VOID SHEET

TO: License Fee Management Branch

FROM: Reg III

SUBJECT: VOIDED APPLICATION

'90 NOV -2 P3:07

Control Number: 88852

Applicant: Ohio State University

Date Voided: 10/19/90

Reason for Void: Failure to respond w/in 30 days.

[signature] 10/19/90
Signature Date

Attachment:
Official Record Copy of
Voided Action

FOR LFMB USE ONLY

Final Review of VOID Completed:

☐ Refund Authorized and processed

☐ No Refund Due

☑ Fee Exempt or Fee Not Required

Comments: ______

Log completed ☑

Processed by: CP

ML30

9101040353 901019
REG3 LIC30
MATLSLICENSING PDR

(FOR LFMS USE)
INFORMATION FROM LTS

BETWEEN:

LICENSE FEE MANAGEMENT BRANCH, ARM
AND
REGIONAL LICENSING SECTIONS

PROGRAM CODE: -----
STATUS CODE: 3
FEE CATEGORY:
EXP. DATE: 0
FEE COMMENTS:

LICENSE FEE TRANSMITTAL

A. REGION

1. APPLICATION ATTACHED
   APPLICANT/LICENSEE: OHIO STATE UNIVERSITY, THE
   RECEIVED DATE: 900307
   DOCKET NO: 3031605
   CONTROL NO.: 388852
   LICENSE NO.:
   ACTION TYPE: NEW LICENSE

2. FEE ATTACHED
   AMOUNT: 0
   CHECK NO.: 0

3. COMMENTS

SIGNED P. Detlaff
DATE 3-8-90

B. LICENSE FEE MANAGEMENT BRANCH (CHECK WHEN MILESTONE 03 IS ENTERED /__/)

1. FEE CATEGORY AND AMOUNT: FEE EXEMPT

2. CORRECT FEE PAID. APPLICATION MAY BE PROCESSED FOR:
   AMENDMENT
   RENEWAL
   LICENSE ✓

3. OTHER

SIGNED
DATE

3

F

OCT 31 1990

The Ohio State University
Office of the Vice President for Health Services
ATTN: Walter E. Carey, Ph.D.
Director, Office of Radiation Safety
200 Meiling Hall
370 West Ninth Avenue
Columbus, OH 43210-1238

Gentlemen:

We have received your letter dated July 13, 1990 in response to our June 15, 1990 letter (copy enclosed) requesting additional information in order to issue a new wet source storage irradiator license. In your response, you addressed only a portion of the areas outlined in our deficiency letter and indicated that due to extraneous circumstances, your response to the remaining items of the letter, (Equipment, Maintenance, Service, Radiation Levels, and Decommissioning) would be submitted under separate cover. Be advised that to date, we have not received your response to these items and consequently, cannot complete our review of your request.

Furthermore, in our June 15, 1990 letter we requested that you respond to us within 30 days and also notified you that we would void your request if you did not respond within that time period. You are hereby notified that we consider your application abandoned and have voided your request. This action is without prejudice to resubmission.

In order to reactivate this request, it will be necessary for you to submit your response, in entirety, to our June 15, 1990 letter. Information submitted in response to this letter should be referenced as additional information to voided Control Number 88852.

Sincerely,

Original Signed By
Patricia J. Pelke
Materials Licensing Section

Enclosure: Letter dated June 15, 1990

RIII
Pelke/mc
10/31/90

RIII
Adam
10/30/90

THE OHIO STATE UNIVERSITY

Office of Radiation Safety

B-042 Graves Hall
333 West 10th Avenue
Columbus, Ohio 43210-1239

Phone 614-292-0122

July 13, 1990

Ms. Patricia J. Pelke
U.S. Nuclear Regulatory Commission
Region III
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Ref: Control No. 88852

Dear Ms. Pelke:

The following sections of this letter are in response to questions contained in your letter of 15 June 90. If you have additional questions, please contact me.

Materials

A further check was made of documents obtained from Battelle, Columbus Laboratories, the General Electric Co., and International Neutronics. We are convinced that the material for which we are seeking a license is denoted by the alpha-numeric designation: GEP-186-xx, where xx ranges from 1 to 15. If there is a discrepancy, it may be in prior correspondence between Battelle and Region III.

Intended Use of Materials

"Provisions" for performance of activities for external users will be similar to those utilized for the University's Research Reactor. Typically, an initial verbal or written contact would be made requesting use of the facility. The use would be tentatively scheduled pending completion of a formal, written request, including details of the proposed irradiation. A safety analysis will be performed prior to performance.

The Ohio State University is a land-grant institution whose mission is defined in three areas: teaching, research, and service. The latter area is the one that allows the University to provide irradiation services to individiuals and institutions engaged in beneficial and productive activities. The University does not, by its charter, engage in for-profit activities. Any "fee" assessed in the performance of services as defined above would be based strictly on a direct-cost recovery only, dependent on the availability of such funds from the individual user.

Since the facility is not in operation, it is not possible to provide a detailed "description of the types of experiments (we) will perform on a 'service type' basis,...". However, as a possible example, an external user might be a researcher at a neigh-

2/19

Patty,

MS 16 entered

P.D.

(E)

boring university, who would request utilization of the irradiator facility for irradiation of biological material, perhaps in a study to assess mutagenic or toxic effects. In this example, the researcher might or might not have sufficient funds for direct-cost reimbursement. "Clients" in this context implies a user who has designed the experiment and will carry out most of the study, with the University providing the irradiation "service".

There will be no "commercial" or "production" processing of materials such as medical supplies for future, in-service use, or foodstuffs destined for consumption or distribution.

Authorized Users

As stated on page 7-2 (Item 7) of the original application, "The irradiator to be licensed is not yet installed at the University, so no prior experience is possible with this specific facility. However, Messrs. Myser, Talnagi and Davis will be responsible for installation and prior activities, such as shielding calculations and design, source handling and movement. This will provide a basis for actual operating experience when the facility is commissioned." Be advised that the irradiator is no longer in operation at Battelle/West Jeffersonm, so it is not possible to obtain any operating experience at that site.

An attempt will be made to find a similar facility at which the aforementioned individuals can receive hands-on training. It should be noted that the planned facility is a relatively simple wet-source design, involving no routine movement of sources, no in-air exposure of sources, and no complex conveyor system. Given these facts, a variance from the "minimum of 3 months of experience in irradiator operations" is requested.

Training

A. Discussion and problem-solving sessions will be added to the topic outline previously included in item 8. The total duration of the training will be 40 hours.

B. Since the proposed irradiator is not currently in service, it is not possible to provide details of an on-the-job training program. Further, on-the-job training will vary for different individuals. A graduate student performing mutliple experiments over an extended period of time will receive more training than an instructor from another university who wishes to perform a one-time irradiation lasting a few minutes. In the latter case, it is likely that the entire irradiation would be conducted by a previously authorized user.

   It is anticipated that on-the-job instruction will cover topics related to routine use of the facility under normal operating conditions, including how to insert and remove samples from the irradiator, indications obtained during operation of the irradiator (lights or meter readings), performance of appropriate radiation surveys, and securing the facility after completion of use. Emergency situations and other special operations are covered in the training program.

Irrespecticve of the details of the on-the-job training to be developed, the licensee hereby confirms that all individuals who load or unload samples, perform maintenance, move sources, or perform any other manipulations directly associated with the irradiator will receive on-the-job training.

C. The written examination will not be completed until details of the training program can be developed.

D. The section noted in your letter (i.e. Item 9, page 9-2 of the application) was written with the assumption that the "other individual" present at the access point would likely be an authorized user or a licensed reactor operator.

Leak Test Procedures

The questions regarding leak test procedures appear to specifically address concerns raised by the January '85 version of Task FC 403-4. This draft regulatory guide is applicable to panoramic dry source-storage irradiators, and panoramic wet source-storage irradiators. The material we are attempting to license will be used in a wet source-storage, fixed source irradiator.

The referenced draft regulatory guide states, in section 10.3, that if a wet source-storage unit has an ion exchange system, an acceptable method of leak-testing is to perform at least weekly checks of the ion exchange resin filter. It further states that the measurement need not be quantitative and that a survey instrument may be used.

Section 9.2 of our original application, as well as Figure 9-2, refer to a pool "demineralizer". This demineralizer is a mixed-resin, ion exchanger. Further, the survey instruments available at the Nuclear Reactor Laboratory are listed in Appendix C of the original application.

Leaking Source Procedure

A. The minimum activity that would indicate a leaking source is approximately 10 microcuries. This estimate is based on the following calculations.

The survey instrument routinely used for monitoring the ion exchange demineralizer is an Eberline model E-530. The normal background count rate at the demineralizer is less than or equal to 100 counts per minute (cpm). Assuming that an easily detectable radiation field is five times background, the necessary count rate would be 500 cpm. Assuming a 1% detector efficiency, the photon interaction rate would be 5E04 photons per minute which is approximately equal to 800 photons per second.

The nominal cross sectional area of the GM detector for the Eberline E-530 is 1.5 sq. in. Then the photon flux would have to be 500 photons/sq. in./second.

Assuming that the activity is concentrated as a point source on the axial centerline of the demineralizer cartridge, photons would traverse approximately six inches of a water/resin mixture and 0.25 inch of steel which comprises the outer shell of the demineralizer. For gamma rays from Co-60, the associated attenuation factors would be about 0.4 for the water/resin mixture and 0.8 for the demineralizer shell. As a result, the unattenuated flux would be approximately 1,600 photons/sq.in./second.

Assuming isotropic emission, the source strength required to produce that flux is 7E05 photons per second. Since two photons are emitted per disintegration, the activity would be 3.5E05 disintegrations per second, which is equal to approximately 10 uCi.

The demineralizer is operated about 20 hours per week with a flow rate of 10 gallons/minute. Thus the weekly flow is about 5E07 ml. Since the total volume of the pool water is a nominal 4E07 ml, the activity in the demineralizer approximates the total activity released during the week between surveys.

B. The storage tank to be used for testing leaking sources has not yet been constructed. The conceptual design of this tank is an aluminum tube of 3.5" inner diameter, 0.25" wall thickness, long enough to reach the bottom of the BSF pool, and capable of being drained and refilled with water. It will be located in the BSF pool, where it will be shielded on all sides by water and concrete.

Specific procedures for disposal of a leaking Co-60 source have not been established.

Personnel Monitoring

Refer to OSU Application for License, Feb 28, 90, Subitems 10.1 and 10.4.1.

A film badge will be issued to and worn by each person using the irradiator facility. These badges are whole body, gamma/beta dosimetry devices. Currently, OSU retains the services of Tech/Ops Landauer, Inc, for badges to be issued to users of the irradiator, as well as to persons conducting operations under all its other NRC licenses, including the Type A License of Broad Scope (No. 34-00293-02). These film badges have a 10-mrem threshold. Equivalent dosimetry services of other accredited companies may be used in the future; no license amendment would be required for such changes.

The commercial whole body film badges will be the personnel monitoring devices of record. Pocket dosimeters discussed in Subitem 10.1 will be available to users of the irradiator and are intended only for immediate indication of possible radiation exposures; they are not for official record (as may have been inferred from Subitem 10.1).

A. Pocket dosimeters worn at the Nuclear Reactor Lab (NRL) are manufactured by Dosimeter Corp., Model 862, with a range of 0-200 milliroentgens. NRL procedure RS-16 (attached) describes the annual calibration procedure of these devices. Since the devices are extremely simple, there are no "maintenance" procedures other than avoidances of mechanical damage, dirt, and moisture.

Usual NRL procedures are followed for using pocket dosimeters. A dosimeter is charged if necessary and the initial reading is noted in a logbook, as are the individual's name wearing the dosimeter, the date and the time of the initial reading, and the activity being performed which required the monitoring device to be worn. After completion of activity, the final dosimeter reading is noted, the difference is recorded between initial and final readings, and the date and time noted on the same line. Thus, the frequency of readout is on an "as needed" basis, when the dosimeter is first put on and later taken off. Of course, the individual wearing the dosimeter may read it at any time while wearing it, should there be a concern or a need to do so.

B. To repeat, pocket dosimeters will not be used for official record -- film badges will be the personnel monitoring devices of record.

It is confirmed that pocket dosimeters will be worn during installation of the irradiator and during subsequent "routine" operations of the irradiator, to establish dose rates that might be expected during the course of such "routine" operation. The intent is to assure that "immediate" dose readouts are available during operations where there is a slight chance of elevated dose rates being encountered (for example, initial placement of the source pins in the Bulk Shielding Facility pool), and during the period where operational experience is being gained by the authorized users. Elevated doses are not expected, and the purpose of this initial monitoring is to document that such is the case.

Also it is confirmed that exposure records will be maintained as explained in item A, immediately above, for establishment of a data base. However, NRC relief from the continued use of pocket dosimeters beyond establishment of a data base will not be necessary because the data base is intended for internal use only. Film badges will always be worn for official exposure data.

This is further justified in light of the use of TLD-type ring badges while placing or removing experiments (Subitem 10.1 of the application) and survey of dose rates at the irradiator access point (Subitem 10.4.3).

Use of pocket dosimeters after initial installation and operation of the irradiator would be required for "non-routine" irradiator operations, such as source pin rearrangement, source relocation, leaking source management, and various emergency operations.

Key Control

The Ohio State University Department of Physical Facilities issues keys to outside doors, room doors, and other area doors. Physical Facilities maintains signature authorization cards which identify persons authorized to request keys, as well as thorough key control procedures. A copy of Physical Facilites key control procedures is retained at the Nuclear Reactor Lab (NRL) (site of the proposed ^{60}Co irradiator) for reference and review.

The NRL staff maintains strict control of keys to the building. (Please see NRL Security Procedure SP-10 "NRL Key Procedures", attached.) In addition, NRL maintains a locked key box for storage of other keys necessary for access to the proposed irradiator. This includes keys to the following items:

- Bulk Shielding Facility pool cover grating;
- Building bridge crane (necessary for removal of the cover grating);
- Underwater tools necessary for manipulation of the ^{60}Co source pins;
- Irradiator sample elevator and pipe end-plug.

A key to the NRL building and a key to the locked key box will be issued to each authorized user of the irradiator by the Associate Director of the NRL. (Building keys are issued to other persons as well; these are persons with need of access to the building, but not necessarily to the irradiator. Except for approved reactor staff, these persons would not have access to the key box.)

(Please note that not all authorized users of the irradiator will necessarily be named on the license as stated in your letter of June 15, 1990. It is intended that users will be authorized by the University Radiation Safety Committee, constituted under the Type A License of Broad Scope, No. 34-00293-02, using training and experience criteria established by that Committee and appropriate to use of the irradiator.)

The 30-day response time that was stated in your letter, coinciding with the annual meeting of the Health Physics Society and annual leave arrangements for Nuclear Reactor Laboratory personnel, has made it impossible to answer all of the concerns you have expressed. Answers to the remaining questions will be sent under separate cover. I am curious about the imposed time limit that would start us back at "Square One". I have never seen this in prior correspondence. Is this new Commission and/or Region III policy? In any event, thank you for your assistance with this proposed licensing action.

Cordially,

Walter E. Carey

Walter E. Carey, Ph.D./CHP
Director

WEC:jnp

cc: R. L. St.Pierre
J. P. Allgeier
D. W. Miller
J. W. Talnagi
R. D. Myser

NRL OPERATING PROCEDURES

I. SCOPE:

This procedure is to standardize The Nuclear Reactor Lab Key request and possession procedures. It is binding to all NRL employees, experimenters and visitors who possess or require any NRL keys

II. DISCUSSION:

A. Use of the NRL Key Status Log

It is not the purpose of the NRL Key Status Log to be a clearing house for the issue of NRL keys. With the exception of the NRL Auxiliary Keys, no keys should be issued, reissued, transferred or passed on by this facility. All keys should be issued by and returned to the OSU Key Control Office via the NRL Key Status Log.

III. REFERENCES:

OSU Key Control Unit Key Regulations.

IV. PRECAUTIONS:

A. Possession of an OSU key implies understood liability by the recipient for that key. Keys will not be loaned to or borrowed by any non-issued person. Violations will result in confiscation of keys. Key recipient is obligated to report any key loss or theft as soon as possible to an NRL Associate Director. Liability, resulting from said key loss or theft to the NRL in terms of loss or property damage may otherwise occur.

B. When issued, the person receiving an Auxiliary Key will be responsible for that key as if it were issued by the OSU Key Control Unit in their name. Recipients of Auxiliary Keys will be cautioned to the fact.

V. PROCEDURES:

A. Issuing of Keys

1. All NRL keys will be issued by the OSU Key Control Unit with the receipt of an "OSU KEY REQUEST". Upon receipt of said key, an entry will be made in the NRL Key Log on the last completed semiannual Key Status Sheet. This entry will be filled out with the name of the recipient, the key serial number, the key type and date of issuance. This entry will be initialed by the NRL Director or Associate Director. The issued key will be signed for "received" on the OSU key request by the recipient.

B. Return of Keys

1. When the holder of an NRL key leaves the NRL or in any other way is determined to no longer require or have the right to possession of an NRL key, that said key or keys will be returned to the NRL.

2. An entry on the last completed semiannual key status sheet will be made indicating key returned with date. This entry will be initialed by the NRL Director or Associate Directors. The returned key will be sent to the OSU Key Control Unit along with the original OSU Key Request.

C. Auxiliary Key Use

1. There will exist three Auxiliary Keys under the control of the Associate Director. When not in use, these keys will remain locked in the control room key locker. These keys may be used by the Associate Directors for the following reasons:

   a) Access to the NRL by personnel who have submitted OSU Key Requests but have not received their key.

   b) Access to the NRL by personnel who have lost or damaged their issued keys and have requested yet not received their replacements.

   c) Access to the NRL by anyone deemed by the NRL Director or Associate Director as requiring the use of an Auxiliary Key.

2. When issued, the Auxiliary Key will have an entry made on the applicable Auxiliary Key Record Sheet in the NRL Key Log. This entry will include; Name of Recipient, Issue Date, and Authorizing Signature.

Auxiliary Keys will be checked semi-annually by a Director or Associate Director and annotated on the Auxiliary Key Record Sheet.

3. When an Auxiliary Key is returned, an entry on the Auxiliary Key Record Sheet will be made. The entry will include the return date and authorizing signature. The Auxiliary Key will then be returned to the control room key locker.

C. Semi Annual Key Check

1. The NRL Semi Annual Key check is to be performed as required by the NRL Maintenance Board and upon changing of NRL Access Locks.

2. Procedure:

a) Obtain the NRL Key Card File and NRL Key Log Book.

b) Check that the key card file and the last completed semi-annual key status sheet agree as to current possessors of NRL keys. Ensure that descrepencies such as retired NRL personnel who have not returned their keys are noted. Verify that each person with a key has completed Orientation Training per SP-04 in the last 5 years.

c) Fill out a new NRL Semi Annual Key Status Sheet from the verified Key Card File. It is not necessary to verify the existance of keys signed out to active NRL personnel.

d) Sign the new Semi Annual Key Status Sheet under the date when #2c is completed.

e) Verify that the OSU Auxiliary Key Record Sheets for each of the OSU Auxiliary Keys are up to date and if not signed out are actually located in the Control Room Key locker.

f) Sign and date the verified OSU Auxiliary Key Record Sheets on the line under the last entry when #2c is completed.

g) Report any discrepancies found to the NRL Associate Directors. Initial the maintenance board and return the Key Card File and NRL Key Log book to their storage locations.

h) If the NRL Access locks are changed, fill out a new Semi Annual Key Status Sheet from the new OSU Key Request Cards. Indicate in the remarks section "New Locks" and use the Date Returned column in the previous Semi Annual Key Status Sheet for return of all the superseded keys.

VI. ATTACHMENTS:

Appendix A, OSU AUXILIARY KEY RECORD SHEET.
Appendix B, NRL SEMIANNUAL KEY STATUS SHEET.

ATTACHMENT 'A'

Type ____________ ____

Serial No. ____________

OSU AUXILIARY KEY RECORD

Name	Issue Date	Auth. Signature	Return Date	Auth. Signature	Comments

ATTACHMENT 'B'

Date: ____________

NRL SEMIANNUAL KEY STATUS

Issued To	Key Serial Number	Key Type	Date Issued	Date Returned	Remarks

I. SCOPE:

This procedure is used to periodically check the calibration of pocket dosimeters by the use of a sealed 137 Cs source (90 μCi on 11/79) (≈ 73 μCi on 11/88).

II. DISCUSSION:

Pocket dosimeters should be worn by NRL staff and researchers along with their film badges and/or TLDs when large amounts of radioactive material are to be handled or relatively large radiation doses can be accumulated in a short period of time. A pocket dosimeter allows the staff or researcher to monitor his/her short-term accumulated dose. The pocket dosimeters have their calibration checked on an annual basis to assure their reliability.

III. REFERENCES:

A. 10CFR20.202.

IV. PRECAUTIONS:

The 06-200 Dosimeter Calibrator is a 90 μCi, Cs-137, hermetically sealed source. External exposure should be around 3.0 mR/Hr at 10 cm. The source should not be left or used in an area where it might be damaged or dropped. Care should be taken to ensure that the source is not inadvertently left where unauthorized personnel or visitors could be exposed. Gloves should be worn when moving the calibrator.

V. PROCEDURE:

1. Obtain the 06-200 Dosimeter Calibrator which is stored in the low level storage chest next to the rabbit sample work bench.

2. Recharge each dosimeter using the instructions on the Charger until a reading of less than 20 mR is reached. Enter the reading along with the date, dosimeter serial number and time, in the Dosimeter Calibration Record.

3. Place the dosimeter in the calibrator as shown in Figure 1.

4. After a time lapse of 30 minutes, remove the dosimeter and record the final reading.

5. Enter the difference between the initial and final readings in the column marked 'Net Increase' on the Dosimeter Calibration Record. If this reading is not between 57 mR and 73 mR, the dosimeter may no longer be usable. (Corrected for decay to 11/88, must be corrected each year.)

6. Repeat steps 2 through 5 for the remaining dosimeters.

7. Following calibration, return all equipment to their normal storage locations for use.

8. After a period of approximately 24 hours has elapsed, recheck all dosimeters for drift as follows:

   a) Take a reading on the dosimeter and subtract this from the final reading value obtained the previous day.

   b) Log this difference in the 'Drift' column of the Dosimeter Calibration Record.

   c) If the absolute value of this number is greater than 5 mR, the dosimeter may no longer be usable. If any dosimeter fails to meet the required specifications of Steps 5 or 8(c), repeat this procedure. If it still does not calibrate, turn the dosimeter over to the Associate Director.

VI. <u>ATTACHMENTS</u>:

A. Appendix 'A', Figure 1

B. Appendix 'B', Sample Dosimeter Calibration Record.

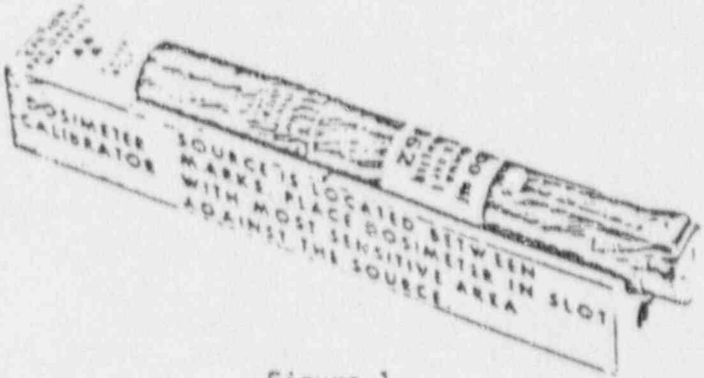
DOSIMETER CALIBRATOR
SOURCE IS LOCATED BETWEEN MARKS. PLACE DOSIMETER IN SLOT WITH MOST SENSITIVE AREA AGAINST THE SOURCE.

Figure 1

DOSIMETER CALIBRATION RECORD

APPENDIX B

Date	Dosimeter Serial #	Start Time of Calibration	Initial Reading	Final Reading	Net Increase	Drift*

is value is the difference between the final reading and a subsequent reading taken 24 hours later.

F

JUN 15 1990

The Ohio State University
Office of the Vice President for Health Services
ATTN: Walter E. Carey, Ph.D.
Director, Office of Radiation Safety
200 Meiling Hall
370 West Ninth Avenue
Columbus, OH 43210-1238

Gentlemen:

We have reviewed your application dated March 5, 1990 for a new wet source storage irradiator and find that we will need the following information in order to complete your request.

Materials

Please clarify the model number of the General Electric cobalt 60 sources you wish to possess. Our records indicate a model number for these sources as GEPR-183-XXX (sources serialized individually) not GEP-186-XX as indicated in your application.

Intended Use of Materials

Item 6. of your application states that you may occasionally use the irradiator for research studies as a service provided to outside institutions. Please describe in greater detail the provisions you have established for performing this activity. Include a description of the types of experiments you will perform on a "service type" basis, the types of "clients" you anticipate, and specify whether or not the university will assess a fee for the service performed.

Authorized Users

Describe in greater detail the experience that Messrs. Myser, Talnagi and Davis have received in the use of the irradiator. Based on the information submitted, it does not appear they meet our criteria for authorized users. Be advised that we require a minimum of 3 months of experience in irradiator operations for authorized users. The experience may include some preoperational involvement while the irradiator is being constructed to learn about the irradiator safety systems and how the irradiator functions, and should include at least four weeks in actual irradiator operations.

Training

A. Be advised that the training program described in Item 8. of your application should be at least 40 hours long, please modify your program accordingly. We suggest you expand the time spent on Operating and Emergency Procedures and that you include a question and answer period.

B. Describe the on-the-job training that will be given to individuals. This training should consist of at least one month of on-the-job training in the actual operation and use of the irradiator and should be conducted by one of the authorized users. Confirm that all individuals that will use the irradiator will complete the on-the-job training.

C. Submit a copy of the written examination along with the correct answers, indicate the passing grade, and describe the reinstruction program to be given in areas missed on the written examination or in which the individual is observed deficient during the on-the-job training.

D. Describe the minimum training required for the individuals that will be present at the irradiator access point to assist the sample handling and health physics surveys specified in Item 9., page 9-2 of your application.

Leak Test Procedures

Be advised that semi-annual leak testing for the cobalt sources used at your facility is a required condition of the licenses we issue to individuals that use sealed sources. Consequently, it will be necessary for you to:

A. Specify the name and address of the organization that will perform the test;

B. Describe the manner in which leak test samples are taken;

C. Specify the manufacturers' name and model number of the instrumentation to be used in the analysis;

D. Describe the method of analysis and include a sample calculation showing how leak test results are converted to microcuries.

Leaking Source Procedures

A. Specify the minimum cobalt-60 activity in the pool that will indicate a leaking source based on the survey results of the resin cartridge of the demineralizer. Be advised that we recommend your action level to take into consideration the Part 20, Appendix B limits for releasable activity of insoluble cobalt-60 in water (3×10^{-5} microcuries/milliliter)

B. Your procedures indicate that if source leakage is detected, you will identify the leaking source by sequential removal of the sources to a shielded storage tank and sampling the storage tank water for contamination. Submit a diagram of the storage tank, specify where it will be located when performing this operation and specify the minimum activity you will consider to be of "sufficient magnitude to be deemed a hazard to safety" requiring source removal and storage. In addition, discuss the provisions you have established for disposal of a leaking cobalt source.

Personnel Monitoring

A. Since you will be using pocket dosimeters to monitor personnel exposures, specify the useful range of the device (in milliroentgens), the frequency of reading, and the procedures for maintaining and calibrating the devices.

B. Your application indicates that you will be using pocket dosimeters during installation of the irradiator and for routine operations until a data base is established for estimating personnel exposures. Please confirm that pocket dosimeters will be worn by personnel and that records will be maintained of the exposures. In addition, confirm that dosimeters will continue to be worn by individuals beyond the establishment of a data base. Be advised that in order to relieve you of this requirement, it will be necessary for you to justify your request and submit supporting documentation of exposures profiles for these types of operations to the NRC for review and approval.

Key Control

Your application states that only approved users would have access to the keys that control the operation of the irradiator and associated systems (e.g crane, grating, handling tools, etc.). Describe in greater detail your key control for the systems and confirm that only individuals listed on your license as authorized users will have access to the keys.

Equipment

Describe the equipment and handling tools you have available to accommodate source loading, geometry modifications, pin relocation, and the equipment available to handle clean-up of your facility if a leaking source is identified.

Maintenance Program

Submit a routine preventative maintenance program which describes the tests performed, as well as the frequency of the tests, to ensure that mechanical, electrical, and safety systems are routinely examined to prevent any defects or system failures and that pool water quality and quantity is maintained at a level that will be conducive to storage of the cobalt-60 sources. Be advised that pool water quality must be maintained at a level that will not adversely affect the integrity of the sources and the quantity of pool water must be maintained in order to comply with 10 CFR Part 20 requirements for radiation levels.

Service

From your application, it appears that you will be performing service operations such as repairs and/or engineering changes to the Bulk Shielding Facility pool; and you may be performing similar activities on other systems associated with the operation of the irradiator. In order to authorize you to perform such services, it will be necessary for you to submit the following:

A. Specify the type(s) of service operations to be performed (e.g. source elevator, pool maintenance/modifications, etc.).

B. Submit a set of step-by-step procedures for each type of service operation to be performed including alternate source storage procedures, and the associated safety precaution; and

ubmit the names and qualifications of the individuals that will be performing the service operations.

Radiation Levels

A. From your application, it does not appear that you have equipped the Bulk Shielding Facility with a fixed radiation monitor to monitor radiation levels within this facility, please clarify.

B. Modify your Standard Operating Procedures to include provisions that require individuals entering the Bulk Shielding Facility to have a survey meter with them to ensure that radiation levels within the facility are at background levels.

C. Submit a copy of the shielding calculations for the Bulk Shielding Facility.

D. Describe the provisions you have established for controlling access into the Bulk Shielding Facility in the event an uncontrolled loss of pool water occurs. In addition, describe the controls you have in place which will maintain the pool water level and prevent an uncontrolled loss.

Decommissioning

Please note, effective June 27, 1988 the NRC established technical and financial criteria for requiring the submission of plans (53 FR 24018). Specifically, Sections 30.35 "Financial Assurance and Recording for Decommissioning" and 30.36 "Expiration and Termination of Licenses" of Title 10 Code of Federal Regulations Part 30 addresses decommissioning planning needs, timing, funding methods, and environmental review requirements for public and private facilities holding by-product material licenses. Based upon review of your licensed material possession limits, it appears that it will be necessary for your organization to comply with the above regulations. The decommissioning funding plans, certification of financial assurance, etc., should be submitted for review and approval along with your response to this letter. Be advised that it will be necessary for you to submit this information prior to the issuance of your new license.

We have enclosed several guides which you should reference when completing your response to this item.

We will continue our review of your application upon receipt of this information. Please reply in duplicate, within 30 days, and refer to Control Number 88852.

Upon failure to file a response within the specified time, we will consider that you have abandoned your request and will void this action. This is without prejudice to resubmission of the application.

Sincerely,

Patricia J. Pelke
Materials Licensing Section

Enclosure:
1. 10 CFR Part 30
2. NUREG 1336
3. Regulatory Guide 3.65

PJP
6/14/90

THE OHIO STATE UNIVERSITY

Associate Vice President for
Health Services and
Academic Affairs
Associate Dean,
College of Medicine

218 Meiling Hall
370 West Ninth Avenue
Columbus, OH 43210-1238

Phone 614-292-4761
FAX 614-292-1544

March 5, 1990

U.S. Nuclear Regulatory Commission
Region III
Materials Licensing Section
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Re: New Application for Self-Contained
Wet Source-Storage Irradiator

Gentlemen:

Enclosed is NRC Form 313, "Application for Material License". The form and its attached sheets are submitted in duplicate. This is an application to posess and use 21,000 Ci of Co-60 in a self-contained, wet source-storage irradiation facility. The application has been prepared in accordance with USNRC Draft Regulatory Guide and Value/Impact Statement FC 403-4, dated January, 1985.

We are requesting that this application receive priority processing. The need for such action is that the material for which the license is requested is being "surplussed" by the current owner, a research institution located close to the University. At least one other University is also attempting to acquire the licensed material and it will apparently be transferred to whichever institution can first acquire an appropriate license.

As an educational institution supported by and for the State of Ohio, The Ohio State University is exempt from licensing fees as provided in 10CFR170.11(a)(9).

Please direct any technical questions or requests for additional information to Dr. Walter E. Carey, Director, or to Mr. Joseph P. Allgeier, Assistant Director - Office of Radiation Safety at 614-292-0122.

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FEE EXEMPT
170.11(a)(9) 3/9/90

MAR 7 1990

CONTROL NO. 88852

Thank you for your continued assistance with our academic programs here at The Ohio State University.

Sincerely,

Ronald L. St. Pierre, Ph.D.
Associate Vice President for
Health Services and Academic Affairs

RLS/WEC:jnp

Enclosures: Form 313 and Attachments

CONTROL NO. 88852

NRC FORM 313
(9-88)
10 CFR 30, 32, 33, 34, 35 and 40

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED BY OMB 3150-0120
Expires 6-30-90

APPLICATION FOR MATERIAL LICENSE

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

APPLICATIONS FOR DISTRIBUTION OF EXEMPT PRODUCTS FILE APPLICATIONS WITH:

U.S. NUCLEAR REGULATORY COMMISSION
DIVISION OF INDUSTRIAL AND MEDICAL NUCLEAR SAFETY, NMSS
WASHINGTON, DC 20555

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS. IF YOU ARE LOCATED IN:

CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, MAINE, MARYLAND, MASSACHUSETTS, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, PENNSYLVANIA, RHODE ISLAND, OR VERMONT, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION I
NUCLEAR MATERIALS SAFETY SECTION B
475 ALLENDALE ROAD
KING OF PRUSSIA, PA 19406

ALABAMA, FLORIDA, GEORGIA, KENTUCKY, MISSISSIPPI, NORTH CAROLINA, PUERTO RICO, SOUTH CAROLINA, TENNESSEE, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION II
NUCEAR MATERIALS SAFETY SECTION
101 MARIETTA STREET, SUITE 2900
ATLANTA, GA 30323

IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION III
MATERIALS LICENSING SECTION
799 ROOSEVELT ROAD
GLEN ELLYN, IL 60137

ARKANSAS, COLORADO, IDAHO, KANSAS, LOUISIANA, MONTANA, NEBRASKA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, SOUTH DAKOTA, TEXAS, UTAH, OR WYOMING, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
MATERIAL RADIATION PROTECTION SECTION
611 RYAN PLAZA DRIVE, SUITE 1000
ARLINGTON, TX 76011

ALASKA, ARIZONA, CALIFORNIA, HAWAII, NEVADA, OREGON, WASHINGTON AND U.S. TERRITORIES AND POSSESSIONS IN THE PACIFIC, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION V
NUCLEAR MATERIALS SAFETY SECTION
1450 MARIA LANE, SUITE 210
WALNUT CREEK, CA 94596

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S. NUCLEAR REGULATORY COMMISSION JURISDICTION.

1. THIS IS AN APPLICATION FOR *(Check appropriate item)*

- [X] A. NEW LICENSE
- [ ] B. AMENDMENT TO LICENSE NUMBER ____________
- [ ] C. RENEWAL OF LICENSE NUMBER ____________

2. NAME AND MAILING ADDRESS OF APPLICANT *(Include Zip Code)*

The Ohio State University
Ofc of the V President for Health Services
200 Meiling Hall, 370 West Ninth Avenue
Columbus, OH 43210-1238

3. ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED

The Ohio State University
Nuclear Reactor Laboratory
1298 Kinnear Road
Columbus, Ohio 43210-1154

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

Walter E. Carey, PhD/CHP Director - Office of Radiation Safety
Institutional Radiation Safety Officer

TELEPHONE NUMBER
614-292-0122

SUBMIT ITEMS 5 THROUGH 11 ON 8½ x 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

5. RADIOACTIVE MATERIAL
a. Element and mass number, b. chemical and/or physical form, and c. maximum amount which will be possessed at any one time.

6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED.

7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE.

8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS.

9. FACILITIES AND EQUIPMENT.

10. RADIATION SAFETY PROGRAM.

11. WASTE MANAGEMENT.

12. LICENSEE FEES *(See 10 CFR 170 and Section 170.31)*
FEE CATEGORY 10CFR170.11(a)(9) AMOUNT ENCLOSED $ 0; Exempt

13. CERTIFICATION. *(Must be completed by applicant)* THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, AND 40 AND THAT ALL INFORMATION CONTAINED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

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.

SIGNATURE—CERTIFYING OFFICER	TYPED/PRINTED NAME	TITLE	DATE
Ronald L. St. Pierre	Ronald L. St. Pierre, PhD	Assoc. Vice President for Health Services and Academic Affairs	3/05/90

FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	COMMENTS

AMOUNT RECEIVED	CHECK NUMBER

APPROVED BY

RECEIVED
MAR 07 1990
REGION III

NRC FORM 313 (9-88)

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: ... FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE OFFICE OF INFORMATION AND REGULATORY AFFAIRS, OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

CONTROL NO. 88852

ITEM 5. RADIOACTIVE MATERIAL

Irradiator Type:	Self-Contained Wet Source-Storage.
Radionuclide:	Co-60, metallic Co pellets, 1 mm X 1 mm.
Sources (15):	Double-encapsulated, 9/16-in outside diameter, 18.4-in length, 0.020-in walls, Type 300 stainless steel, End caps TIG welded, $<2\times10^{-8}$ cc/sec leakage at STP.
Manufacturer of Sources:	General Electric Company, Nuclear Engineering Center, Vallecitos, California, 1974.
Identifiers on Sources:	GEP-186-01 through GEP-186-15.
Maximum Activity:	21,000 Ci in 15 sources, 1400 Ci/source.
Initial Licensee:	International Neutronics, Dover, New Jersey.
Current Licensee:	Battelle Memorial Institute, Columbus, Ohio.

ITEM 6. PURPOSES FOR WHICH LICENSED MATERIAL WILL BE USED

The Co-60 will be used for research and development activities as defined in 10CFR30.4 and for educational activities.

These activities will include:

* Observation of radiation effects on materials and devices.

* Inducement of radiation effects in materials and devices, with subsequent investigation and/or utilization of the effects.

* Demonstration of operation of radiation detectors, and their behavior in high-dose gamma radiation fields.

Such activities may occasionally be performed for persons outside The Ohio State University also.

There will be no irradiation of explosive, flammable, or corrosive materials.

There will be no irradiation of foods destined for distribution or consumption.

CONTROL NO. 88852

ITEM 7. INDIVIDUALS RESPONSIBLE FOR RADIATION SAFETY PROGRAM--THEIR TRAINING AND EXPERIENCE

The radiation safety program for all NRC-licensed activities at The Ohio State University is the responsibility of the Office of the Vice President for Health Services. To fulfill that responsibility, the Vice President maintains an Office of Radiation Safety (ORS). The current Director of the ORS is Dr. Walter E. Carey, who is also the University's Radiation Safety Officer (RSO). The operational radiation safety program specific to the Nuclear Reactor Laboratory (NRL), the proposed location of the sealed sources described in this application, is currently conducted primarily by NRL staff members. Their efforts are guided, and audited, by the Director of the ORS.

In that context, the following persons are denoted as "re'ponsible individuals" with regard to irradiator operation:

* Name: Richard D. Myser
  Date of Training: Autumn Quarter, 1973 (NE 606)
  August, 1986 (ORS Short Course)

* Name: Joseph W. Talnagi
  Date of Training: Autumn Quarter, 1977 (NE 606)
  August, 1986 (ORS Short Course)

* Name: Michael J. Davis
  Date of Training: Autum Quarter, 1985 (NE 606)

For these individuals, "training" consists of enrollment in and successful completion of the course entitled "Radiological Safety", designated as course number NE606 and offered through the University's Nuclear Engineering Graduate Program. The course provides 3 credit-hours towards an undergraduate or graduate degree. This course covers general principles of radiation, radioactivity, and protection methodology with emphasis on approved operating, handling, and waste disposal procedures, and also covers regulations related to radiation protection and the biological effects of radiation. It provides a basis in the principles and fundamentals of radiation protection and good safety practices related to the use of radiation sources and radioactive materials. Classroom and laboratory exercises are provided in the areas of radioactivity measurements and the use of radiation detection and monitoring instruments and methods. Instruction in the appropriate mathematics and calculational methods basic to the use and measurement of radioactivity is also provided. Total contact hours for the course, including classroom and laboratory activities, is approximately 40 hours. All three individuals completed the course when taught by Dr. Walter Carey, Associate Professor of Nuclear Engineering.

In addition, Mr. Talnagi and Mr. Myser have completed the instruction and training sessions required by the ORS for unrestricted use of radioactive materials as governed by the current Broadscope license issued to the University. These instructional sessions, sometimes referred to as the ORS Short Course, consist of three contact-hours of instruction provided by the ORS staff.

All individuals denoted above are licensed Senior Reactor Operators (SRO) for the Ohio State University Research Reactor (OSURR), which is licensed to operate under facility license R-75, docket number 50-150. Part of the training requirements for the SRO license include instruction in radiation safety. Requalification examinations are required on an annual basis for maintenance of these licenses.

Mr. Myser holds an M.Sc. degree in zoology, with experience in radiation biology and health physics. Mr. Talnagi holds an M.S. degree in physics and an M.Sc degree in nuclear engineering, and has experience in nuclear instrumentation, radiation and neutron physics, and reactor engineering.

All three individuals have some experience with a lower-activity, shielded, dry irradiator using about 195 curies of Cs-137, licensed to the University under NRC license no. 34-00293-11.

The irradiator to be licensed under the present application is not yet installed at the University, so no prior experience is possible with this specific facility. However, the indiviuals noted above will be closely involved in the installation activities and prior activities, such as shielding calculations and design, source handling and movement, etc. This will provide a basis for actual operating experience when the facility is commissioned.

At least one of these individuals will be present at the irradiator facility site when the irradiator is in use. In this context, "in use" implies that there is some function related to placement or removal of material or apparatus from the irradiator occurring. Since this facility is planned as a wet source-storage irradiator, the "in use" designation differs from that associated with panoramic-type dry facility irradiators in that the sources are not movable.

Vitae for the three "responsible individuals" and for Dr. Carey are included in Appendix A.

ITEM 8. TRAINING PROVIDED TO OTHER USERS

From time to time, the irradiator will be used by persons other than those designated in Item 7. In such cases, usage will be under the direction of a "responsible individual". If such users have not successfully completed the academic course referenced in Item 7, they will be required to complete a special training program presented by one of the designated "responsible individuals".

The training program will require about 30 hours to complete and will include written and oral examinations. Results of the examinations will be discussed with the user candidates. If there are any areus of deficiency, additional instruction will be provided and additional examinations will be administerd. The examinations will conform to the requirements contained in Draft Regulatory Guide and Value/Impact Statement: Task FC 403-4. Training and examination records will be maintained for a period of at least three years. The training program outline is included below.

1. Basic Radiation Science (8 hours)

   a. Nature of Radiation
      i. types of radiation
      ii. units of radiation
      iii. energy transfer mechanisms

   b. Principles of Radioactivity
      i. types of decay
      ii. units of activity
      iii. half life
      iv. decay calculations

   c. Principles of Radiation Biology
      i. dose units
      ii. mechanisms of biological damage
      iii. early somatic effects
      iv. delayed somatic effects
      v. genetic effects

2. Basic Radiation Safety (10 hours)

   a. Protection Methods
      i. time
      ii. distance
      iii. shielding
      iv. containment

   b. Rules and Regulations
      i. users rights and obligations
      ii. permissible doses, levels and concentrations

iii. personnel monitoring
iv. warning signs
v. records and reports

c. External v.s. Internal Exposure
i. critical organs
ii. burdens
iii. effective half life
iv. risk concepts

d. ALARA

3. Radiation Detection and Instrumentation (6 hours)

a. Survey Instruments
i. detector types
ii. instrument packages
iii. applicability and limitations

b. Smear Wipes
i. necessity of smear wipes
ii. assay of smear wipes

c. Area Monitor

d. Functional Checks

e. Practical Experiences

4. Operating Procedures (4 hours)

a. Irradiator Design
i. wet source/storage (contrast with other types)
ii. source configuration
iii. source activity
iv. dose rates

b. Placement of Materials

c. Removal of Materials

d. Surveys

e. Recordkeeping

5. Emergency Procedures (2 hours)

6. Examinations (3 hours)

ITEM 9. FACILITIES AND EQUIPMENT

9.1 Basic Facility Design and Construction

Building and Location of Pools

The ^{60}Co irradiator facility will be located in The Ohio State University Nuclear Reactor Laboratory. It will be placed in the center of the Bulk Shielding Facility pool - a water pool adjacent to but independent from the Nuclear Reactor pool.

Figures 9-1 through 9-4 show the design of the building and the placement of the two water pools in the building. These figures present relevant dimensions, building and shielding materials, and uses of areas adjacent to the irradiator (Bulk Shielding Facility) pool. (Figures 9-1 through 9-4 are not to scale.)

The Nuclear Reactor Laboratory is located on University property about 2 miles west of the main campus, in an area of university agricultural activities and engineering/science research facilities. An exclusion fence encloses the Nuclear Reactor Lab to the north, east, and west; a parking area is to the south (front) of the building. The fence extends south from the Lab, enclosing other research facilities. There is occasional vehicular and pedestrian traffic outside the exclusion fence.

The nearest occupied building is The Ohio State University Van de Graaff Lab, about 125 ft to the south. The nearest residences are more than 1300 ft to south and west.

Building environmental control is effected by natural gas-fired heating systems and electrically-powered air conditioning units. The bay area is continuously vented under normal conditions by a building exhaust fan with a measured capacity of 1000 cubic feet per minute. Under emergency conditions requiring building ventilation shutdown, all systems which could cause building air venting can be shut off from a single cont ol point. When the exhaust fan is turned off, gravity-actuated louvers automatically cause building isolation.

Note that there is no converter plate of uranium present in the Bulk Shielding Facility. The graphite thermal column is terminated by a steel plate in the pool wall. It is expected that any neutron or gamma radiation streaming into the pool from the reactor pool will be negligible at the position of the irradiator facility.

Cobalt-60 Irradiator Facility

The irradiator facility will consist of the cobalt-60 rods (or pins) arranged coaxially around an irradiation chamber formed from an aluminum tube. The sources will be shielded by water from the top, but the irradiation chamber will be a dry, air-filled tube. Initially, the rods will be arranged around a 4-in outside diameter aluminum tube, but the tube inside diameter may be as large as 6 in or as small as 3 in, to provide some flexibility in available dose rates and irradiation geometries.

Figure 9-5 shows a top view of a typical irradiator configuration, using a 3-in outside diameter irradiation tube with symmetric arrangement of the source pins around the outside of this tube. The source pins are held in position by a circular ring (not shown) surrounding the central tube. The scale of this drawing is approximately 1 in = 0.625 in, so it is slightly larger than actual size.

Source pins will be held in an aluminum rack into which the irradiation tube extends, forming a circular pattern around the tube. Source pins may be removed from this rack to reduce the dose rate in the irradiation volume. A shielded, underwater storage rack, located away from the irradiation tube will be available for pins so removed.

The source pin irradiator rack will always position the center of the pins at 24 in above the floor of the pool, held in a vertical position. The dry irradiation chamber tube will be counterweighted to neutral or slightly negative buoyancy.

Figure 9-5 shows one possible arrangement of the source pins. The actual irradiator configuration may vary from this basic geometry, depending of the requirements of the experiment(s) being conducted. For example, if lower dose rates in the irradiation tube are desired, one or more source pins might be removed from their illustrated position around the central tube. The irradiator facility may also have several different diameter central tubes, and correspondingly different diameter source pin positioning rings.

Procedures for use of the irradiator facility will require a responsible individual to be present at the facility during utilization involving sample placement/removal operations. During these operations, a responsible individual or properly trained and authorized user will perform the actual operation. Another individual will be present at the irradiator access point to assist with sample handling and perform appropriate health physics measurements.

Figure 9-6 shows the elevator assembly which will move within the irradiation tube to lower into position materials to be irradiated in the chamber. This elevator assembly will have lead shielding along its top to reduce the scattered dose at the top of the irradiation tube when the irradiator is in use. When not in use, the elevator assembly will be positioned at the top of the irradiation tube. To reduce extremity dose from scattered radiation when loading or unloading the elevator assembly, a lead-shielded follower will provide shielding along the bottom of the elevator assembly. If the elevator assembly is removed from the irradiation tube, a shielding plug will be inserted into the irradiation tube to reduce scattered radiation dose at the access point to the irradiator. Any containment devices or systems in which materials to be irradiated may be contained will be designed so that there is no interference with the elevator system.

Access, Alarms, and Signals

The Nuclear Reactor Laboratory is a restricted area as defined in 10CFR20.3. It is protected by a security system, and has an NRC-approved security plan and emergency plan. Building access is by key and security code; only trained persons are granted access. Training includes building access and utilization, radiation safety (10CFR19), and emergency procedures. Typically, 3 to 5 Reactor Lab staff occupy the building from 8 AM to 5 PM. Occasional class and tour groups add up to 30 persons for about 2 hours at a time.

Access to the Bulk Shielding Facility pool also is controlled. The pool is covered with a heavy-steel grating which is locked to a steel I-beam attached to the top edge of the pool walls. The weight of the grating precludes manual removal; it must be moved with the overhead building bridge crane, whose power panel is locked. Access to any materials or devices within the pool will require special handling tools to reach to the bottom of the pool; these tools are locked. Only approved users of the ^{60}Co irradiator will have access to the keys to all these systems, ie, to grating, crane, and handling tools.

Audible and visible alarm signals are generated by the local and remote alarm devices in each channel of the building area radiation monitor system. The channel set points for this system are 10 mrem/h.

One area radiation monitor channel detector and local readout is located at the top of the reactor pool, which also provides area monitoring for the Bulk Shielding Facility (irradiator) pool area.

Another channel of the area radiation monitor system measures the radiation level in the vicinity of the demineralizer. (Refer to Figure 9-2.)

An entrance frisker is also located at the front entrance to the Nuclear Reactor Laboratory.

Calculations have shown that the gamma dose rates at the surface of the Bulk Shielding Facility pool wall at ground level at the south end of the pool (which is the area of minimum wall thickness) will be about 0.1 mrem 1 hr. These calculations were based on point-source and line-source geometries, with published linear attenuation coefficients for lead, water, and ordinary concrete. Calculations were performed by staff of the Nuclear Reactor Laboratory, where they are available for review. A pre-operation radiation survey will be performed by Nuclear Reactor Laboratory staff for comparison with calculations, and to establish any controls required to meet 10CFR20.

Note that the regulatory requirements of 10CFR20.203(c)(6) do not apply, as provided for in footnote 2 of paragraph (c)(6). The sources are both stored and operated within the same shielding radiation barrier. There is no location at which a person could have physical access to the sources or could be exposed to 500 rem in one hour, except in the event of an uncontrolled and total loss of water from the Bulk Shielding Facility pool. That is not considered to be a credible accident.

9.2 <u>Other Safety Considerations</u>

<u>Water Irradiation/Storage Pool</u>

The Bulk Shielding Facility pool is equipped with a circulating water purification system including particulate filter and cartridge-type demineralizer. The system is timed to operate for six hours each night.

The pool is lined with an epoxy-based waterproof liner; no significant leakage has been observed in its 28-year life.

The pool system contains no components which would induce significant corrosion of the sealed sources. The irradiator facility will be fabricated from materials (primarily aluminum) which will not promote corrosion.

The Bulk Shielding Facility pool is equipped with a level monitoring system. This system indicates low water level and provides demineralized makeup water to maintain the level at a minimum of 1 in above the lip of the scupper running the width of the pool along the south edge. (Refer to Figure 9-4.) This maintains a minimum water depth of 15 ft 4 in.

The pool demineralizer maintains conductivity below 10 microsiemens/cm. Measurements typically are about 2 microsiemens/cm.

Three systems are in place for the detection of source leakage:

* A 1-liter sample of Bulk Shielding Facility pool water is taken once each calendar quarter and analyzed for radionuclide content with a calibrated gamma ray spectrometer; (refer to Item 10.3, Leak-Testing, below);

* An area radiation monitor measures radiation levels at the pool demineralizer; (refer to Figure 9-2);

* Nuclear Reactor Laboratory personnel perform periodic (at least once per week) meter surveys of the demineralizer during routine reactor health physics monitoring of the Lab.

There are no penetrations through the floor of the Bulk Shielding Facility pool, or through the walls at levels more than 12 in below the normal pool level.

Systems are provided which prevent backflow of Bulk Shielding Facility pool water into the municipal water supply system. Such an occurrence under normal conditions is not possible because of the pressure head present in the municipal supply system. Even if low pressure should develop on the supply side, there is no pressure head to force water backflow from the pool as long as the circulation pumps are off, which they are most hours of the day. Siphoning of the pool is not likely since the water processing system inlets and outlets are within 12 in of the pool surface. Backflow prevention devices are also in place in the water processing system.

Production of Noxious Gases

The irradiation tube will be 3 to 6 in inside diameter and more than 16 ft long. (Refer to page 9-2 and to Figure 9-4.) There will be no forced air flow in the tube. Therefore the release of ozone and other radiolytic noxious gases to the atmosphere will be negligible.

A 1000-cfm building exhaust fan in the Nuclear Reactor Laboratory would deplete any noxious gases.

Heat- and Smoke-Sensing Devices

A number of smoke detectors which provide audible and visible alarms are located throughout the Nuclear Reactor Laboratory. However, since the sealed sources are used and stored under 13 ft of water, it is very unlikely that any credible building-specific incident (eg explosion or prolonged fire) could result in release of radioactive material from the sources. Therefore, it is not necessary that the smoke detection system should act to further shield the sources.

Fire Extinguishing System

There is no installed automatic fire extinguishing system in the Nuclear Reactor Laboratory, but a variety of portable fire extinguishers is available at various locations throughout the building. Again because of the wet source-storage configuration, an automatic fire extuishing system is not necessary for the fire protection of the sources.

Carriers and Packages

There are no source elevating or lowering mechanisms. Instead, an elevator assembly (refer to Figure 9-6) transports materials through the stationary irradiation tube to the sources. The elevator is always separated from the source holder by the wall of the irradiation tube. Therefore, carriers and packages cannot interfere with the source holder.

Alternate Source Storage

Repairs and/or engineering changes to the Bulk Shielding Facility pool may be necessary from time to time, and could require drainage of the pool and removal of the irradiator sources from the pool. In such an event, the sources would be relocated to the east end of the Nuclear Reactor pool for temporary storage. The pool water would be radioassayed before release to the municipal sewer system to assure compliance with 10CFR20 concentration limits and with The Ohio State University's total discharge limits.

The Reactor pool is deeper than the Bulk Shielding Facility pool and its walls provide more shielding. Therefore temporary storage of the sources in the Reactor pool presents no radiation exposure problems.

The Reactor pool is of the same construction as the Bulk Shielding Facility pool and so presents no corrosion potential to the sources. It is equipped with the same water processing, makeup, and level sensing systems, and so offers the same leak detection capability and the same water-shielding protection.

A transfer cask, to be used with the overhead bridge crane, will be designed and constructed for initial installation of the sources into the Bulk Shielding Facility pool. This same cask would be used to transfer sources to and from temporary storage in the Reactor pool. The cask will be designed to keep radiation exposures to personnel as low as reasonably achievable.

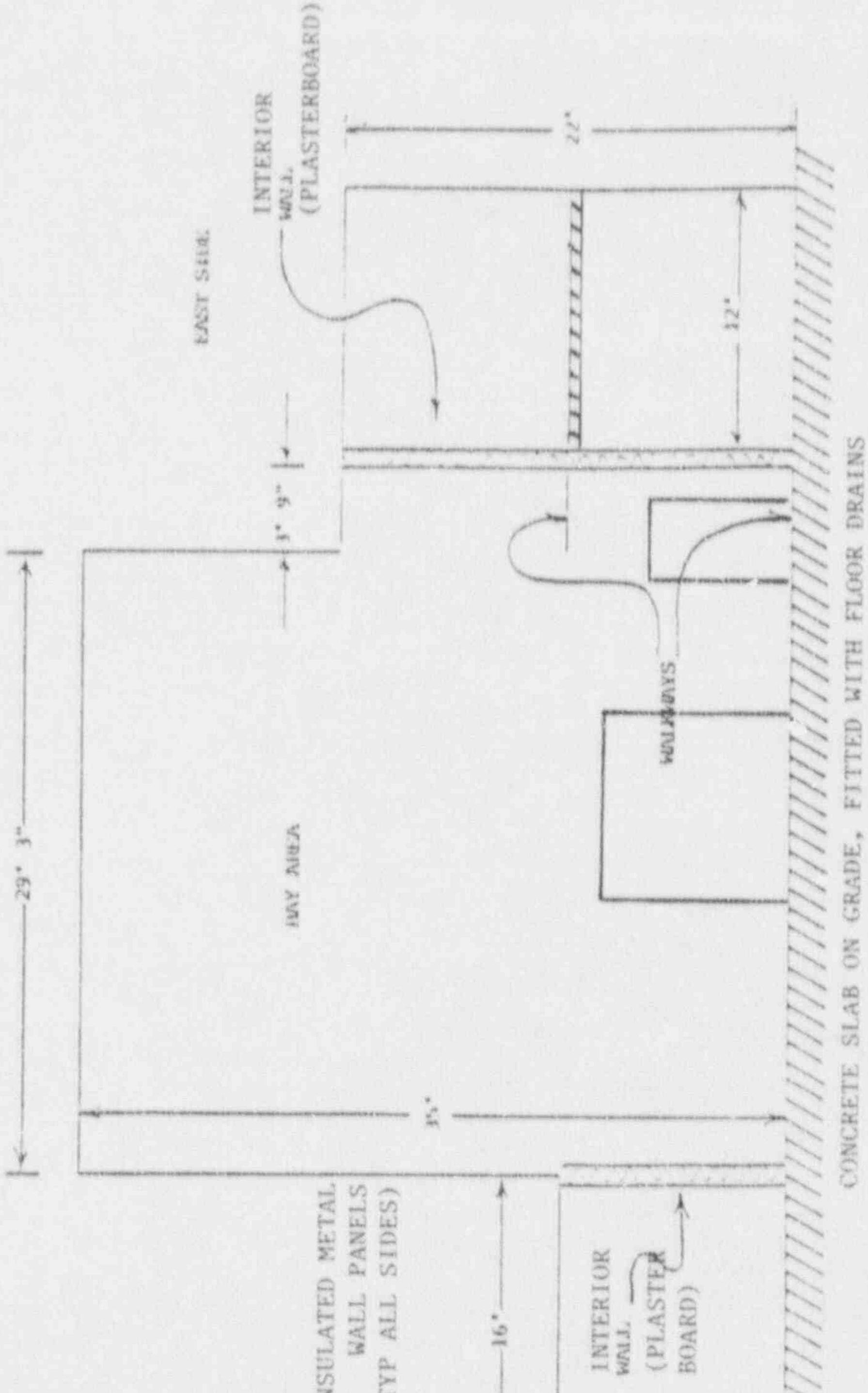


FIGURE 9-1: ELEVATION VIEW OF NUCLEAR REACTOR LABORATORY, LOOKING NORTH (NOT TO SCALE)

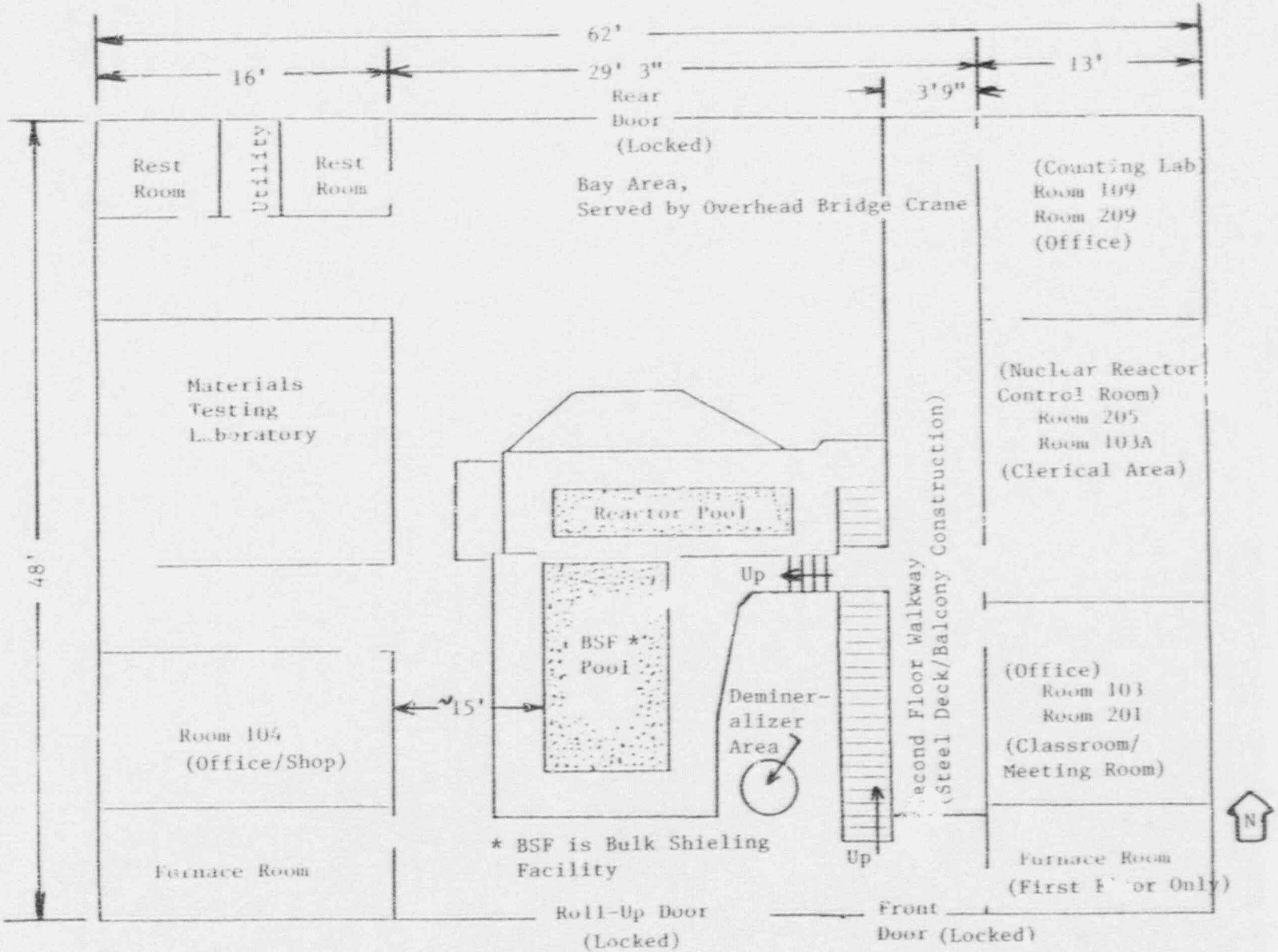


Figure 9-2: Plan View of Nuclear Reactor Laboratory (Not To Scale)

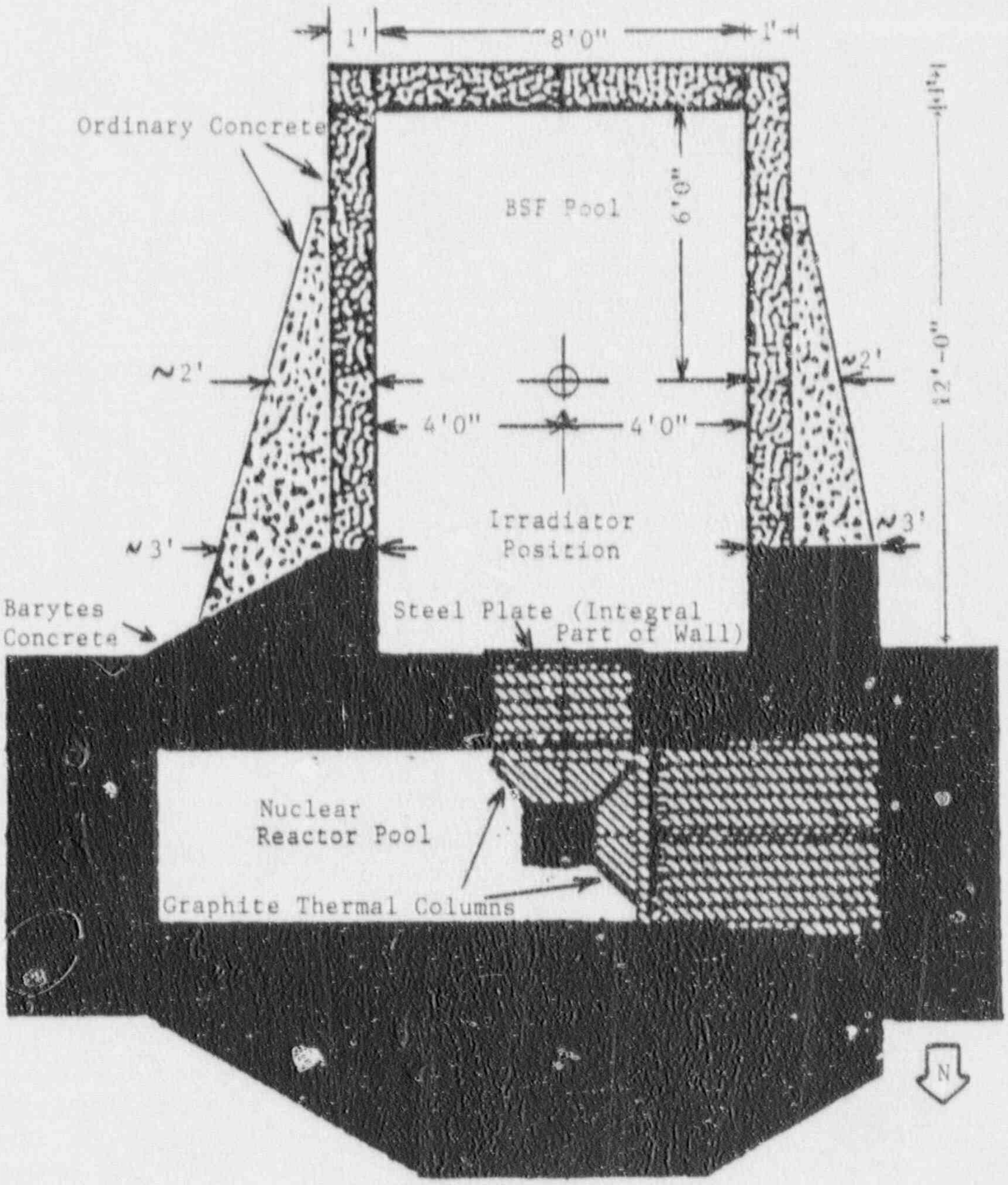


Figure 9-3: Plan View of Reactor Pool and Bulk Shielding Facility
Facility Pool; Showing Location of Co-60 Irradiator

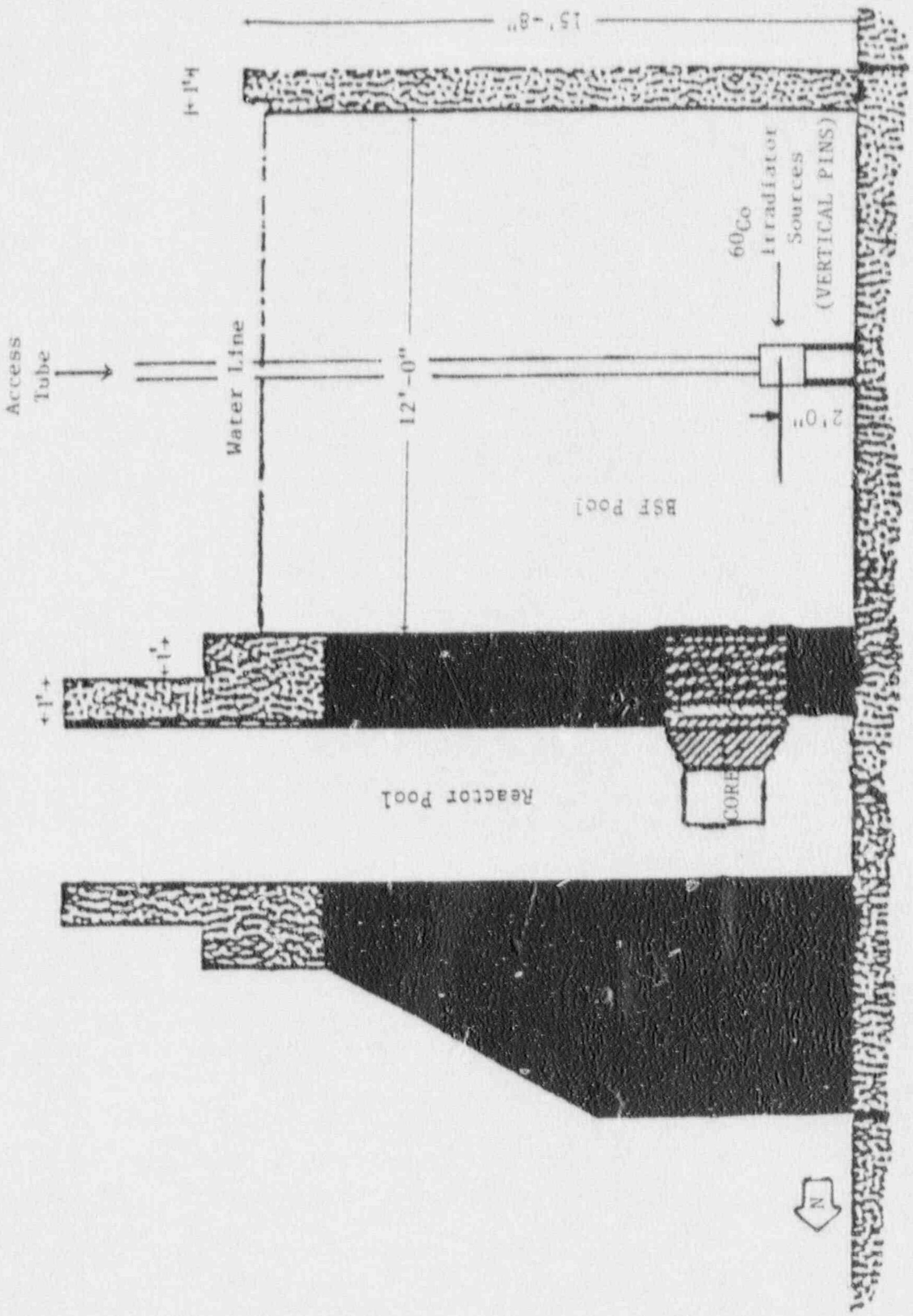


FIGURE 9-4: ELEVATION VIEW OF REACTOR POOL AND BULK SHIELDING FACILITY POOL SHOWING LOCATION OF COBALT-60 IRRADIATOR FACILITY

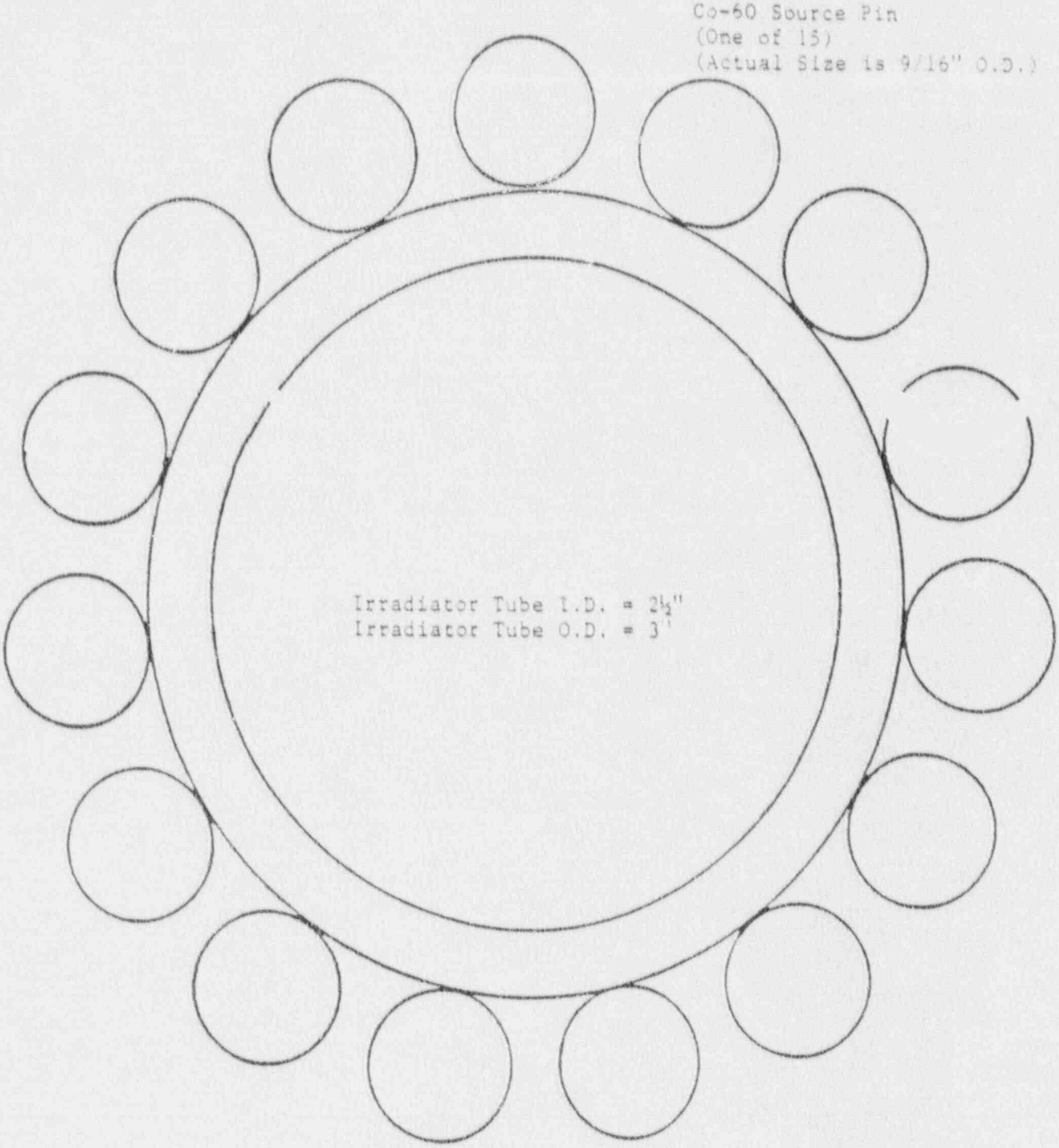


Figure 9-5: Top View of a Typical Irradiator Configuration, Using a 3-in Outside Diameter Irradiation Tube.

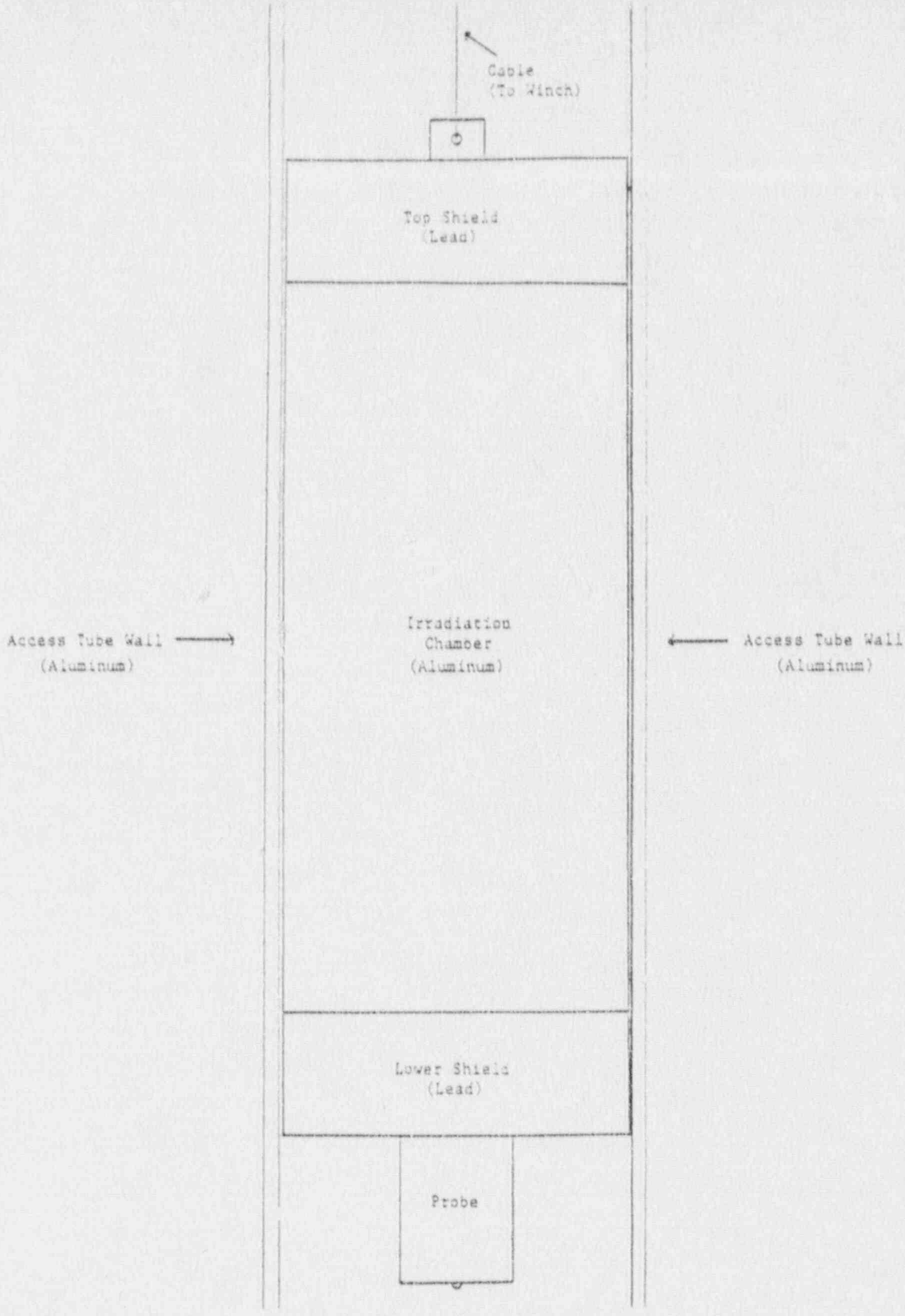


Figure 9-6: Elevator Assembly (Irradiation Chamber) for Transport of Materials To Be Irradiated; Shown Inside Irradiation (Access) Tube.

ITEM 10. RADIATION PROTECTION PROGRAM

10.1 Personnel Monitoring Equipment

Persons using the irradiator facility will wear a film badge capable of detecting gamma and beta doses to a minimum of 10 millirem (mrem). Such badges are normally issued to all persons entering the Reactor Building, unless they have their own permanently-assigned film badge from the ORS. Film badges are changed once a month.

Immediate readouts of exposure can be obtained from self-reading pocket dosimeters available at the Nuclear Reactor Laboratory (NRL). These will be utilized during installation of the irradiator. They will also be used for routine operations until a data base has been established that allows reasonable predictions of personnel doses associated with particular operations.

Persons placing materials into position to be lowered into the irradiator, or removing said materials from the elevator assembly after irradiation, will also wear ring-type thermoluminescent (TLD) dosimeters on one finger of each hand. The TLD dosimeters are also changed once each month.

The Office of Radiation Safety has responsibility for managing all personnel monitoring activities at the University, including those conducted at the NRL. Currently, personnel monitoring services for The Ohio State University are supplied by:

Tech/Ops Landauer, Inc.
2 Science Road
Glenwood Science Park
Glenwood, Illinois 60425-1586

Telephone: 708-755-7000
1-800-323-8830

In the future, the University may contract with other suppliers of dosimetry services accredited by the National Institute of Standards and Technology, under the National Voluntary Laboratory Accreditation Program.

The Ohio State University Office of Radiation Safety and Radiation Safety Committees are aware of the need to maintain radiation exposures to levels as low as reasonably achievable. This philosophy will be considered in reviewing and controlling personnel exposures in all uses of the proposed irradiator.

10.2 Radiation Detection Instruments

A variety of portable radiation detection instruments are maintained at the NRL facility for use by users of the irradiator. Available at all times will be a calibrated, operable survey meter capable of measuring dose rates up to 1 roentgen per hour.

Survey instruments are operable and calibrated with an appropriate radiation source. Instruments are calibrated so that the indicated readings agree to within plus or minus 20% of actual values over the operable range of the instrument. Calibration records for each instrument are generated at each calibration interval and after the instrument is serviced. The records show calibration date, the person's name performing the calibration, and calibration results. A sticker is affixed to the instrument indicating the calibration date and initials of the person performing the calibration. Calibration records are maintained at the NRL for at least 2 years after the calibration is performed.

10.3 Leak Testing

BSF pool water is routinely circulated through a resin-bed ion exchange demineralizer to effect water purification. The resin cartridge of the BSF pool demineralizer system will be surveyed for contact dose rate at least once each week. Survey results will be recorded. Background (off-contact) dose rate will also be measured. Significant positive differences between background and on-contact dose rate will be assumed to result from sealed source leakage. A sample of resin will be withdrawn from the demineralizer cartridge and assayed for radionuclide content using a gamma ray spectrometer system. Source leakage would be confirmed by the presence of a significant quantity of Co-60.

If source leakage is detected, the leaking source pin will be identified by sequential removal of source pins to a shielded storage tank filled with (initially) non-contaminated water. If the source present in the shielded storage tank is a leaker, it will cause Co-60 contamination in the storage tank water. This tank water will be sampled by radionuclide assay to determine if Co-60 is present. If source leakage is of sufficient magnitude to be deemed a hazard to safety, the leaking source will be removed from service by storage in a shielded, sealed area.

10.4 Operating and Emergency Procedures

Users of the irradiator facility will be provided copies of the written procedures detailing operating and emergency procedures for the facility. These procedures will provide instruction in the following areas:

10.4.1 Personnel Monitoring Equipment

The procedures shall specify that persons using the irradiator shall wear personnel monitoring equipment (i.e., dosimeters) while working with and around the irradiator. Generally, this will cover activities at and around the walkway around the top of the BSF pool.

10.4.2 Irradiator Facility Operation

These procedures will instruct the user in placement of samples and materials to be irradiated in the elevator assembly, lowering and raising the elevator, and opening and securing the facility. Also included will be instruction in the operation and use of portable radiation survey instruments and area radiation monitors covering the irradiator area. Precautions to be observed when loading and unloading the elevator assembly will also be noted (e.g., placement of materials to avoid interference with elevator assembly operation, etc.).

10.4.3 Radiation Survey Requirements

The operating procedures will require that appropriate radiation surveys be performed when using the irradiator. Generally, these will include dose rate surveys at the access point (open end of irradiator tube) when loading and unloading samples from the elevator assembly. Because of the wet-storage design of the irradiator, no dose rates approaching those noted in 10CFR20.203(c)(6) are expected.

10.4.4 Emergency Conditions and Procedures

Users will be provided instruction in the kinds of emergency conditions that could arise with this type of irradiator facility, and actions to be taken in the event of emergency conditions. The procedures will include notification of appropriate persons and agencies.

Emergency Procedures will be developed for the following situations:

- Sample elevator stuck
- Dropped pin with obvious damage
- Leaking pin causing significant contamination

. Crane failure while transfer cask is loaded

. Inadequate shielding

10.4.5 Associated Operations

Written procedures for "associated irradiator operations" are included in Appendix B.

10.5 Hospital Arrangements

The Emergency Medicine Department of the University Hospitals is already incorporated into the Emergency Plan for the Nuclear Reactor Laboratory, a part of the Ohio State University Research Reactor's (OSURR) operating license, R-75. Provisions for emergency response support by the Office of Radiation Safety are a part of that plan.

ITEM 11. WASTE MANAGEMENT

The ultimate disposal of the sealed source material authorized by the requested license will be in accordance with paragraph 20.301(a) of 10CFR20.

The only other radioactive waste that could be generated as the result of irradiator operation would be contaminated demineralizer resin. This would occur if the containment integrity of the sealed sources were breached. Should this happen, the contaminated resin would be disposed of by the Office of Radiation Safety through its ongoing low-level radioactive waste management program.

Appendix A

Vitae

VITA

Richard D. Myser

I. PERSONAL

Home Address:

3875 Avis Road
New Albany, Ohio 43054
(614) 855-1139

Office Address:

Nuclear Reactor Laboratory
1298 Kinnear Road
Columbus, Ohio 43212
(614) 292-6755

II. DEGREES

B.A. Biology	1971	Maryville College Maryville, Tennessee
M.S. Zoology	1975	The Ohio State University Columbus, Ohio
Thesis:		The Uptake and Clearance of Cs-137, Co-60, Mn-54, and Zn-65 by Branchiura sowerby (aquatic oligochaete) and Chironmus iparius (midge larva)

III. PRESENT POSITION

September, 1982 to Present
Associate Director, The Ohio State University Nuclear Reactor Laboratory (NRL)

Major Responsibilities: Administration of the Reactor Operator Training and Requalification Program including the preparation and grading of both R.O. and S.R.O. exams; support and development of teaching and research; ensure NRC regulatory requirements are met; administer daily operation of the OSU Research Reactor.

IV. PREVIOUS EMPLOYMENT

February, 1979 to September 1982
Manager of Reactor Operations, The Ohio State University Nuclear Reactor Laboratory (NRL)

Major Responsibilities: managing the operations of the OSU Research Reactor ensuring that nuclear and radiation safety requirements are met; consulting with users of the NRL; assisting with operating and training of operators; also serve as project manager for the OSU Nuclear Services and Training Laboratory.

July 1, 1978 to February, 1979
Assistant Director, Radiation Safety, The Ohio State University

Major Responsibilities: administer the day-to-day operation of the Office of Radiation Safety which includes responsibility for basic and medical sciences and a medical complex; oversee waste disposal, laboratory monitoring, personnel surveillance, inservice teaching, and NRC license compliance.

1975-1978
Radiation Safety Officer, The Ohio State University

Major Responsibilities: establishing criteria and evaluating applications for the use of radioactive materials by University researchers; inservice teaching of Radiation Safety; NRC license compliance and amendments.

1974-1975
The Ohio State University, Department of Zoology

Major Responsibilities: teaching assistant in the introductory biology program.

1971-1973
The Ohio State University, Department of Entomology

Major Responsibilities: laboratory technician collection and analysis of river samples for pesticide content.

V. PUBLICATIONS

The Occurrence of As, Cd, Co, Cr, Cu, Fe, Hg, Ni, Sb, and Zn in Lake Erie Sediments by L. J. Walters, T. J. Wolery, and R. D. Myser in the Proceedings of the 17th Conference on Great Lakes Research.

Note to Health Physics: Concentrations of I-131 in the Air During Thyroid Therapies by R. W. Pollock and R. D. Myser, Vol. 36, 1979.

A Unique Introductory Radiation Safety Instruction Program for Nuclear Power Plant Personnel by W. E. Carey, B. K. Hajek, R. D. Myser, A. D. Evans, and D. M. Barnes, ANS Transactions, Vol. 34.

VI. PAPERS

"Concentration of Radioactivity in Lake Erie Fish" at the 17th Conference on Great Lakes Research, 1974

Thesis material at the Ohio Academy Meetings, 1975

"The Risk for Occupational Radiation Exposure-Instruction Using a Multi-Image Format" at the 26th Annual Meeting of the Health Physics Society, 1981.

"The Reactor Sharing Program at The Ohio State University" at the ANS Tenth Biennial Conference on Reactor Operating Experience, 1981.

"Education and Research at The Ohio State University Nuclear Reactor Laboratory", American Nuclear Society Annual Meeting June, 1989.

VII. PROJECT MANAGEMENT

1980-81	General Orientation Training (Revisions) to meet ANS 3.1 Section 5.4	(funded by the Davis-Besse Nuclear Power Station)
1980-81	The Risk of Occupational Radiation Exposure (a part of Radiological Controls Training) to meet Reg. Guide 8.29	(funded by the Davis-Besse Nuclear Power Station)
1982-83	General Employee Training Radiological Controls Training	(funded by the Perry Nuclear Power Plant)
1983-86	The Reactor Sharing Program	(sponsored by DOE)
1987-88	Reactor Operator Training for Disadvantaged Americans	(sponsored by DOE)

VITA

Joseph W. Talnagi

I. PRESENT POSITION

Senior Research Associate
Nuclear Reactor Laboratory

II. EDUCATION

B.A., Physics	1974	Wittenberg University
M.S., Physics	1976	Miami University
M.S., Nuclear Engineering	1979	The Ohio State University

III. SPECIALIZATION AND RESPONSIBILITIES

Mr. Talnagi is a Senior Research Associate with The Nuclear Reactor Laboratory. He has worked in programs examining the effects of environmental controls on the cost of electricity generation in Ohio, and development of minicomputer based analysis software for instrumental-method neutron activation analysis and gamma-ray spectroscopy. His experience includes background in both large and small computer systems, software system development, and overall system design. He has done research in experimental nuclear physics, neutron and reactor physics, nuclear instrumentation, radiation dosimetry, and neutron activation analysis. Mr. Talnagi has been project manager of research programs to investigate methods of testing the response time of neutron sensors, performance analysis of fission ion chambers utilizing noise analysis techniques, and the development of measurement techniques for coolant level sensing in BWR systems using existing neutron detectors. Recently, he has been a project manager of the program for fuel conversion and power upgrade of The Ohio State University Research Reactor.

IV. PUBLICATIONS

Education and Research at The Ohio State University Research Reactor, (with D.W. Miller and R.D. Myser), Transactions of the American Nuclear Society, 1989 Annual Meeting.

Low-Enriched Uranium Conversion/Power Upgrade of The Ohio State University Research Reactor, (with T. Aldemir and D.W. Miller), Nuclear Technology (publication pending).

An Experimental Demonstration of Nuclear Instrumentation Surveillance In Power Reactors, with Dr. D.W. Miller), presented at the 1985 IEEE Nuclear Science Symposium.

On-Line Surveillance Methods for Neutron Sensors. (with S.A. Arndt and D.W. Miller), presented at the Sixth Power Plant Dynamics, Control and Testing Symposium, Knoxville, Tennessee (April, 1986).

Threshold Reduction For ^{10}B Concentration Measurements Using Cr-39. (with T.E. Blue, T.C. Roberts, R.F. Barth, J.F. Curran, and F. Alam), Transactions of the American Nuclear Society, Vol. 53 (1986).

An Assessment of Neutron Sensor Channel In-Situ Performance Testing Methods. (with D.W. Miller and S.A. Arndt), presented at the 1984 IEEE Nuclear Science Symposium.

Analysis of Random Neutron Sensor Fluctuations for Surveillance of Nuclear Power Channels in Nuclear Power Plant Protection Systems. (with D.W. Miller, A. Behbahani, and S.A. Arndt), presented at the 1983 IEEE Nuclear Science Symposium.

The High Voltage Perturbation Technique for Testing the Response of Neutron Sensors of the Type Used in Nuclear Reactors. (with A. Behbahani, D.W. Miller, and S.A. Arndt), presented at the 1983 IEEE Nuclear Science Symposium.

Emergency Plan Development and Training for The Ohio State University Research Reactor, presented at the Eleventh Biennial Conference on Reactor Operating Experience (1983), Reactor Operations Division of the American Nuclear Society.

Hexavalent Chromium - Resistant Bacteria Isolated from River Sediments. (with G.W. Luli and W.R. Strohl), paper submitted to Archives of Microbiology, February 1983.

Accumulation and Cellular Distributions of Uranium in Thiobacillus Ferroxidans. (with A.A. DiSpirito and O.H. Tuovinen), paper submitted to Archives of Microbiology, February 1983.

Analysis of Rock and Soil Samples by Instrumental Method Neutron Activation Analysis, paper presented at the Annual Meeting of the Ohio Academy of Science, April, 1981.

Analysis of Coal by Neutron Activation. (with P.L. Bradfield and R. Pappas), paper presented at the Fall Meeting of the Ohio Section of the American Physical Society, October 1980.

Fast Timing Spectroscopy. Annual Meeting, ANS Student Conference, Midwest Section, April, 1979.

Radioisotope-Powered Electricity Generation. Annual Meeting, ANS Student Conference Midwest Section, April 1979.

A Minicomputer-Based Software System for Instrumental Method Neutron Activation Analysis. Annual Meeting, ANS Student Conference, Midwest Section, April 1979.

VITA

Michael J. Davis

I. **PERSONAL**

Home Address:

1754 Kenny Road
Columbus, Ohio 43212
(614) 488-1632

Office Address:

Nuclear Reactor Laboratory
1298 Kinnear Road
Columbus, Ohio 43212
(614) 292-6755

II. **EDUCATION**

Nuclear Engineering 505	Introduction to Nuclear Science and Engineering
Nuclear Engineering 606	Radiological Safety

III. **PRESENT POSITION**

December 1985 to present: Student Research Assistant, The Ohio State University Nuclear Reactor Laboratory
May 1988 to present: Senior Reactor Operator, The Ohio State University Nuclear Reactor Laboratory

Major Responsibilities: Operates and maintains the Reactor; gives tours and demonstrations; writes Procedures; handles radioactive materials shipment.

IV. **PREVIOUS EMPLOYMENT**

October 1983 to June 1986: Student Research Assistent, The Ohio State University, High Energy Physics Department

Major Responsibilities: Designed and constructed particle detectors for Physics experiments.

VITA
Walter E. Carey
(rev. October, 1989)

I. PRESENT POSITION

Director,
Office of Radiation Safety
The Ohio State University

Associate Professor,
Mechanical (Nuclear)
Engineering and Zoology

II. EDUCATION

A.B.	Physics	1954	Kenyon College
M.S.	Physics	1957	The Ohio State University
Ph.D.	Zoology	1968	The Ohio State University

III. PRIOR PROFESSIONAL ASSIGNMENTS

1958: Resident Research Associate, Argonne National Laboratory

1959-67: Supervisor, OSU Nuclear Reactor Laboratory

1960-65: Lecturer in National Science Foundation Summer Institutes in Radiobiology at The Ohio State University

1962-67: Lecturer in ASEE-OCD professional development courses on Fallout Shelter Analysis, for architects and engineers throughout Ohio

1965-66: Guest Lecturer at ASEE-OCD Summer Institutes on Nuclear Defense Design at the University of Colorado, the University of Maine, Pennsylvania State University and the University of Washington

1968-74: Director, Nuclear Reactor Laboratory

1968-72: Assistant Professor, Zoology and Mechanical (Nuclear) Engineering

1974-80: Associate Director, CLEAR/Stone Laboratory

1983-84: Interim Director, Office of Radiation Safety

IV. SOCIETY MEMBERSHIPS

Health Physics Society (Plenary member of HPS; charter member and second President of the Buckeye Chapter)

American Academy of Health Physics

American Nuclear Society

Sigma Xi (President of The Ohio State University Chapter in 1976-77)

Ohio Academy of Science (Fellow)

V. REPRESENTATIVE THESIS TITLES (advised)

"Environmental Radioactivity Investigations of Lake Erie Sediments with Special Attention to Cs-137 as an Aid in Determining Sedimentation Rates"; John G. Evans, 1972

"The Development of a Technique to Analyse the Elemental Content of Naiad Shells Using Neutron Activation Analysis"; John C. Merritt, 1974

"The Tagging Efficiency of Electrolytically Reduced Sodium Pertechnetate to Macro-Aggregated Albumin"; Donald G. Lorentz, 1975

"The Uptake and Clearance of Cs-137, Co-60, Mn-54 and Zn-65 by Chironomous riparius (Midge Larvae) and Branchiura sowerbyi (aquatic Oligochaete)"; Richard D. Myser, 1975

"A Personnel Monitor Using Thermoluminescent Dosimeters to Evaluate Mixed Radiation Field Exposure"; Tammra Williams Hornung, 1976

"A Study on the Feasability of Nuclear Transmutation, in Fission Reactors, as a Waste Management Alternative"; Gregory Duniak, 1979

"The Relative Effectiveness of Structures as Protection from Gamma Radiation from Cloud and Fallout Sources as a Function of Source Energy"; James P. Fingerlos, 1984 (Ph.D.)

"Demonstration of the Feasability of a Boron-10 Assay System Using Prompt Alpha Spectoscopy"; Craig E. Jensen, 1987

"A Study of Personnel Exposures During Cavernosography Procedures"; Perjetta Smith, 1988

"Semi-empirical Prediction of Dose Rates in Air, Particle Flux, and Degraded Spectra from Point Beta Sources"; Jeffrey Stapleton, 1988

"An Investigation into the Appropriateness of the Meteorological Monitoring Prog: n at the Donald E. Cook Nuclear Plant"; Walter MacRae, 1988

"A Pharmacokinetic Analysis for Baron Neutron Capture Therapy Using Solid State Nuclear Track Detectors and Sequential.y Drawn Rat Blood Samples"; Timothy Mengers, 1989

"A Program for Demonstrating Compliance with 10CFR50 Appendix A Requirements for the Cook Nuclear Plant Control Room Ventilation System"; Mark Ackerman, 1989

VI. REPRESENTATIVE PUBLICATIONS AND PRESENTATIONS

"Radioactive Samarium-145 and Promethium-145"; W.E. Carey, R.P. Sullivan, M.R. Bhat and M.L. Pool; Annual Meeting of the American Physical Society; 1958

"Determination of Time Behavior of Neutron Density and of Reactivity on the Argonaut Reactor"; W.R. Kimel, W.E. Carey, F.G. Prohammer and G.C. Baldwin; Nuclear Science and Engineering; Vol. 6, No. 3; 1959

"Measurement of Mercury Concentrations in Human Blood by Activation Analysis"; W.E. Carey; 17th Annual Meeting of the American Academy of Occupational Medicine; 1965

"X-ray Radiation Effects on Survival and Sterility of Adults of the Cereal Leaf Beetle"; W.C. Myser, W.E. Carey; Journal of Economic Entomology; Vol. 62, No. 3; 1969

"Distribution of Arsenic Residues by Activation Analysis"; J.R. Geisman, W.E. Carey, W.A. Gould and E.K. Alban; Journal of Food Science; Vol. 34, No. 3; 1969

"Concentration of Radioactivity in Lake Erie Fishes"; W.E. Carey, R.D. Myser and A.E. Stoner; 17th Conference on Great Lakes Research; 1974

"Use of Zinc-65 as an Indicator of the Diel Movements of the Brindled Madtom, Noturus miurus (Jordan)"; C.A. Bowen and W.E. Carey; 85th Annual Meeting of the Ohio Academy of Science, 1976

"Implications of Release of Radioactive Material for the Food Processing Industry"; W.E. Carey; Engineering Foundation Conference; 1980

"Future Implications of Three Mile Island on Public Health Programs"; W.E. Carey; 37th Annual Meeting of the Ohio Public Health Association; 1980

"Nearshore Primary Productivity in Southwestern Lake Erie, 1975-79"; W.E. Carey, P.B. Herdendorf and J.M. Reutter; 24th Conference on Great Lakes Research; 1981

"Radiosensitivity of B16 Melanoma Cells Following Boron-10 Neutron Capture"; C.W. Johnson, W.E. Carey, R.F. Barth and A.H. Soloway; Annual Meeting of the Federation of Associated Societies of Experimental Biology; 1982

"The Risk of Walleye Fishing"; W.E. Carey; F.T. Stone Laboratory Seminary Series; 1982

"Chernobyl .... What Do We Know A Year Later?"; W.E. Carey; Annual Meeting of the Mutual Atomic Energy Reinsurance Pool; 1987; Hilton Head, SC

Appendix B

Written Procedures
for
Associated Irradiator Operations

I. Scope:

This instruction outlines how to change irradiator access tubes and how to move pins to the storage rack located within the BSF Pool.

II. Discussion:

Although the standard irradiation geometry is a source rack surrounding a three inch access tube other geometries may be utilized. For example, for larger samples a six inch access tube and appropriate source rack may be utilized. Or to modify the dose rate one or more pins may be placed in the storage rack. In these instances it is important that the pins be moved in an approved manner.

III. References:

A. Co-60 Irradiator License

B. Original Irradiator Pin Drawings

IV. Precautions/Performance Standards:

A. For all Co-60 pin or access tube changes at least two individuals shall be present, one of whom shall be a responsible individual with regard to irradiator operation.

B. Pins shall be unloaded from the irradiator rack to the storage rack before the access tube or irradiator rack is repositioned for storage.

C. A survey meter and/or ARM shall be in use at the pool top to monitor dose rates during pin manipulations.

D. Each pin shall be accounted for either in an irradiator rack or the storage rack and storage shall be accomplished in a vertical position.

V. Procedures:

A. Use the overhead crane to reposition the grating that covers the BSF Pool so one has access to the irradiator rack and the storage rack simultaneously.

* **Turn off Crane Power!**

B. Using the pin handling tool move as many pins as required from one rack to the other making sure that the dose rate remains as low as possible. Since the pins are about 18 inches long they should be raised no more than two feet toward the surface when being manipulated.

C. Once all pins are in the storage rack, the irradiator rack and/or access tube may be repositioned for storage.

D. Record the position of each pin on Attachment A (Co-60 Irradiator Pin Location) and store in the Irradiator Use Logbook. Attachment B (Co-60 Irradiator Utilization Record) should also be completed as appropriate and stored in the Logbook.

VI. Attachments:

A. Co-60 Irradiator Pin Location

B. Co-60 Irradiator Utilization Records

ATTACHMENT A

Co-60 Irradiator Pin Location

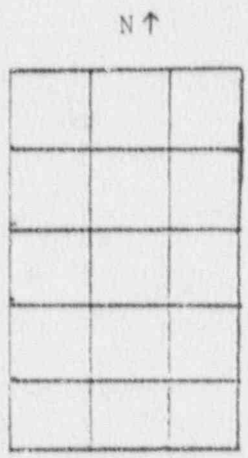
Date __________

Time __________

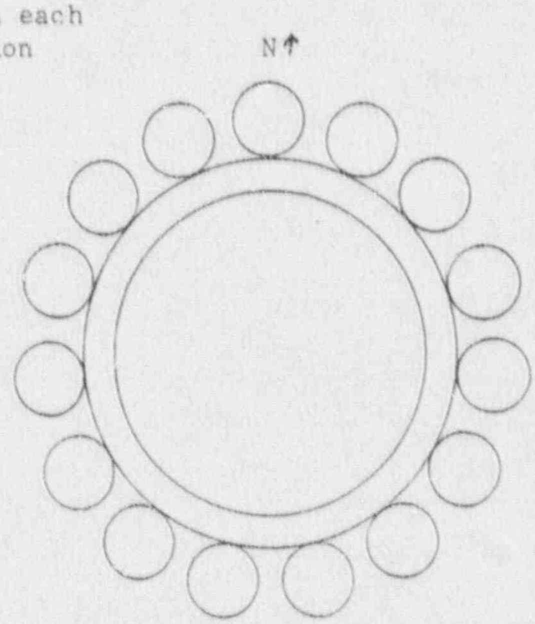
Responsible Individual ______________

Access Tube in Use ________________

Place an X in each pin location



Shielded Storage Rack



Access Tube

BSF Pool ______

Reactor Pool ______

ATTACHMENT B

Co-60 Irradiator Utilization Record

for ______________________, ______________________
Name Institution

Date	EP Rev.	Operator	Second Person	Sample Type	BKG	Time (Samples in)	Time (Samples out)	BKG	Area Secured (Name)

I. Scope:

This instruction outlines procedures to relocate the Co-60 pins from the BSF Pool to the Reactor Pool.

II. Discussion:

It may be necessary to move the Co-60 pins into the Reactor Pool from the BSF Pool for maintenance activities such as repair of the BSF or perhaps a leaking Co-60 pin. If manipulations require the pins to be near the surface of the pool or above, they shall be shielded and transported using the transport cask.

III. References:

A. Co-60 Irradiator License

B. Original Irradiator Pin Drawings

C. Transfer Cask Drawings

IV. Precautions/Performance Standards:

A. For all Co-60 pin transfers using the cask at least two individuals shall be present one of whom shall be a responsible individual with regard to irradiator operation.

B. A survey meter and/or ARM shall be in use at the pool top to monitor dose rates during cask manipulations.

C. The straps attaching the crane to the cask shall be inspected before each use.

V. Procedures:

A. Transfer all pins to the storage rack in accordance with IP-01.

B. Lower the transfer cask into the BSF Pool near the floor.

C. Load the rack into the transfer cask and close all appropriate openings.

D. Monitor the pool surface as the cask is raised.

E. Lower the cask into the East end of the Reactor Pool as far as possible away from the core.

F. Unload the rack from the cask and place it on the floor of the Reactor Pool near the East end.

G. Remove the cask and record the transfer in the Irradiator Use Logbook.

VI. **Attachments:**

None

CONTROL NO. 88852

I. **SCOPE**:

This instruction outlines the approved methods for calibration of the various radiation monitoring instruments used at the NRL.

II. **DISCUSSION**:

The purpose of this procedure is to give the approved method of calibrating the following radiation monitoring instruments:

A. Area Radiation Monitors

B. Portable Beta-Gamma Survey Meter, E-530

C. Portable Air Ionization Chamber, RO-4A

D. Portable Neutron Rem Meter, PNR-4

E. Portal Monitor, RM-14

F. Portal Monitor, GSM-5

The appendices contain dose rate calculations, data, and drawings needed to perform these calibrations. This procedure also requires a quarterly functional check of these instruments.

III. **REFERENCES**:

A. Lab Memo HP-52, NRL Area Radiation Monitor Calibration Procedure.

B. Lab Memo HP-51, NRL Portable Survey Instrument Calibration Procedure.

C. Portable Neutron Rem Counter, Model PNR-4, Technical Manual.

D. Ion Chamber, Model RO-4A, Technical Manual.

E. Technical Manual for Radiation Monitor, Model RM-14.

F. Technical Manual for Geiger Counter, Model E-530.

G. Gamma Alarm System, Model GA-2TMF (Area Radiation Monitors).

H. OM-06, Pu-Be Source Removal.

IV. PRECAUTIONS:

A. Use the principles of ALARA when the sources are being used.

B. Radiation fields shall be calculated before removing sources from storage facilities.

C. Meter readings should be adjusted within ±10% of the calculated value.

D. Adjustments to the High Range of the RO-4A shall be made with the source shielded.

V. PROCEDURES:

A. Calibration of the Area Radiation Monitors

1. Perform dose rate calculations (see appendix A).
2. Adjust the artificial background on ARM 1 to minimum setting (full CCW) and set the alarm level in the control room to its highest setting.
3. Place source at 1.0 mr/hr distance and adjust the brown set pot to within ±10% of the calculated dose rate.
4. Place source at 100 mr/hr distance and adjust the red pot to within ±10% of the calculated dose rate.
5. Place source at 1000 mr/hr distance and adjust the orange pot to within ±10% of the calculated dose rate.
6. Check calibration at 10 mr/hr, should be within ±10% of the calculated dose rate.
7. Repeat steps 2-6 until all three ranges are within ±10% of the calculated dose rates.
8. Set the alarm level (red set pot) in the control room to 10 mr/hr.
9. Set the fail-safe (gold set pot) to 0.1 mr/hr.
10. Attach the up-scale check button to the ARM box and depress.

11. Rotate the up-scale control pot (white) until the panel meter reads 0.1 mr/hr.

12. Rotate the low limit control pot (green) until the gold fail-safe light is lit. Move the pot back in the other direction until light is extinguished.

13. Rotate the up-scale control pot (white) until the panel meter reads 10 mr/hr.

14. Rotate the high limit control pot (blue) until the red alarm light is lit. Move the pot in the other direction until it is just extinguished.

15. Adjust the up-scale check control pot (white) to 12 mr/hr.

16. Test final settings for agreement in the control room.

17. Repeat steps 2-16 for all four ARM's.

B. Calibration of the E-530

1. Perform dose rate calculations (see appendix A).

2. Open case to expose calibration set pots.

3. Place detector at the proper distance for a 100 mr/hr dose rate and adjust to within ±10% of the calculated dose rate.

4. Repeat step 3 for 10, 1.0, and 0.1 mr/hr.

5. Repeat steps 3 and 4 until all dose rates are within ±10%.

C. Calibration of the RO-4A

1. Perform dose rate calculations for high range (see Appendix A).

2. Contact the Division of Veterinary Radiology (in Vet Clinical Science) for permission to use their Cs-137 irradiator (2-1040).

3. Open case to expose calibration set pots.

4. Place detector at the proper distance for a 140 R/hr dose rate and adjust to within ±10% of the calculated dose rate. Adjustments are made while the source is shielded.

5. Repeat step 3 for 100, 70, and 30 R/hr.

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6. Repeat steps 4 and 5 until all dose rates are within ±10%.

7. Perform dose rate calculations for low range (see appendix A).

8. Open case to expose calibration set pots.

9. Place detector at the proper distance for a 100 mr/hr dose rate and adjust to within ±10% of the calculated dose rate.

10. Repeat step 9 for 10 mr/hr.

11. Repeat steps 9 and 10 until all dose rates are within ±10%.

D. Calibration of the PNR-4

1. Obtain activity estimates from the graph on increase in yield of the Plutonium-Beryllium source (see appendix H).

2. Use this information to find the distances for the following dose rates 4, 40, and 400 mr/hr from appendix I.

3. Turn off meter.

4. Open case to expose calibration set pots.

5. (NOTE) Calibration set pots may only be adjusted with power off.

6. Place detector at the proper distance for a 400 mr/hr dose rate and adjust to within ±10% of the calculated dose rate.

7. Repeat step 3-6 for 40 and 4 mr/hr.

8. Repeat steps 3-7 until all dose rates are within ±10%.

E. Check of efficiency of the RM-14

1. This instrument is used as a "frisker" and should be checked for its efficiency by placing it near the Sr-y 90 and Tc-99 sources.

2. Place detector on contact with the sources and record the number of counts per minute for each isotope. Determine the efficiency and record on the Beta Counter Efficiency Check.

3. Compare this value with previous ones for accuracy of detector.

F. Check of efficiency of GSM-5 (Complete as in E.)

G. Quarterly Functional Check of Radiation Monitoring Instruments

1. Place the Cs-137 or other suitable calibration check source near the surface of each β γ detector to assure an upscale reading.

2. If there is no response, have the instrument repaired and/or recalibrated as necessary.

3. Initial and date the appropriate section on the quarterly maintenance board.

IV. ATTACHMENTS:

A. Activity and Dose Rate Calculations For Sources Commonly Used By The NRL.

B. Instrument Calibration Record

C. List of Radiation Survey Instruments at NRL

D. Area Radiation Monitor Calibration Worksheet

E. Survey Instrument Calibration Worksheet

F. Survey Instrument Calibration Worksheet

G. Survey Instrument Calibration Worksheet

H. Increase in Yield of the Plutonium-Beryllium Source

I. Neutron Dose Rate Curve

J. Beta Counter Efficiency Check

APPENDIX A

ACTIVITY AND DOSE RATE CALCULATIONS
FOR SOURCES COMMONLY USED BY THE NRL.

R^-226 A= 88.4 mCi Dose Rates: 1000 mr/hr @ 27.0 cm., 10.6 in.
100 mr/hr @ 85.4 cm., 33.6 in.
10 mr/hr @ 270.0 cm., 106.3 in.

Co-60 A(0)= 12.1 mCi on January 23, 1968

A=A(0)EXP($-\lambda$t)

λ=ln2/t=ln' 5.263 yr.=0.1317 yr^{-1}

$D=6AE/R^2$

R=(6*A*E/D)$^{1/2}$ =118.05*(A/D)$^{1/2}$ cm.

D= mr/hr, R= distance in feet

dose rates needed are .1, 1, and 10 mr/hr.

Pu-Be A= 5 Ci Initial Flux Rate= 8.95×10^6 n/sec

Find % initial flux from graph in appendix H.

multiply % initial flux by initial flux and consult graph

in appendix I.

dose rates needed are 4, 40, and 400 mrem/hr.

Cs-137 A(0)= 1932 Ci on June 30, 1964.

A=A(0)EXP ($-\lambda$ t)

λ=ln2/t=ln2/30.17 yr.=0.0230 yr^{-1}

$D=6AE/R^2$

R=(6*A*E/DR)$^{1/2}$ =121.00*(A/D)$^{1/2}$ cm.

D= R/hr, R= distance in feet

dose rates needed are 30, 70, 100, and 140 R/hr.

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INSTRUMENT CALIBRATION RECORD

INSTRUMENT: ________________

DATE OF CALIBRATION	SERVICE IN	SERVICE OUT	INITIALS	COMMENTS

LIST OF RADIATION SURVEY INSTRUMENTS AT NRL

TYPE	METER	DETECTS	RANGE
G-M	Eberline E-530	$\beta - \gamma$	0-200 mr/hr.
	Johnson GSM-5	$\beta - \gamma$	Frisker
	Eberline RM-14	$\beta - \gamma$	Frisker
AIR IONIZATION	Eberline RO-4A	γ	0.1 mr/hr- 199.9 R/hr
SCINTILLATION	ARM 1 - pool top	γ	0-1000 mr/hr
	ARM 2 - thermal column		0-1000 mr/hr
	ARM 3 - beam port		0-1000 mr/hr
	ARM 4 - process system		0-1000 mr/hr
BF3 PROPORTIONAL	Eberline PNR-4	neutrons	0-5 R/hr

AREA RADIATION MONITOR CALIBRATION WORKSHEET

DATE ______________

CALIBRATED BY ______________

INSTRUMENT: ARM 1 - POOL TOP
ARM 2 - THERMAL COLUMN
ARM 3 - BEAM PORT
ARM 4 - PROCESS SYSTEM

SOURCE 1 ________________________ ACTIVITY ________________________

SOURCE 2 ________________________ ACTIVITY ________________________

SOURCE USED	CALCULATED DISTANCE	CALCULATED DOSE RATE	ARM 1	ARM 2	ARM 3	ARM 4
		1000 mr/hr				
		100 mr/hr				
		10.0 mr/hr				
		1.0 mr/hr				

SURVEY INSTRUMENT CALIBRATION WORKSHEET

DATE ____________ CALIBRATED BY ____________ INSTRUMENT E-530

SOURCE 1 ____________ ACTIVITY ____________

SOURCE 2 ____________ ACTIVITY ____________

SOURCE USED	CALCULATED DISTANCE	CALCULATED DOSE RATE	METER READING	
			INITIAL	FINAL
		100 mr/hr		
		10 mr/hr		
		1.0 mr/hr		
		0.1 mr/hr		

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SURVEY INSTRUMENT CALIBRATION WORKSHEET

DATE ____________ CALIBRATED BY ____________ INSTRUMENT RO-4A

SOURCE 1 ________________________ ACTIVITY ________________________

SOURCE 2 ________________________ ACTIVITY ________________________

SOURCE USED	CALCULATED DISTANCE	CALCULATED DOSE RATE	METER READING	
			INITIAL	FINAL
		140 R/hr		
		100 R/hr		
		70 R/hr		
		30 R/hr		
		100 mr/hr		
		10 mr/hr		

SURVEY INSTRUMENT CALIBRATION WORKSHEET

DATE ____________ CALIBRATED BY ____________ INSTRUMENT PNR-4

SOURCE 1 ____________________ ACTIVITY ____________________

SOURCE USED	CALCULATED DISTANCE	CALCULATED DOSE RATE	METER READING	
			INITIAL	FINAL
		400 mR/hr		
		40 mR/hr		
		4 mR/hr		

APPENDIX H

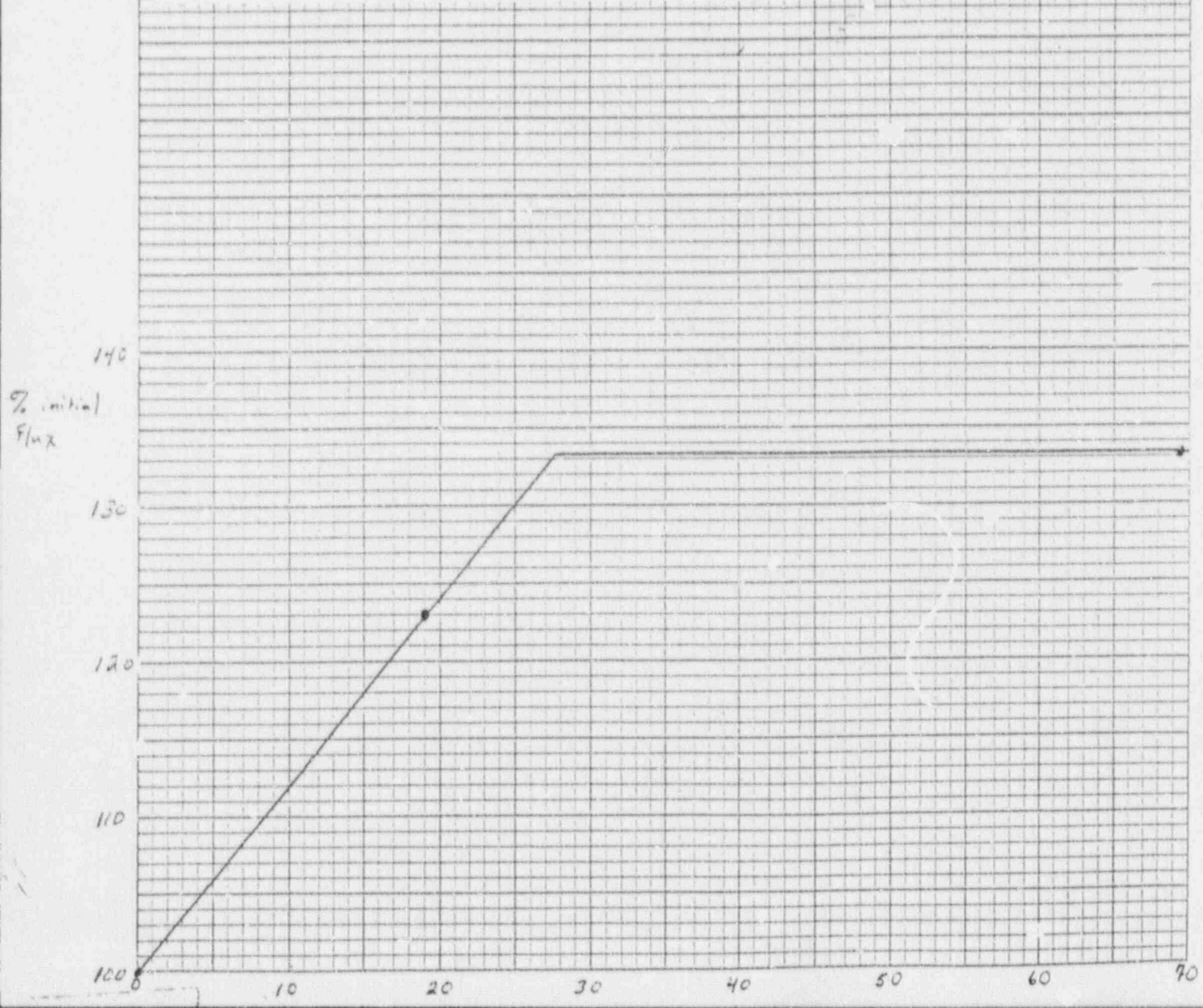
This curve is a three point linear approximation of an exponential curve of percent initial flux (8.95 EXP 6 n/cm2-sec) vs time and therefore forms a conservative estimate of the neutron flux from the Plutonium-Beryllium source for dates post 1980 only.

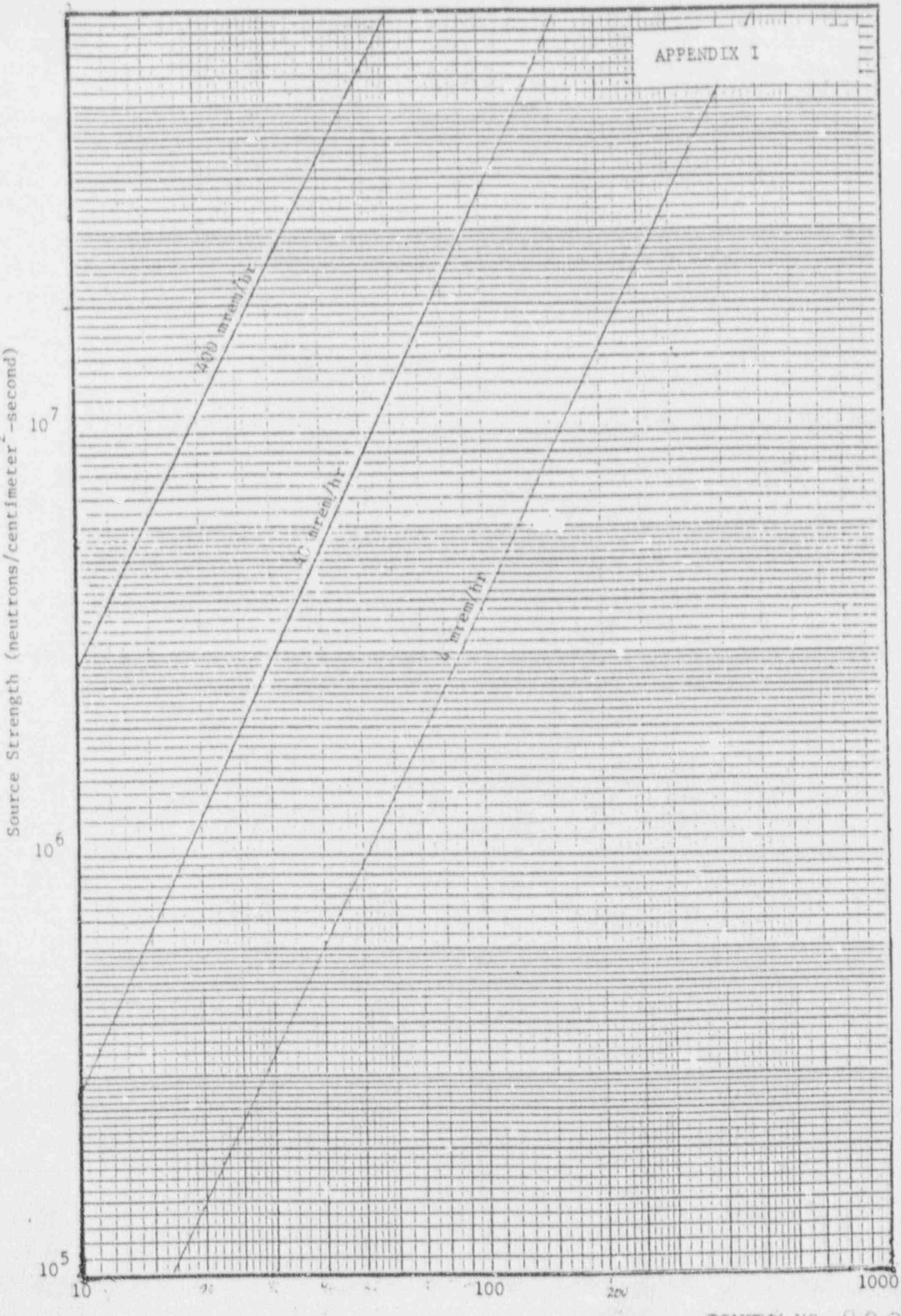
The three points used to form this curve are:

1. An initial percent neutron flux value of 100% of initial flux.
2. A 1980 value of 123% of initial flux which Monsanto derived in March 1980 (see attached letter).
3. A maximum of 133% increase as derived in "Increases in Plutonium-Beryllium Sources", Nuclear Applications, Vol.4, March 1968 Also attatched.

The assumptions made in constructing this graph are:

1. No burnup of the source due to reactor flux has occured.
2. Data on curve is not conservative for dates prior to 1980





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APPENDIX J

BETA COUNTER EFFICIENCY CHECK

Instrument ____________________

Date __________________________ Performed by ________________________

Isotope		
Source Activity (cpm)		
Gross		
Counts		
Total Counts		
Avg. Counts		
Efficiency*		

* Determine the efficiency by the following formula:

$$\text{Eff.} = \frac{\text{Avg. Counts Obtained} \times 100}{\text{Source Act.} \times \text{Count time}}$$

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