TWX 510-655-2634

USR UNITED STATES RADIUM CORPORATION
4150 OLD BERWICK ROAD / BLOOMSBURG, PA. 17815 / (717) 784-3510

March 14, 1969

Division of Materials Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Attention: J. A. McBride, Director

Dear Mr. McBride:

Application for licensing of the reorganized United States Radium Corp. Nuclear Facility is enclosed. Two copies of FORM AEC-313 with supplemental information are included. If you should desire more copies, they are available for immediate delivery to you.

The application is completed as applying for a new license rather than a renewal of an existing license. If a renewal application would be more appropriate, I would appreciate this suggestion.

Present plans call for start up of the new building May 1, 1969, assuming, of course, that we have met all licensing requirements by that time. I will be available to answer questions at your offices anytime you may request.

Sincerely yours,

UNITED STATES RADIUM CORPORATION

Orval L. Olson

Orval L. Olson
Director
Nuclear Division

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Form AEC-313
8-64
10 CFR 30

UNITED STATES ATOMIC ENERGY COMMISSION

APPLICATION FOR BYPRODUCT MATERIAL LICENSE

Form approved.
Budget Bureau No. 38-R027

INSTRUCTIONS.—Complete Items 1 through 16 if this is an initial application or an application for renewal of a license. Information contained in previous applications filed with the Commisson with respect to Items 8 through 15 may be incorporated by reference provided references are clear and specific. Use supplemental sheets where necessary. Item 16 must be completed on all applications. Mail two copies to: U.S. Atomic Energy Commission, Washington, D.C., 20545, Attention: Isotopes Branch, Division of Materials Licensing. Upon approval of this application, the applicant will receive an AEC Byproduct Material License. An AEC Byproduct Material License is issued in accordance with the general requirements contained in Title 10, Code of Federal Regulations, Part 30, and the Licensee is subject to Title 10, Code of Federal Regulations, Part 20.

1. (a) NAME AND STREET ADDRESS OF APPLICANT. *(Institution, firm, hospital, person, etc. Include ZIP Code.)*

United States Radium Corporation
4150 Old Berwick Road
Bloomsburg, Pennsylvania 17815

(b) STREET ADDRESS(ES) AT WHICH BYPRODUCT MATERIAL WILL BE USED. *(If different from 1 (a). Include ZIP Code.)*

same

2. DEPARTMENT TO USE BYPRODUCT MATERIAL

Nuclear Division

3. PREVIOUS LICENSE NUMBER(S). *(If this is an application for renewal of a license, please indicate and give number.)*

4. INDIVIDUAL USER(S). *(Name and title of individual(s) who will use or directly supervise use of byproduct material. Give training and experience in Items 8 and 9.)*

D. B. Cowan, Manager, Gas Filling
G. E. Widger, Manager, Isolite Assembly
I. W. Allam, Manager, Foil Preparation

5. RADIATION PROTECTION OFFICER *(Name of person designated as radiation protection officer if other than individual user. Attach resume of his training and experience as in Items 8 and 9.)*

O. L. Olson, Director,
Nuclear Products Division

6. (a) BYPRODUCT MATERIAL. *(Elements and mass number of each.)*

(b) CHEMICAL AND/OR PHYSICAL FORM AND MAXIMUM NUMBER OF MILLICURIES OF EACH CHEMICAL AND/OR PHYSICAL FORM THAT YOU WILL POSSESS AT ANY ONE TIME. *(If sealed source(s), also state name of manufacturer, model number, number of sources and maximum activity per source.)*

Hydrogen-3	Any chemical form	100,000 Curies
Promethium-147	Any chemical form	100 Curies

7. DESCRIBE PURPOSE FOR WHICH BYPRODUCT MATERIAL WILL BE USED. *(If byproduct material is for "human use," supplement A (Form AEC-313a) must be completed in lieu of this item. If byproduct material is in the form of a sealed source, include the make and model number of the storage container and/or device in which the source will be stored and/or used.)*

Research and development as defined in 10 CFR 30.4(q).
Processing for distribution to authorized recipients.

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(Continued on reverse side)

TRAINING AND EXPERIENCE OF EACH INDIVIDUAL NAMED IN ITEM 4 *(Use supplemental sheets if necessary)*

8. TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB (Circle answer)	FORMAL COURSE (Circle answer)
a. Principles and practices of radiation protection	SEE ITEM 8 ATTACHMENT -		Yes No	Yes No
b. Radioactivity measurement standardization and monitoring techniques and instruments	resumes		Yes No	Yes No
c. Mathematics and calculations basic to the use and measurement of radioactivity			Yes No	Yes No
d. Biological effects of radiation			Yes No	Yes No

9. EXPERIENCE WITH RADIATION. *(Actual use of radioisotopes or equivalent experience.)*

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION OF EXPERIENCE	TYPE OF USE
		See Item 8 attachment - resumes.		

10. RADIATION DETECTION INSTRUMENTS. *(Use supplemental sheets if necessary.)*

TYPE OF INSTRUMENTS *(Include make and model number of each)*	NUMBER AVAILABLE	RADIATION DETECTED	SENSITIVITY RANGE *(mr/hr)*	WINDOW THICKNESS *(mg/cm²)*	USE *(Monitoring, surveying, measuring)*
See Item 10 attachment.					

11. METHOD, FREQUENCY, AND STANDARDS USED IN CALIBRATING INSTRUMENTS LISTED ABOVE.

See Item 11 attachment, frequency on attachment 10

12. FILM BADGES, DOSIMETERS, AND BIO-ASSAY PROCEDURES USED. *(For film badges, specify method of calibrating and processing, or name of supplier.)*

See attached Health Physics procedures.

INFORMATION TO BE SUBMITTED ON ADDITIONAL SHEETS IN DUPLICATE

13. FACILITIES AND EQUIPMENT. Describe laboratory facilities and remote handling equipment, storage containers, shielding, fume hoods, etc. Explanatory sketch of facility is attached. *(Circle answer)* (Yes) No

14. RADIATION PROTECTION PROGRAM. Describe the radiation protection program including control measures. If application covers sealed sources, submit leak testing procedures where applicable, name, training, and experience of person to perform leak tests, and arrangements for performing initial radiation survey, servicing, maintenance and repair of the source.

See attached Health Physics program for Nuclear facility.

15. WASTE DISPOSAL. If a commercial waste disposal service is employed, specify name of company. Otherwise, submit detailed description of methods which will be used for disposing of radioactive wastes and estimates of the type and amount of activity involved.

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RECEIVED
DIVISION OF COMM. REGULATION

CERTIFICATE (This item must be completed by applicant)

16. 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 30, AND THAT ALL INFORMATION CONTAINED HEREIN, INCLUDING ANY SUPPLEMENTS ATTACHED HERETO, IS TRUE AND CORRECT TO THE BEST OF OUR KNOWLEDGE AND BELIEF.

Date March 13, 1969

UNITED STATES RADIUM CORP.
Applicant named in item 1

By: O. L. Olson

O. L. Olson

Director, Nuclear Division
Title of certifying official

WARNING.—18 U. S. C., Section 1001; Act of June 25, 1948; 62 Stat. 749; makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

☆ U.S. GOVERNMENT PRINTING OFFICE : 1964 O—745-381

67-68

SAFETY ANALYSIS REPORT
for
PROPOSED RADIOISOTOPE PROCESSING FACILITY

UNITED STATES RADIUM CORPORATION

BLOOMSBURG, PENNSYLVANIA

-- O. L. Olson, Health Physicist

INTRODUCTION

This Safety Analysis Report describes a facility planned for manufacturing tritiated metal foils and tritium activated self-luminous light tubes. The facility is to be located on the United States Radium Corporation property at 4150 Old Berwick Road, Bloomsburg, Pennsylvania.

The facility will be designed to meet performance specifications which will assure safe operation for employees and occupants in surrounding unrestricted areas. Specifically, the performance specifications are selected to assure operation within all applicable limits established for radioisotope licensing by state and federal agencies.

PURPOSE OF FACILITY

Primary purpose

The primary purpose of this facility is to provide improved housing for new equipment to be used for manufacturing tritiated metal foils and tritium activated light tubes.

Secondary purpose

It is planned to move all radioisotope processing existing at the Bloomsburg location into this facility in order to provide improved housing for all radioisotope operations.

GENERAL DESCRIPTION OF FACILITY

Radioisotope processing will be housed in a new, one-story building set on a concrete slab. The radioisotope processing area will be approximately 5000 square feet. If a non-radioisotope area, e.g. an office area, is attached to the building, the ventilation systems for the radioactive and non-radioactive areas will be separate and isolated by pressure differentials across airlocks.

The radioisotope area ventilation system will exhaust by way of a filter bank and exhaust stack. The stack will be located in the center of a restricted area large enough to provide for a tolerable annual release of 1000 curies of tritium. This compares to a total predicted release of 425 curies from all tritium sources in 1968.

Liquid effluent from potentially contaminated sources will be processed through the existing liquid effluent disposal facility. This facility provides the capability for removal of radioisotopes by evaporation and ion exchange. Quantitative dilution is also provided for disposal of tritium.

Solid radioactive waste will be disposed of by contract with a licensed firm for burial in an AEC approved burial ground.

DESCRIPTION OF BUILDING

Building ventilation

If an office area, or other non-radioactive area, should be added to the building, the ventilation system would be separate and isolated from the radioisotope processing area by air locks. A pressure differential of 0.05 inch water gauge will be maintained to assure positive air flow into the radioisotope area.

A pressure differential of 0.1 inches water gauge will be maintained between the radioisotope area and outdoors. Outside entrances will be protected by air locks if they are to be used routinely. Other openings to the outside will be opened only after approval by the facility manager who will assure that operations in process will not create a radiation hazard due to loss of building air balance.

Within the radioisotope area, the ventilation system will be designed to provide six (6) air changes per hour. The air balance within the area will be designed to maintain positive flow from hallways into individual rooms and out through the exhaust system.

Ventilation air from the radioisotopes area will not be recirculated.

Intake air will be passed through dust-stop type filters to reduce the ventilation air dust load.

A system of dampers will be provided in the ventilation ducts such that a desirable building air balance can be maintained by routine survey and adjustment.

Building ventilation exhaust

The building exhaust system will be designed on the principle of stopping effluents at the source. Primary filtration at each work station will be designed to capture filterable effluent.

Dust-stop type filters will be located in the exhaust plenum just ahead of the main blower(s) which will power the building exhaust system.

Building surface contamination control

Control of surface contamination will be accomplished by providing work station equipment and work procedures designed to minimize the generation of surface contamination.

Protective clothing will be utilized to restrict the movement of radioisotope surface contamination.

Entrance to and exit from the radioisotope area will be through change rooms where protective clothing change procedures will be followed to prevent movement of surface contamination out of the area.

Rooms in the radioisotope area that have a high probability of surface contamination will be painted with epoxy type paint which facilitates decontamination.

Control of contaminated liquid effluent

Contaminated aqueous liquid lines will drain to the existing liquid waste disposal processing facility for appropriate monitoring and processing.

Contaminated organic liquids will be absorbed on an absorbent, then packaged and disposed of as solid waste.

All potentially contaminated liquids will be analyzed for radioisotopes prior to release to the environment to assure that all liquid effluent releases conform to applicable regulations.

Control of direct radiation hazards

Brehmsstrahlung radiation from tritiated foils will be the only significant source of direct radiation in this facility. Appropriate handling procedures and, where required, radiation shielding will be provided.

The radiation hazard from brehmsstrahlung is not a major problem. In AERE-M1169, it is shown that brehmsstrahlung from a tritiated titanium foil is 1.8 mrad/hr/Ci at 10 cm. These targets have a nominal 4 curies of tritium with a range of 2 to 10 curies for special orders.

EVALUATION OF RADIATION HAZARD TO ENVIRONMENT

Airborne radioactive effluents - routine

In this evaluation, the annual tolerable tritium release from a stack located at the center of two different sized circular restricted areas was calculated by three well-known atmospheric dispersion equations. Figure 1 shows how these restricted areas might be located on the Bloomsburg property. Table I gives the results of the atmospheric dispersion calculations.

TABLE I

Calculated Tolerable Annual Release of Tritium

Restricted area radius ft.	Author of equation used	Tolerable Ci/year
260	Turner	1094
260	Sutton	3137
260	Bosanquet & Pearson	891
320	Turner	1585
320	Sutton	4394
320	Bosanquet & Pearson	1310

Values obtained by the Turner and Bosanquet-Pearson methods are considered to be more accurate than the values obtained from Sutton's equation. An explanation of the differences involves an analysis of atmospheric dispersion parameters used in each equation. Such an analysis is beyond the scope of this report.

MAXIMUM CREDIBLE ACCIDENT

Definition of maximum credible accident

For this report Maximum Credible Accident is defined as the event which could release the greatest amount of tritium to unrestricted areas in 24 consecutive hours. For purposes of this report "Acts of God" are not included in the evaluations to determine the maximum credible accident. Fire originating within the building is included in the determination of maximum credible accident.

Description of maximum credible accident

The maximum credible accident in this facility would be the release of the total working volume of tritium from the tritium handling equipment. Such an accident could release 4000 curies of tritium which would be carried by the ventilation exhaust system out through the exhaust stack.

The foil tritiating equipment and the luminous tube filling equipment each have a tritium working volume of 4000 curies. Under separate headings, a discussion of accident probability for each unit is presented.

The radiation hazard which could be generated is indicated by the calculated values in Table II.

TABLE II

Maximum Tritium Concentrations at Points of Interest Following a Release of 4000 Ci/24 Hours

Atomospheric stability	Wind speed MPH	Point of Interest	µCi/cc 24-hr average	Feet downwind from stack
very stable	2	plume centerline	1×10^{-3}	260
very stable	2	plume centerline	7.8×10^{-4}	320
very stable	2	maximum ground level	3.2×10^{-6}	8690
average	2	maximum ground level	1.7×10^{-4}	476

The values in Table II are nominal values. It is extremely unlikely that the exact atmospheric conditions chosen here would occur simultaneously with the other factors required to produce the maximum credible accident.

As can be seen from the table, average weather conditions with a low wind speed create the highest ground level radiation hazard. In the Bloomsburg area, such conditions are extremely unlikely. The average wind speed for all months is well above 2 miles per hour. A review of Local Climatological Data published by Environment Science Services Administration for 1967 at the Williamsport, Pennsylvania airport shows a mean annual wind speed of 8.1 miles an hour. July, August and September had the low mean hourly speed by the month. It was 6.8 miles per hour in each month. Meteorological conditions at Bloomsburg are very similar to those at Williamsport because the general topography is similar and the river valleys run in the same general direction.

The prevailing wind direction at Williamsport in 1967 was west for all months except February and September when it became west northwest.

OPERATION OF TUBE FILLING EQUIPMENT

Description of equipment

This system consists basically of an ultra high vacuum system to remove the air from the tubes to be filled. A tritium supply section with a uranium tritide container as the source of tritium for filling the tubes and a high sensitivity bellows type pressure gauge. A "pull-back" section which utilizes a uranium container to remove the tritium from the system and from the unused portion of the tubes that have been filled. There are cross-over lines connecting the pull-back section and the fill section. The tritium is reclaimed by heating the uranium pull-back container and absorbing the released tritium on the uranium tritide supply container.

The system is a semi-automatic Sorption and Ion pumped system that consists of three modules designed to operate under a single exhaust hood. A central tritium supply section and pull-back section are used for all three modules. Each module fills and seals a group of forty tubes on a manifold per cycle. Each module is expected to cycle three times per shift for a total of three hundred and sixty filled tubes.

The sorption pump absorbs and holds all pumped gases with the exception of helium while it is at liquid nitrogen temperature. The gases, as they are removed during the reactivation of the sorption pump,

are scrubbed to remove any tritium present, before release to the exhaust hood. The ion pump collects and permanently holds all pumped gases.

A single operator's attendance is required at each module during loading, start of the automatic pumping sequence, the duration of the fill cycle, the start of the sealing operations, and the start of the pull-back and pump sequence. The system is designed so that in the event of a leak during the tritium fill cycle or the sealing operation on any module, all valves are automatically closed except the valve to the pull-back sections which opens and retracts the tritium into the uranium container. This emergency pull-back procedure may be manually activated by the operator at any time that it is necessary. The system is designed so that all valves may be manually operated or by-passed when necessary.

The sealing of the glass tubes is accomplished by focused infrared radiation. The tubes are annealed by the unfocused radiation that is emitted by the lamps.

A tritium air monitor installed in the hood exhaust system alerts the operator to any release of tritium, also at a pre-set level initiates the emergency pull-back sequence as previously described. The system is designed to be fail safe. In event of a power failure or a compressed air failure, all the automatic valves will close. Manual bypass valves may then be opened to return the tritium to the uranium container, if necessary.

This system has been designed to encompass high quality materials of construction, most modern techniques of assembly, and safe and easy operation and maintenance.

DISCUSSION OF POTENTIAL RADIATION HAZARD FROM OPERATION OF LUMINOUS TUBE FILLING EQUIPMENT

Accidental release of tritium from new fill system

There are four possible points of accidental release of tritium from the new fill system. These are listed in the order of probability of occurrence, the first being the most frequent.

1) A leak at the glass to metal seal. Our experience in 3 years operating the existing system shows that this would never exceed 10 mCi per hour and that the duration at this level would never be longer than 5 minutes.

2) Complete rupture of a tube while on the manifold. There will be an estimated 400 Ci of tritium in this section at less than atmospheric pressure. The operating schedule of this system is such that the operator must be present while the tritium is in this section. It cannot be visualized how it would be possible to lose in excess of 50 Ci with the emergency procedure that will be set up.

3) Leaks in the gas handling section of the system. The release rate would never exceed 5 mCi per hour with a maximum duration of 10 minutes.

4) Operator error. This is very unlikely to occur, due to the system fail safe automation. If an operator or the automation of the system failed, the tritium would either be contained in the ion pump or trapped in the sorption pump. A special emergency procedure will be set up to strip this absorbed tritium from the sorption pump, if this should occur.

DESCRIPTION OF FOIL TRITIATING PROCESS

Description of equipment

Existing equipment is described here because design for new equipment has not been established yet.

Metal foils are tritiated in a quartz pot with an absolute pressure not greater than two-thirds atmospheric pressure.

Tritium gas is stored on uranium in steel pots. It is moved by a diffusion pump/mechanical pump system which is used to evacuate the system.

Tritium in exhaust from the system is passed through an oil demister, a molecular sieve to remove tritiated water, a copper oxide furnace to oxidize gaseous tritium, and through a second molecular sieve to assure capture of all tritium.

The complete system is enclosed in a glovebox which is exhausted through a tritium removal train to the exhaust stack.

Discussion of potential radiation hazard from operation of foil tritiating equipment

The most probable accidental release of tritium from this equipment would be the loss of 100 to 150 curies during an initial step in the process when a small amount of tritium is moved from the storage pots to the quartz impregnation pot to test the system. The resulting concentration in the environment would be .04 times the values in

Table II if all scrubbing of effluent tritium at the glovebox failed. In a new design, the capacity of the glovebox effluent scrubbing system would be redesigned to a capacity to capture tritium leaks at the glovebox outlet port.

As was explained under Description of Equipment, tritium which is flushed from the equipment as an inevitable consequence of processing is captured by a molecular sieve-copper oxide system.

New equipment would be designed to provide "tritium capture" capacity to reduce the release hazard as much as reasonable cost will allow.

DESCRIPTION OF EQUIPMENT FOR SPECIAL LUMINOUS TUBES

Description of equipment

The details of this equipment have not been developed. It will be a small gas filling unit designed for development work and short production runs of special items.

Performance specifications will require that the maximum credible accidental release not cause unrestricted area concentrations in excess of 500 X unrestricted area limit and that the most probable operating accident release not cause concentrations in excess of unrestricted area limits.

CONTINUOUS EFFLUENT STACK MONITORING

Description of equipment

The effluent stack will be monitored by a train of monitors that includes a particulate filter, an ionization chamber, and a water impinger. The particulate filter will be counted daily in a proportional counter; the water impinger sample will be counted daily in a liquid scintillation counter; the ionization chamber output will be recorded continuously on a chart recorder.

The ionization chamber will be a 14.8 liter Applied Health Physics unit feeding the signal to a Cary 401 vibrating reed electrometer which activates a recording pen on a Honeywell chart recorder.

Discussion of effluent stack monitoring

The effluent stack will be monitored continuously - 24 hours a day. As currently planned, the monitoring equipment will have a nominal sensitivity of 1×10^{-6} μCi/cc for tritium in air. It will be sampling a stack flow at a location in the stack to produce a representative sample of stack effluent.

An instantaneous alarm system adjustable to predetermined levels will be attached to the monitoring system.

Experience has shown that the ratio of tritium activity as particulate, water soluble, and gas is fairly constant. It is possible, therefore, to integrate tritium effluent recorded by the ionization chamber and calculate the total tritium effluent from all three types.

ROOM AIR MONITORING

Discussion of room air monitoring

During the first few months of operation in this facility, it is planned to do continuous air monitoring for tritium in each room of the radioisotope area by utilizing several Johnston Triton units to provide a record of tritium levels and to provide alarm capability.

Water impinger samplers will also be utilized extensively for several months to provide data which can be compared with the Triton sampler data.

From the data collected during the first several months of operation, a determination will be made as to the need and design of a permanent air monitoring system which would operate from a "house vacuum" system.

FIRE CONTROL IN RADIOISOTOPE AREA

Description of equipment

An automatic sprinkler system and construction of the building will, of course, be designed to meet applicable local fire control codes. In this facility, however, the effect of automatic sprinkler spray must be carefully analyzed. First, it may not be desirable to sprinkle equipment such as the tube filling system because unplanned closed circuits might set up an undesirable valving sequence. Some automatic shutdown of the tritium processing equipment will have to be coupled with the sprinkler system.

Another factor to be evaluated is the effect of automatic sprinkling on stack effluent temperature. If the stack exit temperature is lowered, the dispersion of effluent, dilution factor, is reduced significantly.

Selection of materials and procedural controls will be utilized to prevent the accumulation of flammable materials in the radioisotope area.

PERSONNEL MONITORING PROGRAM

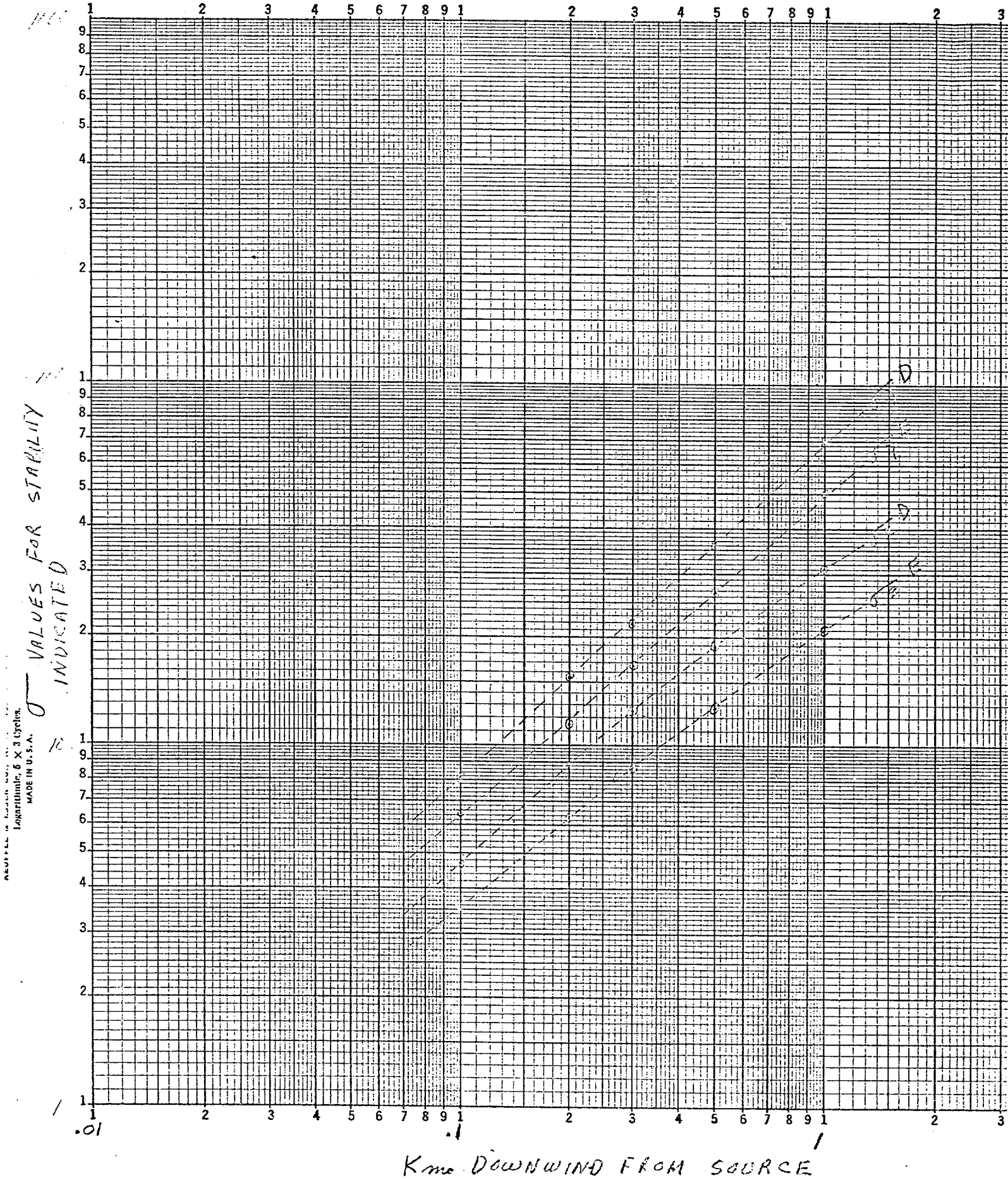
Airborne contamination exposure monitoring

During initial operating periods, breathing zone samples will be obtained for the personnel involved. Once the operation of a piece of equipment is stabilized, it is planned to use stationary samplers located in each room. Currently, it is planned to draw air from each work station in a room to a central room sampler to obtain a daily integrated sample for the room. This program would be coordinated with the program discussed under Room Air Monitoring.

The sampling for personnel monitoring would initially be performed by use of Johnston Triton units and personal water impinger units. If the initial data justify the need, a system of Kanne chambers or permanently installed Johnston Tritons will be provided as part of a permanent system.

Bioassay program

Initially, daily urine samples from each work in the radioisotope area will be analyzed for tritium. Data from the daily urine sample program will be analyzed to define a permanent routine tritium urinalysis program. In any case, all radioisotope area workers will be requested to submit a minimum of one urine sample each work week for tritium analysis.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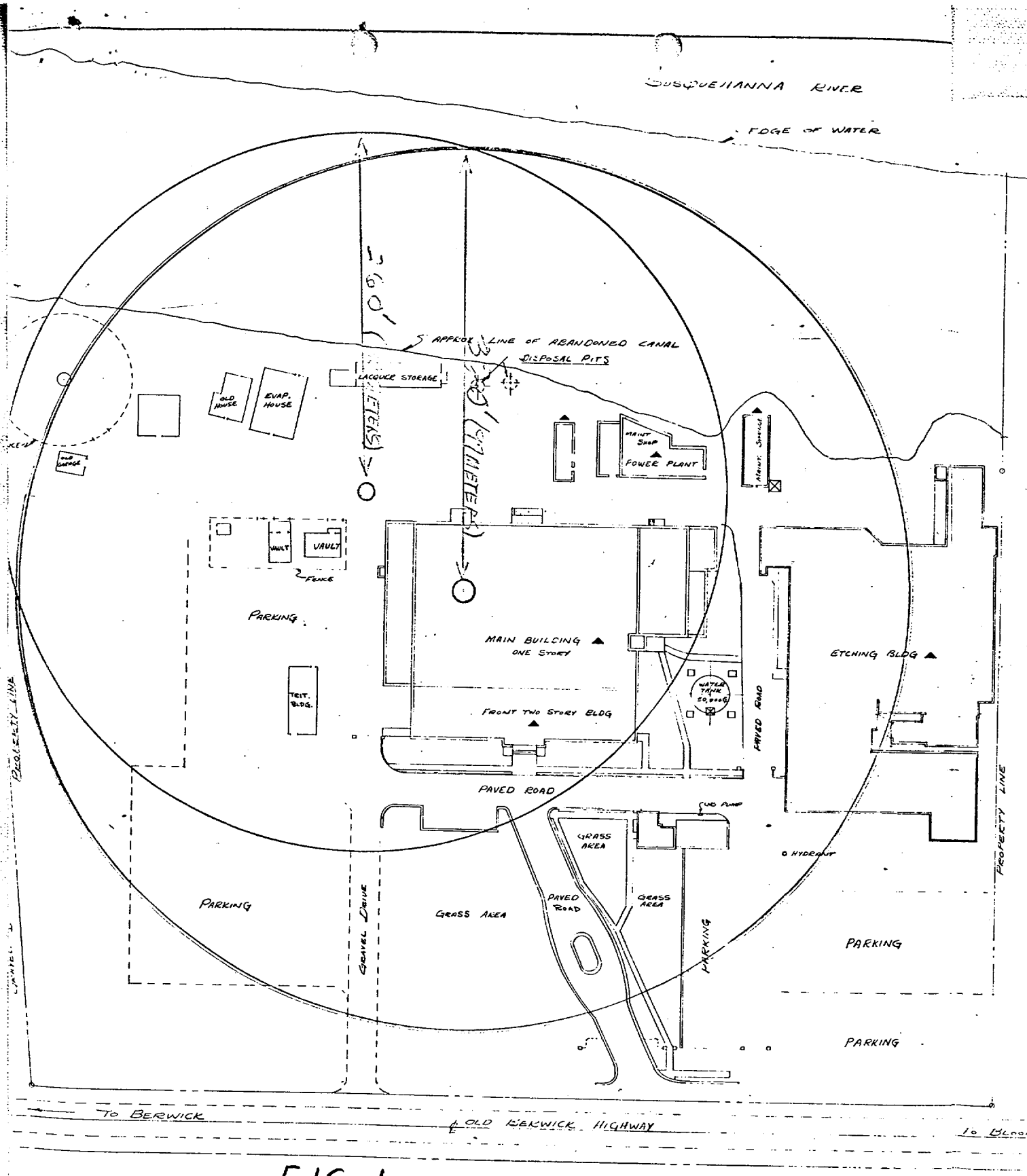
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FIG. 1