.2.1.3.13

#### DECONTAMINATION

##### Area Decontamination

In the instance of a spill involving hazardous materials, Health Physics should be notified immediately.

They will determine the type and extent of contamination and the most suitable method of decontamination. In the event of any possible airborne contamination, personnel should wear respirators during clean-up.

Care should be taken to minimize any spreading of the contamination by taping off the area, thus cutting down on traffic.

Depending on the degree of contamination, equipment may either be cleaned in place, or removed to the Decon Room and cleaned within either hood.

#### Personnel

Protective clothing has been provided to eliminate, as much as possible, the contamination of personnel. In some cases, however, an operator may be unavoidably contaminated. He must then wash thoroughly with soap and water and when necessary with a more effective decontamination materials.

#### Decontamination Materials

Decontamination materials are listed approximately in order of effectiveness.

Alconox and water.

Alcohol or Acetone for greasy or oily items.

Decon Solution which is prepared as follows:

Dissolve 227 g of Citric Acid and 113 g Versene Powder in water in a 1500 ml beaker.

Add 37 ml of Igepal.

Pour concentrate into a 5 gal. container and dilute to 5 gallons.

Nitric Acid, either diluted or concentrated, depending on the requirements.

When contamination cannot be removed with these materials it may be painted over.

#### 4.2.1.3.14

#### NUCLEAR SAFETY MONITORING

##### Operating Principles

Uranium in geometrically unsafe containers is handled in 300 g batches.

Uranium in geometrically safe containers is limited by the volume of the container and the hydrogen to uranium ratio.

Minimum edge to edge separation of twelve inches is maintained between batches of uranium during all stages of processing, storage, and transportation, unless safe geometry controls are used.

Stored batches are maintained in verticle planar arrays to minimize interaction.

Operating criticality limits are posted wherever uranium may be handled.

The nuclear safety plan is contained in the Nuclear Safety Guide, CPC-68, Rev. 1.

##### Inspection of Work and Storage Areas

Nuclear Safety Inspectors continually monitor work on all shifts.

Visual inspections are made to insure that uranium is handled only at approved work stations and storage areas, in accord with the operating principles.

Inspections are made to verify that the uranium being processed at a station, does not exceed the station criticality limit.

Gamma surveys are made to insure that uranium does not accumulate in unsafe places such as low level waste tanks, BeO storage areas, etc.

##### Infractions

A nuclear safety infraction is any action which is not explicitly permitted in the Nuclear Safety Guide, CPC-68.

All infractions are reported on the Nuclear Safety Infraction Report by the Nuclear Safety Inspector monitoring the area where the incident occurs.

The Nuclear Safety Committee studies the report to determine what disciplinary action, if any, is to be taken against the violator. Disciplinary action is then administered by the violator's supervisor.

Individuals violating provisions of the Nuclear Safety Guide are subject to the following disciplinary action:

- A. Personal contact by supervisor and Nuclear Safety Committee to include a written reprimand.
- B. Personal contact by supervisor and Nuclear Safety Committee to include a disciplinary layoff of from one to five days.
- C. Personal contact by supervisor, Division Manager, and Nuclear Safety Committee for purpose of immediate discharge.

For a first offense, the Nuclear Safety Committee will review the violation and recommend action A, B, or C, depending on the circumstances of the offense.

For a second offense, the Nuclear Safety Committee will review the violation and recommend action B or C, depending on the circumstances of the offense.

For a third offense, action C is the only permissible action.

#### Training of Operators

All operators working in areas where uranium is handled must be given a nuclear safety indoctrination by the nuclear safety group and by the operators' supervisor.

The operators' actions are closely watched by the Nuclear Safety Inspectors until the operator demonstrates he understands the importance of following nuclear safety rules.

Date \_\_\_\_\_

Violator(s) \_\_\_\_\_

Time \_\_\_\_\_

Location \_\_\_\_\_

A. Detailed Explanation of Situation: \_\_\_\_\_

B. Nuclear Safety Limits which were in effect:

C. Remedial Action taken and by whom:

\_\_\_\_\_  
Nuclear Safety Inspector

Nuclear Safety Committee Recommendation:

Date \_\_\_\_\_

Corrective action and by whom:

Date \_\_\_\_\_

### Changes in Operating Procedures

Changes in the nuclear safety plan are requested on the Nuclear Safety Deviation Request form.

Minor changes in the plan can be approved by three members of the Nuclear Safety Committee.

Major changes in the plan must be approved by the AEC-SAN office.

### Emergency Conditions

A system of five radiation detectors is installed in the Fuel Element Building to give warning when the radiation levels within an area exceed a preset level. The most likely cause of high radiation levels is an uncontrolled chain reaction (criticality).

The alarm will be enunciated by means of a siren located at the detector. Each detector and its accompanying siren operates independently of the others.

When a siren sounds, all personnel in the building will:

Proceed to the assigned exit for the area in which they are working.

Do not stop to change clothing, shoes, badges, etc.

Proceed to the designated assembly area.

Report to the emergency warden at the assembly area.

Re-entry to the building will be accomplished only after Management and Health Physics have evaluated the situation and have approved re-entry.

Each work area will have an assigned exit and evacuation route which will take personnel to the most feasible exit by the safest route. The accompanying floor plans diagram the exits and the areas to use these exits.



The exits are indicated as:

- A - Front Entrance to Building
- B - South Side of Building, East Crash Door
- C - South Side of Building, West Crash Door
- D - Escape Hatch from Depressed Area
- E - Furnace Room Exit
- F - Mezzanine Exit

The following areas will use the exits designated below:

- A - Offices, Laboratory, Locker Rooms, Vault, Mechanical Technicians Area, Tool Crib, Decontamination Room, Second and Third Levels of Tower, Blanchard and Drum Cut-off Grinding Area.
- B - Ground Floor Level of Tower, Extrusion, Despatch Oven.
- C - Mix Line, Grinding.
- D - Depressed Area.
- E - Furnace Room, Inspection.
- F - Mezzanine, Alternate for Offices.

All personnel after evacuating will assemble in specified areas according to their normal work areas. The Warden for each area will determine if all of the people from his area are present or accounted for. The Area Warden will report to the Chief Warden when this determination has been made.

The Chief Warden, the Health Physicist, and designated Supervision will assemble at the main entrance to the Fuel Element Building.

Personnel will evacuate to the Porcelain Plant by the following route:

Proceed directly to the small door on the north side of the main plant and enter.

Inside the building, proceed south between the two large kilns to the large metal doors opposite the stairway. Turn right and proceed west to the courtyard.

Upon reaching the courtyard turn right and enter the raw material storage area. This area consists of a long hallway with a series of vaults opening on to the hallway.

Assemble in the hallway in groups according to your normal work area. Signs will be posted in the hallway designating assembly areas.

The assembly areas will be designated from west to east in the following order:

- A - Offices
- B - Laboratories
- C - Furnace Room, Mezzanine
- D -- Inspection
- E - Mech Tech
- F - Grinding
- G - Chem Process
- H - Misc., Visitors, Maintenance, Construction, Accountability, Health Physics, Nuclear Safety, etc.

Upon arriving at the secondary assembly area, the Area Wardens will take charge of their groups and await further instructions.

It is absolutely essential that all personnel involved in an emergency evacuation observe the following rules:

Proceed immediately to your assigned assembly area by means of the designated exit.

Report to your Area Warden immediately.

Do not leave the assembly area until instructed by your Area Warden.

Do not discuss with anyone any details of the emergency situation. Public statements to the Press, etc., will be made only by authorized persons.

Plant protection personnel will assist by whatever means necessary to keep out unauthorized personnel and to maintain clear traffic lanes for emergency vehicles.

Normal procedures will be followed for any emergency conditions which occur at night or on weekends.

After accounting for all personnel, the Chief Warden will then telephone the following personnel in the order listed:

Bob Mornin  
George Bidinger  
Dale Smith  
Tony Reeder  
Frank Mayer  
Joe Coors



Plant protection personnel will maintain security surveillance from outside the building until proper authorities arrive to evaluate the situation.

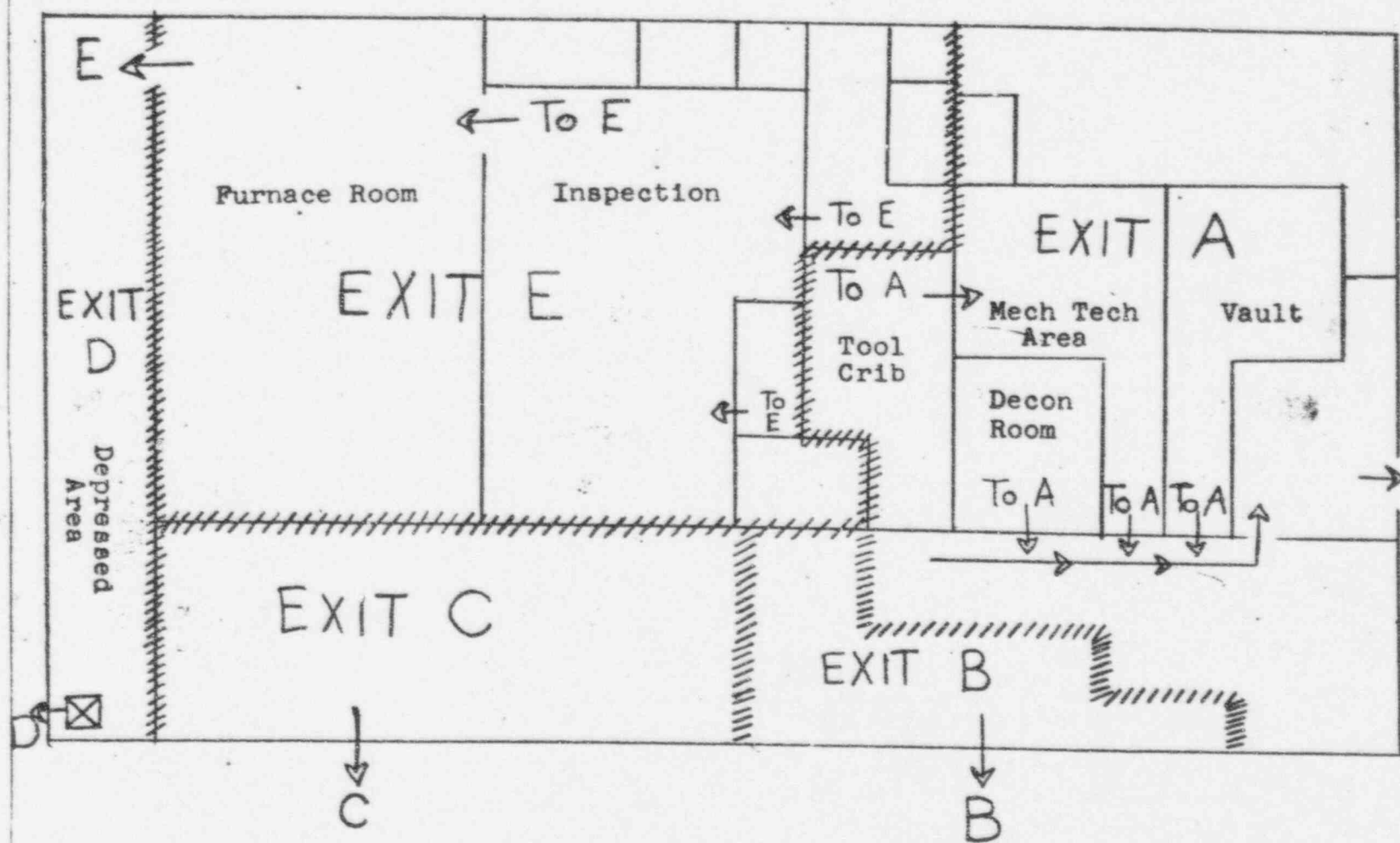
The Chief Warden will meet the above personnel at the Fuel Element Building.

The following emergency equipment will be kept at the main guard post and will be removed to the outside of the main entrance by the guard in case of emergency:

2 Scott Air Paks

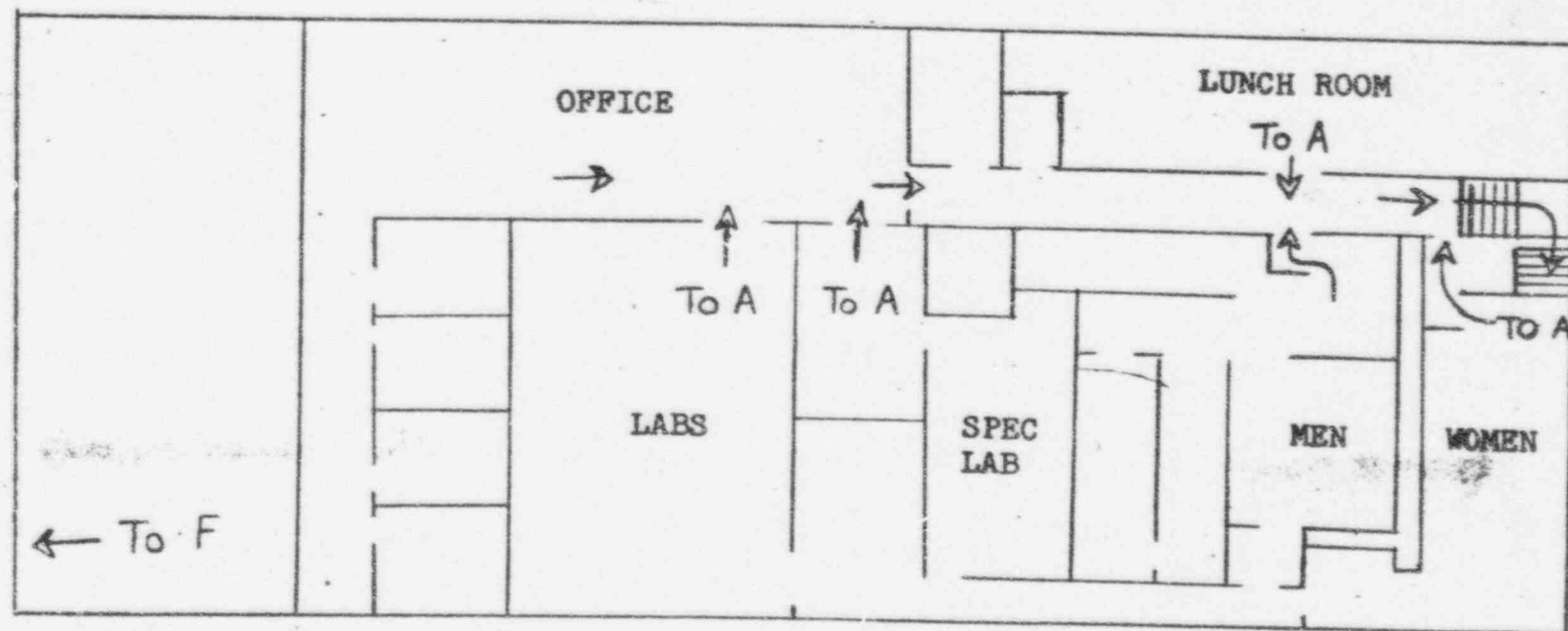
- 1 Emergency Kit containing:
  - 2 pair coveralls
  - 2 respirators
  - 1 High Range Gamma Survey Meter
  - 1 Alpha Survey Meter
  - masking tape
  - rubber gloves
  - hoods
  - Flashlight
  - spare batteries

# EVACUATION ROUTES FUEL ELEMENT BUILDING



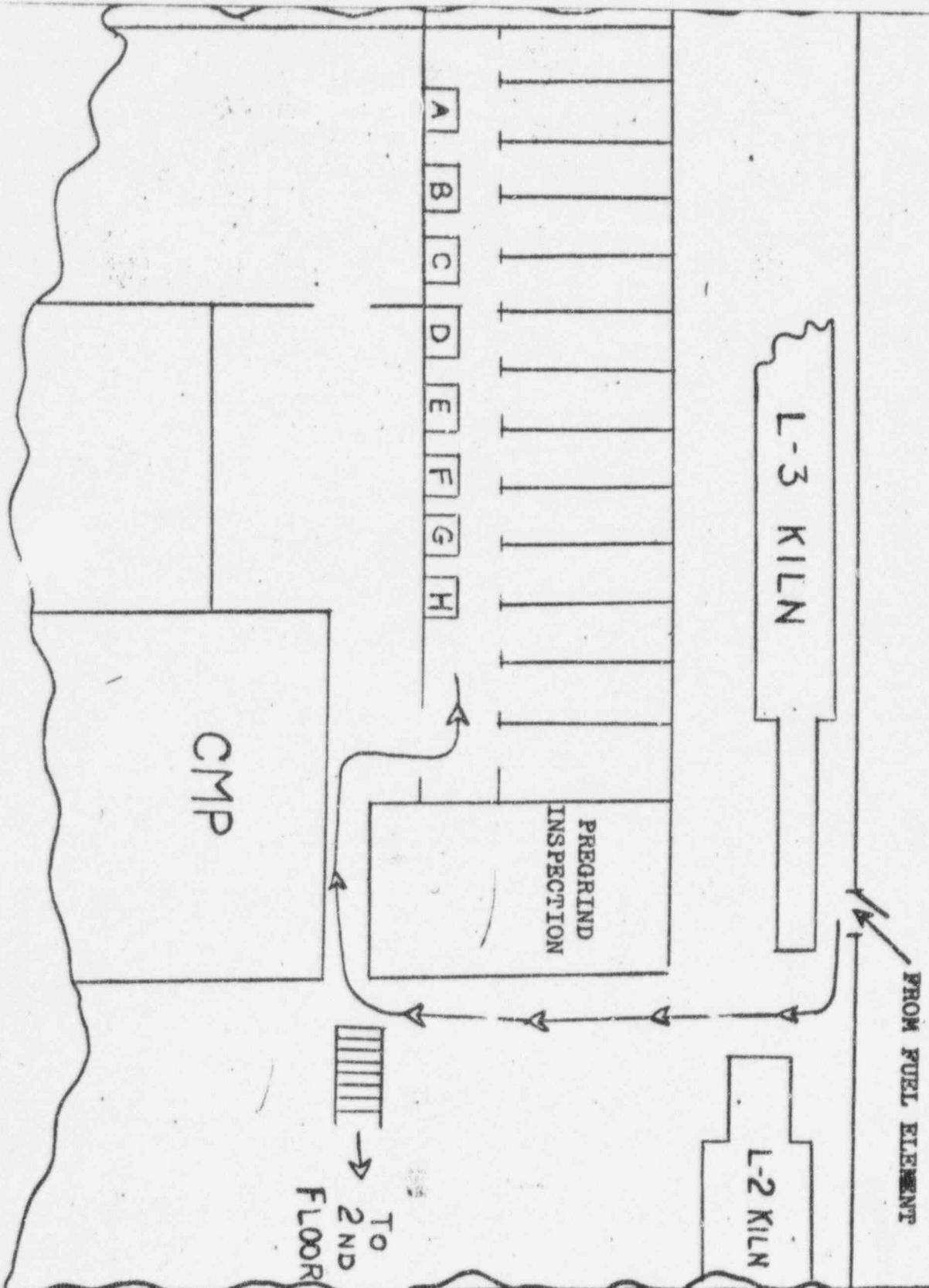
EVACUATION ROUTES, FUEL ELEMENT BUILDING

SECOND FLOOR



ALL SECND FLOOR EVACUATES BY EXIT A, MAIN ENTRANCE

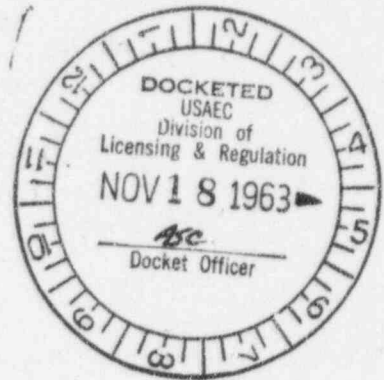
ASSEMBLY AREAS IN COORS PORCELAIN COMPANY





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LICENSE APPLICATION SUPPLEMENT NO. 3  
November 14, 1963



Health Physics Guide

This copy of the Coors Porcelain Company  
"Health Physics Guide" (Amended November 4, 1963)  
is furnished for reference use as a supplement  
to Coors Porcelain Company applications for  
AEC licenses.



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7666

HEALTH PHYSICS GUIDE  
COORS PORCELAIN COMPANY  
GOLDEN, COLORADO

Prepared by:

R. D. Smith

FEBRUARY, 1961

Amended November 4, 1963

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## INTRODUCTION

This manual outlines the Health Physics and Industrial Hygiene problems associated with the fabrication of ceramic fuel elements. These ceramic fuel elements may contain highly-enriched uranium, low enriched uranium, normal uranium, depleted uranium, thorium, and beryllium oxide.

The problems associated with the accountability, criticality, and security phases of this division are discussed under separate sections. The criticality manual appears as classified document number CPG-66. The security manual appears as classified document number CPG-67. The overall responsibility for Health and Safety rests with the Division Manager, Mr. B. L. Mornin. The direct responsibility for administering the Health and Safety Program is assigned to the project Health Physicist, Mr. R. D. Smith. The Health Physicist reports directly to the Division Manager through the Production Superintendent. Trained Health Physics representatives will be present in the processing area at all times that hazardous materials are being processed.

The basic health hazards in this operation are of a toxicological and radiological nature. Both the radioactive material and the beryllium being processed present the greatest hazard to the worker when particulates of these materials are inhaled. While the effects on the body may vary from one material to the other, the problems faced in protecting the worker are similar, and a control program which is effective for one material will likewise be effective for the other.

Enriched uranium presents an added hazard in that the material will enter a critical reaction if certain parameters are met. Therefore, great quantities of enriched uranium should not be stored in one place, and the design should take into account the possibility of criticality. The design should also take into account the radiation associated with enriched uranium and other radioactive materials under normal and abnormal conditions.

While the relative hazards of beryllium and radioactive materials will vary with the quantities present, the toxicological hazard of beryllium will be the controlling factor in all design criteria when both materials are handled. If a design is adequate to control the hazard from beryllium, the hazard from other radioactive materials handled (exclusive of criticality) is adequately controlled.



## II. CONTROL OF AIRBORNE CONTAMINATION

### A. General

In controlling the potential airborne contamination problem, the philosophy of confinement and containment will be pursued in preference to reliance on individual respiratory protection. The basic equipment provided for the confinement and containment of toxic materials are the total enclosure (glove box) and the partial enclosure (velocity hoods).

### B. Glove Boxes

The basic design criteria for glove box design for this application are as follows:

1. Tightness. The enclosure will be sealed with all joints to prevent air leakage in the event of exhaust air failure. The air brought into the enclosure is introduced through a high efficiency filter at one of the sides.

2. Cleanability. Cleanliness is important from a quality control standpoint. Ease of maintaining cleanliness is therefore important. This calls for smooth interior surfaces, rounded corners and absence of hard to reach areas.

3. Workability. The locations of glove ports, window angles, vestibules, etc., are such as to entail a minimum of fatigue to the operator.

4. Air Requirement. Air flow capability is such that there will be a flow of 200 fpm across the face of any opening to contain all contaminants within the dry box.. This means that should a glove break or a vestibule door be opened there will be a surge of air through the opening of such magnitude as to have this velocity. This is provided for by maintaining a flow of 30-50 cfm @ 0.5-0.6 inches water static pressure. The air is drawn through an absolute type filter (99.97% efficient down to 0.3 micron particle size) and exhausted through a 2-inch diameter outlet with a velocity of 500 fpm through the filter and 100 fpm through the outlet. Capacity of the exhaust blower is the sum of all of the air flows from the dry box and glove bag.

#### 5. Velocity Hood

The basic design criteria for velocity hood design for this operation are as follows:

1. Hood Openings. All hood openings are kept to a minimum size commensurate with the operation requirements of the hood. In many of the enclosures doors are provided to close the openings.

2. Air Requirements. The minimum velocity maintained across the face of any hood is 150 fpm. In certain operations where large amounts of contaminants are generated; the minimum velocity will be maintained at 200 fpm. The flow rate designed for each enclosure is such that the minimum desired velocity will be maintained even if all hood openings are open simultaneously.

3. Air Filtration. Air exhausted from a velocity hood is passed through an absolute type filter (99.9% efficient down to 0.3 micron particle size) before being discharged.

excellent control of airborne contaminants. It can be realized that situations may arise when airborne contamination is suspected or known to exist in a work area. When this situation exists, measures must be taken to protect the workers in the area until the desired containment is again achieved. Two types of individual respiratory protection have been provided.

A. Half Mask Respirator

Each worker will be provided, when necessary because of suspected air-borne contamination, with a Willson respirator; Model 809, equipped with Model R520 filters. This filter is designed for effective filtration of toxic aerosols and for extremely fine particles, effectively filtering the finest smokes as well as highly toxic particles including radioactive dusts and beryllium particulates.

A 20% penetration has to be assumed with any half mask.

(Handbook for Radiation Monitoring, LA-1835). Since it

is unlikely and undesirable for individuals to wear

upper limit of exposure is assumed to be the same as the

B. Self Contained Breathing Apparatus

Scott Air-Pak, Model 6000-A2MSP, is provided for emergency use where a worker might be exposed to an environmental concentration exceeding 10 times the  $MPC_g$ . This breathing apparatus is approved for a period of 30 minutes of heavy exertion. It has the feature of maintaining a slight positive pressure within the facepiece, minimizing any penetration of the contaminant atmosphere into the facepiece due to poor fit, leaks, etc.

#### IV. AIR SAMPLING

##### A. Process Area Sampling

A comprehensive program of air sampling will be conducted on a routine basis to provide day by day evaluation of normal plant operations. Special samples will be taken to evaluate new or modified operations, maintenance work, or unusual conditions.

To assure adequate sampling of the general air, a number of portable air pumps capable of continuous operation are provided. Each of these pumps will be strategically located to provide coverage of all operations and areas.

These pumps operate continuously during working hours at all times when the plant is in operation. The pumps are of the type manufactured by the Gelman Instrument Corporation or the Staplex Manufacturing Company.

The type of pump used for portable sampling will be similar to the Gast Model 0740 pump "Giraffe Sampler".

To collect breathing zone samples required by the Atomic Energy Commission recommendations, two types of sampling equipment are available. The portable Gast sample pumps can be located in the proper position with respect to the operation, air currents, and personnel. To sample operations of a short duration, the High Volume air sampler of the type manufactured by the Gelman Instrument Corporation or the Staplex Manufacturing Company will be used.

Air samples obtained with the portable pumps are collected on an ashless filter paper of a 2 inch diameter. Whatman #41 is a typical paper of this type. The flow rate will be measured by controlling the pressure drop across the filter paper, using a Magnehelic vacuum gage as the indicating instrument. Flow rate curves have been determined for this type of paper and sample holder, equating flow rate to pressure drop. Each air sampling pump will be regulated by a gascock type of valve.

#### B. Duct Sampling

Air being discharged from the building is sampled continuously for beryllium and uranium content. Because of the proximity of the building to the environment, the recommended maximum level of  $2.0 \times 10^{-13}$  uc/cm<sup>3</sup> for beryllium and uranium is not applicable. The maximum level of  $4 \times 10^{-13}$  uc/cm<sup>3</sup> for gross alpha activity from mixed nuclides.

All air which has passed through process equipment and enclosures must pass through absolute type filters before leaving the building. Room air is controlled by exhausting through the enclosure ventilation system.

To assure optimum collecting of particulates, a pitot sampling tube is introduced into the exhaust air duct drawing air at a flow rate which will produce isokinetic conditions at the pitot orifice.



C. Out-Plant Air Sampling

Off-site air samples will be collected by means of two systems. Three permanently installed air sampling stations will collect air continuously on a weekly basis. The Gelman Nuclear Air Sampler will be used to collect these samples. The samples will be collected at a flow rate of 1 cfm.

High volume samples of a shorter duration will be collected at various locations around the plant environs. These samples will be taken at frequent intervals prior to plant start-up and on a continuing basis of 3-4 samples a week after plant start-up.

The location of the three permanent sampling stations is shown in the vicinity of the site in Figures A, B, and C of the accompanying diagram. The UTM grid coordinates of these stations are:

- A. 8092 0095. 100 meters southeast of plant.
- B. 8135 0100. 500 meters east of plant.
- C. 8240 0165. 1600 meters east-northeast of plant.

These stations will be supplemented by a permanent sampling station operated by the Dow Chemical Company. This station is located at coordinates 8023 0158, approximately 850 meters northwest of the plant.

In the event that the maximum average neighborhood concentration at the ground during any calendar month,

NORTH TABLE MOUNTAIN

SOUTH TABLE MOUNTAIN

CASTLE  
O  
ROCK

REF

AIR SAMPLE LOCATIONS

PERMANENT CPC

PERMANENT REF

AIR SAMPLES INTERMITTENTLY

NEARBY 500 - CONTOUR ELEVATIONS IN FEET

N

1000 METERS

99

79

CLARE CREEK  
CANYON

GOLDEN GATE  
CANYON

6000

6000

6000

6400

6700

6700

6200

as determined on a monthly basis, exceeds 0.01 micrograms per cubic meter, but does not exceed 0.05 ug/M<sup>3</sup>, the plant will inform the AEC of specific procedures which will be undertaken to reduce the airborne concentration. In the event that concentration exceeds 0.05 ug/M<sup>3</sup> operations will be immediately halted and the necessary corrections made to reduce the average concentration to below 0.05 ug/M<sup>3</sup>. In any event, concentrations above 0.01 ug/M<sup>3</sup> will be permitted to exist for not more than a 60 day period unless specifically authorized by the Commission. Such authorization will be forthcoming only if steps are taken which are expected to result in a satisfactory reduction of the concentration.

In the event that the average concentration of uranium at the ground during any calendar month, as determined on a monthly basis, exceeds  $4 \times 10^{-2}$  ug/cm<sup>3</sup>, or  $4 \times 10^{-3}$  ug/cm<sup>3</sup> when thorium is being processed, the plant will inform the AEC of specific procedures which will be taken to reduce the airborne contamination. Further actions will be at the direction of the AEC.

#### V. OUT-PLANT WATER SAMPLING

There are four drainage systems which might be affected by our operations.

Tracker Gulch. This is a small stream which flows out of Golden Gate Canyon to the northwest of the plant site. It

is joined at a distance of approximately 1200 meters north west of the plant site by 1.5 miles.

Cressman's is a small intermittent stream. After confluence, the stream flows within 50 meters of the plant site and drains into the

Clear Creek. This is a large stream flowing from Clear Creek Canyon through Golden in a northeasterly direction.

Church Ditch. This is an irrigation canal which originates at Clear Creek west of Golden and flows open to the edge of the plant site. It then goes underground about 100 feet to the plant site and then flows open to the

above and below the plant site and at the plant site. A sample point will be established at the confluence of Tucker Gulch and Clear Creek.

These points will be sampled weekly for four weeks to establish background levels before plant start-up. After operations commence, samples will be collected from each of the established sampling points monthly on a schedule which requires each drainage system to be sampled weekly unless in-plant conditions dictate otherwise.

All water samples will be analyzed spectrographically for beryllium. A tributylphosphate extraction will be performed and the samples then counted for alpha activity in a scintillation alpha counter. The geographic location of the sample locations is shown on the accompanying diagram.

## VI. CONTAMINATION CONTROL

### A. Protective Clothing

Protective clothing will be provided for all personnel actively processing beryllium and/or uranium. The normal protective clothing for all production personnel working in the processing and grinding phases will be rubber gaiters, (overall's or dress), a hat and safety shoes. The garments and socks will be changed daily. Personnel working in the inspection, laboratories and services will be provided smocks or laboratory coats, socks, and safety shoes. The smocks will be changed on a weekly basis, the socks daily. Visitors to the area will be provided smocks and shoe covers.

Separate facilities are provided in the clothing change area for street clothing and work clothing. These facilities are physically separated to prevent the possible spread of contamination to street clothing from the work clothing. Used protective clothing will not be allowed beyond the portion of the locker room provided for changing protective clothing.

Used protective clothing will be shipped to a commercial laundry service equipped and approved for laundering contaminated clothing.

B. Personnel Decontamination

Showers will be required of certain personnel working in the processing and grinding operations on a daily basis. Personnel in the Laboratories, Inspection and Services will be provided showers on an optional basis.

Washing of the hands and face is the minimum clean up required before lunch and breaks.

Personnel decontamination will be performed in the presence of the Health Physics or Environmental Health Officer. Decontamination areas will be marked with signs and caution tape will be placed at the decontamination sink.

A hooded enclosure and decontamination sink is provided for material and equipment decontamination. Chemical and physical decontamination supplies are available at this location. Health Physics will determine amounts and locations of contamination and monitor decontamination operations.

C. Contamination Surveys

Routine smear surveys are made in the process and administrative areas to determine uranium and thorium contamination.



Whenever contamination levels are found which exceed the working limits, decontamination will be effected immediately.

Area decontamination will be accomplished by vacuuming, mopping, and/or wet scrubbing with a power scrubber, followed with a pickup of the water by an industrial vacuum cleaner equipped with an absolute type filter on the air discharge.

Surveys will be made on all outgoing materials and equipment to assure that no contamination leaves the process area.

Periodic alpha surveys of equipment and areas are made. Whenever enriched uranium is in the process areas surveys will indicate equipment leakage and failure.

#### D. Maximum Permissible Working Limits

##### 1. Alpha Activity

The maximum levels for alpha contamination on materials leaving the control of the process area or in the administrative areas of the building are:

50 d/m/ft<sup>2</sup> removable by smearing

250 c/m direct as measured at 2 Pi geometry.

The maximum levels for alpha contamination within the process area are:

250 d/m/ft<sup>2</sup> removable by smearing

500 c/m direct as measured at 2 Pi geometry.

2. Beryllium Contamination

The maximum permissible levels for surface contamination removable by smearing are:

Floors and walls	0.02 ug/cm <sup>2</sup>
Unenclosed equipment	0.01 ug/cm <sup>2</sup>

3. The following values are being used for the Maximum

Permissible Concentrations for airborne contamination:

Beryllium: 2 micrograms per cubic meter for continuous exposure with a maximum concentration of 25 micrograms per cubic meter for any period of time as stated in the above. These figures are based on the MPPC of the American Industrial Hygiene Association.

Uranium:  $10^{-10}$  microcuries per cubic centimeter.

Thorium:  $10^{-11}$  microcuries per cubic centimeter.

#### E. Analytical Methods

All alpha determinations on air samples and smear samples will be made in a scintillation type alpha counter. This instrument is the Eberline Instrument Corporation Model SAC-2. This instrument operates at a background level of approximately 0.1 c/m with a geometry of 40%.

General air samples will be counted once. If more than the  $2\text{PC}_{\alpha}$  is indicated on the sample, the sample will be counted a second time a minimum of four hours later. Koval's formula is then applied to the two counts to give the long lived activity after correction for short lived activity from the Raion-Thoron decay products.

Special air samples and dust samples will be counted twice and the Koval determination for long lived activity applied.

Beryllium analysis of air samples and smear samples will be performed using an emission spectrograph. Sample preparation procedures will involve the Silver Chloride Carrier Method developed by the Dow Chemical Company for the determination of beryllium in air filter samples.

#### F. Contaminated Waste Disposal

Liquid waste will be collected in four drainage systems. Criticality considerations of these systems are discussed elsewhere.

All liquid drains which originate in areas where there is no possibility of contamination drain directly to the domestic sewer. These drains originate in the administrative and office areas.

Liquid drains which originate in the process area where there is a possibility but a low probability of contamination, will be collected in 1000 gallon holding tanks where it can be sampled.

If the samples indicate levels below 1.0 ppm for beryllium and  $3 \times 10^{-5}$  uc/cm<sup>3</sup> for uranium, or uranium-thorium mixtures, the liquid will be released to the domestic sewer system. If the samples indicate levels above this, the liquid will be decontaminated in our own low level waste treatment facility by decontamination and filtration. The decontaminated liquid will again be sampled to assure levels below the above stated levels before being released to the domestic sewer system.

Liquid waste which originates in areas such as the decontamination sinks, filtrate drains, etc., where there is a high probability of contamination above the allowable levels for sewer discharge, will be collected in 1000 gallon holding tanks. Liquid in these tanks will be decontaminated in our own low level liquid waste treatment facility. Decontaminated liquids will be sampled to assure contamination levels below those indicated above before being released to the domestic sewer.

Liquids which originate where enriched uranium solutions are processed will be collected in critically safe vessels for ultimate recovery.

Solid waste originating in the process area which contains non-recoverable amounts of beryllium, uranium and/or thorium will be collected in closed containers lined with plastic bags. This will be primarily such materials as paper, wiping rags, etc. The bags, after being sealed, will be packed in metal drums for ultimate disposal in accordance with instructions from the ABC.

Solid waste containing recoverable amounts of enriched uranium will be collected in covered, critically safe containers for shipment to recovery processing areas.

3. Smoking and Eating

Smoking and eating are prohibited in the process area. Smoking and eating are permitted in designated areas. The portion of the building where protective clothing is allowed is designated as a smoking area. Washing facilities are available in this area and all personnel are required to wash their hands prior to smoking in this area.

VII. RADIATION DOSIMETRY

A. Film Badges

The greatest radiation hazard from enriched uranium will arise in the event of an accidental nuclear excursion. It is

impossible to predict what personnel might be involved in such an incident. Therefore, all personnel in the process area are required to wear film badges containing both low level and high level beta-gamma sensitive film.

Similar film badges will be provided for all visiting personnel not normally assigned to the area.

A commercial film badge supplier will furnish the film badges and processing. This firm will also keep a set of permanent records on all exposures. This is in addition to the records maintained by the Health Physics group. The sensitivity range of the film badge is from 10 to 100,000 mrem.

Compliance with the AEC requirements will be assured by shutting down any operation and removing the operator from further exposure if any individual receives more than:

3 Rem penetrating exposure in a 13 week period, or

6 Rem skin dose in a 13 week period, or

15 Rem penetrating dose in a year's period, or

30 Rem skin dose in a year's period, or

An accumulation which exceeds an average of 5 Rem penetrating dose for each year of age past the age of 13.



It is not expected that any operation performed in conjunction with this project will yield radiation exposure which will even approach these levels. Experience on similar operations at other installations has shown very little radiation problem.

#### B. Gamma Alarms and Threshold Detectors

A gamma alarm system is provided with five detecting stations. Each of these stations is located optimally with respect to detecting radiation from a criticality. The processing area will have two detectors, the inspection area one, the furnace area one, and the storage vault one.

A central follow meter panel with individual readout for each detector is coupled with a master alarm panel and follow meter. In the event that the radiation at any detector reaches the level set on the alarm panel, an alarm light and distinctive audible alarm will be indicated at the detector. This will be the signal to personnel in the area to evacuate as rapidly as possible. At the same time, an alarm will sound at the follow meter panel. This panel is located in the foyer near the main entrance. This location allows reentry personnel to determine radiation levels in the process area without having to enter this area.

The alarm levels set at each detector will be 15 mr/hr.

Special film badges with beta-gamma film, MDA neutron film and threshold detectors of indium, sulfur, gold, and cadmium covered gold, will be placed around the process area. These area monitoring film badges will provide information about radiation intensities and spectra.

#### VIII. MEDICAL PROGRAM

##### A. Physical Examinations

A pre-employment physical examination is required of all employees working on this project. This places special emphasis on previous work history, complete blood and urine analyses, chest x-ray, visual acuity, and hearing. All employees must be examined by a physician. A complete physical examination will be required of all personnel working on this project. Periodic physicals will be required of supervisory and administrative and maintenance personnel. A complete physical will be required upon termination of an employee.

All complaints of upper respiratory irritation will be immediately referred to a physician for examination.

All wounds incurred in the process area will be reported and treated for possible contamination. A trained First Aid attendant will be available for minor wounds.

A physician with a security clearance is available on call to treat injured persons. Open wounds will not be allowed in the process area.

#### B. Urinalysis

An initial urine sample will be requested of all employees. Periodic urine samples will be collected from all personnel associated with this project. These samples are submitted to a commercial bioassay laboratory for uranum analysis by the ether extraction alpha counting method.

Special samples may be required when exposure of an individual is suspected.

### III. PROCESS STATIONS

Process stations are discussed in detail on pages 22 through 33 in the classified copies of this manual.

23 thru 32

These pages are included in CPC-69. This document is unclassified  
without the inclusion of these pages.

3 Apr 61

X. RECORDS

A. Operating Personnel Exposures:

A complete set of records will be maintained covering all phases of potential exposure to the workers within the plant. Records will cover:

1. Routine air contamination levels within the plant.
2. Air contamination levels as a result of special operations, spills, etc.
3. Contaminated accidents or incidents which might cause personnel exposure.

4. Urinalysis results.
5. Film Badge readings.
6. Periodic Physical examinations.

B. Environmental Exposures: caused by the contact with the plant

Records will be kept on all evaluations made which might have some effect on the plant workers and nearby residents.

1. Off-site air samples.
2. Samples of effluent plant air.
3. Samples of effluent plant wastes.
4. Water and soil samples off-site.

XI. MATERIAL SHIPPING AND PACKING

All process materials to be shipped will be packaged in accordance with AEC and DOT regulations governing shipping of radioactive materials. Shipping containers will be checked for contamination before shipping. Decontamination facilities are available to assure complete removal of contamination.

XII. PERSONNEL TRAINING PROGRAM

All employees entering the project will be required to participate in a training program related to Health and Safety. The meetings will be of the conference type, with direct employee participation. The initial phase of the program will be a meeting to present

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all of the phases of the Health and Safety program as outlined below. This initial contact will be followed up by further periodic meetings to review the phases individually and to test the employees on their knowledge of the program. Periodic practice evacuations will be held to assure that employees recognize alarms and know evacuation routes and procedures. After successful completion of the training program, which will take approximately 8 hours per employee, each participating employee will be given written recognition of his participation and qualification.

The following outline will be used as a guide in preparing the training program. The Health Physicist for this project will conduct the program.

1. Hazards of radiation and radioactive materials

Methods of entry to the body are by:

A. Inhalation. Preventative measures include:

1. Confinement

a. Glove Box

b. Velocity Hood

B. Ingestion

1. No smoking rule.

2. No food or drinks in process area.

C. Injection

1. No open wounds in process area.

2. All injuries must be reported.

## II. External problem of radioactive material.

### A. Film Badges

1. Description of method
2. Reason for need

### B. Criticality Alarms

1. Purpose and function
2. Location of alarms
3. Visual and audible signals.
4. Evacuation procedures and routes

## III. Medical Program

- A. Pre-employment physical examination
- B. Periodic re-examination
- C. Analysis program

### D. Health Survey

- A. Characteristics
- B. Method of detection

## V. Basis for MFC levels

- A. Maximum level for continuous exposure without harm.
- B. Exceeding MFC for short periods is undesirable, but not immediately dangerous

## VI. Safety Program

- A. Company policies
- B. Compensation laws
- C. Importance of reporting all injuries

### VII. Definition of responsibility

- A. Management's responsibility to provide safe working conditions.
- B. Health Physics responsibility to assure that conditions are safe.
- C. Individual's responsibility for compliance with rules and procedures.

### XIII. EMERGENCY COVERAGE

A fully equipped and trained monitoring team operating under the Radiological Assistance Plan is available to provide emergency coverage in case of major emergencies. This team is located at the Rocky Flats Plant.

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SAMPLE LOCATIONS

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