US Nuclear Regulatory Commission (NRC)

LICENSE APPLICATION

FOR

RENEWAL AND COMPLETE REVISION OF NRC BYPRODUCT MATERIAL LICENSE NUMBER 29-01022-08

FOR THE

AN/UDM-2 RADIAC CALIBRATOR SET

HEADQUARTERS

U.S.ARMY COMMUNICATIONS-ELECTRONICS COMMAND

(CECOM)

Fort Monmouth, New Jersey 07703

II/13

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accordance with the Freedom of Information
t, exemptions 2 + 6
IA- 2006-0238

"OFFICIAL RECORD COPY"

117758

ML10

DEPARTMENT OF THE ARMY
HEADQUARTERS US ARMY COMMUNICATIONS–ELECTRONICS COMMAND
AND FORT MONMOUTH
FORT MONMOUTH, NEW JERSEY 07703

REPLY TO
ATTENTION OF:

DRSEL-SF-MR

25 MAY 1984

SUBJECT: Renewal and Complete Revision of US Nuclear Regulatory Commission (NRC) Byproduct Material License No. 29-01022-08

Commander
US Army Materiel Development and Readiness Command
ATTN: DRCSF-P
5001 Eisenhower Avenue
Alexandria, Virginia 22333

The enclosed application for the renewal and complete revision of subject license for the AN/UDM-2 Radiac Calibrator Set is submitted for review and forwarding to the NRC.

FOR THE COMMANDER:

1 Encl
as

RAYMOND E. B. KETCHUM, II
Colonel, GS
Chief of Staff

"OFFICIAL RECORD COPY"

ML10

117758

NRC Form 313 I
(12-81)
10 CFR 30

U.S. NUCLEAR REGULATORY COMMISSION

APPLICATION FOR BYPRODUCT MATERIAL LICENSE
INDUSTRIAL

See attached instructions for details.

Completed applications are filed in duplicate with the Division of Fuel Cycle and Material Safety, Office of Nuclear Material Safety, and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555 or applications may be filed in person at the Commission's office at 1717 H Street, NW, Washington, D. C. or 7915 Eastern Avenue, Silver Spring, Maryland.

1. APPLICATION FOR: *(Check and/or complete as appropriate)*

	a. NEW LICENSE
	b. AMENDMENT TO: LICENSE NUMBER
X	c. RENEWAL OF: LICENSE NUMBER 29-01022-08

2. APPLICANT'S NAME *(Institution, firm, person, etc.)*
Department of the Army
US Army Communications-Electronics Command

TELEPHONE NUMBER: AREA CODE — NUMBER EXTENSION
(201) 544-4427

3. NAME AND TITLE OF PERSON TO BE CONTACTED REGARDING THIS APPLICATION
Barry J. Silber, RPO

TELEPHONE NUMBER: AREA CODE — NUMBER EXTENSION
(201) 544-4427

4. APPLICANT'S MAILING ADDRESS *(Include Zip Code)* *(Address to which NRC correspondence, notices, bulletins, etc., should be sent.)*
ATTN: DRSEL-SF-MR
Fort Monmouth, NJ 07703

5. STREET ADDRESS WHERE LICENSED MATERIAL WILL BE USED *(Include Zip Code)*
See Supplement A

(IF MORE SPACE IS NEEDED FOR ANY ITEM, USE ADDITIONAL PROPERLY KEYED PAGES.)

6. INDIVIDUAL(S) WHO WILL USE OR DIRECTLY SUPERVISE THE USE OF LICENSED MATERIAL
(See Items 16 and 17 for required training and experience of each individual named below)

	FULL NAME	TITLE
a.	Individuals meeting the minimum requirements stated in Items 16 and 17.	
b.	See Supplement B	
c.		

7. RADIATION PROTECTION OFFICER
See Supplement C

Attach a resume of person's training and experience as outlined in Items 16 and 17 and describe his responsibilities under Item 15.

8. LICENSED MATERIAL

LINE NO.	ELEMENT AND MASS NUMBER A	CHEMICAL AND/OR PHYSICAL FORM B	NAME OF MANUFACTURER AND MODEL NUMBER (If Sealed Source) C	MAXIMUM NUMBER OF MILLICURIES AND/OR SEALED SOURCES AND MAXIMUM ACTIVITY PER SOURCE WHICH WILL BE POSSESSED AT ANY ONE TIME D
(1)	^{90}Strontium	See Supplement D		
(2)	^{90}Strontium	See Supplement D		
(3)	^{90}Strontium	See Supplement D		
(4)	^{90}Strontium	See Supplement D		

	DESCRIBE USE OF LICENSED MATERIAL E
(1)	See Supplement D
(2)	
(3)	8409210507 840924 REG1 LIC30 29-01022-08 PDR
(4)	17758

NRC FORM 313 I (12-81)

INFORMATION REQUIRED FOR ITEMS 15, 16 AND 17

Describe in detail the information required for Items 15, 16 and 17. Begin each item on a separate page and key to the application as follows:

15. RADIATION PROTECTION PROGRAM. Describe the radiation protection program as appropriate for the material to be used including the duties and responsibilities of the Radiation Protection Officer, control measures, bioassay procedures *(if needed)*, day-to-day general safety instruction to be followed, etc. If the application is for sealed source's also submit leak testing procedures, or if leak testing will be performed using a leak test kit, specify manufacturer and model number of the leak test kit.
See Supplement J

16. FORMAL TRAINING IN RADIATION SAFETY. Attach a resume for each individual named in Items 6 and 7. Describe individual's formal training in the following areas where applicable. Include the name of person or institution providing the training, duration of training, when training was received, etc.

    a. Principles and practices of radiation protection.

    b. Radioactivity measurement standardization and monitoring techniques and instruments.

    c. Mathematics and calculations basic to the use and measurement of radioactivity.

    d. Biological effects of radiation. See Supplements B and C

17. EXPERIENCE. Attach a resume for each individual named in Items 6 and 7. Describe individual's work experience with radiation, including where experience was obtained. Work experience or on-the-job training should be commensurate with the proposed use. Include list of radioisotopes and maximum activity of each used.

See Supplements B and C

18. CERTIFICATE

(This item must be completed by applicant)

The applicant and any official executing this certificate on behalf of the applicant named in Item 2, certify that this application is prepared in conformity with Title 10, Code of Federal Regulations, Part 30, and that all information contained herein, including any supplements attached hereto, is true and correct to the best of our knowledge and belief.

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.

FOR THE COMMANDER:

a. LICENSE FEE REQUIRED *(See Section 170.31, 10 CFR 170)*	b. CERTIFYING OFFICIAL *(Signature)* [signature]
	c. NAME *(Type or print)* RAYMOND E.B. KETCHUM, II
(1) LICENSE FEE CATEGORY:	d. TITLE Colonel, GS, Chief of Staff
(2) LICENSE FEE ENCLOSED: $	e. DATE 25 May 1984

NOTE

1. Enclosures 1 through 6 are the concurrences from the major field commands who are responsible for the use of the AN/UDM-2 Radiac Calibrator Sets.

2. Enclosure 7 is the concurrence from the US Army TMDE Support Group who is responsible for the major use of the AN/UDM-2 Radiac Calibrator Sets.

3. Enclosure 8 is the concurrence from US Army Depot Systems Command which provide bulk storage and/or maintenance of these devices.

4. Enclosure 9 is the concurrence from the Secretary, US Air Force Radioisotope Committee for use of the calibrators by Army, civilian and/or military personnel located on Air Force property.

5. The Fort Monmouth Radiation Control Committee and appropriate CECOM directorates have concurred in the renewal application.

AFLG-FMC (5 Mar 84) 1st Ind
SUBJECT: Renewal and Complete Revision of US Nuclear Regulatory Commission (NRC) Byproduct Material License (BML) Number 29-01022-08

HQ FORSCOM, Ft McPherson, GA 30330 17 APR 1984

TO: Commander, U. S. Army Communications-Electronics Command & Fort Monmouth, ATTN: DRSEL-SF-MR, Fort Monmouth, New Jersey 07703

1. The draft copy of subject renewal application has been reviewed by the Radiation Control Officer as requested.

2. Concur with the renewal application which includes the environmental documentation in accordance with AR 200-2.

FOR THE COMMANDER:

wd Incl 1

CHARTLEY M. MCMASTER
Captain, AGC
Assistant Adjutant General

Encl 1

DEPARTMENT OF THE ARMY
HEADQUARTERS UNITED STATES ARMY TRAINING AND DOCTRINE COMMAND
FORT MONROE, VIRGINIA 23651

REPLY TO
ATTENTION OF:

19 MAR 1984

ATCD-NC

SUBJECT: Renewal and Complete Revision of US Nuclear Regulatory Commission (NRC) Byproduct Material License (BML) Number 29-01022-08

Commander
US Army Communications-Electronics
Command
ATTN: DRSEL-SF-MR
Fort Monmouth, NJ 07703

1. Reference letter, DRSEL-SF-MR, CECOM, 5 March 1984, SAB.

2. This headquarters has reviewed both the NRC license renewal application and the environmental documentation for the AN/UDM-2 Radiac Calibrator Set. We concur with both documents.

3. POC at this headquarters is CPT Fisher, AUTOVON 680-4411.

FOR THE COMMANDER:

Doretha Mangrum

DORETHA MANGRUM
ASSISTANT ADJUTANT GENERAL

Encl 2

DEPARTMENTS OF THE ARMY AND THE AIR FORCE
NATIONAL GUARD BUREAU
WASHINGTON, D.C. 20310

REPLY TO
ATTENTION OF

NGB-AVN-S

14 May 1984

SUBJECT: Renewal and Complete Revision of US Nuclear Regulatory Commission (NRC) By-Product Material License (BML) Number 29-01022-08

Commander
US Army Communications - Electronics Command
ATTN: DRSEL-SF-MR
Fort Monmouth, NJ 07703

1. The National Guard Bureau concurs with draft copy of subject renewal application for the AN/UDM-2 Radiac Calibrator Set.

2. Concurrence with the environmental documentation of subject document will be rendered by NGB-ARI-E under separate correspondence.

3. Point of contact in NGB-AVN-S is Mrs. Judith Smith, AUTOVON 584-4727.

(For) Alvin A. Marshall
JOHN J. STANKO, Jr.
Chief, Army Aviation Division
National Guard Bureau

ALVIN A. MARSHALL
Chief, Aviation Logistics Branch

CF:
NGB-ARI-E
NGB-ARL-M

Encl 3

ROUTINE

(2 ACT 1 INFO) DRSEL PM'S ERAD OTHER
GS:CC:CP:ED:FMD:HI:IG:IL:IO:LG ATC:GARS:MSCS: AQ:CP-FM AA:AR:CCNC:CHB:CHS:
ME:MICO:MM:MS:PA:PC:PL:PT:OC: OTDS:PLRS:SC: CS:ET:EW CSA:DEN:II:JITF:MAF
SF:SM:SP:SS:SCCO: TE:TF: BD:FF: SA:SD: MCR:PH:PMO:SSD:TSO:
RDXO:FI:POD: COM:SDSC:SEI:TCS: MI: ASE: ACSC: SSC: USMC:54:235:513:902

RCTUZEXW RULNETC3890 1511735-UUUU--RUEDBIA.
ZNR UUUUU
R 291430Z MAY 84 ZEX
FM CNGB APG MD//NGB-AVN-SG//
TO RUEDBIA/CDR CECOM FT MONMOUTH NJ//DRSEL-SF-MR//
INFO ZEN CNGB APG MD//NG2-ARI-E//
RUEAUSA/CNGB WASHDC//NGB-ARI/NGB-ARS/
NGB-ARL/NGB-JA/NGN-PA/NGB-PO/
NGB-ARO//
BT
UNCLAS
SUBJECT: RENEWAL AND COMPLETE REVISION OF US NUCLEAR REGULATORY COMMISSION (NRC) BYPRODUCT MATERIAL LICENSE (BML) NUMBER 29-01022-08
A. LETTER, NGB-AVN-S, 14 MAY 84, SAB.
B. LETTER, DRSEL-SF-MR, 5 MAR 84, SAB.
C. AR 200-I, ENVIRONMENTAL PROTECTION AND ENHANCEMENT, 15 JUL 82.
D. AR 385-11, IONIZING RADIATION PROTECTION, 1 MAY 80.
E. TM 3-261, HANDLING AND DISPOSAL OF UNWANTED RADIOACTIVE MATERIAL, MAR 81.
F. AR 200-2, ENVIRONMENTAL EFFECTS OF ARMY ACTIONS, 15 OCT 82 WITH DARCOM SUPPLEMENT 1, 26 FEB 82.
2. IAW PARA 2, REF A, THE SUBJECT NRC LICENSE APPLICATION (REF B)

AND SUPPORTING ENVIRONMENTAL DOCUMENTATION HAS BEEN REVIEWED BY THE NGB AND CONCURRENCE IS PROVIDED BASED ON THE FOLLOWING:
A. DISPOSAL OF UNWANTED RADIOACTIVE WASTE WILL BE IAW REFERENCES C, D, AND E. IN ADDITION, IT SHOULD BE NOTED THAT IAW REF D, DISPOSAL OF UNWANTED RADIOACTIVE MATERIAL IS THE RESPONSIBILITY OF THE US ARMY MATERIEL DEVELOPMENT AND READINESS COMMAND (DARCOM) AND NOT NGB.
B. STORAGE AND DISPOSAL PROCEDURES FOR UNWANTED RADIOACTIVE MATERIAL ARE ADDRESSED IN SUPPLEMENT 1, REF B, AND IN PARAGRAPHS III-B-11 AND III-B-13 OF ANNEX 1, REF B.
C. ENVIRONMENTAL ASSESSMENT AT ANNEX 1 (REF B) HAS BEEN PREPARED IAW REF F, WHICH CONCLUDED IN THE FINDING OF NO SIGNIFICANT IMPACT (FNSI) AT PARA II-A, ANNEX 1.
D. IAW PARA 1-4D, REF F, OPSEC REVIEW HAS BEEN ADDRESSED AT PARA I, ANNEX 1, REF B.
3. RECOMMEND THAT COMPLETED EA AND FNSI BE PROCESSED IAW PARA 3-2C, DARCOM SUPPLEMENT 1 TO AR 200-2 AND IAW PARA 5-5, AR 200-2 (REF F).
4. FINALLY, REQUEST THAT CECOM PROVIDE NGB-ARI-E:
A. A COPY OF THE FINAL, SIGNED EA.

17758

B. A COPY OF THE FINAL, SIGNED FNSI.
C. A COPY OF THE PUBLIC NOTIFICATION DOCUMENTS PROCESSED IAW

PARAGRAPHS 5-5C AND 5-5D, AR 200-2 (REF F).
5. NGB POINTS OF CONTACT ARE:
A. MS. JUDITH SMITH, INDUSTRIAL HYGIENIST, SAFETY BRANCH, ARMY AVIATION DIVISION, NGB-AVN-S, AUTOVON 584-4727 (PRIMARY NGB ACTION OFFICE).
B. MR. JAMES HENSLEY, ENVIRONMENTAL PROTECTION SPECIALIST FOR HAZARDOUS/TOXIC MATERIALS/WASTE, ENVIRONMENTAL RESOURCES BRANCH, ARMY INSTALLATIONS DIVISION, NGB-ARI-E, AUTOVON 584-4701.
C. MR. STEVEN HORNE, NGB-RCO, DRSEL-SF-MR, AUTOVON 995-4427.
BT
#3890

NNNN

AEAGD-MMC-RA-CS (1 Dec 83) 2d Ind CPT Short/lo/ZBN Mil (2281-)6211
SUBJECT: Review of US Nuclear Regulatory Commission by Product Material License Number 29-01022-08

DA, Headquarters 200th TAMMC APO 09052 24 January 1984

TO: Commander USA CECOM, ATTN: DRSEL-SF-MR Fort Monmouth, New Jersey, 07703

1. IAW basic letter, the draft renewal for NRC BML number 29-01022-08 has been reviewed.

2. 10th Medical Laboratory comments are provided with concurrence from USAREUR RPO and RCO.

3. This center provides one additional comment. Para five of supplement B gives instructions for Maintenance Depot without any reference to Reserve Storage Activities (RSA). The assumption that Maintenance Depot are RSA cannot be made. Some reference must be made for RSA. This reference should be included in all future NRC License.

4. Point of contact for this center is, CPT Paul Short, USAREUR Radiological Control Officer, AUTOVON (494-)7328/6211.

FOR THE COMMANDER:

ROBERT L. NIER, JR.
LTC, GS
Chief, Armament & Chemical Equipment Systems Division

CF:
HQ USAREUR, ATTN: AEAGA-SE, APO 09403
HQ 10th Medical Laboratory, APO 09180

Encl 4

APOP-NC (5 Mar 84) 1st Ind
SUBJECT: Renewal and Complete Revision of US Nuclear Regulatory Commission (NRC) Byproduct Material License (BML) Number 29-01022-08

HQ, United States Army Western Command, Fort Shafter, HI 96858, 16 Apr 84

TO: Commander, HQ USA Communications-Electronics Command and Fort Monmouth, ATTN: DRSEL-SF-MR, Fort Monmouth, New Jersey 07703

This headquarters concurs with subject renewal application.

FOR THE COMMANDER:

wd all incl

James T. Bushong
JAMES T. BUSHONG
Colonel, GS
Chief, NC Div, ODCSOPS

Encl 5

DJ-MS-MC (5 Mar 84) 3rd Ind
SUBJECT: Renewal and Complete Revision of US Nuclear Regulatory Commission (NRC) By-product Material License (BML) Number 29-01022-08

Headquarters, Eighth United States Army, APO San Francisco 96301 9 APR 84

TO: Commander, United States Army Communications-Electronics Command and Fort Monmouth, ATTN: DRSEL-SF-MR, Fort Monmouth, New Jersey 07703

1. Subject license application has been reviewed by qualified members of this command and we concur with renewal application and environmental documentation provided.

2. POC this headquarters is MSG Kruse, 293-8230/8914.

FOR THE COMMANDER:

wd all incl

MISIUAITA A. MAGA
CPT, AGC
Assistant Adjutant General

Encl 6

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(2 ACT 1 INFO)  DRSEL                    PM'S        ERAD         OTHER
GS:CC:CP:ED:FMD:HI:IG:IL:IO:LG ATC:GARS:MSCS: AQ:CP-FM AA:AR:CCNC:CHB:CHS
ME:MICO:MM:MS:PA:PC:PL:PT:OC:  OTDS:PLRS:SC:  CS:ET:EW CSA:DEN:II:JITF:MA
SF:SM:SP:SS:SCCO:              TE:TF: BD:FF:  SA:SD:   MCR:PH:PMO:SSD:TSO
2
RDXO:FI:POD: COM:SDSC:SEI:TCS: MI: ASE: ACSC: SSC:     USMC:54:235:513:90
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PCTUZYUW RUCDSRA1167 1431938-UUUU--RUEDBIA.
ZNR UUUUU
P 222001Z MAY 84
FM CDR USATSG REDSTONE ARSENAL AL//DRXTM-SR//
TO CDR CECOM FT MONMOUTH NJ//DRSEL-SF-MR//
ACCT DA-BHCSVD
BT
UNCLAS
SUBJ: US NUCLEAR REGULATORY COMMISSION (NRC) LICENSE NO.
29-01022-08.
A. MSG, DRSEL-SF-MR, 171400Z MAY 84, SAB.
CONCUR WITH US NUCLEAR REGULATORY COMMISSION LICENSE NO. 29-01022-08
RENEWAL APPLICATION WITH THE INCLUSION OF THE CHANGES LISTED IN
REFERENCE MSG.
BT
#1167

NNNN

Encl 7

1 3 171400Z MAY 84 PP PP UUUU TT 1381400

CDR CECOM FT MONMOUTH NJ //DRSEL-SF-MR//

CDR USATSG REDSTONE ARSENAL AL //DRXTM-SR//

UNCLAS

SUBJ: US NUCLEAR REGULATORY COMMISSION (NRC) LICENSE NO. 29-01022-08

A. LETTER, DRXTM-SR, UNDATED, SUBJECT: USNRC LICENSE NO. 29-01022-08.

1. IN RESPONSE TO REFERENCE A, THE FOLLOWING IS PROVIDED:

2. ITEM 2A AND 2B: CONCUR. REFERENCED DOCUMENT, I.E., LBDA RADIOLOGICAL SAFETY PROGRAM, IS THE RESPONSIBILITY OF LEXINGTON BLUE - GRASS DEPOT ACTIVITY (LBDA). AS SUCH, THIS COMMAND DOES NOT HAVE THE AUTHORITY TO ALTER REFERENCED DOCUMENT IN ANY MANNER. HOWEVER, A LETTER HAS BEEN PROVIDED TO LBDA REQUESTING APPROPRIATE ACTION BE TAKEN IN THIS REGARD.

#.**3. ITEM 2C: CONCUR.

4. ITEM 2D: CONCUR. ON 2 DEC 83, A REQUEST WAS MADE TO CHANGE PARAGRAPH 3.4.3 OF MIL-R-55350A (ER) TO INDICATE A SURFACE DOSE RATE CONSISTENT WITH THE NRC CONCEPT OF AS LOW AS REASONABLY ACHIEVABLE (ALARA).

5. ITEM 2E: USE OF THE TERM "COMBAT AREA" IN TB 11-6665-227-12 IS INTENDED TO DESIGNATE ACTUAL COMBAT AREAS. EXCLUDING THE CALIBRATOR SETS IN THESE ~~THERE**SE~~ AE*REAS, ALL AN/UDM-2'S ARE TO BE LEAK TESTED AT

CG READING FILE

JOSEPH M. SANTARSIERO, HEALTH PHYSICIST

DRSEL-SF-MR, 54427

B.M.SAVAIKO/C/SAF OFC/ DRSEL-SF/54427

RECEIVED
TELECOMMUNICATION
CENTER

17 MAY 84 17 11 2

UNCLAS 171400

INTERVALS NOT TO EXCEED 6 MONTHS.

6. ITEM 2F: CONCUR.

7. ITEM 2G: DUE TO THE LARGE NUMBER AND WORLDWIDE DISTRIBUTION OF AN/UDM-2 CALIBRATOR SETS IN USE/STORAGE, IT IS NOT FEASIBLE TO FURNISH EACH USER/OPERATOR WITH NOTICES OF VIOLATIONS* REGARDING INDIV*-VIDUAL FACILITIES. PRACTICALITY, THEREFORE, DICTATES THAT VIOLATION NOTICES, LICENSE CONDITIONS, APPROPRIATE REGULATIONS, AMENDMENTS AND OTHER PERTINENT DOCUMENTATION RELATED TO THE LICENSING OF THE AN/UDM-2 BE MADE AVAILABLE TO MAJOR COMMAND AND USERS AS INDICATED IN SUPPLEMENT J, PARAGRAPH H, OF SUBJECT LICENSE. MOREOVER, THE PROCEDURE OF MAKING THE AFOREMENTIONED MATERIALS AVAILABLE TO THE USER/OPERATOR OF THE AN/UDM-2 IN LIEU OF ACTUAL POSTING OF SAME, HAS BEEN PREVIOUSLY APPROVED BY THE NRC. GIVEN THESE CIRCUMSTANCES, SUPPLEMENT J, PARAGRAPH H, OF SUBJECT LICENSE SHALL REMAIN AS PRESENTED.

8. SUBJECT NRC APPLICATION HAS BEEN/WILL BE REVISED TO INCORPORATE RECOMMENDATIONS INDICATED IN ITEMS 2A, 2B, 2C, 2D AND 2F OF A.

9. REQUEST YOU PROVIDE THIS HQ, ATTN: DRSEL-SF-MR, WITH COMMENTS TO INDICATED CHANGES/REVISIONS AND CONCURRENCE TO SUBJECT NRC ~~LICN***~~ BJF LICENSE APPLICATION BY 25 MAY 1984.

10. POC, THIS COMMAND, IS MR. BARRY J. SILBER OR MR. JOSEPH M. SANTARSIERO, AV 995-4427.

DEPARTMENT OF THE ARMY
UNITED STATES ARMY TEST, MEASUREMENT AND DIAGNOSTIC EQUIPMENT SUPPORT GROUP
REDSTONE ARSENAL, ALABAMA 35898

REPLY TO
ATTENTION OF

DRXTM-SR

SUBJECT: Review of US Nuclear Regulatory Commission (NRC) By-Product Material License No. 29-01022-08

Commander
HQ, US Army Communications - Electronics Command
ATTN: DRSEL-SF-MR
Fort Monmouth, NJ 07703

1. Reference letter and document dated 5 March 1984 from your office regarding SAB.

2. Comments pursuant to SAB are as follows:

a. (Ref. Supplement C - LBDA Radiological Safety Program, Section 6.d.(6)). "Caution Radiation" is not an approved sign IAW AR 385-30 and 10 CFR 20. The sign should read "Caution - Radiation Area," "Caution - Radioactive Material," or "Restricted Area - Do Not Enter," depending upon applicable situation.

b. (Ref. Supplement C - LBDA Radiological Safety Program, Section 6.e.(2)) RPO or individual knowledgeable in radioactive contamination should accompany the individual with an appropriate survey meter to afford monitoring capability and technical advice to medical personnel.

c. (Ref. Supplement D - 9.a.) Constituency of sealed sources per device is too ambiguously portrayed. Three separate totals per device can be derived from the license application.

d. (Ref. Supplement D, MIL-R-55350A, p.6, 3.4.3) The requirement for the maximum allowable dose rate at the external surface of the device to be less than 5.0 mrem per hours is in conflict with the specified requirement in paragraph 3.4.3. of MIL-R-55350.

e. (Ref. TB 11-6665-227-12, p.4, para. 5.e.) Are combat areas designated as zones of potential combat (cease fire in Korea) or areas of actual combat?

f. (Ref. Supplement J, para.4.f.) Recalibration and recertification of the AN/UDM-2 is accomplished by the Area Calibration and Repair Center (ACRC) - Lexington and not the AIRDC as indicated in this paragraph.

g. (Supplement J, para. h) It appears that the NRC requires that all notices of violation regarding any facility be posted at that

DRXTM-SR
SUBJECT: Review of US Nuclear Regulatory Commission (NRC) By-Product Material License No. 29-01022-08

facility IAW 10 CFR Part 19. Retention of such documents at CECOM Headquarters may not suffice in meeting this requirement.

3. POC regarding SAB is Mr. Bob Owen, AV 746-5042/2879.

Del Loney

DELBERT D. LONEY
Chief
Radiation Standards & Development Lab
Metrology Directorate
US Army TMDE Support Group

DRSDS-T (7 May 84) 1st Ind
SUBJECT: Renewal and Complete Revision of US Nuclear Regulatory Commission (NRC) Byproduct Material License (BML) Number 29-01022-08

HQ, US Army Depot System Command, Chambersburg, PA 17201   16 May 1984

TO: Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703

1. Forwarded is concurrence on subject renewal and revision.

2. "Quality Equipment and Support for an Excellent Army."

FOR THE COMMANDER:

John E. Rankin

1 Encl
nc

JOHN E. RANKIN
Chief
Safety Office

Ord 8

DEPARTMENT OF THE ARMY

HEADQUARTERS, LEXINGTON-BLUE GRASS DEPOT ACTIVITY
LEXINGTON, KENTUCKY 40511

REPLY TO
ATTENTION OF

SDSAN-LAS

20 Apr 84

SUBJECT: Renewal and Complete Revision of US Nuclear Regulatory Commission (NRC) Byproduct Material License (BML) Number 29-01022-08

THRU: Commander
Anniston Army Depot
ATTN: SDSAN-SF — PJBurgsan
Anniston, AL 36201

Commander
US Army Depot Systems Command
ATTN: DRSDS-T
Chambersburg, PA 17201

TO: Commander
US Army Communications-Electronics Command
ATTN: DRSEL-SF-MR
Fort Monmouth, NJ 07703

1. Reference letter, DRSEL-SF-MR, 5 Mar 84, SAB.

2. Pursuant to your request, basic concurrence is submitted, however, the following comments are offered:

a. The ISSA agreement between USA TMDE Support Group and LBDA states that IRDC will serve as LBDA RPO in the absence of the designated RPO and alternate. The ISSA agreement further states that John R. Dorton serves as Alternate RPO for LBDA. Due to qualification and time factors, Mr. Dorton was not appointed as alternate and as of this date no one has been appointed to that position. The lack of a properly qualified alternate RPO was a significant finding of the DESCOM Safety Program Evaluation conducted 17-28 Oct 83. It was requested by LBDA that DESCOM provide an overhire space for the position of alternate RPO, but no action has been taken to date. In the absence of an alternate RPO, IRDC has been acting as Depot RPO in the absence of the designated RPO, Bill Baber.

b. Supplement D, Encl 4, 3.4.3, page 6, Surface Dose Rate. This section states that no point on the surface of the calibrator set shall exceed 5m R/hr. However, actual measurement of the surface with the AN/PDR-27 will locate points with readings significantly higher than the stated limit.

3. An updated resume for the LBDA RPO is enclosed.

4. "Quality Equipment and Support for an Excellent Army".

FOR THE COMMANDER:

John R. Dorton
JOHN R. DORTON
Safety Director

1 Encl
as

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
BOLLING AFB, D.C. 20332

REPLY TO ATTN OF: AFMSC/SGPA
BROOKS AFB TEXAS 78235

14 March 1984

SUBJECT: USNRC License Number 29-01022-08

TO: Department of the Army
U.S. Army Communications - Electronics Command
ATTN: DRSEL-SF-MR
Fort Monmouth NJ 07703

1. Application for renewal of subject license has been reviewed and the following comments are provided:

a. Reference Supplement A, paragraph 4: Recommend that authorized users be identified as calibration personnel at DOD facilities. As currently written, other users are limited to Army facilities.

b. Reference Supplement B, paragraph 2: Recommend that Radiation Protection Officer (RPO) training and experience requirements be commensurate with the hazard involved as related to the routine operation of the UDM-2 in lieu of specific formal training requirements. This would preclude potential differences in individual Service requirements for designating RPO's.

c. Reference Supplement B, paragraph 3: Training of users should indicate that training and experience with similar uses/quantities of radioactive material may be substituted for the training requirements specified.

d. Reference Supplement B, paragraph 4: The distinction between an RPO and an RCO is not clear. A definition of the RPO/RCO functions may eliminate the ambiquity.

e. Reference Supplement F: Calibration of radiation detection equipment should be performed at least annually in accordance with the applicable Service end-item directives. Current Air Force directives indicate 180 day calibration frequency for the AN/PDR-27.

f. Reference Supplement G: The requirements for personal dosimetry should be determined and provided in accordance with applicable Service directives. Also recommend elimination of reference to film badges as the Air Force has converted to TLD dosimetry.

Encl 9

g. Reference Supplement J, paragraph 3: As written, it is implied that Army inspection elements would conduct inspections of other Service organizations. Possessing organizations outside the Army should be inspected by individual Service inspection elements and the NRC to assess compliance with applicable Service directives and 10CFR.

2. Concur with draft application contingent upon inclusion/clarification of the information indicated above.

LANCE J. BOLLINGER, Captain, USAF, BSC
Secretary, USAF Radioisotope Committee
Office of the Surgeon General

DEPARTMENT OF THE ARMY
HEADQUARTERS US ARMY COMMUNICATIONS-ELECTRONICS COMMAND
AND FORT MONMOUTH
FORT MONMOUTH, NEW JERSEY 07703

REPLY TO
ATTENTION OF:

DRSEL-SF-MR

9 May 1984

SUBJECT: US Nuclear Regulatory Commission (NRC) Byproduct Material License Number 29-01022-08

Department of the Air Force
Aerospace Medical Division
ATTN: AFMSC/SGPA
Brooks Air Force Base, Texas 78235

1. Reference, letter, AFMSC/SGPA, 14 March 1984, subject: USNRC License Number 29-01022-08.

2. Item 1a of referenced letter: Concur.

3. Item 1b and 1c of referenced letter: Use of the AN/UDM-2 Radiac Calibrator Set will be under the supervision of qualified DA personnel who have met, at a minimum, the requirements stipulated in Supplement B, paragraphs 2 and 3 of subject license application. If individuals other than DA personnel were to assume sole responsibility for the AN/UDM-2 Calibrator Set, the minimum requirements stipulated in the aforementioned Supplement should be maintained.

4. Item 1d of referenced letter: The RCO designation is applicable to DA personnel with functions as outlined in AR 385-11. Qualifications stipulated in AR 385-11 are as outlined in Supplement B, paragraph 4 of subject license. Selection of a local RPO is contingent upon review and written approval by the RCO.

5. Item 1e of referenced letter: Concur.

6. Item 1f of referenced letter: Concur.

7. Item 1g of referenced letter: Concur.

8. Subject NRC application has been revised to incorporate recommendations indicated in Items 1a, 1e, 1f and 1g of referenced letter.

FOR THE COMMANDER:

For Steven A. Horne

BERNARD M. SAVAIKO
Chief, Safety Office

SUPPLEMENT A

1. Reference: Item 5 of NRC Form 313 I.

2. The AN/UDM-2 Radiac Calibrator Sets will be possessed, maintained and used by US Department of Defense (DOD) installations and activities world-wide under the control of Department of the Army (DA) military or civilian personnel. Storage of assets containing radioactive material will be provided by Lexington-Blue Grass Depot Activity (LBDA), Lexington, Kentucky.

3. The AN/UDM-2 Radiac Calibrator Sets will be issued only to authorized calibration activities at the direct, general and depot support levels. Typically, instrumentation will be sent to authorized calibration activities or will be calibrated by a visiting mobile calibration activity (team). Active Army calibration activities are managed by the US Army Test Measurement and Diagnostic Equipment (TMDE) Support Group on the basis of approved Table of Distribution and Allowances/Modification Table of Organization and Equipment, authorized facilities, equipment, standards, procedures and qualifications of personnel as specified in those documents.

4. Most of the sets will be used by four to seven-man Army TMDE Support Teams who have received training in the safe use of the calibrator set. At least one team member will be qualified and approved as a local Radiation Protection Officer (RPO) receiving a minimum of 40 hours formal training in radiation protection as outlined in paragraph 2 of Supplement B. The teams will operate at various Army installations/activities described in Supplement H which possess beta-gamma detection instrumentation. Other users will be authorized calibration personnel located at Army training facilities, Army National Guard calibration facilities, and other approved DOD facilities.

SUPPLEMENT B

1. Reference: Item 6 of NRC Form 313 I.

2. Local Radiation Protection Officer/Designated Calibrator Custodian. All calibration in which the AN/UDM-2 Calibrator Set is used will be supervised by a qualified local RPO. To be qualified as a local RPO, a person must have received a minimum of 40 hours of formal training in radiation protection inclusive of the following :

a. Principles and practices of radiation protection.

b. Biological effects of radiation.

c. Radioactivity measurement standardization and monitoring techniques and instrumentation.

d. Mathematics and calculations basic to the use and measurement of radioactivity.

e. The operation and use of the AN/UDM-2.

NOTES

A. Completion of the Radiological Safety or Calibrator Custodian Course at the US Army Chemical School or at the US Army Ordnance Center and School meets these requirements.

B. Where circumstances warrant, alternate training may be substituted if this training is approved by Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, New Jersey 07703. Such training must be received under the guidance of a qualified local RPO, and must include at least 16 hours of actual experience in the use of the AN/UDM-2.

3. Operator or User. The operator or user of the AN/UDM-2 shall have a minimum of 8 hours training under the guidance of a qualified local RPO for the AN/UDM-2 in the basic fundamentals of radiological operations, radiac instrumentation theory, application, survey techniques and 16 hours on-the-job training in operation and care of the AN/UDM-2. Instructions shall include safe working practices and inherent hazards associated with the instrument.

4. Radiation Control Officer (RCO). To be qualified as an RCO for the AN/UDM-2, a person must have a technical, scientific, or engineering background and have successfully completed a minimum of 80 hours of formal training in radiation protection including the topics listed in item 2 above.

5. Maintenance Depot for the AN/UDM-2.

a. Depot Radiation Protection Officer and Alternate(s) must have as a minimum:

(1) A Bachelor's degree, or specialty, in Science, Engineering, Health Physics or equivalent discipline.

(2) 160 hours of specialized training in radiation protection including:

(a) Principles and practices of radiation protection.

(b) Biological effects of radiation.

(c) Radioactivity measurement standardization and monitoring techniques and instrumentation.

(d) Mathematics and calculations basic to the use and measurement of radioactivity.

(e) At least one year of satisfactory experience in applied Health Physics.

b. <u>Technicians/Calibration Specialists</u>. The following are the minimum requirements necessary for persons performing leak tests:

(1) Same as in 3 above, and

(2) Sufficient training by the depot RPO or his appointed representative(s) in the use of radiation detection instruments for leak test analysis, which shall include the method of performing the test, e.g., points on equipment to be smeared and method of taking smear; method of instrument calibration; and analysis of smears and reporting of smear results.

SUPPLEMENT C

1. Reference: Item 7 of Form NRC-313 I

2. Enclosures 1, 2, 3, and 4 are the qualifications of the US Army Communications-Electronics Command (CECOM) RPO, Alternate RPOs, and License Manager, respectively.

BARRY J. SILBER, Health Physicist, US Army Communications-Electronics Command (CECOM), Fort Monmouth, New Jersey

a. Education:

(1) A.A. - Brooklyn College of the City University of New York, Brooklyn, New York [ ] Ex 6

(2) B.S. - Brooklyn College of the City University of New York, Brooklyn, New York [ ] Major: Chemistry.
Ex 6

b. Professional Experience:

(1) October 1966 - May 1967:
Allen Pharmacal Corporation, 175 Pearl Street, Brooklyn, New York.
Laboratory Technician - Analytical Chemistry Laboratory.
Laboratory analyses of pharmaceuticals at various stages of manufacture to insure compliance with Food and Drug Administration Regulations as well as United States Pharmacopeia and National Formulary Monographs.

(2) June 1967 - March 1970:
EON Corporation, 175 Pearl Street, Brooklyn, New York.
Chemist - Responsible for all health physics activities, including radiation surveys, air sampling and wipe tests, leak testing of sealed sources, decontamination of facilities and equipment, disposal of radioactive wastes, calibration of radiation survey and measurement instrumentation, record-keeping, etc., to insure compliance with US Nuclear Regulatory Commission (NRC) and New York State Regulations; liaison between regulatory agencies and corporate management; authorized radiation worker (user) of multiple types of radioactive materials used in the manufacture of radiation sources for commercial, military and highly specialized (custom-made) use; responsible for all chemistry activities including metallurgical applications on products at various stages of manufacture to meet quality control specifications.

(3) March 1970 - June 1977:

State of New York Department of Labor, Division of Safety and Health, 2 World Trade Center, New York, New York.
Senior Radiophysicist - Radiological Health Unit.
Responsible for the review of applications, including the evaluation of facilities, equipment, personnel and products containing radioactive materials, and in the preparation of State licenses authorizing the possession and use of radioactive materials by persons in industry and related activities in this State; assist in the administration of the licensing program; consult with and assist industrial management personnel and others in establishing radiation protection programs; conduct inspections, special prelicensing investigations, radiation surveys and tests at the sites of licensees and registrants using radiation sources to enforce state regulations and to insure that radiation workers and the general public are fully protected; assemble environmental research data, analyze and interpret this data, assist in the publication of scientific reports, and training of new staff members.

Ex 6

Encl 1

(4) June 1977 - January 1978:
US Army Electronics Command (ECOM), Fort Monmouth, New Jersey.
Health Physicist - Responsible for health physics functions in the establishment and implementation of the ECOM Safety Program aimed at establishing life cycle controls of ECOM commodities utilizing radioactive material and ionizing radiation producing devices; responsible for the evaluation of radiological protection programs and radiation facilities to determine their adequacy and to insure compliance with DA Authorizations and NRC Licenses; perform studies and evaluations necessary to minimize the health risks to personnel; prepare and review applications for DA Authorizations and NRC Licenses; establish and maintain radiation protection records and files.

(5) January 1978 - April 1981:
US Army Communications and Electronics Materiel Readiness Command (CERCOM), Fort Monmouth, New Jersey.
Duties are the same as in Item b(4) above. Name change from ECOM to CERCOM.

(6) May 1981 - Present:
CECOM, Fort Monmouth, New Jersey.
Duties are the same as in Item b(4) above. Name change from CERCOM to CECOM.

c. Formal Training in Radiation Protection Methods, Measurements and Effects:

	Duration of Training	On-The-Job	Formal Course
(1) X-Ray Technology for Radiological Health Personnel-Memorial Hospital for Cancer and Allied Diseases, 444 East 68th Street, New York, New York - 11 January - 14 January 1971.	3 Days	No	Yes
(2) Orientation Course in Regulatory Practices and Procedures - NRC, Bethesda, Maryland - 1 March - 19 March 1971.	3 Weeks	No	Yes
(3) Health Physics and Radiation Protection - Special Training Division, Oak Ridge Associated Universities, Oak Ridge, Tennessee - 12 February 1973 to 20 April 1973. Sponsored by the NRC for Agreement State regulatory personnel.	10 Weeks	No	Yes
(4) Radiological Safety Course - US Army Ordnance and Chemical Center and School, Aberdeen Proving Ground, Maryland - 25 October - 15 November 1977.	3 Weeks	No	Yes
(5) Internal Dosimetry for Fixed Nuclear Facilities-Oak Ridge Associated Universities, Oak Ridge, Tennessee - 5 November - 9 November 1979.	1 Week	No	Yes
(6) Managers' Environmental Course - US Army Logistics Management Center, Fort Lee, Virginia - 13 July - 17 July 1981.	1 Week	No	Yes

d. Experience with Radiation.

Isotope	Maximum Amount	Duration of Experience	Type of Use
(1) ^{14}C	60 mCi	3 Years	For items 1 through 10-manufacture of sealed sources, health physics surveys and wipe tests.
(2) ^{32}P	10 mCi	3 Years	
(3) ^{36}Cl	10 mCi	3 Years	
(4) ^{63}Ni	10 mCi	3 Years	
(5) $^{90}Sr/^{90}Y$	50 mCi	3 Years	For items 11 and 14-calibration of radiation instrumentation, health physics surveys and wipe tests.
(6) ^{99}Tc	100 mCi	3 Years	
(7) $^{106}Ru/^{106}Rh$	50 mCi	3 Years	
(8) $^{144}Ce/^{144}Pr$	500 mCi	3 Years	
(9) ^{147}Pm	500 mCi	3 Years	For items 12 and 13-health physics surveys and wipe tests.
(10) ^{204}Tl	50 mCi	3 Years	
(11) ^{60}Co	10 mCi	3 Years	
(12) ^{60}Co	200 Ci	3 Years	
(13) ^{137}Cs	250 Ci	3 Years	
(14) ^{226}Ra	20 mCi	3 Years	

STEVEN A. HORNE, Health Physicist, US Army Communications - Electronics Command (CECOM), Fort Monmouth, New Jersey 07703

1. Educational Background:

Old Dominion University Norfolk, Virginia	3 Years	- Associate in Applied Science
The Catholic University of America Washington, DC	2 Years	- BSE Nuclear Science and Engineering
The Catholic University of America Washington, DC	-	1975 - Graduate Work in Nuclear Science and Engineering

Ex 6

2. Formal Training and Experience in Radiation Protection Methods, Measurements and Effects:

	Duration of Training	On The Job	Formal Course
a. Fifty-six semester hours pertaining to radiation, including college physics, Environmental Aspects of Nuclear Power Plant Management, Environmental Radioactivity, Nucleonic Fundamentals, Nuclear Properties and Interactions, Nuclear Physics, Nuclear Radiation Detection, Nuclear Reactor Physics, Radiation Biology, Radioisotope Techniques and Radiological Physics - Old Dominion University and The Catholic University of America.	1961-1975	No	Yes
b. Radiation Detection Effects and Devices Utilizing various type of high energy accelerators - Virginia Associated Research Center Newport News, Virginia, and NASA Langley Research Center, Langley, Virginia.	1 Year	Yes	No
c. Radiation safety, detection instrumentation and isotopic handling equipment - Flow Corp, Fort Belvoir, Virginia.	2 Months	Yes	No

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Encl 2

	Duration of Training	On The Job	Formal Course
d. Radiological Safety Course pertaining to Nuclear Moisture/ Density Instrumentation - Seaman Nuclear Corporation, Milwaukee, Wisconsin.	24 Hours	No	Yes
e. Occupational Radiation Protection Course 212 - Public Health Services, Las Vegas, Nevada.	80 Hours	No	Yes
f. Fundamentals of Non-Ionizing Radiation Protection Course 264 - Public Health Service, Rockville, Maryland.	40 Hours	No	Yes
g. Laser Safety Course - University of Cincinnati, Ohio.	40 Hours	No	Yes
h. Radionuclide Analysis by Gamma Spectrocopy Course 208 - Public Health Service, Winchester, Massachusetts.	80 Hours	No	Yes
i. Radiation Guides and Dose Assessment Course 272 - Environmental Protection Agency, Las Vegas, Nevada.	80 Hours	No	Yes

3. Experience with Radioisotopes:

Isotope	Maximum Activities in Curies	Duration of Experience	Type of Experience
^{241}Am	1	3 Years	For all radionuclides listed, experience consisted of laboratory analysis, wipe tests, experiments and evaluations utilizing these sources.
^{252}Cf	.27	3 Years	
^{57}Co	0.1	4 Years	
^{60}Co	1200	8 Years	
^{137}Cs	1	8 Years	
^{3}H	20	8 Years	
^{192}Ir	100	8 Years	
^{147}Pm	1	8 Years	

Isotope	Maximum Activities in Curies	Duration of Experience
$^{226}RaBe$	1	5 Years
$^{239}PuBe$	1	1 Year
^{90}Sr	0.1	2 Years

4. Experience with other Radiation Producing Machines:

Radiation Machine	Duration of Experience	Type of Experience
a. NASA Langley Research Center, and Virginia Associated Research Center's, Space Radiation Effects Laboratory consisting of a 2 MeV Van de Graff accelerator, 3 MeV Dynamitron accelerator, 10 MeV Linear Electron Accelerator, a 600 MeV Proton Synchrocyclotron Accelerator and a 14 MeV Neutron Generator.	1.5 Year	Radiation damage Shielding Experiments and Related Health Physics Studies.
b. 250 KeV General Electric Corporation X-ray machine	8 Years	Health Physics and laboratory experiments.
c. Various energy dispersive and wave length X-ray fluorescence spectrometry with X-ray generators up to 50 KeV.	8 Years	Health Physics and laboratory experiments.

5. Experience with radiation:

1964-1965 - Virginia Associated Research Center, NASA, Langley Research Center, Virginia as Health Physics Technologist.

1965-1966 - E.R. Squibb, New Brunswick, New Jersey as Radiochemist Isotope Technologist.

1966-1968 - Flow Corporation, Nuclear Division, Fort Belvoir, Virginia as Radiation Engineer.

1968-1976 - US Army Mobility Equipment Research and Development Command, Fort Belvoir, Virginia as Health Physicist.

1976-1978 - US Army Electronics Command, Fort Monmouth, New Jersey as Health Physicist.

1978-1981 - US Army Communications and Electronics Materiel Readiness Command, Fort Monmouth, New Jersey, as Health Physicist.

1981-Present - US Army Communications-Electronics Command, Fort Monmouth, New Jersey, as Chief, Materiel Safety Engineering Division, Safety Office and Supervisory Health Physicist.

JOSEPH M. SANTARSIERO, Health Physicist, US Army Communications-Electronics Command (CECOM), Fort Monmouth, New Jersey 07703

a. Education:

(1) Seton Hall University, East Orange, New Jersey
Biology program 1972-1973.

(2) Brookdale Community College, Lincroft, New Jersey

(3) Rutgers, The State University, New Brunswick, New Jersey
BS degree in Biology, Ex. 6

(4) Middlesex General Hospital, New Brunswick, New Jersey
Certification in Nuclear Medicine Technology, May 1978.

(a) American Registry of Radiologic Technologists (ARRT).

(b) Certifying Board of Nuclear Medicine Technology (CBNMT).

(c) State of New Jersey Certification - Nuclear Medicine Technology.

(5) Rutgers, the State University, New Brunswick, New Jersey
Presently completing program of graduate study in Radiation Science (Masters Program). Course work has included: Advanced Special Problems; Special Topics in Radiological Health; Radiation Detection and Measurement; Radiation Chemistry; Radiation Safety; Radiation Health Physics; Nuclear Instrumentation; Radionuclide Chemistry and Radiopharmaceuticals; Radiation Protection; Radiation Biology; Radiation Biochemistry; Clinical Applications of Radionuclides; Radiation Dosimetry; Radiation Therapy; Interactions of Radiation with Matter; Atomic Theory and Structure; Nuclear Theory and Structure; Radioactivity and the Environment; Instrumentation and Radiation; Nuclear Physics; Radiation Biophysics.

b. Professional Experience:

(1) May 1978-August 1982:

Monmouth Medical Center, 3rd and Pavillon Avenues, Long Branch, New Jersey.

Senior Nuclear Medicine Technologist-Department of Nuclear Medicine. Licensed to prepare and administer radiopharmaceuticals for diagnostic imaging of disease in or on human beings. Responsible for the quality control of imaging systems and computers, dose calculation and assay prior to administration, patient orientation to procedures and on-call emergency procedures. Performed various health physics activities including radiation surveys, air sampling and wipe tests, leak testing of sealed sources, decontamination of facilities and equipment, disposal of radioactive wastes, calibration of

Ex 6

Encl 3

radiation survey and measurement instrumentation, record-keeping, etc., to insure compliance with US Nuclear Regulatory Commission (NRC) and New Jersey State Regulations.

(2) August 1982-September 1983:

Bio-Med Associates, Inc., 753 Boulevard, Kenilworth, New Jersey.

Provide consultation to hospitals, doctors, administrators, etc., regarding the safe and proper use of radiation and radioactive materials. Determine the requirements of, and design the shielding for X-ray installations and nuclear medicine departments. Prepare applications for the use of radioactive materials for both USNRC and State regulated radioactive materials. Amend licenses as requested and required. Evaluate radiation safety programs, prepare and give lectures to physicians, nurses, administrators, etc., regarding radiation and radioactivity. Design areas where radioactive materials are stored and/or used. Perform quality control procedures on X-ray machines and nuclear medicine instruments. Instruct X-ray students. Review personnel monitoring records and methods, evaluate personnel performance regarding radiation and its use, perform sealed source leak tests on various radionuclides.

(3) September 1983-February 1984:

State of New Jersey, Department of Environmental Protection, Bureau of Radiation Protection, 380 Scotch Road, Trenton, New Jersey.

Radiation Physicist.

Approved or rejected licenses or amendments for possession and use of radioactive materials, in the State of New Jersey, after assessment of user qualification, radiation safety program, and compliance with State rules and regulations. Reorganized program format and developed inspection procedures, criteria and forms. Evaluated and provided recommendations for quality assurance of radiopharmaceuticals and instruments at user facilities. Performed inspections and violation investigations of facilities utilizing State licensable materials, initiated legal proceedings for areas found to be in non-compliance, and issued letters of compliance. Authorized to impound non-compliant units to prevent usage that may be detrimental to public and/or occupational safety. Conducted special projects evaluating radiation hazards and development of procedures for control and reduction of unnecessary radiation. Investigated violations and incidents post notification of radiation hazard with authority to establish improved radiation safety requirements. Registered NRC licensable materials. Registered accelerators and reviewed radiation safety surveys. Member of emergency response team with authority to make immediate decisions relative to public health and safety regarding the control of radiation. Responsible for monthly report and statistic preparation involving radioactive material users, inspections, violations, NRC registrations, and accelerators. Responded to all public and private inquiries involving radioactive materials or non-ionizing radiations. Proposed regulations for NJ Administrative Code adoption.

(4) February 1984-present

US Army Communications-Electronics Command (CECOM), Fort Monmouth, New Jersey.

Health Physicist - Responsible for health physics functions in the establishment and implementation of the CECOM Safety Program aimed at establishing life cycle controls of CECOM commodities utilizing radioactive material and ionizing radiation producing devices; responsible for the evaluation of radiological protection programs and radiation facilities to determine their adequacy and to insure compliance with DA Authorizations and NRC Licenses; perform studies and evaluations necessary to minimize the health risks to personnel; prepare and review applications for DA Authorizations and NRC Licenses; establish and maintain radiation protection records and files.

c. Experience with Radioactive Materials:

	Maximum Isotope	Duration of Amount		Experience	Type of Use
1.	$^{99}Mo/^{99m}Tc$	2	Ci	5 years	For items 1 through 19, radiopharmaceutical preparation, dose injection, and/or related diagnostic/therapeutic procedures, health physics surveys, wipe test analysis, and instrument calibration.
2.	^{131}I	20	mCi	5 years	
3.	^{75}Se	5	mCi	5 years	
4.	^{67}Ga	50	mCi	5 years	
5.	^{201}Tl	30	mCi	5 years	
6.	^{32}P	40	mCi	5 years	
7.	^{133}Xe	200	mCi	5 years	
8.	$^{81}Rb/^{81m}Kr$	25	mCi	2 years	
9.	^{125}I	50	mCi	5 years	
10.	^{123}I	10	mCi	5 years	
11.	^{137}Cs	5	Ci	5 years	
12.	^{226}Ra	800	mg	5 years	
13.	^{192}Ir	80	Ci	6 months	
14.	^{60}Co	100	Ci	3 months	
15.	^{57}Co	30	mCi	5 years	
16.	^{133}Ba	10	mCi	5 years	
17.	^{51}Cr	25	mCi	5 years	
18.	^{59}Fe	20	mCi	1 year	
19.	^{111}In	3	mCi	5 years	

BERNARD M. SAVAIKO, Chief, Safety Office, US Army Communications-Electronics Command (CECOM), Fort Monmouth, New Jersey

a. Education: [redacted] - B.S. Industrial Engineering, Columbia University, New York, New York. Ex 6

b. Professional Experience:

(1) 5 years - Safety Officer - US Air Force.

(2) 4 years - Industrial Safety - U.S. Steel Corporation.

(3) 20 years - Industrial Safety and Chief, Safety Office- USACECOM (formerly US Army Communications and Electronics Materiel Readiness Command and US Army Electronics Command) Fort Monmouth, New Jersey, including 3 years experience as a Radiation Protection Officer with responsibilities for the control of various commodities containing radioactive materials.

Mr. Savaiko is designated as the manager of Nuclear Regulatory Commission Licenses and Department of the Army Authorizations.

Encl 4

Ex 6

SUPPLEMENT D

1. Reference: Item 8 and 9 of NRC Form 313 I.

2. The maximum number of sealed sources and maximum activity per source to be possessed at any one time shall include:

a.

b. Source B: Sealed sources (ECOM Drawing Number SM-B-509048) not to exceed 150 microcuries (uCi) per source or 75 mCi total.

c.

d. Source D: Sealed Sources (3M Drawing Number 12-1921-0474-8) not to exceed 36 uCi per source or 18 mCi total.

3. The sealed sources incorporated in the AN/UDM-2 Radiac Calibrator Sets have been manufactured by various corporations. Based on the useful lifetime of the sealed sources, new sources are being procured for the refurbishment of all calibrator sets utilized by authorized activities. AN/UDM-2 Radiac Calibrator Sets incorporating Sources A and B will be utilized by authorized DOD activities until such time as refurbishment with Sources C and D is achieved. Once refurbishment is completed, all AN/UDM-2 Radiac Calibrator Sets not included in the refurbishment program will be maintained at LBDA in storage until such time as proper disposal of these sources can be accomplished.

4.

a.

b. Gulf Nuclear, Inc. (formerly Nuclear Environmental Engineering, Inc.) Houston, Texas: Union Carbide Corporation, Linde Division, molecular sieves compressed into disk or pellet form are immersed into a ^{90}Strontium Nitrate aqueous solution of specific concentration for a specified period of time. Molecular sieves are sodium, calcium or potassium aluminum silicates. The chemical composition of the molecular sieve may vary depending upon the type used. The molecular sieve used in the manufacture of these sealed sources is the Type AW-500 and has a chemical composition of $Ca_4[(AlO_2)_8(SiO_2)_{16}]H_2O$. The

Ex 2

^{90}Strontium (^{90}Sr) exchanges with some of the calcium in this compound by the ion exchange method forming a strontium calcium aluminum silicate. To insure that the ^{90}Sr remains, the molecular sieve is dried at approximately 300 degrees Celsius. The source descriptions for Gamma Industries, Inc., and Gulf Nuclear, Inc., are similar to the Minnesota Mining and Manufacturing (3M) Company sealed sources with the exception of the radiating microspheres. The descriptions provided of the manufacturing processes used by these corporations identify microsphere equivalency.

5.

6. As indicated, all sealed sources are subjected to and comply with production/quality assurance tests as outlined within the applicable military specification. These tests are witnessed by Defense Contract Administration Service (DCAS) representatives. Testing includes but is not limited to:

a. First encapsulation leak test.

b. Source bloat test.

c. Second encapsulation leak test.

d. Second encapsulation bloat test.

e. Source contamination test.

f. Source radioactivity test.

g. Environmental durability/Source integrity (i.e., temperature, immersion, humidity, vibration, shock, etc).

The applicable military specification should be referenced for detailed description of each test.

7. All sources are manufactured as special form material in accordance with applicable drawing numbers and Titles 10 and 49, Code of Federal Regulations.

8. <u>Use Of The AN/UDM-2 Radiac Calibrator Set</u>

a. The AN/UDM-2 Radiac Calibrator Set is utilized for checking calibration of pocket dosimeters and radiac survey instruments. Prior to use, the eight container latches are released, the two halves of the calibrator are placed on the work surface open side up, and shipping locks are unfastened.

Ex 2

b. Checking Calibration of Pocket Dosimeters - The Discharge Well Assembly is unlocked with a key and the cover (with set and wound stop watch) is swung aside. A clean, zeroed pocket dosimeter is inserted into the Discharge Well access hole. For low range dosimeters (usually less than 1 R maximum reading), the dosimeter rests on the undepressed, spring-loaded dosimeter platform and the cover swings against the body of the dosimeter to the low intensity field of the 36 uCi source*. For high range dosimeters (usually more than 1 R maximum reading), the dosimeter is pressed down so that the cover swings over the dosimeter. This procedure exposes the chamber of the dosimeter to the high intensity field of the three 45* mCi sources. The dosimeter is removed after the fixed time determined for each specific type of dosimeter. The stop watch mounted on the swivel is used to time each exposure. The dosimeter reading is then checked against acceptable limits also listed in the applicable calibration report. When a dosimeter is not in the discharge well, the spring-pivoted cover automatically swings back over the discharge well access hole. Upon completion of use of the Discharge Well Assembly, the cover is relocked in the closed position.

c. Calibration of Radiac Survey Instruments - The Doserate Jig Assembly is used to calibrate standard Army radiacmeters in a variety of configurations to produce varying gamma equivalent fields for the specific instruments. The detector probe is placed appropriately exterior to the Doserate Jig Assembly, on the open drawer, or through an access hole in the drawer. A specially designed Spacer Block is provided for proper positioning of some probes. After positioning of the operating instrument, the instrument reading is read with the shutter in one of three positions, "closed", "10 rad/hr", and "100 rad/hr". The shutter can be rotated to the open positions only after unlocking with a key and only with the drawer tightly closed.

9. Description Of The AN/UDM-2 Radiac Calibrator Set

a. The AN/UDM-2 Radiac Calibrator Set is comprised of two major assemblies, the Doserate Jig Assembly (TS 3494/UDM-2) and the Discharge Well Assembly (TS 3495/UDM-2). The Doserate Jig Assembly contains one 35 mCi$\pm$20.0 percent ^{90}Sr sealed source and the Discharge Well Assembly contains three 35 mCi$\pm$20.0 percent ^{90}Sr sealed sources and one 30 uCi$\pm$20 percent ^{90}Sr sealed source. The calibrator sets have been labeled to indicate a nominal activity of 180 mCi based on the quantity of radioactive material incorporated. The Doserate Jig Assembly is labeled as containing a 45 mCi ^{90}Sr sealed source and the Discharge Well Assembly indicates a 135 mCi quantity. Sealed ^{90}Sr sources referred to in this document will be 45 mCi and 36 uCi as applicable. Enclosure 6 (3M Drawing No. 12-1921-3466-1 shows the construction of the plug assembly, the rear portion of the source assembly, and how the threaded source can be screwed into and out of its shield with the use of an allen wrench. The Doserate Jig Assembly is used to calibrate contingent standard Army beta-gamma radiac survey instruments while the Discharge Well Assembly is used to check the calibration of standard Army pocket dosimeters. Each assembly is housed in one-half of a waterproof, aluminum case. Enclosures 7 and 8 are Technical Manual (TM) 11-6665-227-12 and Technical Bulletin (TB) 11-6665-227-12 which describe the operation, control, maintenance and calibration of the calibrator.

*Quantities specified are based on sealed sources contained in all refurbished AN/UDM-2 Radiac Calibrator Sets. Statements regarding the 36 uCi source (Source D) are applicable to the 150 uCi source (Source B) as are statements regarding the 45 mCi source (Source C) equivalent to the 50 mCi source (Source A) identified in paragraph 2 above.

b. Discharge Well Assembly

(1) The construction of the Discharge Well Assembly is described in enclosure 9 (ECOM Drawing SM-D-508975). A parts list is also provided with this enclosure. The threaded 36 uCi source is screwed directly into the upper housing as described in enclosure 10 (ECOM Drawing SM-D-508991), and is locked into position by the Shield Plug described in enclosure 11 (ECOM Drawing SM-B-509029). Its window is about 1/4 inch from the access hole. The three threaded 45 mCi sources are screwed into the "doughnut" shield as described in enclosures 12 (ECOM Drawing SM-B-508981) and 13 (ECOM Drawing SM-B-508983), and are backed by the Shield Plugs described in enclosure 14 (ECOM Drawing SM-B-508984). Their windows are approximately 0.1 inch recessed from the dosimeter access hole with respect to the retaining pins to prevent the source from entering the access hole.

(2) The Discharge Well Assembly, which is attached by environmentally sealed screws to one half of the aluminum case, consists of a discharge well, a dosimeter shelf, and a stopwatch. The dosimeter shelf contains 30 holes to hold dosimeters to be tested and the discharge well. The discharge well has an access hole to the central cavity centered in the top. The cover over the access hole is mounted on a spring-loaded pivot and is key-locked in the closed position when the well is not in use. The lock is a standard National Lock filing cabinet lock held in place by a set screw. The tongue drops down into a slot in the cover and blocks movement of a pin which projects from the upper housing. The pin guides through the slot in the cover when the cover is swung aside. A shipping lock fastens the cover closed for shipment. The tungsten alloy "doughnut" containing the three 45 mCi sources is mounted between the two anodized aluminum halves of the discharge well. Three long bolts pass through the doughnut and fasten the two halves together. A spring mounted dosimeter platform plugs the center of the cavity (about 0.01 inch clearance) and rests on a steel spring. The spring is mounted on a stop that is an integral part of the bottom cover. The bottom cover is screw-fastened to a cylinder that is force fitted into the lower housing.

c. Doserate Jig Assembly

(1) The construction of the Doserate Jig Assembly is described in enclosure 15 (ECOM Drawing SM-D-508994). A parts list is also provided with this enclosure. A threaded 45 mCi source screws into the tungsten alloy shield cylinder which is force fitted on an arbor press into the aluminum shield assembly. The source is locked in place by the threaded Shield Plug described in enclosure 14 (ECOM Drawing SM-B-508984) and the window of the source is recessed approximately 1/4 inch from the edge of the shield assembly. Enclosure 16 (ECOM Drawing SM-C-509011) describes the shutter absorber which shields the window end of the source.

(2) The Doserate Jig Assembly consists of a drawer unit which is fastened to the other half of the aluminum case by environmentally sealed screws and an aluminum spacer block which is stored in the drawer when not in use. The drawer unit is constructed primarily of anodized aluminum with tungsten alloy shielding around the 45 mCi source. The drawer unit consists of a housing assembly, a drawer assembly, (with a clearance of about 0.01 inch above the shield assembly between the source and the drawer) and a thumbwheel shutter by which the radiation reaching the drawer can be controlled. The shutter has three position indications as follows: closed (source is shielded), "10 rad/hr" (hole with an

attenuator plug over source window), and "100 rad/hr" (large hole over source window). A steel pin in the shutter fits in a slot in the underside of the drawer so that the shutter must be in the closed position before the drawer opens. The key-lock is force fitted into the shield assembly, and the tongue engages a slot in the underside of the shutter. A shipping lock fastens the drawer closed for shipment.

10. Quality assurance and performance testing is conducted for each calibrator/assembly prior to acceptance as outlined in MIL-R-55350A(ER) inclusive of, but not limited to, the following:

a. Calibrator contamination tests.

b. Calibration accuracy.

c. Dosimeter jig assembly measurements and wipe tests.

d. Dose rate jig assembly measurements and wipe tests.

Complete testing description is contained in the military specification and should be referred to for specific information.

MIL-R-55350 (EL)
Amendment 2
11 Oct 1977
SUPERSEDING
Amendment 1
3 May 1977

MILITARY SPECIFICATION

RADIAC CALIBRATOR AN/UDM-2( )

This amendment forms a part of Military Specification MIL-R-55350(EL), 16 December 1971 and is approved for use by all departments and agencies of the Department of Defense.

Page 3

3.4.1.2: Delete "0.95mR ± 0.05mR" and substitute "95mR/min. ± 5mR/min."

Page 4

*3.4.3: Delete "2mr/hr" and substitute "5mr/hr."

3.6.1: Add "and shall have no corrosion deterioration, physical degradation, or change in tolerance limits which could effect operational service or maintenance requirements."

Page 5

3.6.3.3: Delete and substitute "Immersion. The equipment shall show no evidence of leakage after it is tested as specified in 4.12."

3.6.3.6: Delete and substitute "Vibration. The equipment shall withstand vibration such as encountered in a field service environment (See 4.16)."

Page 10

4.5: Delete.

Page 14

Table V: Delete "EVR".

FSC 6665

Encl 1

Page 14

4.6.3.2: Delete the first sentence.

Page 17

*4.10: Delete "(with beta shield removed)."

Page 18

4.12: Delete and substitute "Immersion. Immerse the equipment, closed as for storage or transportation, according to MIL-STD-810, Method 512, Procedure 1. The equipment shall be immersed for two hours and then removed and visually inspected for evidence of leakage into the case (See 3.6.3.3)."

Page 19

4.16: Delete and substitute "Vibration. The equipment shall be subjected to procedure X, curve AW (based on 6000 miles of land transportation) and curve AY of MIL-STD-810, Method 514.1. Upon completion of the test, the equipment shall meet the performance check of 4.7.1 and 4.7.2 (See 3.6.3.6)."

4.18: Delete: "Method 508" and substitute "Method 509".

NOTE: The margins of this amendment are marked with an asterisk to indicate where changes from the previous amendment were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous amendment.

Custodian:

Army - EL

Preparing activity:

Army - EL

Project No. 6665-A389

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FSC 6665

MILITARY SPECIFICATION

RADIAC CALIBRATOR AN/UDM-2( )

1. SCOPE

1.1 Scope. - This specification covers the Radiac Calibrator AN/UDM-2( ) which provides the facilities for checking the operational reliability and calibration accuracy of various radiacmeters and radiac set. The calibrator consists of a dosimeter jig assembly and a doserate jig assembly; each assembly can be utilized independently of the other (see 6.1).

2. APPLICABLE DOCUMENTS

2.1 Documents. - The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of the specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

PPP-B-585	Box, Wood, Wirebound
PPP-B-601	Box, Wood, Cleated-Plywood
PPP-B-621	Box, Wood, Nailed and Lock-Corner
PPP-B-636	Box, Fiberboard
PPP-B-640	Box, Fiberboard, Corrugated, Triple-Wall
PPP-F-320	Fiberboard, Corrugated and Solid, Sheet Stock Container Grade and Cut Shapes
PPP-S-760	Strapping, Nonmetallic and Connectors
PPP-T-76	Tape, Pressure-Sensitive Adhesive Paper, Water Resistant, for Carton Sealing
PPP-T-97	Tape, Pressure-Sensitive Adhesive, Filament Reinforced
NN-P-71	Pallets, Material Handling
QQ-S-781	Steel Strapping, Flat

FSC 6665

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FSC 6665

3. REQUIREMENTS

3.1 Construction.- The equipment shall be constructed in accordance with the requirements of this specification, and of Drawing DL-SM-B-508965.

3.2 First Article Samples.- The contractor shall furnish first article samples of the calibrator in accordance with the requirements contained in the bid request and contract (see para. 4.3).

3.3 Parts, Materials and Processes.- In addition to any requirements of this specification covering parts, materials and processes, such items shall conform to MIL-P-11268, including the selection requirements therein.

3.4 Performance Characteristics.-

3.4.1 Calibration Accuracy.-

3.4.1.1 Dosimeter Jig Assembly (lower source).- The dose rate produced by the lower sources shall be within ±5R/min when related to a secondary calibration standard. When measured in accordance with paragraph 4.8.1, using a Government Furnished Victoreen Model 555 Radacon II, the dose rate produced by the lower sources shall be 205 R/min ±5R/min (see para. 4.8.1.2).

3.4.1.2 Dosimeter Jig Assembly (upper source).- The dose rate produced by the upper source shall be within ±0.05 mR/min when related to a secondary calibration standard. When measured in accordance with paragraph 4.8.2 using a Government Furnished Victoreen Model 555 Radacon II the dose rate produced by the upper source shall be 0.95 mR ± 0.05 mR (see paragraph 4.8.2.2).

3.4.1.3 Doserate Jig Assembly.- All measured test position dose rates shall be within ± .5R/min when related to a secondary calibration standard. When measured in accordance with paragraph 4.8.2, using a Government Furnished Victoreen Model 555 Radacon II, the dose rate produced with the shutter in the 100 R/hr position shall be 44.5 R/min ± 0.5 R/min (see paragraph 4.8.3).

3.4.2 Compatibility.-

3.4.2.1 Radiacmeters IM-9( )/PD, IM-93( )/UD and IM-147( )/PD, when exposed in the dosimeter jig assembly for the time specified on drawing SM-C-509026, shall respond in accordance with the appropriate reading and tolerance specified on drawing SM-C-509026. The discharge times should be adjusted for source decay in accordance with the instructions and data furnished on drawing SM-B-509027 and specified in paragraph 3.10 (see 4.9.1).

3.6.3.2 Altitude.- Altitudes up to and including 50,000 feet above sea level (see 4.14.2).

3.6.3.3 Immersion.- Immersion in water for 2 hours at a covering depth of 3 feet. There shall be no evidence of water inside the equipment (see 4.12).

3.6.3.4 Bench Handling.- The equipment shall meet the test of 4.13 without degradation of performance.

3.6.3.5 Bounce.- The equipment shall meet the test of 4.17 without degradation of performance.

3.6.3.6 Vibration.- The amplitude of any part , subassembly or structural member of the equipment shall not exceed twice the amplitude of the vibration applied to the equipment at any frequency between 10 and 55 Hertz (see 4.16).

3.6.3.7 Rain.- After testing as specified in 4.23 the equipment shall meet paragraph 4.7 without degradation of performance (see 4.23).

3.6.3.8 Shock.- Shock such as is encountered in transportation via aircraft, or dropping by parachute (see 4.21).

3.7 Special Capability Requirements.-

3.7.1 Facilities.- The contractor shall be required to provide in his plant, or have direct access to a cobalt 60 source capable of providing a minimum field intensity of 125 rads/hr at a distance of 1 meter from its geometrical center.

3.7.2 Equipment.- The contractor shall be required to provide in his plant a Victoreen Condenser "R" meter, or equivalent, calibrated by the National Bureau of Standards or other agency approved by the Government for measuring radiation flux.

3.7.3 License. - The contractor shall be required to possess or obtain a byproduct material license for the AN/UDM-2( ) and its sources from the Atomic Energy Commission as per Title 10, Chapter I, Code of Federal Regulations, Part 30.3, or from an agreement-state in which located as per the Agreement-state Regulations.

3.8 Interchangeability.- Like units, assemblies, subassemblies and replaceable parts shall be physically and functionally interchangeable, without modification of such items or of the instrument. Individual items shall not be handpicked for fit or performance however, matched pairs or sets, when permitted, may be interchangeable as such. Reliance shall not be placed on any unspecified dimension, rating, is installed in the calibrator. The net counting rate in counts/minute (c/min) of the smear paper, used to smear the source, must not exceed 100 times the counting efficiency (E) of the smear counting system for strontium -90. A higher counting rate indicates that the source is contaminated above acceptable limits and must be decontaminated and tested again until it meets the acceptable limits or is rejected for use in a radiac calibrator.

3.11.2 Calibrator Contamination Tests.- Each calibrator shall be subjected to the tests of paragraph 4.20.2. The net counting rate (c/min) of each of the cotton swabs used when following the procedures of paragraphs 4.20.2.2 and 4.20.2.3 must not exceed 25 times the counting efficiency (E) of the smear counting system for strontium -90. A higher counting rate indicates that the source is contaminated above acceptable limits.

3.12 Fungus.- The equipment (including accessories) shall show no evidence of viable fungus or corrosion when subjected to the test specified in 4.22. Corrosion is any visible degradation that can be attributed to flaky, pitted, blistered, or otherwise loosened finished or metal surface.

3.13 Workmanship.- The calibrator shall be manufactured and assembled in accordance with the applicable portions of MIL-P-11268.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection.- Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the contractor may utilize his own facilities, facilities of a subcontractor or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that the supplies and services conform to prescribed requirements.

4.1.1 Contractor Quality Assurance.- The contractor shall provide and maintain a means of determining product conformance in accordance with the requirements specified herein or elsewhere in the contract. The Government, at its option, may perform any evaluation deemed necessary to assure the adequacy of the means employed and the effectiveness of the contractor's quality assurance methods and systems.

4.1.2 Government Verification.- All quality assurance operations required of the contractor shall be subject to Government verification at scheduled or unscheduled intervals. Verification will consist of the following:

numbers in each column indicate the particular tests to which a particular unit will be submitted and the sequence in which it will be conducted. After completing tests of Table I, each unit shall have their sources removed and the sources shall be tested in accordance with paragraph 4.20 (less paragraph 4.20.1.3 and 4.20.1.4).

Table I. - Order of Environmental and Stress Inspection

Inspection (Note 1)	Number of First Article Samples (Units)									
	10 Samples									
	5 Samples									
	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10
Non-damaging(Note2)										
Temperature										
Low-------------	1					1				
High-------------	2					2				
Altitude(elevation)-		1					1			
Leakage(immersion)-			1					1		
Dust-------------			2					2		
Vibration----------				1					1	
Rain-------------			3					3		
Potentially damaging										
Humidity(moisture resistance)-------	3					3				
Fungus (Note 3)----					1					
Salt Fog(Note 3)---		2								1
Bounce------------				2					2	
Bench handling-----					2					2
Shock------------				3					3	

Note 1: Other inspections may precede, follow, or be interspersed between the non-damaging tests.

Note 2: The order on non-damaging tests and the choice of which units are subjected to the non-damaging tests may be varied if convenient, except that the vibration test shall be performed on the same unit used for the bounce and shock tests.

Note 3: The equipment shall be thoroughly washed, cleaned, dried, and refurbished, if necessary, before preceding with subsequent tests.

(b) As required, responsible personnel from each functional department available for discussions in their respective areas.

(c) Adequate administrative support for the EVR.

4.6 Quality Conformance Inspection of Equipment Before Preparation for Delivery.- The contractor shall perform the inspection specified in 4.4. and 4.6.1 through 4.6.3. This does not relieve the contractor of his responsibility for performing any additional inspection which is necessary to control the quality of the product and to assure compliance with all specification requirements. The Government will review and evaluate the contractor's inspection procedures and examine the contractor's inspection records as an element of Government verification (see 4.1.2).

4.6.1 Group A Inspection.- Equipment shall be assembled into discrete lots for quality conformance inspection, utilizing the criteria of MIL-STD-105 for determination of lot composition. Unless otherwise specified, the lot size shall be determined from table II, as related to production rates necessary to meet delivery schedules of the contract. The lot size shall be adjusted throughout the life of the contract as necessary to provide for changes in contract delivery schedules and production rates. Each unit of each lot of equipment shall be inspected for conformance to all the examinations and tests required in table III. The quality conformance of each lot shall then be subjected to an audit, utilizing the procedures of MIL-STD-105, under the general inspection level II and the Acceptable Quality Level (AQL) indicated in table III. Group A functional inspection shall be performed in the order specified in table III.

Table II. - Lot Formation

Production Rate	Size of Lot
500 or more per month	One week's production
51 to 499 per month	Two week's production
0 to 50 per month	One month's production

4.6.2 Group B Inspection.- This inspection, including sampling, shall conform to table IV and to procedures for special inspection levels of MIL-STD-105. Group B inspection shall be performed on production lots of product that have passed group A inspection. (See 4.6.1 for lot formation)

4.6.2.1 Order of inspection within Group B.- Group B inspection shall be performed in the following order:

Table IV. - Group B Inspection

Inspection	Req Para	Test Para	AQL
Interchangeability	3.8	4.6.1.2	4.0% Level S-3
Temperature	3.6.2.1	4.11	2.5% Level S-4
Immersion	3.6.3.3	4.12	4.0% Level S-3
Bench Handling	3.6.3.4	4.13	4.0% Level S-3
Weight	3.5	4.6.1.3	4.0% Level S-3

4.6.3 Group C Inspection.- This inspection shall consist of the tests specified in table V and shall be performed on units of product that have been subjected to and passed group A and group B inspection requirements. Sample units shall be selected in accordance with 4.6.3.1.

4.6.3.1 Group C inspections shall be performed on the first production lot and at the 25%, 50%, 75% and 100% points in production. It is not the intention of the Government to require that all the group C tests be performed on the same radiac calibrators. Simultaneous testing, using several groups of radiac calibrators, may be performed. The order of tests and the choice of which units are subjected to each test may be varied to suit the availability of test facilities and decrease total testing time.

responsible technical activity designated in the contract. After corrective action has been taken, additional sample units shall be subjected to group C inspection (all inspections, or the inspections which the sample failed, at the option of the technical activity) and group A and group B inspections may be reinstituted. However, final acceptance and shipment will be withheld until group C reinspection results have shown that the corrective action was effective and approved by the technical activity.

4.6.4 Reinspection of Conforming Group B and Group C Sample Units.- Unless otherwise specified, sample units which have been subject to and passed both group B and group C inspections may be accepted on the contract provided all damage is repaired and the sample units are resubjected to and pass group A inspection.

4.7 Performance Checks.-

4.7.1 Dosimeter Jig Assembly.- Insert a charged and calibrated Radiacmeter IM-93A/UD (see 4.9.1) into the central well of the assembly and discharge it in accordance with the instructions on drawing SM-C-509026. Repeat the above procedure for a total of 3 readings and calculate the average reading. The average reading shall be within the allowable tolerances specified on drawing SM-C-509026; readings shall be adjusted for source decay. Repeat the above using a Radiacmeter IM-147( )/PD and a Radiacmeter IM-9( )/PD.

4.7.2 Doserate Jig Assembly.- Insert the detector unit of a calibrated Radiacmeter IM-174A/PD into the assembly and expose it to fields of 100 Rads and 10 Rads from the source; readings shall be in accordance with the allowable tolerances specified on drawing SM-C-509024. Readings shall be adjusted for source decay. Repeat the above using a calibrated IM-174/PD; readings shall be in accordance with the allowable tolerances specified on drawing SM-C-509024. Readings shall be adjusted for source decay. Separate the probe unit of a calibrated AN/PDR-27( ) into the two tubular sections. Insert the small probe into the assembly and with the radiac set switched to the 500mR/hr range, rotate the calibrator shutter to the 100R position. The reading shall be within the allowable tolerances specified on drawing SM-C-509024; readings shall be adjusted for source decay.

4.8 Accuracy.- Each calibrator, when checked with the Government furnished Victoreen Model 555 Radacon II in accordance with the procedures specified herein, shall meet the requirements of paragraph 3.4.1.

4.8.1 Dosimeter Jig Assembly Measurements (lower source).-

4.9.2 Doserate Jig Assembly.- Calibrate all Radiacmeters IM-174 and IM-174A and Radiac Sets AN/PDR-27( ) supplied as GFE using a cobalt 60 source, the calibration of which is traceable to the National Bureau of Standards. The instruments shall be calibrated at the following points:

Instrument	Calibration Point	Tolerance
IM-174A/PD	100R/hr	±15%
IM-174/PD	100R/hr	±10%
AN/PDR-27( )	250 mR 25 mR 2.5 mR 0.25 mR	±20%

Any Government furnished equipment which can not be calibrated shall not be used. Select 2 units each of Radiacmeters IM-174 and IM-174A and 2 units of Radiac Set AN/PDR-27( ) and check the calibration of each unit in the calibrator in accordance with the procedures specified on drawing SM-C-509024. Repeat each check for a total of 3 readings per unit and the average reading per unit shall be within the allowable tolerances specified on drawing SM-C-509024; readings shall be adjusted for source decay (see 3.4.2.2).

4.10 Surface Dose Rate.- Using a Government furnished Radiac Set AN/PDR-27 (with beta shield removed), calibrated as specified in paragraph 4.9.2, the surfaces of the Radiac Calibrator AN/UDM-2 shall be monitored for conformance to the requirement of paragraph 3.4.3.

4.11 Temperature Tests.-

4.11.1 High Temperature.- The dosimeter jig assembly as defined by drawing SM-D-508967 and the doserate jig assembly as defined by drawing SM-D-508993 shall be subjected to Procedure I, Method 501 of MIL-STD-810 with the following exceptions:

(a) Temperature of step 2 shall be +155°F.

(b) Step 3 shall be for 24 hours.

(c) Step 4 shall be +125°F.

(d) At steps 5 and 7, equipment shall meet the performance checks of paragraphs 4.7.1 and 4.7.2.

4.15 Humidity.- The equipment shall be subjected to Procedure II, Method 507 of MIL-STD-810 except that:

(a) The equipment shall be opened into its 2 halves during step 1.

(b) Step 2 shall be deleted.

(c) Performance check, per paragraphs 4.7.1 and 4.7.2 shall be accomplished during step 4.

(d) Equipment shall be closed as for storage or transportation during the first 3 cycles of step 6. During cycles 4 and 5, the equipment shall be opened as in step 3.

(e) Performance check, per paragraphs 4.7.1 and 4.7.2 shall be accomplished during step 8 (see 3.6.2.3).

4.16 Vibration (Resonance Search).- The equipment shall be subjected to Procedure XI, paragraph 4.16.1, Method 514.1 of MIL-STD-810. Bolt each half of the equipment on to the table in turn so that the equipment may be observed during the testing. Upon completion of the test, the equipment shall meet the performance checks of 4.7.1 and 4.7.2 (see 3.6.3.6).

4.17 Bounce.- The equipment shall be subjected to Procedure XI, paragraph 4.16.2, Method 514.1 of MIL-STD-810. Upon completion of the test, the equipment shall meet the performance checks of 4.7.1 and 4.7.2 (see 3.6.3.5).

4.18 Salt Fog.- The equipment, opened as in operational use, shall be subjected to Method 508, procedure 1, of MIL-STD-810. Salt concentration shall be 20%. Upon completion of the test the equipment shall meet the requirements of 4.7.1 and 4.7.2 (see 3.6.2.4).

4.19 Sand and Dust.- The equipment, opened as in operational use, shall be subjected to Method 510 Procedure I of MIL-STD-810. Upon completion of the test the equipment shall meet the requirements of 4.7.1 and 4.7.2 (see 3.6.2.5).

4.20 Radiological Tests.- These tests shall be performed by or under the direct supervision of the Radiological Protection or Radiological Safety Officer employed by the contractor in accordance with current Atomic Energy Commission Regulations.

4.20.1 Source Tests.-

4.20.1.1 Source Leak Tests.- Fill a 200-500 ml beaker about 2/3 full efficiency (E) in counts per disintegration of Sr^{90} by subtracting background number of counts (gotten by counting clean piece of smear paper for same time as standard solution smear paper) from the number of counts from the standard solution smear paper, dividing by the counting time, then dividing by A. Calculate the standard counting time (T) in minutes by using the following formula:

$$T = \frac{8 \times 10^{-4} (50E + B)}{E^2}$$

where B is background counting rate in counts per minute.

3. To test each source attach a clean piece of smear paper to the rubber or plastic-tipped handles (use rubber cement if necessary). Protect testing personnel by placing a transparent shield (at least 1 g/cm^2, preferably plastic) between the personnel and source handling area. Handling the source with one pair of tongs and the smear paper handle with another pair of tongs wipe all surfaces of the source applying moderate pressure. Count the test smear paper in the same manner as the background and standard solution smear paper were counted. The counting time will be the next largest whole number of minutes greater than T.

4.20.2 Calibrator Contamination Test.-

4.20.2.1 Equipment and Counting Procedure.- Use the identical procedure outlined in 4.20.1.5 with the following exceptions:

1. Use commercially available cotton swabs in place of smear paper and handle. To count the cotton swab, cut off all but a short stub of the handle and tape the stub to the planchet, centering the cotton in the planchet.

2. Use the following formula to calculate T:

$$T = \frac{6.4 \times 10^{-3} (12.5E + B)}{E^2}$$

4.20.2.2 Dosimeter Jig Assembly Wipe Test.-

WARNING

Do not under any circumstances expose the eyes to the radiation field by peering into the access hole while the swivel cover is swung aside.

5. PREPARATION FOR DELIVERY

5.1 Preservation and Packaging.- Preservation and Packaging shall be level A or C as specified (see 6.1).

5.1.1 Level A.-

5.1.1.1 Cleaning.- Radiac Calibrator AN/UDM-2 shall be cleaned in accordance with process C-1 of MIL-P-116.

5.1.1.2 Drying.- Radiac Calibrator AN/UDM-2 shall be dried in accordance with the applicable procedures of MIL-P-116.

5.1.1.3 Preservation Application.- None required.

5.1.1.4 Unit Packaging.- Unit packaging shall be in accordance with the methods prescribed in MIL-P-116 as specified herein.

5.1.1.4.1 Technical Literature.- Each technical literature shall be packaged Method IC-1.

5.1.1.4.2 Radiac Calibrator AN/UDM-2.- Each calibrator shall be individually packaged Method III as follows: Secure the shipping locks of both assemblies of the calibrator. Place the 2 halves of the calibrator together and secure the fastenings. Cushion the calibrator on all surfaces with cells or pads or both fabricated of fiberboard conforming to PPP-F-320, type CF, class weather-resistant, variety SW, grade W5c, designed to protect all projections and absorb the shock of impact in handling and transit. Place the cushioned calibrator within a close-fitting fiberboard box conforming to PPP-B-636, W5c. Place the technical literature, packaged as specified in 5.1.1.4.1, on top of the cushioned calibrator, directly under the lid of the box. Close the box as specified in the appendix of the box specification.

5.1.2 Level C.- Radiac Calibrator AN/UDM-2 shall be preserved and packaged in a manner that will afford adequate protection against physical and environmental damage during shipment, handling and limited intransit storage.

5.2 Packing.- Packing shall be level A, B or C as specified. Shipping containers for all levels shall be capable of stacking and supporting superimposed loads, during shipment and storage without damaging the container(s) or its contents (see 6.1(b)).

5.2.1 Level A.-

the appendix of the applicable box specification.

5.2.3 Level C.-

5.2.3.1 Palletized Load.- A quantity of Radiac Calibrators AN/UDM-2, packaged as specified in 5.1, shall be palletized as specified in 5.2.1.1 except that the fiberboard caps shall be class domestic.

5.2.3.2 Less Than Palletized Load.- When quantities per destination are less than a pallet load, a quantity of Radiac Calibrator AN/UDM-2, packaged as specified in 5.1, shall be packed as specified in 5.2.2.2 except that the fiberboard boxes shall conform to PPP-B-640 and PPP-B-636, class 1 and class domestic, respectively, and reinforcing shall not be required for boxes conforming to PPP-B-636.

5.3 Marking.- In addition to any special marking required by the contract or order, interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use.-

6.1.1 The dosimeter jig assembly is used to check Radiacmeters IM-9( )/PD, IM-93( )/UD and IM-147( )/PD (dosimeters). The assembly containes four SR-90 sources (one 20 microcurie source and three 25 millicurie sources) arranged to radiate into a central cavity. The upper field is utilized in checking the operational reliability of Radiacmeter IM-9( )/PD while the lower field performs a similar function for Radiacmeters IM-93( ) and IM-147( )/PD.

6.1.2 The doserate jig assembly consists of a drawer unit and a spacer block. The drawer unit contains an encapsulated 25 millicurie SR-90 source. The spacing block provides varying field intensities used to calibrate radiacmeter probes. This assembly is utilized to calibrate Radiacmeters IM-174 and IM-174( ) and Radiac Set AN/PDR-27( ).

6.2 Ordering Data.- Procurement documents should specify the following:

(a) Title, number and date of this specification and any amendment thereto.

(b) Levels of preservation, packaging and packing (see Section 5).

Victoreen Model 555 Radacon II with instruction manual, Victoreen Model 555-100-MB probe, Victoreen Model 555-100-1C probe, and accessories 1-5 per drawing SM-A-509093, Timer 555-50	1 each

Custodian
Army-EL

Preparing Activity
Army-EL
Project Number 6665-A285

☆U.S. GOVERNMENT PRINTING OFFICE: 1971-714-161/13307

SPECIFICATION ANALYSIS SHEET	Form Approved Budget Bureau No. 22-R255

INSTRUCTIONS: This sheet is to be filled out by personnel, either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments and suggestions submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or serve to amend contractual requirements.

SPECIFICATION MIL-R-55350(EL) RADIAC CALIBRATOR AN/UDM-2( )

ORGANIZATION

CITY AND STATE	CONTRACT NUMBER

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO *(If "yes", in what way?)*

4. REMARKS *(Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity).*

SUBMITTED BY *(Printed or typed name and activity - Optional)*	DATE

DD FORM 1 JAN 66 1426 REPLACES EDITION OF 1 OCT 64 WHICH MAY BE USED.

ESC-FM 1068-68

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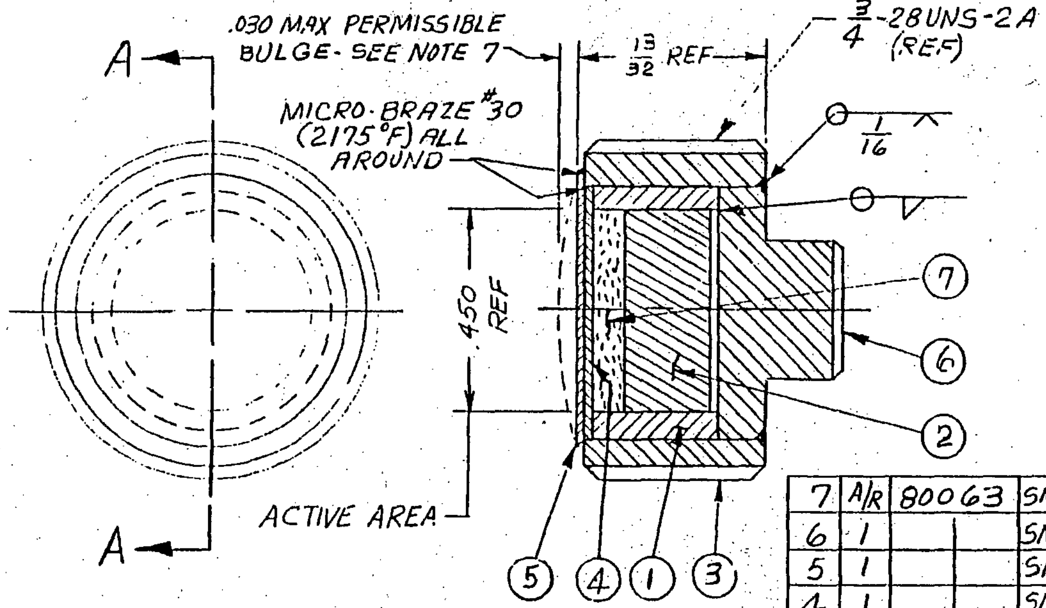
REVISIONS

LTR	DESCRIPTION	DATE	APPROVED
C	REDRAWN ALSO ECP NIBFDZ2010 NOR010 INCORPORATED	12 AUG 81	ES HJW

Encl 2



SECTION A-A

SOURCE CONTROL DRAWING

FIND NO.	QTY REQD	CODE IDENT.	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	NOTE
7	A/R	80063	SM-B-509048-1	MATERIAL, RADIOACTIVE		8 & 7
6	1		SM-B-509054	PLUG		
5	1		SM-B-509053	WINDOW, OUTER		
4	1		SM-B-509052	WINDOW, INNER		
3	1		SM-B-509051	CAPSULE, OUTER		
2	1		SM-B-509050	PLUG		
1	1		SM-B-509049	CAPSULE, INNER		

PARTS LIST

APPROVED SOURCE

	MFG PART NO	SOURCE
1	3 FIG	3M CO. ST. PAUL MINN. 55105

APPLICATION

NEXT ASSY	USED ON
SM-D-508975	DL-508965

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS — DECIMALS — ANGLES —

MATERIAL:

DA-28-043-AMC-02402E

ELECTRONICS COMMAND
REVIEWED ER-1 SM'F
APPROVED ER-1 SM'F
DATE 24 FEB 69

DEPARTMENT OF DEFENSE
U.S. ARMY ELECTRONICS COMMAND
FORT MONMOUTH NEW JERSEY 07703

SOURCE ASSEMBLY

SIZE B | CODE IDENT NO. 80063 | SM-B-509048

SCALE 4/1 | SHEET 1 OF 3

AMSEL FORM 1049B 1 APR 73 HISA-FM 558-73

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REVISIONS

LTR	DESCRIPTION	DATE	APPROVED
C	SEE SHEET 1	12 MAY 81	ES-HJW

NOTES

1. THIS ASSEMBLY SHALL MEET SPECIAL FORM MATERIAL TEST REQUIREMENTS OF TITLES 49, CODE OF FEDERAL REGULATIONS.
2. THE STRONTIUM -90 (SR90) SOURCES MUST MEET THE ANSI CLASSIFICATION OF 43343 (REFERENCE ANSI N542-1977).
3. THE RADIOACTIVE SOURCE ASSEMBLY MUST BE EVALUATED AND APPROVED FOR USE BY THE NUCLEAR REGULATORY COMMISSION OR AGREEMENT STATE. CONTRACTOR TO SUBMIT DOCUMENTATION OF THE ABOVE TO HEADQUARTERS, CECOM, DRSEL-SF-H, FORT MONMOUTH, NJ 07703.
4. WHEN THE SOURCE ASSEMBLIES ARE INSTALLED IN THE AN/UDM-2 ( ) RADIAC CALIBRATOR, EACH ASSEMBLY SHALL MEET THE FOLLOWING REQUIREMENT AND TEST PARAGRAPHS OF SPEC MIL-R-55350:

REQT PARA	TEST PARA
3.4.1.2	4.6.1.2

5. IN ADDITION, EACH SOURCE ASSEMBLY SHALL MEET THE FOLLOWING REQUIREMENT AND TEST PARAGRAPHS OF SPEC MIL-R-55350:

REQT PARA	TEST PARA
3.11	4.10
3.11.1	4.10.1.1
3.11.1.1	4.10.1.3
3.11.1.2	4.10.1.2 & 4.1.10.1.4
3.11.1.3	4.10.1.5

6. BACK SURFACE TO BE PAINTED YELLOW (COMMERCIAL) FOR IDENTIFICATION AND EACH SOURCE ASSEMBLY SHALL CONTAIN A SERIAL NUMBER IN ACCORDANCE WITH PARAGRAPH 3.9.2 OF MIL-R-55350.
7. AIR PRESSURE BUILD UP DURING ASSEMBLY PROCEDURES MAY PRODUCE BULGING OF EITHER OR BOTH ITEMS 4 OR 5. ACCEPTABLE BULGING IS AS NOTED.
8. THE SR-90 RADIOISOTOPE SHALL BE CONTAINED IN A CERAMIC CARRIER MATERIAL. THIS CARRIER SHALL BE SPHERICAL, DRY, FREE FLOWING MATERIAL WITH AT LEAST 95% HAVING A DIAMETER IN THE RANGE OF 35 MICRONS MINIMUM TO 65 MICRONS MAXIMUM.
9. THE SR-90 RADIOISOTOPE WHEN CONTAINED IN THE CARRIER SHALL BE IDENTIFIED AS THE ACTIVATOR.

9.1. THE ACTIVATOR SHALL HAVE A MINIMUM SPECIFIC ACTIVITY OF 100 MILLICURIES PER GRAM OF ACTIVATOR.

9.2. THE ACTIVATOR SHALL EXHIBIT A SOLUBILITY NOT IN EXCESS OF 0.1 PERCENT WHEN A SAMPLE IS SOAKED AT 25°C FOR 24 HOURS IN 100 MILLILITERS OF 0.1 NORMAL HYDROCHLORIC ACID.

10. THE VENDOR OF THE SOURCE ASSEMBLY SHALL UTILIZE A QUALITY ASSURANCE SYSTEM THAT MEETS THE REQUIREMENTS OF MIL-Q-9858.
11. PRIOR TO THE AWARD OF A CONTRACT FOR SOURCE ASSEMBLIES, THE VENDOR SHALL SUBMIT FOR APPROVAL WRITTEN PROCEDURE FOR:
    A. MEASURING THE RADIATION OUTPUT OF THE SR-90 SOURCES.

FIND NO.	QTY REQD	CODE IDENT.	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	NOTE

PARTS LIST

NEXT ASSY	USED ON
SM-D-508975	DL-508965

APPLICATION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS DECIMALS ANGLES

MATERIAL:

ELECTRONICS COMMAND
REVIEWED
APPROVED
DATE

DEPARTMENT OF DEFENSE
U. S. ARMY ELECTRONICS COMMAND
FORT MONMOUTH NEW JERSEY 07703

SOURCE ASSEMBLY

SIZE	CODE IDENT NO.	
B	80063	SM-B-509048

SCALE

SHEET 2 OF 3

AMSEL FORM 1049B HISA-FM 358-73
1 APR 73

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REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
C	SEE SHEET 1	12 AUG 81	ES-HJW

B. DETERMINE THE QUANTITY OF SR-90 CONTAINED IN EACH SOURCE ASSEMBLIES.

12. ONLY THE ITEM DESCRIBED ON THIS DRAWING WHEN PROCURED FROM THE VENDORS LISTED HEREON IS APPROVED BY HDQTRS, CS&TA LABS (ERADCOM), FT. MONMOUTH, NJ 07703 FOR USE IN THE APPLICATION SPECIFIED HEREON. A SUBSTITUTE ITEM SHALL NOT BE USED WITHOUT PRIOR TESTING AND APPROVAL BY HDQTRS, CS & TA LABS. PRIOR TO SUBMISSION FOR HDQTRS, CS&TA LABS APPROVAL, THE SUBSTITUTE ITEM SHALL MEET NOTES 1-11 REQUIREMENTS.

FIND NO.	QTY REQD	CODE IDENT.	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	NOTE

PARTS LIST

NEXT ASSY	USED ON
SM-D-508975	DL-508965

APPLICATION

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DIMENSIONS ARE IN INCHES
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MATERIAL:

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REVIEWED
APPROVED
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U. S. ARMY ELECTRONICS COMMAND
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SOURCE ASSEMBLY

SIZE	CODE IDENT NO.	
B	80063	SM-B-509048

SCALE

SHEET 3 OF 3

AMSEL FORM 1049B 1 APR 73 HISA-FM 558-73

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REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
C	REDRAWN WITH ECP N/BFØ22010, NOR 020	13 AUG 81	ES · HJW

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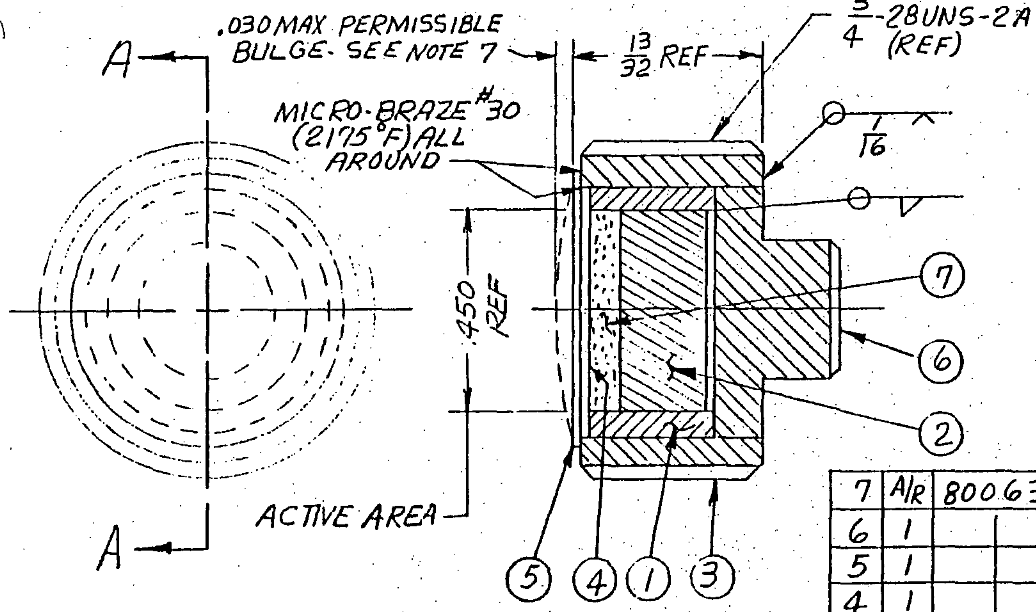

SECTION A-A

SOURCE CONTROL DRAWING

APPROVED SOURCE

MFG PART NO	SOURCE
3 FIG	3M CO ST PAUL MINN. 55105

FIND NO.	QTY REQD	CODE IDENT.	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	NOTE
7	A/R	80063	SM-B-509057-1	MATERIAL, RADIOACTIVE		8 & 9
6	1		SM-B-509054	PLUG		
5	1		SM-B-509053	WINDOW, OUTER		
4	1		SM-B-509052	WINDOW, INNER		
3	1		SM-B-509051	CAPSULE, OUTER		
2	1		SM-B-509050	PLUG		
1	1		SM-B-509049	CAPSULE, INNER		

PARTS LIST

NEXT ASSY	USED ON
SM-D-508994	
SM-D-508981	DL-508965

APPLICATION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS DECIMALS ANGLES

MATERIAL:

DA-28-043-AMC-02402E

ELECTRONICS COMMAND
REVIEWED ER-I SM'F
APPROVED ER-I SM'F
DATE 24 FEB 69

DEPARTMENT OF DEFENSE
U. S. ARMY ELECTRONICS COMMAND
FORT MONMOUTH NEW JERSEY 07703

SOURCE ASSEMBLY

SIZE B | CODE IDENT NO. 80063 | SM-B-509057

SCALE | SHEET 1 OF 3

AMSEL FORM 1049B 1 APR 73 HISA-FM 358-73

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REVISIONS

LTR	DESCRIPTION	DATE	APPROVED
C	SEE SHEET 1	13 AUG 81	ES-HJW

NOTES

1. THIS ASSEMBLY SHALL MEET SPECIAL FORM MATERIAL TEST REQUIREMENTS OF TITLE 49, CODE OF FEDERAL REGULATIONS.
2. THE STRONTIUM -90 (SR90) SOURCES MUST MEET THE ANSI CLASSIFICATION OF 43343 (REFERENCE ANSI N542-1977).
3. THE RADIOACTIVE SOURCE ASSEMBLY MUST BE EVALUATED AND APPROVED FOR USE BY THE NUCLEAR REGULATORY COMMISSION OR AGREEMENT STATE. CONTRACTOR TO SUBMIT DOCUMENTATION OF THE ABOVE TO HEADQUARTERS, CECOM, DRSEL-SF-H, FORT MONMOUTH, NJ 07703.
4. WHEN THE SOURCE ASSEMBLIES ARE INSTALLED IN THE AN/UDM-2 ( ) RADIAC CALIBRATOR, EACH ASSEMBLY SHALL MEET THE FOLLOWING REQUIREMENT AND TEST PARAGRAPHS OF SPEC MIL-R-55350:

REQT PARA	TEST PARA
3.4.1.1	4.6.1.1
3.4.1.3	4.6.1.3

5. IN ADDITION, EACH SOURCE ASSEMBLY SHALL MEET THE FOLLOWING REQUIREMENT AND TEST PARAGRAPHS OF SPEC MIL-R-55350:

REQT PARA	TEST PARA
3.11	4.10
3.11.1	4.10.1.1
3.11.1.1	4.10.1.3
3.11.1.2	4.10.1.2 & 4.10.1.4
3.11.1.3	4.10.1.5

6. BACK SURFACE TO BE PAINTED RED (COMMERCIAL) FOR IDENTIFICATION AND EACH SOURCE ASSEMBLY SHALL CONTIAN A SERIAL NUMBER IN ACCORDANCE WITH PARAGRAPH 3.9.2 OF MIL-R-55350.
7. AIR PRESSURE BUILD UP DURING ASSEMBLY PROCEDURES MAY PRODUCE BULGING OF EITHER OR BOTH ITEMS 4 OR 5. ACCEPTABLE BULGING IS AS NOTED.
8. THE SR-90 RADIOISOTOPE SHALL BE CONTAINED IN A CERAMIC CARRIER MATERIAL. THIS CARRIER SHALL BE SPHERICAL, DRY, FREE FLOWING MATERIAL WITH AT LEAST 95% HAVING A DIAMETER IN THE RANGE OF 35 MICRONS MINIMUM AND 65 MICRONS MAXIMUM.
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9.1. THE ACTIVATOR SHALL HAVE A MINIMUM SPECIFIC ACTIVITY OF 100 MILLCURIES PER GRAM OF ACTIVATOR.
9.2. THE ACTIVATOR SHALL EXHIBIT A SOLUBILITY NOT IN EXCESS OF 0.1 PERCENT WHEN A SAMPLE IS SOAKED AT 25°C FOR 24 HOURS IN 100 MILLILITERS OF 0.1 NORMAL HYDROCHLORIC ACID.
10. THE VENDOR OF THE SOURCE ASSEMBLY SHALL UTILIZE A QUALITY ASSURANCE SYSTEM THAT MEETS THE REQUIREMENTS OF MIL-Q-9858.
11. PRIOR TO THE AWARD OF A CONTRACT FOR SOURCE ASSEMBLIES, THE VENDOR SHALL SUBMIT FOR APPROVAL WRITTEN PROCEDURE FOR:
    A. MEASURING THE RADIATION OUTPUT OF THE SR-90 SOURCES.

FIND NO.	QTY REQD	CODE IDENT.	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	NOTE

PARTS LIST

NEXT ASSY	USED ON
SM-D-508994	
SM-D-508981	DL-508965

APPLICATION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS DECIMALS ANGLES

MATERIAL:

ELECTRONICS COMMAND
REVIEWED
APPROVED
DATE

DEPARTMENT OF DEFENSE
U. S. ARMY ELECTRONICS COMMAND
FORT MONMOUTH NEW JERSEY 07703

SOURCE ASSEMBLY

SIZE B | CODE IDENT NO. 80063 | SM-B-509057

SCALE | SHEET 2 OF 3

AMSEL FORM 10498 1 APR 73 HISA-FM 558-73

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REVISIONS

LTR	DESCRIPTION	DATE	APPROVED
C	SEE SHEET 1	13AUG 81	ES HJW

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FIND NO.	QTY REQD	CODE IDENT.	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	NOTE

PARTS LIST

NEXT ASSY	USED ON
SM-D-508994	
SM-D-508981	DL-508965

APPLICATION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
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MATERIAL:

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DEPARTMENT OF DEFENSE
U. S. ARMY ELECTRONICS COMMAND
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SOURCE ASSEMBLY

SIZE B | CODE IDENT NO. 80063 | SM-B-509057

SCALE | SHEET 3 OF 3

AMSEL FORM 10498 1 APR 73 HISA-FM 558-73

WHEN REFERRING TO THIS DRAWING STATE DRAWING NO., APPLICABLE ISSUE LETTER IF ANY, AND DATE

)RSEL-SF-MR Minutes of Project Control Board Meeting (PCB), 3 Nov 83
Refurbishment of AN/UDM-2 Radiac Calibrator

EL-ED-ES-1 DRSEL-SF 2 December 1983
.r. L. Fischer) C. Watson/mm/54427

. This office has taken the following actions with regards to tasks assigned IAW subject 'CB meeting:

a. The configuration and placement of all labels was completed via PCB meeting, 28 November 1983.

b. A specific set of instructions for refurbishing and restoring AN/UDM-2 to "A" condit-.on~~al~~ was completed via PCB meeting, 28 November 1983.

c. The present radiation level at the external surface of the AN/UDM-2 is consistent with the US Nuclear Regulatory Commission concept of maintaining radiation exposure As Low As Reasonably Achievable (ALARA). IAW the above concept, request that Para 3.4.3 of MIL-R-55350A(ER) lated 9 June 1982 be changed to the following:

"SURFACE DOSE RATE. The maximum dose rate at any point on the external surface of the Calibrator Set shall be As Low As Reasonably Achievable (ALARA) consistent with US Nuclear Regulatory Commission and US Department of Transportation Requirements. This requirement applies under all conditions of storage (see 4.8)".

!. Request that draft documents, referenced in paragraph 1 be provided this office for re-vi nd recommendations as soon as possible.

STEVEN A. HORNE
Chief, Materiel Sfty Engrg Div

MILITARY SPECIFICATION

RADIAC CALIBRATOR AN/UDM-2( )

This specification is approved for use by Electronics Research and Development Command, Department of the Army, and is available for use by all departments and agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the requirements for Radiac Calibrator which provides the facilities for checking the operational reliability and calibration accuracy of various radiacmeters and radiac set. The calibrator consists of a dosimeter jig assembly and a dose rate jig assembly; each assembly can be utilized independently of the other (see 6.1).

2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The effective issue or revision of the following documents shall be that listed in the Department of Defense Index of Specifications and Standards (DODISS) and supplements thereto, unless (i) specific issues are set forth therefor in the cited specifications, or (ii) issues different than those specified in the cited specifications are set forth in the solicitation. The date of the applicable DODISS and supplements thereto shall be as specified in the solicitation or contract.

SPECIFICATIONS

MILITARY

MIL-P-116	- Preservation Packing, Methods of
MIL-P-11268	- Parts, Materials, and Processes Used in Electronic Equipment
MIL-M-13231	- Marking of Electronic Items
MIL-F-14072	- Finishes for Ground Electronic Equipment

Beneficial comments (recommendations, additions, deletions and any pertinent data which may be of use in improving this document should be addresssed to: Commander, US Army Electronics Research and Development Command, Combat Surveillance and Target Acquisition Laboratory, ATTN: DELCS-PE, Fort Monmouth, NJ 07703, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.)

Encl 4

3.4 Performance.

3.4.1 Calibration accuracy.

3.4.1.1 Dosimeter jig assembly (lower source). The dose rate produced by the lower sources shall be within ± 5R/min when related to a secondary calibration standard. When measured in accordance with 4.6.1.1, using a government furnished Victoreen Model 555 Radacon II, the dose rate produced by the lower sources shall be 205 R/min ± 5R/min.

3.4.1.2 Dosimeter jig assembly (upper source). The dose rate produced by the upper source shall be within ± 0.05 mR/min when related to a secondary calibration standard. When measured in accordance with 4.6.1.2, using a government furnished Victoreen Model 555 Radacon II, the dose rate produced by the upper source shall be 0.95 mR/min ± 0.05 mR/min.

3.4.1.3 Dose rate jig assembly. All measured test position dose rate shall be within ± .5R/min when related to a secondary calibration standard. When measured in accordance with 4.6.1.3, using a government furnished Victoreen Model 555 Radacon II, the dose rate produced with the shutter in the 100 R/hr position shall be 44.5 R/min ± 0.5 R/min.

3.4.1.4 Radioactivity. The government shall be provided with the maximum quantity of radioactive material contained in each sealed source needed to produce the required radiation output for compliance with 3.4.1.1, 3.4.1.2 and 3.4.1.3. Each sealed source shall not exceed the maximum quantity of radioactive material specified and shall in accordance with:

a. Special form material test requirements of Title 49, Code of Federal Regulations of US Department of Transportation regulations.

b. American National Standards Institute N542-1977 classification of at least 43343.

c. Approval by the US Nuclear Regulatory Commision or Agreement State for its integrity of construction.

The government shall be provided with supporting documentation indicating compliance with a, b, and c above.

3.4.2 Compatibility. Radiacmeters IM-9( )/PD, IM-93( )/UD and IM-147( )/PD, when exposed in the dosimeter jig assembly for the time specified shall respond in accordance with the appropriate reading and tolerance specified in figure 3-1 (see 4.7.1). Radiacmeters IM-174A/PD and IM-174B/PD and Radiac Set AN/PDR-27( ), when calibrated in the dose rate jig assembly in accordance with the instructions shall respond in accordance with the appropriate reading and tolerance specified in figure 3-2 (see 4.7.2).

FIGURE 3 - 2. Dose rate jig assembly.

1. IM-174( )/PD; IM-174A/PD; IM-174B/PD

a. Release shipping lock
b. Remove detector assembly from IM-174( )/PD. Position it securely in drawer. Switch on IM-174( )/PD. Set it up per its instruction plate.
c. Close drawer
d. Rotate shutter to 100 R/hr position. Note meter reading.
e. Rotate shutter to 10 R/hr position. Note meter reading.
f. Meter should read:
(1) IM-174 between 177 and 117 at 100 R/hr and between 18 and 11 at 10 R/hr.
(2) IM-174(A) and IM-174(B) between 120 and 80 at 100 R/hr and between 12 and 8 at 10 R/hr.
If not, remove calibration control cover. Adjust IM-174( )/PD until it reads in tolerance at both positions.
g. Close shutter. Open drawer. Remove detector assembly. Replace it in the IM-174( )/PD.
h. Close drawer locate and close shipping lock. Lock source shutter with the key.

2. AN/PDR-27 J, L, R and S

a. Release shipping lock.
b. By removing bolts from probe clips, separate both probe units.
c. Check that spacer block is completely inside drawer.
d. Close the drawer. Insert smaller probe into hole in handle end of drawer. Switch to 500 mR/hr range and rotate shutter to 100 R/hr position. Rotate small probe to achieve minimum and maximum readings. Note readings.
e. The average reading shall be 200 mR/hr $\pm$ 30% or 140 to 260 mR/hr.
f. Rotate shutter to off position. Remove probe unit and open drawer. Remove spacer block and turn over to fit on handle close drawer.
g. Insert smaller probe in new position. Switch to 50 mR/hr range. Rotate shutter to 100 R/hr position. Rotate smaller probe to achieve minimum and maximum readings. Note readings.
h. The average reading shall be 30 mR/hr $\pm$ 30% or 21 to 39 mR/hr.
i. Rotate shutter to off position. Remove probe from drawer.
j. Switch to 5 mR/hr position and place large probe on the top rear edge of drawer unit, opened to its fullest extremity. Leave shutter in off position, and observe readings.
k. Average reading should be 3.2 mR/hr $\pm$ 30% or 2.2 to 4.2 mR/hr.
l. Place large probe on uper edge of handle side of box. Switch to 0.5 mR/hr position and observe readings.
m. Average reading should be 0.30 mR/hr $\pm$ 30% or 0.21 to 0.39 mR/hr.
n. If readings obtained are outside quoted tolerances, remove cover over calibration controls and adjust appropriate control to correct reading.
o. Screw down shipping lock. Lock source shutter with key.
p. Reassemble AN/PDR-27 probe assembly.

3.6.3.4 Bench handling. The equipment shall meet the requirement of 3.4.2 without degradation of performance after being subjected to the test of 4.9.4.

3.6.3.5 Bounce. The equipment shall meet the requirement of 3.4.2 without degradation of performance after being subjected to the test of 4.9.8.

3.6.3.6 Vibration. The equipment shall meet the requirement of 3.4.2 after being subjected to vibration such as encountered in a field service environment (see 4.9.7).

3.6.3.7 Rain. The equipment shall meet the requirement of 3.4.2 without degradation of performance after being subjected to the test of 4.9.12.

3.6.3.8 Shock. The equipment shall meet the requirement of 3.4.2 after being subjected to shock such as is encountered in transportation via aircraft, or dropping by parachute (see 4.9.10).

3.6.3.9 Fungus. The equipment (including accessories) shall show no evidence of viable fungus or corrosion when subjected to the test specified in 4.9.11. Corrosion is any visible degradation that can be attributed to flaky, pitted, blistered, or otherwise loosened finished or metal surface.

3.7 Special capability requirements.

3.7.1 Facilities. The contractor is required to possess in his plant, or have direct access to a cobalt 60 source capable of providing a minimum field intensity of 125 R/hr at a distance of 1 meter from its geometrical center.

3.7.2 Equipment. The contractor is required to possess in his plant a Victoreen Condenser "R" meter, or equivalent, calibrated by the National Bureau of Standards or other agency approved by the government for measuring radiation flux.

3.7.3 License. The contractor is required to possess or obtain a byproduct material license for the AN/UDM-2( ) and its sources from the US Nuclear Regulatory Commission as per Title 10, Chapter I, Code of Federal Regulations, Part 30.3, or from an agreement-state in which located as per the agreement-state regulations.

3.8 Interchangeability. Like units, assemblies, subassemblies and replaceable parts shall conform to requirement 7 of MIL-STD-454 (see 4.12).

3.9 Marking.

3.9.1 General. Marking shall conform to MIL-M-13231.

3.9.2 Radioactive warnings. In addition to the general markings required by 3.9.1, the contractor shall comply with the requirements of Title 10, Code of Federal Regulations, Part 20. Each source shall be etched or stamped with a unique serial number and some symbol identifying the manufacturer and model

3.11.2 Calibrator contamination tests. Each calibrator shall be subjected to the tests of 4.10.2. The results of these tests shall not exceed 0.001 microcuries of removable radioactive material. Calibrators exceeding 0.001 microcuries of removable radioactive material shall be rejected.

3.12 Recycled, virgin and reclaimed materials. It is required that, to the maximum extent possible, recovered or reclaimed materials, in lieu of the virgin materials, shall be used without jeopardizing the intended use of the manufactured item.

3.13 Workmanship. The calibrator shall be manufactured and assembled in accordance with requirement 9 of MIL-STD-454 and the applicable portions of MIL-P-11268.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may utilize his own facilities, facilities of a subcontractor or any commercial laboratory acceptable to the government. The government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that the supplies and services conform to prescribed requirements.

4.2 Classification of inspections. Inspections shall be classified as follows:

a. First article inspection (does not include packaging) (see 4.3).

b. Inspections covered by subsidiary documents (see 4.4).

c. Quality conformance inspections.

(1) Quality conformance inspection of equipment before packaging (see 4.5).

(2) Quality conformance inspection of packaging (see 4.14).

4.3 First article. Unless otherwise specified in the contract or purchase order, the first article inspection shall be performed by the contractor.

4.3.1 First article units. The contractor shall furnish nine (9) first article units of the AN/UDM-2( ) for group A, B and C testing.

4.3.2 First article inspection. The first article inspection shall consist of the inspections specified in table I, and shall be performed in the order specified in table I. After completing tests of table I, each unit shall have their sources removed and the sources shall be tested in accordance with 4.10 (less 4.10.1.3 and 4.10.1.4).

4.4 Inspections covered by subsidiary documents. The following shall be inspected under the applicable documents as part of the inspection required by this specification, and the inspection requirement specified in the contract or purchase order.

Item	Where required
Parts, materials, and processes; general	3.3
Finish	3.3.1
Marking	3.9
Workmanship	3.13

4.5 Quality conformance inspection of equipment before packaging. The contractor shall perform the inspections specified in 4.4, 4.5.1 through 4.5.3. This does not relieve the contractor of his responsibility for performing any additional inspection which is necessary to control the quality of the product and to assure compliance with all specification requirements.

4.5.1 Group A inspection. Each unit on contract or purchase order shall be inspected for conformance to the inspection in table II. Discrete lots shall be formed from units that pass this inspection. Factors of lot composition not defined herein, or in the contract or purchase order, shall be in accordance with MIL-STD-105. Each lot shall be subject to sampling inspection, utilizing the procedures of MIL-STD-105, using the general inspection levels and AQLs indicated in table II.

4.5.1.1 Order of inspection within Group A. Group A inspection shall be performed in an order satisfactory to the government.

4.5.1.2 Visual and mechanical inspection. These inspections shall be performed in any order which is satisfactory to the government. The units shall be examined for the applicable defects listed in MIL-STD-252 (see 3.1).

TABLE III. Group B inspection.

Inspection	Requirement paragraph	Test paragraph	AQL
Interchangeability	3.8	4.12	4.0%
Weight	3.5	4.13	4.0%

4.5.3 Group C inspection. This inspection shall consist of the tests specified in table IV and shall be performed on units of product that have been subjected to and passed group A and group B inspection requirements. Sample units shall be selected in accordance with 4.5.3.1.

4.5.3.1 Sampling for group C inspection. Group C inspections shall be performed on the first production lot and at the 25 percent, 50 percent, 75 percent and 100 percent points in production. Three (3) samples of AN/UDM-2 shall be selected at random for each group of inspections and shall be performed in an order shown in table IV.

4.6.1.2 Dosimeter jig assembly measurements (upper source). Same as 4.6.1.1 except probe Victoreen Part No. 555-100-1C shall be used. The upper source of the dosimeter jig assembly shall be tested in accordance with SM-A-509093, paragraph 3.2 and shall meet the requirements of 3.4.1.2.

4.6.1.3 Dose rate jig assembly measurements. Same as 4.6.1.1. Dose rate jig assembly shall be tested in accordance with SM-A-509093 paragraph 4.0 and shall meet the requirements of 3.4.1.3.

4.7 Compatibility.

4.7.1 Dosimeter jig assembly. Calibrate all Radiacmeters IM-9, IM-93 and IM-147 supplied as Government Furnished Equipment (GFE) at mid scale using a cobalt 60 source, the calibration of which is traceable to the National Bureau of Standards. The radiacmeters shall read as follows:

IM-9( )/PD	100 mR ± 10 percent
IM-93A/UD	300 R ± 10 percent
IM-147( )/PD	25 R ± 10 percent

Any government furnished radiacmeter, whose reading exceeds the specified tolerance, shall not be used. Select 10 units of each type of radiacmeter and charge to zero. Discharge each radiacmeter in its appropriate position in the dosimeter jig assembly for the period specified for the particular radiacmeter under test. Repeat the above procedure for a total of 3 readings for each radiacmeter and calculate the average reading. The average reading shall be within the allowable tolerances specified in 3.4.2.

4.7.2 Dose rate jig assembly. Calibrate all Radiacmeters IM-174A/PD, IM-174B/PD and Radiac Sets AN/PDR-27( ) supplied as GFE using a cobalt 60 source, the calibration of which is traceable to the National Bureau of Standards. The instruments shall be calibrated at the following points:

Instrument	Calibration point	Tolerance
IM-174A/PD	100R/hr	± 10 percent
IM-174B/PD	100R/hr	± 10 percent
AN/PDR-27( )	250 mR 25 mR 2.5 mR 0.25 mR	± 20 percent

Any government furnished equipment which can not be calibrated shall not be used. Select 2 units each of Radiacmeters IM-174A, IM-174B and 2 units of Radiac Set AN/PDR-27( ) and check the calibration of each unit in the calibrator in accordance with the procedures specified. Repeat each check for a total of 3 readings per unit and the average reading per unit shall be within the allowable tolerances specified on 3.4.2.

4.9.5 Altitude.

4.9.5.1 Operating. The equipment shall be subjected to procedure I, Method 500.1 of MIL-STD-810. In step 2 test for conformance to 3.4.2 a chamber pressure of 20.6 inches of hg (10,000 ft (3048m) above sea level). Upon completion of the performance test, return the chamber to standard ambient pressure and repeat the performance test for conformance to 3.4.2 (see 3.6.2.2).

4.9.5.2 Non-operating. The equipment, closed for storage or transportation, shall be subjected to steps 2 and 4 of Procedure I, Method 500.1 of MIL-STD-810. Upon completion of step 4, the equipment shall be tested for conformance to 3.4.2 (see 3.6.3.2).

4.9.6 Humidity. The equipment shall be subjected to Procedure II, Method 507.1 of MIL-STD-810 except that:

a. The equipment shall be opened into its 2 halves during step 1.

b. Step 2 shall be deleted.

c. Conformance to 3.4.2 shall be testing during step 4.

d. Equipment shall be closed as for storage or transportation during the first 3 cycles of step 6. During cycles 4 and 5, the equipment shall be opened as in step 3.

e. Conformance to 3.4.2 shall be tested during step 8 (see 3.6.2.3).

4.9.7 Vibration. The equipment shall be subjected to Procedure X, curve AW of MIL-STD-810, Method 514.1. Upon completion of the test, the equipment shall meet the performance requirement of 3.4.2 (see 3.6.3.6).

4.9.8 Bounce. The equipment shall be subjected to Procedure X, paragraph 4.16.2, Method 514.2 of MIL-STD-810. Upon completion of the test, the equipment shall meet the performance requirement of 3.4.2 (see 3.6.3.5).

4.9.9 Salt fog. The equipment, opened as in operational use, shall be subjected to Method 509.1, Procedure 1 of MIL-STD-810. Salt concentration shall be 20 percent. Upon completion of the test the equipment shall meet the performance requirements of 3.4.2 (see 3.6.2.4).

4.10.1.2 Source bloat test. After a source has passed a leak test, the source shall be tested for bloating (bulging) of the thin window. Thin window bloating (bulging) in excess of 0.030 inch shall be considered failure of the test.

4.10.1.3 Second encapsulation leak test. After the second encapsulation of the source repeat the test described in 4.10.1.1.

4.10.1.4 Second encapsulation bloat test. After a source has passed the test outlined in 4.10.1.3, repeat the test of 4.10.1.2 (see 3.11.1.2).

4.10.1.5 Source contamination test. (see 3.11.1.3)

a. Use any standard beta counting system which includes a scaler and timer and has a detector window at least one inch in diameter and not exceeding 2.0 mg/cm^2. Commercially available sponge or smooth surface filter paper wipes shall be utilized whose diameter shall not exceed the diameter of the detector window or counting planchet.

b. The beta counting system utilized in a above shall be calibrated using calibration reference standards certified by, or traceable to the National Bureau of Standards. The radioactive material incorporated into the calibration reference standards shall be of the same type as contained in the sealed sources utilized in the AN/UDM-2 Radiac Calibrator Sets (i.e., Strontium-90). A detailed procedure for the analysis of wipe test samples, including the determination of the quantity of contamination in microcuries, shall be provided the government for evaluation and approval for use.

4.10.1.6 Source radioactivity test. Each sealed source shall be tested to determine its radioactive material content by utilizing appropriate radiation measurement instrumentation to assure that the maximum quantity limitations for radioactive material contained in each sealed source type are not exceeded. The radiation measurement instrumentation shall be calibrated utilizing calibration standard sources certified by, or traceable to, the National Bureau of Standards. The radioactive material incorporated into the calibration standard sources shall be of the same type as contained in the sealed sources utilized in the AN/UDM-2 Radiac Calibrator Sets. A detailed procedure for the determination of the quantity of radioactive material contained in the sealed sources shall be provided the government for evaluation and approval for use.

4.10.2 Calibrator contamination test.

4.10.2.1 Equipment and counting procedure. The equipment and counting procedure stipulated in 4.10.1.5 above shall be followed with regards to the analysis of the wipe test samples as acquired below. Wipe test sampling shall be performed with commercially available cotton swabs in place of sponge or smooth surface filter paper wipes. To count cotton swabs, cut off all but a short stub of the handle and tape the stub to the planchet, centering the cotton on the planchet.

reliability of Radiacmeter IM-9( )/PD while the lower field performs a similar function for Radiacmeters IM-93( ) and IM-147( )/PD. The dose rate jig assembly consists of a drawer unit and a spacer block. The drawer unit contains one each sealed source. The spacing block provides varying field intensities used to calibrate radiacmeter probes. This assembly is utilized to calibrate Radiacmeters IM-174A/PD, IM-174B/PD and Radiac Set AN/PDR-27( ).

6.2 Ordering data. Procurement documents should specify the following:

a. Title, number and date of this specification and any amendment thereto.

b. Complete equipment or individual units to be procured.

c. Level A or B preservation and packing (see section 5).

d. When rough handling test is required.

e. Number of first articles to be submitted for approval (see 3.2).

f. Marking and shipping of samples.

g. Place of final inspection.

h. Technical literature required.

6.3 Environmental. Environmental pollution prevention measures are contained in the packaging material specifications referenced herein. Refer to material specifications or preparing activity for recommended disposability methods.

6.4 Nomenclature. The contractor should apply for nomenclature in accordance with the applicable clause in the contract.

6.5 Government furnished property (loaned). Unless otherwise stated in the contract, the following government property, in the quantities specified, shall be loaned to the contractor for the purpose of performing acceptance tests on the equipment being procured:

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS: This form is provided to solicit beneficial comments which may improve this document and enhance its use. DoD contractors, government activities, manufacturers, vendors, or other prospective users of the document are invited to submit comments to the government. Fold on lines on reverse side, staple in corner, and send to preparing activity. Attach any pertinent data which may be of use in improving this document. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity. A response will be provided to the submitter, when name and address is provided, within 30 days indicating that the 1426 was received and when any appropriate action on it will be completed.
NOTE: This form shall not be used to submit requests for waivers, deviations or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

DOCUMENT IDENTIFIER *(Number)* AND TITLE
MIL-R-55350A(ER) RADIAC CALIBRATOR AN/UDM-2( )

NAME OF ORGANIZATION AND ADDRESS OF SUBMITTER

☐ VENDOR ☐ USER ☐ MANUFACTURER

1. ☐ HAS ANY PART OF THE DOCUMENT CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE? ☐ IS ANY PART OF IT TOO RIGID, RESTRICTIVE, LOOSE OR AMBIGUOUS? PLEASE EXPLAIN BELOW.

A. GIVE PARAGRAPH NUMBER AND WORDING

B. RECOMMENDED WORDING CHANGE

C. REASON FOR RECOMMENDED CHANGE(S)

2. REMARKS

SUBMITTED BY *(Printed or typed name and address — Optional)*

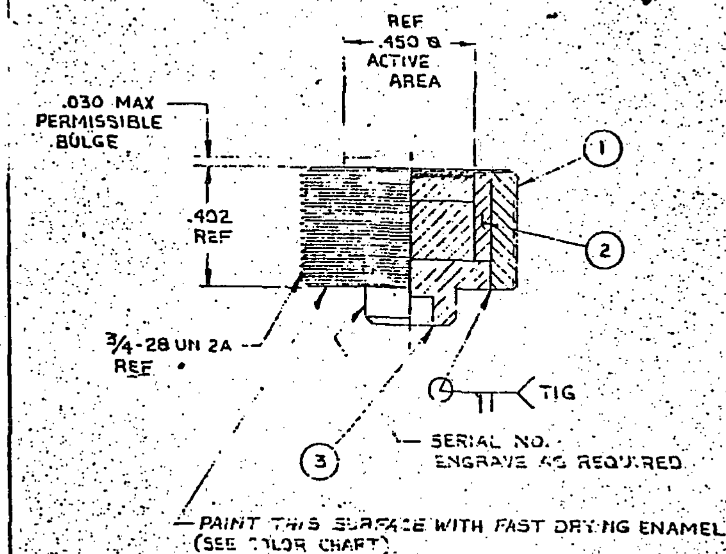
TELEPHONE NO.

DATE

DD FORM 1426, 1 OCT 76 — EDITION OF 1 JAN 72 WILL BE USED UNTIL EXHAUSTED.

Encl 5

ITEM	QTY	PART NO.	DESCRIPTION
1	1	B-12-1921-3464-6	ASSY WINDOW-OUTER CAPSULE
2	1	B-12-1921-3493-5	ASSY INNER CAPSULE
3	1	B-12-1921-3466-1	OUTER PLUG



COLOR CHART	
LOADING	COLOR
20 MICROCURIES	YELLOW
25 MILLICURIES	RED
OTHER REQ	NONE

NOTE:

1. CONSTRUCTION TO MEET OR EXCEED ANSI CLASSIFICATION 77C-43343 AND SPECIAL FORM TITLE 49 CFR

USED ON

ISSUE	ISSUE DATE AND CHANGE RECORD	REV.	CHG.
F	OCT 4, 82 ECO 82-0080 REDRAWN FROM A-0474-3.5	CRZ	RG

TOLERANCE AND SURFACE ROUGHNESS UNLESS NOTED

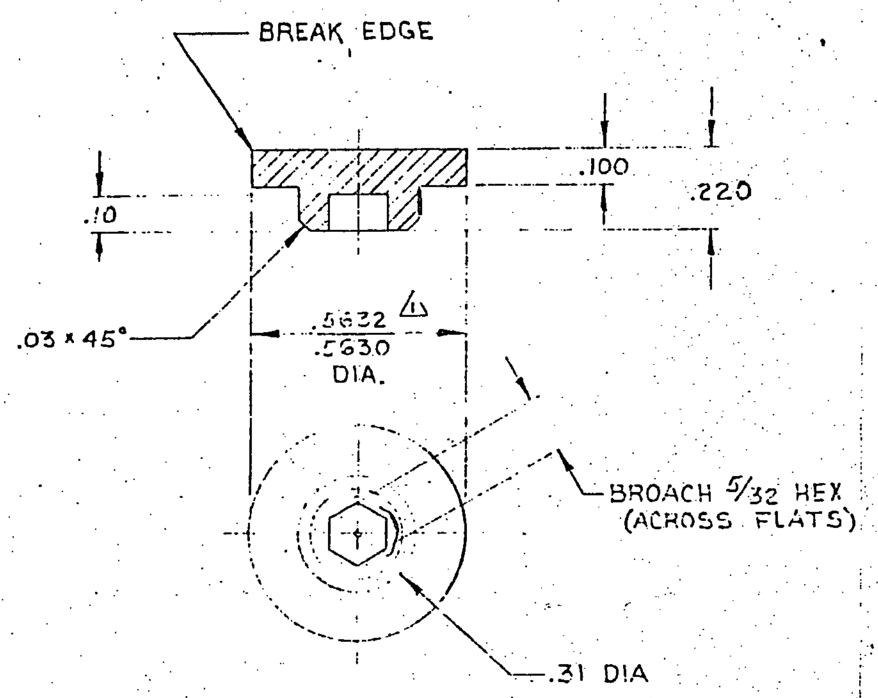
OPERATION	PLACES IN DIMENSION .0	.00	.000	MAXIMUM SURFACE ROUGHNESS
MACHINING	±.1	±.02	±.005	✓
CUT-OFF (SAW, BURN, SHEAR)	±.1	±.04		
	±	±	±	
WELDING	±.1	±.06		
ANGULAR DIM.	±			
SCALE	5X			

DR. CHUCK ZENDER
CH. RTS [illegible]
APP. [illegible]
B

3M
Engineering Division 3M
St. Paul, Minnesota 55101

TITLE
ASSEMBLY:
Sr-90 BETA SOURCE
3F1G

PART NO.
12-1921-0474-8



MATERIAL:
TYPE 304 SSTL.

NOTE:
1. REMOVE ALL BURRS AND SHARP EDGES

USED ON B-12-1921-0474-8

ISSUE	ISSUE DATE AND CHANGE RECORD	REV.	CHG.
A	OCT 1, 82 ECO 82-OC80 REDRAWN FROM A-0475-5, 6 ⚠ WAS .5610/.5607	CRZ	

TOLERANCE AND SURFACE ROUGHNESS UNLESS NOTED

OPERATION	.0	.00	.000	MAXIMUM SURFACE ROUGHNESS
MACHINING	±.1	±.02	±.005	√
CUT-OFF (SAW, BURN, SHEAR)	±.1	±.04		
	±	±	±	
WELDING	±.1	±.06		
ANGULAR DIM.	± 5°			
SCALE	3X			

(PLACES IN DIMENSION: .0, .00, .000)

3M
Engineering Division/3M
St. Paul, Minnesota 55101

DR. CHUCK ZENDER
CH.
APP.

B

TITLE
OUTER PLUG
3FIG

PART NO.
12-1921-3466-1

DRSEL-SF-MR

30 May 1984

MEMORANDUM FOR RECORD

SUBJECT: TM 11-6665-227-12, Operator's and Organizational Maintenance Manual, Calibrator Set, Radiac AN/UDM-2 (NSN 6665-00-179-9037)

1. Reference is made to the following:

a. FONECON, 21 May 1984, between Mr. Barry J. Silber, CECOM Safety Office, and Mr. Paul Stevens, Directorate of Maintenance Engineering, subject as above.

b. DA Forms 2028, dated 21 October 1983, subject as above.

2. As indicated in reference 1a, it is anticipated that the recommended changes to subject TM, reference 1b, will be prepared for publication during the June 1984 timeframe.

Prepared By: Barry J Silber

BARRY J. SILBER
C, Radiological Engrg
Materiel Safety Engrg Div
Safety Office

Reviewed and Approved By: Steven A Horne

STEVEN A. HORNE
Chief, Materiel Safety Engrg Div
Safety Office

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 310-1; the proponent agency is the US Army Adjutant General Center.	Use Part II (reverse) for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).	DATE 21 Oct 83

TO: (Forward to proponent of publication or form) (Include ZIP Code)	FROM: (Activity and location) (Include ZIP Code)
Commander US Army CECOM ATTN: DRSEL-ME-MQ Fort Monmouth, NJ 07703	Commander US Army CECOM ATTN; DRSEL-SF-MR Fort Monmouth, NJ 07703

PART I - ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	TITLE
TM-11-6665-227-12	21 May 1982	Operator's & Organizational Matenance Manual Calibrator Set, Radiac AN/UDM-2 (NSN 6665-00-179-9037)

ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO.*	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Exact wording of recommended change must be given)
1	Inside Item	Front 3,	Cover line	15		Change; "... of a Radiological Protection Officer..." To; "...of a Radiation Protection Officer:.." Reason: To reflect proper designation of the position listed
2	1-1	1-6.2a	10	-	-	Change: "...parts 19 and 20)." To: "... parts 19,20, and 21)." Reason: To reflect changes in TB 11-6665-227-12 and US Nuclear Regulatory Commission regulations
3	1-1	1-6.2c	3	-	-	Change: "...US Army Electronics Command..." To: "...US Army Communications - Electronics Command..." Reason: To reflect command name change.
4	1-2	1-6.2c	5	-	-	Change: "...DRSEL-SF-H..." To: "...DRSEL-SF-MR..." Reason: To reflect attention symbol change.
5	1-3	1-8	5	-	-	Change: "...Three encapsulated sources of 25 millicuries..." To: "Three encapsulated sources of 45 millicuries ..." Reason: AN/UDM-2 has been refurbished with replacement sources of greater activity.
6	1-3	1-8	7	-	-	Change: "... source of 20 microcuries." To: "...source of 30 microcuries." Reason: AN/UDM-2 has been refurbished with replacement sources of greater activity.
7	1-3	1-8	8	-	-	Change: "One encapsulated source of 25 millicuries." To: "One encapsulated source of 45 millicuries." Reason: AN/UDM-2 has been refurbished with replacement sources of greater activity.

*Reference to line numbers within the paragraph or subparagraph.

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
RICHARD TENPENNY Health Physicist	AV 995-4427	Richard Tenpenny

Encl 1 to Encl 1

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS

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Use Part II (reverse) for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).

DATE: 21 Oct 83

TO: (Forward to proponent of publication or form) (Include ZIP Code)
Commander
US Army CECOM
ATTN: DRSEL-ME-MQ
Fort Monmouth, NJ 07703

FROM: (Activity and location) (Include ZIP Code)
Commander
US Army CECOM
ATTN; DRSEL-SF-MR
Fort Monmouth, NJ 07703

PART I - ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	TITLE
TM-11-6665-227-12	21 May 1982	Operator's & Organizational Maintenance Manual Calibrator Set, Radiac AN/UDM-2 (NSN 6665-00-179-9037)

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5	1-3	1-8	5	-	-	Change: "... Three encapsulated sources of 25 millicuries..." To: "Three encapsulated sources of 45 millicuries ..." Reason: AN/UDM-2 has been refurbished with replacement sources of greater activity.
6	1-3	1-8	7	-	-	Change: "... source of 20 microcuries." To: "...source of 30 microcuries." Reason: AN/UDM-2 has been refurbished with replacement sources of greater activity.
7	1-3	1-8	8	-	-	Change: "One encapsulated source of 25 millicuries." To: "One encapsulated source of 45 millicuries." Reason: AN/UDM-2 has been refurbished with replacement sources of greater activity.

*Reference to line numbers within the paragraph or subparagraph.

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
RICHARD TENPENNY Health Physicist	AV 995-4427	Richard Tenpenny

Encl 1 to Encl 7

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 310-1; the proponent agency is the US Army Adjutant General Center.	Use Part II (reverse) for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).	DATE 21 Oct 83

TO: (Forward to proponent of publication or form) (Include ZIP Code)	FROM: (Activity and location) (Include ZIP Code)
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PART I - ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	TITLE
TM-11-6665-227-12	21 May 1982	Operator's & Organization Matenance Manual Calibrator Set, Radiac AN/UDM-2 (NSN 6665-00-179-9037)

ITEM NO.	PAGE NO.	PARAGRAPH	LINE NO.*	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Exact wording of recommended change must be given)
8	1-3	1-8	11	-	-	Delete; "Bremmstrahlung produced...Radiation dose rate from source... "to end of the sentence. Reason: Information supplied is inaccurate and not required in a TM.
9	1-3	1-10a	6	-	-	Change: "...(one 20 microcurie source..." To: "...(one 30 microcurie source..." Reason: AN/UDM-2 has been refurbished with replacement sources of greater activity.
10	1-3	1-10a	10	-	-	Change: "...20-microcurie source..." To: "...30-microcurie source..." Reason: AN/UDM-2 has been refurbished with replacement sources of greater activity.
11	1-3	1-10a	6	-	-	Change: "...three 25..." To: "...three 45..." Reason: AN/UDM-2 has been refurbished with replacement sources of greater activity.
12	1-3	1-10a	11	-	-	Change: "...three 25-millicuries sources..." To: "...three 45-millicuries sources..." Reason: AN/UDM-2 has been refurbished with replacement sources of greater activity.
13	1-6	1-10b	4	-	-	Change: "...encapsulated 25-millicurie..." To: "...encapsulated 45-millicurie..." Reason: AN/UDM-2 has been refurbished with replacement sources of greater activity.
14	2-1	2-2c	-	-	-	Add the following paragraph after para 2,2b as paragraph 2-2c and redesignate paragraphs 2-2c and 2-2d as paragraphs 2-2d and 2-2e, respectively: "Turn the manual valve clockwise to the closed position to avoid damaging the manual valve. It should be noted that a damaged manual valve may void the AN/UDM-2 container from being considered as US

*Reference to line numbers within the paragraph or subparagraph.

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
RICHARD TENPENNY Health Physicist	AV 995-4427	Richard Tenpenny

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27 Oct 83

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PART I - ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER: TM-11-6665-227-12

DATE: 21 May 1982

TITLE: Operator's & Organization Maintenance Manual Calibrator Set, Radiac AN/UDM-2 (NSN 6665-00-179-9037)

ITEM NO.	PAGE NO.	PARAGRAPH	LINE NO.*	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Exact wording of recommended change must be given)
4 cont.						Department of Transportation Specification 7A Type A packaging." Reason; To prevent damage to the manual valve of the AN/UDM-2.
5	3-1	-	4	-	3-1	Change: "TS-3495/IDM-2 (fig. 1-2): " To: "TS-3495/UDM-2 (fig. 1-2): " Reason: To reflect the proper designation.
6	3-9	-	-	3-1.1	-	Delete: "Figure 3-1.1 TS-3495/UMD-2 discharge well assembly, correction factor chart" and table above Reason: A specific correction factor chart is supplied with each AN/UDM-2.
7	3-9	-	-	3-1.1	-	Delete: "Figure 3-1.2 TS 3494/UMD rate meter assembly, correction factor chart" and table above Reason: A specific correction factor chart is supplied with each AN/UDM-2.
8	4-2	-	12	-	4-2	Change: "...of the Radiological Protection Officer ..." To: "...of the Radiation Protection Officer..." Reason: To reflect the proper designation of the position listed.
9	A-1	-	-	Appendix A		Delete: "AR 55-55 Transportation of Radiactive and Fissile Materials Other than Weapons." Delete: "AR-700-52 Licensing and Control of Sources of Ionizing Radiation" Delete: "AR 755-15 Disposal of Unwanted Radioactive Material" Replace with: "AR 385-11 Ionizing Radiation Protection (Licensing, Control, Transportation, Disposal, and Radiation Protection)" Reason: Above listed ARs have been recinded and replaced by AR 385-11.

*Reference to line numbers within the paragraph or subparagraph.

TYPED NAME, GRADE OR TITLE: RICHARD TENPENNY, Health Physicist

TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION: AV 995-4427

SIGNATURE: Richard Tenpenny

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TITLE: Operator's & Organization Maintenance Manual Calibrator Set, Radiac AN/UDM-2 (NSN 6665-00-179-9037)

ITEM NO.	PAGE NO.	PARAGRAPH	LINE NO.*	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Exact wording of recommended change must be given)
20	Glos	sary 1,	7 of	Colum	n 1	Change; "Bremsstrahlung - Secondary electro-magnetic radiation..."to the end of the definition. To; "Bremsstrahlung (braking radiation) - Are those X-rays that are emitted when high-speed charged particles passing close to a nucleus suffer rapid acceleration due to the strong attractive coulombic force of the nucleus." Reason: To have the definition comply with the modern conception of the definition.
21	Glos	sary 1,	10 of	Colum	n 1	Change; "Curie - That quantity of a radioactive..." To: "Curie (Ci) - The activity of that quantity of radioactive material in which the number of disintegrations per second is $3.7X10^{10}$. Reason; To have the definition comply with the modern conception of the definition.
22	Glos	sary 1,	16 of	Colum	n 1	Change and alphabetize definition: "Dose rate - The radiation dose delivered per..." to the end of the definition. To; "Absorbed dose rate ($\dot{D}$) - That quotient of dD by dt, where dD is the increment of absorbed dose in the time dt. A special unit of absorbed dose rate is any quotient of the rad or its dose rate is any quotient of the rad or its multiple or submultiple by a suitable unit of time (rad s^{-1},mrad h^{-1}, etc.). See absorbed dose." Reason: To have the definition comply with ICRU Report 19 definitions.
23	Glos	sary 1,	20 of	Colum	n 2	Change; "Rad (r) - An exposure does of X- ..."to the end of the definition. To: "Rad (Radiation Absorbed Dose) - Is the special unit of absorbed dose where 1 rad = 10^{-2} J Kg^{-1} and J represents joule and Kg represents kilogram. See absorbed dose." Reason: To modify definition so it complies with ICRU Report 19 Radiation Quantities and Units.

*Reference to line numbers within the paragraph or subparagraph.

TYPED NAME, GRADE OR TITLE: RICHARD TENPENNY, Health Physicist

TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION: AV 995-4427

SIGNATURE: Richard Tenpenny

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24 Oct 83

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US Army CECOM
ATTN: DRSEL-ME-MQ
Fort Monmouth, NJ 07703

FROM: (Activity and location) (Include ZIP Code)
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US Army CECOM
ATTN; DRSEL-SF-MR
Fort Monmouth, NJ 07703

PART I - ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER: TM-11-6665-227-12

DATE: 21 May 1982

TITLE: Operator's & Organization Maintenance Manual Calibrator Set, Radiac AN/UDM-2 (NSN 6665-00-179-9037)

ITEM NO.	PAGE NO.	PARAGRAPH	LINE NO.*	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Exact wording of recommended change must be given)
24	Glos	sary 1,	25,	of Co	lumn 2	Change; "Strontiurm-90 (Sr 90) -..." To: "Strontium-90 (Sr 90)-..." Reason; Spelling correction.
25	Glos	sary 1				Add and alphabetize definition; "Absorbed dose (D)-is the quotient of d$\bar{E}$ by dm, where d$\bar{E}$ is the mean energy imparted by ionizing radiation to the matter in a volume element and dm is the mass of the matter in that volume element. See rad." Reason; Updating of glossary to comply with ICRU Report 19.
26	Glos	sary 1				Add and alphabetize definition: "Exposure (X) - Is the quotient of dQ by dm where dQ is the absolute value of the total charge of the ions of one sign produced in air when all the electrons (negatrons and positrons) liberated by photons in a volume element of air has mass dm are completely stopped in air. See roentgen." Reason; Updating of glossary to comply with ICRU Report 19.
27	Glos	sary 1				Add and alphabetize definition: "Roentgen (R) - Is the special unit of exposure where 1 R = 2.58X 10^{-4}C kg $^{-1}$ and C represents coulomb. See exposure." Reason; Compliance with ICRU Report 19.
28	Glos	sary 1				Add and alphabetize definition: "Dose equivalent (H) - Is the product of D, Q and N, at the point of interest in tissue, where D is the absorbed dose, Q is the Quality factor and N is the product of any other modifying factors. The dose equivalent is a measure of the biological effectiveness of a given absorbed dose. See rem." Reason: Compliance with ICRU Report 19.
29.	Glos	sary 1				Add and alphabetize definition: "Rem - Is the special unit of dose equivalent. When absorbed dose

*Reference to line numbers within the paragraph or subparagraph.

TYPED NAME, GRADE OR TITLE: Richard Tenpenny, Health Physicist

TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION: AV 995-4427

SIGNATURE: Richard Tenpenny

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PUBLICATION/FORM NUMBER	DATE	TITLE
TM-11-6665-227-12	21 May 1982	Operator's & Organization Maintenance Manual Calibrator Set, Radiac AN/UDM-2 (NSN 6665-00-179-9037)

ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO.*	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Exact wording of recommended change must be given)
29	cont.					is expressed in rads, H is in rems. See dose equivalent." Reason; Compliance with ICRU Report 19.
30	NRC For	ms 3 af	ter	Glos	sary	Replace; NRC Forms 3, dated June 1977, with the most recent edition of NRC Form 3, dated June 1982, provided at enclosure 1. Reason; To utilize the most current data in the TM.

*Reference to line numbers within the paragraph or subparagraph.

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
RICHARD TENPENNY Health Physicist	AV 995-4427	Richard Tenpenny

TM 11-6665-227-12

TECHNICAL MANUAL

OPERATOR'S AND ORGANIZATIONAL MAINTENANCE MANUAL

CALIBRATOR SET, RADIAC AN/UDM-2

NSN 6665-00-179-9037

This copy is a reprint which includes current pages from Changes 1 through 4.

HEADQUARTERS, DEPARTMENT OF THE ARMY

JUNE 1975

ENCL 7

Change No. 4

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, *21 May 1982*

Operator's and Organizational Maintenance Manual CALIBRATOR SET, RADIAC AN/UDM-2 (NSN 6665-00-179-9037)

TM 11-6665-00-227-12, June 1975, is changed as follows:

1. New or changed material is indicated by a vertical bar in the margin of the page.

2. Remove old pages and insert new pages as indicated below:

Remove	*Insert*
i/(ii blank)	i/(ii blank)
1-1 and 1-2	1-1 and 1-2
None	1-2.1/(1-2.2 blank)
3-1 through 3-8	3-1 through 3-7/(3-8 blank)
3-13 and 3-14	3-13 and 3-14
Appendix A	A-1/(A-2 Blank)
Glossary 1	Glossary 1

3. File this change sheet in the front of the publication for reference purposes.

By Order of the Secretary of the Army:

E. C. MEYER
General, United States Army
Chief of Staff

Official:

ROBERT M. JOYCE
Brigadier General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with DA Form 12-50, Operator Maintenance requirements for AN/UDM-2

4. NEVER PEER INTO THE RATEMETER ASSEMBLY WHEN THE COVER PLATE IS REMOVED.

Technical Manual No. 11-6665-227-12

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 13 June 1975

Operator's and Organizational Maintenance Manual

CALIBRATOR SET, RADIAC AN/UDM-2

(NSN 6665-00-179-9037)

CHAPTER 1 INTRODUCTION

Section 1. General

1-1. Scope

a. This manual describes Calibrator Set, Radiac AN/UDM-2 (fig. 1-1) and covers its installation, operation, and organizational maintenance. It includes instructions for initial service, operation cleaning, and inspection of the equipment.

b. Official nomenclature followed by (*) is used to indicate all models of an equipment referenced in this manual. Thus, Radiac Set AN/PDR-27(*) represents AN/PDR-27J, AN/PDR-27L, AN/PDR-27P, AN/PDR-27Q, AN/PDR-27R and AN/PDR-27S; Radiacmeter IM-9(*)/PD represents IM-9E/PD and IM-9F/PD; Radiacmeter IM-93(*)/UD represents IM-93/UD and IM-93A/UD; Radiacmeter IM-174(*) represents IM-174/PD, IM-174A/PD and IM-174B/PD.

1-2. Index of Technical Publications

Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

1-3. Maintenance Forms, Records, and Reports

a. Reports of Maintenance and Unsatisfactory Equipment. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by TB 750-25-1 Maintenance of Supplies and Equipment: Army Test, Measurement and Diagnostic Equipment (TMDE) Calibration and Repair Support Program.

b. Report of Packaging and Handling Deficiencies. Fill out and forward SF 364 (Report of Discrepancy (ROD)) as prescribed in AR 735-11-2/DLAR 4140.55/NAVMATINST 4355.73/AFR 400-54/MCO 4430.3E.

c. Discrepancy in Shipment Report (DISREP) SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR55-38/NAVSUPINST 4610.33B/AFR 75-18/MCO 4610.19C/DLAR 4500.15.

1-4. Administrative Storage

Administrative storage of AN/UDM-2 shall be in accordance with TB 11-6665-227-12.

1-5. Destruction of Army Electronics Materiel

Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

1-6. Reporting Errors and Recommending Improvements

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) direct to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703. A reply will be furnished direct to you.

1-6.1 Reporting Equipment Improvement Recommendations (EIR)

If your Calibrator Set, Radiac AN/UDM-2 needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703. We'll send you a reply.

1-6.2 Nuclear Regulatory Commission (NRC) Requirements

The US Nuclear Regulatory Commission sets standards/conditions and issues licenses for use of radioactive material in the United States. The AN/UDM-2 comes under the NRC regulations and a license for its use has been issued. Information required by the NRC license/regulations is contained below.

a. Radiation Protection. Users of the AN/UDM-2 should refer to instructions on control, safe handling, storage and transportation contained in TB 11-6665-227-12. Operation and maintenance instructions for the AN/UDM-2 are contained in this manual. These two publications, TB 11-6665-227-12 and TM 11-6665-277-12, satisfy the radiation protection requirements of the NRC regulations (title 10, chapter 1, Code of Federal Regulations, parts 19 and 20).

b. Notice to Employees. Form NRC-3, Notice to Employees, contained in the back of this manual, may be removed for posting wherever the AN/UDM-2 is used and/or stored. The posting requirements are contained on the form.

c. NRC License. The NRC license for the AN/UDM-2 and documents relating to that license are held by the US Army Electronics Command Safety

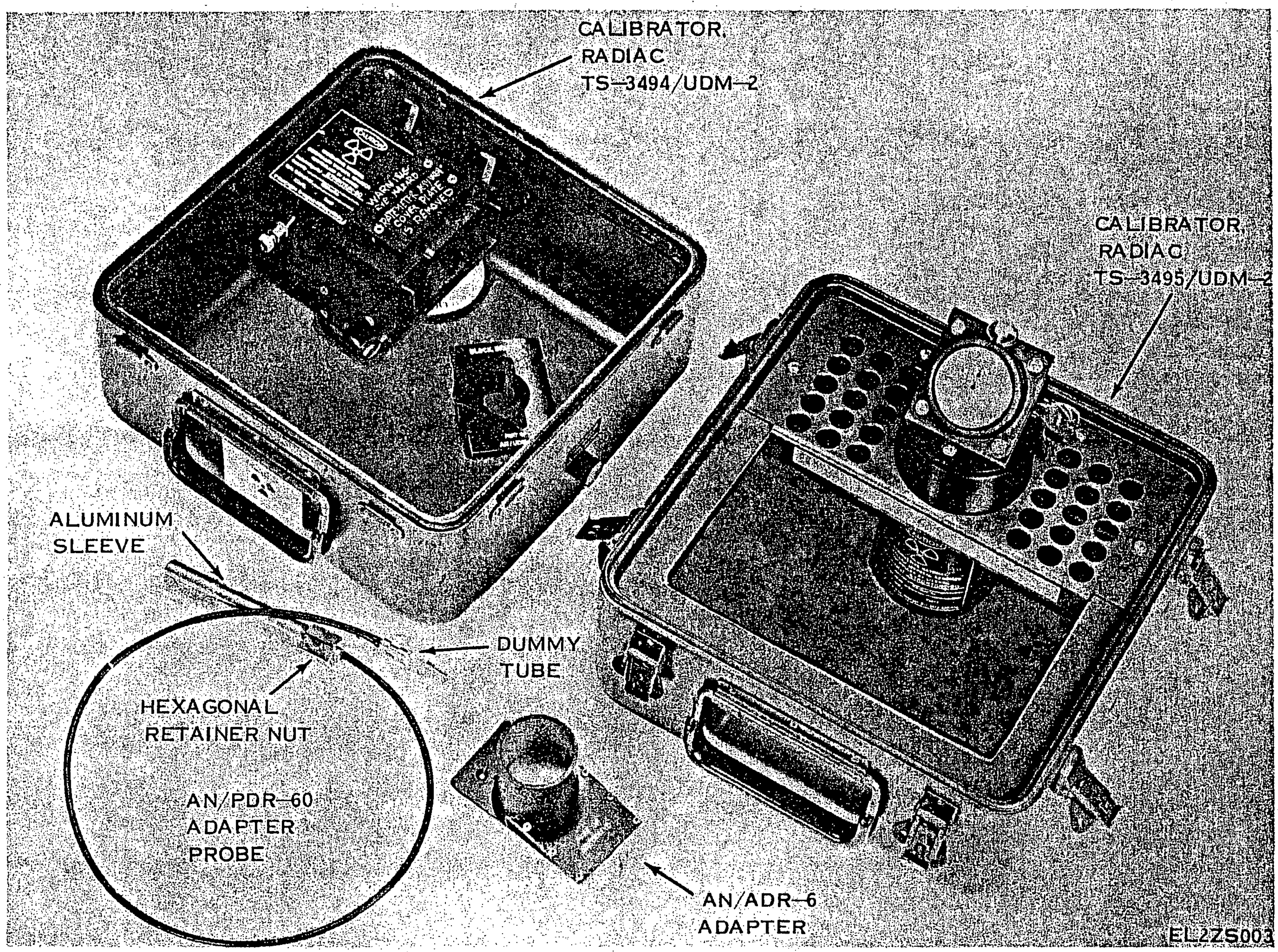

Figure 1-1, Calibrator Set, Radiac AN/UDM-2.

Section II. DESCRIPTION AND DATA

1-7. Purpose and Use
(fig. 1-1)

a. Purpose. Calibrator Set, Radiac AN/UDM-2 (consisting of two main sections (*b* below)) provides the facilities for checking the operational reliability and calibration accuracy of various radiacmeters and radiac sets.

b. Use. Calibrator, Radiac TS-3495/UDM-2 (discharge well assembly) is used to check Radiacmeters IM-93(*)/UD, IM-147/PD, and IM-9E/PD (dosimeters). Calibrator, Radiac TS-3494/UDM-2 (RATEMETER assembly) is used to check Radiacmeter IM-174(*)/PD (radiacmeter), Radiac Set AN/PDR-27(*) (radiac set), Radiac Set AN/PDR-60, and Aerial Radiac System AN/ADR-6.

1-8. Technical Characteristics

Type of radioactive isotope in each source capsule .... Strontium-Yttrium 90 (Sr-Y90).

Decay of isotope .... 27.7 years half life.

Quantity of isotope:

Discharge well assembly... Three encapsulated sources of 25 millicuries each. One encapsulated source of 20 microcuries.

RATEMETER assembly ..... One encapsulated source of 25 millicuries.

Type of radiation emitted...... Beta particles.

Bremmstrahlung produced..... Radiation doserate from sources (4) no greater than 2 millirads per hour at outer case surface.

Maximum range of beta particles in air.............. 30 feet.

Stopwatch indication.......... Two indications: a minute hand for a maximum of 30 minutes and a second hand for a maximum of 60 seconds.

1-9. Items Comprising an Operable Calibrator Set, Radiac AN/UDM-2
(figs. 1-1, 1-2, and 1-3)

The components of the AN/UDM-2 that make up an operable equipment are listed in table 1-1.

Table 1-1. Items Comprising an Operable Calibrator Set, Radiac AN/UDM-2

NSN	Item	Qty	Dimensions (in.) Height	Depth	Width	Wt (lb)
6665-00-610-1487	Calibrator, Radiac TS-3494/UDM-2	1	5	12	12	10⅛
6665-00-610-1496	Calibrator, Radiac TS-3495/UDM-2	1	8¼	12	12	18¼
Not available	Adapter, AN/ADR-6	1	2⅝	3¼	2¼	⅜
Not available	Adapter probe, AN/PDR-60	1	⅝	5	....	¼
Not available	Stopwatch	1	....	....	....	....
Not available	Spacer block	1	3⅝	2½	1¼	½

1-10. Description of Calibrator Set, Radiac AN/UDM-2

Calibrator Set, Radiac AN/UDM-2 (fig. 1-1) consists of two major assemblies, Calibrator, Radiac TS-3495/UDM-2 and Calibrator, Radiac TS-3494/UDM-2, plus the AN/PDR-60 adapter probe, and the AN/ADR-6 adapter. Each major assembly is housed in one-half of a waterproof, aluminum case.

A handle is provided on each assembly to facilitate handling.

a. Calibrator, Radiac TS-3495/UDM-2 (fig. 1-2). The discharge well assembly consists of a discharge well, a dosimeter shelf, and a stopwatch. The dosimeter shelf contains 30 holes (to hold dosimeters to be tested) and the discharge well. The discharge well contains four Sr-Y90 sources (one 20 microcurie source and three 25 millicurie sources). The sources are arranged to radiate into a central cavity. Two fields of radiation are provided within the discharge well; one field is provided by the 20-microcurie source (upper field), the other field is provided by the three 25-millicurie sources (lower field). The upper field will cause Radiacmeter IM-9E/PD to discharge but will have no effect on Radiacmeter IM-93(*)/PD or IM-147/PD. The lower field will cause the IM-93(*)/PD or the IM-147/PD to discharge and will also cause the IM-9E/PD to discharge within two seconds. An access hole in the top of the discharge

Figure 1-2. Calibrator, Radiac TS-3495/UDM-2.

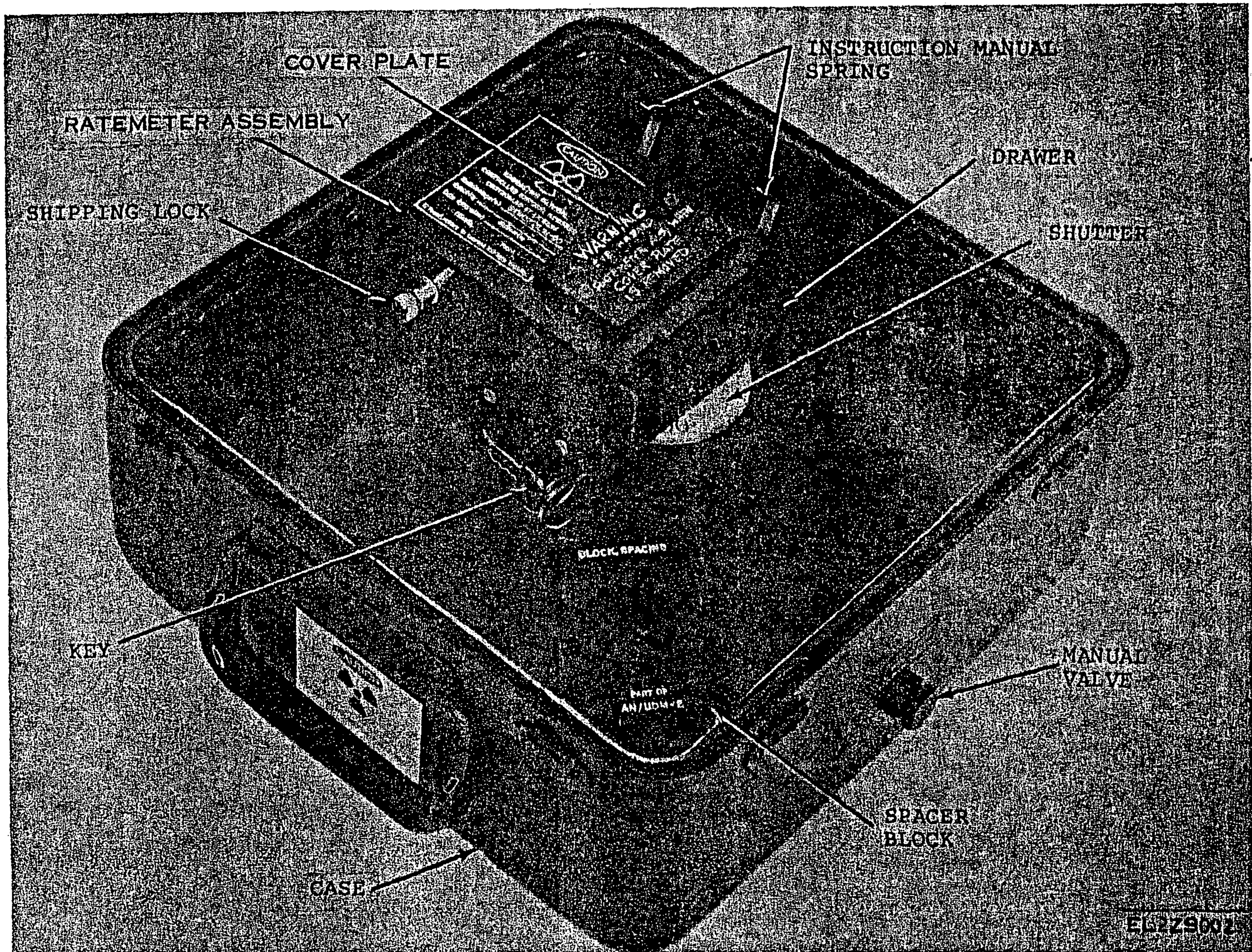

Figure 1-3. Calibrator, Radiac TS-3494/UDM-2.

CHAPTER 2

INSTALLATION

2-1. Unpacking
(fig. 2-1)

a. Packaging Data. When packed for shipment, the AN/UDM-2 is packaged in an inner corrugated carton. The packaged AN/UDM-2 is further protected by being placed in an outer corrugated carton. All joints and seams on both cartons are sealed with waterproof, pressure-sensitive tape. Corrugated fillers are placed around the six sides of the package. The outside dimensions of the complete package are approximately 17 inches long, 16½ inches wide, and 15 inches high. The volume is 2.5 cubic feet and the total weight is approximately 35 pounds.

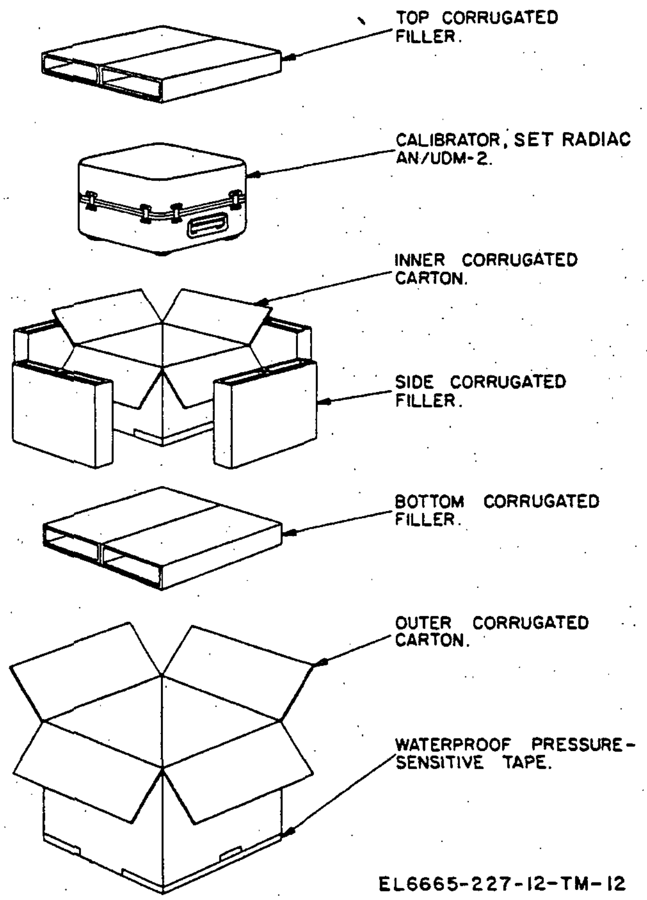

Figure 2-1. Calibrator Set, Radiac AN/UDM-2, typical packaging diagram.

b. Removing Contents. Unpack the equipment as follows:

(1) Remove the waterproof, pressure-sensitive tape from the top of the outer corrugated carton.

(2) Lift open the flaps and remove the top and side corrugated fillers.

(3) Remove the inner corrugated carton containing the AN/UDM-2.

(4) Remove the waterproof, pressure-sensitive tape from the top of the inner carton.

(5) Lift open the flaps and remove the AN/UDM-2.

(6) Turn the manual valve (fig. 1-3) counterclockwise to equalize the pressure.

2-2. Checking Unpacked Equipment

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on DD Form 6 (para 1-3) and notify the Radiological Protection Officer (TB 11-6665-227-12).

b. Release the eight fasteners (fig. 1-1) and separate the two halves of the AN/UDM-2.

c. See that the equipment is complete as listed on the packing slip. If a packing slip is not available, check the equipment against the listing in table 1-1. Report all discrepancies in accordance with TM 38-750. Shortage of a minor assembly or part that does not affect proper functioning of the equipment should not prevent use of the equipment.

d. If the equipment has been used or reconditioned, see whether it has been changed by a modification work order (MWO). If the equipment has been modified, the MWO number will appear near the nomenclature plate. Check to see whether the MWO number (if any) and appropriate notations concerning the modification have been entered in this manual.

NOTE

Current MWO's applicable to this equipment (if any) are listed in DA Pam 310-7.

2-3. Preparation for Use

WARNING

Refer to paragraphs 1-11 and 3-1 for precautions pertaining to this equipment.

a. Release the shipping locks of both assemblies (figs. 1-2 and 1-3) by rotating the captive screws counterclockwise. The shipping locks are spring-loaded, will spring outward when fully unscrewed, and will release the latches.

CHAPTER 3
OPERATING INSTRUCTIONS

3-1. General

WARNING

Radioactive materials are used in this equipment. Read and understand all operational data and procedures in this chapter *before* using the equipment. Become thoroughly familiar with the contents of TB 11-6665-227-12. Never look directly into the access hole (fig. 1-2) when the swivel cover is swung open; do not poke sharp pointed objects into the access hole. This equipment will be used only under the direction of a Radiological Protection Officer.

Table 3-1 lists all controls and indicators used by the operator. In addition, this chapter contains the following:

a. Procedures for checking Radiacmeters IM-9(*)/PD, IM-93(*)/UD, and IM-147/PD (para 3-4).

b. The procedures for calibrating Radiacmeter IM-174(*)/PD (para 3-5).

c. The procedures for calibrating Radiac Set AN/PDR-27(*) (para 3-6).

d. The procedures for calibrating Radiac Set AN/PDR-60 (para 3-7).

e. The procedures for calibrating Aerial Radiac System AN/ADR-6 will be given in paragraph 3-8 when they become available.

3-2. Controls and Indicators

All operators controls and indicators are listed in table 3-1.

Table 3-1. List of Controls and Indicators

Control or indicator	*Function*
Calibrator, Radiac	
TS-3495/IDM-2 (fig. 1-2):	
Stem (stopwatch)	Stops, starts, and winds stopwatch. Positions seconds indicator to zero (60) and minutes indicator to zero (30) for reuse.
Second indicator (stopwatch)	Indicates elapsed time from 0 to 60 seconds.
Minute indicator (stopwatch)	Indicates elapsed time from 0 to 30 minutes.
Key	Unlocks swivel cover allowing it to be swung open.
Swivel cover (spring-loaded)	Allows dosimetor entry into access hole.
Calibrator, Radiac	
TS-3494/UDM-2 (fig. 1-3):	
Shutter	Rotated to select radiation fields of 10 rad/hr or 100 rad/hr.
Key	Unlocks shutter allowing it to be rotated.

NOTE

Substitute corrected times from AN/UDM-2 Calibration Report. DO *NOT* USE THE VALUES IN THE TIME COLUMN shown above.

3-4. Dosimeter Checking

To check an IM-9(*)/PD, perform the procedures in *a*, *b* and *d* below. To check an IM-93(*)/UD or IM-147/PD, perform the procedures in *a*, *c* and *d* below. For information on operation of dosimeters refer to TM 11-6665-214-10.

WARNING

Serious eye injury may result from the use of this equipment. Take the following precautions:

- Always wear safety or prescription glasses while using the AN/UDM-2.
- Never look or peer into the discharge well hole (even when wearing safety glasses).

a Preliminary Procedures.

(1) Examine the dosimeter (and clean it if necessary) to insure that it will not carry mud or dirt into the access hole.

(2) Remove the calibration label from the dosimeter.

(3) Charge the dosimeter to a zero indication TM 11-6665-214-10).

(4) Test dosimeter for leakage (TM 11-6665-214-10).

(5) Insert the key in the discharge well assembly lock and release the lock (fig. 1-2).

(6) Reset and wind the stopwatch, if necessary.

b. Checking the IM-9(*)/PD.

(1) Refer to the calibration report to determine the time (number of minutes or seconds) the dosimeter is to remain in the discharge well.

(2) Open the discharge well swivel cover by sliding it aside.

(3) Insert the dosimeter, charging end down, gently into the discharge well and lower it to the first level (about two-thirds in). The instant the dosimeter touches the first level, start the stopwatch.

NOTE

Do not press the dosimeter down to the lowest level (where its top would be flush with the top surface of the well); the lower level will expose it to a stronger radiation field than is required and will discharge it completely in less than 2 seconds. If the dosimeter is accidently pressed down into the lower level, remove the dosimeter, recharge it, and start over again.

(4) Leave the dosimeter in the discharge well for the required amount of time and then remove it. (During timing, the well cover may be released against the dosimeter.)

(5) Read the dosimeter and then compare its value with table 3-2. If it is within tolerance, the dosimeter is serviceable.

c. Checking the IM-93(*)/UD or IM-147/PD.

(1) Refer to the calibration report to determine the time (number of minutes or seconds) the dosimeter is to remain in the discharge well.

(2) Open the discharge well swivel cover by sliding it aside (fig. 1-2).

(3) Insert the dosimeter, charging end down, gently into the discharge well and lower it to the first level; then push it down to the second level and slide the swivel cover over the dosimeter to hold it in place. Start the stopwatch as soon as the dosimeter reaches the second level.

NOTE

It is convenient and desirable to use a pusher (small piece of wood or flat blade screwdriver) to get the dosimeter under the swivel cover.

(4) Leave the dosimeter in the discharge well for the required amount of time and then remove it.

(5) Read the dosimeter and then compare its value with table 3-2. If it is within tolerance, the dosimeter is serviceable.

d. Final Procedures.

(1) If dosimeter is serviceable, fill out calibration label (see TB 750-25-1), and place it on dosimeter. Use transparent tape to hold calibration label on dosimeter (so that old labels will be easily removed).

(2) If the dosimeter reads outside the limits in table 3-2, it is unserviceable.

(3) Fill out the appropriate maintenance forms (TB 750-25-1), and turn in unserviceable dosimeters for repair.

(4) When all dosimeters are checked, relock the swivel cover in place.

3-5. Calibrating Radiacmeter IM-174(*)/PD

To check Radiameter IM-174/PD, perform the procedures in *a* and *c* below. To check Radiacmeter IM-174A/PD or IM-174B/PD, perform the procedures in *b* and *c* below. For information on how to operate the equipment, refer to TM 11-6665-213-12 (IM-174/PD) or TM -6665-232-12 (IM-174A/PD and IM-174B/PD).

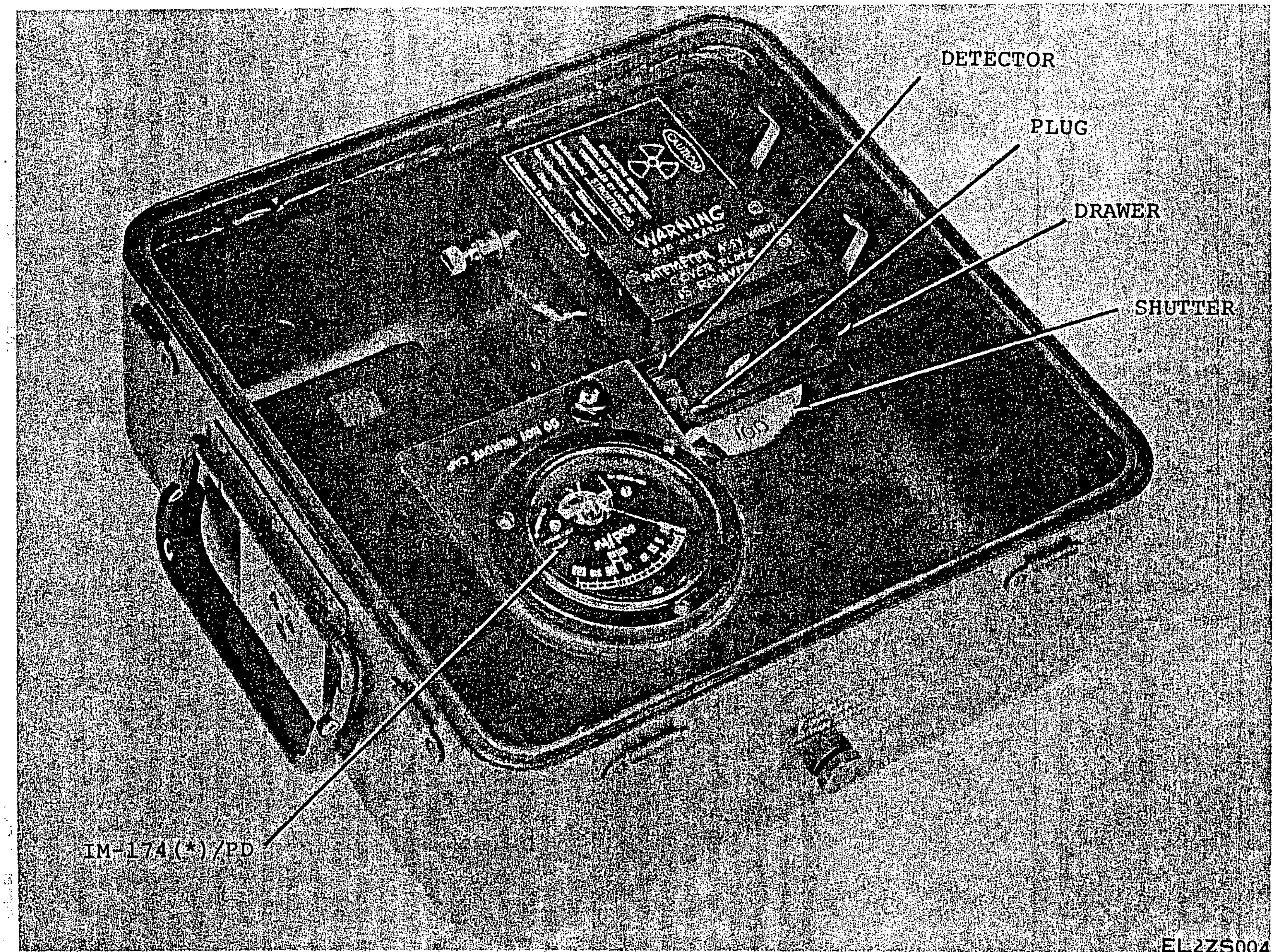

Figure 3-1. Checking Radiacmeter IM-174(*)/PD

DISCHARGE TIMES SHOULD BE ADJUSTED EACH YEAR BY MULTIPLYING ORIGINAL DISCHARGE TIME BY CORRECTION FACTOR FOR YEAR OF OPERATION, WHEN OBTAINING READINGS ON THE IM-93(*)UD, IM-147/PD, AND IM-9E/PD.

TIME CORRECTION TABLE

YEAR	CORR. FACTOR	YEAR	CORR. FACTOR	YEAR	CORR. FACTOR	YEAR	CORR. FACTOR	YEAR	CORR. FACTOR
1975	1.000	1979	1.106	1983	1.221	1987	1.350	1991	1.492
1976	1.025	1980	1.133	1984	1.252	1988	1.384	1992	1.530
1977	1.051	1981	1.162	1985	1.284	1989	1.419	1993	1.569
1978	1.078	1982	1.191	1986	1.317	1990	1.455	1994	1.609

EL2ZS009

Figure 3-1.1 TS-3495/UMD-2 discharge well assembly, correction factor chart.

READINGS OBTAINED ON THE 174(*)/PD, AN/PDR-27, AN/PDR-60, AND AN/ADR-6 SHOULD BE CORRECTED EACH YEAR BY MULTIPLYING THEM BY THE CORRECTION FACTOR FOR THE YEAR OF OPERATION.

TIME CORRECTION TABLE

YEAR	CORR. FACTOR	YEAR	CORR. FACTOR	YEAR	CORR. FACTOR	YEAR	CORR. FACTOR
1975	1.000	1980	0.883	1985	0.778	1990	0.687
1976	0.976	1981	0.861	1986	0.759	1991	0.670
1977	0.951	1982	0.840	1987	0.741	1992	0.654
1978	0.928	1983	0.819	1988	0.723	1993	0.637
1979	0.904	1984	0.789	1989	0.705	1994	0.622

EL2ZS010

Figure 3-1.2 TS 3494/UMD ratemeter assembly, correction factor chart

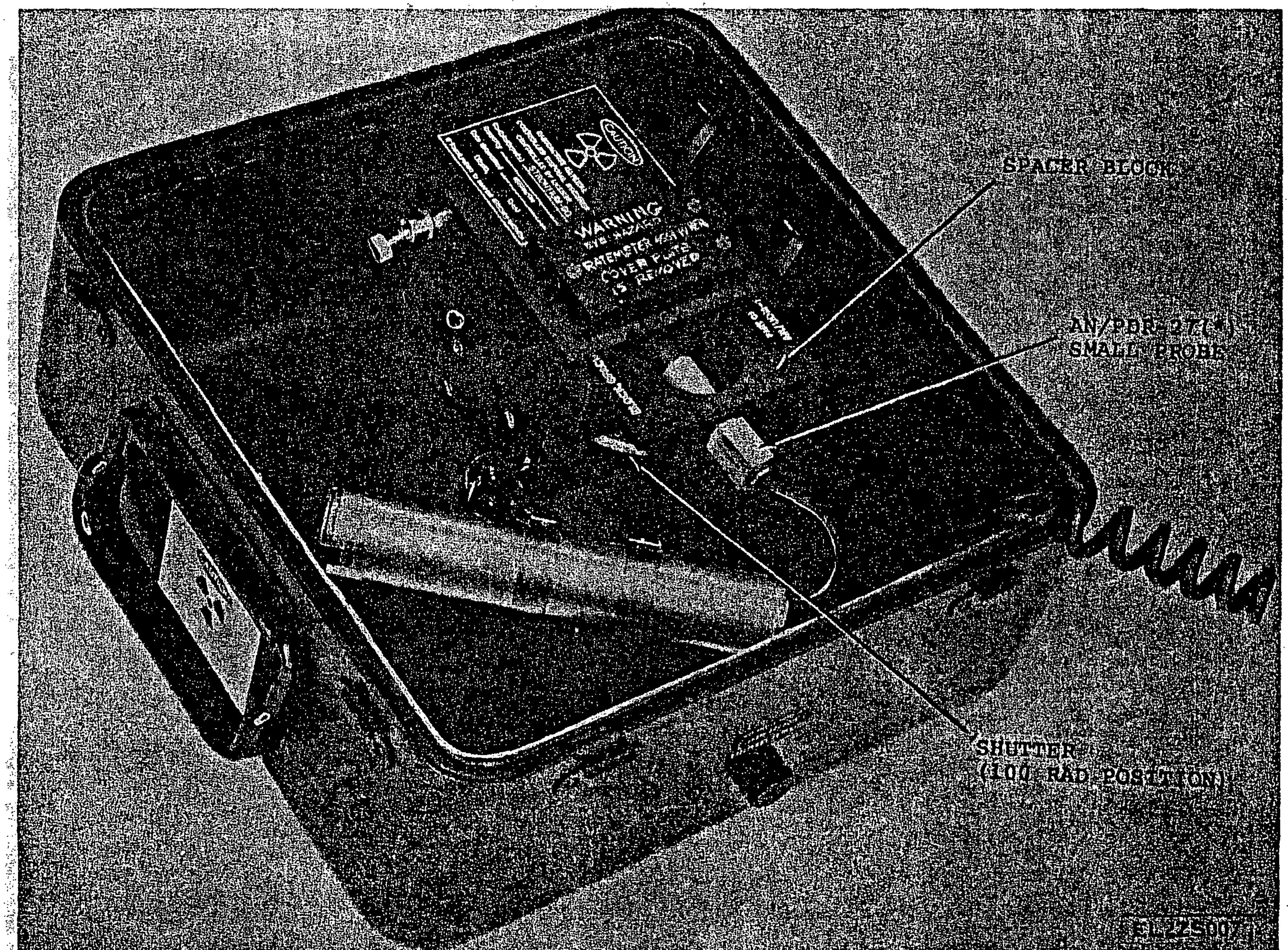

Figure 3-3. Checking AN/PDR-27(*) on 50 mrad/hr range.

3-6. Calibrating Radiac Set AN/PDR-27(*)

In some cases, while reading the radiacmeter, the meter needle will not come to rest on a fixed value. The needle will move up and down scale (vary) in a random manner. This is to do with the nature of the radiation field being measured, which is random in itself. This random needle movement is more noticeable on the lower reading scales. When observing the meter under conditions where this needle variation is present, watch the meter needle for a minimum period of 1 minute and note the highest and lowest values obtained during that period. The average of the highest and lowest values (the center point) is the value which should be used to be compared to the values given in the calibration report (para 3-3). Check the radiac set as follows:

CAUTION

Be careful of the short piece of cable that joins the two probes, it is easily damaged and difficult to repair.

a. On the AN/PDR-27(*), remove the two screws on the clamps holding the two probes together and separate the two probes. Set the range switch to the 500 mr/hr position. Allow a short warm up time. Refer to applicable manual listed in appendix A.

b. On the ratemeter assembly (fig. 1-3), release the shipping lock, pull out the drawer and place the spacer block in the drawer.

c. Close the drawer, insert the smaller probe into the hole in the center of the drawer (fig. 3-2) and insert the key and unlock the shutter. Set the shutter to the 100 position.

d. Twist or turn the small probe in the drawer hole to obtain maximum and minimum meter readings. Record the center value of the two meter readings. If both readings are inside of calibration report limits proceed to *f* below, if not, proceed to *e* below.

e. Remove the calibration control cover and adjust the 500 mr/hr calibration control until the reading is in center of the calibration report limits (nominal reading).

f. Rotate the ratemeter assembly shutter to the closed position, remove the small probe and open the drawer.

g. Remove the spacer block from inside the drawer. Install the spacer block on the drawer handle and close the drawer (fig. 3-3). Install the small probe into the spacer block.

h. Rotate the shutter of the ratemeter assembly to the 100 position.

i. On the An/PDR-27(*), set the range switch to the 50 mr/hr position.

j. Twist or turn the small probe in the drawer hole to achieve maximum and minimum meter readings. Record the center value of the two meter readings. If both readings are inside of calibration report limits proceed to *l* below, if not, proceed to *k* below.

k. Adjust the 50 mr/hr calibration control until the reading is in the center of the calibration report limits (nominal reading).

l. On the ratemeter assembly, rotate the shutter to the off position. Remove the small probe and then the spacer block from the drawer. Position the large probe to lie across the semicircular cutouts on the edges of the drawer with the drawer opened to its fullest extremity (fig. 3-4).

m. Leave the ratemeter assembly shutter closed. On the AN/PDR-27(*), set the range switch to the 5 mr/hr position. Adjust the 5 mr/hr calibration control, if center value is outside of calibration report limits, until the average meter reading is in the center of the calibration report limits. Otherwise, make no adjustment.

n. Position the large probe on the upper edge of the handle side of the TS-3494/UDM-2 case (fig. 3-5).

o. Leave the ratemeter assembly shutter closed. On the AN/PDR-27(*), set the range switch to 0.5 mr/hr position. Adjust the 0.5 mr/hr calibration control, if center value is outside of calibration report limits, until the average meter reading is in the center of the calibration report limits. Otherwise, make no adjustment.

NOTE

If any of the meter ranges cannot be adjusted to center of the calibration report limits, adjust them to within those limits.

p. Deenergize the AN/PDR-27(*), fasten the two probes together and replace calibration control cover, if necessary.

q. Lock the ratemeter lock and set the shipping lock when no further calibrations are required.

r. Fill out the calibration label (see TB 750-25-1) for radiac sets that are serviceable. For unserviceable radiac sets fill out the appropriate maintenance forms (TB 750-25-1) and repair or turn in to organization with repair capability.

3-7. Calibrating Radiac Set AN/PDR-60

NOTE

Refer to paragraph 3-6 concerning how to make average readings when meter needle varies. This procedure also applies to the AN/PDR-60.

CHAPTER 4

MAINTENANCE INSTRUCTIONS

4-1. Scope of Maintenance

The maintenance duties assigned to the operator and organizational repairman of the AN/UDM-2 are listed below together with a reference to the paragraphs covering the specific maintenance function. The AN/UDM-2, when the two halves are sealed, is waterproof. The swivel cover on the discharge well assembly restricts entry of foreign matter to the access hole, but is not waterproof. This cover may be removed to clean the pivot pin assembly when required.

WARNING

NEVER disassemble the cavities of the discharge well assembly or the ratemeter assembly. This procedure is dangerous and must be performed only by higher category maintenance personnel with adequate facilities meeting all requirements of TB 11-6665-227-12.

a. Operator preventive maintenance checks and services (table 4-1).

b. Organizational preventive maintenance checks and services (table 4-2).

c. Cleaning and touchup painting (para 4-5).

d. Troubleshooting (para 4-6).

e. Wipe test (TB 11-6665-227-12).

4-2. Tools and Equipment Required

No special tools or test equipment other than those listed in appendix C are required. The materials required for maintenance are listed below.

a. Trichlorethane (NSN 6810-00-664-0273).

b. Cleaning cloth (NSN 8305-00-245-4509).

c. Cotton swabs (NSN 6515-00-303-8250).

d. Sandpaper (No. 000).

e. Petroleum jelly or light machine oil.

4-3. Preventive Maintenance

To insure that the AN/UDM-2 is always ready for operation, it must be inspected systemactically so that defects may be discovered and corrected before they result in serious damage or failure. The necessary preventive maintenance checks and services to be performed are listed and described in tables 4-1, 4-2, and 4-3. The item numbers in each table indicate the sequence of and the minimum inspection required. Defects discovered during operation of the unit will be noted (TB 11-6665-227-12) for future correction to be made as soon as operation has ceased. Stop operation immediately if a deficiency is noted during operation which would damage the equipment or harm personnel. Record all deficiencies together with the corrective action taken in accordance with the requirements of TB 11-6665-227-12 and TM 38-570.

4-4. Preventive Maintenance Checks and Services (PMCS)

a. General. Before performing PMCS, note the following:

(1) *Before you operate.* Always keep in mind the CAUTIONS and WARNINGS. Perform your before (B) PMCS.

(2) *While you operate.* Always keep in mind the CAUTIONS and WARNINGS. Perform your during (D) PMCS.

(3) *After you operate.* Be sure to perform your after (A) PMCS.

b. Item Number Column. Use the number in this column for this *TM number* column on DA Form 2404, Equipment Inspection and Maintenance Worksheet, when recording results of PMCS.

c. Interval Column. A dot (•) in the column indicates when the check is to be made.

d. For Readiness Reporting, Equipment Is Not Ready/Available If: Column. This column contains the standards which will cause the equipment to be reported not ready or not available because it cannot perform its primary mission.

Provide thorough ventilation whenever used. DO NOT use near an open flame. Trichloroethane is not flammable, but exposure of the fumes to an open flame converts the fumes to highly toxic, dangerous gases.

(2) Remove fungus and ground-in dirt with a cloth dampened (not wet) with cleaning compound; dry thoroughly.

CAUTION

Do not press on the face of the stopwatch; the stopwatch may become damaged.

(3) Clean the face of the stopwatch with a soft clean cloth. If the dirt is difficult to remove, dampen (do not wet) the cloth with water; if necessary, use a mild soap.

(4) If the pivot of the swivel cover becomes stiff or binds, clean the pivot and relubricate the pivot with a very small amount of light lubricating oil or petroleum jelly.

b. Touchup Painting.

(1) Remove rust and corrosion from metal surfaces by lightly sanding them with fine sandpaper.

(2) Brush two thin coats of paint on the bare metal to protect it from further corrosion.

(3) Refer to the applicable cleaning and refinishing practices specified in SB 11-573 and TB 746-10.

4-6. Troubleshooting

Troubleshooting of this equipment is based upon the checks contained in the preventive maintenance checks and services tables. To troubleshoot the equipment, perform all functions starting with sequence number 3 in the daily preventive maintenance checks and services (table 4-1) and proceed through the remaining sequence numbers (tables 4-1 and 4-2) until an abnormal condition or result is observed. Perform the checks and corrective measures indicated in the troubleshooting procedures (table 4-3). If the corrective measures do not result in correction of the trouble, higher category maintenance is required.

Table 4-3. Troubleshooting AN/UDM-2

Item No.	Trouble symptom	Probable trouble	Corrective measures
1	Swivel cover binds	Dirty or corroded pivot bearing.	Disassemble swivel cover only. Clean and relubricate pivot bearing (para 4-5a).
2	Stopwatch nonoperative	Run-down or defective	Rewind and recheck stopwatch.

APPENDIX A
REFERENCES

AR 40-14	Control and Recording Procedures: Occupational Exposure to Ionizing Radiation.
AR 40-27	Personnel Radiation Exposures.
AR 55-55	Transportation of Radioactive and Fissile Materials Other Than Weapons.
AR 700-52	Licensing and Control of Sources of Ionizing Radiation.
AR 700-64	Radioactive Commodities in the DOD Supply Systems.
AR 755-15	Disposal of Unwanted Radioactive Material.
DA Pam 310-4	Index of Technical Publications.
SB 11-573	Painting and Preservation of Supplies Available for Field Use for Electronics Command Equipment.
SB 38-100	Preservation, Packaging, Packing and Marking Materials, Supplies, and Equipment Used by the Army.
TB 11-6665-227-12	Safe Handling, Storage, and Transportation of Calibrator Set, Radiac AN/UDM-2 (NSN 6625-00-179-9037).
TB 43-0118	Field Instructions for Painting and Preserving Electronics Command Equipment Including Camouflage Pattern Painting of Electrical Equipment Shelters.
TB 43-0122	Instructions for Safe Handling and Identification of the US Army Communications and Electronics Materiel Readiness Command Managed Radioactive Items in the Army Supply System.
TB 750-25-1	Maintenance of Supplies and Equipment: Army Test, Measurement, and Diagnostic Equipment (TMDE) Calibration and Repair Support Program.
TM 11-6665-209-15	Operator's, Organizational, DS, GS, and Depot Maintenance Manual (Including Repair Parts and Special Tools List): Radiac Sets AN/PDR-27J, AN/PDR-27L, and AN/PDR-27Q.
TM 11-6665-213-12	Operator and Organizational Maintenance Manual (Including Repair Parts and Special Tool Lists): Radiacmeter IM-174/PD (NSN 6665-00-856-8037).
TM 11-6665-214-10	Operator's Manual: Radiacmeters IM-9E/PD (NSN 6625-00-243-8199) IM-93/UD, IM-93A/UD (6625-00-752-7759) and IM-147/PD (6625-00-542-0729).
TM 11-6665-221-15	Operator's, Organizational, Direct Support, General Support and Depot Maintenance Manual: Radiac Set AN/PDR-60 (NSN 6665-00-965-1516).
TM 11-6665-224-15	Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual: Radiac Set AN/PDR-27P (NSN 6665-00-975-7222).
TM 11-6665-230-15	Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual (Including Repair Parts and Special Tool Lists): Radiac Set AN/PDR-27R (NSN 6665-00-961-0846).
TM 11-6665-232-12	Operator's, and Organizational Maintenance Manual: Radiacmeter IM-174A/PD (NSN 6665-00-999-5145) and IM-174B/PD (6665-00-056-7422).
TM 38-750	The Army Maintenance Management System (TAMMS).

APPENDIX C

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

C-1. General

This appendix provides a summary of the maintenance operations for the AN/UDM-2. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

C-2. Maintenance Function

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i. e., to clean, preserve, drain, paint, or to replenish fuel/lubricants/hydraulic fluids or compressed air supplies.

d. Adjust. Maintain within prescribed limits by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Align. To adjust specified variable elements of an item to about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement. Consists of the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment/system.

h. Replace. The act of substituting a serviceable like-type part, subassembly, model (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module/component/assembly, end item or system.

j. Overhaul. That periodic maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (e.g., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like-new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like-new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipment/components.

C-3. Column Entries

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies and modules with the next higher assembly.

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "worktime" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance

SECTION II MAINTENANCE ALLOCATION CHART FOR

CALIBRATOR SET, RADIAC AN/UDM-2

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIPMENT
00	CALIBRATOR SET, RADIAC AN/UDM-2	Inspect	0.08					
		Service[1]	0.14	0.25				1
		Calibrate					3.0	2 thru 7
		Replace		0.4				
		Repair					3.0	2 thru 7
		Overhaul					6.0	2 thru 7
01	CALIBRATOR, RADIAC TS-3494/UDM-2	Inspect	0.02	0.06				
		Service	0.06	0.08				1
		Calibrate					1.5	2,5,6,7
		Replace		0.2				
		Repair					1.5	2,5,6,7
		Overhaul					3.0	2,5,6,7
02	CALIBRATOR, RADIAC TS-3495/UDM-2	Inspect	0.01	0.04				
		Service	0.05	0.07				1
		Calibrate					1.5	2,3,4,6
		Replace		0.2				
		Repair					1.5	2,3,4,6
		Overhaul					3.0	2,3,4,6

(1) Perform wipe test (TB 11-6665-227-12) at organizational level.

GLOSSARY

Beta particle—A charged particle emitted from the nucleus of an atom and having a mass and charge equal to that of an electron.

Beta window—A small area in the wall of an ionizaton chamber which is thin enough to permit the entrance of a substantial fraction of beta particles.

Bremsstrahlung—Secondary electromagnetic radiation similar to X-ray produced by deceleration of charged particles passing through matter.

Curie—That quantity of a radioactive nucleus disintegrating at the rate of $3{,}700 \times 10^{10}$ atoms per second.

Decay, radioactive—The natural process whereby the activity of a radioactive source decreases with respect to time.

Dose rate—The radiation dose delivered per unit time. The common unit of measure for X- or gamma radiation is rad per hour (r/hr) or millirad per hour (mr/hr).

Dosimeter—An instrument used to detect and measure an accumulated dose of radiation; normally it is in a pencil size self-reading ionization chamber used for personnel monitoring.

Half-life (radioactive)—The time required for the activity of a given radioactive species to decrease to half of its initial value due to radioactive decay.

Ionization chamber—An instrument consisting essentially of a closed chamber or tube of air or gas with two electrodes used for detecting and measuring nuclear radiation.

Isotope—A form of the same element having identical chemical properties but differing in its atomic mass and nuclear properties.

Millicure—One one-thousandth (1/1,000) part of a curie. See curie.

Millirad (mr)—One one-thousandth part of an rad. See Rad.

Nuclear radiation—The particulate and electromagnetic radiation emitted from atomic nuclei in various nuclear processes. The important nuclear radiations, from weapons standpoint, are alpha and beta particles, gamma radiation, and neutrons.

Radioactive standard—A sample of radioactive material in which the number and type of radioactivity at a definite time is known and therefore may be used to calibrate radiation measuring instruments.

Rad (r)—An exposure does of X- or gamma radiation such that the associated corpuscular emission per 0.001293 gram of air produces, in air, an ion carrying 1 electrostatic unit of electricity of either sign (negative or positive).

Strontiurm-90 (Sr 90)—The radioactive isotope of Strontium with 90 atomic mass units.

Yttrium-90 (Y 90)—The decay product of Strontium-90 with 90 atomic mass units.

By Order of the Secretary of the Army:

FRED C. WEYAND
General, United States Army,
Chief of Staff.

Official:
VERNE L. BOWERS
Major General, United States Army,
The Adjutant General.

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UNITED STATES NUCLEAR REGULATORY COMMISSION
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NOTICE TO EMPLOYEES

STANDARDS FOR PROTECTION AGAINST RADIATION (PART 20); NOTICES, INSTRUCTIONS AND REPORTS TO WORKERS; INSPECTIONS (PART 19); EMPLOYEE PROTECTION

The *Nuclear Regulatory Commission* (NRC) in its Rules and Regulations: Part 20 has established standards for your protection against radiation hazards from radioactive material under license issued by the NRC; Part 19 has established certain provisions for the options of workers engaged in NRC licensed activities; Parts 30, 40, 50, and other parts containing provisions related to employee protection.

POSTING REQUIREMENTS Copies of this notice must be posted in a sufficient number of places in every establishment where activities licensed by the NRC are conducted, to permit employees to observe a copy on the way to or from their place of employment.

YOUR EMPLOYER'S RESPONSIBILITY

Your employer is required to—

1. *Apply these NRC regulations* and the conditions of his NRC license to all work under the license.
2. Post or otherwise make available to you a copy of the NRC regulations, licenses, and operating procedures which apply to work you are engaged in, and explain their provisions to you.
3. Post Notices of Violation involving radiological working conditions, proposed imposition of civil penalties and orders.
4. *Refrain from discriminatory* acts against employees who provide *information to NRC.*

YOUR RESPONSIBILITY AS A WORKER

You should familiarize yourself with those provisions of the NRC regulations, and the operating procedures which apply to the work you are engaged in. You should observe their provisions for your own protection and protection of your co-workers.

WHAT IS COVERED BY THESE NRC REGULATIONS

1. Limits on exposure to radiation and radioactive material in restricted and unrestricted areas;
2. Measures to be taken after accidental exposure;
3. Personnel monitoring, surveys and equipment;
4. Caution signs, labels, and safety interlock equipment;
5. *Exposure records and reports;*
6. Options for workers regarding *NRC inspections;*
7. Identifies "protected activities" *that employees may engage in;*
8. Prohibits discrimination against employees who engage in these protected activities;
9. Identifies the Department of Labor as a source of relief in the event of discrimination; and
10. Related matters.

REPORTS ON YOUR RADIATION EXPOSURE HISTORY

1. The NRC regulations require that *your employer* give you a written report if you receive an exposure in excess of any applicable limit as set forth in the regulations or in the license. The basic limits for exposure to employees are set forth in Section 20.101, 20.103, and 20.104 of the Part 20 regulations. These Sections specify limits on exposure to radiation and exposure to concentrations of radioactive material in air.
2. If you work where personnel monitoring *is required pursuant* to Section 20.202;
   (a) your employer *must give you a* written report of your radiation exposures *upon the termination* of your employment, if you request it, and
   (b) your employer must advise you annually of your exposure to radiation, if you request it.

INSPECTIONS

All activities under the license are subject to inspection by representatives of the NRC. In addition, any worker or representative of workers who believes that there is a violation of the Atomic Energy Act of 1954, the regulations issued thereunder, or the terms of the employer's license with regard to radiological working conditions in which the worker is engaged, may request an inspection by sending a notice of the alleged violation to the appropriate United States Nuclear Regulatory Commission Regional Office (shown on map below). The request must set forth the specific grounds for the notice, and must be signed by the worker or the representative of the workers. *During inspections,* NRC inspectors may confer privately with workers, *and any worker may bring to* the attention of the inspectors any past *or present condition* which he believes contributed to or caused any violation as described above.

EMPLOYEE PROTECTION

If an employee believes that discrimination has occurred *due to engaging* in the "protected activities" said employees may, within 30 days of the discriminatory act, file a complaint with the Department of Labor, Employment Standards Administration, Wage and Hour Division. The Department of Labor shall conduct an investigation and shall, where discrimination has occurred, *issue an order providing* relief to the employee if relief is not *provided by other means of settlement.*

PROTECTION OF INSPECTORS

The amended Atomic Energy Act, section 235, provides criminal penalties against any individual who kills, forcibly assaults, resists, opposes, impedes, intimidates or interferes with any person who performs any inspections which (1) are related to any activity or facility licensed by the Commission, and (2) are carried out to satisfy requirements under the Atomic Energy Act or under any other Federal *law covering the safety of licensed* facilities or the safety of radioactive materials. *The acts described above* are criminal not only if taken against inspection *personnel who are engaged* in the performance of such inspection duties, but also if taken against inspection personnel on account of such duties.

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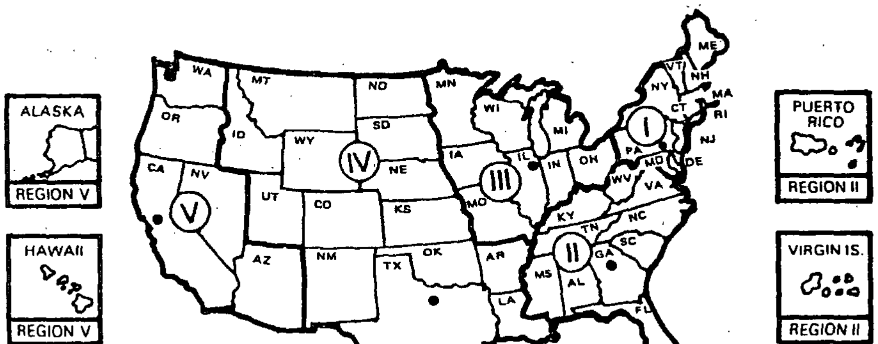

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NRC FORM 3
(6-82)

UNITED STATES NUCLEAR REGULATORY COMMISSION
Washington, D.C. 20555

NOTICE TO EMPLOYEES

STANDARDS FOR PROTECTION AGAINST RADIATION (PART 20); NOTICES, INSTRUCTIONS AND REPORTS TO WORKERS; INSPECTIONS (PART 19); EMPLOYEE PROTECTION

The Nuclear Regulatory Commission (NRC) in its Rules and Regulations: Part 20 has established standards for your protection against radiation hazards from radioactive material under license issued by the NRC; Part 19 has established certain provisions for the options of workers engaged in NRC licensed activities; Parts 30, 40, 50, and other parts containing provisions related to employee protection.

POSTING REQUIREMENTS Copies of this notice must be posted in a sufficient number of places in every establishment where activities licensed by the NRC are conducted, to permit employees to observe a copy on the way to or from their place of employment.

YOUR EMPLOYER'S RESPONSIBILITY

Your employer is required to—

1. Apply these NRC regulations and the conditions of his NRC license to all work under the license.
2. Post or otherwise make available to you a copy of the NRC regulations, licenses, and operating procedures which apply to work you are engaged in, and explain their provisions to you.
3. Post Notices of Violation involving radiological working conditions, proposed imposition of civil penalties and orders.
4. Refrain from discriminatory acts against employees who provide information to NRC.

YOUR RESPONSIBILITY AS A WORKER

You should familiarize yourself with those provisions of the NRC regulations, and the operating procedures which apply to the work you are engaged in. You should observe their provisions for your own protection and protection of your co-workers.

WHAT IS COVERED BY THESE NRC REGULATIONS

1. Limits on exposure to radiation and radioactive material in restricted and unrestricted areas;
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6. Options for workers regarding NRC inspections;
7. Identifies "protected activities" that employees may engage in;
8. Prohibits discrimination against employees who engage in these protected activities;
9. Identifies the Department of Labor as a source of relief in the event of discrimination; and
10. Related matters.

REPORTS ON YOUR RADIATION EXPOSURE HISTORY

1. The NRC regulations require that your employer give you a written report if you receive an exposure in excess of any applicable limit as set forth in the regulations or in the license. The basic limits for exposure to employees are set forth in Section 20.101, 20.103, and 20.104 of the Part 20 regulations. These Sections specify limits on exposure to radiation and exposure to concentrations of radioactive material in air.
2. If you work where personnel monitoring is required pursuant to Section 20.202;
   (a) your employer must give you a written report of your radiation exposures upon the termination of your employment, if you request it, and
   (b) your employer must advise you annually of your exposure to radiation, if you request it.

INSPECTIONS

All activities under the license are subject to inspection by representatives of the NRC. In addition, any worker or representative of workers who believes that there is a violation of the Atomic Energy Act of 1954, the regulations issued thereunder, or the terms of the employer's license with regard to radiological working conditions in which the worker is engaged, may request an inspection by sending a notice of the alleged violation to the appropriate United States Nuclear Regulatory Commission Regional Office (shown on map below). The request must set forth the specific grounds for the notice, and must be signed by the worker or the representative of the workers. During inspections, NRC inspectors may confer privately with workers, and any worker may bring to the attention of the inspectors any past or present condition which he believes contributed to or caused any violation as described above.

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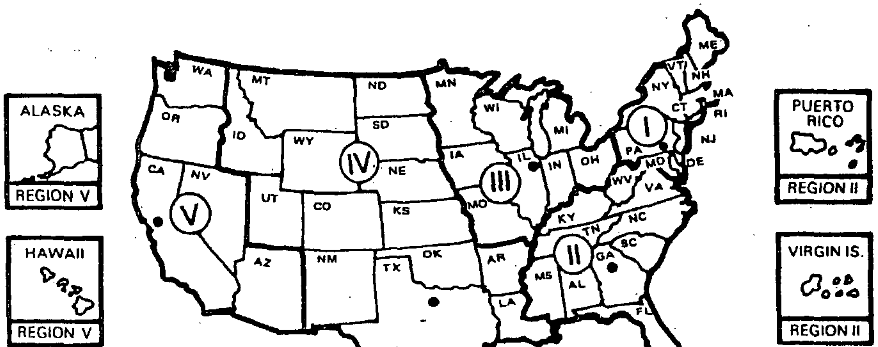

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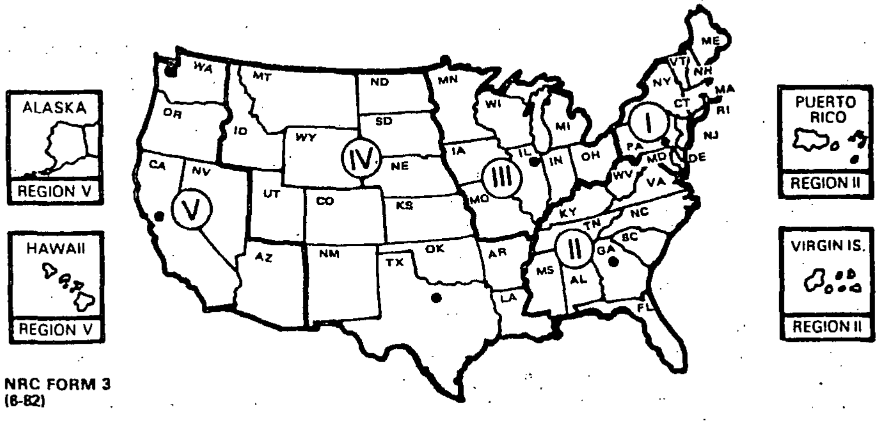

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NRC FORM 3
(6-82)

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

SAFE HANDLING, STORAGE, AND TRANSPORTATION OF CALIBRATOR SET, RADIAC AN/UDM-2 NSN 6665-00-179-9037

Headquarters, Department of the Army, Washington, DC
9 January 1978

TB 11-6665-227-12, 2 July 1975, is changed as follows:

AMSEL is changed to DRSEL in the following places:

Page 3. Paragraph 3.
Paragraph 5d.
Paragraph 8*a*(2) and (3).
Paragraph 8*b*(1).
Page 4. Paragraph 8*b*(4), (6), and (7).
Paragraph 9*a*. in NOTES 2.
Page 5. Paragraph 11*q*.
Paragraph 12.
Page 6. Paragraph 14*b*(3).

Page 2. Safety Precautions. Change the last two sentences to read: Calibrator Set, Radiac AN/UDM-2 is issued throughout the Army under Nuclear Regulatory Commission (NRC) license held by the US Army Electronics Command Safety Office at Fort Monmouth, New Jersey. Information about the NRC license may be requested by letter to: Commander, US Army Electronics Command, ATTN: DRSEL-SF-H Fort Monmouth, New Jersey 07703. The Safety Office may also be contacted by telephone on AUTOVON 992-3493.

Page 5. Paragraph 10*d*, line 2: Change "daily," to "monthly."

Line 3: Delete "when in use, for possible contamination."

Paragraph a10*f* is added after paragraph 10*e*:

f. Form NRC-3, Notice to Employees, contained in this bulletin, may be removed for posting wherever the AN/UDM-2 is used and/or stored. The posting requirements are contained on the form.

By Order of the Secretary of the Army:

BERNARD W. ROGERS
General, United States Army
Chief of Staff

Official:

J. C. PENNINGTON
Brigadier General, United States Army
The Adjutant General

To be distributed in accordance with DA Form 12-50, Operator maintenance requirements for AN/UDM-2.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1977-765-096/436

Encl 8

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UNITED STATES NUCLEAR REGULATORY COMMISSION
Washington, D.C. 20555

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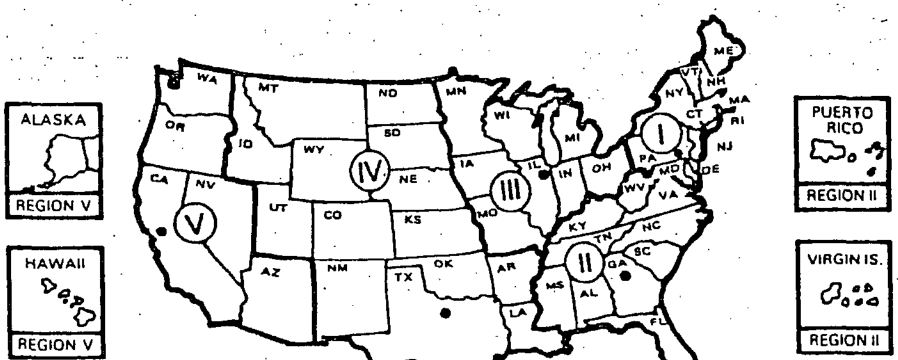

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NRC FORM 3
(6-82)

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

SAFE HANDLING, STORAGE, AND TRANSPORTATION OF CALIBRATOR SET, RADIAC AN/UDM-2 NSN 6665-00-179-9037

Headquarters, Department of the Army, Washington, DC
2 July 1975

1. Purpose. This bulletin prescribes the minimum safety precautions that are essential during the handling, storage, issue, transportation, accountability, and use of Calibrator Set, Radiac AN/UDM-2.

NOTE

Official nomenclature followed by (*) is used to indicate all models of the equipment covered in this bulletin. Thus, Radiac Set AN/PDR-27(*) represents Radiac Sets AN/PDR-27J, AN/PDR-27L, AN/PDR-27P, AN/PDR-27Q, and AN/PDR-27R and later models.

2. Indexes of Publications. *a. DA Pam 310-4.* Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

3. Reporting of Errors. Reporting of errors, omissions, and recommendations for improving this bulletin by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Change to Publications and Blank Forms) and forwarded direct to Commander, US Army Electronics Command. ATTN: AMSEL-MA-Q, Fort Monmouth, New Jersey 07703.

4. Description. Calibrator Set, Radiac AN/UDM-2 contains a total of 100.020 millicuries of Strontium 90 (Sr^{90}) and consists of Calibrator, Radiac TS-3494/UDM-2 and Calibrator, Radiac TS-3495/UDM-2. Calibrator, Radiac TS-3494/UDM-2 contains 25 millicuries of Sr^{90} and is used to calibrate Radiacmeters IM-174/PD and IM-174A/PD, Radiac Set AN/PDR-27(*), Radiac Set AN/PDR-60, and Aerial Radiac System AN/ADR-6. Calibrator, Radiac TS-3495/UDM-2 contains three 25 millicurie Sr^{90} and one 20 microcurie SR^{90} sources. It is used for serviceability testing of Radiacmeters IM-9E/PD, IM-147/PD and IM-93(*)/UD.

5. Calibrator Set, Radiac AN/UDM-2, General. *a.* Calibrator Set, Radiac AN/UDM-2 is marked in accordance with Code of Federal Regulations Title 10, Part 20 and MIL-STD-1458.

b. Calibrator Set, Radiac AN/UDM-2 is nonexpendable.

c. Calibrator Set, Radiac AN/UDM-2 may be transferred only to another qualified radiological protection officer (RPO) (paragraph 9).

d. Calibrator Set, Radiac AN/UDM-2 will be disposed of only on instructions of Commander, US Army Electronics Command, ATTN: AMSEL-MM-S-CS-TA-1, Fort Monmouth, New Jersey 07703.

e. Wipe tests must be performed at intervals not to exceed 6 months on all Calibrator Sets, Radiac AN/UDM-2, except those sets in combat areas.

f. All correspondence relating to certification of radiological protection officers or control of Calibrator Set, Radiac AN/UDM-2 should be addressed Commander, US Army Electronics Command, ATTN: AMSEL-SF, Fort Monmouth, New Jersey 07703 through the radioactive material control point.

6. Inherent Danger. *a.* The radioactive Strontium-Yttrium 90 sources in Calibrator Set, Radiac AN/UDM-2 emit beta radiation. Interaction of this beta radiation with the radiac calibrator set housing results in the emission of secondary X-rays (Bremsstrahlung). Excessive absorption of ionizing radiation by the human body may be injurious (AR 40-14). The radioactive sources *will not* be removed from the radiac calibrator set, except by qualified personnel of nucleonics facilities established at the Lexington-Blue Grass and Sacramento Army Depots, CONUS, or other installations having an Atomic Energy Commission (AEC) License authorizing maintenance of Calibrator Set, Radiac AN/UDM-2.

b. Familiarity with these criteria and strict observance of the health protection procedures contained in the following paragraphs are essential.

7. Applicability. The provisions of this technical bulletin apply to all persons and activities who have the responsibility for the handling, transportation, storage, and use of any issued Calibrator Set, Radiac AN/UDM-2. This technical bulletin does not apply to the Army stocks of radiac calibrator sets stored in depots.

8. Responsibility. *a. Responsibilities of Major Commands.*

(1) Establishing at least one Radioactive Material Control Point (RMCP) (AR 725-1).

(2) Appointing a Radiological Control Officer (RCO) for each RMCP and forwarding two copies of appointee's orders and qualifications to Commander, US Army Electronics Command, ATTN: AMSEL-SF, Fort Monmouth, New Jersey 07703.

(3) Developing implementation procedures to insure periodic leak testing and forwarding two copies of procedures to Commander, US Army Electronics Command, ATTN: AMSEL-SF, Fort Monmouth, New Jersey 07703.

(4) Forwarding leak test smears to nearest approved smear counting station for evaluation.

(5) Insuring that each installation or activity using the AN/UDM-2 has an effective radiation protection program.

b. Responsibilities of Radiological Control Officer (RCO).

(1) Review and approve the qualifications of each local Radiological Protection Officer (RPO) for the AN/UDM-2 and forward to Commander, US Army Electronics Command, ATTN: AMSEL-SF,

0.5 rem in one calendar year. Unnecessary exposure of personnel in this area will not be permitted. (For the purpose of this document, 1 millirem is equal to 1 milliroentgen or millirad).

b. Store Calibrator Set, Radiac AN/UDM-2 in a locked container or area that permits external gamma radiation levels in potentially occupied areas no greater than 0.5 millirems per hour (mr/hr). Access to the container stored in a locked area shall be controlled by the radiological protection officer. Storage instructions are as follows:

(1) One or more AN/UDM-2's may be stored in a locked container constructed of wood or metal. The size of the container may be varied; however, the gamma radiation level on the outside of the container shall not exceed 0.5 mr/hr. The inside of the container may be lined with sheet lead to reduce the radiation intensity to an acceptable level. The container must be marked in accordance with MIL-STD-1458.

(2) One or more AN/UDM-2's may be stored in a locked room of such dimensions and construction that the gamma radiation level at any point *outside* the room does not exceed 0.5 mr/hr.

c. Only authorized, qualified personnel will be permitted to enter the storage or calibration areas alone. These areas will be physically secured and safeguarded when in use. Visitors must be escorted by the RPO or a qualified user and must be briefed on radiation hazards and precautions to minimize these hazards.

d. Storage areas and areas where equipment is being calibrated will be monitored at least daily, when in use, for possible contamination. Table of Allowance (TA) 50-914 (Individual Safety and Protective Clothing and Equipment) authorizes one each Radiac Set AN/PDR-27(*) per work group requiring radiation monitoring protection.

e. Personnel monitoring devices will be used when entering the storage or calibration areas or when operating Calibrator Set, Radiac AN/UDM-2 (AR 40-14). Operators will use wrist-type film badges in addition to regular body-type badges.

11. Duties of Radiological Protection Officer for AN/UDM-2. The specific duties of the appointed radiological protection officer will be to:

a. Insure that AN/UDM-2's under his jurisdiction are properly used and stored.

b. Train local users and operators and maintain list and record of training of users and operators.

c. Insure records are maintained on each item.

d. Advise RMCP of any forthcoming change in accountability, local RPO, or installation relocation for the AN/UDM-2.

e. Submit Radiation Incident Report according to published directives.

f. Establish radiation controlled areas for AN/UDM-2 storage and use.

g. Post Radiation Area warning signs.

h. Insure items are stored in a fire-resistant structure and no explosives of any kind are stored in the same structure.

i. Immediately refer actual or suspected overexposure to medical officer.

j. Insure film badges and pocket dosimeters are worn when required and that film badge exposures are recorded.

k. Insure that periods of time between leak tests do not exceed 6 months and supervise performance of leak tests.

l. Secure items against unauthorized use and removal.

m. Insure that all Army and Federal regulations are being followed and that personnel are exposed to a minumum of radiation consistent with practical considerations.

n. Conduct a physical inventory according to published frequencies.

o. Submit inventory, leak test, and other reports to RMCP as required.

p. Prior to relief from duties, place all AN/UDM-2's under this jurisdiction in locked storage.

q. Investigate each case of excessive or abnormal exposure to determine the cause, recommend remedial action to prevent recurrence, and submit a complete written report to the Commander, US Army Electronics Command, ATTN: AMSEL-SF, Fort Monmouth, NJ 07703 within 24 hours (para 8*b*(6)).

12. Requisitioning Procedure. Stations in CONUS and Oversea supply agencies will submit requisitions through *radioactive material supply* channels to Commander, US Army Electronics Command, ATTN: AMSEL-MM-S-CS-TA-1, Fort Monmouth, New Jersey 07703, for issue to certified Radiological Protection Officers. All requisitions will be accompanied by the name of the Radiological Protection/Control Officer who is to be responsible for the equipment. In addition, each request will include the following certification: "As required by chapter 3, AR 725-1, sufficient safety equipment, facilities, and trained personnel are available at this installation for the safe handling, use and storage of radioactive material ordered on this requisition." The certification must have the signature and the typed name and grade of the appropriate radiological control officer.

13. Leak Testing Procedure. *a. Safety Precautions.* The FPO is required to perform the leak test. Each person performing the leak test will wear a film badge.

b. Performing Calibrator, Radiac TS-3495/UDM-2 leaking calibrator is:

(1) Discontinue use of the calibrator. Cover it with plastic, seal it with tape, and label it as contaminated.

(2) Monitor personnel, equipment, and areas for possible contamination and decontaminate as required.

(3) Report the item to the Radioactive Material Control Point and to the US Army Electronics Command.

(4) Dispose of the AN/UDM-2 as directed by Lexington-Blue Grass Army Depot or the Radioactive Material Control Point.

(5) Report the completed disposal action to the US Army Electronics Command and the Radioactive Material Control Point.

'Technical Manual
No. 11-6665-227-12

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *13 June 1975*

Operator's and Organizational Maintenance Manual

CALIBRATOR SET, RADIAC AN/UDM-2

(NSN 6665-00-179-9037)

CHAPTER 1
INTRODUCTION

Section 1. General

1-1. Scope

a. This manual describes Calibrator Set, Radiac AN/UDM-2 (fig. 1-1) and covers its installation, operation, and organizational maintenance. It includes instructions for initial service, operation cleaning, and inspection of the equipment.

b. Official nomenclature followed by (*) is used to indicate all models of an equipment referenced in this manual. Thus, Radiac Set AN/PDR-27(*) represents AN/PDR-27J, AN/PDR-27L, AN/PDR-27P, AN/PDR-27Q, AN/PDR-27R and AN/PDR-27S; Radiacmeter IM-9(*)/PD represents IM-9E/PD and IM-9F/PD; Radiacmeter IM-93(*)/UD represents IM-93/UD and IM-93A/UD; Radiacmeter IM-174(*) represents IM-174/PD, IM-174A/PD and IM-174B/PD.

1-2. Index of Technical Publications

Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

1-3. Maintenance Forms, Records, and Reports

a. Reports of Maintenance and Unsatisfactory Equipment. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by TB 750-25-1 Maintenance of Supplies and Equipment: Army Test, Measurement and Diagnostic Equipment (TMDE) Calibration and Repair Support Program.

b. Report of Packaging and Handling Deficiencies. Fill out and forward SF 364 (Report of Discrepancy (ROD)) as prescribed in AR 735-11-2/DLAR 4140.55/NAVMATINST 4355.73/AFR 400-54/MCO 4430.3E.

c. Discrepancy in Shipment Report (DISREP) SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR55-38/NAVSUPINST 4610.33B/AFR 75-18/MCO 4610.19C/DLAR 4500.15.

1-4. Administrative Storage

Administrative storage of AN/UDM-2 shall be in accordance with TB 11-6665-227-*12*.

1-5. Destruction of Army Electronics Materiel

Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

1-6. Reporting Errors and Recommending Improvements

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) direct to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703. A reply will be furnished direct to you.

1-6.1 Reporting Equipment Improvement Recommendations (EIR)

If your Calibrator Set, Radiac AN/UDM-2 needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703. We'll send you a reply.

1-6.2 Nuclear Regulatory Commission (NRC) Requirements

The US Nuclear Regulatory Commission sets standards/conditions and issues licenses for use of radioactive material in the United States. The AN/UDM-2 comes under the NRC regulations and a license for its use has been issued. Information required by the NRC license/regulations is contained below.

a. Radiation Protection. Users of the AN/UDM-2 should refer to instructions on control, safe handling, storage and transportation contained in TB 11-6665-227-12. Operation and maintenance instructions for the AN/UDM-2 are contained in this manual. These two publications, TB 11-6665-227-12 and TM 11-6665-277-12, satisfy the radiation protection requirements of the NRC regulations (title 10, chapter 1, Code of Federal Regulations, parts 19 and 20).

b. Notice to Employees. Form NRC-3, Notice to Employees, contained in the back of this manual, may be removed for posting wherever the AN/UDM-2 is used and/or stored. The posting requirements are contained on the form.

c. NRC License. The NRC license for the AN/UDM-2 and documents relating to that license are held by the US Army Electronics Command Safety

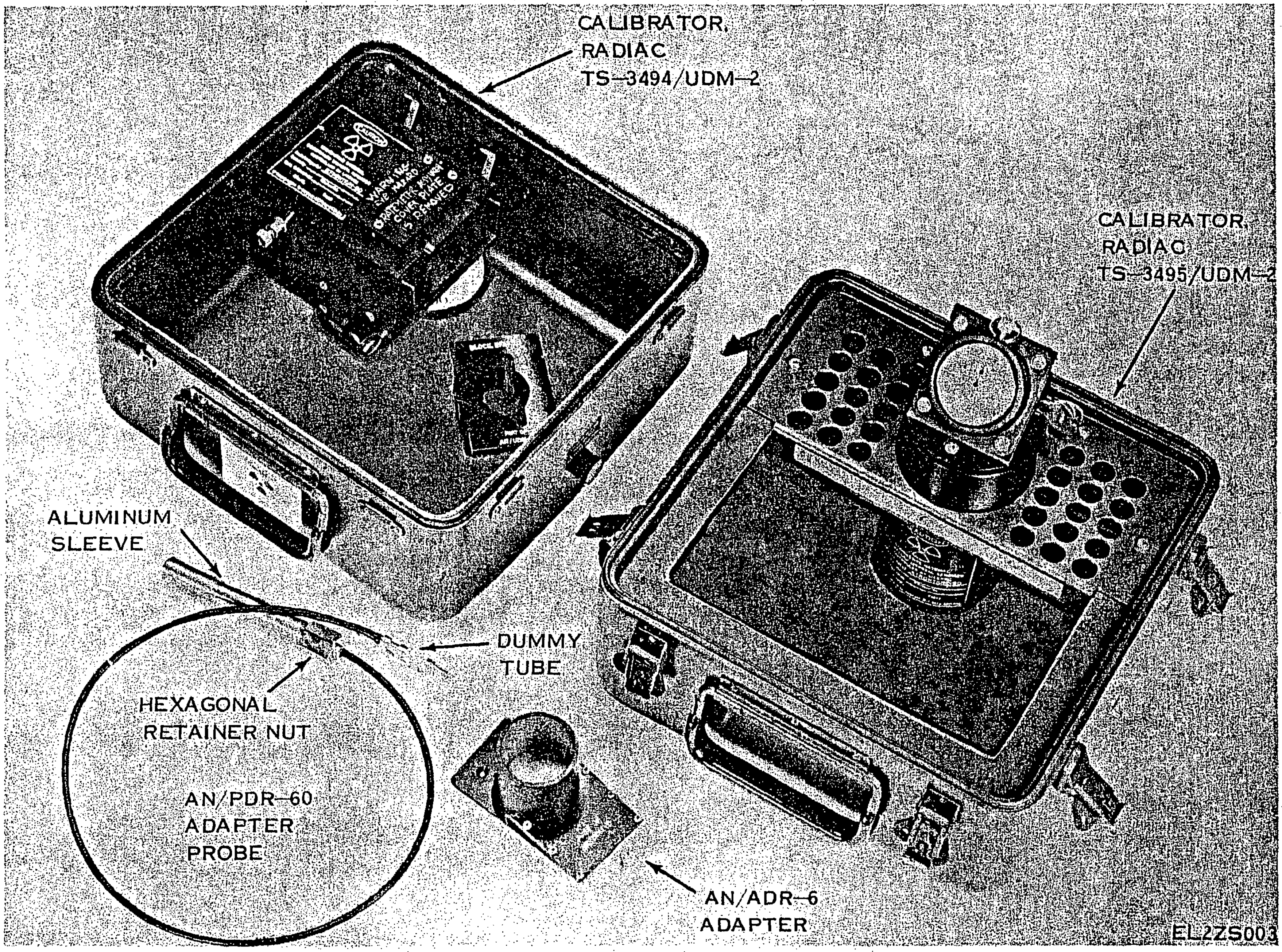

Figure 1-1, Calibrator Set, Radiac AN/UDM-2.

Section II. DESCRIPTION AND DATA

1-7. Purpose and Use
(fig. 1-1)

a. Purpose. Calibrator Set, Radiac AN/UDM-2 (consisting of two main sections (*b* below)) provides the facilities for checking the operational reliability and calibration accuracy of various radiacmeters and radiac sets.

b. Use. Calibrator, Radiac TS-3495/UDM-2 (discharge well assembly) is used to check Radiacmeters IM-93(*)/UD, IM-147/PD, and IM-9E/PD (dosimeters). Calibrator, Radiac TS-3494/UDM-2 (RATEMETER assembly) is used to check Radiacmeter IM-174(*)/PD (radiacmeter), Radiac Set AN/PDR-27(*) (radiac set), Radiac Set AN/PDR-60, and Aerial Radiac System AN/ADR-6.

1-8. Technical Characteristics

Type of radioactive isotope in each source capsule .... Strontium-Yttrium 90 (Sr-Y90).

Decay of isotope .... 27.7 years half life.

Quantity of isotope:

Discharge well assembly... Three encapsulated sources of 25 millicuries each. One encapsulated source of 20 microcuries.

RATEMETER assembly..... One encapsulated source of 25 millicuries.

Type of radiation emitted...... Beta particles.

Bremmstrahlung produced..... Radiation doserate from sources (4) no greater than 2 millirads per hour at outer case surface.

Maximum range of beta particles in air.............. 30 feet.

Stopwatch indication.......... Two indications: a minute hand for a maximum of 30 minutes and a second hand for a maximum of 60 seconds.

1-9. Items Comprising an Operable Calibrator Set, Radiac AN/UDM-2
(figs. 1-1, 1-2, and 1-3)

The components of the AN/UDM-2 that make up an operable equipment are listed in table 1-1.

Table 1-1. Items Comprising an Operable Calibrator Set, Radiac AN/UDM-2

NSN	Item	Qty	Dimensions (in.) Height	Depth	Width	Wt (lb)
6665-00-610-1487	Calibrator, Radiac TS-3494/UDM-2	1	5	12	12	10⅛
6665-00-610-1496	Calibrator, Radiac TS-3495/UDM-2	1	8¼	12	12	18¼
Not available	Adapter, AN/ADR-6	1	2⅝	3¼	2¼	⅜
Not available	Adapter probe, AN/PDR-60	1	⅝	5	....	¼
Not available	Stopwatch	1	....	....	....	....
Not available	Spacer block	1	3⅝	2½	1¼	½

1-10. Description of Calibrator Set, Radiac AN/UDM-2

Calibrator Set, Radiac AN/UDM-2 (fig. 1-1) consists of two major assemblies, Calibrator, Radiac TS-3495/UDM-2 and Calibrator, Radiac TS-3494/UDM-2, plus the AN/PDR-60 adapter probe, and the AN/ADR-6 adapter. Each major assembly is housed in one-half of a waterproof, aluminum case.

A handle is provided on each assembly to facilitate handling.

a. Calibrator, Radiac TS-3495/UDM-2 (fig. 1-2). The discharge well assembly consists of a discharge well, a dosimeter shelf, and a stopwatch. The dosimeter shelf contains 30 holes (to hold dosimeters to be tested) and the discharge well. The discharge well contains four Sr-Y90 sources (one 20 microcurie source and three 25 millicurie sources). The sources are arranged to radiate into a central cavity. Two fields of radiation are provided within the discharge well; one field is provided by the 20-microcurie source (upper field), the other field is provided by the three 25-millicurie sources (lower field). The upper field will cause Radiacmeter IM-9E/PD to discharge but will have no effect on Radiacmeter IM-93(*)/PD or IM-147/PD. The lower field will cause the IM-93(*)/PD or the IM-147/PD to discharge and will also cause the IM-9E/PD to discharge within two seconds. An access hole in the top of the discharge

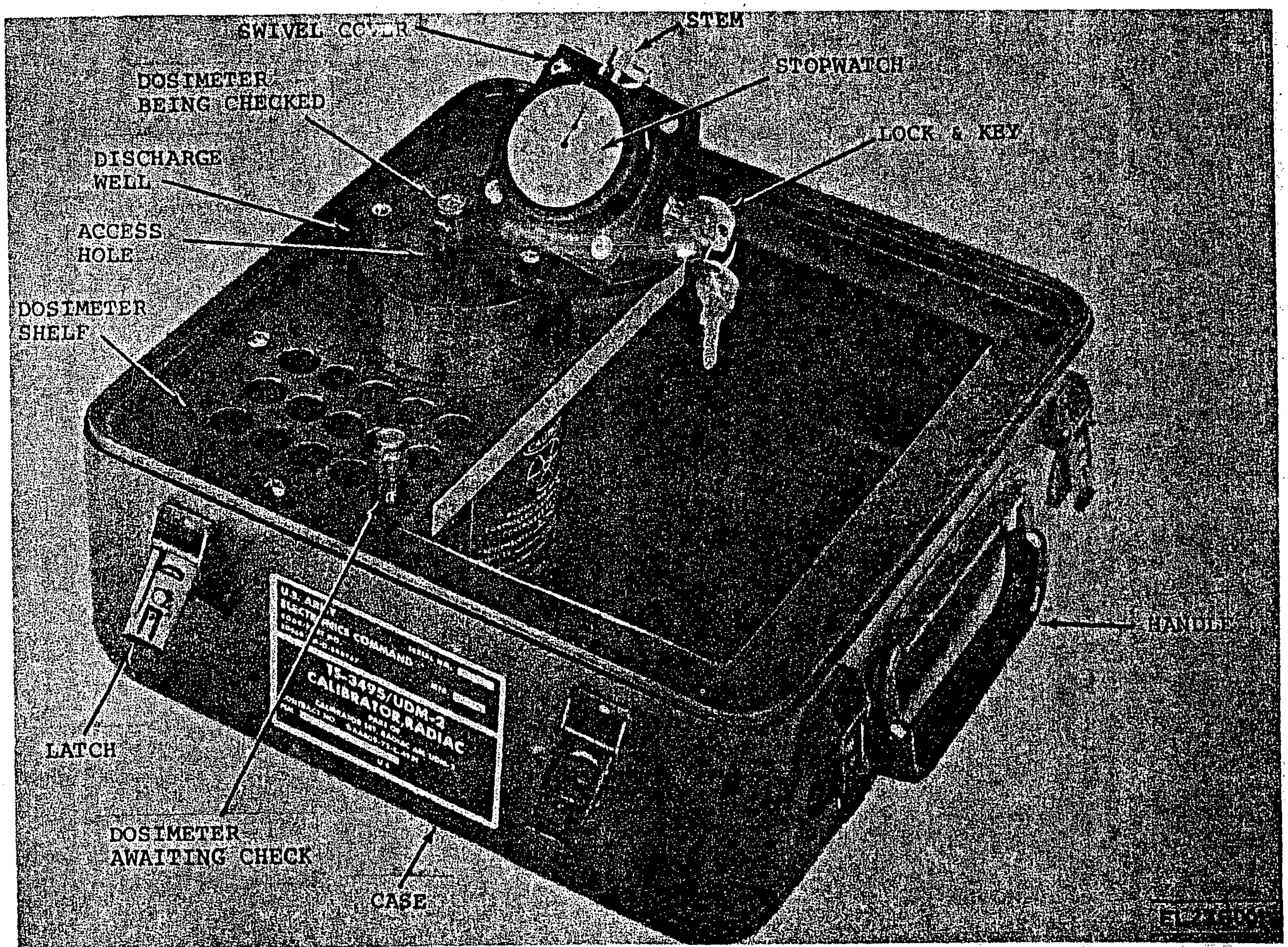

Figure 1-2. Calibrator, Radiac TS-3495/UDM-2.

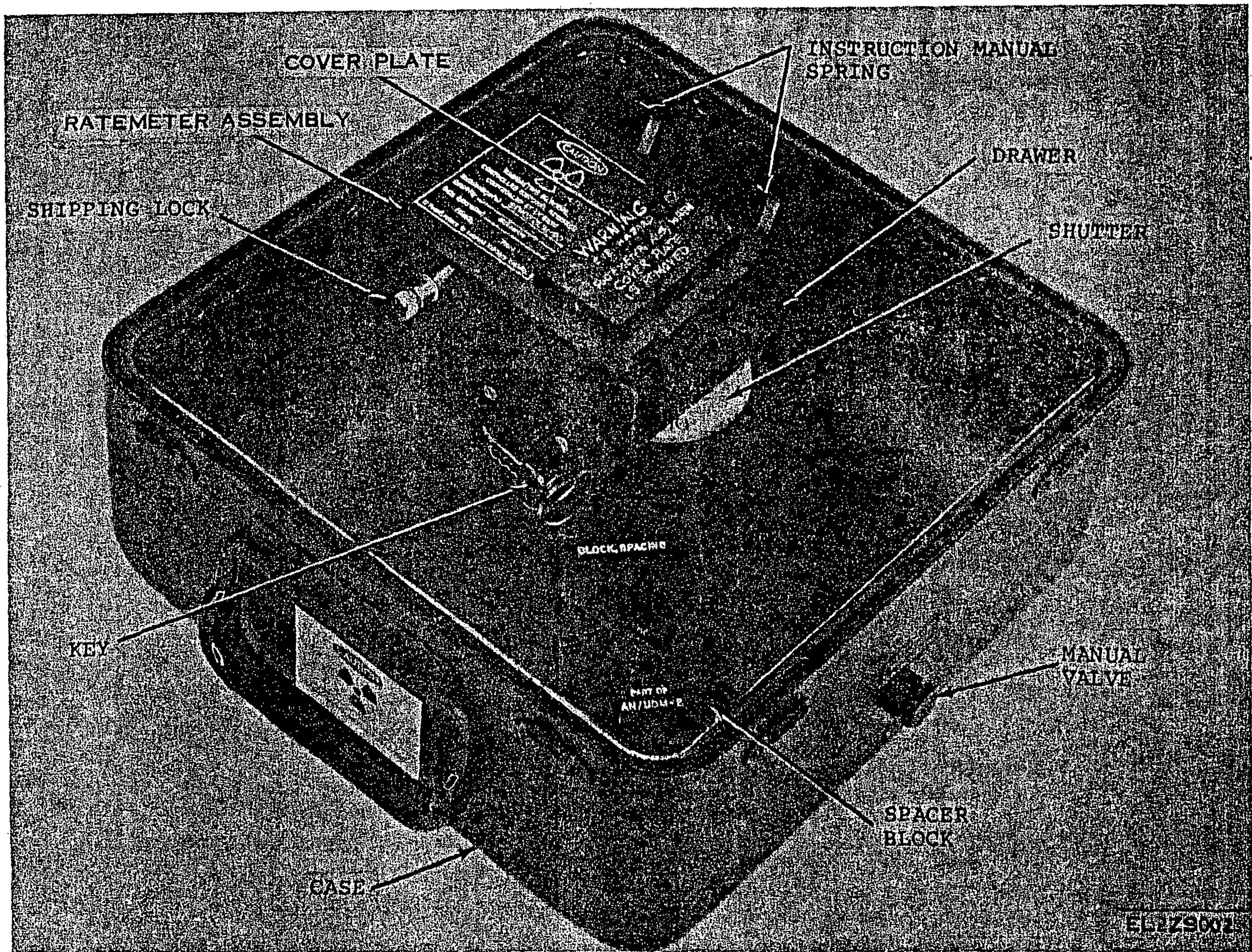

Figure 1-3. Calibrator, Radiac TS-3494/UDM-2.

CHAPTER 2

INSTALLATION

2-1. Unpacking
(fig. 2-1)

a. Packaging Data. When packed for shipment, the AN/UDM-2 is packaged in an inner corrugated carton. The packaged AN/UDM-2 is further protected by being placed in an outer corrugated carton. All joints and seams on both cartons are sealed with waterproof, pressure-sensitive tape. Corrugated fillers are placed around the six sides of the package. The outside dimensions of the complete package are approximately 17 inches long, 16½ inches wide, and 15 inches high. The volume is 2.5 cubic feet and the total weight is approximately 35 pounds.

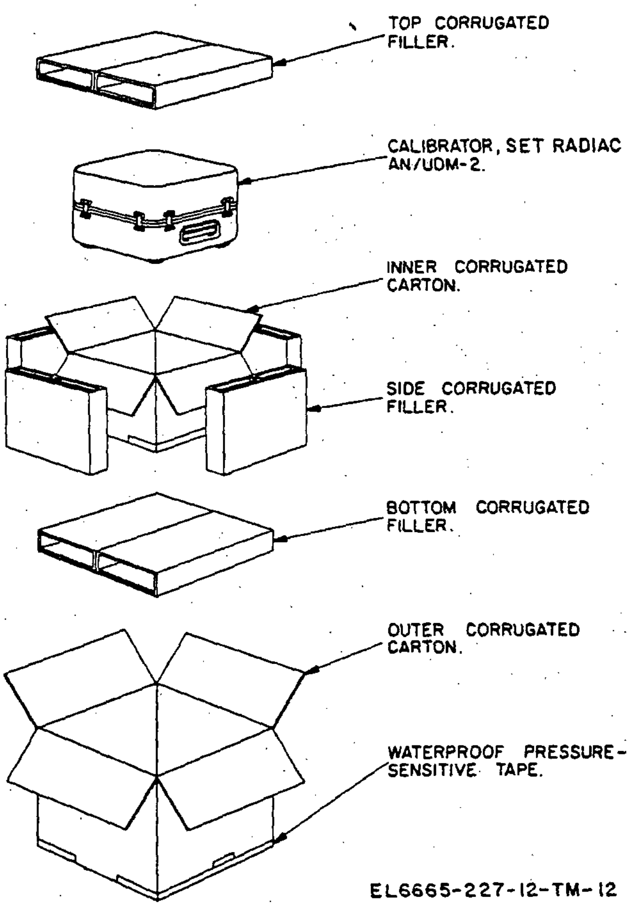

Figure 2-1. Calibrator Set, Radiac AN/UDM-2, typical packaging diagram.

b. Removing Contents. Unpack the equipment as follows:

(1) Remove the waterproof, pressure-sensitive tape from the top of the outer corrugated carton.

(2) Lift open the flaps and remove the top and side corrugated fillers.

(3) Remove the inner corrugated carton containing the AN/UDM-2.

(4) Remove the waterproof, pressure-sensitive tape from the top of the inner carton.

(5) Lift open the flaps and remove the AN/UDM-2.

(6) Turn the manual valve (fig. 1-3) counterclockwise to equalize the pressure.

2-2. Checking Unpacked Equipment

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on DD Form 6 (para 1-3) and notify the Radiological Protection Officer (TB 11-6665-227-12).

b. Release the eight fasteners (fig. 1-1) and separate the two halves of the AN/UDM-2.

c. See that the equipment is complete as listed on the packing slip. If a packing slip is not available, check the equipment against the listing in table 1-1. Report all discrepancies in accordance with TM 38-750. Shortage of a minor assembly or part that does not affect proper functioning of the equipment should not prevent use of the equipment.

d. If the equipment has been used or reconditioned, see whether it has been changed by a modification work order (MWO). If the equipment has been modified, the MWO number will appear near the nomenclature plate. Check to see whether the MWO number (if any) and appropriate notations concerning the modification have been entered in this manual.

NOTE

Current MWO's applicable to this equipment (if any) are listed in DA Pam 310-7.

2-3. Preparation for Use

WARNING

Refer to paragraphs 1-11 and 3-1 for precautions pertaining to this equipment.

a. Release the shipping locks of both assemblies (figs. 1-2 and 1-3) by rotating the captive screws counterclockwise. The shipping locks are spring-loaded, will spring outward when fully unscrewed, and will release the latches.

CHAPTER 3
OPERATING INSTRUCTIONS

3-1. General

WARNING

Radioactive materials are used in this equipment. Read and understand all operational data and procedures in this chapter *before* using the equipment. Become thoroughly familiar with the contents of TB 11-6665-227-12. Never look directly into the access hole (fig. 1-2) when the swivel cover is swung open; do not poke sharp pointed objects into the access hole. This equipment will be used only under the direction of a Radiological Protection Officer.

Table 3-1 lists all controls and indicators used by the operator. In addition, this chapter contains the following:

a. Procedures for checking Radiacmeters IM-9(*)/PD, IM-93(*)/UD, and IM-147/PD (para 3-4).

b. The procedures for calibrating Radiacmeter IM-174(*)/PD (para 3-5).

c. The procedures for calibrating Radiac Set AN/PDR-27(*) (para 3-6).

d. The procedures for calibrating Radiac Set AN/PDR-60 (para 3-7).

e. The procedures for calibrating Aerial Radiac System AN/ADR-6 will be given in paragraph 3-8 when they become available.

3-2. Controls and Indicators

All operators controls and indicators are listed in table 3-1.

Table 3-1. List of Controls and Indicators

Control or indicator	*Function*
Calibrator, Radiac	
TS-3495/IDM-2 (fig. 1-2):	
Stem (stopwatch)	Stops, starts, and winds stopwatch. Positions seconds indicator to zero (60) and minutes indicator to zero (30) for reuse.
Second indicator (stopwatch)	Indicates elapsed time from 0 to 60 seconds.
Minute indicator (stopwatch)	Indicates elapsed time from 0 to 30 minutes.
Key	Unlocks swivel cover allowing it to be swung open.
Swivel cover (spring-loaded)	Allows dosimetor entry into access hole.
Calibrator, Radiac	
TS-3494/UDM-2 (fig. 1-3):	
Shutter	Rotated to select radiation fields of 10 rad/hr or 100 rad/hr.
Key	Unlocks shutter allowing it to be rotated.

NOTE

Substitute corrected times from AN/UDM-2 Calibration Report. DO *NOT* USE THE VALUES IN THE TIME COLUMN shown above.

3-4. Dosimeter Checking

To check an IM-9(*)/PD, perform the procedures in *a*, *b* and *d* below. To check an IM-93(*)/UD or IM-147/PD, perform the procedures in *a*, *c* and *d* below. For information on operation of dosimeters refer to TM 11-6665-214-10.

WARNING

Serious eye injury may result from the use of this equipment. Take the following precautions:

- Always wear safety or prescription glasses while using the AN/UDM-2.
- Never look or peer into the discharge well hole (even when wearing safety glasses).

a Preliminary Procedures.

(1) Examine the dosimeter (and clean it if necessary) to insure that it will not carry mud or dirt into the access hole.

(2) Remove the calibration label from the dosimeter.

(3) Charge the dosimeter to a zero indication TM 11-6665-214-10).

(4) Test dosimeter for leakage (TM 11-6665-214-10).

(5) Insert the key in the discharge well assembly lock and release the lock (fig. 1-2).

(6) Reset and wind the stopwatch, if necessary.

b. Checking the IM-9(*)/PD.

(1) Refer to the calibration report to determine the time (number of minutes or seconds) the dosimeter is to remain in the discharge well.

(2) Open the discharge well swivel cover by sliding it aside.

(3) Insert the dosimeter, charging end down, gently into the discharge well and lower it to the first level (about two-thirds in). The instant the dosimeter touches the first level, start the stopwatch.

NOTE

Do not press the dosimeter down to the lowest level (where its top would be flush with the top surface of the well); the lower level will expose it to a stronger radiation field than is required and will discharge it completely in less than 2 seconds. If the dosimeter is accidently pressed down into the lower level, remove the dosimeter, recharge it, and start over again.

(4) Leave the dosimeter in the discharge well for the required amount of time and then remove it. (During timing, the well cover may be released against the dosimeter.)

(5) Read the dosimeter and then compare its value with table 3-2. If it is within tolerance, the dosimeter is serviceable.

c. Checking the IM-93(*)/UD or IM-147/PD.

(1) Refer to the calibration report to determine the time (number of minutes or seconds) the dosimeter is to remain in the discharge well.

(2) Open the discharge well swivel cover by sliding it aside (fig. 1-2).

(3) Insert the dosimeter, charging end down, gently into the discharge well and lower it to the first level; then push it down to the second level and slide the swivel cover over the dosimeter to hold it in place. Start the stopwatch as soon as the dosimeter reaches the second level.

NOTE

It is convenient and desirable to use a pusher (small , piece of wood or flat blade screwdriver) to get the dosimeter under the swivel cover.

(4) Leave the dosimeter in the discharge well for the required amount of time and then remove it.

(5) Read the dosimeter and then compare its value with table 3-2. If it is within tolerance, the dosimeter is serviceable.

d. Final Procedures.

(1) If dosimeter is serviceable, fill out calibration label (see TB 750-25-1), and place it on dosimeter. Use transparent tape to hold calibration label on dosimeter (so that old labels will be easily removed).

(2) If the dosimeter reads outside the limits in table 3-2, it is unserviceable.

(3) Fill out the appropriate maintenance forms (TB 750-25-1), and turn in unserviceable dosimeters for repair.

(4) When all dosimeters are checked, relock the swivel cover in place.

3-5. Calibrating Radiacmeter IM-174(*)/PD

To check Radiameter IM-174/PD, perform the procedures in *a* and *c* below. To check Radiacmeter IM-174A/PD or IM-174B/PD, perform the procedures in *b* and *c* below. For information on how to operate the equipment, refer to TM 11-6665-213-12 (IM-174/PD) or TM -6665-232-12 (IM-174A/PD and IM-174B/PD).

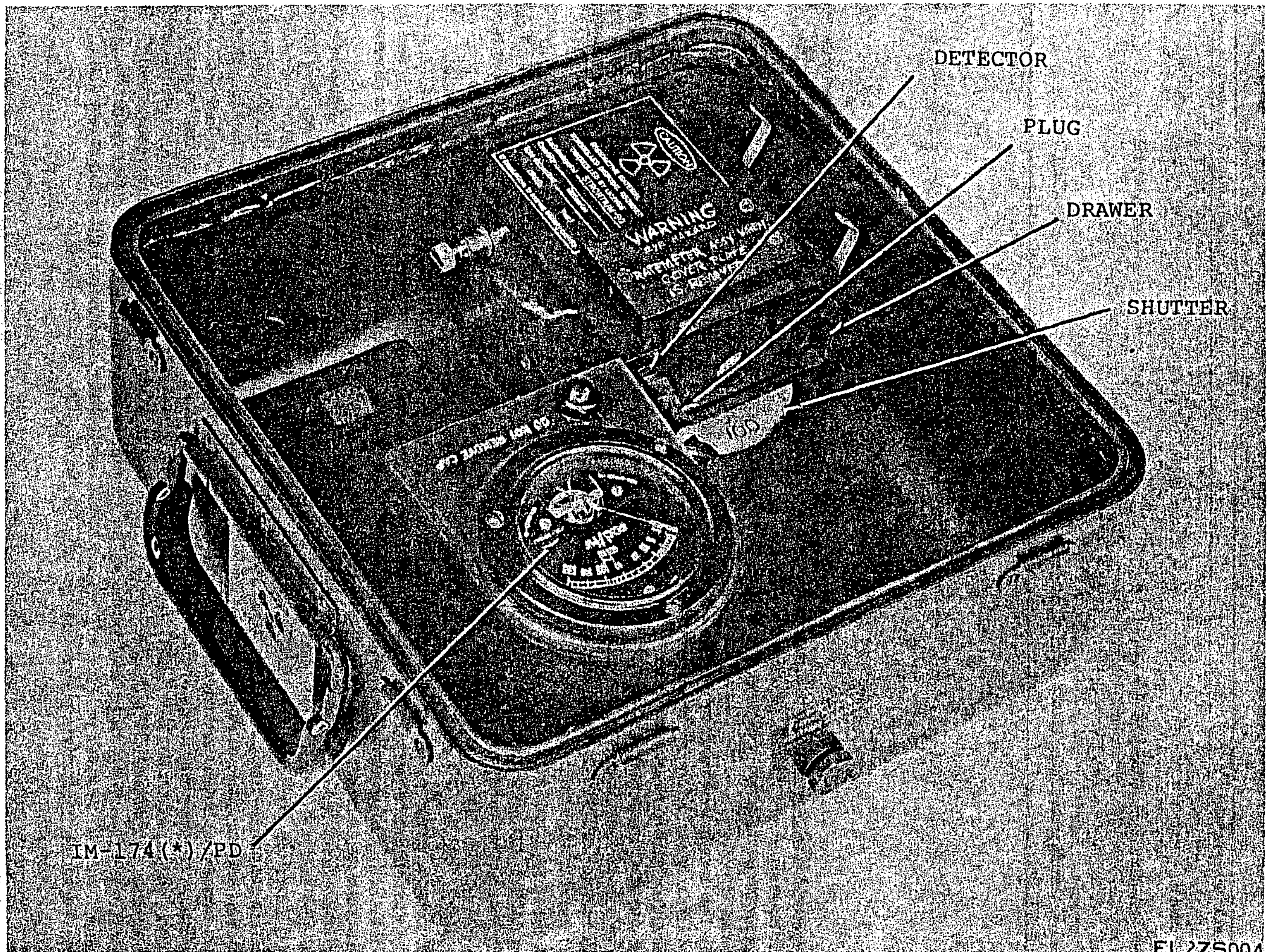

Figure 3-1. Checking Radiacmeter IM-174(*)/PD

shipping lock. Lock the ratemeter assembly lock and remove the key.

c. Final Procedures.

(1) ON IM-174(*)/PD which are serviceable, fill out a calibration label and place it on the radiacmeter (see TB 750-25-1).

(2) For IM-174(*)/PD which are not serviceable, annotate DA Form 2417 (see TB 750-25-1). Repair and calibrate radiacmeter or turn item in to organization with repair capability. See *a*(9) above reguarding unserviceable IM-174/PD's.

DISCHARGE TIMES SHOULD BE ADJUSTED EACH YEAR BY MULTIPLYING ORIGINAL DISCHARGE TIME BY CORRECTION FACTOR FOR YEAR OF OPERATION, WHEN OBTAINING READINGS ON THE IM-93(*)UD, IM-147/PD, AND IM-9E/PD.

TIME CORRECTION TABLE									
YEAR	CORR. FACTOR	YEAR	CORR. FACTOR	YEAR	CORR. FACTOR	YEAR	CORR. FACTOR	YEAR	CORR. FACTOR
1975	1.000	1979	1.106	1983	1.221	1987	1.350	1991	1.492
1976	1.025	1980	1.133	1984	1.252	1988	1.384	1992	1.530
1977	1.051	1981	1.162	1985	1.284	1989	1.419	1993	1.569
1978	1.078	1982	1.191	1986	1.317	1990	1.455	1994	1.609

EL2ZS009

Figure 3-1.1 TS-3495/UMD-2 discharge well assembly, correction factor chart.

READINGS OBTAINED ON THE 174(*)/PD, AN/PDR-27, AN/PDR-60, AND AN/ADR-6 SHOULD BE CORRECTED EACH YEAR BY MULTIPLYING THEM BY THE CORRECTION FACTOR FOR THE YEAR OF OPERATION.

TIME CORRECTION TABLE							
YEAR	CORR. FACTOR	YEAR	CORR. FACTOR	YEAR	CORR. FACTOR	YEAR	CORR. FACTOR
1975	1.000	1980	0.883	1985	0.778	1990	0.687
1976	0.976	1981	0.861	1986	0.759	1991	0.670
1977	0.951	1982	0.840	1987	0.741	1992	0.654
1978	0.928	1983	0.819	1988	0.723	1993	0.637
1979	0.904	1984	0.789	1989	0.705	1994	0.622

EL2ZS010

Figure 3-1.2 TS 3494/UMD ratemeter assembly, correction factor chart

Figure 3-3. Checking AN/PDR-27(*) on 50 mrad/hr range.

3-6. Calibrating Radiac Set AN/PDR-27(*)

In some cases, while reading the radiacmeter, the meter needle will not come to rest on a fixed value. The needle will move up and down scale (vary) in a random manner. This is to do with the nature of the radiation field being measured, which is random in itself. This random needle movement is more noticeable on the lower reading scales. When observing the meter under conditions where this needle variation is present, watch the meter needle for a minimum period of 1 minute and note the highest and lowest values obtained during that period. The average of the highest and lowest values (the center point) is the value which should be used to be compared to the values given in the calibration report (para 3-3). Check the radiac set as follows:

CAUTION

Be careful of the short piece of cable that joins the two probes, it is easily damaged and difficult to repair.

a. On the AN/PDR-27(*), remove the two screws on the clamps holding the two probes together and separate the two probes. Set the range switch to the 500 mr/hr position. Allow a short warm up time. Refer to applicable manual listed in appendix A.

b. On the ratemeter assembly (fig. 1-3), release the shipping lock, pull out the drawer and place the spacer block in the drawer.

c. Close the drawer, insert the smaller probe into the hole in the center of the drawer (fig. 3-2) and insert the key and unlock the shutter. Set the shutter to the 100 position.

d. Twist or turn the small probe in the drawer hole to obtain maximum and minimum meter readings. Record the center value of the two meter readings. If both readings are inside of calibration report limits proceed to *f* below, if not, proceed to *e* below.

e. Remove the calibration control cover and adjust the 500 mr/hr calibration control until the reading is in center of the calibration report limits (nominal reading).

f. Rotate the ratemeter assembly shutter to the closed position, remove the small probe and open the drawer.

g. Remove the spacer block from inside the drawer. Install the spacer block on the drawer handle and close the drawer (fig. 3-3). Install the small probe into the spacer block.

h. Rotate the shutter of the ratemeter assembly to the 100 position.

i. On the An/PDR-27(*), set the range switch to the 50 mr/hr position.

j. Twist or turn the small probe in the drawer hole to achieve maximum and minimum meter readings. Record the center value of the two meter readings. If both readings are inside of calibration report limits proceed to *l* below, if not, proceed to *k* below.

k. Adjust the 50 mr/hr calibration control until the reading is in the center of the calibration report limits (nominal reading).

l. On the ratemeter assembly, rotate the shutter to the off position. Remove the small probe and then the spacer block from the drawer. Position the large probe to lie across the semicircular cutouts on the edges of the drawer with the drawer opened to its fullest extremity (fig. 3-4).

m. Leave the ratemeter assembly shutter closed. On the AN/PDR-27(*), set the range switch to the 5 mr/hr position. Adjust the 5 mr/hr calibration control, if center value is outside of calibration report limits, until the average meter reading is in the center of the calibration report limits. Otherwise, make no adjustment.

n. Position the large probe on the upper edge of the handle side of the TS-3494/UDM-2 case (fig. 3-5).

o. Leave the ratemeter assembly shutter closed. On the AN/PDR-27(*), set the range switch to 0.5 mr/hr position. Adjust the 0.5 mr/hr calibration control, if center value is outside of calibration report limits, until the average meter reading is in the center of the calibration report limits. Otherwise, make no adjustment.

NOTE

If any of the meter ranges cannot be adjusted to center of the calibration report limits, adjust them to within those limits.

p. Deenergize the AN/PDR-27(*), fasten the two probes together and replace calibration control cover, if necessary.

q. Lock the ratemeter lock and set the shipping lock when no further calibrations are required.

r. Fill out the calibration label (see TB 750-25-1) for radiac sets that are serviceable. For unserviceable radiac sets fill out the appropriate maintenance forms (TB 750-25-1) and repair or turn in to organization with repair capability.

3-7. Calibrating Radiac Set AN/PDR-60

NOTE

Refer to paragraph 3-6 concerning how to make average readings when meter needle varies. This procedure also applies to the AN/PDR-60.

CHAPTER 4

MAINTENANCE INSTRUCTIONS

4-1. Scope of Maintenance

The maintenance duties assigned to the operator and organizational repairman of the AN/UDM-2 are listed below together with a reference to the paragraphs covering the specific maintenance function. The AN/UDM-2, when the two halves are sealed, is waterproof. The swivel cover on the discharge well assembly restricts entry of foreign matter to the access hole, but is not waterproof. This cover may be removed to clean the pivot pin assembly when required.

WARNING

NEVER disassemble the cavities of the discharge well assembly or the ratemeter assembly. This procedure is dangerous and must be performed only by higher category maintenance personnel with adequate facilities meeting all requirements of TB 11-6665-227-12.

a. Operator preventive maintenance checks and services (table 4-1).

b. Organizational preventive maintenance checks and services (table 4-2).

c. Cleaning and touchup painting (para 4-5).

d. Troubleshooting (para 4-6).

e. Wipe test (TB 11-6665-227-12).

4-2. Tools and Equipment Required

No special tools or test equipment other than those listed in appendix C are required. The materials required for maintenance are listed below.

a. Trichlorethane (NSN 6810-00-664-0273).

b. Cleaning cloth (NSN 8305-00-245-4509).

c. Cotton swabs (NSN 6515-00-303-8250).

d. Sandpaper (No. 000).

e. Petroleum jelly or light machine oil.

4-3. Preventive Maintenance

To insure that the AN/UDM-2 is always ready for operation, it must be inspected systemactically so that defects may be discovered and corrected before they result in serious damage or failure. The necessary preventive maintenance checks and services to be performed are listed and described in tables 4-1, 4-2, and 4-3. The item numbers in each table indicate the sequence of and the minimum inspection required. Defects discovered during operation of the unit will be noted (TB 11-6665-227-12) for future correction to be made as soon as operation has ceased. Stop operation immediately if a deficiency is noted during operation which would damage the equipment or harm personnel. Record all deficiencies together with the corrective action taken in accordance with the requirements of TB 11-6665-227-12 and TM 38-570.

4-4. Preventive Maintenance Checks and Services (PMCS)

a. General. Before performing PMCS, note the following:

(1) *Before you operate.* Always keep in mind the CAUTIONS and WARNINGS. Perform your before (B) PMCS.

(2) *While you operate.* Always keep in mind the CAUTIONS and WARNINGS. Perform your during (D) PMCS.

(3) *After you operate.* Be sure to perform your after (A) PMCS.

b. Item Number Column. Use the number in this column for this *TM number* column on DA Form 2404, Equipment Inspection and Maintenance Worksheet, when recording results of PMCS.

c. Interval Column. A dot (•) in the column indicates when the check is to be made.

d. For Readiness Reporting, Equipment Is Not Ready/Available If: Column. This column contains the standards which will cause the equipment to be reported not ready or not available because it cannot perform its primary mission.

Provide thorough ventilation whenever used. DO NOT use near an open flame. Trichloroethane is not flammable, but exposure of the fumes to an open flame converts the fumes to highly toxic, dangerous gases.

(2) Remove fungus and ground-in dirt with a cloth dampened (not wet) with cleaning compound; dry thoroughly.

CAUTION

Do not press on the face of the stopwatch; the stopwatch may become damaged.

(3) Clean the face of the stopwatch with a soft clean cloth. If the dirt is difficult to remove, dampen (do not wet) the cloth with water; if necessary, use a mild soap.

(4) If the pivot of the swivel cover becomes stiff or binds, clean the pivot and relubricate the pivot with a very small amount of light lubricating oil or petroleum jelly.

b. Touchup Painting.

(1) Remove rust and corrosion from metal surfaces by lightly sanding them with fine sandpaper.

(2) Brush two thin coats of paint on the bare metal to protect it from further corrosion.

(3) Refer to the applicable cleaning and refinishing practices specified in SB 11-573 and TB 746-10.

4-6. Troubleshooting

Troubleshooting of this equipment is based upon the checks contained in the preventive maintenance checks and services tables. To troubleshoot the equipment, perform all functions starting with sequence number 3 in the daily preventive maintenance checks and services (table 4-1) and proceed through the remaining sequence numbers (tables 4-1 and 4-2) until an abnormal condition or result is observed. Perform the checks and corrective measures indicated in the troubleshooting procedures (table 4-3). If the corrective measures do not result in correction of the trouble, higher category maintenance is required.

Table 4-3. Troubleshooting AN/UDM-2

Item No.	Trouble symptom	Probable trouble	Corrective measures
1	Swivel cover binds	Dirty or corroded pivot bearing.	Disassemble swivel cover only. Clean and relubricate pivot bearing (para 4-5a).
2	Stopwatch nonoperative	Run-down or defective	Rewind and recheck stopwatch.

APPENDIX A
REFERENCES

AR 40-14	Control and Recording Procedures: Occupational Exposure to Ionizing Radiation.
AR 40-27	Personnel Radiation Exposures.
AR 55-55	Transportation of Radioactive and Fissile Materials Other Than Weapons.
AR 700-52	Licensing and Control of Sources of Ionizing Radiation.
AR 700-64	Radioactive Commodities in the DOD Supply Systems.
AR 755-15	Disposal of Unwanted Radioactive Material.
DA Pam 310-4	Index of Technical Publications.
SB 11-573	Painting and Preservation of Supplies Available for Field Use for Electronics Command Equipment.
SB 38-100	Preservation, Packaging, Packing and Marking Materials, Supplies, and Equipment Used by the Army.
TB 11-6665-227-12	Safe Handling, Storage, and Transportation of Calibrator Set, Radiac AN/UDM-2 (NSN 6625-00-179-9037).
TB 43-0118	Field Instructions for Painting and Preserving Electronics Command Equipment Including Camouflage Pattern Painting of Electrical Equipment Shelters.
TB 43-0122	Instructions for Safe Handling and Identification of the US Army Communications and Electronics Materiel Readiness Command Managed Radioactive Items in the Army Supply System.
TB 750-25-1	Maintenance of Supplies and Equipment: Army Test, Measurement, and Diagnostic Equipment (TMDE) Calibration and Repair Support Program.
TM 11-6665-209-15	Operator's, Organizational, DS, GS, and Depot Maintenance Manual (Including Repair Parts and Special Tools List): Radiac Sets AN/PDR-27J, AN/PDR-27L, and AN/PDR-27Q.
TM 11-6665-213-12	Operator and Organizational Maintenance Manual (Including Repair Parts and Special Tool Lists): Radiacmeter IM-174/PD (NSN 6665-00-856-8037).
TM 11-6665-214-10	Operator's Manual: Radiacmeters IM-9E/PD (NSN 6625-00-243-8199) IM-93/UD, IM-93A/UD (6625-00-752-7759) and IM-147/PD (6625-00-542-0729).
TM 11-6665-221-15	Operator's, Organizational, Direct Support, General Support and Depot Maintenance Manual: Radiac Set AN/PDR-60 (NSN 6665-00-965-1516).
TM 11-6665-224-15	Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual: Radiac Set AN/PDR-27P (NSN 6665-00-975-7222).
TM 11-6665-230-15	Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual (Including Repair Parts and Special Tool Lists): Radiac Set AN/PDR-27R (NSN 6665-00-961-0846).
TM 11-6665-232-12	Operator's, and Organizational Maintenance Manual: Radiacmeter IM-174A/PD (NSN 6665-00-999-5145) and IM-174B/PD (6665-00-056-7422).
TM 38-750	The Army Maintenance Management System (TAMMS).

APPENDIX C

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

C-1. General

This appendix provides a summary of the maintenance operations for the AN/UDM-2. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

C-2. Maintenance Function

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i. e., to clean, preserve, drain, paint, or to replenish fuel/lubricants/hydraulic fluids or compressed air supplies.

d. Adjust. Maintain within prescribed limits by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Align. To adjust specified variable elements of an item to about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement. Consists of the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment/system.

h. Replace. The act of substituting a serviceable like-type part, subassembly, model (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module/component/assembly, end item or system.

j. Overhaul. That periodic maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (e.g., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like-new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like-new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipment/components.

C-3. Column Entries

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies and modules with the next higher assembly.

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "worktime" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance

SECTION II MAINTENANCE ALLOCATION CHART FOR

CALIBRATOR SET, RADIAC AN/UDM-2

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQUIPMENT
			C	O	F	H	D	
00	CALIBRATOR SET, RADIAC AN/UDM-2	Inspect	0.08					
		Service[1]	0.14	0.25				1
		Calibrate					3.0	2 thru 7
		Replace		0.4				
		Repair					3.0	2 thru 7
		Overhaul					6.0	2 thru 7
01	CALIBRATOR, RADIAC TS-3494/UDM-2	Inspect	0.02	0.06				
		Service	0.06	0.08				1
		Calibrate					1.5	2,5,6,7
		Replace		0.2				
		Repair					1.5	2,5,6,7
		Overhaul					3.0	2,5,6,7
02	CALIBRATOR, RADIAC TS-3495/UDM-2	Inspect	0.01	0.04				
		Service	0.05	0.07				1
		Calibrate					1.5	2,3,4,6
		Replace		0.2				
		Repair					1.5	2,3,4,6
		Overhaul					3.0	2,3,4,6

(1) Perform wipe test (TB 11-6665-227-12) at organizational level.

GLOSSARY

Beta particle—A charged particle emitted from the nucleus of an atom and having a mass and charge equal to that of an electron.

Beta window—A small area in the wall of an ionizaton chamber which is thin enough to permit the entrance of a substantial fraction of beta particles.

Bremsstrahlung—Secondary electromagnetic radiation similar to X-ray produced by deceleration of charged particles passing through matter.

Curie—That quantity of a radioactive nucleus disintegrating at the rate of $3{,}700 \times 10^{10}$ atoms per second.

Decay, radioactive—The natural process whereby the activity of a radioactive source decreases with respect to time.

Dose rate—The radiation dose delivered per unit time. The common unit of measure for X- or gamma radiation is rad per hour (r/hr) or millirad per hour (mr/hr).

Dosimeter—An instrument used to detect and measure an accumulated dose of radiation; normally it is in a pencil size self-reading ionization chamber used for personnel monitoring.

Half-life (radioactive)—The time required for the activity of a given radioactive species to decrease to half of its initial value due to radioactive decay.

Ionization chamber—An instrument consisting essentially of a closed chamber or tube of air or gas with two electrodes used for detecting and measuring nuclear radiation.

Isotope—A form of the same element having identical chemical properties but differing in its atomic mass and nuclear properties.

Millicure—One one-thousandth (1/1,000) part of a curie. See curie.

Millirad (mr)—One one-thousandth part of an rad. See Rad.

Nuclear radiation—The particulate and electromagnetic radiation emitted from atomic nuclei in various nuclear processes. The important nuclear radiations, from weapons standpoint, are alpha and beta particles, gamma radiation, and neutrons.

Radioactive standard—A sample of radioactive material in which the number and type of radioactivity at a definite time is known and therefore may be used to calibrate radiation measuring instruments.

Rad (r)—An exposure does of X- or gamma radiation such that the associated corpuscular emission per 0.001293 gram of air produces, in air, an ion carrying 1 electrostatic unit of electricity of either sign (negative or positive).

Strontiurm-90 (Sr 90)—The radioactive isotope of Strontium with 90 atomic mass units.

Yttrium-90 (Y 90)—The decay product of Strontium-90 with 90 atomic mass units.

By Order of the Secretary of the Army:

FRED C. WEYAND
General, United States Army,
Chief of Staff.

Official:
VERNE L. BOWERS
Major General, United States Army,
The Adjutant General.

DISTRIBUTION:
To be distributed in accordance with DA Form 12-50 (qty rqr block no. 65), Operator requirements for AN/UDM-2.

UNITED STATES NUCLEAR REGULATORY COMMISSION
Washington, D.C. 20555

NOTICE TO EMPLOYEES

STANDARDS FOR PROTECTION AGAINST RADIATION (PART 20); NOTICES, INSTRUCTIONS AND REPORTS TO WORKERS; INSPECTIONS (PART 19); EMPLOYEE PROTECTION

The Nuclear Regulatory Commission (NRC) in its Rules and Regulations: Part 20 has established standards for your protection against radiation hazards from radioactive material under license issued by the NRC; Part 19 has established certain provisions for the options of workers engaged in NRC licensed activities; Parts 30, 40, 50, and other parts containing provisions related to employee protection.

POSTING REQUIREMENTS Copies of this notice must be posted in a sufficient number of places in every establishment where activities licensed by the NRC are conducted, to permit employees to observe a copy on the way to or from their place of employment.

YOUR EMPLOYER'S RESPONSIBILITY

Your employer is required to—

1. Apply these NRC regulations and the conditions of his NRC license to all work under the license.
2. Post or otherwise make available to you a copy of the NRC regulations, licenses, and operating procedures which apply to work you are engaged in, and explain their provisions to you.
3. Post Notices of Violation involving radiological working conditions, proposed imposition of civil penalties and orders.
4. Refrain from discriminatory acts against employees who provide information to NRC.

YOUR RESPONSIBILITY AS A WORKER

You should familiarize yourself with those provisions of the NRC regulations, and the operating procedures which apply to the work you are engaged in. You should observe their provisions for your own protection and protection of your co-workers.

WHAT IS COVERED BY THESE NRC REGULATIONS

1. Limits on exposure to radiation and radioactive material in restricted and unrestricted areas;
2. Measures to be taken after accidental exposure;
3. Personnel monitoring, surveys and equipment;
4. Caution signs, labels, and safety interlock equipment;
5. Exposure records and reports;
6. Options for workers regarding NRC inspections;
7. Identifies "protected activities" that employees may engage in;
8. Prohibits discrimination against employees who engage in these protected activities;
9. Identifies the Department of Labor as a source of relief in the event of discrimination; and
10. Related matters.

REPORTS ON YOUR RADIATION EXPOSURE HISTORY

1. The NRC regulations require that your employer give you a written report if you receive an exposure in excess of any applicable limit as set forth in the regulations or in the license. The basic limits for exposure to employees are set forth in Section 20.101, 20.103, and 20.104 of the Part 20 regulations. These Sections specify limits on exposure to radiation and exposure to concentrations of radioactive material in air.
2. If you work where personnel monitoring is required pursuant to Section 20.202;
   (a) your employer must give you a written report of your radiation exposures upon the termination of your employment, if you request it, and
   (b) your employer must advise you annually of your exposure to radiation, if you request it.

INSPECTIONS

All activities under the license are subject to inspection by representatives of the NRC. In addition, any worker or representative of workers who believes that there is a violation of the Atomic Energy Act of 1954, the regulations issued thereunder, or the terms of the employer's license with regard to radiological working conditions in which the worker is engaged, may request an inspection by sending a notice of the alleged violation to the appropriate United States Nuclear Regulatory Commission Regional Office (shown on map below). The request must set forth the specific grounds for the notice, and must be signed by the worker or the representative of the workers. During inspections, NRC inspectors may confer privately with workers, and any worker may bring to the attention of the inspectors any past or present condition which he believes contributed to or caused any violation as described above.

EMPLOYEE PROTECTION

If an employee believes that discrimination has occurred due to engaging in the "protected activities" said employees may, within 30 days of the discriminatory act, file a complaint with the Department of Labor, Employment Standards Administration, Wage and Hour Division. The Department of Labor shall conduct an investigation and shall, where discrimination has occurred, issue an order providing relief to the employee if relief is not provided by other means of settlement.

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The amended Atomic Energy Act, section 235, provides criminal penalties against any individual who kills, forcibly assaults, resists, opposes, impedes, intimidates or interferes with any person who performs any inspections which (1) are related to any activity or facility licensed by the Commission, and (2) are carried out to satisfy requirements under the Atomic Energy Act or under any other Federal law covering the safety of licensed facilities or the safety of radioactive materials. The acts described above are criminal not only if taken against inspection personnel who are engaged in the performance of such inspection duties, but also if taken against inspection personnel on account of such duties.

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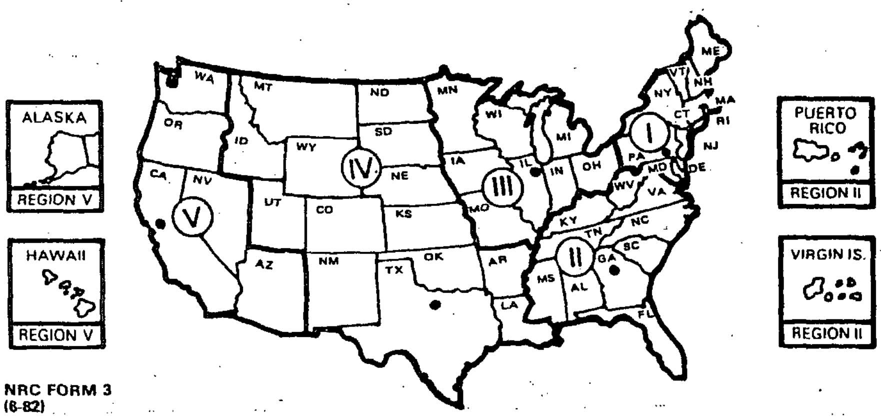

Regional Offices

REGION	ADDRESS	TELEPHONE
I	U.S. Nuclear Regulatory Commission Region I 631 Park Avenue King of Prussia, PA 19406	215 337-5000
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NRC FORM 3
(6-82)

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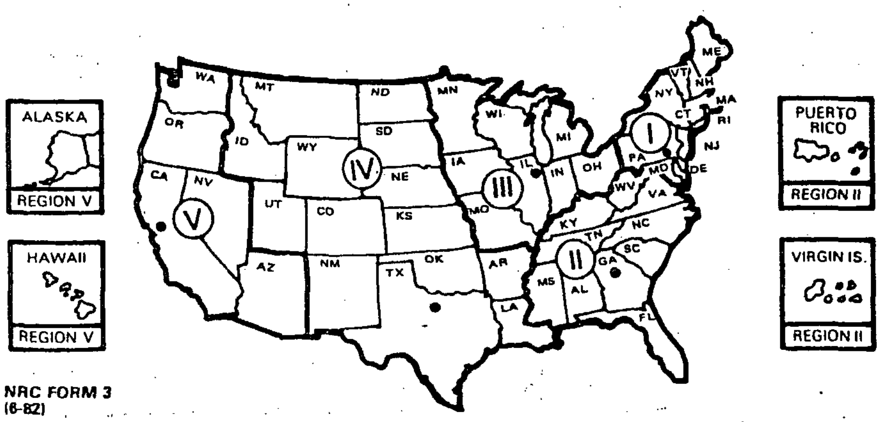

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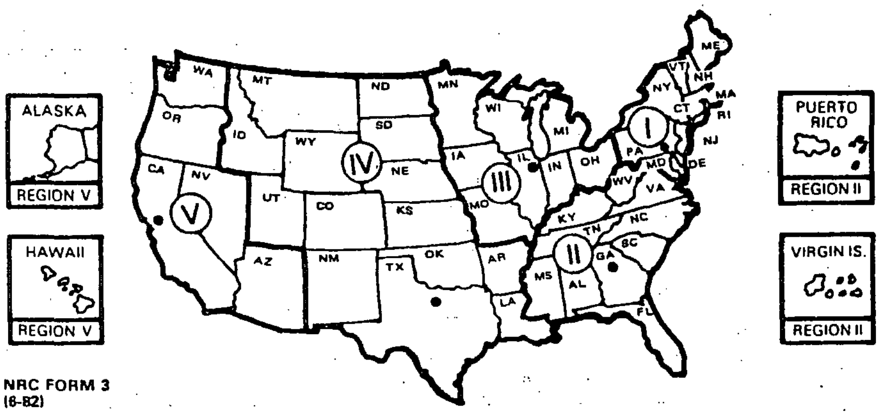

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I	U.S. Nuclear Regulatory Commission Region I 631 Park Avenue King of Prussia, PA 19406	215 337-5000
II	U.S. Nuclear Regulatory Commission Region II 101 Marietta St., N.W., Suite 3100 Atlanta, GA 30303	404 221-4503
III	U.S. Nuclear Regulatory Commission Region III 799 Roosevelt Road Glen Ellyn, IL 60137	312 932-2500
IV	U.S. Nuclear Regulatory Commission Region IV 611 Ryan Plaza Drive, Suite 1000 Arlington, TX 76012	817 465-8100
V	U.S. Nuclear Regulatory Commission Region V 1450 Maria Lane, Suite 210 Walnut Creek, CA 94596	415 943-3700

NRC FORM 3
(6-82)

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

SAFE HANDLING, STORAGE, AND TRANSPORTATION OF CALIBRATOR SET, RADIAC AN/UDM-2 NSN 6665-00-179-9037

Headquarters, Department of the Army, Washington, DC
9 January 1978

TB 11-6665-227-12, 2 July 1975, is changed as follows:
AMSEL is changed to DRSEL in the following places:

Page 3. Paragraph 3.
Paragraph 5d.
Paragraph 8*a*(2) and (3).
Paragraph 8*b*(1).
Page 4. Paragraph 8*b*(4), (6), and (7).
Paragraph 9*a*. in NOTES 2.
Page 5. Paragraph 11*q*.
Paragraph 12.
Page 6. Paragraph 14*b*(3).

Page 2. Safety Precautions. Change the last two sentences to read: Calibrator Set, Radiac AN/UDM-2 is issued throughout the Army under Nuclear Regulatory Commission (NRC) license held by the US Army Electronics Command Safety Office at Fort Monmouth, New Jersey. Information about the NRC license may be requested by letter to: Commander, US Army Electronics Command, ATTN: DRSEL-SF-H Fort Monmouth, New Jersey 07703. The Safety Office may also be contacted by telephone on AUTOVON 992-3493.

Page 5. Paragraph 10*d*, line 2: Change "daily," to "monthly."

Line 3: Delete "when in use, for possible contamination."

Paragraph a10*f* is added after paragraph 10*e*:

f. Form NRC-3, Notice to Employees, contained in this bulletin, may be removed for posting wherever the AN/UDM-2 is used and/or stored. The posting requirements are contained on the form.

By Order of the Secretary of the Army:

BERNARD W. ROGERS
General, United States Army
Chief of Staff

Official:

J. C. PENNINGTON
Brigadier General, United States Army
The Adjutant General

To be distributed in accordance with DA Form 12-50, Operator maintenance requirements for AN/UDM-2.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1977-765-096/436

Encl 8

17750

UNITED STATES NUCLEAR REGULATORY COMMISSION
Washington, D.C. 20555

NOTICE TO EMPLOYEES

STANDARDS FOR PROTECTION AGAINST RADIATION (PART 20); NOTICES, INSTRUCTIONS AND REPORTS TO WORKERS; INSPECTIONS (PART 19); EMPLOYEE PROTECTION

The Nuclear Regulatory Commission (NRC) in its Rules and Regulations: Part 20 has established standards for your protection against radiation hazards from radioactive material under license issued by the NRC; Part 19 has established certain provisions for the options of workers engaged in NRC licensed activities; Parts 30, 40, 50, and other parts containing provisions related to employee protection.

POSTING REQUIREMENTS Copies of this notice must be posted in a sufficient number of places in every establishment where activities licensed by the NRC are conducted, to permit employees to observe a copy on the way to or from their place of employment.

YOUR EMPLOYER'S RESPONSIBILITY

Your employer is required to—

1. Apply these NRC regulations and the conditions of his NRC license to all work under the license.
2. Post or otherwise make available to you a copy of the NRC regulations, licenses, and operating procedures which apply to work you are engaged in, and explain their provisions to you.
3. Post Notices of Violation involving radiological working conditions, proposed imposition of civil penalties and orders.
4. Refrain from discriminatory acts against employees who provide information to NRC.

YOUR RESPONSIBILITY AS A WORKER

You should familiarize yourself with those provisions of the NRC regulations, and the operating procedures which apply to the work you are engaged in. You should observe their provisions for your own protection and protection of your co-workers.

WHAT IS COVERED BY THESE NRC REGULATIONS

1. Limits on exposure to radiation and radioactive material in restricted and unrestricted areas;
2. Measures to be taken after accidental exposure;
3. Personnel monitoring, surveys and equipment;
4. Caution signs, labels, and safety interlock equipment;
5. Exposure records and reports;
6. Options for workers regarding NRC inspections;
7. Identifies "protected activities" that employees may engage in;
8. Prohibits discrimination against employees who engage in these protected activities;
9. Identifies the Department of Labor as a source of relief in the event of discrimination; and
10. Related matters.

REPORTS ON YOUR RADIATION EXPOSURE HISTORY

1. The NRC regulations require that your employer give you a written report if you receive an exposure in excess of any applicable limit as set forth in the regulations or in the license. The basic limits for exposure to employees are set forth in Section 20.101, 20.103, and 20.104 of the Part 20 regulations. These Sections specify limits on exposure to radiation and exposure to concentrations of radioactive material in air.
2. If you work where personnel monitoring is required pursuant to Section 20.202;
   (a) your employer must give you a written report of your radiation exposures upon the termination of your employment, if you request it, and
   (b) your employer must advise you annually of your exposure to radiation, if you request it.

INSPECTIONS

All activities under the license are subject to inspection by representatives of the NRC. In addition, any worker or representative of workers who believes that there is a violation of the Atomic Energy Act of 1954, the regulations issued thereunder, or the terms of the employer's license with regard to radiological working conditions in which the worker is engaged, may request an inspection by sending a notice of the alleged violation to the appropriate United States Nuclear Regulatory Commission Regional Office (shown on map below). The request must set forth the specific grounds for the notice, and must be signed by the worker or the representative of the workers. During inspections, NRC inspectors may confer privately with workers, and any worker may bring to the attention of the inspectors any past or present condition which he believes contributed to or caused any violation as described above.

EMPLOYEE PROTECTION

If an employee believes that discrimination has occurred due to engaging in the "protected activities" said employees may, within 30 days of the discriminatory act, file a complaint with the Department of Labor, Employment Standards Administration, Wage and Hour Division. The Department of Labor shall conduct an investigation and shall, where discrimination has occurred, issue an order providing relief to the employee if relief is not provided by other means of settlement.

PROTECTION OF INSPECTORS

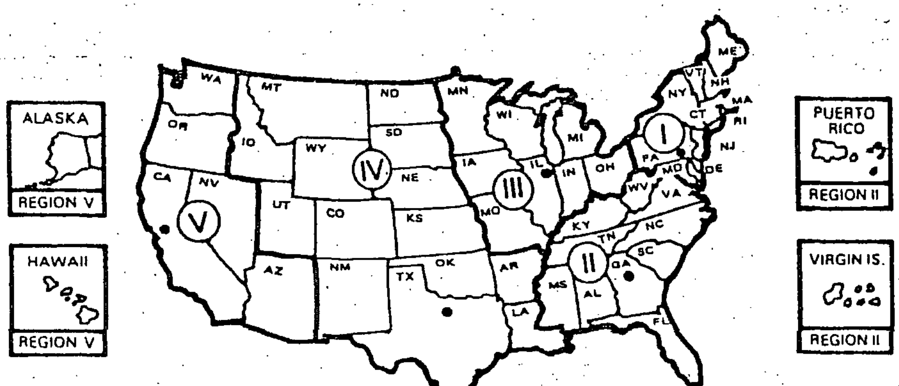
The amended Atomic Energy Act, section 235, provides criminal penalties against any individual who kills, forcibly assaults, resists, opposes, impedes, intimidates or interferes with any person who performs any inspections which (1) are related to any activity or facility licensed by the Commission, and (2) are carried out to satisfy requirements under the Atomic Energy Act or under any other Federal law covering the safety of licensed facilities or the safety of radioactive materials. The acts described above are criminal not only if taken against inspection personnel who are engaged in the performance of such inspection duties, but also if taken against inspection personnel on account of such duties.

SABOTAGE OF NUCLEAR FACILITIES OR FUEL

The amended Atomic Energy Act, section 236, provides criminal penalties against any individual who intentionally and willfully destroys or causes physical damage, or attempts to do so, to any production, utilization, or waste storage facility licensed under the act, or any nuclear fuel or spent fuel regardless of location.

UNITED STATES NUCLEAR REGULATORY COMMISSION REGIONAL OFFICE LOCATIONS

A representative of the Nuclear Regulatory Commission can be contacted at the following addresses and telephone numbers. The Regional Office will accept collect telephone calls from employees who wish to register complaints or concerns about radiological working conditions or other matters regarding compliance with Commission rules and regulations.



Regional Offices

REGION	ADDRESS	TELEPHONE
I	U.S. Nuclear Regulatory Commission Region I 631 Park Avenue King of Prussia, PA 19406	215 337-5000
II	U.S. Nuclear Regulatory Commission Region II 101 Marietta St., N.W., Suite 3100 Atlanta, GA 30303	404 221-4503
III	U.S. Nuclear Regulatory Commission Region III 799 Roosevelt Road Glen Ellyn, IL 60137	312 932-2500
IV	U.S. Nuclear Regulatory Commission Region IV 611 Ryan Plaza Drive, Suite 1000 Arlington, TX 76012	817 465-8100
V	U.S. Nuclear Regulatory Commission Region V 1450 Maria Lane, Suite 210 Walnut Creek, CA 94596	415 943-3700

NRC FORM 3
(6-82)

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

SAFE HANDLING, STORAGE, AND TRANSPORTATION OF CALIBRATOR SET, RADIAC AN/UDM-2 NSN 6665-00-179-9037

Headquarters, Department of the Army, Washington, DC
2 July 1975

1. Purpose. This bulletin prescribes the minimum safety precautions that are essential during the handling, storage, issue, transportation, accountability, and use of Calibrator Set, Radiac AN/UDM-2.

NOTE

Official nomenclature followed by (*) is used to indicate all models of the equipment covered in this bulletin. Thus, Radiac Set AN/PDR-27(*) represents Radiac Sets AN/PDR-27J, AN/PDR-27L, AN/PDR-27P, AN/PDR-27Q, and AN/PDR-27R and later models.

2. Indexes of Publications. *a. DA Pam 310-4.* Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

3. Reporting of Errors. Reporting of errors, omissions, and recommendations for improving this bulletin by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Change to Publications and Blank Forms) and forwarded direct to Commander, US Army Electronics Command, ATTN: AMSEL-MA-Q, Fort Monmouth, New Jersey 07703.

4. Description. Calibrator Set, Radiac AN/UDM-2 contains a total of 100.020 millicuries of Strontium 90 (Sr^{90}) and consists of Calibrator, Radiac TS-3494/UDM-2 and Calibrator, Radiac TS-3495/UDM-2. Calibrator, Radiac TS-3494/UDM-2 contains 25 millicuries of Sr^{90} and is used to calibrate Radiacmeters IM-174/PD and IM-174A/PD, Radiac Set AN/PDR-27(*), Radiac Set AN/PDR-60, and Aerial Radiac System AN/ADR-6. Calibrator, Radiac TS-3495/UDM-2 contains three 25 millicurie Sr^{90} and one 20 microcurie SR^{90} sources. It is used for serviceability testing of Radiacmeters IM-9E/PD, IM-147/PD and IM-93(*)/UD.

5. Calibrator Set, Radiac AN/UDM-2, General. *a.* Calibrator Set, Radiac AN/UDM-2 is marked in accordance with Code of Federal Regulations Title 10, Part 20 and MIL-STD-1458.

b. Calibrator Set, Radiac AN/UDM-2 is nonexpendable.

c. Calibrator Set, Radiac AN/UDM-2 may be transferred only to another qualified radiological protection officer (RPO) (paragraph 9).

d. Calibrator Set, Radiac AN/UDM-2 will be disposed of only on instructions of Commander, US Army Electronics Command, ATTN: AMSEL-MM-S-CS-TA-1, Fort Monmouth, New Jersey 07703.

e. Wipe tests must be performed at intervals not to exceed 6 months on all Calibrator Sets, Radiac AN/UDM-2, except those sets in combat areas.

f. All correspondence relating to certification of radiological protection officers or control of Calibrator Set, Radiac AN/UDM-2 should be addressed Commander, US Army Electronics Command, ATTN: AMSEL-SF, Fort Monmouth, New Jersey 07703 through the radioactive material control point.

6. Inherent Danger. *a.* The radioactive Strontium-Yttrium 90 sources in Calibrator Set, Radiac AN/UDM-2 emit beta radiation. Interaction of this beta radiation with the radiac calibrator set housing results in the emission of secondary X-rays (Bremsstrahlung). Excessive absorption of ionizing radiation by the human body may be injurious (AR 40-14). The radioactive sources *will not* be removed from the radiac calibrator set, except by qualified personnel of nucleonics facilities established at the Lexington-Blue Grass and Sacramento Army Depots, CONUS, or other installations having an Atomic Energy Commission (AEC) License authorizing maintenance of Calibrator Set, Radiac AN/UDM-2.

b. Familiarity with these criteria and strict observance of the health protection procedures contained in the following paragraphs are essential.

7. Applicability. The provisions of this technical bulletin apply to all persons and activities who have the responsibility for the handling, transportation, storage, and use of any issued Calibrator Set, Radiac AN/UDM-2. This technical bulletin does not apply to the Army stocks of radiac calibrator sets stored in depots.

8. Responsibility. *a. Responsibilities of Major Commands.*

(1) Establishing at least one Radioactive Material Control Point (RMCP) (AR 725-1).

(2) Appointing a Radiological Control Officer (RCO) for each RMCP and forwarding two copies of appointee's orders and qualifications to Commander, US Army Electronics Command, ATTN: AMSEL-SF, Fort Monmouth, New Jersey 07703.

(3) Developing implementation procedures to insure periodic leak testing and forwarding two copies of procedures to Commander, US Army Electronics Command, ATTN: AMSEL-SF, Fort Monmouth, New Jersey 07703.

(4) Forwarding leak test smears to nearest approved smear counting station for evaluation.

(5) Insuring that each installation or activity using the AN/UDM-2 has an effective radiation protection program.

b. Responsibilities of Radiological Control Officer (RCO).

(1) Review and approve the qualifications of each local Radiological Protection Officer (RPO) for the AN/UDM-2 and forward to Commander, US Army Electronics Command, ATTN: AMSEL-SF,

0.5 rem in one calendar year. Unnecessary exposure of personnel in this area will not be permitted. (For the purpose of this document, 1 millirem is equal to 1 milliroentgen or millirad).

b. Store Calibrator Set, Radiac AN/UDM-2 in a locked container or area that permits external gamma radiation levels in potentially occupied areas no greater than 0.5 millirems per hour (mr/hr). Access to the container stored in a locked area shall be controlled by the radiological protection officer. Storage instructions are as follows:

(1) One or more AN/UDM-2's may be stored in a locked container constructed of wood or metal. The size of the container may be varied; however, the gamma radiation level on the outside of the container shall not exceed 0.5 mr/hr. The inside of the container may be lined with sheet lead to reduce the radiation intensity to an acceptable level. The container must be marked in accordance with MIL-STD-1458.

(2) One or more AN/UDM-2's may be stored in a locked room of such dimensions and construction that the gamma radiation level at any point *outside* the room does not exceed 0.5 mr/hr.

c. Only authorized, qualified personnel will be permitted to enter the storage or calibration areas alone. These areas will be physically secured and safeguarded when in use. Visitors must be escorted by the RPO or a qualified user and must be briefed on radiation hazards and precautions to minimize these hazards.

d. Storage areas and areas where equipment is being calibrated will be monitored at least daily, when in use, for possible contamination. Table of Allowance (TA) 50-914 (Individual Safety and Protective Clothing and Equipment) authorizes one each Radiac Set AN/PDR-27(*) per work group requiring radiation monitoring protection.

e. Personnel monitoring devices will be used when entering the storage or calibration areas or when operating Calibrator Set, Radiac AN/UDM-2 (AR 40-14). Operators will use wrist-type film badges in addition to regular body-type badges.

11. Duties of Radiological Protection Officer for AN/UDM-2. The specific duties of the appointed radiological protection officer will be to:

a. Insure that AN/UDM-2's under his jurisdiction are properly used and stored.

b. Train local users and operators and maintain list and record of training of users and operators.

c. Insure records are maintained on each item.

d. Advise RMCP of any forthcoming change in accountability, local RPO, or installation relocation for the AN/UDM-2.

e. Submit Radiation Incident Report according to published directives.

f. Establish radiation controlled areas for AN/UDM-2 storage and use.

g. Post Radiation Area warning signs.

h. Insure items are stored in a fire-resistant structure and no explosives of any kind are stored in the same structure.

i. Immediately refer actual or suspected overexposure to medical officer.

j. Insure film badges and pocket dosimeters are worn when required and that film badge exposures are recorded.

k. Insure that periods of time between leak tests do not exceed 6 months and supervise performance of leak tests.

l. Secure items against unauthorized use and removal.

m. Insure that all Army and Federal regulations are being followed and that personnel are exposed to a minumum of radiation consistent with practical considerations.

n. Conduct a physical inventory according to published frequencies.

o. Submit inventory, leak test, and other reports to RMCP as required.

p. Prior to relief from duties, place all AN/UDM-2's under this jurisdiction in locked storage.

q. Investigate each case of excessive or abnormal exposure to determine the cause, recommend remedial action to prevent recurrence, and submit a complete written report to the Commander, US Army Electronics Command, ATTN: AMSEL-SF, Fort Monmouth, NJ 07703 within 24 hours (para 8*b*(6)).

12. Requisitioning Procedure. Stations in CONUS and Oversea supply agencies will submit requisitions through *radioactive material supply* channels to Commander, US Army Electronics Command, ATTN: AMSEL-MM-S-CS-TA-1, Fort Monmouth, New Jersey 07703, for issue to certified Radiological Protection Officers. All requisitions will be accompanied by the name of the Radiological Protection/Control Officer who is to be responsible for the equipment. In addition, each request will include the following certification: "As required by chapter 3, AR 725-1, sufficient safety equipment, facilities, and trained personnel are available at this installation for the safe handling, use and storage of radioactive material ordered on this requisition." The certification must have the signature and the typed name and grade of the appropriate radiological control officer.

13. Leak Testing Procedure. *a. Safety Precautions.* The RPO is required to perform the leak test. Each person performing the leak test will wear a film badge.

b. Performing Calibrator, Radiac TS-3495/UDM-2 leaking calibrator is:

(1) Discontinue use of the calibrator. Cover it with plastic, seal it with tape, and label it as contaminated.

(2) Monitor personnel, equipment, and areas for possible contamination and decontaminate as required.

(3) Report the item to the Radioactive Material Control Point and to the US Army Electronics Command.

(4) Dispose of the AN/UDM-2 as directed by Lexington-Blue Grass Army Depot or the Radioactive Material Control Point.

(5) Report the completed disposal action to the US Army Electronics Command and the Radioactive Material Control Point.

By Order of the Secretary of the Army:

FRED C. WEYAND
General, United States Army
Chief of Staff

Official:

VERNE L. BOWERS
Major General, United States Army
The Adjutant General

DISTRIBUTION:
To be distributed in accordance with DA Form 12-50 (qty rqr block no. 65), Operator requirements for AN/UDM-2.

GPO 942 537

DRSEL-SF-MR

31 May 1984

MEMORANDUM FOR RECORD

SUBJECT: TB 11-6665-227-12, Safe Handling, Storage and Transportation of Calibrator Set, Radiac AN/UDM-2 (NSN 6665-00-179-9037)

Subject revised TB has been forwarded to the Directorate of Maintenance Engineering, CECOM, for edit, review and publication.

Prepared by: Joseph M Santarsiero
JOSEPH M. SANTARSIERO
Health Physicist

Reviewed by: Barry J. Silber
BARRY J. SILBER
Chief, Radiological Engr Br
Materiel Safety Engr Div

Approved by: Barry J. Silber
for STEVEN A. HORNE
Chief, Materiel Safety Engr Div
Safety Office

DRAFT

TB 11-6665-227-12

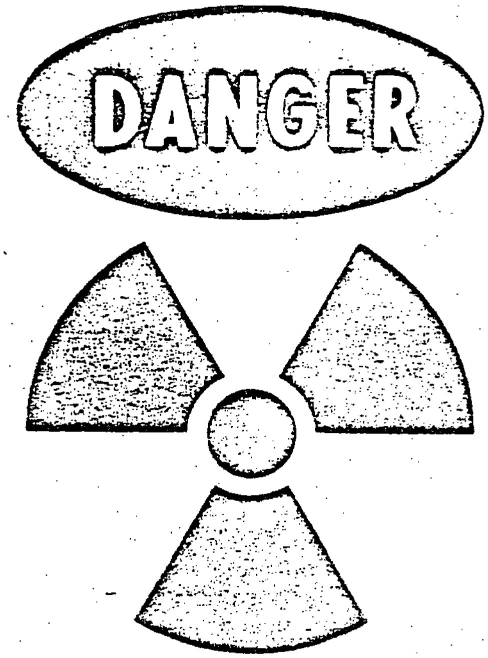
DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

SAFE HANDLING, STORAGE, AND TRANSPORTATION OF CALIBRATOR SET, RADIAC AN/UDM-2 NSN 6665-00-179-9037

Headquarters, Department of the Army, Washington, DC

Paragraph Page

Encl 8



SAFETY PRECAUTIONS

Calibrator Set, Radiac AN/UDM-2 will be used only under the direction of a Radiation Protection Officer. Do not eat, drink, or smoke while using or handling the AN/UDM-2. After handling the AN/UDM-2 wash the hands thoroughly with warm water and mild soap. Dry the hands thoroughly and monitor them for radioactive contamination with the AN/PDR-27(*) Radiac Set or equivalent. Do not place hands or body in front of the open port of the calibrator. Calibrator Set, Radiac AN/UDM-2 is used throughout the Army under a US Nuclear Regulatory Commission (NRC) license held by the US Army Communications-Electronics Command Safety Office, Fort Monmouth, New Jersey. Information about the NRC license may be requested by letter to: Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703. The Safety Office may also be contacted by telephone on Autovon 995-4427 or commercial (201) 544-4427.

1. PURPOSE. This bulletin prescribes the minimum safety precautions that are essential during the handling, storage, issue, transportation, accountability, and use of Calibrator Set, Radiac AN/UDM-2.

NOTE

Official nomenclature followed by (*) is used to indicate all models of the equipment covered in this bulletin. Thus, Radiac Set AN/PDR-27(*) represents Radiac Sets AN/PDR-27J, AN/PDR-27L, AN/PDR-27P, AN/PDR-27Q, ~~and~~ AN/PDR-27R and later models.

2. INDEXES OF PUBLICATIONS. a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders pertaining to the equipment.

3. REPORTING OF ERRORS. Reporting of errors, omissions, and recommendations for improving this bulletin by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Change to Publications and Blank Forms) and forwarded direct to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703 and copy furnished to the CECOM Safety Office, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703.

4. DESCRIPTION. Calibrator Set, Radiac AN/UDM-2 contains a total of 180.0 millicuries of Strontium 90 (Sr-90) and consists of Calibrator, Radiac TS-3494/UDM-2 and Calibrator, Radiac TS-3495/UDM-2. Calibrator, Radiac TS-

3494/UDM-2 contains 45 millicuries of Sr-90 and is used to calibrate contingent Radiacmeters IM-174(*)/PD, Radiac Set AN/PDR 27(*), Radiac Set AN/PDR-60, Aerial Radiac System AN/ADR-6, and Radiac Set AN/VDR-2. Calibrator, Radiac TS-3495/UDM-2 contains 135 millicuries of Sr-90 and is used for serviceability testing of Radiacmeters IM-9(*)/PD, IM-147/PD, IM-93(*)/UD, and IM-185(*)/UD.

5. CALIBRATOR SET, RADIAC AN/UDM-2, GENERAL. a. Calibrator Set, Radiac AN/UDM-2 is marked in accordance with Title 10, Code of Federal Regulations, Part 20.

b. Calibrator Set, Radiac AN/UDM-2 is nonexpendable.

c. Calibrator Set, Radiac AN/UDM-2 may be transferred only to another qualified Radiation Protection Officer (RPO) (paragraph 9).

d. Calibrator Set, Radiac AN/UDM-2 will be disposed of only on instructions of Commander, US Army Communications-Electronics Command, ATTN: DRSEL-MME-VC, Fort Monmouth, NJ 07703.

e. Leak tests must be performed at intervals not to exceed six months on all Calibrator Sets, Radiac AN/UDM-2, except those sets in combat areas.

f. All correspondence relating to certification of RPO's or control of Calibrator Set, Radiac AN/UDM-2 should be addressed to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703 through the Radioactive Material Control Point (RMCP).

6. INHERENT DANGER. a. The radioactive Sr- 90 sources in Calibrator Set, Radiac AN/UDM-2 emit beta radiation. Interaction of this beta radiation with the radiac calibrator set housing results in the emission of X-rays (Bremsstrah-

lung). Excessive absorption of ionizing radiation by the human body may be injurious (AR 40-14). The radioactive sources will not be removed from the radiac calibrator set, except by qualified personnel located at Lexington-Blue Grass Depot Activity (LBDA).

b. Familiarity with these criteria and strict observance of the radiation protection procedures contained in the following paragraphs are essential.

7. APPLICABILITY. The provisions of this technical bulletin (TB) apply to all persons and activities who have the responsibility for the handling, transportation, storage, and use of any issued Calibrator Set, Radiac AN/UDM-2. This TB does not apply to the Army stocks of radiac calibrator sets stored in authorized storage depots.

8. RESPONSIBILITY. a. Responsibilities of Major Commands.

(1) Establish at least one RMCP (AR 385-11).

(2) Appoint a Radiation Control Officer (RCO) for each RMCP and forward two copies of appointee's orders and qualifications to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703.

(3) Develop implementation procedures to insure periodic leak testing and forwarding two copies of procedures to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703.

(4) Forward leak and wipe test smears to the approved smear counting station for evaluation.

(5) Insure that each installation or activity using the AN/UDM-2 has an effective and documented radiation protection program .

b. Responsibilities of Radiation Control Officer.

(1) Review and approve the qualifications of each local RPO for the AN/UDM-2 and forward to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703, a list of these local RPO's and their qualifications for approval and certification.

(2) If a qualified local RPO is not available, take one or more of the following actions:

(a) Suspend the requisition for the AN/UDM-2.

(b) Suspend the use of AN/UDM-2 until someone can be qualified by training.

(c) Transfer the AN/UDM-2 to an installation or activity with qualified personnel.

(3) Maintain the following records for each AN/UDM-2 under his control:

(a) National stock number.

(b) Description.

(c) Serial number.

(d) Isotope, source activity.

(e) Dates and results of leak tests.

(f) Shipment number.

(g) Shipped from.

(h) Shipped to.

(i) Date shipped.

(j) Name and qualifications of local RPO's.

(k) Radiation incident reports.

(4) Notify Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703, within 30 days of permanent transfer of AN/UDM-2 within <u>or</u> between major commands.

(5) Insure that AN/UDM-2 is properly handled in accordance with Army and NRC regulations. Periodically inspect and audit records of installations and activities possessing the AN/UDM-2.

(6) Assure that a Radiation Incident Report is submitted by electrical means to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703, within 24 hours, when an incident occurs.

(7) Forward DA Form 3252-R (Radioisotope Inventory and Leak Test Report) (RCS DRC 192) listing all Calibrator Sets, Radiac AN/UDM-2 in area of responsibility to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703 at least semi-annually (31 January and 31 July). Reports may include information on other CECOM managed calibration and test items of supply listed in AR 385-11.

9. SUPERVISION. a. All calibration in which Calibrator Set, Radiac AN/UDM-2 is used will be supervised by a qualified RPO. Supervision in this sense is used to indicate performance of all duties listed in paragraph 11. To be a qualified RPO, a person must have received a <u>minimum of 40 hours</u> formal training on radiation including the following topics:

(1) Principles and practices of radiation protection.

(2) Biological effects of radiation.

(3) Radioactivity measurement standardization and monitoring techniques and instruments.

(4) Mathematics and calculations basic to the use and measurement of radioactivity.

(5) The operation and use of the AN/UDM-2.

NOTES

1. Completion of the Radiological Safety Course or the Radiac Calibrator Custodian Course at the US Army Chemical School or at the US Army Ordnance Center and School meet these requirements.

2. Where circumstances warrant, alternate training may be substituted if this training is approved by Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703. Such training must be received under the guidance of a qualified RPO, and must include at least 16 hours of actual experience in the use of the AN/UDM-2.

By Order of the Secretary of the Army:

FRED C. WEYAND
General, United States Army
Chief of Staff

Official:

VERNE L. BOWERS
Major General, United States Army
The Adjutant General

DISTRIBUTION:
To be distributed in accordance with DA Form 12-50 (qty rqr block no. 65), Operator requirements for AN/UDM-2.

GPO 942 537

DRSEL-SF-MR

31 May 1984

MEMORANDUM FOR RECORD

SUBJECT: TB 11-6665-227-12, Safe Handling, Storage and Transportation of Calibrator Set, Radiac AN/UDM-2 (NSN 6665-00-179-9037)

Subject revised TB has been forwarded to the Directorate of Maintenance Engineering, CECOM, for edit, review and publication.

Prepared by: Joseph M Santarsiero
JOSEPH M. SANTARSIERO
Health Physicist

Reviewed by: Barry J. Silber
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Chief, Radiological Engr Br
Materiel Safety Engr Div

Approved by: Barry J. Silber
for STEVEN A. HORNE
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DRAFT

TB 11-6665-227-12

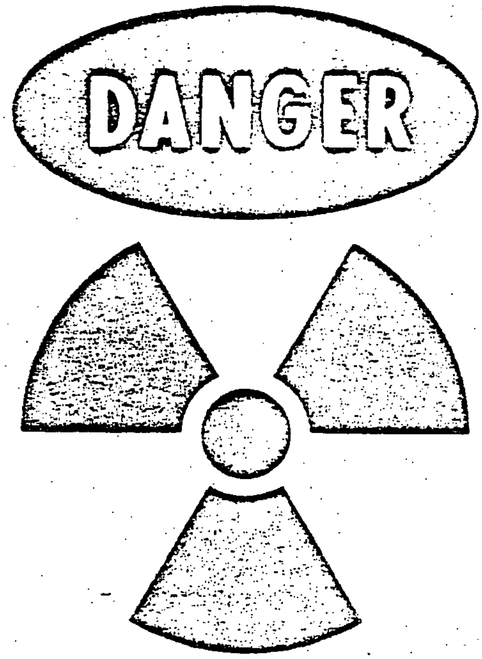
DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

SAFE HANDLING, STORAGE, AND TRANSPORTATION OF CALIBRATOR SET, RADIAC AN/UDM-2 NSN 6665-00-179-9037

Headquarters, Department of the Army, Washington, DC

Paragraph Page

Encl 8



SAFETY PRECAUTIONS

Calibrator Set, Radiac AN/UDM-2 will be used only under the direction of a Radiation Protection Officer. Do not eat, drink, or smoke while using or handling the AN/UDM-2. After handling the AN/UDM-2 wash the hands thoroughly with warm water and mild soap. Dry the hands thoroughly and monitor them for radioactive contamination with the AN/PDR-27(*) Radiac Set or equivalent. Do not place hands or body in front of the open port of the calibrator. Calibrator Set, Radiac AN/UDM-2 is used throughout the Army under a US Nuclear Regulatory Commission (NRC) license held by the US Army Communications-Electronics Command Safety Office, Fort Monmouth, New Jersey. Information about the NRC license may be requested by letter to: Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703. The Safety Office may also be contacted by telephone on Autovon 995-4427 or commercial (201) 544-4427.

1. PURPOSE. This bulletin prescribes the minimum safety precautions that are essential during the handling, storage, issue, transportation, accountability, and use of Calibrator Set, Radiac AN/UDM-2.

NOTE

Official nomenclature followed by (*) is used to indicate all models of the equipment covered in this bulletin. Thus, Radiac Set AN/PDR-27(*) represents Radiac Sets AN/PDR-27J, AN/PDR-27L, AN/PDR-27P, AN/PDR-27Q, ~~and~~ AN/PDR-27R and later models.

2. INDEXES OF PUBLICATIONS. a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders pertaining to the equipment.

3. REPORTING OF ERRORS. Reporting of errors, omissions, and recommendations for improving this bulletin by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Change to Publications and Blank Forms) and forwarded direct to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703 and copy furnished to the CECOM Safety Office, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703.

4. DESCRIPTION. Calibrator Set, Radiac AN/UDM-2 contains a total of 180.0 millicuries of Strontium 90 (Sr-90) and consists of Calibrator, Radiac TS-3494/UDM-2 and Calibrator, Radiac TS-3495/UDM-2. Calibrator, Radiac TS-

3494/UDM-2 contains 45 millicuries of Sr-90 and is used to calibrate contingent Radiacmeters IM-174(*)/PD, Radiac Set AN/PDR 27(*), Radiac Set AN/PDR-60, Aerial Radiac System AN/ADR-6, and Radiac Set AN/VDR-2. Calibrator, Radiac TS-3495/UDM-2 contains 135 millicuries of Sr-90 and is used for serviceability testing of Radiacmeters IM-9(*)/PD, IM-147/PD, IM-93(*)/UD, and IM-185(*)/UD.

5. CALIBRATOR SET, RADIAC AN/UDM-2, GENERAL. a. Calibrator Set, Radiac AN/UDM-2 is marked in accordance with Title 10, Code of Federal Regulations, Part 20.

b. Calibrator Set, Radiac AN/UDM-2 is nonexpendable.

c. Calibrator Set, Radiac AN/UDM-2 may be transferred only to another qualified Radiation Protection Officer (RPO) (paragraph 9).

d. Calibrator Set, Radiac AN/UDM-2 will be disposed of only on instructions of Commander, US Army Communications-Electronics Command, ATTN: DRSEL-MME-VC, Fort Monmouth, NJ 07703.

e. Leak tests must be performed at intervals not to exceed six months on all Calibrator Sets, Radiac AN/UDM-2, except those sets in combat areas.

f. All correspondence relating to certification of RPO's or control of Calibrator Set, Radiac AN/UDM-2 should be addressed to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703 through the Radioactive Material Control Point (RMCP).

6. INHERENT DANGER. a. The radioactive Sr- 90 sources in Calibrator Set, Radiac AN/UDM-2 emit beta radiation. Interaction of this beta radiation with the radiac calibrator set housing results in the emission of X-rays (Bremsstrah-

lung). Excessive absorption of ionizing radiation by the human body may be injurious (AR 40-14). The radioactive sources will not be removed from the radiac calibrator set, except by qualified personnel located at Lexington-Blue Grass Depot Activity (LBDA).

b. Familiarity with these criteria and strict observance of the radiation protection procedures contained in the following paragraphs are essential.

7. APPLICABILITY. The provisions of this technical bulletin (TB) apply to all persons and activities who have the responsibility for the handling, transportation, storage, and use of any issued Calibrator Set, Radiac AN/UDM-2. This TB does not apply to the Army stocks of radiac calibrator sets stored in authorized storage depots.

8. RESPONSIBILITY. a. Responsibilities of Major Commands.

(1) Establish at least one RMCP (AR 385-11).

(2) Appoint a Radiation Control Officer (RCO) for each RMCP and forward two copies of appointee's orders and qualifications to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703.

(3) Develop implementation procedures to insure periodic leak testing and forwarding two copies of procedures to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703.

(4) Forward leak and wipe test smears to the approved smear counting station for evaluation.

(5) Insure that each installation or activity using the AN/UDM-2 has an effective and documented radiation protection program .

b. Responsibilities of Radiation Control Officer.

(1) Review and approve the qualifications of each local RPO for the AN/UDM-2 and forward to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703, a list of these local RPO's and their qualifications for approval and certification.

(2) If a qualified local RPO is not available, take one or more of the following actions:

(a) Suspend the requisition for the AN/UDM-2.

(b) Suspend the use of AN/UDM-2 until someone can be qualified by training.

(c) Transfer the AN/UDM-2 to an installation or activity with qualified personnel.

(3) Maintain the following records for each AN/UDM-2 under his control:

(a) National stock number.

(b) Description.

(c) Serial number.

(d) Isotope, source activity.

(e) Dates and results of leak tests.

(f) Shipment number.

(g) Shipped from.

(h) Shipped to.

(i) Date shipped.

(j) Name and qualifications of local RPO's.

(k) Radiation incident reports.

(4) Notify Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703, within 30 days of permanent transfer of AN/UDM-2 within <u>or</u> between major commands.

(5) Insure that AN/UDM-2 is properly handled in accordance with Army and NRC regulations. Periodically inspect and audit records of installations and activities possessing the AN/UDM-2.

(6) Assure that a Radiation Incident Report is submitted by electrical means to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703, within 24 hours, when an incident occurs.

(7) Forward DA Form 3252-R (Radioisotope Inventory and Leak Test Report) (RCS DRC 192) listing all Calibrator Sets, Radiac AN/UDM-2 in area of responsibility to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703 at least semi-annually (31 January and 31 July). Reports may include information on other CECOM managed calibration and test items of supply listed in AR 385-11.

9. SUPERVISION. a. All calibration in which Calibrator Set, Radiac AN/UDM-2 is used will be supervised by a qualified RPO. Supervision in this sense is used to indicate performance of all duties listed in paragraph 11. To be a qualified RPO, a person must have received a minimum of 40 hours formal training on radiation including the following topics:

(1) Principles and practices of radiation protection.

(2) Biological effects of radiation.

(3) Radioactivity measurement standardization and monitoring techniques and instruments.

(4) Mathematics and calculations basic to the use and measurement of radioactivity.

(5) The operation and use of the AN/UDM-2.

NOTES

1. Completion of the Radiological Safety Course or the Radiac Calibrator Custodian Course at the US Army Chemical School or at the US Army Ordnance Center and School meet these requirements.

2. Where circumstances warrant, alternate training may be substituted if this training is approved by Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703. Such training must be received under the guidance of a qualified RPO, and must include at least 16 hours of actual experience in the use of the AN/UDM-2.

b. The person appointed as RPO may be a commissioned officer, a warrant officer, enlisted person, or civilian, if he/she meets the minimum qualifications prescribed above. An RPO/designated custodian for the AN/UDM-2 is a specified person designated to control the use of the AN/UDM-2.

c. The operator or user of the AN/UDM-2 shall have a minimum of 8 hours training under the guidance of a qualified RPO for the AN/UDM-2 in the basic fundamentals of radiological operations, radiac instrumentation theory and application and survey techniques and 16 hours on-the-job training in operation and care of the AN/UDM-2. Instructions shall include safe working practices and inherent hazards associated with the instrument.

10. STORAGE AND WORK AREAS. a. Storage areas and work areas where the AN/UDM-2 is used will be considered radioactive material/radiation areas and will be marked in accordance with AR 385-30. If the radiation area is in the same vicinity of areas which are occupied by the individuals who are not designated as radiation workers, the radiation level in the unmarked area must be such that personnel will not be exposed to ionizing radiation in excess of 2 millirems in any one hour; or 100 millirems in any 7 consecutive days; or 0.5 rem in one calendar year. Unnecessary exposure of personnel in this area will not be permitted. (For the purpose of this document, 1 millirem is equal to 1 milliroentgen or millirad).

b. Store Calibrator Set, Radiac AN/UDM-2 in a locked container or area that permits external gamma radiation levels in potentially occupied areas no greater than 2.0 millirems per hour (mrem/hr). Access to the container stored in a locked area shall be controlled by the RPO. Storage instructions are as follows:

(1) One or more AN/UDM-2's may be stored in a locked container constructed of wood or metal. The size of the container may be varied; however, the gamma radiation level on the outside of the container shall not exceed 2.0 mrem/hr. The inside of the container may be lined with sheet lead to reduce the radiation intensity to an acceptable level. The container must be marked in accordance with AR 385-30.

(2) One or more AN/UDM-2's may be stored in a locked room of such dimensions and construction that the gamma radiation level at any point outside the room does not exceed 2.0 mrem/hr.

(3) Storage containers and rooms will be marked as radioactive materials storage in accordance with AR 385-30.

c. Only authorized, qualified personnel will be permitted to enter the storage or calibration areas alone. These areas will be physically secured and safeguarded when in use. Visitors must be escorted by the RPO or a qualified user and must be briefed on radiation hazards and precautions to minimize these hazards.

d. Storage areas and areas where equipment is being calibrated will be surveyed and documented at least monthly (Appendix B, sample survey form).

e. AN/PDR-27(*) or equivalent will be used to monitor radiation areas at all times when equipment is being calibrated with the AN/UDM-2.

f. AN/PDR-27(*) or equivalent radiac sets that are used to survey and monitor the AN/UDM-2 storage and calibration areas will be marked with embossing tape, with the word "Active" and must be calibrated at two points on each scale by a source traceable to the National Bureau of Standards. This requirement specifically excludes the use of the AN/UDM-2 as a calibration source for Active (Health and Safety) survey meters.

g. The cyclic calibration interval for Active survey meters is 90 days (TB 43-180).

h. Personnel monitoring devices will be used when entering the storage or calibration areas or when operating Calibrator Set, Radiac AN/UDM-2 (AR 40-14). Operators will use wrist-type film badges in addition to whole body badges.

i. Form NRC-3, Notice to Employees, contained in this TB, should be removed for posting wherever the AN/UDM-2 is used and/or stored. The posting requirements are contained on the form.

j. Section 206, "Energy Reorganization Act of 1974", (10 CFR Part 21) contained in this TB, should be removed for posting whenever the AN/UDM-2 is used and/or stored. The posting requirements are contained in Appendix D.

11. DUTIES OF THE RADIATION PROTECTION OFFICER FOR THE AN/UDM-2. The specific duties of the appointed RPO will be to:

a. Insure that AN/UDM-2's under their jurisdiction are properly used and stored.

b. Train local users and operators and maintain list and record of training of users and operators.

c. Insure records are maintained on each item.

d. Advise the RMCP of any forthcoming change in accountability, local RPO, or installation relocation for the AN/UDM-2.

e. Establish radioactive material/radiation areas for AN/UDM-2 storage and use.

f. Post Caution-Radiation Area and Caution-Radioactive Materials warning signs as appropriate.

g. Insure the AN/UDM-2 Radiac Calibrator Sets are stored in a fire-resistant structure and no explosives of any kind are stored in the same structure.

h. Insure film badges are worn as required and that film badge exposures are recorded.

i. Insure that periods of time between leak tests do not exceed 6 months and perform the leak tests.

j. Secure the AN/UDM-2 Radiac Calibrator Set against unauthorized use and removal.

k. Insure that all Army and Federal regulations are being followed and that personnel are exposed to a minimum of radiation consistent with practical considerations.

l. Conduct a semi-annual physical inventory.

m. Submit inventory, leak test, and other reports to RMCP as required.

n. Prior to relief from duties, place all AN/UDM-2's under this jurisdiction in locked storage or transfer to authorized activity.

o. Immediately refer actual or suspected overexposure to medical officer.

p. Submit Radiation Incident Report according to published directives.

q. Investigate each case of excessive or abnormal exposure to determine the cause, recommend remedial action to prevent recurrence, and submit a complete written report to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703, within 24 hours (paragraph 8b(5)).

12. REQUISITIONING PROCEDURE. Stations in CONUS and oversea supply agencies will submit requisitions through RMCP channels to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-MME-VC, Fort Monmouth, NJ 07703, for issue to certified RPOs. All requisitions will be accompanied by the name and phone number of the RPO who is to be responsible for the equipment. In addition, each request will include the following certification: "As required by Chapter 3, AR 385-11, sufficient safety equipment, facilities, and trained personnel are available at this installation for the safe handling, use and storage of radioactive material ordered on this requisitions." The certification must have the signature and the typed name and grade of the appropriate RPO.

13. LEAK TESTING PROCEDURE.

a. General.

(1) Safety Precautions.

(a) The RPO is required to perform the leak test and must be thoroughly familiar with the equipment.

b. Each person performing the leak test will wear whole body and wrist film badges.

c. Do not under any circumstance expose the eyes to the radiation field by peering into the access hole while the swivel cover is swung aside on the discharge well assembly (TS-3495/UDM-2).

(2) Equipment required.

(a) Cotton swabs furnished by the US Army Ionizing Radiation Dosimetry Center (AIRDC) at LBDA.

(b) Distilled or clean tap water.

(c) Plastic bags furnished by AIRDC.

(d) Radiacmeter AN/PDR-27(*).

(e) Long nose pliers.

b. Leak Test - Discharge Well Assembly (TS-3495/UDM-2).

(1) Take the cotton swab furnished and fill in the date and serial number on the paper tab.

(2) Moisten the swab with distilled or clean tap water.

(3) Swing aside the swivel cover.

(4) Using the moistened swab and long nose pliers carefully wipe the inside surface of the access hole.

WARNING

After removal of the swab from the access hole, <u>DO</u> <u>NOT</u> lay the swab down or allow it to touch any other object.

(5) Using the procedure in subparagraph d below, check the swab for contamination.

c. Leak Test-Doserate Jig Assembly (TS-3494/UDM-2).

(1) Repeat steps 1 and 2, paragraph 13b, above.

(2) Open the drawer in the Doserate Jig.

(3) Using a moistened cotton swab, wipe the inside and outside surfaces of the drawer.

(4) Close the drawer.

WARNING

After wiping the drawer, <u>DO</u> <u>NOT</u> lay the swab down or allow it to touch any other object.

(5) Using the procedure in subparagraph d below, check the swab for contamination.

d. Checking for contamination and mailing cotton swabs.

NOTE

Perform the following procedures in an area that is free from all radiation, except for normal background radiation.

(1) Adjust Radiac Meter, AN/PDR-27(*), to measure 0 to 0.5 mR/hr.

(2) Open cover on end of probe.

(3) Place the cotton swab approximately 1/4 inch in front of the probe and note the indication: DO NOT TOUCH THE PROBE WITH THE COTTON SWAB.

WARNING

Any sustained reading on the AN/PDR-27(*) above twice background or 0.1 mR/hr indicates contamination of the AN/UDM-2. Discontinue use of the AN/UDM-2 immediately, and refer to paragraph 16 for action to be taken.

(4) Place the cotton swab in the plastic bag provided and proceed as follows:

(a) If no detectable reading is observed on the AN/PDR-27(*), place the plastic bag and swab in the self-addressed envelope provided, and mail immediately to AIRDC.

(b) If a reading is observed on the AN/PDR-27(*), in excess of 0.1 mR/hr or twice the background, the plastic bag and swab should be placed in a small cardboard box and mailed to AIRDC.

WARNING

The radiation reading at the surface of the box must not exceed 0.4 mR/hr. If the measured radiation is more than 0.4 mR/hr, wrap a thin sheet of lead, aluminum, or other metal around the plastic bag and place in a small cardboard box and recheck the surface radiation.

14. TRANSPORTATION OF THE AN/UDM-2. The AN/UDM-2 requires shipment in accordance with the requirements of the US Department of Transportation (DOT) as set forth in Title 49, Code of Federal Regulations (49 CFR), AR 385-11 and NRC License 29-01022-08.

a. Upon receipt of the AN/UDM-2 contact the US Army Communications-Electronics Command Safety Office by phone on Autovon 995-4427 or commercial (201) 544-4427 or by electronic means, ATTN: DRSEL-SF-MR.

b. Shipment of AN/UDM-2 by US Postal Service is prohibited (USPS Publication 52).

c. For shipment of the AN/UDM-2 to be in accordance with the above regulations and NRC license the following requirements must be met.

(1) The AN/UDM-2, consisting of both TS-3494/UDM-2 and TS 3495/UDM-2, meets the requirements for Type "A", DOT-7A shipping container. When assembling the AN/UDM-2, care must be taken to assure that the manual valve located on the TS-3494/UDM-2 is turned clockwise to the closed position to avoid damaging the manual valve. It should be noted that a damaged manual valve may void the AN/UDM-2 container from being considered as a Type "A", DOT-7A shipping container. To prevent damage to the painted surface and to provide space for shipping labels, a cardboard overpack is required.

(2) The overpack must be sealed with fiber tape, labelled on opposite sides with Radioactive Yellow-II labels (49 CFR 172.403) and marked with 1/2 inch or larger letters with the following: TYPE 'A' DOT-7A, RADIOACTIVE MATERIAL, SPE-

CIAL FORM, NOS, UN 2974.

(3) A shipping package wipe test must be performed to assure that no significant removable radioactive surface contamination exists on the exterior of the package (49 CFR 173.443, 173.475 (i)).

(a) The wipe test procedure to be used is contained in paragraph 15 of this TB. A DOT wipe test kit is provided by AIRDC.

(b) The wipe test must be performed within two weeks prior to the desired shipping date.

(c) Evaluation of the wipe test must be received from AIRDC prior to shipment.

4. Report of shipment (RESHIP) must be transmitted to the receiving installation transportation officer (AR 385-11, paragraph 4-1) with information copy to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703.

5. The following information must be listed on the shipping documentation as required by 49 CFR 172.200, 172.202, 172.203(d), 172.204, and AR 385-11, paragraph 4-1a.

(a) Proper shipping name: RADIOACTIVE MATERIAL, SPECIAL FORM, NOS.

(b) Hazardous Material Identification Number: UN 2974.

(c) Pieces, weight and volume: Required.

(d) Type of packaging: Type "A" DOT-7A.

(e) Radioactive material: Strontium-90

(f) Description of chemical and physical form: SPECIAL FORM.

(g) Activity: 180.0 millicuries or as indicated on the AN/UDM-2.

(h) Type label required: Radioactive Yellow-II.

(i) Shipper's certification: Required.

(k) NRC License Number: 29-01022-08.

(l) Exposure rate at the package surface and at one meter: As determined by RPO.

(m) Results of package wipe test: As determined by AIRDC.

6. Commercial air shipment of the AN/UDM-2 requires, in addition to 5 above, a "cargo aircraft only" label on opposite sides of the shipping package and the words "Cargo Aircraft Only" listed on the shipping documentation (49 CFR 175.30).

7. Basic requirements for shipment of radioactive materials by military (USAF Cargo) aircraft are contained in Chapter 12 of AFR 71-4/TM 38-250.

15. WIPE TESTING PROCEDURE FOR SHIPMENT.

a. The shipping package wipe test is performed for compliance to DOT regulations, to assure that no significant removable radioactive surface contamination is located on the exterior of the shipping package.

WARNING

The NuCon Smear is never to be used for sealed source leak testing (paragraph 13) of the AN/UDM-2 Radiac Calibrator Set, Dosimeter Discharge Well Assembly or Doserate Jig Assembly. It is <u>only</u> to be utilized in the wipe testing of the exterior surfaces of the outer shipping package incorporating the AN/UDM-2 Radiac Calibrator Set.

b. Equipment required:

(1) NuCon Smear (1.75 inch diameter circular cloth adhered to an associated paper jacket).

(2) Envelope, pre-addressed to AIRDC.

(3) Radiac Meter, AN/PDR-27(*).

c. Wipe test procedure.

(1) Record date, name of the individual performing the test, and serial number(s) of the AN/UDM-2 Radiac Calibrator(s) on the jacket of the NuCon Smear.

(2) With the NuCon Smear retained within its jacket and using moderate finger pressure, wipe on all exterior surfaces of the package for a total of at least 300 square centimeters (about 48 square inches).

d. Checking for contamination and mailing the NuCon Smear.

NOTE

Perform the following procedure in an area that is free from all radiation, except for normal background radiation.

(1) Adjust Radiac Meter, AN/PDR-27(*) to measure 0 to 0.5 mR/hr.

(2) Open cover on end of probe.

(3) Place the NuCon Smear approximately 1/4 inch in front of the probe and note the indication: DO NOT TOUCH THE PROBE WITH THE NUCON SMEAR.

WARNING

Any sustained reading on the AN/PDR-27(*) above twice background or 0.1 mR/hr indicates contamination of the shipping package. Secure shipping package to prevent the spread of contamination and refer to paragraph 16d for action to be taken.

(4) If no detectable reading is observed on the AN/PDR-27(*), place the NuCon Smear in the self-addressed envelope provided, and mail immediately to AIRDC.

(5) If a reading is observed on the AN/PDR-27(*), in excess of 0.1 mR/hr or twice the background, the NuCon Smear should be placed in a small cardboard box and mailed to AIRDC.

WARNING

The radiation reading at the surface of the box must not exceed 0.4 mR/hr. If the measured radiation is more than 0.4 mR/hr, wrap a thin sheet of lead, aluminum, or other metal around the NuCon Smear and place in a small cardboard box and recheck the surface radiation.

(6) Notification of the results of the shipping package wipe test must be received from AIRDC prior to making shipment of the AN/UDM-2 Radiac Calibrator Set(s).

16. EMERGENCY PROCEDURES. The procedures outlined below will be followed in an emergency situation.

a. Loss of Calibrator.

(1) Attempt to recover the radiac calibrator set.

(a) Review records to determine the responsibile individual.

(b) Make a physical survey.

(2) If the radiac calibrator set is recovered, revise procedures as necessary to prevent a recurrence.

(3) If the radiac calibrator set is not recovered, report the loss through command channels to the RMCP (AR 385-11) and to the US Army Communications-Electronics Command Safety Office stating the serial number of the radiac calibrator set, the circumstances involved, and the action taken to prevent recurrence.

b. Excessive Personnel Exposure (AR 40-14). If an individual receives a dose of ionizing radiation from an AN/UDM-2 in an amount exceeding 416 millirem in one month, the following actions will be taken:

(1) Obtain immediate medical advice from the Medical Officer.

(2) Remove the individual from duties involving occupational exposure to ionizing radiation until subsequent exposure limitations are established by proper medical authority (AR 40-14).

(3) Prepare written report of circumstances leading to overexposure. Include serial number(s) of the AN/UDM-2 involved, actions taken to prevent recurrence, and other applicable information. Forward the report through proper channels to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-SF-MR, Fort Monmouth, NJ 07703.

c. Damage or Leaking AN/UDM-2. An AN/UDM-2 could begin to leak as a result of being dropped, damage to the source, or even as a result of age. Action required in the event of a known or suspected leaking calibrator is:

(1) Discontinue use of the calibrator. Cover it with plastic, seal it with tape, and label it as contaminated.

(2) Monitor personnel, equipment, and areas for possible contamination and decontaminate as required.

(3) Report the item to the RMCP and to the US Army Communications-Electronics Command.

(4) Dispose of the AN/UDM-2 as directed by the US Army Communications-Electronics Command.

(5) Report the completed disposal action to the US Army Communications-Electronics Command and the RMCP.

d. Contaminated shipping package. If the wipe test procedure (paragraph 15) indicates excessive contamination, the following actions will be taken:

(1) Discontinue shipping procedure.

(2) Cover the shipping package with plastic, seal it with tape, and label it as contaminated.

(3) Monitor personnel, equipment, and areas for possible contamination and decontaminate as required.

Note

See AR 385-11 for contamination limits.

(4) Report the contaminated shipping package to the RMCP and to the US Army Communications-Electronics Command.

APPENDIX A

REFERENCES

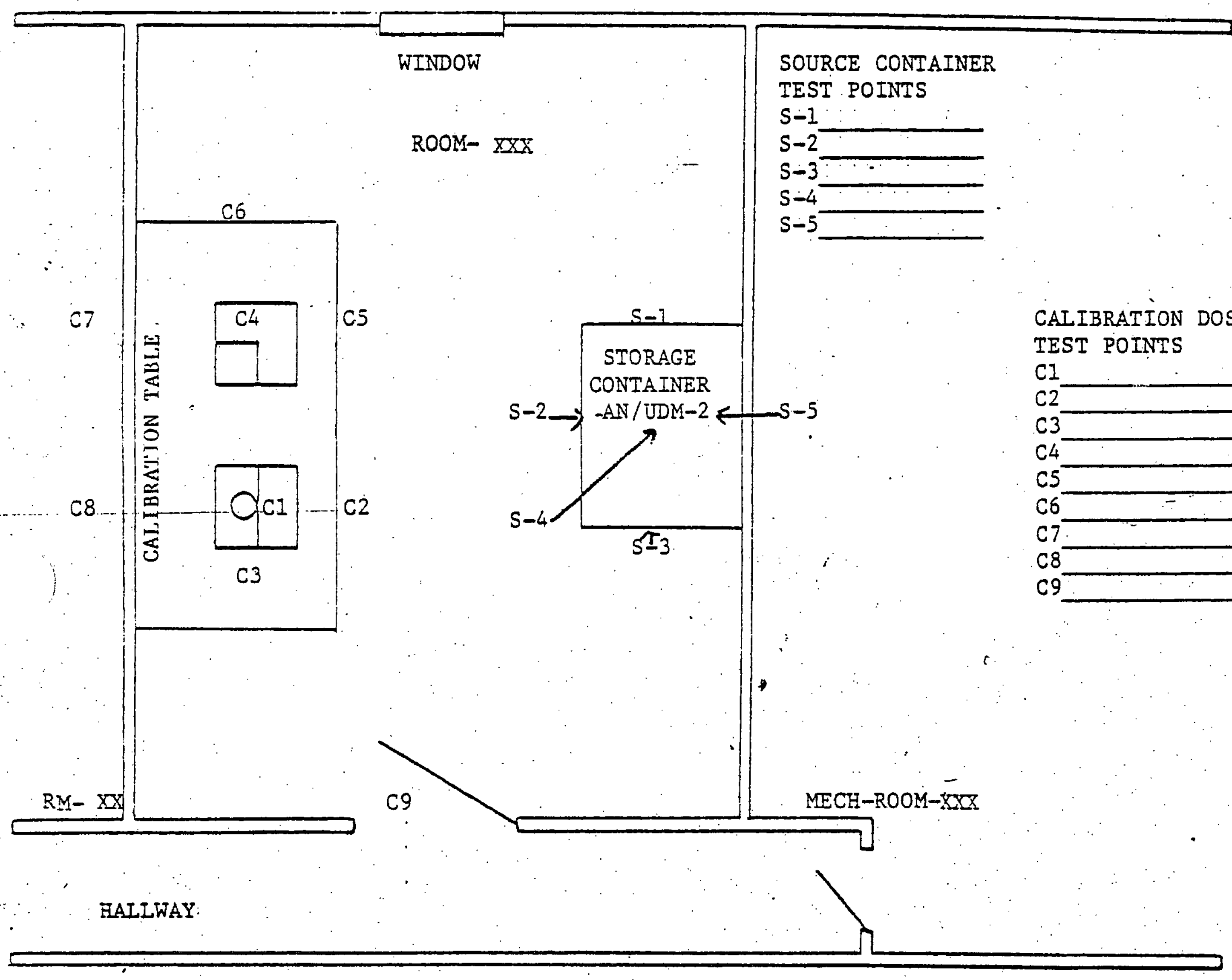
AR 40-14	Control and Recording Procedures for Exposure to Ionizing Radiation and Radioactive Materials (DLAR 1000.28).
AR 385-11	Ionizing Radiation Protection (Licensing, Control, Transportation, Disposal, Radiation Safety).
AR 385-30	Safety Color Code Markings and Signs.
DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9) Supply Bulletins, Lubrication Orders, and Modification Work Orders.
DA Pam 310-7	Index of Modification Work Orders.
MIL STD-129	Marking for Shipment and Storage.
TM 11-6665-209-15	Operator, Organization, DS, GS, and Depot Maintenance Manual Including Repair Parts and Special Tools Lists: Radiac Sets AN/PDR-27J, AN/PDR-27L, and AN/PDR-27Q.
TM 11-6665-213-12	Operator and Organizational Maintenance Manual Including Repair Parts and Special Tools Lists: Radiacmeter IM-174/PD.
TM 11-6665-213-40	Field and Depot Maintenance Manual: Radiacmeter IM-174/PD.
TM 11-6665-224-15	Organizational, Direct Support, General Support, and Depot Maintenance Manual (Including Repair Parts and Special Tools Lists): Radiac Set AN/PDR-27P.
TM 11-6665-228-15	Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manuals Including Parts and Special Tools List: Radiac Set AN/PDR-27G.
TM 11-6665-230-15	Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual Including Repair Parts and Special Tools Lists: Radiac Set AN/PDR-27R.
TM 11-6665-232-12	Operator's and Organizational Maintenance Manual Including Repair Parts and Special Tools List: Radiacmeter IM-174A/PD.

TM 11-6665-232-45	GS and Depot Maintenance Manual, Including Repair Parts and Special Tools List: Radiacmeter IM-174A/PD.
TM 38-750	The Army Maintenance Management System (TAMMS). Standards for Protection Against Radiation.
TB 9-6665-285-15	Army Calibration Program for Radiac Survey Meters.
TB 43-180-1	Calibration and Repair Requirements for the Maintenance of Army Materiel.
Title 10, Code of Federal Regulations, Parts 19, 20 and 21	
Title 49, Code of Federal Regulations.	

APPENDIX B

SAMPLE SURVEY FORM FOR AN/UDM-2

RADIAC ROOM - BLDG XXX



SOURCE CONTAINER
TEST POINTS
S-1 ______
S-2 ______
S-3 ______
S-4 ______
S-5 ______

CALIBRATION DOSE RATE
TEST POINTS
C1 ______
C2 ______
C3 ______
C4 ______
C5 ______
C6 ______
C7 ______
C8 ______
C9 ______

DATE OF SURVEY: ______ TYPE OF SURVEY: IN USE ______

INSTRUMENT TYPE: ______ IN STORAGE ______

CALIBRATION DUE DATE: ______ COMBINED ______

SURVEYED BY: ______

APPENDIX C

UNITED STATES NUCLEAR REGULATORY COMMISSION
Washington, D.C. 20555

NOTICE TO EMPLOYEES

STANDARDS FOR PROTECTION AGAINST RADIATION (PART 20); NOTICES, INSTRUCTIONS AND REPORTS TO WORKERS; INSPECTIONS (PART 19); EMPLOYEE PROTECTION

The Nuclear Regulatory Commission (NRC) in its Rules and Regulations: Part 20 has established standards for your protection against radiation hazards from radioactive material under license issued by the NRC; Part 19 has established certain provisions for the options of workers engaged in NRC licensed activities; Parts 30, 40, 50, and other parts containing provisions related to employee protection.

POSTING REQUIREMENTS Copies of this notice must be posted in a sufficient number of places in every establishment where activities licensed by the NRC are conducted, to permit employees to observe a copy on the way to or from their place of employment.

YOUR EMPLOYER'S RESPONSIBILITY

Your employer is required to—

1. Apply these NRC regulations and the conditions of his NRC license to all work under the license.
2. Post or otherwise make available to you a copy of the NRC regulations, licenses, and operating procedures which apply to work you are engaged in, and explain their provisions to you.
3. Post Notices of Violation involving radiological working conditions, proposed imposition of civil penalties and orders.
4. Refrain from discriminatory acts against employees who provide information to NRC.

YOUR RESPONSIBILITY AS A WORKER

You should familiarize yourself with those provisions of the NRC regulations, and the operating procedures which apply to the work you are engaged in. You should observe their provisions for your own protection and protection of your co-workers.

WHAT IS COVERED BY THESE NRC REGULATIONS

1. Limits on exposure to radiation and radioactive material in restricted and unrestricted areas;
2. Measures to be taken after accidental exposure;
3. Personnel monitoring, surveys and equipment;
4. Caution signs, labels, and safety interlock equipment;
5. Exposure records and reports;
6. Options for workers regarding NRC inspections;
7. Identifies "protected activities" that employees may engage in;
8. Prohibits discrimination against employees who engage in these protected activities;
9. Identifies the Department of Labor as a source of relief in the event of discrimination; and
10. Related matters.

REPORTS ON YOUR RADIATION EXPOSURE HISTORY

1. The NRC regulations require that your employer give you a written report if you receive an exposure in excess of any applicable limit as set forth in the regulations or in the license. The basic limits for exposure to employees are set forth in Section 20.101, 20.103, and 20.104 of the Part 20 regulations. These Sections specify limits on exposure to radiation and exposure to concentrations of radioactive material in air.
2. If you work where personnel monitoring is required pursuant to Section 20.202:
   (a) your employer must give you a written report of your radiation exposures upon the termination of your employment, if you request it, and
   (b) your employer must advise you annually of your exposure to radiation, if you request it.

INSPECTIONS

All activities under the license are subject to inspection by representatives of the NRC. In addition, any worker or representative of workers who believes that there is a violation of the Atomic Energy Act of 1954, the regulations issued thereunder, or the terms of the employer's license with regard to radiological working conditions in which the worker is engaged, may request an inspection by sending a notice of the alleged violation to the appropriate United States Nuclear Regulatory Commission Regional Office (shown on map below). The request must set forth the specific grounds for the notice, and must be signed by the worker or the representative of the workers. During inspections, NRC inspectors may confer privately with workers, and any worker may bring to the attention of the inspectors any past or present condition which he believes contributed to or caused any violation as described above.

EMPLOYEE PROTECTION

If an employee believes that discrimination has occurred due to engaging in the "protected activities" said employees may, within 30 days of the discriminatory act, file a complaint with the Department of Labor, Employment Standards Administration, Wage and Hour Division. The Department of Labor shall conduct an investigation and shall, where discrimination has occurred, issue an order providing relief to the employee if relief is not provided by other means of settlement.

PROTECTION OF INSPECTORS

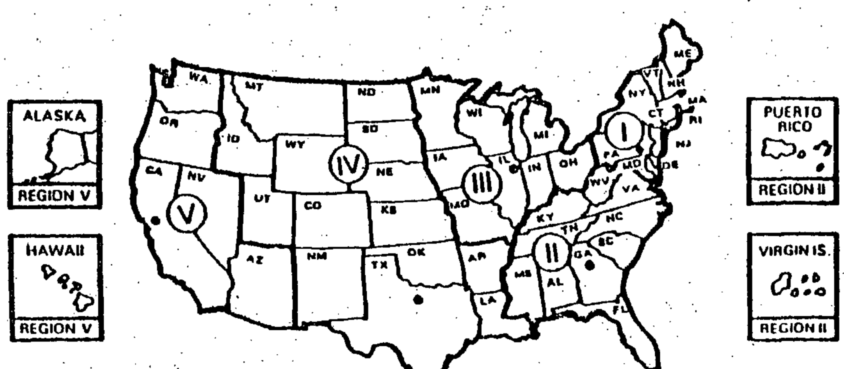
The amended Atomic Energy Act, section 235, provides criminal penalties against any individual who kills, forcibly assaults, resists, opposes, impedes, intimidates or interferes with any person who performs any inspections which (1) are related to any activity or facility licensed by the Commission, and (2) are carried out to satisfy requirements under the Atomic Energy Act or under any other Federal law covering the safety of licensed facilities or the safety of radioactive materials. The acts described above are criminal not only if taken against inspection personnel who are engaged in the performance of such inspection duties, but also if taken against inspection personnel on account of such duties.

SABOTAGE OF NUCLEAR FACILITIES OR FUEL

The amended Atomic Energy Act, section 236, provides criminal penalties against any individual who intentionally and willfully destroys or causes physical damage, or attempts to do so, to any production, utilization, or waste storage facility licensed under the act, or any nuclear fuel or spent fuel regardless of location.

UNITED STATES NUCLEAR REGULATORY COMMISSION REGIONAL OFFICE LOCATIONS

A representative of the Nuclear Regulatory Commission can be contacted at the following addresses and telephone numbers. The Regional Office will accept collect telephone calls from employees who wish to register complaints or concerns about radiological working conditions or other matters regarding compliance with Commission rules and regulations.



Regional Offices

REGION	ADDRESS	TELEPHONE
I	U.S. Nuclear Regulatory Commission Region I 631 Park Avenue King of Prussia, PA 19406	215 337-5000
II	U.S. Nuclear Regulatory Commission Region II 101 Marietta St., N.W., Suite 3100 Atlanta, GA 30303	404 221-4503
III	U.S. Nuclear Regulatory Commission Region III 799 Roosevelt Road Glen Ellyn, IL 60137	312 932-2500
IV	U.S. Nuclear Regulatory Commission Region IV 611 Ryan Plaza Drive, Suite 1000 Arlington, TX 76012	817 465-8100
V	U.S. Nuclear Regulatory Commission Region V 1450 Maria Lane, Suite 210 Walnut Creek, CA 94596	415 943-3700

NRC FORM 3
(6-82)

APPENDIX D

PUBLIC LAW 93-438
93rd CONGRESS, H. R. 11510
OCTOBER 11, 1974

AN ACT

To reorganize and consolidate certain functions of the Federal Government in a new Energy Research and Development Administration and in a new Nuclear Regulatory Commission in order to promote more efficient management of such functions.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SHORT TITLE

Section 1. This Act may be cited as the "Energy Reorganization Act of 1974".

NONCOMPLIANCE

Section 206. (a) Any individual director, or responsible officer of a firm constructing, owning, operating, or supplying the components of any facility or activity which is licensed or otherwise regulated pursuant to the Atomic Energy Act of 1954 as amended, or pursuant to this Act, who obtains information reasonably indicating that such facility or activity or basic components supplied to such facility or activity--

(1) fails to comply with the Atomic Energy Act of 1954 as amended, or any applicable rule, regulation, order, or license of the Commission relating to substantial safety hazards, or

(2) contains a defect which could create a substantial safety hazard, as defined by regulations which the Commission shall promulgate, shall immediately notify the Commission of such failure to comply, or of such defect, unless such person has actual knowledge that the Commission has been adequately informed of such defect or failure to comply.

(b) Any person who knowingly and consciously fails to provide the notice required by subsection (a) of this section shall be subject to a civil penalty in an amount equal to the amount provided by section 234 of the Atomic Energy Act of 1954, as amended.

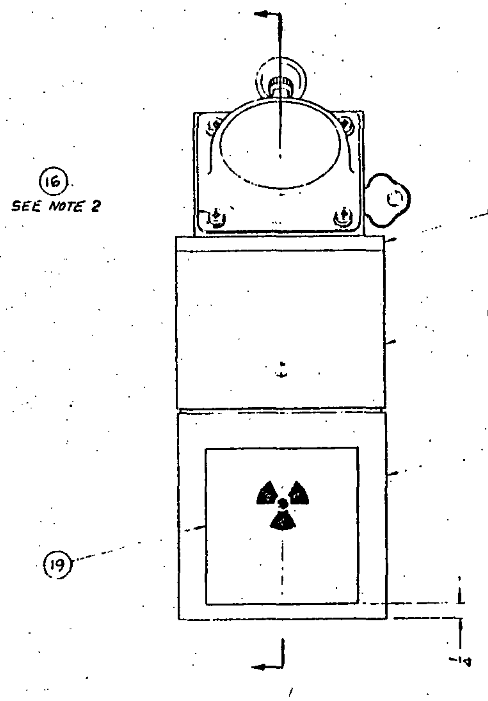
(c) The requirements of this section shall be prominently posted on the premises of any facility licensed or otherwise regulated pursuant to the Atomic Energy Act of 1954, as amended.

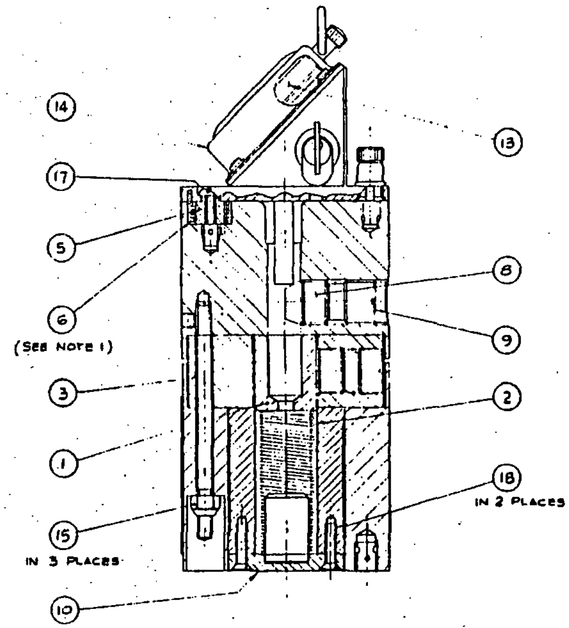
(d) The Commission is authorized to conduct such reasonable inspections and other enforcement activities as needed to insure compliance with the provisions of this section.

NOTE
DATA MARKED WITH AN ASTERISK (*) IS PECULIAR TO A PRIOR MANUFACTURER. IT DOES NOT TAKE PRECEDENCE OVER ANY OTHER DATA ON THIS DRAWING, AND IS NOT CONTRACTUALLY BINDING ON EITHER THE CONTRACTOR OR THE GOVERNMENT

REVISIONS				
LTR	ZONE	DESCRIPTION	DATE	APPROVED
A		REVISED PER ECP 1RP005, NOR 1	15 SEP 80	GS NJ

Encl 9





PART SECTION A-A

NOTES
1. ITEM 6 TO BE ASSEMBLED SO THAT IT IS WOUND 1/8 TURN (45°) IN CLOCKWISE DIRECTION WHEN ITEM 4 IS IN CLOSED POSITION.
2. ADD LOCTITE TO THREADS OF STOPWATCH DIAL SCREWS.

	REQD	PART NO.	DESCRIPTION	SPECIFICATION	NOTE
19	1	SM-C-509025-2	LABEL, RADIATION		
18	2	MS 35259-54	SCREW, MACHINE	FF-S-92	
17	1	MS 35207-266	SCREW, MACHINE	FF-S-92	
16	4	MS 35206-227	SCREW, MACHINE	FF-S-92	2
15	3	SM-B-509045-2	NUT, SELF-LOCKING		
14	1	SM-B-509044	HOLDER, STOPWATCH		
13	1	SM-B-509043	STOPWATCH		
12					
11	1	SM-B-509035	HOUSING ASSY LOWER		
10	1	SM-D-509034	COVER ASSY, BOTTOM		
9	1	SM-D-509029	PLUG, SHIELD		
8	1	SM-B-509048	SOURCE ASSY		
7	1	SM-D-508990	HOUSING ASSY UPPER		
6	1	SM-B-504989	SPRING, PIVOT		
5	1	SM-B-508988	PIVOT		
4	1	SM-D-508986	COVER ASSY, TOP		
3	1	SM-B-508981	SHIELD ASSY		
2	1	SM-B-508980	SPRING, PLATFORM		
1	1	SM-B-508979	PLATFORM, DOSIMETER		

LIST OF PARTS

NEXT ASSY	USED ON
SM-D-508967	DL-508945

APPLICATION

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES ON:

FRACTIONS	DECIMALS	ANGLES
± 1/64	—	—

MATERIAL: —

DA-28-043-AMC-02402B

DRAWN F.J.O
CHECKED
ELECTRONICS COMMAND
REVIEWED ER-1 SM'F
APPROVED ER-1 SM'F
DATE 15 MAY 70

U. S. ARMY ELECTRONICS COMMAND
PROCUREMENT AND PRODUCTION DIRECTORATE
FORT MONMOUTH NEW JERSEY 07703

WELL ASSY.

SIZE D | CODE IDENT NO. 80063 | SM-D-508975
SCALE 1/1 | SHEET —

WHEN REFERRING TO THIS DRAWING STATE DRAWING NO., APPLICABLE ISSUE LETTER IF ANY, AND DATE

THIS DOCUMENT HAS BEEN PURCHASED BY THE GOVERNMENT AND MAY BE REPRODUCED AND USED IN CONNECTION WITH ANY GOVERNMENT PROCUREMENT OR MAINTENANCE OPERATION

NOTE
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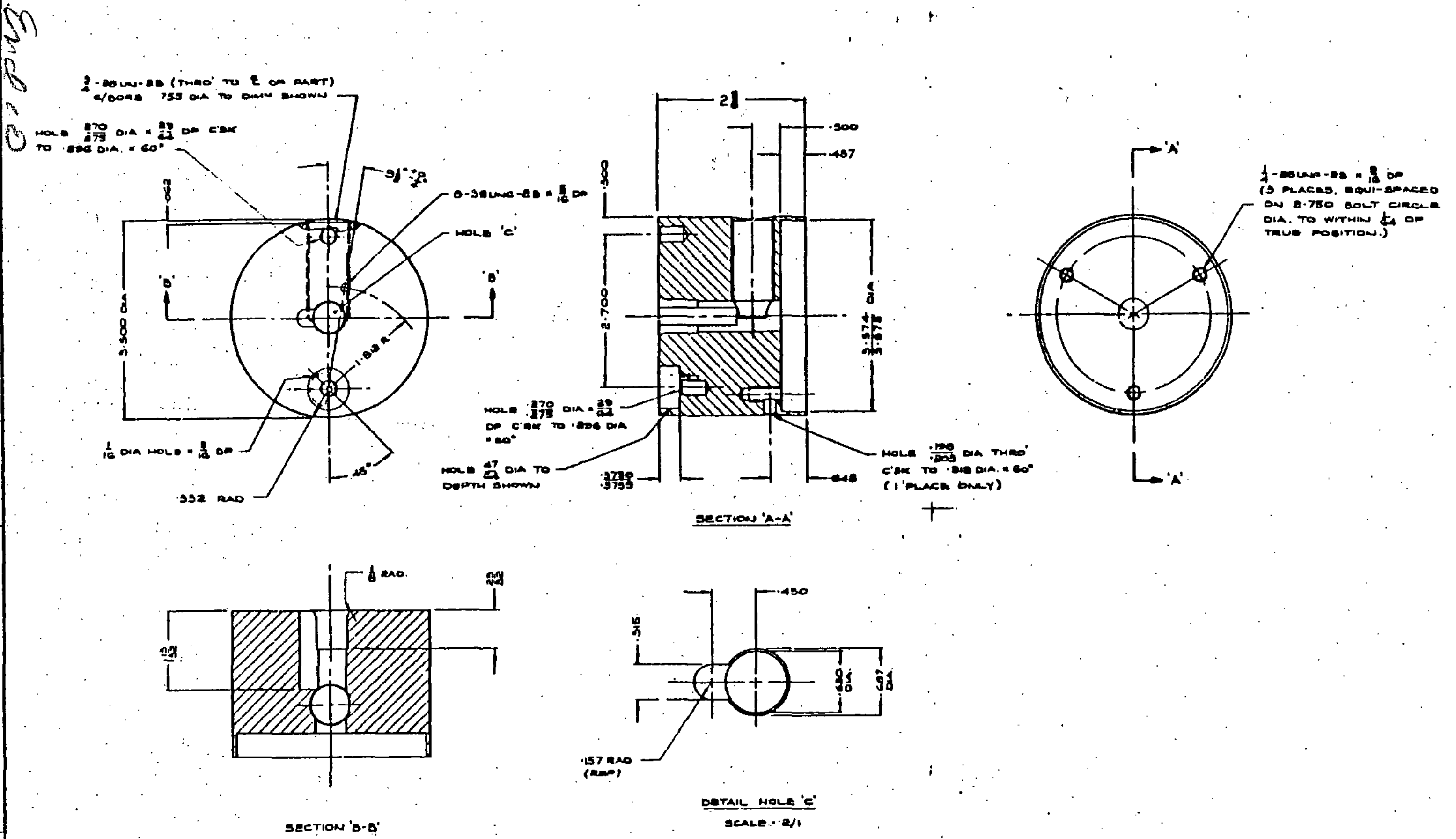
LTR	ZONE	REVISIONS DESCRIPTION	DATE	APPROVED



NOTES :-

1. REMOVE ALL BURRS & SHARP EDGES.
2. ALL SURFACE FINISHES TO BE 125 UNLESS OTHERWISE STATED.
3. FINAL PROTECTIVE FINISH - 5 511 PER SPEC. MIL-F-14072 (BLACK)

REQD	PART NO.	DESCRIPTION	SPECIFICATION	NOTE
LIST OF PARTS				

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES ON: FRACTIONS ± 1/64, DECIMALS ±.005, ANGLES ± 2°	DA-28-043-AMC-02402E
	DRAWN R.J.D.
	CHECKED
MATERIAL: AL / ALLOY BAR 6061-T6 PER. SPEC -QQ-A-225/8	ELECTRONICS COMMAND
	REVIEWED ER-1 SM'F
	APPROVED ER-1 SM'F
	DATE 19 JUN 70

NEXT ASSY	USED ON
SM-D-[illegible]	DL-[illegible]
APPLICATION	

U. S. ARMY ELECTRONICS COMMAND
PROCUREMENT AND PRODUCTION DIRECTORATE
FORT MONMOUTH NEW JERSEY 07703

HOUSING, UPPER.

SIZE	CODE IDENT NO.	
D	80063	SM-D-508991
SCALE 1/1		SHEET -

WHEN REFERRING TO THIS DRAWING STATE DRAWING NO., APPLICABLE ISSUE LETTER IF ANY, AND DATE

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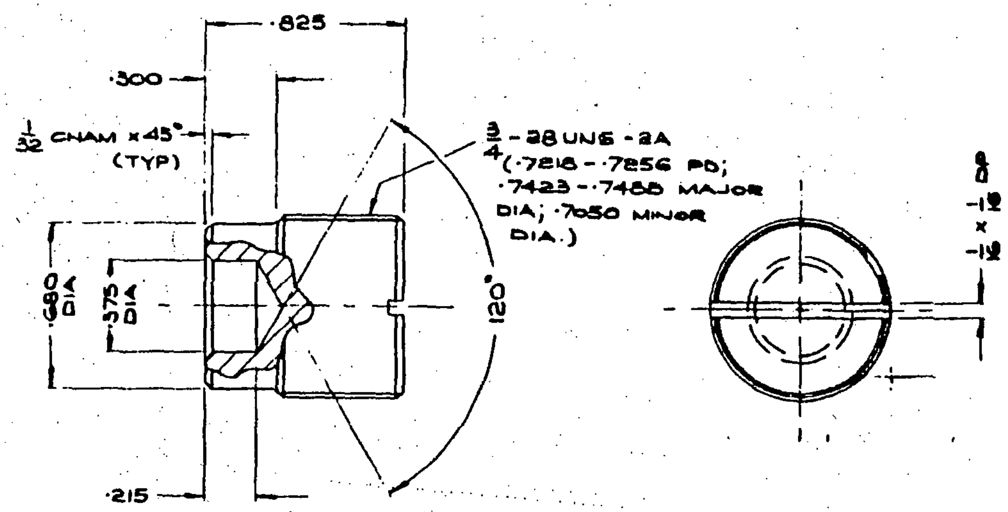
REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

Encl 11



NOTES:-

1. REMOVE ALL BURRS & SHARP EDGES
2. FINAL PROTECTIVE FINISH:- M262 PER SPEC. MIL-F-14072

ITEM	REQD	PART NO.	DESCRIPTION	SPECIFICATION	NOTE

LIST OF PARTS

SM-D-508975	DL-508965
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES ± 2°

MATERIAL: BRASS, COMP 22, 1/2 H PER. SPEC. QQ-B-626

DA-28-043-AMC-02402E

DRAWN F.J.O

CHECKED

ELECTRONICS COMMAND

REVIEWED ER-1 SMF

APPROVED ER-1 SMF

DATE 21 FEB 69

U. S. ARMY ELECTRONICS COMMAND
PROCUREMENT AND PRODUCTION DIRECTORATE
FORT MONMOUTH NEW JERSEY 07703

PLUG, SHIELD

B | CODE IDENT NO. 80063 | SM-B-509029

SCALE 2/1 | SHEET —

WHEN REFERRING TO THIS DRAWING STATE DRAWING NO., APPLICABLE ISSUE LETTER IF ANY, AND DATE

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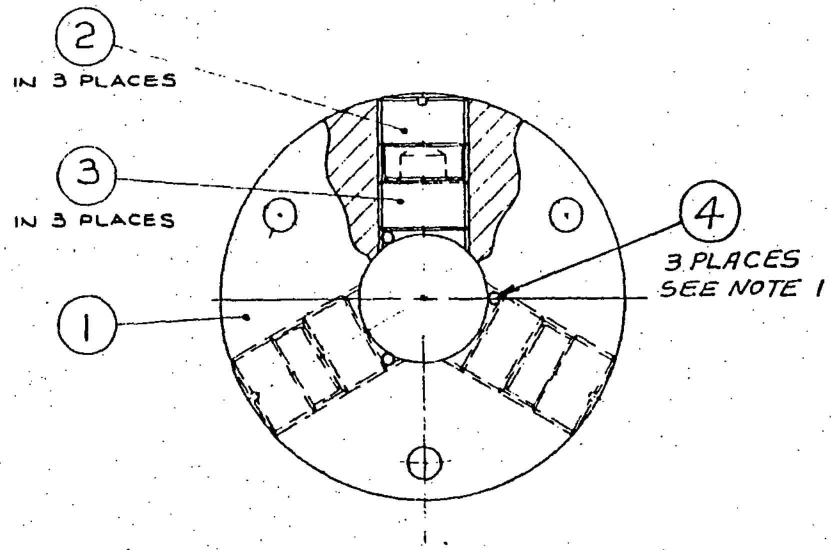
REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	ITEM 4 ADDED	7JA1980	ES HJW

Encl 6



CAUTION:
CONTAINS RADIOACTIVE SOURCE

NOTES:
1. PIN (4) MUST BE INSTALLED BELOW SURFACE OF (1)

ITEM	REQD	PART NO.	DESCRIPTION	SPECIFICATION	NOTE
4	3	MS16562-204	PIN, SPRING	MIL-P-10971	1
3	3	SM-B-509057	SOURCE ASSY.		
2	3	SM-B-508984	PLUG, SHIELD		
1	1	SM-B-508983	SHIELD		

LIST OF PARTS

NEXT ASSY	USED ON
SM-D-508975	DL-508965
APPLICATION	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS — DECIMALS — ANGLES —

MATERIAL:

Canadian Admiral Corporation Ltd.
DA-28-043-AMC-02402E

DRAWN F.J.O.
CHECKED
ELECTRONICS COMMAND
REVIEWED ER-1 SMF
APPROVED ER-1 SMF
DATE 19 JAN 69

U. S. ARMY ELECTRONICS COMMAND
PROCUREMENT AND PRODUCTION DIRECTORATE
FORT MONMOUTH NEW JERSEY 07703

SHIELD ASS'Y.

B CODE IDENT NO. 80063 SM-B-508981

SCALE 1/1 SHEET —

WHEN REFERRING TO THIS DRAWING STATE DRAWING NO., APPLICABLE ISSUE LETTER IF ANY, AND DATE

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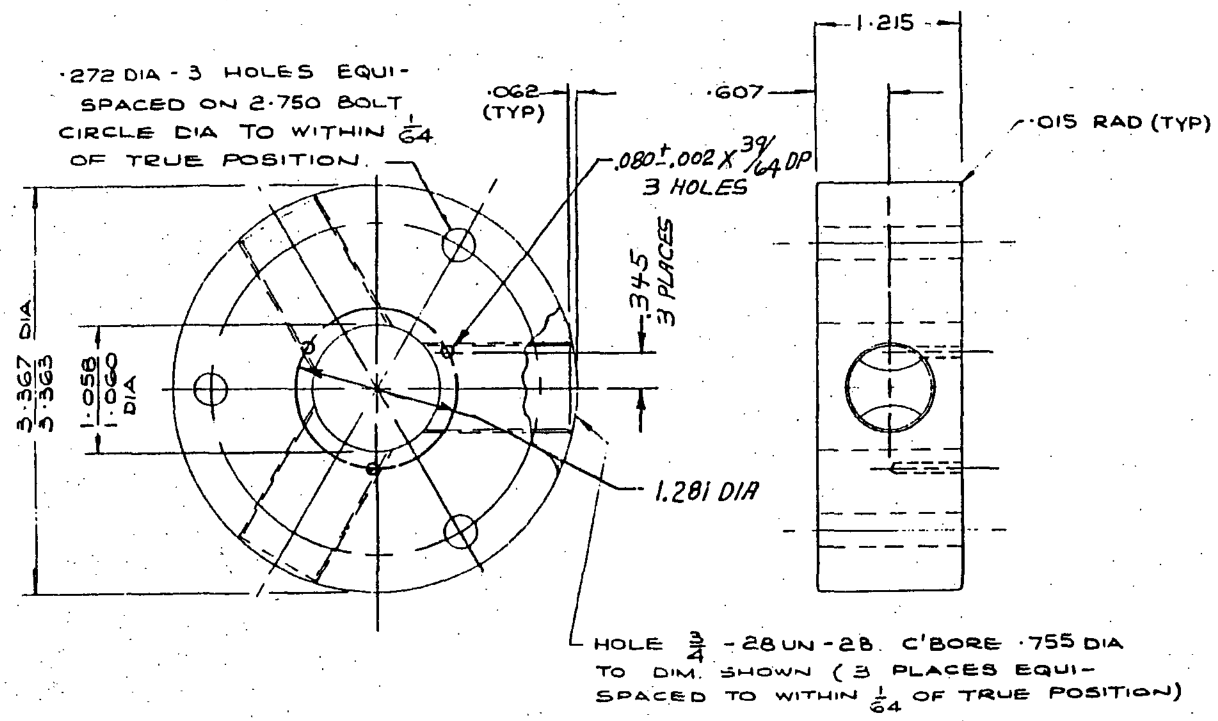
REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	ADDED 3 .080 HOLES	7JAN70	ES HJW



NOTES -

1. ALL SURFACE FINISHES TO BE 63✓ UNLESS OTHERWISE STATED.
2. REMOVE ALL BURRS & SHARP EDGES.
3. FINAL PROTECTIVE FINISH - M262 PER SPEC MIL-F-14072

ITEM	REQD	PART NO.	DESCRIPTION	SPECIFICATION	NOTE

LIST OF PARTS

SM-B-508981	DL-508965
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:

FRACTIONS	DECIMALS	ANGLES
-	±.005	-

MATERIAL:
M 1000 METAL
P R. MALLORY
INDIANAPOLIS, IND.
- OR EQUAL.

Canadian Admiral Corporation Ltd.
DA-28-043-AMC-02402E

DRAWN F J O
CHECKED
ELECTRONICS COMMAND
REVIEWED ER-1 SM&F
APPROVED ER-1 SM&F
DATE 19 JAN 69

U. S. ARMY ELECTRONICS COMMAND
PROCUREMENT AND PRODUCTION DIRECTORATE
FORT MONMOUTH NEW JERSEY 07703

SHIELD

B | CODE IDENT NO. 80063 | SM-B-508983

SCALE 1/1 | SHEET -

WHEN REFERRING TO THIS DRAWING STATE DRAWING NO., APPLICABLE ISSUE LETTER IF ANY, AND DATE

NOTE
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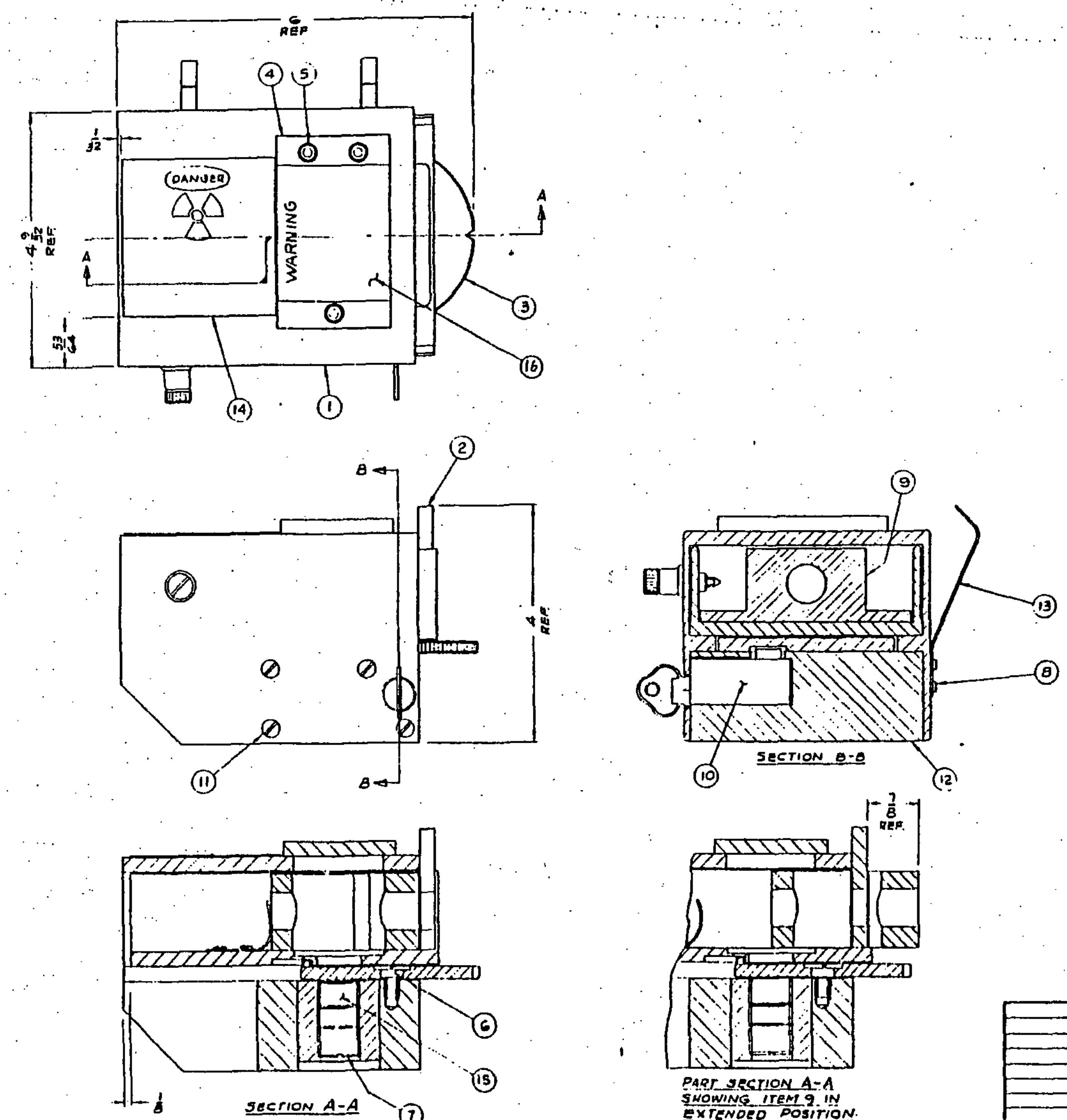
REVISIONS				
LTR	ZONE	DESCRIPTION	DATE	APPROVED
	A	REV. PER ECP EON 012, NOR 1	30 DEC 80	SS HJW



ITEM	REQD	PART NO.	DESCRIPTION	SPECIFICATION	NOTE
16	1	SM-B-483638	WARNING LABEL		
15	1	SM-B 509057	SOURCE ASSY		
14	1	SM-C-509025-1	LABEL, RADIATION		
13	2	SM-B-509020	SPRING, INSTRUC MANUAL		
12	1	SM-C-508997	SHIELD ASSY		
11	8	MS-35239-36	SCREW: FLAT HD, 6-32 UNC × 5/16	FF-S-92	
10	1	SM-B-509007	LOCK		
9	1	SM-B-509012	BLOCK, SPACING		
8	4	MS 35206-213	SCREW, PAN HD, 4-40UNC × 1/4	FF-S-92	
7	1	SM-B-508984	PLUG, SHIELD		
6	1	SM-B-509010	SCREW, SHOULDER		
5	3	SM-B-509022-1	SCREW, CAP		
4	1	SM-B-508999	COVER		
3	1	SM-B-509008	ABSORBER ASSY		
2	1	SM-B-508996	DRAWER ASSY		
1	1	SM-C-508995	HOUSING ASSY		

LIST OF PARTS

NEXT ASSY	USED ON
SM-D-508993	DL 508965

APPLICATION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES
TOLERANCES ON: FRACTIONS ± $\frac{1}{64}$ DECIMALS — ANGLES —
MATERIAL: —

~~Canadian Admiral Corp. Ltd.~~
DA-28-043-AMC-02402E

DRAWN A.R.S.
CHECKED
ELECTRONICS COMMAND
REVIEWED ER-1 SM'F
APPROVED ER-1 SM'F
DATE 6 JUN 70

U. S. ARMY ELECTRONICS COMMAND
PROCUREMENT AND PRODUCTION DIRECTORATE
FORT MONMOUTH NEW JERSEY 07703

UNIT ASSY DOSERATE

SIZE	CODE IDENT NO	
D	80063	SM-D-508994

SCALE 1/1 SHEET —

WHEN REFERRING TO THIS DRAWING STATE DRAWING NO., APPLICABLE ISSUE LETTER IF ANY, AND DATE

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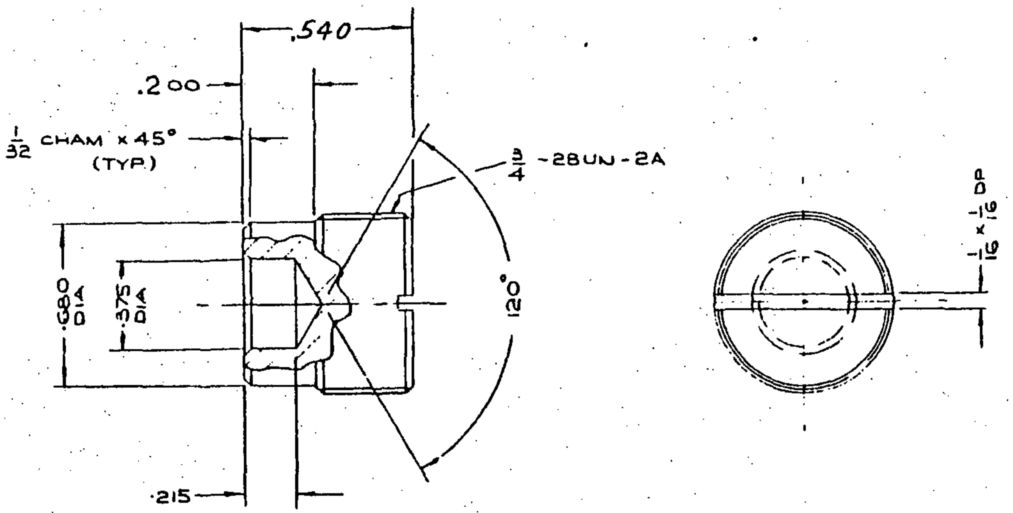
REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	REVISED PER ECP EON 004, NOR 1	15 SEP 80	ES HJW

Sheet 15



NOTES:-

1. REMOVE ALL BURRS & SHARP EDGES.
2. FINAL PROTECTIVE FINISH - M262 PER SPEC MIL-F-14072

ITEM	REQD	PART NO.	DESCRIPTION	SPECIFICATION	NOTE

LIST OF PARTS

NEXT ASSY	USED ON
SM-D-508994	
SM-B-508981	DL-508965

APPLICATION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± $\frac{1}{64}$ DECIMALS ± .005 ANGLES ± 2°

MATERIAL:
M 1000 METAL
P.R. MALLORY
INDIANAPOLIS, IND.
-OR EQUAL.

Canadian Admiral Corporation Ltd.
DA-28-043-AMC-02402E
DRAWN F.J.O.
CHECKED
ELECTRONICS COMMAND
REVIEWED ER-1 GM'F
APPROVED ER-1 GM'F
DATE 20 FEB 69

U. S. ARMY ELECTRONICS COMMAND
PROCUREMENT AND PRODUCTION DIRECTORATE
FORT MONMOUTH NEW JERSEY 07703

PLUG, SHIELD

B | CODE IDENT NO. 80063 | SM-B-508984
SCALE 2/1 | SHEET -

WHEN REFERRING TO THIS DRAWING STATE DRAWING NO., APPLICABLE ISSUE LETTER IF ANY, AND DATE

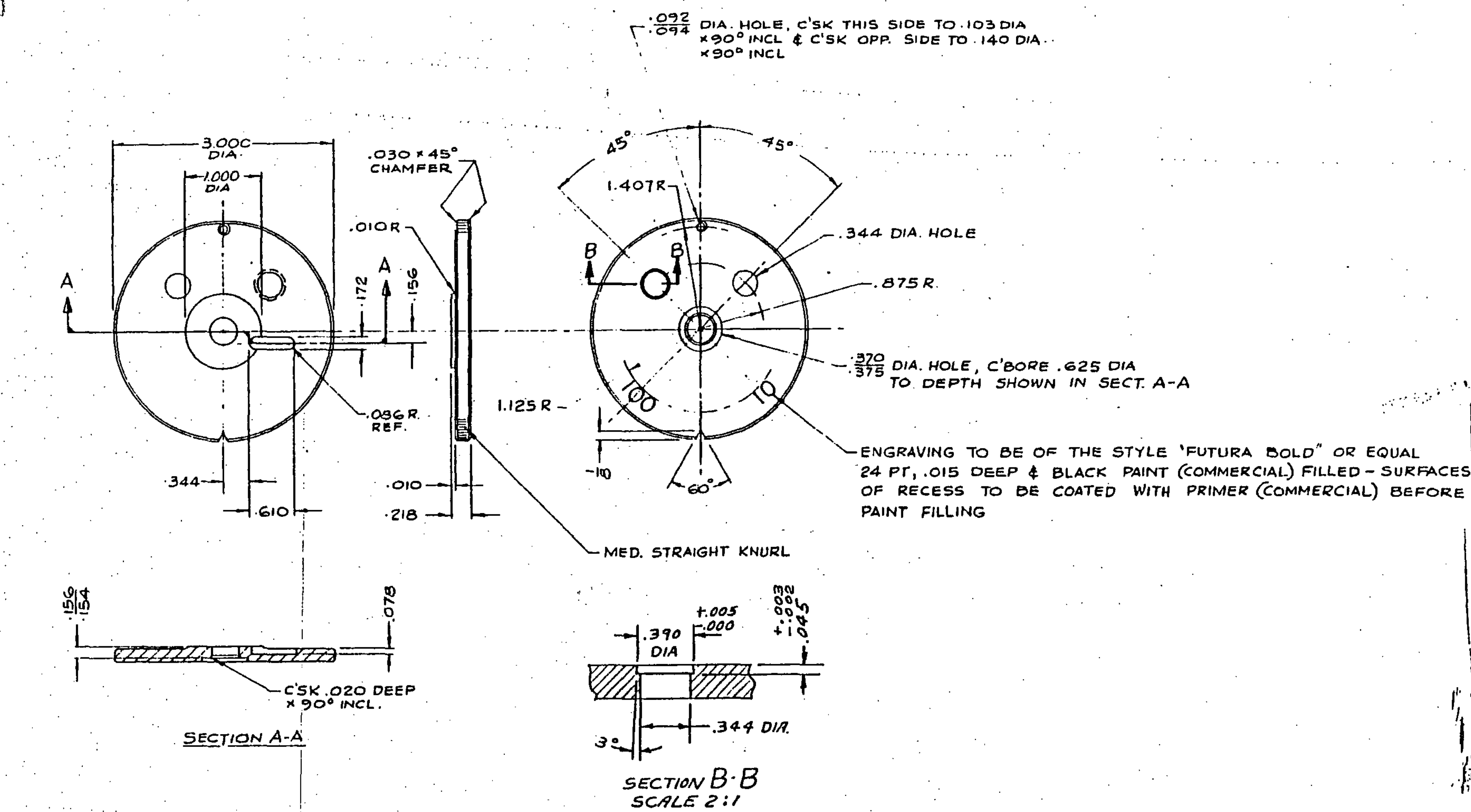
THIS DO[illegible] AS BEEN PURCHASED BY THE GO[illegible]ENT AND MAY BE REPRODUCED AND USED IN CONNECTION WITH ANY GOVERNMENT PROCUREMENT OR MAINTENANCE OPERATION

NOTE
DATA MARKED WITH AN ASTERISK (*) IS PECULIAR TO A PRIOR MANUFACTURER. IT DOES NOT TAKE PRECEDENCE OVER ANY OTHER DATA ON THIS DRAWING, AND IS NOT CONTRACTUALLY BINDING ON EITHER THE CONTRACTOR OR THE GOVERNMENT

REVISIONS

LTR	ZONE	DESCRIPTION		APPROVED
	A	REV. PER ECP EON001, NOR 1		ES HJW

Encl 16



NOTES
1. FINISH – M262 PER MIL-F-14072

REQD	PART NO.	DESCRIPTION	SPECIFICATION	NOTE
LIST OF PARTS				

NEXT ASSY	USED ON
SM-B-509008	DL 508965
APPLICATION	

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ±1/64 DECIMALS ±.005 ANGLES ±2°

MATERIAL:
M1000 METAL
P.R. MALLORY
INDIANAPOLIS, IND.
OR EQUAL.

~~CANADIAN ADMIRAL CORP. LTD~~
DA-28-043-AMC-02402E
DRAWN NB
CHECKED
ELECTRONICS COMMAND
REVIEWED ER-1 SM°F
APPROVED ER-1 SM°F
DATE 5 JUN 69

U. S. ARMY ELECTRONICS COMMAND
PROCUREMENT AND PRODUCTION DIRECTORATE
FORT MONMOUTH NEW JERSEY 07703

ABSORBER

SIZE C CODE IDENT NO. 80063 SM-C-509011
SCALE 1/1 SHEET —

WHEN REFERRING TO THIS DRAWING STATE DRAWING NO., APPLICABLE ISSUE LETTER IF ANY, AND DATE

SUPPLEMENT E

1. Reference: Item 10 of NRC Form 313 I.

2. Calibration activities authorized to receive the AN/UDM-2 Radiac Calibrator Set are required to possess measuring/surveying instruments (radiac set), i.e., the AN/PDR-27( ) standard Army beta-gamma detection instrument or commercial equivalent instruments. The sensitivity range of the AN/PDR-27 is zero to 500 mR/hr in 4 decade scales.

3. A list of radiation detection instruments used by LBDA personnel where bulk storage and maintenance will be performed for the AN/UDM-2 Radiac Calibrator Set are contained in NRC Byproduct Material License 16-05033-01, NRC Source Material License SUB-417 and NRC Special Nuclear Material License SNM-623 issued to the US Army Ionizing Radiation Dosimetry Center (AIRDC) at LBDA.

SUPPLEMENT F

1. Reference: ITEM 11 OF NRC Form 313 I.

2. The AN/PDR-27( ) standard Army beta-gamma detection instruments for field use are calibrated with the AN/UDM-2 Radiac Calibrator Set in accordance with the frequency specified in TB 750-25-1, Maintenance of Supplies and Equipment: Army Test, Measurement, and Diagnostic Equipment (TMDE) Calibration and Repair Support Program; TB 43-180-1, Calibration and Repair Requirements for the Maintenance of Army Materiel; TB 9-6665-285-15, Army Calibration Program for Radiac Survey Meters; and procedures prescribed in the technical manuals issued with the instruments. Presently the calibration frequency specified is once every 240 days.

3. The AN/PDR-27( ) standard Army beta-gamma detection instruments used for health and safety purposes are calibrated in accordance with the frequency specified in TB 750-25-1. These instruments are required to be marked Active (Health and Safety). Presently the calibration frequency specified is once every 90 days. Calibration standards used are the AN/UDM-1 (^{60}Cobalt), AN/UDM-1A (^{137}Cesium) or equivalent and are certified by, or traceable to, the National Bureau of Standards (NBS).

4. Health physics instrumentation is immediately available to all personnel for operations involving ionizing radiation. The radiation detection/measurement instrumentation, method of calibration, frequency and standards utilized by LBDA-AIRDC are contained in NRC Byproduct Material License 16-05033-01, NRC Source Material License SUB-417 and NRC Special Nuclear Material License SNM-623 issued to AIRDC at LBDA.

SUPPLEMENT G

1. Reference: Item 12 of NRC Form 313 I.

2. For personnel dosimetry, whole-body and wrist or ring beta-gamma film badge or Thermoluminescent Dosimetry(TLD) service will be furnished by AIRDC at LBDA in accordance with AR 40-14, Control and Recording Procedures for Occupational Exposure to Ionizing Radiation and Supply Bulletin 11-206, Personnel Dosimetry Supply and Service for Technical Ionizing Radiation Exposure Control. Film badges and TLDs are processed monthly. It is estimated that TLDs will be introduced into the Army radiation protection program as a replacement for film badge dosimetry during the timeframe allotted for this license revision/renewal.

3. Self-reading gamma dosimeters (0-200mR) are also available upon request.

4. Bioassay services, if required, are available from the Surgeon General.

SUPPLEMENT H

1. Reference: Item 13 of NRC Form 313 I.

2. Facilities for use and storage of the AN/UDM-2 Radiac Calibrator Set will be designated radiation or radioactive material areas as determined by the local RPO.

3. Sets used by the mobile calibration teams will be used and stored in specially designed vans, access to which is limited to team members. The sets will be stored in locked cabinets within locked vans. At other locations the sets will be used and stored in controlled areas and secured against unauthorized removal. Areas/buildings will be posted with "Caution-Radioactive Materials" signs, where applicable.

4. LBDA-AIRDC Storage, maintenance and serviceability installation.

a. Construction: (1) The maintenance and serviceability installation is concrete block and steel with steel and concrete roof. The calibration and storage rooms are constructed of 36 inches of poured concrete with door containing 1/4 inch of lead shielding.

(2) The storage installation (warehouse) is cinder block and brick construction with asphalt covered wooden roof.

b. Fire Protection: The entire installation is protected by a fire sprinkler system which is linked to LBDA's self supporting fire department. The fire department has a maximum response time of 2 to 3 minutes to its furthest building.

c. Security: The security of the installation is such that all buildings are locked when not inhabited and the perimeters of LBDA are secured by chain-linked fence with roving patrols and sentries at the gate.

d. Instrumentation: Adequate health physics instrumentation is immediately available for operations involving ionizing radiation as outlined in Supplement E and F.

e. Hoods: Should it become necessary to remove leaking sealed sources from the AN/UDM-2 during serviceability, the required disassembly of the AN/UDM-2 will be performed in a standard chemical hood by qualified personnel. The leaking sources will be disposed of as radioactive waste and the good sources will be stored in approved type storage containers.

f. Shielding: Temporary or permanent shielding such as lead bricks and sheets, lucite, and glass will be employed to reduce unnecessary exposure when time and distance factors alone are inadequate. In general, shielding will be used whenever feasible to minimize exposure to personnel.

SUPPLEMENT I

1. Reference: Item 14 of NRC Form 313 I.

2. Title 10, Code of Federal Regulations, AR 385-11 and AR 700-64 are followed for disposal of radioactive waste. Initial request for disposition is submitted to Headquarters, CECOM for review. After determination has been made for final disposition as radioactive waste, CECOM authorizes the user to dispose of the radioactive material in accordance with AR 385-11. LBDA is the storage/consolidation area for the AN/UDM-2 Radiac Calibrator Set with regards to the preparation of this commodity for its ultimate disposal as radioactive waste. In lieu of LBDA, the 524th Maintenance Company, Pirmasens, Germany (Pirmasens) and the US Army Area TMDE Support Center-Korea, Camp Carroll, Korea (Camp Carroll), as required, may also serve as the storage/consolidation area for the ultimate disposal of the AN/UDM-2 for their geographical area of responsibility. Headquarters, US Army Armament, Munitions and Chemical Command (AMCCOM) has been delegated the responsibility of management coordination for radioactive waste disposal. AMCCOM assures that all radioactive wastes are packaged and shipped in accordance with all applicable requirements for ultimate transfer of the radioactive waste to an authorized burial site.

SUPPLEMENT J

1. Reference: Item 15 of NRC Form 313 I.

2. The Army program for control of radioactive items of supply is prescribed specifically in two regulations. AR 700-64, Radioactive Commodities in the DOD Supply Systems, is an interservice regulation which prescribes responsibilities for control of radioactive items and components which are introduced in the supply system. AR 385-11, Ionizing Radiation Protection, establishes requirements for obtaining NRC licenses for radioactive materials, authorizations to possess radioactive material not controlled by NRC, requirements for individually controlled items of supply, transportation of radioactive materials and the disposal of unwanted radioactive material. Major Army commands and all Army activities are required to implement these DA regulations as required/supplemented through appropriate command channels.

3. The authority contained in NRC licenses and DA Radiation Authorizations (DARA) issued to CECOM permits DOD installations and activities to acquire and use certain radioactive calibration and test items without obtaining their own license or DARA for these items (a DARA is required for radioactive material not controlled under an NRC specific license). This is based upon commitments made by CECOM that all Army elements will comply with conditions contained in those licenses and DARAs and with pertinent Federal, DOD and Army regulations. Both NRC and DA require control of all operations involving radioactive items to insure the safety of personnel and property. Army activities possessing licensed radioactive sources and the agencies controlling them are subject to inspection by the NRC in addition to inspection by Army elements.

4. The mission of CECOM includes the management and performance of all material life cycle functions and services and acts as DA licensee for Army-wide distribution of these items. The following is a description of functions of the various CECOM elements providing a coordinated effort:

a. The functions for the manager of the NRC License/DARA are assigned to the Chief, Safety Office of the Command Staff of this headquarters. The responsibilities of the manager are as follows:

(1) Coordinate, obtain, administer, review, amend and maintain necessary licenses/authorizations for radioactive commodities managed by this command.

(2) Provide information and guidance to all commanders, with respect to limitations, constraints, conditions or procedures which affect the responsibilities of those commanders for the radioactive commodity.

(3) Monitor the various elements of the life cycle program of the radioactive commodities to assure compliance with conditions of the applicable license/authorization.

(4) Assure that licensed/authorized material is not transferred to unauthorized persons or organizations.

b. The health physicists serve as the CECOM staff contact for radiation control and NRC license/DARA matters to the Army Materiel Development and Readiness Command, other major commands and DA elements, other services and federal agencies; provide advice and assistance to other CECOM elements involved in the fielding of radioactive items, the National Inventory Control Point (NICP) (an element of CECOM), depots and other Army elements; prepare applications for NRC licenses/DARAs for Army-wide distribution of assigned items; prepare radiation safety instructions for incorporation in technical literature and other published guidance pertaining to the items; coordinate with the NICP to assure that requisitioning elements are authorized to and technically capable of receiving the item and the procurements do not exceed the quantity or use limitations imposed by the various licenses; perform pre-award and post award health physics surveys of contractors; provide health physics advice to be included in instructions for disposal of radioactive waste, and serve as staff officers for notification, investigation, and preparation of reports required in the event of an accident or incident in which this command's radioactive items may be involved.

c. The CECOM NICP located at Fort Monmouth, New Jersey, in conjunction with the CECOM Safety Office, has adopted special procedures for individually controlled radioactive items that are in addition to standard Army supply practices used for all type classified items. These procedures include maintenance of a computerized data retrieval system by the Safety Office that contains information such as the radioactive commodity type number, set serial number, location, responsible RPO, alternate RPO, where applicable, their qualifications, and all leak test results. This information is reviewed by CECOM health physicists on a monthly basis for accuracy, significant leak test results and issuance of notices for required leak tests. In addition, the control point maintains records of procurements, receipts, storage locations, shipments, using locations, and authorizes, issues, and assures adequate supply. It reviews requisitions submitted, and when approved, issues material release orders to the designated depot for shipment of the material to the requisitioner. Requisitions are submitted through various command control channels. The control point bases its approval on the previously established authorization of the requisitioner to receive the item from the supply standpoint such as an approved Total Army Equipment Distribution Program. Upon approval of the requisition, the control point issues a material release order to the depot storing the item. The depot ships the item directly to the requisitioner, notifies the control point and furnishes appropriate shipping data to be forwarded also through supply property office channels.

d. The major Army commands have established regulatory requirements for control of the radioactive items. Each major command has established at the headquarters level a radioactive material control point and appointed a command RCO to administer control of radioactive items within the commands. That officer reviews and concurs in the qualifications of local RPOs within the command, maintains records of radioactive items by location and assures periodic inventory and leak tests by using activities, performs periodic inspection/audits of accountable installations/activities to assure that the items are properly handled in accordance with Army and NRC regulations, and to assure the submission of inventory and leak test reports and accident/incident reports to the appropriate commodity command as required by Army regulations. The local

RPO is responsible for administering the local radiation protection program. Local programs provide for designated controlled areas, dosimetry, instrumentation, operating procedures to supplement published manuals for the items, receipts, transfers, storage and records. Requisitions originated by using elements are processed through the local RPO to the major command RCO. The requisition is reviewed from the radiation protection standpoint and logistics authority for possession. If approved, the requisition is forwarded to the NICP. Upon receipt of notification from the NICP of the transaction the information is forwarded to the local RPO who assumes radiation protection responsibility for the item. Requests for transfers of items between installations/activities are reviewed by the command RCO and if approved reported to the NICP. Transfers outside the major commands are reviewed and approved by the NICP following coordination with CECOM health physicists. Reports of excess items are submitted through command channels to the NICP for review of serviceability, turn-in, or disposal as radioactive waste. The NICP, in conjunction with assistance and directives provided by health physicists at the CECOM Safety Office, determines disposition of the excess items.

e. LBDA and/or AIRDC will provide bulk storage, maintenance, and when required, leak test analyses, recalibrations, quality surveillance and issue of the AN/UDM-2 Radiac Calibrator Set. Maintenance that might be performed is the necessary removal and exchange of leaking sealed sources from the Discharge Well Assembly and/or Doserate Jig Assembly. This will be performed in the facility described in Supplement H. Where radioactive materials are involved, LBDA and AIRDC have established warehousing facilities and handling procedures governed by a formal radiation protection program. The program is administered by qualified RPOs from AIRDC of the US Army TMDE Support Group located at LBDA through a Memorandum of Understanding between the two organizations, and LBDA. As with non-radioactive items, items are inspected when received, at intervals during storage and immediately before shipment. All AN/UDM-2 Radiac Calibrator Sets are tested for leakage of radioactive material prior to shipment to users. Item inspections are conducted according to established surveillance procedures as determined by CECOM. The quality surveillance program for the AN/UDM-2 Radiac Calibrator Set will be performed by either the LBDA or AIRDC RPO, his alternates or the CECOM health physicists and will involve the annual leak testing of a random sampling of at least one percent of depot assets and/or a minimum of five each of the AN/UDM-2 Radiac Calibrator, whichever is greater. AIRDC will provide the results to Commander, USACECOM, ATTN: DRSEL-SF-MR, Fort Monmouth, New Jersey 07703. Appropriate action will be taken if results indicate a trend toward leakage. LBDA will provide the NICP with notification of individually controlled item receipts, inspections and shipment. NRC licenses issued to AIRDC, NRC Byproduct Material License 16-05033-01, NRC Source Material License SUB-417, and NRC Special Nuclear Material License SNM-623, describe the qualifications of the AIRDC RPO, his alternates and the AIRDC Radiation Protection Program. The LBDA RPO qualifications are at enclosure 1. LBDA Memorandum No. 385-14 (Enclosure 2) describes the LBDA radiation protection program. LBDA and AIRDC also maintain an Interservice Support Agreement to insure appropriate control of all aspects involving the AN/UDM-2 Radiac Calibrator Set (Enclosure 3).

f. Recalibration and recertification of the AN/UDM-2 Radiac Calibrator Set will be performed by the Area Calibration and Repair Center (ACRC), Lexington, Kentucky, Camp Carroll; Pirmasens; and the Nucleonics Laboratory Branch, US Army

Calibration and Repair Center - Sacramento (ACRC-S), Sacramento Army Depot, Sacramento, California. Additional health physics laboratory counting equipment capable of measuring 0.001 microcuries are also available from Camp Carroll, Pirmasens, ACRC-S, and CECOM as needed for evaluation of the six month leak test smears of the calibrator set. Leak test results are forwarded through Army channels to Commander, USACECOM, ATTN: DRSEL-SF-MR, Fort Monmouth, New Jersey 07703 for inclusion into the computerized data retrieval system as specified in paragraph 4c above. The health physicists of the CECOM Safety Office will review wipe test analysis for trends toward leakage of the source sets as contained within the AN/UDM-2 Radiac Calibrator Set.

g. The program for control of the AN/UDM-2 Radiac Calibrator Set, as with other radioactive items is, to the extent practical, the same logistics procedures applied to other Army supplies. Regulatory guidance has been established by DA and implemented by the various commands governing the management process, life-cycle management of material, logistics management and support, procurement, maintenance, storage, transportation, including packaging and disposal. For radioactive items the procedures are augmented by specific regulatory controls pertaining to the possession and use of radioactive materials, control of personnel radiation exposure, safe storage, handling, maintenance, transportation and disposal of the items. For the AN/UDM-2 Radiac Calibrator Set, more stringent controls have been established as distribution of these devices are limited to authorized calibration activities as outlined in Supplement A. These controls include identifying and insuring that the AN/UDM-2 Radiac Calibrator Set is coded in the Commodity Command Standard System (CCSS) Automated Data Processing Program as radioactive in accordance with Appendix A of AR 708-1, Cataloging and Supply Management Data. This calibrator set is coded with a Special Control Item Code (SCIC) of "B" meaning Regulated-Principal and containing a radioactive item. Requisitions are processed initially by computers and due to the radioactive SCIC designation, are then processed manually by the NICP item manager to verify that the requisitioners are authorized to receive the calibrator set. To insure that the above requirements are being implemented, the CECOM health physicists maintain close coordination with the item manager. Further, the CECOM health physics staff maintains a continuous program for control of radioactive commodities by providing coordination with other CECOM elements in that all equipment folders utilized by the NICP are tagged with the following: "Prior to procurement, reprocurement, disposal or change in SCIC, contact Health Physics/Safety Office, x54427." Further, System Change Requests to the CCSS were initiated in order to assure the above as follows:

(1) Monthly printouts containing all known radioactive commodities, including National Stock Numbers (NSN), item manager codes, SCICs and demilitarization codes are provided the CECOM health physics staff. This information is revised when new radioactive items are discovered.

(2) Monthly printouts are provided indicating planned changes to be made in the SCICs assigned to radioactive commodities as well as the individual responsible for making them. These changes are held in the CCSS for 60 days prior to actual implemented changes. In this matter tracking of all planned changes in the system can be accomplished prior to actual changes thereby preventing the loss of control over radioactive commodities.

(3) Printouts are also provided indicating property disposal office actions in relation to radioactive items. In this manner, monitoring of all disposal actions and advance notification to the depots can be accomplished. This will aid in assuring proper demilitarization and disposal of radioactive items and preclude their disposal through normal nonradioactive channels.

(4) Procurement Work Directive (PWD) printouts are provided to the CECOM health physicists for all planned procurements of radioactive commodities for approval or disapproval. Further, additional printouts provide advance notice to all manual or automated procurements of radioactive commodities.

(5) The CECOM health physics staff closely coordinates with the Directorate of International Logistics (IL), CECOM, on foreign military sale (FMS) cases for all radioactive commodity components and End Article Applications (EAAs) incorporating these components. IL is required to notify all FMS customers of all radioactive components, by radionuclide and activity, of EAAs offered for purchase so as to preclude sales of radioactive material to foreign countries not wishing to receive it. Further, IL requests the CECOM health physicists to provide advanced exception data advising the receiving country to contact their radiation protection organization for appropriate guidance. This advance notice of FMS cases allows health physicists to review applicable rules of export for specific radioactive materials as governed in 10 CFR Part 110.

h. Additional controls involve the following:

(1) Users of the AN/UDM-2 Radiac Calibrator Set are provided with specific instructions on safe handling, storage and transportation as described in TB 11-6665-227-12. TM 11-6665-227-12 also provides the users with specific instructions on the operation, control and maintenance of the calibrator. This information satisfies the radiation protection instructions to users as required by Title 10, Chapter 1, Code of Federal Regulations, Parts 19, 20 and 21. In addition, Form NRC-3, Notice to Employees, and Section 206 of the Energy Reorganization Act of 1974, are provided within the aforementioned technical literature. Commander, USACECOM, ATTN: DRSEL-SF-MR, Fort Monmouth, New Jersey 07703 will make available, upon request, to the major commands and users the appropriate NRC regulations, the NRC license, license conditions, documents incorporated into the license by reference, and amendments thereto, and any notice of violation involving radiological working conditions for examination. Personnel monitoring reports are made available to the users in their individual medical records for examination as required by AR 40-14.

(2) Presently, the implementation of a Hazardous Materiel Data System (HMDS) is utilized in conjunction with normal logistical handling. The HMDS is a computerized system providing Army elements with required shipping information. The following information is common to all listed NSNs coded with an SCIC indicating radioactive content:

(a) Item Nomenclature

(b) Maximum Activity

(c) Radionuclide

(d) Chemical/Physical Form

(e) Primary Inventory Control Activity

(f) Transport Index

(g) Fissile Class

(h) NRC license or DA Authorization Number

(i) Special Instruction Narrative

5. In evaluating possible radiological hazard resultant from utilization of the AN/UDM-2 Radiac Calibrator Set, an Environmental Assessment (EA) was prepared based on conservative assumptions which lead to the conclusion that external exposure rate would not exceed ten percent of regulatory limits stipulated for occupational workers. Hypothetical internal dose evaluations resulting from ingestion or inhalation following source damage, improper disposal, installation fire and a transport accident identify committed dose equivalents below recommendations stated in the International Commission on Radiological Protection Publications 26 and 30. Complete analyses for external and internal doses are presented within the EA for radiological considerations. Exposure levels presented confirm that the utilization of the AN/UDM-2 Radiac Calibrator Set poses insignificant to non-existent radiological consideration and excludes consideration of environmental quality degradation. The EA is included as Annex I.

201 File

DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

...NCE OR OFFICE SYMBOL	SUBJECT
SDSAN-LAS	Announcement of Appointment of Radiation Protection Officer

TO SEE DISTRIBUTION FROM DATE 1 Oct 83 CMT 1

1. Effective 1 Oct 83, GS-07 WILLIAM E. BABER
Rank Name
Admin & Svcs Division; Safety Office is
Organization

[ ] Assumes command of:

[x] Appointed as: Radiation Protection Officer

[ ] Designated as:

[ ] Certified as:

[ ] Assigned as:

...uthority: AMCR 385-25, 12 Aug 68, Radiation Protection, paragraph 6a(3)

3. Purpose: Provide Commander with advice and assistance on all matters pertaining to radiation safety and to implement the radiation safety program.

4. Period: Indefinite

5. Special Instructions:

FOR THE COMMANDER:

Linda L. Fortner
LINDA L. FORTNER
Adjutant

DISTRIBUTION:
C & E

...DSAN-L FL 2016, 18 Sep 80

WILLIAM E. BABER
HEALTH PHYSICIST/RADIATION PROTECTION OFFICER

Lexington-Blue Grass Depot Activity (LBDA)
ATTN: SDSAN-LAS
Lexington, Kentucky 40511

A. EDUCATION

1. BS, Mathematics, Eastern Kentucky University (Including 12 hours in Physics and 10 hours in Chemistry)

2. MA, Guidance and Counseling, Eastern Kentucky University

B. PROFESION EXPERIENCE

1. U.S. Army Ionizing Radiation Dosimetry Center (USAIRDC) - 8 months
While at IRDC, I worked in the Army Film Badge and TLD dosimetry program.

2. LBDA Safety Office - October 1982 to present.
During the first year, I received on-the-job training from IRDC personnel in preparation for the transfer of RPO duties from that Activity to the Safety Office. I was appointed RPO on 1 October 1983.

C. RADIOLOGICAL HEALTH TRAINING

1. Radiological Safety, 3 weeks, U.S. Army Chemical School, Fort McClellan, AL

2. Basic Radiological Health, 1 week, University of Texas Health Science Center, San Antonio, TX

3. Radiological Safety I, 13 credit hours by correspondence, Army Institute for Professional Development.

4. Radiological Hygiene, 8 hours, Eastern Kentucky University

5. Laser and Microwave Workshop, 1 week, Edgewood Arsenal, Aberdeen Proving Ground, MD

6. US Army Ionizing Radiation Dosimetry Center on-the-job training - 2 years

7. Emergency Planning and Control, Radiation Management Corp., Fort Belvoir, VA 1 week

D. EXPERIENCE WITH RADIATION

Isotope	Amount	Experience	Use
Co 60	130mCi-10Ci	1 yr.	Source exchange, leak testing receiving, shipping & storage

Encl 1

Isotope	Amount	Experience	Use
Kr 85	5m Ci	1 yr.	Shipping, storage
Pu 239	1.4uCi-50.21uCi	1 yr	Leak testing, storage, calibration, shipping, receiving
Sr/Y-90	200mCi	1 yr.	Leak testing, calibration, shipping, receiving, storage
Cs 137	.01uCi-120Ci	1 yr	Storage
Ra 226	Var.	1 yr.	Shipping, storage
Thorium 230, 232	Var.	1 yr.	Shipping, storage
Radioactive Waste Shipment	7.6 Ci (25 drums)		

HEADQUARTERS
LEXINGTON-BLUE GRASS DEPOT ACTIVITY
LEXINGTON, KENTUCKY 40511

LBDA MEMORANDUM
NO. 385-14

22 February 1983

Safety

RADIOLOGICAL SAFETY PROGRAM

1. Purpose. This memorandum prescribes methods of handling items which contain radioactive materials, including protective measures to be taken during receipt, storage, issue, maintenance and disposal.

2. Scope. This memorandum is applicable to all divisions and tenants of Lexington Blue Grass Depot Activity.

3. Definitions.

a. Dosimeter. A device worn by an individual for determining the dose of radiation received from exposure to sources of ionizing radiation.

b. Film Badge. A holder containing photographic film worn by personnel exposed to radiation to measure the dosage received.

c. Radioactive Material. Any material or combination of materials that spontaneously emit ionizing radiation.

d. Radiation Worker. Any person regularly or frequently occupationally exposed to ionizing radiation and/or radioactive materials.

4. Policy. Procurement action will not be initiated on any item containing radioactive luminous compounds unless approved by the Depot Activity Radiation Control Committee.

5. Responsibilities.

a. The Commander will:

(1) Appoint in writing a Radiological Protection Officer.

(2) Insure that a radiation control committee is established.

15Nil)

b. Administration and Services Division will:

(1) Identify those persons who will be assigned as radiation workers on Standard Form 78, "Certificate of Medical Examination," in order that baseline blood chemistry can be obtained.

(2) Assure that all employees terminating assignments as radiation workers can be identified so that post-assignment physical examinations can be accomplished.

(3) Coordinate and schedule radiation training and periodic retraining of all radiation workers, guards, firemen and emergency personnel. Such training will encompass, as a minimum, those items listed in 10 CFR 19.12 and a review of local applicable procedures.

(4) Inform the RPO and custodian of DD 1141 of the selection/termination of radiation workers.

(5) Insure that RPO and alternate RPO are given training that is commensurate with the type of radiation hazards for which they are responsible.

(6) Provide equipment inspector to perform inspection of vehicle and execute DD Form 626 and provide one copy of form to Transportation Officer.

(7) Assure that job descriptions identify those persons classified as diation workers.

(8) Insure that annual and pre-employment orientation training is given to radiation workers on radiological safety hazards and safeguards.

c. Post Surgeon, US Army Health Clinic will:

(1) Appoint in writing an individual to be responsible for preparing and maintaining the radiation exposure records (DD Form 1141).

(2) Provide pre-placement, periodic and termination physical examinations as required for radiation workers.

(3) Maintain DA Form 1952 film badge application and record of occupational exposure in ionizing radiation.

d. Storage and Distribution Division will:

(1) Receive, store, package, mark and ship radioactive materials in accordance with existing regulations and instructions issued by the Radiological Protection Officer.

(2) Notify the Radiological Protection Officer (RPO) when radioactive material is being shipped or received if dose rate exceeds 0.5 mr/hr on the surface of the package.

(3) Assure that designated storage areas for radioactive materials are rked in accordance with the existing regulations.

(4) Maintain a current set of DOT regulations concerning transfer, packaging and transport of radioactive materials.

(5) Notify customers of all radioactive shipments using electrical messages.

(6) Follow up on all outstanding radioactive shipments when a confirmation of receipt from customers is not received within three days following estimated time of arrival.

(7) Include a statement in the notification of shipments requiring customers to notify LBDA that radioactive shipments have been received at their installation.

(8) Insure that radioactive materials are not commingled with incompatible material on the same shipment and add this check to those prescribed in the transportation office checklist in TM 55-315.

(9) Insure that all radioactive material shipments are marked in accordance with Mil-Std 129H.

(10) Provide DD Form 835 to motor vehicle drivers on Dot Label I, II and Yellow III shipments and to larger shipments of lower level radioactive material not requiring Dot labels.

(11) Notify RPO of delayed radioactive shipments.

(12) Insure that radioactive material on vehicles within the Depot Activity are attended at all times.

(13) Notify Quality Assurance Division of each receipt or shipment of radioactive material so that a 100% inspection can be performed to insure compliance with packaging, labeling and marking requirements.

(14) Label all radioactive material in storage in accordance with Mil-Std 129H.

(15) Will inform the RPO of pending radioactive shipment requiring Dot Label I, II, or III, their locations and actual shipments of pending issues.

(16) Insure that radioactive material received at LBDA requiring Dot Label I, II, III are stored in a timely manner.

(17) Maintain an automated listing and a manual listing of all radioactive items stored on LBDA as needed.

(18) Perform annual inventory of radioactive material stored on the Depot Activity in accordance with DARCOM-R 740-17.

(19) Insure that DLA and MRC are notified of nonradioactive material identified as radioactive in the LBDA computer system.

(20) Insure that NCR Form 3 is posted in all locations containing radioactive material.

(21) Notify Quality Assurance Division of receipt of radioactive materials requiring inspection.

(22) Maintain on file for a period of one year following shipment, proof that the shipping containers used meet the packing specifications in accordance with Title 49, Code of Federal Regulations.

(23) Insure the accuraay of automatic listing balances and correct any .fferences in a timely manner.

e. Quality Assurance Division will:

(1) Inspect all radioactive material received by or shipped from this Activity to assure all shipments are packaged and labeled in accordance with the references in paragraph 7.

(2) Perform visits to shipping section to validate compliance with all shipping requirements.

(3) Insure that all radioactive material shipped and received by LBDA is inspected for proper labeling.

f. Radiological Protection Officer will:

(1) Monitor the Depot Activity radiological safety program.

(2) Coordinate safety measures with the Depot Activity Safety Manager.

(3) Issue special instructions as required.

(4) Determine film badge requirements.

(5) Direct the disposal of radioactive materials and notify C, Resources .anagement Division at the time of packing.

(6) Assure that all radioactive material storage areas are checked once each month.

(7) Review shipping documents on radioactive material and furnish survey data on outgoing shipments to the Transportation Office.

(8) Assure that all incoming and outgoing shipments of radioactive material are monitored for excessive radiation.

(9) Maintain a current set of Nuclear Regulatory Commission Regulations concerning transfer, packaging and transport of radioactive material.

(10) Insure that radioactive materials are stored in a centralized area that is properly marked.

(11) Insure that all buildings containing radioactive material are marked and labeled in accordance with AR 385-30.

(12) Provide dosimetry results upon request to the duty station of visitors receiving radiation exposure at the Depot Activity.

(13) Review DD Form 1141 on a quarterly basis to insure accuracy of adiation exposure.

(14) Validate the selection of radiation workers in conjunction with Radiation Control Committee.

(15) Review instances where control film badges indicate radiation exposure.

(16) Supplement DA Form 1952 to identify specific radiation hazards and safeguards applicable to LBDA.

(17) Insure that LBDA obtains an NRC license for all licensable radioactive materials owned.

(18) Provide radioactive materials listings for fire department.

(19) Insure that SOP's are developed and followed on applicable radiological operations.

(20) Insure maximum attendance at radiation control committee meetings.

(21) Insure that radiation control committee meetings are held on a quarterly schedule.

g. Resource Management Division will periodically audit shipments of radioactive waste to assure that all regulatory requirements governing the shipment are met.

h. The immediate chief of each section will assure that a film badge is worn by any individual entering a designated radiation area or who handles radioactive material and assure that duties are arranged so employees spend a minimum amount of time in radiation areas. He will be required to notify the Civilian Personnel Officer of any additions/deletions of radiation workers. He is also responsible for reporting any observed radiological hazards to the Radiological Protection Officer.

6. Procedures. The following paragraphs outline special actions required in addition to normal processing for receipt, handling, storage, packing, packaging, marking, shipment and disposal of radioactive materials.

a. Receipt of Radioactive Material and Radioactive Commodities.

(1) Storage and Division will:

(a) Immediately contact the Radiological Protection Officer if any inbound package containing radioactive material shows evidence of damage, leakage or mishandling. Such packages and the vehicles transporting them will not be moved except at the direction of the Radiological Protection Officer. NOTE: The vehicle and package will be cordoned off to insure that exposure of personnel and spread of contamination is kept to a minimum.

(b) Monitor all incoming packages identified as containing radioactive material with an appropriate survey instrument within three hours after receipt. Packages received during non-duty hours will be monitored within 18 hours of receipt. If the dose exceeds 0.5 mr/hr on any surface of the package the RPO will be immediately contacted for handling instructions.

(c) Each package of radioactive material will be checked to insure that packing, marking and labeling complies with CFR 49 and other existing regulations.

(d) Wipe representative areas on each side of the outer shipping container with absorbent material provided by the RPO. The swipe and the shipping papers wil be presented to the RPO for analysis/review. The package containing the radioactiv material shall be kept in a marked segregated area in the receiving area until proper disposition instructions are provided by the RPO.

(e) Receive any special instructions from RPO.

(f) Assure that the radioactive material is properly packaged and marked in accordance with the reference in paragraph 7.

(g) Complete tally-in operations and move material to appropriate storage area. Materials requiring SF Label 414 or 415 will not remain in an operational area overnight.

(h) Send a report of arrival of the shipment to the consignor by electrical means, as appropriate.

(2) Radiological Protection Officer will:

(a) Respond promptly to any notification by Storage and Distribution Division of any damaged radioactive shipment or of a package which has a surface dose rate in excess of 0.5 mr/hr and will provide guidance in assuring safe disposition of the shipment.

(b) Evaluate smears and record results for containers of radioactive material.

(c) Provide proper radiological safety instructions regarding the radioactive shipment.

(d) Insure that SOP's for the receiving, handling, storage and shipping f radioactive items are prepared and followed as appropriate.

b. Shipment of Radioactive material.

(1) Storage and Distribution Division will:

(a) Receive material release order for radioactive material.

(b) Forward shipping documents on all radioactive material to the Radiological Protection Officer.

(c) Pack and mark material in accordance with existing regulations and special instructions issued by the Radiological Protection Officer.

(d) Affix appropriate radiation labels to the package and indicate the type and activity of contents.

(e) Indicate kind of packages (fiberboard, wood, lead, etc.) and number of items contained in each package in remarks block of the shipping documents and make normal distribution of shipping documents.

(f) Send a report of shipment to the receiving installation by electric means where applicable.

(g) Have highway vehicles inspected by requesting DD Form 626 from quipment inspector, Administration and Services Division, except where exempted by Section 173.391 of CFR.

(h) Give truck driver instructions (DD Form 836) on actions required in case of accident.

(i) Assure that the following certificate is placed on the Bill of Lading per 172.204 CFR: "This is to certify that the above named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation."

(j) Check and load material according to current regulations.

(2) Radiological Protection Officer will:

(a) Receive shipping document for radioactive material from Storage and Distribution Division.

(b) Determine radioactive material labels which the package requires. If the shipment does not require radioactive material labels, so annotate on shipping papers. For shipments requiring labels enter radioisotopes, quantity of material and type of labels required on the shipping document.

(c) File one copy of the shipping document.

(d) Issue special handling instructions to Storage and Distribution Division. NOTE: All radioactive calibrators and check sources not incorporated in an end item will be packed and stored in Bldg 139 until shipment. Check sources incorporated in end items and radioactive manufactured articles may be packed and stored until shipment in a specially marked holding area in the shipping area.

(e) Perform a smear test of all outgoing packages. Results of smear test are to be recorded.

(3) Quality Assurance Division will inspect material for conformance to stock number, nomenclature, labels, documentation, etc., in accordance with existing regulations, assuring that radioactive material labels are attached and instruction sheets are included.

c. Disposal of Radioactive Material. All unserviceable surplus radioactive material will be disposed of under the direction of the Radiological Protection Officer following the procedures given in TM 3-261. The RPO will notify Resource Management Division when disposal action is being initiated so that the process may be audited.

d. Storage and Repair Areas for Radioactive Materials.

(1) Warehouse 14F, 128 and 139 are designated as storage areas for radioactive materials.

(2) Building 139 is designated as the repair area for radioactive materials.

(3) Changes or additions to storage areas will be accomplished only upon the approval of the Radiological Protection Officer.

(4) Marking of buildings and areas for repair and storage of radioactive materials must be approved by the Radiological Protection Officer.

(5) All areas determined to be dangerous to personnel will be marked with signs, "DO NOT ENTER THIS AREA WITHOUT A FILM BADGE".

(6) No person will enter areas marked "CAUTION RADIATION" except on official business, and then only upon his supervisor's orders.

e. Special Rules for Handling Radioactive Materials.

(1) Personnel will not be allowed to eat, drink, smoke or apply cosmetics in the presence of radioactive material. Foodstuffs, cosmetics and tobacco will not be stored in radioactive material storage areas or in workshops where radioactive materials are being handled.

(2) Personnel receiving cuts, scratches or punctures by radioactive objects will report to the Health Clinic immediately for treatment. Questions regarding contamination and hazard will be forwarded to the Radiological Protection Officer.

f. Security of Mission Stock Radioactive Materials in Storage. All Radiac Calibrators and Radioactive Check Sources, including those incorporated in end items will be stored in a warehouse and used exclusively for storage of radioactive material. The warehouse will be secured by a two lock system. The keys to one lock will be maintained by Chief, Storage and Distribution Division and the keys to the other lock will be maintained by the Radiological Protection Officer.

7. References.

a. AR 385-11, "Ionizing Radiation Protection".

b. AR 385-14, "Occupational Exposure to Ionizing Radiation".

c. AR 735-50, "Requisitioning, Receipt, and Issue System".

d. TM 43-0116, "Radioactive Material Used in Self-Luminous Light Sources, Protective Measures".

e. TB 43-0108, "Handling, Storage and Disposal of Army Aircraft Components Containing Radioactive Materials".

f. TM 3-261, "Handling and Disposal of Unwanted Radioactive Material".

g. TM 11-665-227-12, "Safe Handling, Storage and Transportation of Calibrator Set, Radiac AN/UDM-2, NSN 6665-00-179-9037".

h. TM 55-315, "Transportability Guidance for Safe Transport of Radioactive Materials".

i. National Bureau of Standards Handbook No. 59, "Permissible Dose from External Sources of Ionizing Radiation".

j. National Bureau of Standards Handbook No. 69, "Maximum Permissible Amounts of Radioisotopes in Human Body and Maximum Concentration in Air and Water".

k. Title 10, Code of Federal Regulations.

l. Title 59, Code of Federal Regulations, Parts 100-199.

m. SB 11-206, "Film Badge (Photodosimetry) Supply and Service for Technical Radiation Exposure Control".

n. MIL STD 129H, "Marking for Shipment and Storage".

o. LBDA-M 385-1, "Lexington-Blue Grass Depot Activity Safety Program".

p. Ltr, AMSEL-MA-SS, dated 25 Apr 73.

q. Nuclear Regulatory Commission IE Bulletin No. 79-19 dated 10 Aug 79.

(SDSAN-LAS)

FOR THE COMMANDER:

Linda L. Fortner

LINDA L. FORTNER
Chief, Administrative Branch

DISTRIBUTION:
B
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SUPPORT AGREEMENT

1. DOCUMENT IDENTIFIER ("X" one)

XX NEW ☐ REVIEW NO. ____ ☐ REVISION NO. ____ ☐ TERMINATION

2. SUPPLIER (Name, Office Symbol & complete address)

USA TMDE SUPPORT GROUP
Chief US Army Ionizing Radiation Dosimetry Center
ATTN: DRXTM-CI-DC
Lex-Bluegrass Depot Activity
Lexington, KY 40511

GEOGRAPHICAL AREA OR COUNTRY CODE:

2a. MAJOR COMMAND CODE: W73QKK

2b. SUBORDINATE COMMAND CODE:

3. PRESENT AGREEMENT NUMBER: W31POX-83210-022

3a. SUPERSEDED AGREEMENT NUMBER:

4. TERMINATION DATE (Month and Year): 0689

5. RECEIVER (Name, Office Symbol & complete address)

Commander
Lex-Bluegrass Depot Activity
ATTN: SDSAN-LRF
Lexington, KY 40511

GEOGRAPHICAL AREA OR COUNTRY CODE:

5a. DODAAC/FEDSTRIP NUMBER:

5b. MAJOR COMMAND CODE: W73QKK

5c. SUBORDINATE COMMAND CODE: W31G1Y

6. SUPPORT AGREEMENT RESOURCE SUMMARY

a. CATEGORY CODES	SUPPLIER				
	b. MAN YEARS		c. GROSS ADDITIONAL COSTS		
	MILITARY	CIVILIAN	TOTAL	NON-REIMBURSEABLE	REIMBURSEABLE
BB			41,600		41,600
TOTAL					

6d. RECEIVER DATA (When applicable, provide similar data required in blocks 6a, b and c)

N/A

7. SAVINGS ACCRUED/COSTS INCURRED/MAN YEARS SAVED/EXPENDED TO FEDERAL GOVERNMENT

7a. SAVINGS	7b. COSTS	7c. MAN YEARS SAVED	7d. MAN YEARS EXPENDED
Exempt: Sole Source	N/A FY:	FY:	FY:

8. FUNDING AND REIMBURSEMENT ARRANGEMENT (Include all details concerning billing/reimbursement procedures, funding limitations, and the appropriate "billing/submit thru" addresses. Also list those references which specifically apply to the type of organization being supported.)

The receiver will certify funds on reimbursable order for USATSG to the Cdr, USA MICOM, ATTN: DRSMI-FAO, RSA, AL 35898 on an annual basis citing the applicable accounting classification. USAMICOM will accept the reimbursable order for USATSG, mail an accepted copy to the receiver, and forward notice of acceptance to the appropriate calibration/repair facility as the authority to perform work. USAMICOM will prepare SF 1080 billings on a monthly basis for cost incurred based upon a prearranged hourly stabilized rate. Funds on reimbursable order in excess of the final year SF 1080 will be withdrawn by amendment of the order by the receiver.

Encl 2

9. GENERAL PROVISIONS *(Complete blank spaces)*: The following general provisions, as set forth in Chapter III, DOD 4000.19-M, apply to this agreement unless otherwise specified in "Remarks" block below:

a. The Receiving Activity will provide the Supplying Activity projections of support required to accomplish its mission. Significant changes in the Receiving Activity function, mission or support requirements will be submitted by the Receiving Activity in a manner that will permit timely modification of resource requirements.

b. It is the responsibility of each agency providing support under this agreement to bring any required or requested change in support to the attention of USATSG prior to providing/reducing unilaterally such additional/reduced support.

c. Activities providing reimbursable support in this agreement will submit a monthly statement of costs to USATSG for preparation of billing document, SF 1080.

d. Manpower required in support of this agreement which is subject to return to the lending activity upon termination of the agreement: None (Enter number or if no manpower is required, enter "None").

e. All rates expressing the unit cost of services provided in this agreement are based on current rates which may be subject to change for uncontrollable reasons, such as Congressional legislation, DOD directives, commercial utility rate increases, etc. The receiver will be notified immediately of such rate changes.

f. This agreement will be reviewed biennially at least 120 days prior to the anniversary date. It may be revised at any time upon the mutual consent in writing of the parties concerned.

g. This agreement may be cancelled at any time by mutual consent of the parties concerned. This agreement may also be cancelled by either party upon giving at least 180 days written notice to the other party.

h. In case of mobilization or other emergency, this agreement will remain in force within supplier's capabilities, subject to normal cancellation provisions and will be subject to review at that time. This agreement will not be terminated if such action impairs the combat mission of the receiving activity as determined by higher headquarters.

10. REMARKS

a. This Intraservice Support Agreement is prepared to document mutual understanding and accord between Lexington-Bluegrass Depot Activity (LBDA) and USATSG Redstone Arsenal, AL. The USATSG will provide specific support services as required by LBDA on behalf of the Radiological Protection Officer.

b. The following individuals of Lexington-Bluegrass Depot Activity Safety Office will act as primary Radiological Protection Officer (RPO) and alternate on behalf of the Commander, LBDA, with assistance from IRDC to maintain the A Radiation Protection program.

William E. Baber - Primary RPO
John R. Dorton - Alternate RPO

c. This Agreement becomes effective upon approval by both parties.

11. COMPTROLLER CONCURRENCE *(Supplier Signature & Date)*	12. COMPTROLLER CONCURRENCE *(Receiver Signature & Date)*	
Nancy H. Walker 11 Aug 83	W. LARRY SHELBY LTC, ORDC Dir for Resources Mgt	
13. TYPED NAME AND ORGANIZATION OF SUPPLIER APPROVING AUTHORITY	**13a. SIGNATURE**	**13b. DATE**
GEORGE T. SHEPARD COL, OrdC Cdr, US Army TMDE Support Group	Geo T. Shepard	15 Sep 83
14. TYPED NAME AND ORGANIZATION OF RECEIVER APPROVING AUTHORITY	**14a. SIGNATURE**	**14b. DATE**
HUGH W. GRACEY COL, OD Commanding	Hugh W. Gracey	20 SEP 1983

ATTACHMENT I - SP[illegible]IC PROVISIONS

INTRASERVICE SUPPORT AGREEMENT - W31POX-83210-022

CATEGORY OF SUPPORT	SUPPLIER WILL	RECEIVER WILL
3B - Safety	1. Obtain and maintain NRC Licenses and DA Radiation Authorizations for all ISA items on LBDA (all but one item is used either in USAIRDC or USAACRC).	1. Perform all routine radiation surveys of work and storage areas on LBDA.
	2. Provide RPO support for all license-able radioactive property book items within USAIRDC, USAACRC and LBDA.	2. Perform RPO support for all incoming and outgoing shipments of radioactive material.
	3. Share expertise with LBDA-RPO and act in an advisory capacity as required.	3. Perform RPO support for all radioactive mission stock.
	4. Serve as LBDA RPO in absence of regular activity RPO and Alternate. This service will be provided at written request of Commander, LBDA, and will be limited to 30 days each tour of duty.	4. Provide training to radiation workers and annual retraining to radiation workers and emergency personnel.
	5. Limit overall support of LBDA to one half man-year per year on a reimbursable basis to include acting as LBDA RPO and evaluating leak tests, smear tests and radioactive samples.	5. Document all RPO actions to support LBDA Radiation Safety Program and have documentation available for review by IGs, DARCOM Field Safety Agency, USAEHA and others.
		6. Advise LBDA Commander on matters involving radiation safety.
		7. Chair the Radiation Control Committee and maintain minutes of meetings.
		8. Review DD Forms 1141 and DD Forms 1952 at least quarterly.
		9. Serve as RPO for LBDA elements requiring radioactive materials/calibration sources.
		10. Coordinate response to radiation safety inspection/survey findings of outside agencies.
		11. Control the issue/release of NRC license mission stock on behalf of responsible MRC.

19 JUL 1983

MEMORANDUM OF UNDERSTANDING

BETWEEN: US ARMY IONIZING RADIATION DOSIMETRY CENTER (IRDC) AND LEXINGTON-BLUE GRASS DEPOT ACTIVITY SAFETY OFFICE

1. The LBDA Safety Office will assume Radiation Protection Officer functions effective 1 October 1983. In order to make this transition between IRDC and LBDA a well planned and deliberate action, a plan of action and the meshing of functions between IRDC and the Safety Office, LBDA are considered essential to ensure a smooth and orderly transfer of Radiation Protection Officer (RPO) functions on 1 October 1983.

2. To ensure the orderly transfer of RPO functions from IRDC to the Safety Office, LBDA, the following procedures and/or actions are deemed appropriate:

a. IRDC Radiation Protection Officer will provide the following support:

(1) Obtain and maintain Nuclear Regulatory Commission (NRC) licenses and Department of the Army radiation authorization for all ISA items on LBDA.

(2) Provide RPO support for all licensable radioactive property book items within IRDC, US Area Calibration Repair Center (ACRC), and LBDA.

(3) Share expertise with LBDA Safety Office/RPO and act in an advisory capacity as needed.

(4) Serve as LBDA RPO in absence of LBDA RPO as outlined in Intraservice Support Agreement, W80KGD-83157-002 between LBDA and USATSG.

(5) Provide at least one-half manyear of RPO support on a reimbursable basis.

(6) Provide radiation detection instruments on an emergency basis pending procurement of instruments by the Safety Office.

(7) Provide a member for the Radiation Control Committee

(8) Evaluate leak tests and smear samples submitted by LBDA RPO.

(9) Provide on the job training for Safety Office RPO to include the following:

(a) Radiological survey of incoming and outgoing shipments of radioactive material (including wipe tests).

(b) Shipping papers and documents associated with the shipping and receiving of radioactive materials.

(c) Building surveys

(d) Leak testing of calibration sources

(e) Air monitoring of Building 14F

(f) Methods of inventory for radioactive materials

(g) Preparation of wipe test kit

(h) Instruction in use of survey instruments and RPO kits

(i) Depot film badge service

(j) Type of survey, search and personal monitoring instrumentation needed and sources to obtain these instruments.

(k) Supplies needed to carry out RPO function and sources for these supplies.

(l) Introduction to all forms used in reporting surveys, transfer, etc., sources of information to complete these forms. Filing system.

b. The LBDA RPO will perform the following functions in support of the total Depot Activity Radiation Safety Program:

(1) Perform all routine radiation surveys of work and storage area on LBDA.

(2) Perform RPO support for all incoming and outgoing shipments of radioactive material.

(3) Perform RPO support for all radioactive mission stock.

(4) Provide training to radiation workers and annual retraining to radiation workers and emergency personnel.

(5) Document all RPO actions to support LBDA Radiation Safety Program and have documentation available for review by IG's, DARCOM Field Safety Agency, USAEHA and others.

(6) Advise LBDA Commander on matters involving radiation safety.

(7) Chair the Radiation Control Committee and maintain minutes of meetings.

(8) Review DD Forms 1141 and DD Forms 1952 at least quarterly.

(9) Serve as RPO for LBDA elements requiring radioactive materials/calibration sources.

(10) Coordinate responses of radiation safety inspection/survey findings of outside agencies.

(11) Control the issue/release of NRC licensed mission stock on behalf of responsible MRC.

APPROVED:

Joseph M. King
JOE M. KING
C, USA Ionizing Radiation
Dosimetry Center

John R. Dorton
JOHN R. DORTON
Safety Director

NOTE

Enclosed is an abbreviated organizational chart as required by paragraph 3-2.g.(3) of AR 700-64, Radioactive Commodities in the DOD Supply Systems.

RADIATION SAFETY CONTROLS-FUNCTIONAL CHART

ARMY MATERIEL DEVELOPMENT AND READINESS COMMAND
QUALITY ASSURANCE PROGRAM MANAGEMENT
RADIATION PROTECTION PROGRAM MANAGEMENT

ARMY TEST MEASUREMENT DIAGNOSTIC EQUIPMENT SUPPORT GROUP
TECHNICAL GUIDANCE, ARMY METROLOGY SYSTEM
STANDARDIZATION OF CALIBRATION STANDARDS & PROCEDURES

ARMY COMMUNICATIONS - ELECTRONICS COMMAND
COMMODITY MANAGEMENT, CALIBRATION SOURCES

OTHER INSPECTION AGENCIES
DEPARTMENT OF THE ARMY, OFFICE OF THE INSPECTOR GENERAL AND SUBORDINATE COMMAND COUNTERPARTS
US ARMY AUDIT AGENCY
US ARMY HEALTH SERVICES COMMAND, ENVIRONMENTAL HYGIENE AGENCY

RECTORATE OF MAINTENANCE
INTENANCE PROCEDURES
GISTICS SUPPORT
CHNICAL MANUALS

SAFETY OFFICE HEALTH PHYSICS
RAD SAFETY PROCEDURES
LICENSING
CONTRACTOR SAFETY
PRE-AWARD, POST AWARD SURVEYS

DIRECTORATE OF PROCUREMENT
INVITATION FOR BIDS
REQUEST FOR QUOTATION
PROCUREMENT
PROCUREMENT AUTHORIZATION

DIRECTORATE OF PRODUCT ASSURANCE
QUALITY ASSURANCE PROCEDURES
PRE-PRODUCTION TESTS
INITIAL PRODUCTION TESTS
PRODUCTION ACCEPTANCE TESTS
DEPOT QA SURVEILLANCE PROCEDURES

DIRECTORATE OF MATERIEL MANAGEMENT NATIONAL INVENTORY CONTROL POINT
CATALOGING
INVENTORY CONTROL
REQUISITION REVIEW
MATERIAL RELEASE ORDERS

XINGTON-BLUEGRASS DEPOT ACTIVITY
ITIAL RECEIPT AND INSPECTION
LK STORAGE
LIBRATION
SUE
PAIR
CALIBRATION
SURVEILLANCE
AK TEST EVALUATION

***SACRAMENTO ARMY DEPOT**
RECALIBRATION
LEAK TEST EVALUATION

*** PIRMASENS, GERMANY**
RECALIBRATION
LEAK TEST EVALUATION

***CAMP CARROLL, KOREA**
RECALIBRATION
LEAK TEST EVALUATION

libration and leak test evaluations are performed by TMDE organizations at these locations.

MAJOR COMMAND RADIOACTIVE MATERIAL CONTROL POINTS

COMMAND RADIATION CONTROL PROGRAM MANAGEMENT
INVENTORY AND LEAK TEST PROCEDURES, RECORD, REPORTS
SURVEYS/INSPECTIONS OF USER ACTIVITES

SUBORDINATE COMMAND RADIATION CONTROL PERSONNEL

IMPLEMENTATION OF COMMAND RADIATION CONTROL PROGRAM
SURVEYS/INSPECTIONS OF USER LOCATIONS

USERS - AUTHORIZED CALIBRATION ACTIVITIES

IOBILE TEAMS

:ALIBRATE INSTRUMENTS AT USER LOCATIONS

DEPOTS

CALIBRATE INSTRUMENTS RECEIVED FROM USERS NOT VISITED BY MOBILE TEAMS AND INSTRUMENTS FOR OWN USE EVALUATION OF USER LEAK TESTS AS REQUESTED

INSTALLATIONS

CALIBRATE INSTRUMENTS FOR OWN USE

TRAINING CENTER/SCHOOL

RAD SAFETY TRAINING OF ARMY PERSONNEL

DEPARTMENT OF THE ARMY
US ARMY COMMUNICATIONS-ELECTRONICS COMMAND
FORT MONMOUTH, NEW JERSEY 07703

ENVIRONMENTAL ASSESSMENT

AND

FINDING OF NO SIGNIFICANT IMPACT

FOR THE

AN/UDM-2 RADIAC CALIBRATOR SET

SECURITY VERIFICATION: THIS DOCUMENT HAS BEEN REVIEWED IN FULL CONSIDERATION OF THE REQUIREMENTS OF OPERATIONS SECURITY (OPSEC) AND HAS BEEN DETERMINED TO BE ACCEPTABLE FOR PUBLIC RELEASE (SEE SECTION I)

PREPARED BY:

Patricia Ann Elker
PATRICIA ANN ELKER
Health Physicist

APPROVED BY:

Bm Savaiko
BERNARD M. SAVAIKO
Chief, Safety Office

OCTOBER 1983

TABLE OF CONTENTS

LISTING OF TABLES

LISTING OF ABBREVIATIONS

AEHA	US Army Environmental Hygiene Agency
AIRDC	US Army Ionizing Radiation Dosimetry Center
ALI	Annual Limit on Intake
AMCCOM	US Army Armament, Munitions and Chemical Command
AR	Army Regulation
Bq	Becquerel
CECOM	US Army Communications-Electronics Command
cm	centimeter
cpm	counts per minute
d	day
DA	Department of the Army
DOD	Department of Defense
DOT	Department of Transportation
h	hour
ICRP	International Commission on Radiological Protection
LBDA	Lexington-Blue Grass Depot Activity
m	meter
3M	Minnesota Mining and Manufacturing
MSC	Major Subordinate Command
NBS	National Bureau of Standards
NICP	National Inventory Control Point
NRC	Nuclear Regulatory Commission
NSN	National Stock Number
OPSEC	Operations Security

Pu-239	Plutonium-239
R	Roentgen
Rad	Radiation Absorbed Dose
RCO	Radiation Control Officer
RMCP	Radioactive Material Control Point
RPO	Radiation Protection Officer
s	second
Sr-90	Strontium 90
Sv	Sievert
TB	Technical Bulletin
TM	Technical Manual
TMDE	Test Measurement and Diagnostic Equipment
yr	year

I. OPERATIONS SECURITY (OPSEC) REVIEW

A. Security Verification

1. The Environmental Assessment and Finding of No Significant Impact for the AN/UDM-2 Radiac Calibrator Set supports a US Nuclear Regulatory Commission (NRC) license in accordance with requirements set forth in Army Regulation (AR) 200-2 and AR 385-11. The NRC license managed by the US Army Communications-Electronics Command, Fort Monmouth, NJ is available for public review in the Public Documents Room, Washington, DC as required by Title 10, Code of Federal Regulations.

2. The information contained within this environmental documentation has been reviewed in accordance with OPSEC intentions/requirements in AR 530-1, and has been determined to be acceptable for public release.

Prepared by: Patricia Ann Elker
PATRICIA ANN ELKER
Health Physicist

Concurred by: Christopher Kencik
CHRISTOPHER KENCIK
OPSEC Officer
CECOM Safety Office

II. PUBLIC NOTIFICATION

A. Finding of No Significant Impact

1. Since 1972, the US Army Communications-Electronics Command (CECOM) has managed the AN/UDM-2 Radiac Calibrator Set governed by US Nuclear Regulatory Commission (NRC) License Number 29-01022-08. The AN/UDM-2 Radiac Calibrator Set contains ^{90}Strontium (Sr-90) as sealed sources for calibration checks of standard Army beta-gamma radiation survey instrumentation and pocket dosimeters. The calibrator set has been successfully utilized by activities worldwide in support of radiac equipment. A detailed Environmental Assessment supports the NRC license application and complies with Army Regulation (AR) 200-2, Environmental Quality, Environmental Effects of Army Actions, which requires evaluation of any radionuclide proposed for use within Army activities. The assessment documents all safety protocol implemented during use, possession, transfer, storage and disposal. In addition, this assessment demonstrates compliance with all regulatory requirements inclusive of minimum radiation protection training requirements of authorized users, technical manuals and instructions concerning radiation safety policies, rigorous logistical control, storage facility design, and specific disposal procedures for the calibrator set.

2. Alternative radionuclides have been presented for implementation with the AN/UDM-2 Radiac Calibrator Set, but are considered unacceptable based on weight design criteria for field equipment, increased potential for external exposure, greater expense and tremendous impact on the Army resultant from financial/manpower resources necessary if development of a replacement set were initiated. A "no action" proposal is not considered based on Federal regulatory

requirements and need of calibration standards for the continued Army mission.

3. The assessment provides complete dosimetric analyses for external/internal exposure presented to both occupational and non-occupational individuals from highly improbable incidents releasing radioactive materials to the environs. Included in this assessment are scenarios which involve source damage, improper disposal, installation fire or transport accident for evaluation of radiological and/or environmental impact. The dosimetric evaluations identify air/water concentration and exposure levels below Federal and Army regulatory requirements. The internal exposure presented individuals through various pathways have also been identified to remain below International Commission on Radiological Protection (ICRP)[1] recommendations. Based on this criteria, stringent military radiation safety policy, and previous successful use without significant documented hazard, the Environmental Assessment has concluded no discernable radiological health or environmental quality degradation. Therefore, the proposed action is non-substantive/exclusive of environmental impact and does not require an Environmental Impact Statement. The Environmental Assessment is available for review upon request from Commander, US Army CECOM, ATTN: DRSEL-SF-MR, Fort Monmouth, New Jersey 07703.

III. ENVIRONMENTAL ASSESSMENT

A. Summary and Conclusion

1. The following Environmental Assessment supporting a Finding of No Significant Impact and concurrent with an application for an NRC license to receive, own, acquire, deliver, possess, use and transfer radioactive material, has been prepared to maintain compliance with AR 200-2. The basic objectives

specified in this regulation are to perform all actions with consideration given to minimizing adverse effects on the quality of the human environment without impairment to the Army mission.

2. This document outlines:

a. The proposed use, need, and description of the AN/UDM-2 Radiac Calibrator Set, inclusive of maximum safety design specifications and Army policies more restrictive than comparable governing Federal regulatory requirements.

b. Alternatives considered for calibrator set substitution.

c. Theoretical radiological impacts with resulting dose assessments from hypothetical accidents or misuse. The comprehensive evaluation concludes and documents that there is no potential degradation of environmental quality or significant radiological impact to occupational workers or to the health of the general public resultant from fielding of the AN/UDM-2 Radiac Calibrator Set or any combination of calibrator sets utilized at authorized activities.

3. The intended use of the AN/UDM-2 Radiac Calibrator Set is solely for calibration checks of beta-gamma radiation detection instrumentation/dosimeters employed for tactical (field) purposes. Unit description, authorized user qualification, location, control of calibrator use, accountability, transfer and ultimate disposal are outlined in Part B. These meet stringent Army safety policies compliant with governmental agencies having regulatory responsibilities. Further control has been established in that distribution is limited by approval from the Department of the Army (DA) based upon previously established authorization of user organizations to receive the item from a supply standpoint along with specific storage requirements, protective handling and maintenance

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procedures, and disposal through the US Army Armament, Munitions and Chemical Command (AMCCOM).

4. Properly implemented safety procedures for actions involving calibrator sets preclude any unnecessary radiation exposure to the occupational worker or the general public and exclude consideration of any potential release to the environment. In determining radiological hazards to the occupational worker or the general public, assessments for both internal and external doses are presented. ICRP Publication 30[2] identifies recommended Annual Limits on Intake (ALI) for radionuclides. These recommendations are based upon mathematical and biological parameters of standard man for which exposure risk to the individual from the radionuclide is acceptable. The recommendations are derived from specified quantities which have been identified as not leading to the induction of significant biological effect and are computed in terms of committed dose equivalents spanned over 50 years. The maximum committed dose equivalent for internal dose was determined for an occupational worker upon ingestion of 5.00E+03* becquerels (Bq) (1.35E-04 millicuries (mCi)) Sr-90 from source leakage/damage which resulted in 2.10E-03 sieverts (Sv) (2.10E-01 rem) to the bone surface. The ingested activity is 0.5 percent of the ALI (1.00E+06 Bq) and is well below ICRP recommendations. Additional hypothetical incidents involving release of radioactive materials through various environmental pathways resultant from installation fire, improper disposal and transport incident are also outlined and summarized in Table A-1. The consideration of external dose was evaluated from theoretical and thermoluminescent dosimetry studies performed. The conclusions presented in the US Army Environmental Hygiene Agency (AEHA) report (Encl 1) indicated that a user would not receive more than 10 percent of the stipulated limits of 5.00E-02 Sv/year (5.00E+00

rem/year). Complete derivation of the evaluations and identification of compliance to regulatory standards are provided for review in Part C. The environmental assessment continually outlines possible modes of exposure and identifies under most severe conditions minimal environmental or radiological health impact.

TABLE A-1

Summary of Committed Dose Equivalent Limits to Bone Surface Subsequent to Hypothetical Incidents

Incident	Sievert (rem)
Source Leakage/Damage	2.10E-03 (2.10E-01)
Source Incineration	2.25E-08 (2.25E-06)
Terrestrial Transport	4.02E-04 (4.02E-02)
Installation Fire	2.37E-04 (2.37E-02)
Individual Storage Area Fire	1.14E-05 (1.14E-03)
Transportation	1.74E-04 (1.74E-02)

*The use of exponential (scientific) notation, i.e., 9.79E-03 (9.79×10^{-3}) is employed in lieu of standard notation, i.e., 0.00979.

5. The specific need for the AN/UDM-2 Radiac Calibrator Set is evident as outlined in Part D regarding Army mission requirements with respect to calibration methods for beta-gamma detection instrumentation or dosimeters employed in tactical activities. Minimal radiological risk is associated with the AN/UDM-2 Radiac Calibrator Set. It has been used successfully in the Army Supply System with no adverse indication demanding discontinuation of calibrator usage. The assessment does not consider the worldwide fielding of the AN/UDM-2 Radiac Calibrator Set environmentally controversial, as it is neither capable of significantly affecting the quality of the human environment nor is it demonstrative of any radiological impact.

B. Description and Proposed Action for the AN/UDM-2 Radiac Calibrator Set.

1. The AN/UDM-2 Radiac Calibrator Set incorporates five Sr-90 sealed sources, which have been manufactured by various corporations. Due to the limited useful lifetime of the sealed sources, new sources will be procured for refurbishment of all calibrator sets being utilized by authorized activities. This environmental document will encompass the newly procured sealed sources to be utilized by field elements. It should be noted, as the previous Sr-90 sealed sources are replaced, they will be restricted to storage areas until final disposal. All evaluations are based on the activity contained in the newly procured sources, which is approximately equivalent to the decayed activity of previous radioactive sources.

2. The Sr-90 sealed sources have been manufactured by Minnesota Mining and Manfacturing (3M) Company, New Brighton, Minnesota in accordance with Military Specification MIL-R-55350 (ER)[3]. The Sr-90 contained in these sources are chemically combined with a ceramic base which is then fired to produce micro-

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spheres of a controlled shape having a diameter of approximately fifty (50) microns. A specified amount of Sr-90 microspheres are funneled into the inner aluminum capsule upon which a plug is depressed and welded. The inner capsule is checked for contamination prior to placement within an outer capsule and bubble tested to insure no bubbles are detected at the window area. Additional bulge testing, and output measurements are performed prior to final acceptance and enclosure within the outer capsule. The outer capsule is fabricated in the same manner. The inner capsule is placed within the outer capsule and a plug is welded onto the unit. Quality assurance testing inclusive of bubble, bulge, output and contamination checks are performed prior to acceptance. The capsule assembly is then labeled with the manufacturer's identification and serial number. All sources are manufactured as special form material in accordance with Army specifications, US Department of Transportation (DOT) regulations, Title 49, Chapter 1, Code of Federal Regulations (49 CFR), NRC regulations, 10 CFR, and the International Atomic Energy Agency. Additionally, these radioactive sources must comply with the American National Standards Institute (ANSI) N542-1977 sealed source classification criteria of 45343.

3. The Sr-90 sealed sources are contained within the AN/UDM-2 Radiac Calibrator Set components. These components are the Doserate Jig Assembly (TS-3494/UDM-2) and Discharge Well Assembly (TS-3495/UDM-2). The Doserate Jig Assembly contains one 35 ± 20 percent mCi Sr-90 sealed source and is used to check the calibration of standard Army beta-gamma radiac survey instruments. The Discharge Well Assembly contains three 35 ± 20 percent mCi Sr-90 sealed sources and one 30 ± 20 percent microcurie (uCi) Sr-90 sealed source. The Discharge Well Assembly is used to check the calibration of standard Army pocket dosimeters. The calibrator sets have been labeled to indicate a total maximum quantity of

180 mCi based on the percent of radioactive material incorporated. The Doserate Jig Assembly is labeled as containing a 45 mCi Sr-90 sealed source and the Discharge Well Assembly indicates a 135 mCi quantity. Sealed source quantities referred to within this document will be 45 mCi and 36 uCi as applicable.

4. The construction of the Discharge Well Assembly, clamped to one half of the aluminum case, basically incorporates a discharge well, a dosimeter shelf and a stopwatch. The dosimeter shelf contains 30 holes to hold dosimeters to be tested, and the discharge well. The discharge well has an access hole to the central cavity centered in the top. The cover over the access hole is mounted on a spring-loaded pivot and is key-locked in the closed position when the well is not in use. A standard National Lock filing cabinet lock is held in place by a set screw. The tongue drops down into a slot in the cover and blocks movement of a pin which projects from the upper housing. The pin guides through the slot in the cover when the cover is swung aside. A shipping lock fastens the cover closed for shipment. When the cover is open, the access hole is visible. A threaded 36 uCi source is screwed directly into the upper aluminum housing and is locked into position by a shield plug whose window is about 1/4 inch from the access hole. Three threaded 45 mCi sources are screwed into a tungsten alloy doughnut shield mounted between two anodized aluminum halves of the discharge well. The sources are backed by plugs and their windows are about 0.1 inches recessed from the central access hole. Three long bolts pass through the doughnut and fasten the upper and lower assembly halves together. A spring mounted dosimeter platform plugs the center of the cavity (about 0.01 inch clearance) and rests on a steel spring. The spring is mounted on a stop that is force fitted into the bottom cover. The three 45 mCi sources are located below this platform. The bottom cover is screw-fastened to a cylinder that is force fitted

into the lower housing.

5. The Doserate Jig Assembly consists of a drawer unit fastened to the second half of the aluminum case. An aluminum spacer block is stored in the drawer when not in use. The drawer unit is anodized aluminum with tungsten alloy shielding around the 45 mCi source. The threaded 45 mCi source is screwed into the tungsten alloy shield cylinder which is force fitted into the aluminum shield assembly. The source is locked in place by a plug and the window is recessed about 1/4 inch from the edge of the shield assembly. A shutter absorber at the window end of the source shields the radiation reaching the drawer area. The shutter has three positions as follows: closed (source is shielded), 10 "rad/hr" (hole with an attenuator plug over source window), and 100 "rad/hr" (large hole over source window). A steel pin in the shutter fits in a slot in the underside of the drawer so that the shutter must be in the closed position before the drawer opens. The key-lock is force fitted into the shield assembly, and the tongue engages a slot in the underside of the shutter. A shipping lock fastens the drawer closed for shipment.

6. It should be noted, quality assurance testing of the calibrator sets/assemblies are performed prior to acceptance in accordance with MIL-R-55350A(ER) inclusive of calibrator contamination checks, calibration accuracy, dosimeter assembly measurements and doserate jig assembly measurements.

7. Prior to use, the eight transport container latches are released, the two aluminum halves of the calibrator are placed on the work surface open side up, and shipping locks are unfastened. The Discharge Well Assembly is unlocked with a key and the cover is swung aside. A clean, zeroed pocket dosimeter is inserted into the Discharge Well access hole. For low range dosimeters

(usually less than 1 Roentgen (R) maximum reading), the dosimeter rests on the undepressed, spring-loaded dosimeter platform, and the cover swings against the body of the dosimeter projecting from the well. This procedure exposes the dosimeter to the low intensity field of the 36 uCi source. For high range dosimeters (usually more than 1 R maximum reading), the dosimeter is pressed down enabling the cover to swing over the dosimeter. This procedure exposes the chamber of the dosimeter to the high intensity field of the three 45 mCi sources. The dosimeter is removed after the predetermined time for each specific type of dosimeter. The stop watch mounted on the swivel cover is used to time each exposure. The dosimeter reading is then checked against acceptable limits also listed in chart form. When a dosimeter is not in the discharge well, the spring-pivoted cover automatically swings back over the discharge well access hole. Upon completion of use of the Discharge Well Assembly, the cover is relocked in the closed position. The Doserate Jig Assembly is used to calibrate standard Army radiacmeters in a variety of configurations to produce varying gamma equivalent fields for the specific instruments. The detector probe is placed appropriately exterior to the Doserate Jig Assembly, on the open drawer, or through an access hole in the drawer. A special spacer block is provided for proper positioning of some probes. After positioning of the operating instrument, the instrument reading is read with the shutter in one of three positions, "closed", "10 rad/hr", and "100 rad/hr". The shutter can be rotated to the open positions only after unlocking with a key and only with the drawer tightly shut.

8. Reference should be made to Technical Manual (TM) 11-6665-227-12[4] for complete diagrams and description of the AN/UDM-2 Radiac Calibrator Set. Technical Bulletin (TB) 11-6665-227-12[5] details completely the operation and use, appropriate warnings and instructions for proper handling, set inspection,

testing, storage, disposition and actions to be taken during emergency situations. Radiation safety policies assure qualified users, proper labeling and operating procedures for maximum user safety. The aluminum transport case provides additional attenuation of the Sr-90 sealed sources for storage and transportation requirements. All packaging and labeling of the Radiac Calibrator Sets comply with both NRC and DOT specifications.

9. The AN/UDM-2 Radiac Calibrator Set will be utilized by the US Army Ionizing Radiation Dosimetry Center (AIRDC) of the US Army Test Measurement and Diagnostic Equipment (TMDE) Support Group located at the Lexington-Blue Grass Depot Activity (LBDA), Lexington, Kentucky, and Department of Defense (DOD) installations and activities at worldwide locations. Radiac Calibrator Sets at DOD installations and activities will be possessed and utilized under the control of DA military and/or civilian personnel on the basis of approved facilities, radiation safety standards, procedures and qualifications of authorized user as approved by CECOM and in accordance with AR 385-11[6]. The AN/UDM-2 Radiac Calibrator Sets will be issued only to authorized calibration activities at the Direct Support/General Support level. Radiac Calibrator Sets issued to authorized activities are for calibration of specific beta-gamma radiation detection instruments, i.e., the AN/PDR-27( ) and IM-174( )/PD and pocket dosimeters, i.e., IM-9( ), IM-147( ), IM-93( ), and IM-185( ). Typically, instrumentation will be sent to authorized calibration activities or will be calibrated by a visiting mobile calibration activity (team). Calibrator sets are returned to LBDA for cosmetic repair, replacement of non-radioactive components, examination, and where applicable, leak testing, recalibration, and return to depot stock. All calibration activities will be supervised by a qualified local Radiation Protection Officer (RPO) who will have received at least

forty hours training in the principles and practices of radiation protection which includes specific training in the safe use of the calibrator set. The operator/user will have a minimum of eight hours training in basic fundamentals of radiation protection, radiac instrumentation theory, application and survey techniques inclusive of practical training in the operation of the AN/UDM-2 Radiac Calibrator Set. Most of the sets will be used by four to seven-man mobile calibration teams with at least one individual qualified as a local RPO. Operations are performed with maximum safety procedures insuring lowest achievable occupational exposures. For personnel dosimetry purposes, bioassays are available and provided when needed, by The Surgeon General of the Army.

10. CECOM will individually control the logistics of the AN/UDM-2, serve as National Inventory Control Point (NICP) for the item, and assure that requesting elements are authorized and technically capable of receiving the item in accordance with the NRC license. The Army program for control of radioactive items is prescribed in two regulations, AR 385-11 and AR 700-64[7]. The CECOM Safety Office has adopted special procedures in addition to standard Army supply practices used for all type classified items through maintenance of a computerized data retrieval system that contains information regarding the radioactive commodity type number, location, responsible RPO, and leak test results. In addition, the control point maintains records of procurements, receipts, shipments, excess items and using/storage locations. The NICP reviews requisitions submitted, authorizes and issues material release orders to the designated depot for shipment of the material to the requisitioner. Each major command has established at the headquarters level a radioactive material control point (RMCP) and appointed a radiation control officer (RCO) to administer control of radioactive items within the command. The RCO reviews and concurs in the quali-

fications of local RPO's within the command, maintains records of radioactive items by location and assures periodic inventory and leak tests by using activities, performs periodic inspections/audits of accountable installations/activities to assure that items are properly handled in accordance with Army and NRC regulations, and to assure the submission of inventory and leak test reports and accident/incident reports. The local RPO is responsible for administering the local radiation protection program. Local programs provide for designated controlled areas, dosimetry, instrumentation, operating procedures supplementing published manuals for the items, receipts, transfers, storage and records. Requisitions originated by using elements are forwarded to the NICP for review and approval.

11. Facilities for use and storage of the AN/UDM-2 Radiac Calibrator Sets will be designated radiation controlled areas for those purposes as approved by the local RPO. Sets used by the mobile calibration teams will be used and stored in specifically designed vans, access to which is limited to team members. In addition, at other user facilities, the sets will be used and stored in controlled areas and secured against unauthorized removal. Areas/buildings will be posted with appropriate radiation warning signs. LBDA storage, maintenance, and serviceability facilities used for bulk storage of the AN/UDM-2 Radiac Calibrator Set are constructed of concrete block and steel. The calibration and storage rooms are constructed of thirty-six inch poured concrete with a door containing one-quarter inch of lead shielding. The installation is protected by a fire sprinkler system which is linked to the LBDA self-support fire department. The fire department has a maximum response time of two to three minutes to its furthest building. The security of the installation is such that all buildings are locked when not inhabited and the perimeter of LBDA

is secured by chain-linked fence with roving patrols and sentries at the gate eliminating any possibility of unauthorized possession.

12. Packaging and shipment of the AN/UDM-2 Radiac Calibrator Set is in compliance with all Federal and Army regulations. These regulations require that the information on radioactive shipment documentation contain the proper shipping name (Radioactive Material, Special Form, NOS), identification number, unit description and weight, type of packaging, radionuclide and activity, chemical and physical form, type label required, shipper's certification and NRC license number. This information is provided to the authorized activity through the Hazardous Material Data System and the TB for the AN/UDM-2 Radiac Calibrator Set.

13. Ultimate disposal of the AN/UDM-2 Radiac Calibrator Set sources will be in accordance with AR 385-11, AR 700-64 and 10 CFR. Request for final disposal of Sr-90 sealed sources must be made through Army channels. Headquarters, AMCCOM has been delegated this responsibility. Replaced Sr-90 sealed sources will be stored at LBDA or with the manufacturer until final disposition and waste disposal can be accomplished.

C. Proposed Environmental Impact for Fielding of the AN/UDM-2 Radiac Calibrator Set.

1. The following paragraphs will present information and theoretical/actual radiological information concerning the use/fielding of the AN/UDM-2 Radiac Calibrator Set to identify non-existent to insignificant environmental or radiological concern/impact. Specific operations regarding use, transfer or disposal of the AN/UDM-2 Radiac Calibrator Set will identify

the logistical/radiological control governing this commodity. In addition, the proposed incidents presented from these operations will prove undoubtedly the conclusions contained in the Finding of No Significant Impact (Section II). Further, since the AN/UDM-2 is utilized by mobile US Army TMDE Support Group Teams which also possess the AN/UDM-6 or AN/UDM-7C Radiac Calibrator Sets, an evaluation of proposed incidents concerning use of all calibrators sets will be presented to identify or determine any significant environmental impact arising from use of Army radiac calibrator sets at these activities.

a. Several studies have been conducted for the AN/UDM-2 Radiac Calibrator Set to determine radiological impact to users of this equipment. No radiological impact can be associated with the calibrator set under normal operating conditions with the implementation of proper procedures. AEHA has conducted a survey of the calibrator set (Encl 1) utilizing thermoluminescent dosimetry techniques. This study was performed on calibrator sets with Sr-90 sealed sources totaling 200 millicuries. The external exposure rates indicated that an operator would not be likely to receive more than 10 percent of the dose equivalent stipulated in AR 40-14[8] during normal use of the item when the procedures in TM 11-6665-227-12 are implemented. The stipulated occupational limits are 5.0 rem per year (yr) to the whole body, head and trunk, active blood forming organs, gonads or lens of the eye. Further, it was found that there were no health hazards due to ionizing radiation from the calibrator set.

b. In addition, a computerized theoretical dose evaluation was completed by Science Applications Inc. (SAI), (Encl 2 and 3). The theoretical dose evaluation identified a dose rate of approximately 30.0 millirem (mrem)/ hour (h) directly above the opened Discharge Well Assembly and 20.0 mrem/h at one centimeter (cm) directly above the assembly with the platform depressed. Typical operator distances are one meter. The dose rate at one meter is given to be approximately 1.60E-02 mrem/h. If the maximum individual operating time is assumed to be forty hours per week, fifty weeks per year, the total dose at an operating distance of one meter is 3.20E-02 rem/yr. This value represents 0.64 percent of annual external exposure limits stipulated by 10 CFR Part 20 and AR 40-14 for occupational exposure. It should be noted, the use factor identified (forty hours per week, fifty weeks per year) is approximately three times actual using time elements.

c. Individuals are required to wear whole-body and wrist film badges when utilizing the AN/UDM-2 Radiac Calibrator Set. Film badges are analyzed at AIRDC, LBDA, Lexington, Kentucky. Results have never indicated an actual exposure above stipulated regulatory limits. Typically, there is no measurable exposure to ionizing radiation for users.

d. The International System of Units (SI) indicates a value of 5.00E-02 Sv/yr or, stated in the more familiar notation, 5.00E+00 rem/yr as an equivalent occupational exposure limit for uniform irradiation of the whole body. As demonstrated, the resultant exposure from continuous use is 0.64 percent of the permissible limits. Theoretical doses determined are conservative (high) in consideration of actual operational distance, duration of operations, and actual radionuclidic quantities contained in each set.

e. Hypothetical situations were examined to determine whether any configuration of the AN/UDM-2 could result in excessive exposure to operational personnel. It was determined that an individual improperly utilizing the Dose-rate Jig Assembly during removal of the plate for placement of the AN/ADR-6 adapter with the shutter in the "100 R/hr" position could be within a beta field of approximately 1.00E+00 rad/h to 1.22E+01 rad/h ten inches above the assembly. The 1.00E+00 rad/h was determined through theoretical computer calculations contained in Enclosures 2 and 3. The 1.22E+01 rad/h was determined by actual measurement utilizing a Victoreen Intercomparison Chamber Model No. 415A (SN 137) calibrated indirectly by a National Bureau of Standards (NBS) Sr(Y)-90 reference source. A 1.03E+01 rad/h determination was through thermoluminescent dosimetry (TLD) techniques performed on a "refurbished" calibrator set (Table C-1). Assuming a five minute exposure directly within the beta radiation field, the user's eye is exposed to a total of approximately 8.00E-02 rad to 1.02E+00 rad for the theoretical and measured values (or 8.00E-02 rem to 1.02E+00 rem with an assumed quality factor of one for beta particles), and 9.79E-01 rad (9.79E-01 rem) for the dosimetric determination. This total dose represents 1.60 to 20.4 percent respectively, of limits specified within Part 20 of 10 CFR and AR 40-14. It should be noted, this exposure is considered highly improbable based on several factors inclusive of:

(1) The AN/ADR-6 is currently developmental and is not utilized with the AN/UDM-2.

(2) The operator would need to be directly in the centrally located twelve inch diameter field ten inches above the assembly.

(3) The operator would be slow in removing the plate to require the five minute time interval.

(4) The operator would be improperly utilizing the AN/UDM-2 with the shutter at the "100 R/hr" position rather than the "closed" position.

(5) The operator would not be heeding warning statements or proper procedures specifically outlined within the TB for the AN/UDM-2. Based on the training of the operator and the requirement of all parameters to exist simultaneously, the hypothetical occurrence is determined to be unlikely. Consideration for exposure to the user's eye if looking directly into the well of the Discharge Well Assembly with the platform depressed, can only identify a maximum five minute exposure to be 2.50E+00 Sv (2.50E-02 rem). This is 0.5 percent of the stipulated limits. In addition, it is highly unlikely that the platform would be depressed or the user would attempt to peer into the well for any length of time. The assumptions do not include actual operational distance, angular operational position or time duration. Further external dosimetric review can be evaluated from reference to the enclosed SAI reports.

TABLE C-1

CUMULATIVE COMPARISON OF EXPOSURE RATE DETERMINATIONS
UTILIZING FILM BADGE AND TLD TECHNIQUES ON AN
"INITIAL ISSUE" AND "REFURBISHED" AN/UDM-2 RADIAC CALIBRATOR SET

**TLD No.	* Film Badge No.	Ring No.	Distance from Source (inches)	Exposure Time (min)	Exposure (Rad/hr) TLD	Exposure (Rad/hr) Film Badge	Exposure (Rad/hr) Ring
0005124	-----	-----	8	60	13.8	-----	-----
0005125	A-004	-----	8	30	15.1	20.2	-----
0005126	A-005	A-001	8	15	14.8	18.8	15.6
0005127	-----	-----	12	60	6.1	-----	-----
0005128	A-002	-----	12	30	5.6	6.4	-----
0005129	A-003	A-003	12	15	5.4	6.8	6.3
0005130	A-001	-----	18	60	2.3	2.4	-----
0005131	-----	-----	18	30	2.2	-----	-----
0005132	-----	A-005	18	15	2.2	-----	2.48
0005134	-----	-----	8	60	26.9	-----	-----
0005135	B-009	-----	8	30	28.7	33.0	-----
0005136	B-010	B-002	8	15	25.4	33.4	30.2
0005137	-----	-----	12	60	10.3	-----	-----
0005138	B-007	-----	12	30	10.2	13.2	-----
0005139	B-008	B-0004	12	15	10.5	13.2	11.6
0005140	B-006	-----	18	60	3.8	4.8	-----
0005141	-----	-----	18	30	3.8	-----	-----
0005142	-----	B-006	18	15	3.7	-----	4.2
0005123	Control						
0005133	Control						

*"A" indicates "Initial Issue" Calibrator serial number 102.
"B" indicates "refurbished" (with new sources) Calibrator, serial number 149.

**TLD numbers 0005124 thru 0005132, inclusive, were used for measurement of the "Initial Issue" AN/UDM-2 Calibrator, serial number 102.

TLD numbers 0005134 thru 0005142, inclusive, were used for measurement of the "refurbished" AN/UDM-2 Calibrator, serial number 149.

2. In order to determine radiological impact due to internal ingestion or inhalation, the proceeding hypothetical incidents are proposed to determine the uppermost bound of impact. The radiological assessments are expressed in terms of committed dose equivalents determined for organs with the greatest potential of risk resultant from highly improbable incidents involving ingestion or inhalation. The absorption of strontium following ingestion occurs primarily throughout the volume of mineral bone. Inhalation of Sr-90 has been assigned to inhalation class "D" since it is not a titanate compound which has a more tenacious retention. Class "D" indicates a retention time in the pulmonary region of less than 10 days. Internal exposure due to Sr-90 is proposed to demonstrate committed dose equivalent limits magnitudes below ICRP 30 recommendations and permissible levels compliant with regulatory stipulations. The following incidents are highly improbable but unquestionably identify that there is no significant environmental impact resultant from fielding of the AN/UDM-2 Radiac Calibrator Set.

a. Source Leakage/Damage Leading to Ingestion:

(1) The AN/UDM-2 Radiac Calibrator Set contains sealed sources which are required to be leak tested for removable contamination every six months using protective handling procedures. The incidents described concern source leakage without detection or source damage resulting in ingestion with the additional assumptions:

(a) The Discharge Well Assembly contains a total of approximately 5.00E+09 Bq (1.35E+02 mCi) within the sealed sources.

(b) One percent of the total activity (5.00E+07 Bq or 1.35E+00 mCi) is distributed within the well assembly.

(c) Ten percent is accessible for contaminating an occupational worker (5.00E+06 Bq or 1.35E-01 mCi).

(d) Ten percent of the accessible contamination is transferred to the individual (5.00E+05 Bq or 1.35E-02 mCi).

(e) One percent is assumed ingested by the worker (5.00E+03 Bq or 1.35E-04 mCi).

(2) The tabulated committed dose equivalents (Table C-2) are based on ICRP 30 data. The maximum dose equivalent of 2.10E-03 Sv (2.10E-01 rem) to bone is estimated for ingestion resultant from source damage. The total ingested activity of 5.00E+03 Bq (1.35E-04 mCi) is 0.5 percent of the recommended ALI (1.00E+06 Bq) given for ingestion.

TABLE C-2

Committed Dose Equivalents to Various Organs Following Ingestion of Removable Contamination from Source Leakage/Damage

ACTIVITY INGESTED	BONE SURFACE	R. MARROW
5.00E+03 Bq (1.35E-04 mCi)	2.10E-03 Sv (2.10E-01 rem)	9.50E-04 Sv (9.50E-02 rem)

(3) It should be noted, previous problems of source manufacture resulting in source bulge never identified contamination of greater than 0.005 microcuries. Therefore, the assumptions given for this incident assessment are extreme in consideration of the actual quantities assumed available for contamination or removed from resultant damage and subsequently ingested. In addi-

tion, operator training/guidance from TMs prevents mishandling of calibrator sets and ensure proper protective handling and testing at required intervals for determination of possible removable contamination.

b. Source Loss Leading to Improper Disposal in a Public Incinerator[9]:

(1) The following assessment proposes incineration of an AN/UDM-2 Radiac Calibrator Set. This incident is considered highly inconceivable due to calibrator size and radioactive warning symbols attached to outer encasements and source assemblies. The assumptions[10] employed for estimation of resultant air concentration levels from incinerator emissions are:

(a) The AN/UDM-2 Radiac Calibrator Set is incinerated yielding an initial activity (Q_i) of 6.66E+09 Bq (1.80E+02 mCi) within a municipal incinerator processing 300 tons of refuse per day at fifty percent excess air.

(b) The Sr-90 released during the incineration process (f_s) is ten percent of the initial activity due to source encapsulation.

(c) The efficiency of the installed air pollution control systems for particulates is 90 percent (i.e., the fraction of Sr-90 which escapes with stack gases, $f_r = 0.1$).

(d) The aerodynamic mean activity diameter (AMAD) of the released particles is one micron. The diameter of the Sr-90 microspheres is typically 50 microns.

(e) The number of persons feeding one incinerator disposal route is also assumed to be the exposed population of 73,000 individuals.

(f) The entire activity of Sr-90 is released within a twenty-four hour time frame.

(g) Fifty percent excess of the theoretical volume of air required for complete combustion of one pound (lb) is 2.00E+06 cm^3/lb (V_a). The weight of refuse (W_r) incinerated is 6.60E+05 pounds.

(h) The atmospheric dispersion coefficient (X/Q) is assumed to be 2.00E-05 seconds/m^3.

(2) The total activity released in a day (Q) is calculated using the formula:

$$Q = Q_i f_s f_r$$

The total activity released is 6.66E+07 Bq (1.80E+00 mCi). The continuous release (Q') rate over twenty-four hs is 7.71E+02 Bq/s (2.08E-05 mCi/sec).

(3) The concentration of Sr-90 in the stack gas (X_s) is given by:

$$X_s = Q/V_a W_r$$

The average twenty-four h concentration of Sr-90 is 5.05E-05 Bq/cm^3 (1.36E-12 mCi/cm^3).

(4) Meteorologic conditions are assumed to be moderately stable with a constant wind speed of one meter (m) per second. The maximum downwind concen- tra-

tion (X) is estimated from the general formula:

$$X = Q' \, (X/Q)$$

Resultant values indicate a concentration of 1.54E-02 Bq/m^3 (4.16E-10 mCi/m^3).

(5) Assuming an average daily breathing rate of 20.0 m^3 per day, the maximum exposed individual would inhale 3.08E-01 Bq (8.32E-09 mCi) on the day of incineration. Conservatively proposing that the average person inhales an amount of Sr-90 equal to one-third of this concentration, the total activity inhaled would be 1.03E-01 Bq (2.78E-09 mCi).

(6) Committed dose equivalent limits using ICRP 30 dosimetric data are summarized in Table C-3. Realistic consideration of this incident is eliminated based on user ability to maintain authorized possession with minimal to non-existent occasion arising where transfer of a radiac calibrator set to an incinerator becomes possible.

TABLE C-3

Committed Dose Equivalents to Various Organs Resultant From Inhalation Following Source Incineration

Effected Group	Activity Inhaled	Bone Surface	R. Marrow
Average Exposed Person	1.02E-02 Bq (2.77E-10 mCi)	7.45E-09 Sv (7.45E-07 rem)	3.37E-09 Sv (3.37E-07 rem)
Maximum Exposed Person	3.08E-02 Bq (8.32E-10 mCi)	2.25E-08 Sv (2.25E-06 rem)	1.02E-08 Sv (1.02E-06 rem)

(7) The maximum downwind concentration was estimated to be 1.54E-02 Bq/m^3 (4.16E-13 uCi/cm^3). The air concentration limit for unrestricted areas as specified in Part 20 of 10 CFR is given as 1.11E+00 Bq/m^3 (3.00E-11 uCi/cm^3) for soluble forms and 7.40E+00 Bq/m^3 (2.00E-10 uCi/cm^3) for insoluble forms. This limit is based on the standard for non-occupational radiation exposure which is

5.00E-03 Sv/yr (5.00E-01 rem/yr). The air concentrations resultant from this incident are identified to be magnitudes below regulatory requirements and continue to demonstrate insignificant to nonexistent environmental impact even with severe assumptions outlined with each incident. Further, if the AMAD is assumed to be 50 microns, deposition within the stack, and minimal release would occur resulting in a tremendous decrease in airborne concentrations. In addition, the inhalation pathway of a particle with an AMAD of 50 microns would be complete deposition within the nasal-pharynx region. Particulate transport processes would translocate material to the gastrointestinal region, i.e., the material would be ingested. Complete analysis of this process is not detailed within this assessment and would be considered the primary occurrence, but does not present the worst possible theoretical impact as does consideration of a one micron AMAD particle.

c. Source Loss Resulting in Improper Disposal Directly to a Public Landfill[9]:

(1) Proposing the AN/UDM-2 Radiac Calibrator Set incinerated in Section III.C.2.b.(1)(a) is transferred to a solid waste landfill for disposal, exposure to surrounding populations is evaluated. The mode of exposure is presented through ingestion of contaminated ground water which has infiltrated public drinking water supply systems. The subsequent suppositions detail the parameters developed for evaluation of impact to the environs and feeding population:

(a) One percent leaching of the total sealed source activity (A_t= 6.66E+07 Bq or 1.80E+00 mCi) has occurred entering the ground water without further dispersion (f_{L1} = 1.0).

(b) The total volume (V_L) of leachate generated per year from an average twenty-five acre landfill based on US Environmental Protection Agency (EPA) estimates is 6.76E+06 gallons (2.56E+10 cm^3) accounting only for the average precipitation infiltrate of ten inches per year.

(c) No significant dilution of the contamination zone occurs from surrounding groundwater (f_{L2}=1.0).

(d) One percent of the contaminated water is withdrawn for domestic water supply (f_{d1}) and five percent is consumed as drinking water (f_{d2}).

(2) The concentration of Sr-90 in the leachate (A_L) as it enters the zone of saturation is calculated by:

$$A_L = A_t f_{L1} f_{L2} / V_L$$

The average Sr-90 concentration in the leachate generated is approximated to be 2.59E+03 Bq/m^3 (7.00E-08 uCi/cm^3).

(3) The amount of activity ingested (A_{ing}) as a result of contaminated water in the public drinking water supply is estimated by:

$$A_{ing} = V_L f_{d1} f_{d2} A_L$$

The dietary intake by the entire surrounding population (73,000) would be 3.33E+04 Bq (9.00E-04 mCi). The average individual dietary intake would be 4.55E-01 Bq (1.23E-08 mCi).

(4) The dose commitment to the maximally exposed individual is assessed with the assumption that the annual dietary intake of water (I_W) is 3.70E+05 cm^3 and consists entirely of ground water contaminated with Sr-90 at the same

concentration as calculated for leachate (A_L = 2.59E+03 Bq/m^3, 7.00E-08 uCi/cm^3) incorporated into the formula:

$$A_{ing} = I_W A_L$$

The total activity estimated to be consumed is 9.58E+02 Bq (2.59E-02 uCi). Committed dose equivalents due to leaching from a landfill to accessible drinking water are summarized in Table C-4.

TABLE C-4

Committed Dose Equivalents to Various Organs Resultant From Ingestion Following Leaching of Contaminated Groundwater to Public Drinking Water

Effected Group	Activity Inhaled	Bone Surface	R. Marrow
Average Exposed Person	4.55E-01 Bq (1.23E-08 mCi)	1.91E-07 Sv (1.91E-05 rem)	8.65E-08 Sv (8.65E-06 rem)
Maximum Exposed Person	9.58E+02 Bq (2.59E-02 uCi)	4.02E-04 Sv (4.02E-02 rem)	1.82E-04 Sv (1.82E-02 rem)
TOTAL PUBLIC	3.33E+04 Bq (9.00E-04 mCi)	1.39E-02 Sv (1.39E+00 rem)	6.33E-03 Sv (6.33E-01 rem)

(5) The maximum permissible water concentration as specified in 10 CFR Part 20 is 1.11E+04 Bq/m^3 (3.00E-07 uCi/cm^3) for soluble forms and 1.48E+06 Bq/m^3 (4.00E-05 uCi/cm^3) for insoluble forms of Sr-90 in unrestricted areas. The concentrations assessed for Sr-90 in the leachate are 3.30E+01 percent of the soluble limit and 1.75E-01 percent of the insoluble limit. It should be noted that no consideration has been given to actual dispersion coefficients, deposition, or dilution factors which would occur during ground transport tremendously decreasing resultant values.

d. Installation Fire:

(1) The proposed incident involves an installation fire which occurs during bulk storage at LBDA enveloping AN/UDM-2 Radiac Calibrator Sets and releasing Sr-90. The warehouse facility is equipped with complex sprinkler systems covering one-hundred percent of the area and an automatic alert to the LBDA firefighting unit which has at maximum a two to three minute response time. The firefighter unit is aware of the radioactive material storage area and has standard operating procedures inclusive of protective clothing, self-contained respiratory devices and procedures limiting water usage and immediate evacuation of personnel from downwind areas if necessary. The hypothetical incident assumed the following for occupationally involved firefighters in the immediate vicinity performing extinguishing operations:

(a) The maximum number of AN/UDM-2 Radiac Calibrator Sets possibly stored at any time in the installation is five hundred for a total storage activity of 3.33E+12 Bq (9.00E+04 mCi).

(b) Prior to extinguishing the fire, ten percent of the units are involved releasing one percent of the total activity for each set within the assemblies. One percent of the total activity for each set within the case is released and not deposited. Ten percent of the activity is not deposited within the transport container case and is released as airborne particulates.
The quantity released during a one hour time interval is 3.33E+06 Bq (9.00E-02 mCi).

(c) The volume of air in the warehouse is 1.23E+04 m^3 yielding 2.71E+02 Bq/m^3 (7.32E-06 mCi/m^3).

(d) The breathing rate of persons involved is 1.2 m^3/h.

(e) The total intake for each firefighter is 3.25E+02 Bq (8.78E-06 mCi) assuming no implementation of respiratory protective devices during the one hour period.

(2) The committed dose equivalents as calculated using ICRP 30 data are given in Table C-5. No additional estimates were included for the general public due to conservative dose equivalents derived for non-occupational individuals in the immediate vicinity and dispersion factors which would further reduce dose commitments. It should be noted that no consideration in dose estimates for firefighters included ventilation of the building during extinguishment or the use of respiratory protective devices. The total inhaled activity is 4.64E-01 percent of the ALI (7.00E+04 Bq) recommendation for inhalation. The air concentration (2.71E+02 Bq/m^3 or 7.32E-09 uCi/cm^3) when averaged over one year (365 days) is equivalent to 7.42E-01 Bq/m^3 (2.01E-11 uCi/cm^3). The concentration limits as specified in Part 20 of 10 CFR are 1.11E-00 Bq/m^3 (3.00E-11 uCi/cm^3) for soluble forms or 7.40E+00 Bq/m^3 (2.00E-10 uCi/cm^3) for insoluble forms. The concentration limits derived in this evaluation are below one third maximum permissible limits accounting for variation of individual doses. Further, considerations indicated in paragraph C.2.b(7) also apply regarding particle size, pathway and deposition parameters.

TABLE C-5

Committed Dose Equivalents to Various Organs Following
Inhalation Due to Installation Fire

Activity Inhaled	Bone Surface	R. Marrow
3.25E+02 Bq (8.78E-06 mCi)	2.37E-04 Sv (2.37E-02 rem)	1.07E-04 Sv (1.07E-02 rem)

(3) Operations in the unlikely event of occurrence would be conducted with some awareness of the potential hazard and with measures of protection to reduce inhalation risks. The probability of fire at the installation involving the AN/UDM-2 Radiac Calibrator Sets approaches zero due to institution structural composition, fire walls between warehouse sections, complex sprinkler systems, and firefighter units which would respond prior to any conceivable incorporation of units containing radioactive materials.

e. Individual Storage Area Fire:

(1) The fielded AN/UDM-2 Radiac Calibrator Set will be used by mobile calibration teams in specifically designed vans. The calibrator set is stored within a fire resistant cabinet. Hypothetically, if the unit were subjected to heat or fire causing breach of the calibrator source integrity, the following assumptions are presented:

(a) Within a fifteen minute time frame, fire surrounds the cabinet causing one percent release of activity to the calibrator assembly, one percent release to the encasement resulting in ten percent escape to the storage cabinet, i.e., 6.66E+04 Bq (1.80E-03 mCi).

(b) Fifty percent of the activity escapes the encasement to the cabinet interior releasing ten percent to the van interior (2.14E+01 m^3) yielding 1.56E+02 Bq/m^3 (4.21E-06 mCi/m^3).

(c) The breathing rate of an occupational worker is 1.20 m^3/h. Assuming air concentrations are unchanged, the worker failing to implement a protective respiratory device for approximately five minutes would inhale a total activity of 1.56E+01 Bq (4.21E-07 mCi).

(2) The committed dose equivalents using ICRP 30 data are summarized in Table C-6. The evaluation presented considered the minute possibility of fire enveloping the specifically designed fire-resistant cabinet and the attempt to arrest the fire without respiratory protective devices or air exchange causing dilution and decrease in inhaled activity. Release of activity prior to extinguishment is realistically improbable with the availability of firefighting devices and user response. The total inhaled activity is 2.23E-03 percent of the recommended ALI for inhalation (7.00E+05 Bq). The concentration guides for restricted areas as specified in Part 20 of 10 CFR are 3.70E+01 Bq/m^3 (1.00E-09 uCi/cm^3) for soluble forms and 1.85E+02 Bq/m^3 (5.00E-09 uCi/cm^3) for insoluble forms. The presented air concentration is equivalent to 1.56E+01 Bq/m^3 (4.21E-10 uCi/cm^3) or averaged over one year equal to 4.26E-02 Bq/m^3 (1.15E-12 uCi/cm^3). The air concentration levels are below one third of the permissible limits which are based on standards for occupational exposure levels of 5.00E-02 Sv/yr (5.00E+00 rem/yr).

TABLE C-6

Committed Dose Equivalents to Various Organs Following Inhalation Due to Individual Storage Area Fire

Activity Inhaled	Bone Surface	R. Marrow
1.56E+01 Bq (4.21E-07 mCi)	1.14E-05 Sv (1.14E-03 rem)	5.15E-06 Sv (5.15E-04 rem)

f. Transportation Accidents:

(1) Transportation of the AN/UDM-2 Radiac Calibrator Sets between facilities is most frequent during operations with regard to mobile calibration teams. The transport scenario involves vehicular collision resulting in fire, explosion, and subsequent release of calibrator source activity to the environ. Inhalation risk is considered the primary immediate mode of exposure to individuals in the vicinity with the assumptions:

(a) The AN/UDM-2 Radiac Calibrator Set transported is assumed to possess a total activity of 6.66E+09 Bq (1.80E+02 mCi).

(b) Fifty percent of the total activity is instantaneously and uniformly distributed within a hemispherical volume whose radius equals 200 meters yielding a total volume of 1.67E+07 m^3 and whose activity concentration per unit volume is 1.99E+02 Bq/m^3 (5.39E-06 mCi/m^3).

(c) Individuals within the prescribed area have a breathing rate of 1.20 m^3/hr. Assuming no change in activity per unit volume through dispersion for an hour or evacuation of any individual, the total activity inhaled within the one hour time period would be 2.39E+02 Bq (6.47E-06 mCi).

(2) Approximations of committed dose equivalents to various organs using ICRP 30 evaluation are summarized in Table C-7. The air concentration of 1.97E+02 Bq/m^3 (5.29E-09 uCi/cm^3) when averaged over a one year time interval is 5.43E-01 Bq/m^3 (1.48E-11 uCi/cm^3). This concentration is below maximum permissible unrestricted air concentrations specified in Part 20 of 10 CFR . Further reduction in quantities inhaled and resultant committed dose equivalents would occur through wind dispersion and evacuation of contaminated areas and as discussed in paragraph C.2.b(7) above.

TABLE C-7

Committed Dose Equivalents to Various Organs Resultant from Inhalation Following a Transport Incident

Activity Inhaled	Bone Surface	R. Marrow
2.39E+02 Bq (6.47E-06 mCi)	1.74E-04 Sv (1.74E-02 rem)	7.89E-05 Sv (7.89E-03 rem)

(3) The probability of transport incident as proposed is considered highly improbable due to absence of documented incidents within the history of the calibrator set possession, publications statistically identifying minimal probability in comparison to total shipment incident[11] and compliance to applicable DOT regulations governing packaging/transport. Any conceivable damage to the unit in transit would not be of a severe nature but rather from jolting or compression which would not release material to the environ. Upon occurrence, damage would be immediately obvious to the authorized user who would take appropriate action to contain the unit for return or disposal as specified in AR 385-11 and associated technical manuals.

(4) Table A-1 summarized resultant committed dose equivalents to bone surfaces from proposed hypothetical incidents. The occupational worker is identified as receiving the maximum unnecessary internal exposure to Sr-90 through improper use or damage to the source contained within the AN/UDM-2 Radiac Calibrator Set. Each proposed incident, although regarded as highly inconceivable, demonstrated levels below those recommended by ICRP or regulatory standards. The total intake of Sr-90 assessed for the various evaluations are estimates based on general assumptions and are in excess of more realistic or actual quantity intake which would result in decreased committed dose equivalent determinations. Properly implemented procedures for use and indicated safety precautions eliminate association of radiological/environmental impact with the use of the calibrator set. The established safety requirements and strict operational guidelines dismiss consideration of any proposed incident as probable and conclude that no environmental impact or radiological health hazard would arise from implementation or incorporation of the AN/UDM-2 Radiac Calibrator Set anywhere within the Army Supply System.

g. Theoretical Radiological Evaluation of Utilizing Both the AN/UDM-2 and AN/UDM-7C Radiac Calibrator Sets.

(1) In order to completely encompass theoretical environmental/radiological impact resulting from utilization of radiac calibrator sets within the Army system, a cumulative tabulation is presented in Table C-8 based on data provided within this assessment and the Environmental Assessment for the AN/UDM-7C Radiac Calibrator Sets[12]. The AN/UDM-2 and AN/UDM-7C Radiac Calibrator Sets may often be utilized, stored, or transferred simultaneously at various Army activities/installations. The parameters and assumptions utilized

within both environmental documents are similar and are determined to be sufficient for simple comparative means in final evaluation.

(2) Review of Table C-8 data, indicates the highest cumulative percent ALI to an occupational worker resultant from the theoretical incident of source leakage/damage. An overall view of the theoretical incidents and their probabilities would suggest source leakage/damage to be the most probable of theoretical incidents. The cumulative percent ALI is identified as 6.30E+00 percent. This value is minimal in consideration of calibrator design and stringent safety requirements not fully considered within the assumptions. Therefore, any actual/true environmental or radiological impact is undoubtedly minimal to non-existent. The comparison is presented to fulfill local command environmental review in accordance with AR 200-2.

TABLE C-8

CUMULATIVE COMPARISON OF THEORETICAL IMPACTS
FROM UTILIZATION OF RADIAC CALIBRATOR SETS

THEORETICAL INCIDENT	ACTIVITY INGESTED/INHALED	ALI	PERCENT ALI	CUMMULATIVE PERCENT ALI
A. SOURCE LEAKAGE/DAMAGE				
1. AN/UDM-7C	1.16E+04 Bq (3.10E-01 uCi)	2.00E+05 Bq	5.80E+00%	
2. AN/UDM-2	5.00E+03 Bq (1.35E-04 mCi)	1.00E+06 Bq	5.00E-01%	6.30E+00%
B. IMPROPER DISPOSAL TO INCINERATOR (MAXIMUM EXPOSED PERSON)				
1. AN/UDM-7C	4.30E-03 Bq (1.20E-07 uCi)	2.00E+01 Bq*	2.15E-02%	
2. AN/UDM-2	3.08E-02 Bq (8.32E-10 mCi)	7.00E+04 Bq*	4.40E-05%	2.15E-02%
C. IMPROPER DISPOSAL TO LANDFILL (AVERAGE EXPOSED PERSON)				
1. AN/UDM-7C	6.70E+01 Bq (1.80E-03 uCi)	2.00E+04 Bq*	3.35E-01%	
2. AN/UDM-2	4.55E-01 Bq (1.23E-08 mCi)	1.00E+05 Bq*	4.55E-04%	3.35E-01%
D. STORAGE AREA INSTALLATION FIRE				
1. AN/UDM-7C	1.80E+00 Bq (4.91E-05 uCi)	2.00E+02 Bq	9.00E-01%	
2. AN/UDM-2	3.25E+02 Bq (8.78E-06 mCi)	7.00E+05 Bq	4.64E-02%	9.46E-01%
E. INDIVIDUAL STORAGE AREA FIRE				
1. AN/UDM-7C	8.70E-01 Bq (2.30E-05 uCi)	2.00E+02 Bq	1.30E+00%	
2. AN/UDM-2	1.56E+01 Bq (4.21E-07 mCi)	7.00E+05 Bq	2.23E-03%	1.30E+00%
F. TRANSPORT				
1. AN/UDM-7C	5.30E+00 Bq (1.40E-04 uCi)	2.00E+01 Bq	2.60E+01%	
2. AN/UDM-2	2.39E+02 Bq (6.47E-06 mCi)	7.00E+04 Bq	3.41E-01%	2.63E+01%

*Ten percent of ICRP 30 ALI due to exposure to non-occupational individual

D. EVALUATION OF ALTERNATIVES

1. Radionuclides, such as Cobalt-60 or Cesium-137, which are gamma emitters and utilized for calibration of radiation detection instrumentation traceable to the National Bureau of Standards, are utilized for calibration of the AN/PDR-27( ) which support operations involving the AN/UDM-2 Radiac Calibrator Set. These radionuclides require a tremendous amount of shielding to insure occupational safety to ionizing radiation. All field equipment is required to weigh fifty pounds or less. Therefore, a calibrator was developed utilizing Sr-90 producing an output of at least 300 mR/h$\pm$30 percent to check the highest scale of the AN/PDR-27( ) and approximately 130 R/h$\pm$30 percent to check the highest scale of the IM-174( ). It is impossible to utilize any gamma-emitting radionuclide within the AN/UDM-2 Radiac Calibrator Set and remain below the fifty pound weight limit in addition to retaining the functional requirements of this equipment.

2. The AN/UDM-2 Radiac Calibrator Set is mandatory for maintaining tactical capability within the Army for checking beta-gamma detection instrumentation and pocket dosimeters. A "no action" alternative cannot be considered based on requirements and activities which fulfill the Army mission.

E. Status of Compliance

The AN/UDM-2 Radiac Calibrator Set containing Sr-90, is subject to regulation by the NRC. The extent of the regulation is stated in 10 CFR. The CECOM NRC license renewal application has identified all areas of compliance to 10 CFR. No specific state or local permits or licenses are required due to Federal control. The proposed action includes transport of calibrator sets between installations for which CECOM has demonstrated compliant measures with regard to shipment and packaging as required by DOT regulations.

F. Listing of Agencies/Persons Contacted:

1. Edward Abney: Physicist
   US Army Ionizing Radiation Dosimetry Center
   Lexington, Kentucky

2. Lawrence Fischer: Engineer/Project Leader
   Engineering Directorate
   US Army Communications-Electronics Command
   Fort Monmouth, New Jersey

G. References:

1. International Commission on Radiological Protection, Publication 26, Recommendations of the International Commission on Radiological Protection, Pergamon Press, New York, adopted 1977.

2. International Commission on Radiological Protection, Publication 30, Limits for Intakes of Radionuclides by Workers, Pergamon Press, New York, Adopted 1978.

3. Military Specification MIL-R-55350A (ER), Radiac Calibrator AN/UDM-2( ), 9 June 1981.

4. Technical Manual 11-6665-227-12, Operator's and Organizational Maintenance Manual, Calibrator Set, Radiac AN/UDM-2, NSN 6665-00-179-9037, June 1975, with changes (1 thru 4).

5. Technical Bulletin 11-6665-227-12, Safe Handling, Storage, and Transportation of Calibrator Set, Radiac AN/UDM-2, NSN 6665-00-179-9037 (Revision in publication), 2 July 1975.

6. Army Regulation 385-11, Safety, Ionizing Radiation Protection (Licensing, Control, Transportation, Disposal and Radiation Safety), 1 May 1980.

7. Army Regulation 700-64, DLAM 4145.8, NAV SUPINST 4000.34A, AFR 67-8, MCO P4000.105B, Radioactive Commodities in the DOD Supply Systems, November 1976.

8. Army Regulation 40-14, Control and Recording Procedures for Occupational Exposure to Ionizing Radiation, 15 March 1982.

9. Belanger, R., Buckley, D. W. and Swenson, J. B., Environmental Assessment of Ionization Chamber Smoke Detectors Containing Americium-241, NUREG/CR-1156, Science Applications Inc., California, 1979.

10. US Department of Health, Education and Welfare, Radiological Health Handbook, Public Health Service, Rockville, Maryland, 1970.

11. Finley, Nancy, Aldrich, David, et al, Transportation of Radionuclides in Urban Environs: Draft Environmental Assessment, NUREG/CR-0743, Sandia National Laboratories, New Mexico, 1980.

12. Elker, P., et al, Environmental Assessment and Finding of No Significant Impact for the AN/UDM-7C Radiac Calibrator Set, US Army Communications-Electronics Command, 1981.

DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010

CPT Cherry/lm/AUTOVON
584-3502

13 NOV 1980

HSE-RH/WP

SUBJECT: Radiation Protection Special Study No. 28-43-0910-81, Calibrator Set, Radiac AN/UDM-2, NSN 6665-00-179-9037, 25 March - 17 October 1980

Commander
US Army Materiel Development
and Readiness Command
ATTN: DRCSG
5001 Eisenhower Avenue
Alexandria, VA 22333

1. AUTHORITY.

a. AR 40-5, Health and Environment, 25 September 1974.

b. Letter, DRSEL-SF-H, HQ US Army Communications and Electronics Materiel Readiness Command (CERCOM) and Fort Monmouth, 17 June 1980, subject: Request for Health Physics Services, and indorsement thereto.

2. REFERENCES.

a. AR 40-14, Control and Recording Procedures for Occupational Exposure to Ionizing Radiation, 20 May 1975.

b. TM 11-6665-227-12, Operator's and Organizational Maintenance Manual: Calibrator Set, Radiac AN/UDM-2 (NSN 6665-00-179-9037), 13 June 1975.

c. TB 11-6665-227-12, Safe Handling, Storage, and Transportation of Calibrator Set, Radiac AN/UDM-2, NSN 6665-00-179-9037, 2 July 1975.

d. Message, HQ CERCOM, DRSEL-SF-H, 072020Z Apr 80, subject: Deadlining of the AN/UDM-2 Radiac Calibrator Set, NSN 6665-00-179-9037.

3. PURPOSE. This special study was performed to determine the presence and extent of health hazards due to ionizing radiation from the Calibrator Set, Radiac AN/UDM-2, NSN 6665-00-179-9037. Further, the associated radiation protection program was evaluated for conformance with current directives for radiation protection.

Encl 1

(2) Locations and results of measurements on the Calibrator, TS-3495/UDM-2, are given in Table 2 in Inclosure 2. These data indicated that an operator would not be likely to receive more than 10 percent of the dose equivalent limits in paragraph 6a, AR 40-14, during normal use of this item when the procedures in TM 11-6665-227-12 are followed.

(3) Locations and results of measurements on the Calibrator, TS-3494/UDM-2, are given in Table 3 in Inclosure 3. These data indicated that an operator would not be likely to receive more than 10 percent of the dose equivalent limits in paragraph 6a, AR 40-14, during normal use of this item when the procedures in TM 11-6665-227-12 are followed.

b. Eye Exposure to Beta Particles. Warnings embossed on the Calibrators, TS-3494/UDM-2 and TS-3495/UDM-2, and contained in TM 11-6665-227-12 were adequate to inform personnel of the eye hazard of strontium-90 beta particles. The design of the equipment was such that eye exposure to beta particles was not likely during normal use when the procedures in TM 11-6665-227-12 are followed.

c. Source Leakage. Four wipe tests were taken on Calibrator Sets, AN/UDM-2, serial numbers 027 and 479. No significant leakage from the sources was found.

d. Records, Reports, and Surveys.

(1) Paragraph 1-8, TM 11-6665-227-12, states that bremsstrahlung produced "....radiation dose rates from sources (4) no greater than 2 millirads per hour at outer case surface." As data in Table 1, Inclosure 1, indicated, this statement is incorrect.

(2) It has been noted by CERCOM that "....several sealed radioactive sources extended into the cavity chamber of the dosimeter discharge well assembly, TS-3495/UDM-2, portion of...." Calibrator Set, Radiac AN/UDM-2 (see reference 2d). Wipe tests taken by CERCOM personnel were analyzed by this Agency. No significant leakage of the sources was found. Calibrators, TS-3495/UDM-2, were deadlined by CERCOM pending repair and replacement of faulty units.

6. CONCLUSION. A review of the findings indicated that there were no health hazards due to ionizing radiation from the Calibrator Sets, Radiac AN/UDM-2, available for study. The associated radiation protection program was being conducted in accordance with current directives for radiation protection with an exception for which the following recommendation is provided.

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SUBJECT: Radiation Protection Special Study No. 28-43-0910-81, Calibrator Set, Radiac AN/UDM-2, NSN 6665-00-179-9037, 25 March - 17 October 1980

TABLE 1. EXPOSURE RATES - CLOSED CASE.

Point No.*	Coordinates (x, y, z)(inches)*	Exposure Rate (mR/h) above background
1	(0, 6, 0)	2.0 ± 0.5
2	(0, 0, 5)	4.4 ± 0.2
3	(-6, 0, 5)	1.05 ± 0.13
4	(0, -6, 0)	2.5 ± 0.5
5	(-6, 6, -5)	1.8 ± 0.3
6	(6, 6, -5)	2.0 ± 0.3
7	(0, 0, 44.4)	0.082 ± 0.011†
8	(0, 0, -5)	4.1 ± 0.5
9	(6, 0, 0)	2.12 ± 0.19
10	(6, -6, 5)	1.11 ± 0.08
11	(-6, 6, 5)	0.93 ± 0.08
12	(6, 6, 5)	1.13 ± 0.17
13	(-6, -6, -5)	1.26 ± 0.16
14	(6, -6, -5)	2.1 ± 0.4
15	(-6, -6, 5)	0.78 ± 0.06
16	(45.4, 0, 0)	0.070 ± 0.010
17	(0, 45.4, 0)	0.060 ± 0.011
18	(0, 25.7, 0)	0.144 ± 0.016
19	(25.7, 0, 0)	0.19 ± 0.04

* Refer to figure for point locations and coordinate system.
† Weighted average of two TLD packets.

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SUBJECT: Radiation Protection Special Study No. 28-43-0910-81, Calibrator Set, Radiac AN/UDM-2, NSN 6665-00-179-9037, 25 March - 17 October 1980

TABLE 2. EXPOSURE RATES - TS-3495/UDM-2

Location*	Exposure Rate (mR/h)†
1. Face of stopwatch	3.4 $\pm$ 1.0
2. Stem of stopwatch	1.0 $\pm$ 0.3
3. Center of opening above instruction plate in plane of dosimeter shelf	1.33 $\pm$ 0.20
4. Same as 3 except near center of edge opposite nomenclature label	1.0 $\pm$ 0.2
5. Underside of dosimeter shelf below middle hole of row farthest from discharge well on side nearest nomenclature label	1.8 $\pm$ 0.4
6. Same as 5 except on opposite side	1.64 $\pm$ 0.20
7. On radiation symbol on discharge well	7 $\pm$ 2
8. On surface of discharge well near access hole towards side with nomenclature label	16 $\pm$ 5
9. Same as 8 except towards opposite side	15.2 $\pm$ 0.9
10. Same as 3 except near center edge closest to handle	0.61 $\pm$ 0.13

* Refer to Figure 1-2, TM 11-6665-227-12.
† Measurements made with stopwatch in position shown in figure 1-2, TM 11-6665-227-12, but with no dosimeters present.

SAI-139-82-15-RV

CALCULATION OF DOSE RATES DURING OPERATION OF RADIAC AN/UDM-2 CALIBRATOR SET

October 29, 1982

Contract Number
DAAB07-82-M-T370

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Encl 2

ABSTRACT

This report contains the results of dose rate calculations to operating personnel using the RADIAC AN/UDM-2 calibrator. The calibrator contains four 50 millicurie and one 125 microcurie Sr-90 sources. Five locations on the calibrator assembly and one hypothetical semi-infinite cloud were calculated for personnel exposure. Contribution to dose rate due to bremsstrahlung was included.

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LIST OF FIGURES

SECTION 1

INTRODUCTION

Realistic upper-bound dose rates were calculated for personnel operating the RADIAC AN/UDM-2 Calibrator Set which contains four nominal 50 millicurie Sr-90 sources and one nominal 125 microcurie Sr-90 source.

The RADIAC AN/UDM-2 Calibrator Set consists of two major assemblies, the RADIAC TS-3495/UDM-2 calibrator assembly, and the RADIAC TS-3494/UDM-2 calibrator assembly, shown in Figures 1 and 2, respectively. Each major assembly is housed in one-half of a waterproof, aluminum case. A handle is provided on each assembly to facilitate handling. (1)

Figure 3 is a sectional view of the RADIAC TS-3495/UDM-2 discharge well assembly, which contains four Sr/Y-90 sources; three 50 millicurie sources in the lower cavity and one 125 microcurie source in the upper cavity. The lower field of radiation (due to the three 50 mCi sources) is closed off from the access hole by a spring loaded platform. The lower field is exposed when a dosimeter is inserted deep into the access hole by depressing the spring loaded platform. A spring loaded swivel cover (not shown) attached to the top of the discharge well assembly covers the access hole.

Figure 4 is a sectional view of the RADIAC TS-3494/UDM-2 dose rate jig assembly, which contains a single 50 millicurie Sr/Y-90 source. Access to the radiation field is gained through a sliding drawer in the assembly. A rotating shutter is located between the sliding drawer and the encapsulated source. The shutter has two holes which provide radiation fields for calibration purposes.

Section 2 of this report describes the calculational tasks performed and all relevant assumptions. Section 3 presents the results of the calculations performed. Section 4 is a discussion of the results obtained in comparisons to dose rate measurements at selected locations as performed by the Department of the Army (6). References used in the preparation of this report are tabulated in Section 5. Section 6 presents the mathematical techniques used to calculate the dose rates from bremsstrahlung and beta radiation.

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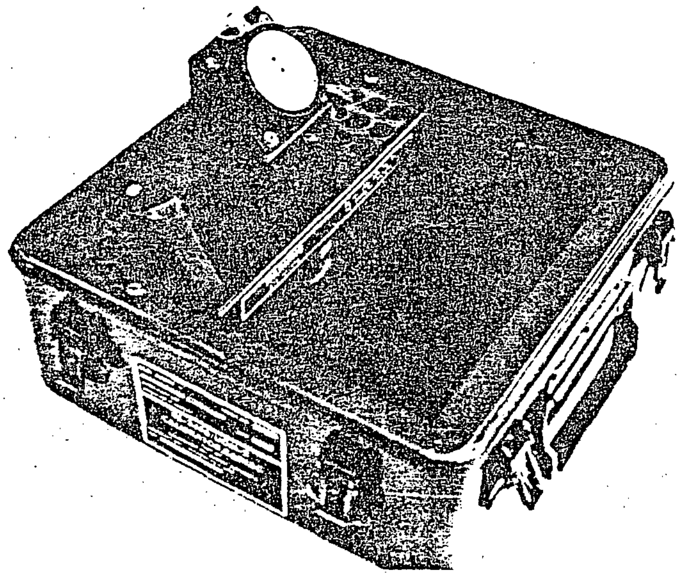


Figure 1 - Radiac 3495/UDM-2 Calibrator Assembly

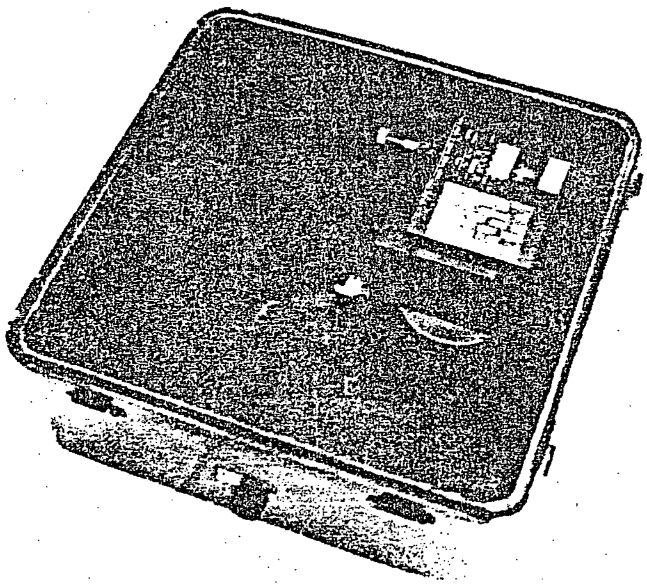
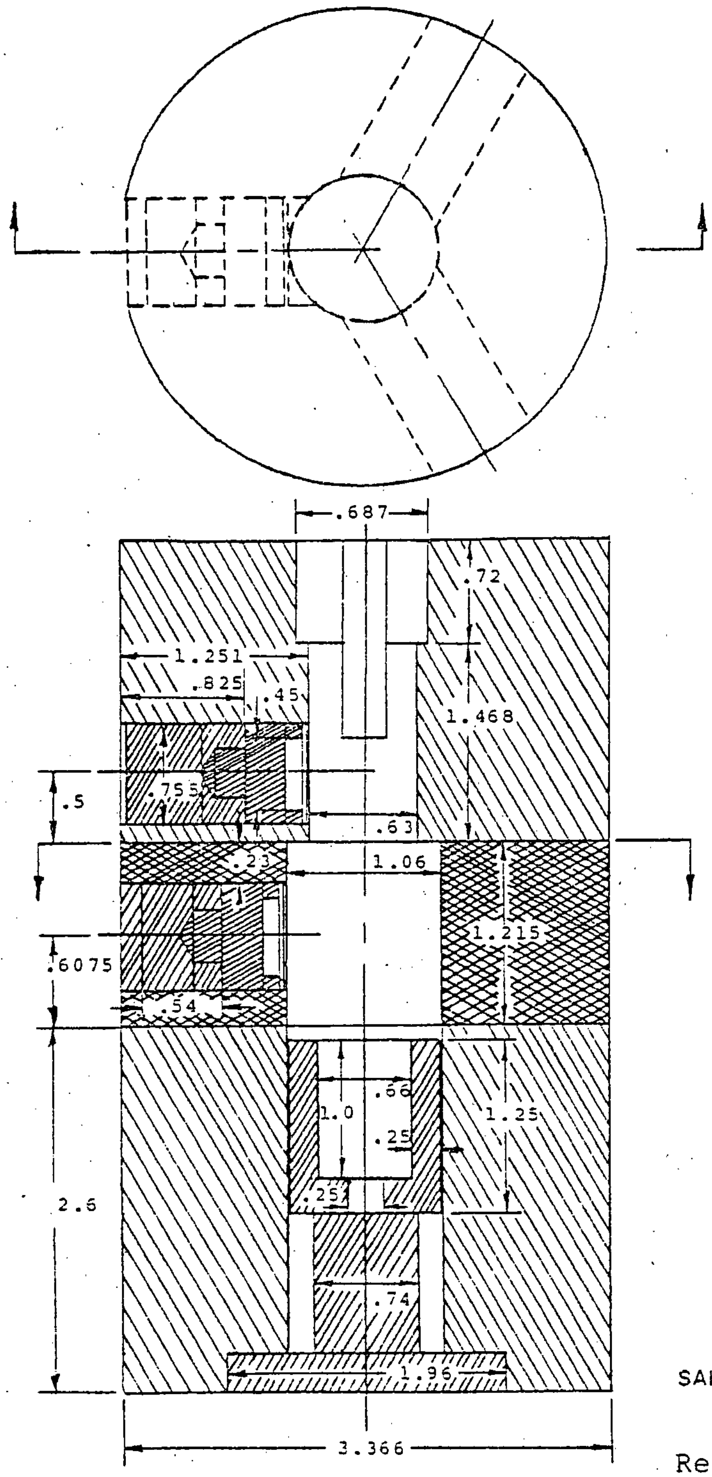


Figure 2 - Radiac 3494/UDM-2 Calibrator Assembly



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Ref: Dwg SM-D-5089
SM-B-5089

FIGURE 3: DISCHARGE WELL ASSEMBLY

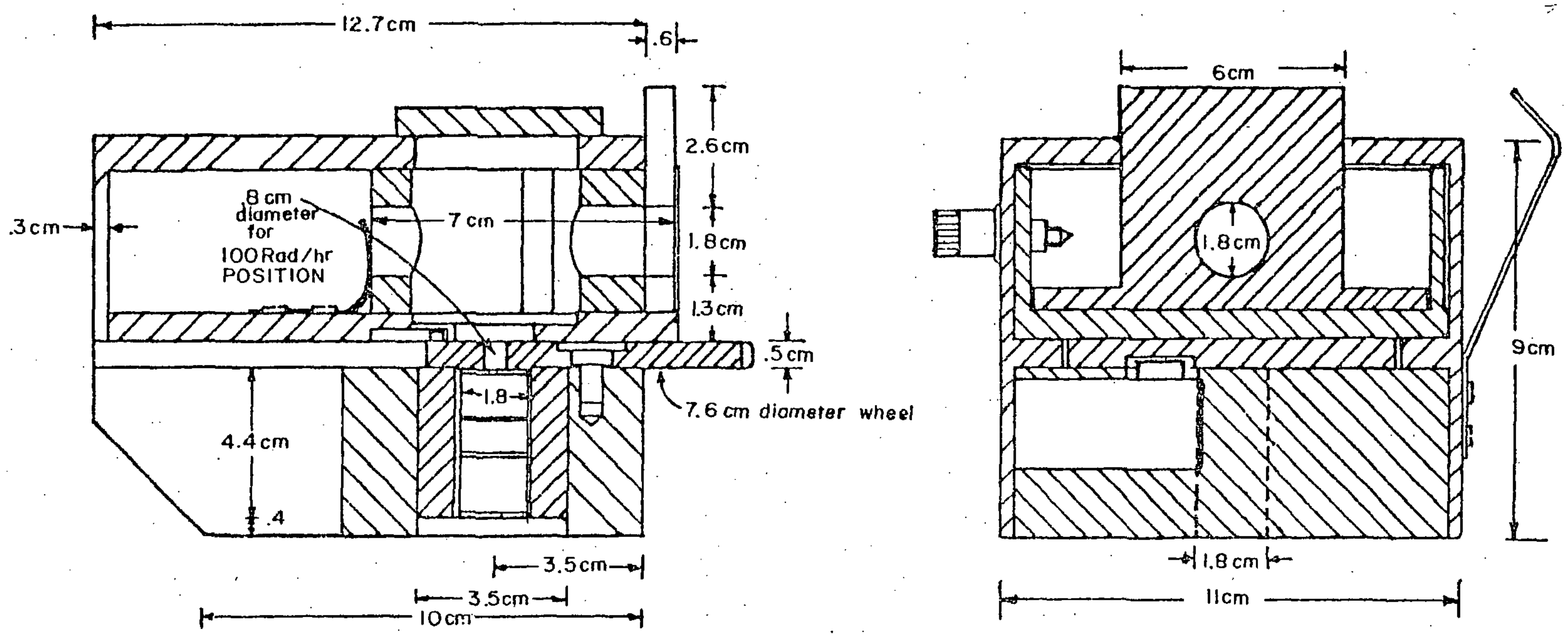

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FIGURE 4 DOSERATE METER ASSEMBLY

SECTION 2

CALCULATIONAL TASKS AND ASSUMPTIONS

Five locations were selected as primary areas of concern for personnel exposure, and one hypothetical case was selected to provide a worst-case upper bound. Each location selected was designated as a unique task, and calculations were performed to determine resultant dose rates. These tasks are described below with relative assumptions identified. A general assumption for Tasks 1,2,3,5 and 6 is that the Sr/Y-90 was uniformly distributed on the source assemblies.

Task 1

The dose rates to operating personnel at the handles of the subassemblies, Figures 5,6,7 and 8, were calculated from contact at the handles to a distance of 91 centimeters (3 ft). It was assumed that the spacer block was in place, the brass components consisted of 65% copper and 35% zinc, and that all sources were inserted until their windows were aligned with but not protruding from the openings in their shields.

Task 2

The dose rate to operating personnel using the TS-3495/UDM-2 calibrator, Figures 9 and 10, was calculated assuming the swivel cover open, the spring loaded dosimeter platform fully depressed, and no dosimeter in the well. Dose rates were calculated to a distance of 91 centimeters (3 ft) above the horizontal plane at the centerline of the well opening. The same assumptions as Task 1 were also made in Task 2.

Task 3

The dose rate to operating personnel using the TS-3494/UDM-2 calibrator assembly was calculated assuming the cover plate removed and the shutter rotated to expose the source, Figures 11, 12 & 13. Dose rates were calculated to a distance of 91 centimeters (3ft) above the opening perpendicular to the horizontal plane of the opening. Spacer block was removed.

Task 4

A hypothetical case was calculated in which an individual was enveloped in a 200.125 millicurie Sr-90 semi-infinite cloud equal in radius to the mean range of the Sr-90 beta particle. This calculation represents the total airborne dispersion of the four 50 millicurie and the one 125 microcurie Sr/Y-90 sources.

Task 5

The dose rate to operating personnel using the TS-3495/UDM-2 calibrator, Figures 14 & 15, was calculated assuming that the swivel cover on the discharge well was open, the spring loaded dosimeter platform was in its raised position and the dosimeter well was empty. Dose rates were calculated to a distance of 91 centimeters (3 ft) above the well perpendicular to the horizontal plane of the well opening. The same assumptions made in Task 1 were also made in Task 5.

Task 6

The dose rate to operating personnel using the TS-3494/UDM-2 calibrator, Figures 16 & 17 was calculated at the opening in the drawer to the point on the case in line with this geometry, assuming that the shutter was rotated to the 100 Rad setting and that the spacer block was removed from the drawer. It was also assumed that the source was inserted in the tungsten shield with the windows aligned with but not protruding from the opening in the shield.

SECTION 3

RESULTS OF CALCULATIONS

Task 1

Photon flux from bremsstrahlung for seven energy groups (0.0-1.6 MeV) are shown in figure 5 for contact with the case at the handle located nearest the discharge well to 91 cm perpendicular to the case. The total photon dose rate from bremsstrahlung is shown in figure 6 for the same configuration.

Photon flux from bremsstrahlung for six energy groups (0.23-1.6 MeV) are shown in figure 7 for contact with the case at the handle located nearest the doserate meter to 91 cm perpendicular to the case. The total photon dose rate from bremsstrahlung is shown in figure 8 for the same configuration.

Task 2

Figure 9 shows the photon flux from bremsstrahlung for seven energy groups (0.0-1.6 MeV) for the centerline perpendicular to the horizontal plane at the opening on the discharge well with the platform fully depressed and no dosimeter in the well. Figure 10 shows the total photon dose rate from bremsstrahlung for this same configuration. Both figures are from 0.0 cm to 91 cm above the opening on the discharge well.

Task 3

Figure 11 shows the photon flux from the bremsstrahlung for seven energy groups (0.0-1.6 MeV) for the centerline perpendicular to the horizontal plane at the opening in the doserate meter assembly beneath the removed plate that bears the "warning" label. The total photon dose rate from bremsstrahlung is shown in figure 12 for this same configuration. Figure 13 provides the beta dose rate from the uncollided flux. All three figures are from 0.0 cm to 91 cm above the opening.

Task 4

Calculations were performed for the beta dose rate to a man standing on the ground in a semi-infinite 200.125 millicurie cloud equal in radius to one mean free path. The concentration of Sr/Y-90 in the cloud was $3.44 \times 10^{-2} Ci/m^3$ each, for Ci total of $6.9 \times 10^{-2} Ci/m^3$. The dose rate was calculated to be 31.2 Rad/hr.

Task 5

Figure 14 shows the photon flux from bremsstrahlung for seven energy groups (0.0-1.6 MeV) for the centerline perpendicular to the horizontal plane at the opening on the discharge well with the platform fully released and no dosimeter in the well. Figure 15 shows the total photon dose rate from bremsstrahlung for this same configuration. Both figures are from 0.0 cm to 91 cm above the opening on the discharge well.

Task 6

Figure 16 shows the photon flux from bremsstrahlung for seven energy groups (0.0-1.6 MeV) beginning at the upper edge of the 1.8 cm hole in the doserate meter drawer up to the case at a 45° angle to the centerline of the hole.

Figure 17 shows the total photon dose rate from bremsstrahlung for this same configuration.

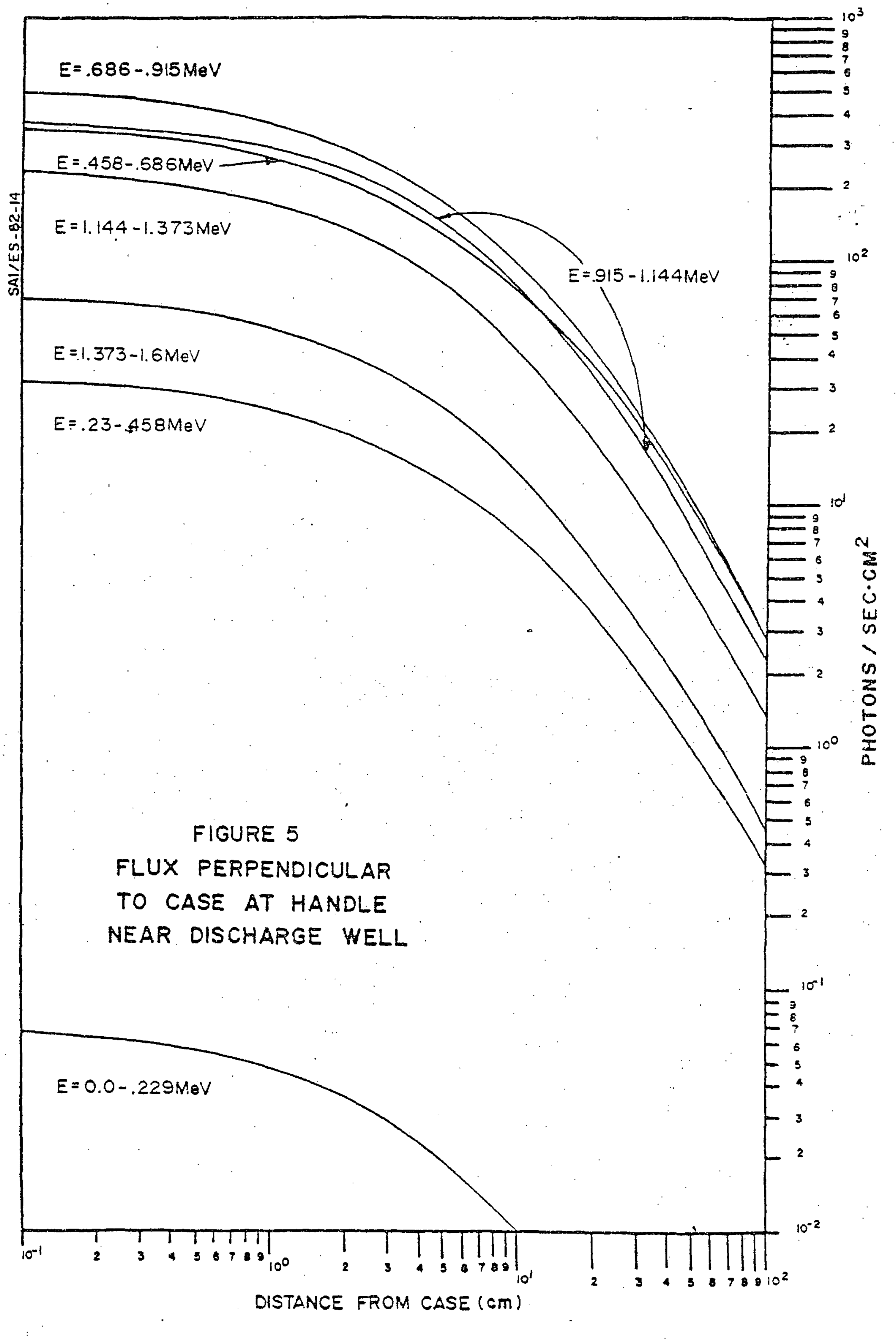

FIGURE 5
FLUX PERPENDICULAR
TO CASE AT HANDLE
NEAR DISCHARGE WELL

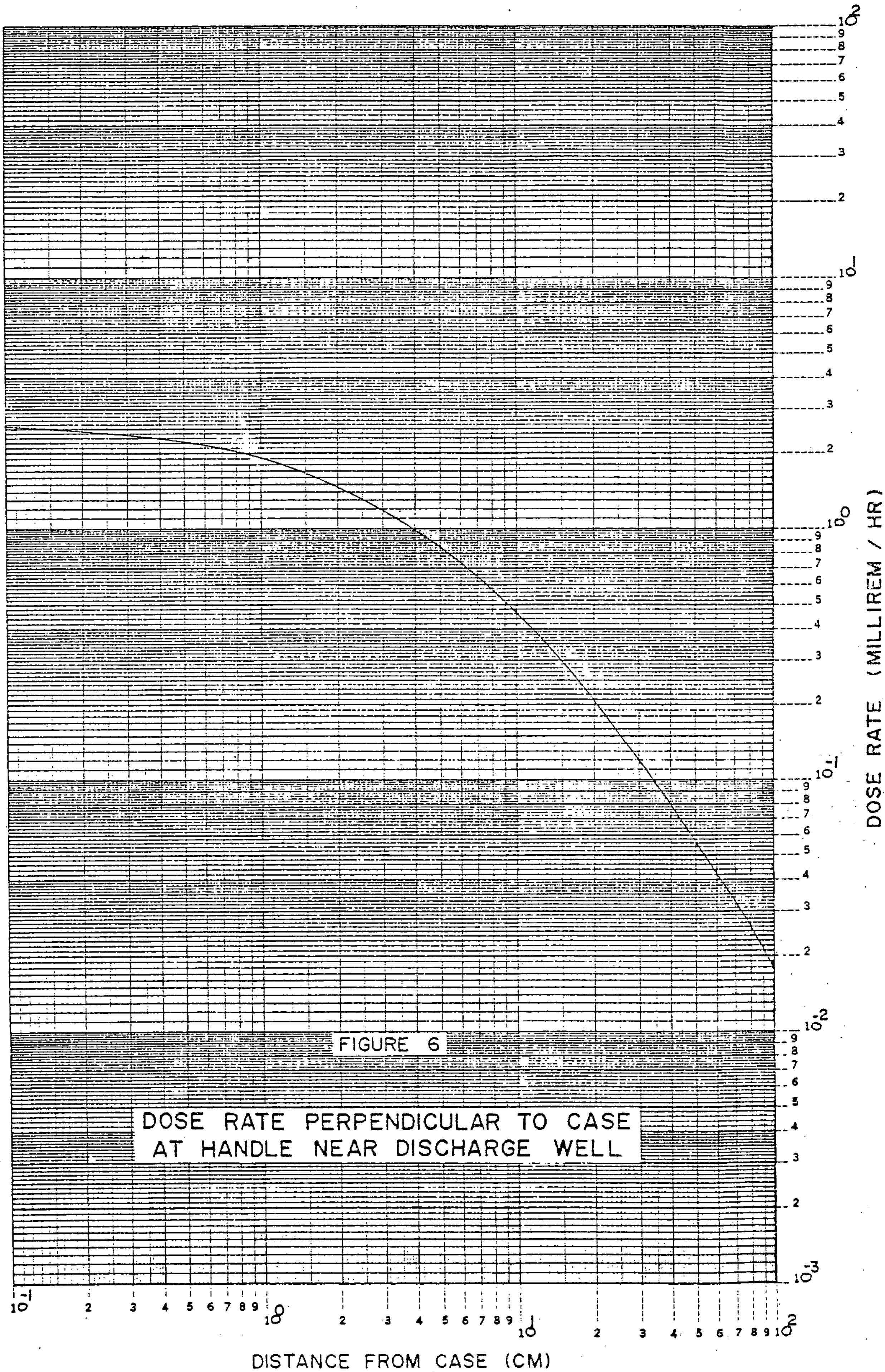

FIGURE 6

DOSE RATE PERPENDICULAR TO CASE
AT HANDLE NEAR DISCHARGE WELL

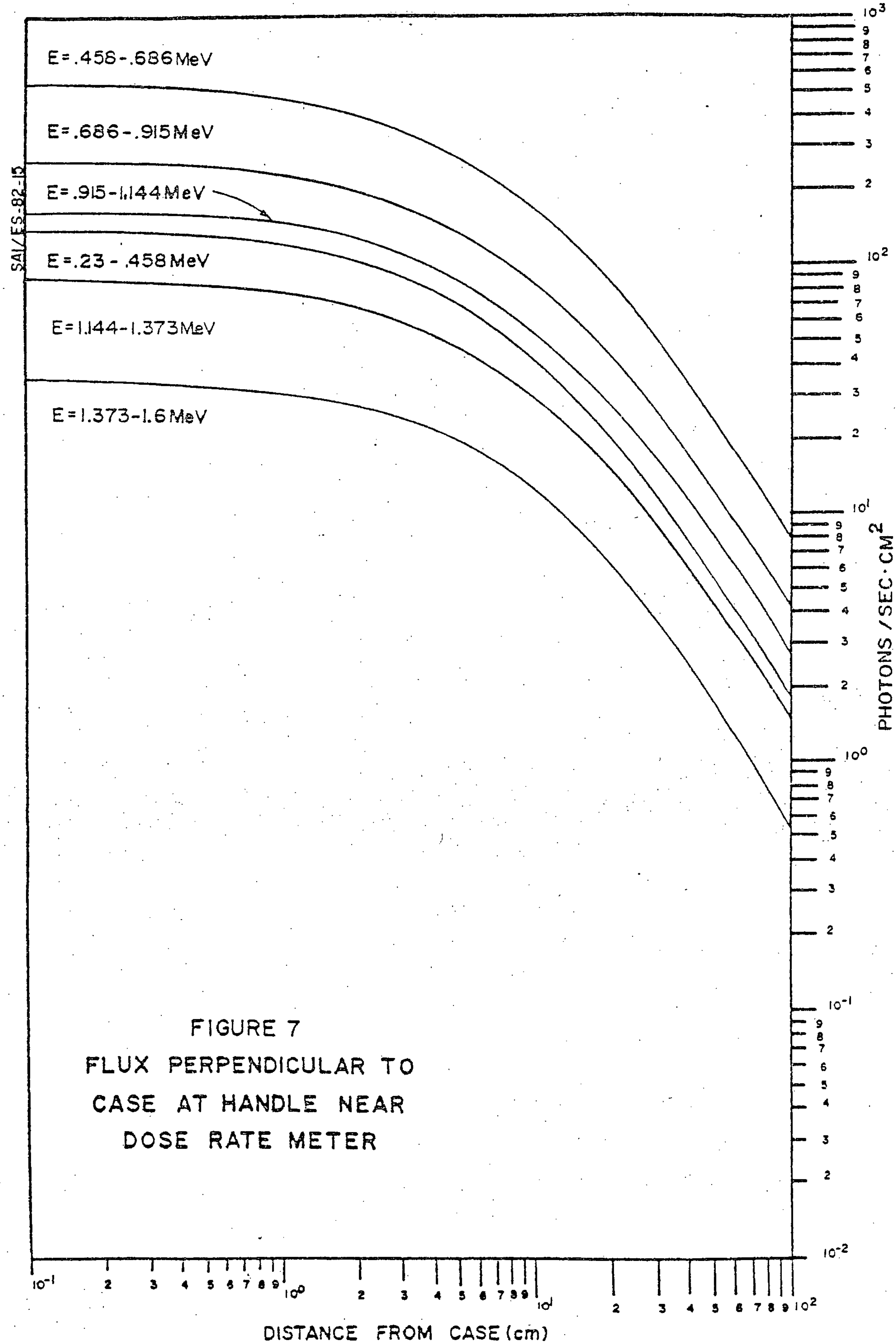

FIGURE 7
FLUX PERPENDICULAR TO
CASE AT HANDLE NEAR
DOSE RATE METER

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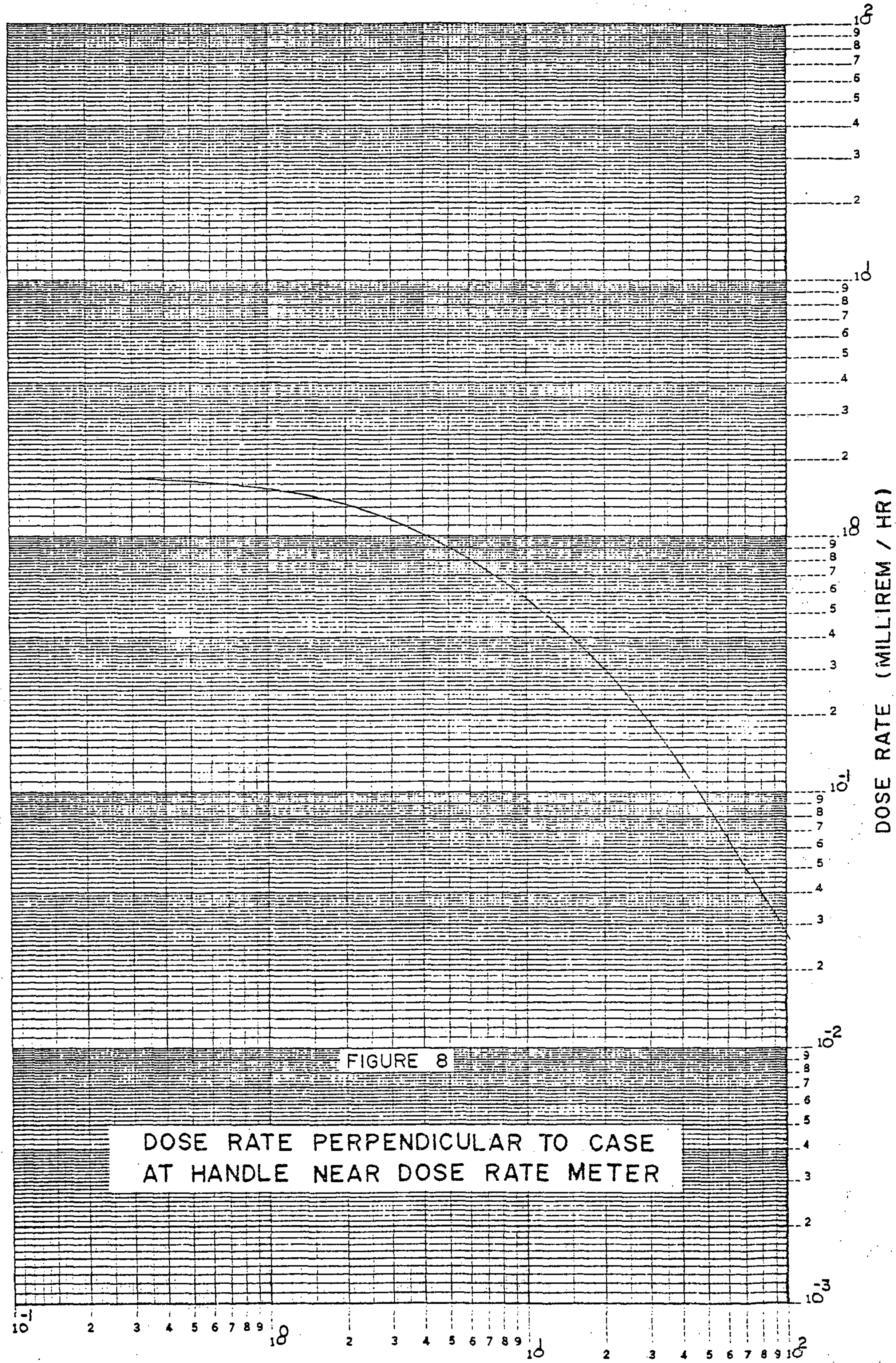


FIGURE 8

DOSE RATE PERPENDICULAR TO CASE AT HANDLE NEAR DOSE RATE METER

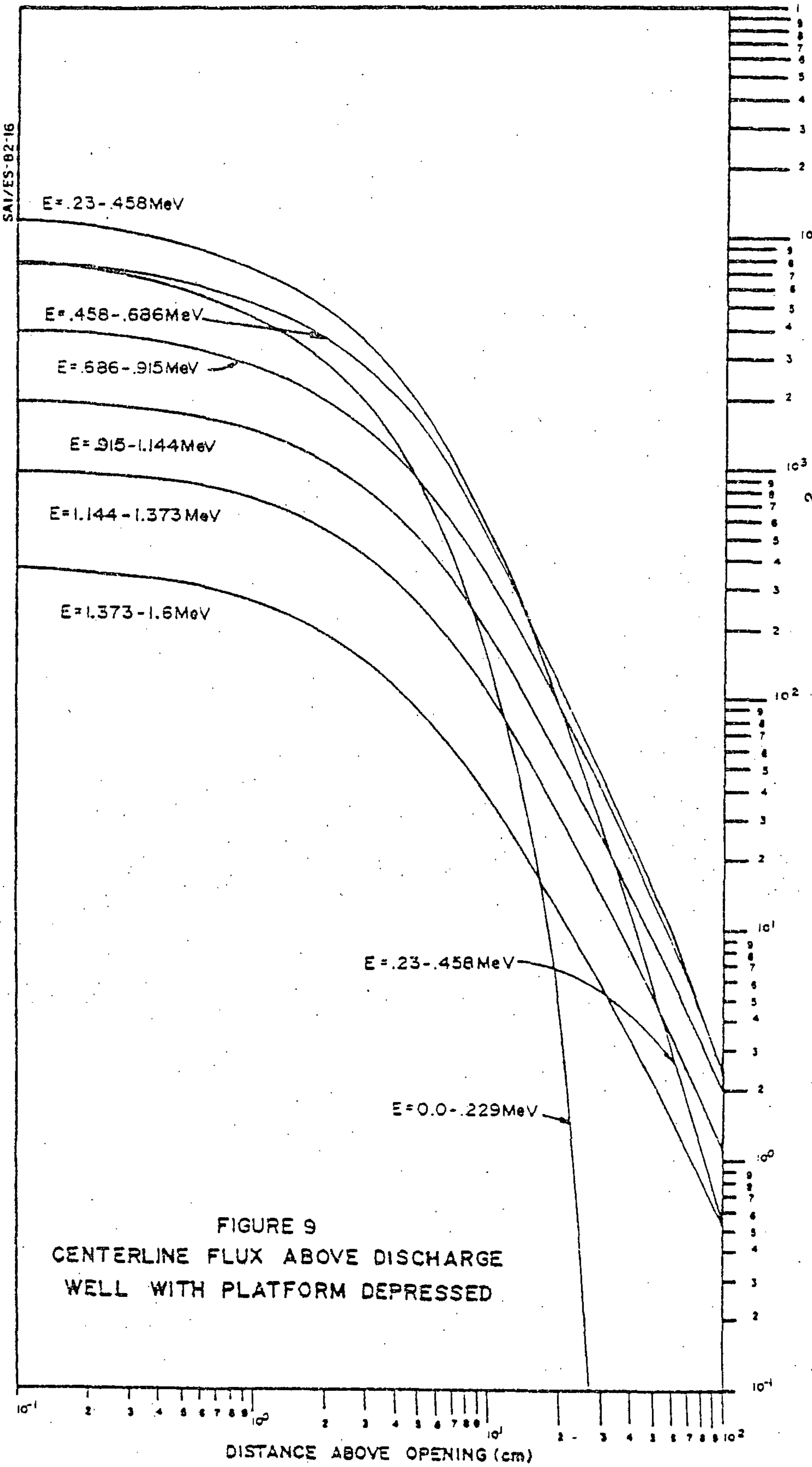
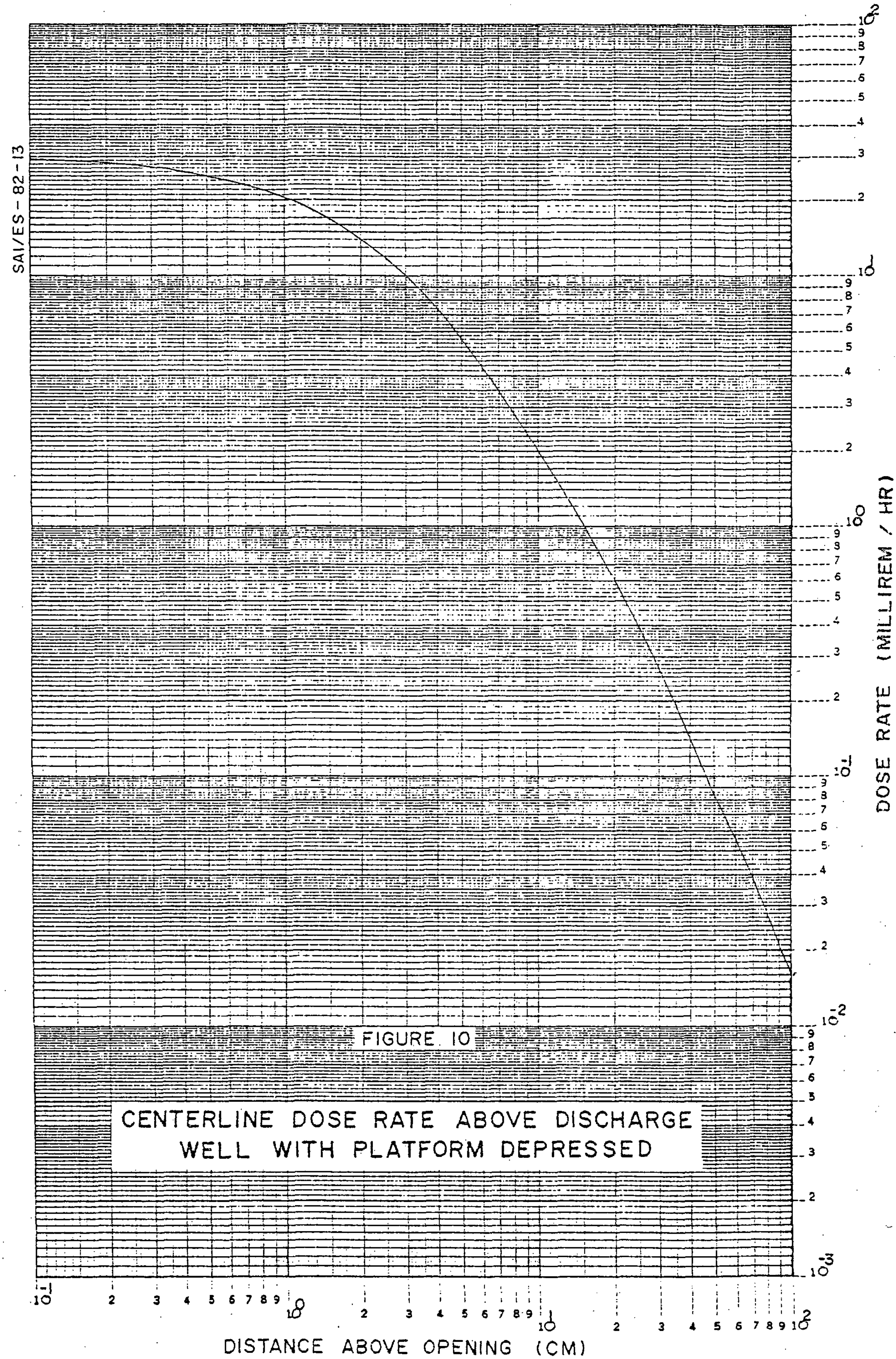


FIGURE 9
CENTERLINE FLUX ABOVE DISCHARGE WELL WITH PLATFORM DEPRESSED


DOSE RATE (MILLIREM / HR)
DISTANCE ABOVE OPENING (CM)
FIGURE 10
CENTERLINE DOSE RATE ABOVE DISCHARGE WELL WITH PLATFORM DEPRESSED

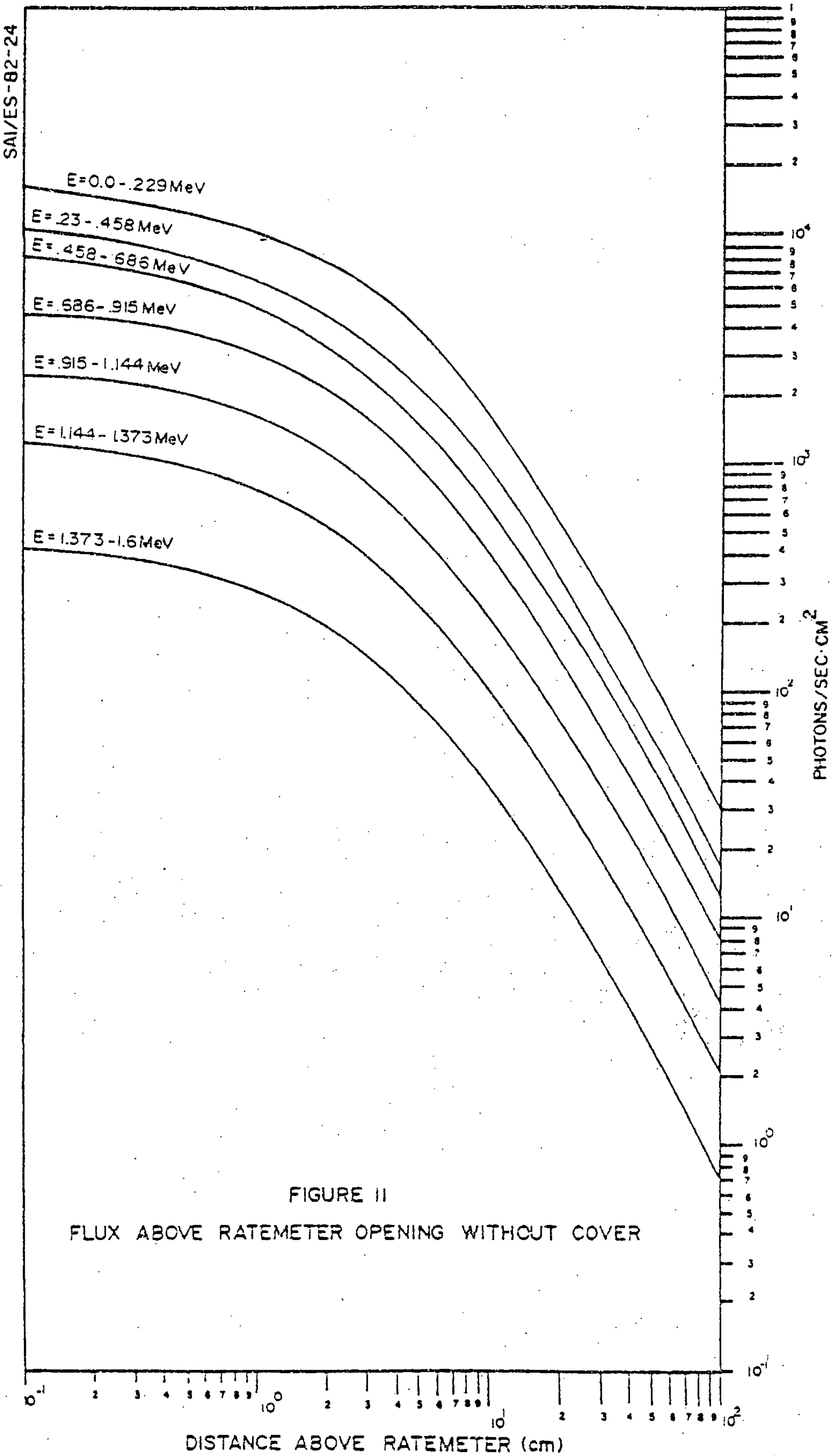


FIGURE 11

FLUX ABOVE RATEMETER OPENING WITHOUT COVER

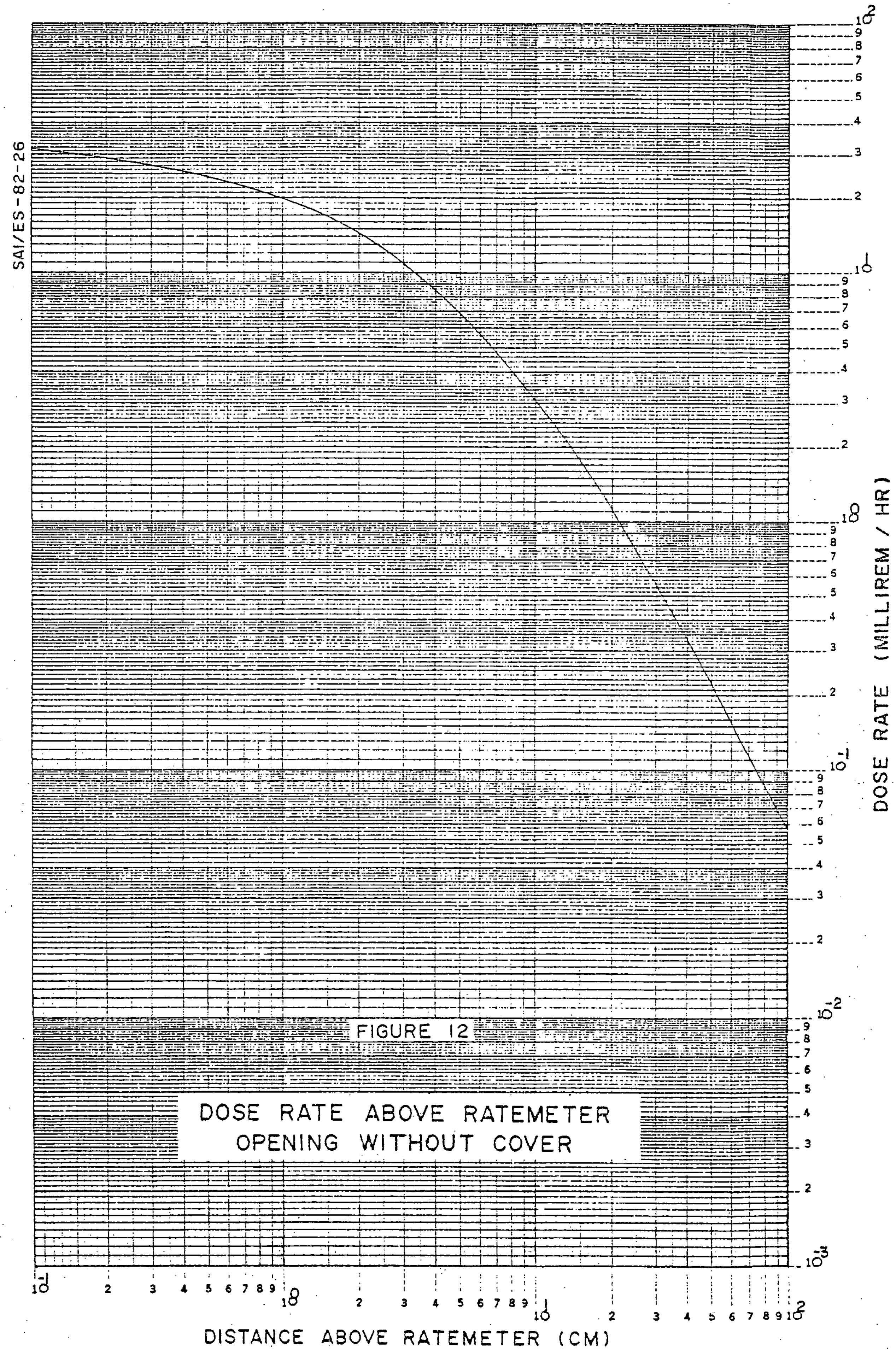

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FIGURE 12
DOSE RATE ABOVE RATEMETER OPENING WITHOUT COVER
DOSE RATE (MILLIREM / HR)
DISTANCE ABOVE RATEMETER (CM)

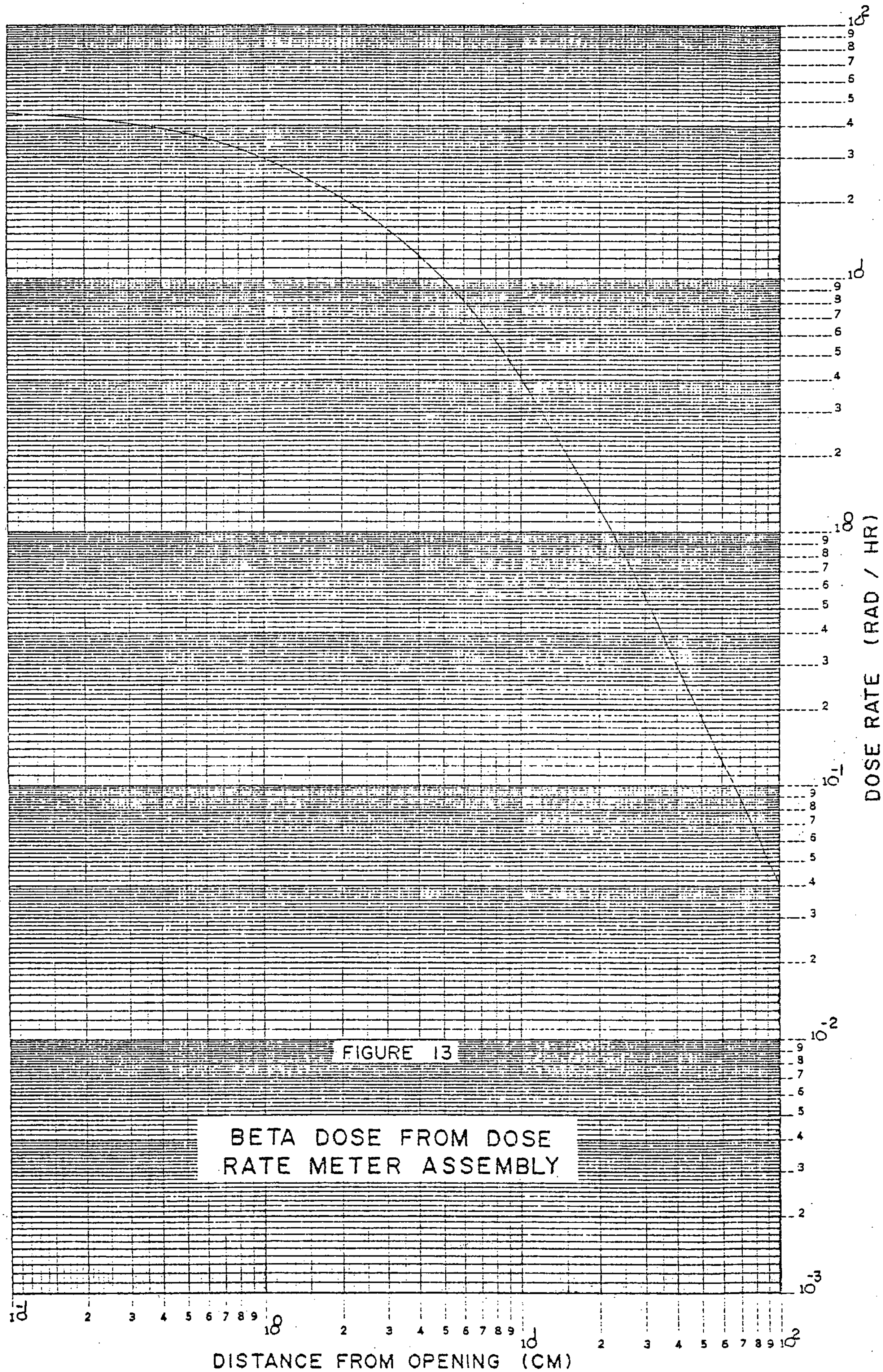

FIGURE 13

BETA DOSE FROM DOSE RATE METER ASSEMBLY

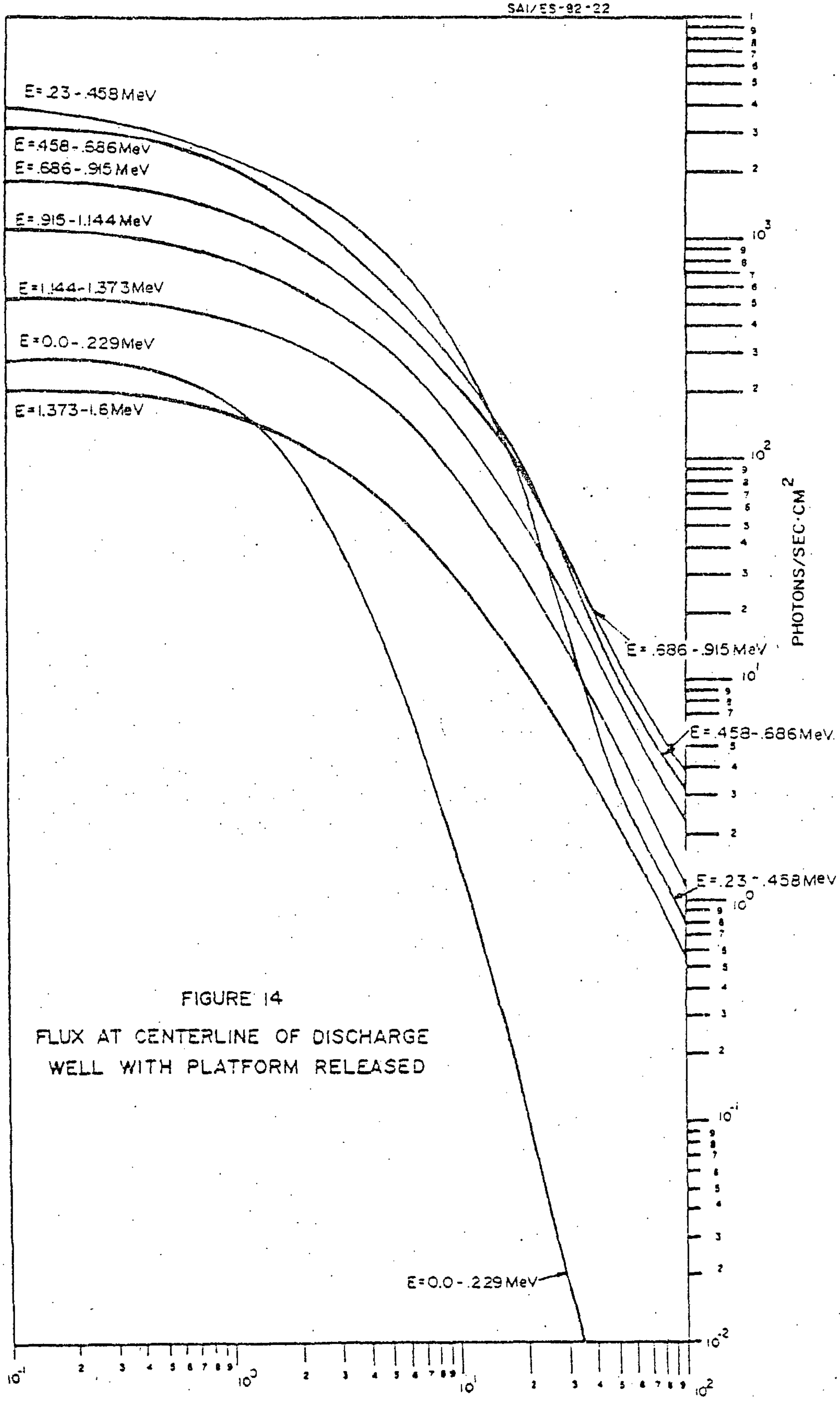

FIGURE 14

FLUX AT CENTERLINE OF DISCHARGE WELL WITH PLATFORM RELEASED

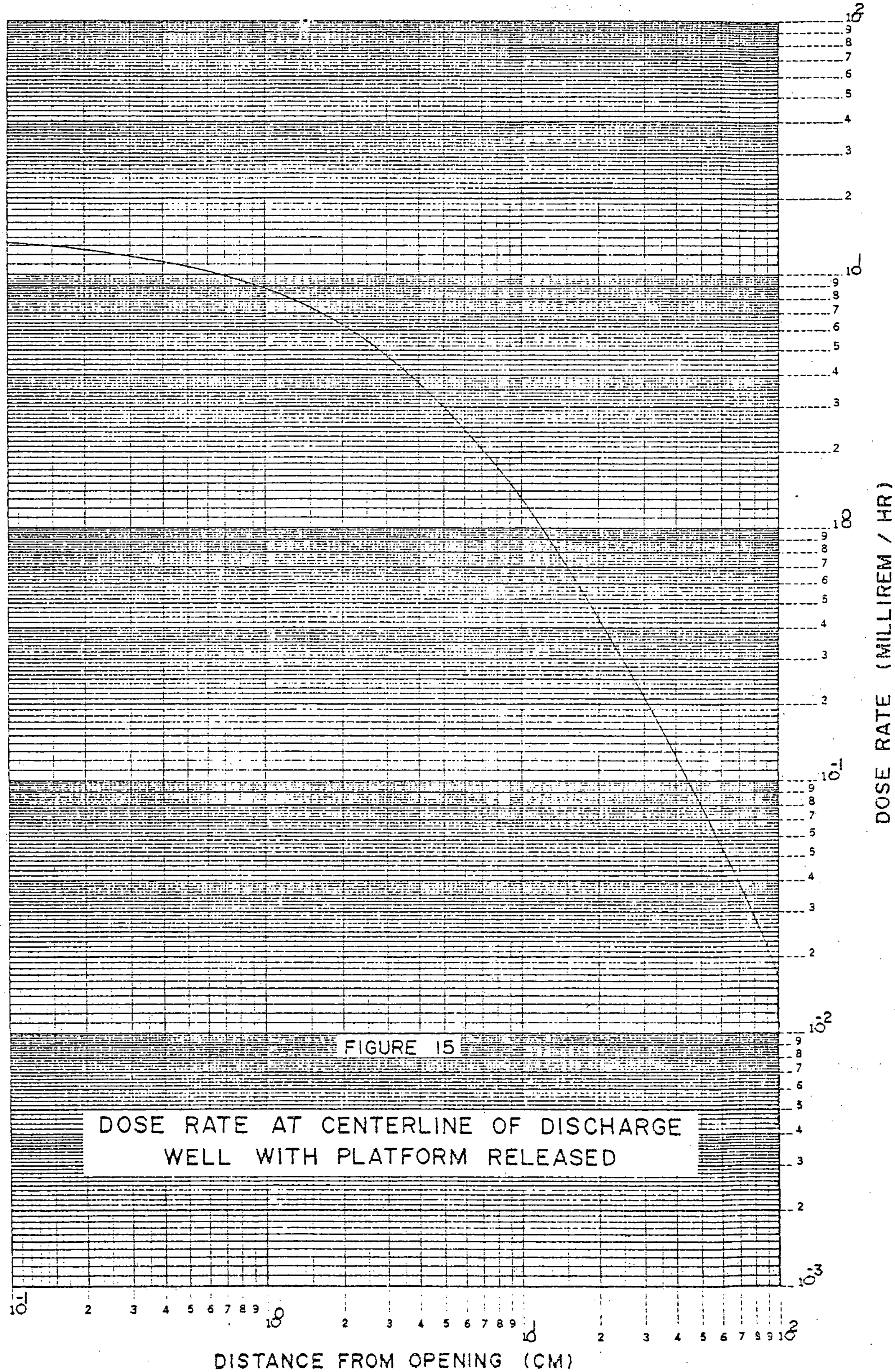

FIGURE 15

DOSE RATE AT CENTERLINE OF DISCHARGE WELL WITH PLATFORM RELEASED

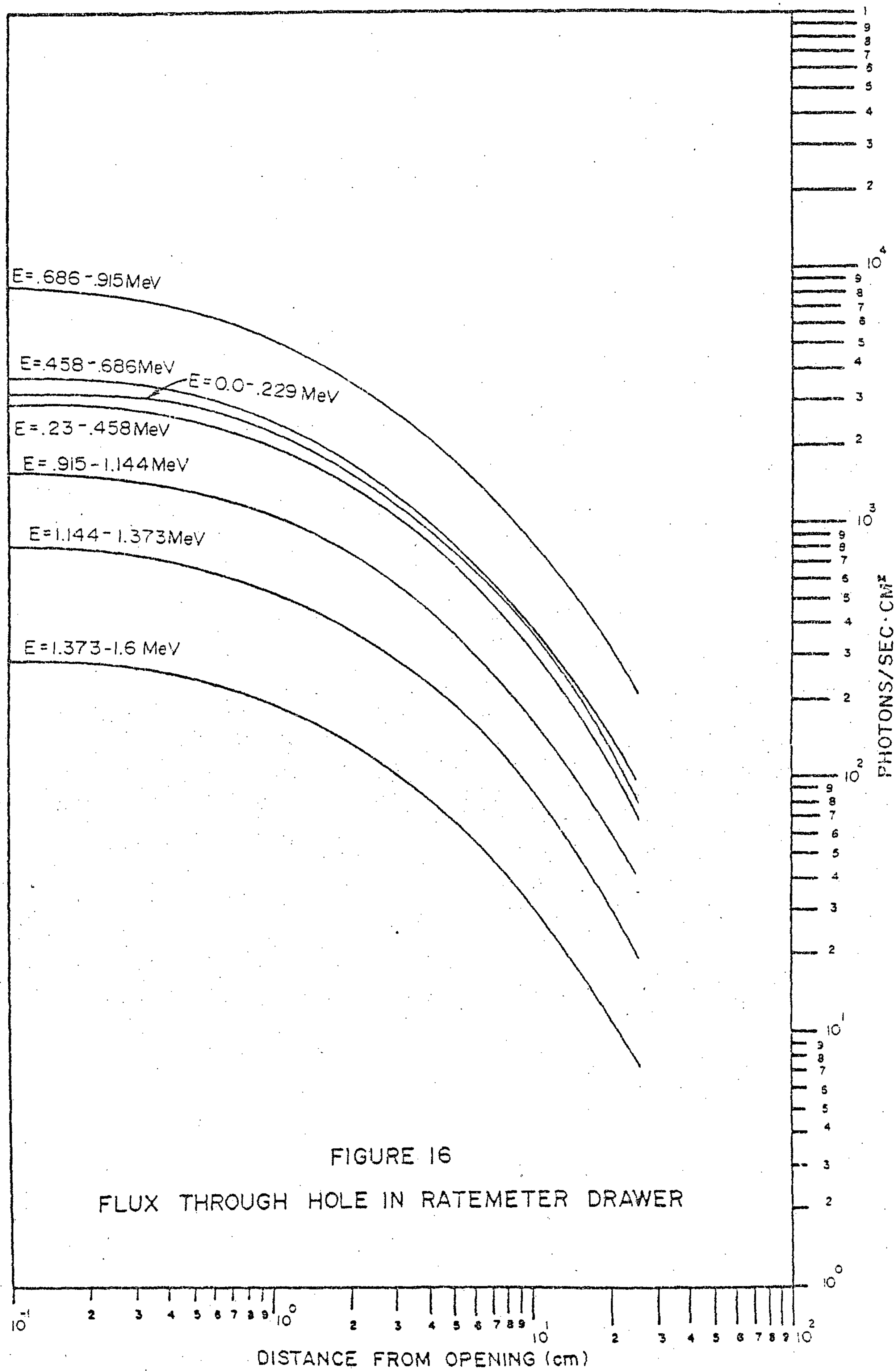

FIGURE 16

FLUX THROUGH HOLE IN RATEMETER DRAWER

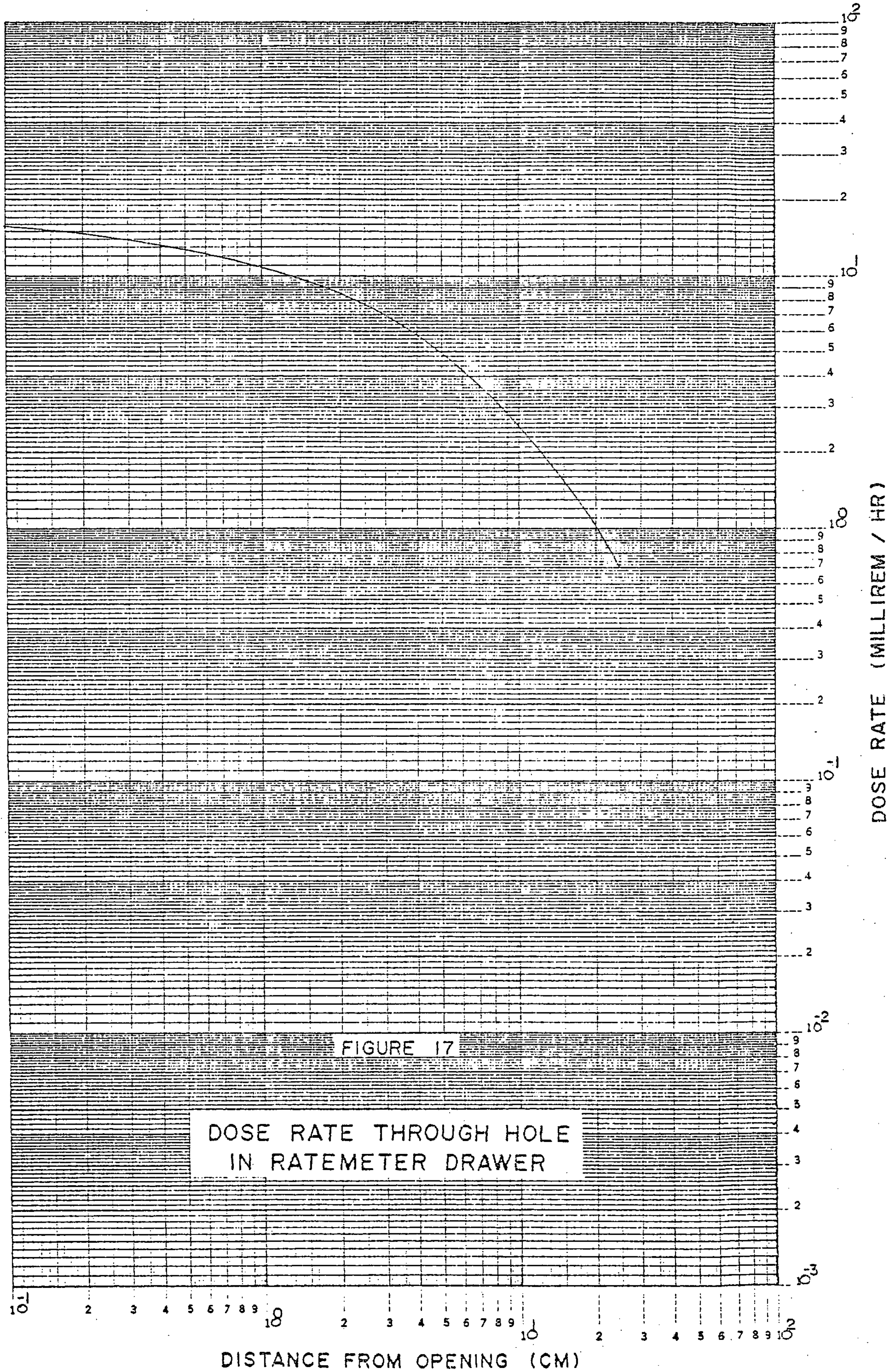

FIGURE 17

DOSE RATE THROUGH HOLE IN RATEMETER DRAWER

SECTION 4

DISCUSSION OF RESULTS

Task 1 (Figures 5, 6, 7, 8)

This task required the determination of the amount of bremsstrahlung produces by all five sources. The photon flux for each of the seven energy groups were attenuated through the multi-materials to the outside of the case. The contact dose rate on the case at the handle closest to the discharge well was calculated to be 2.6 millirem/hr and compared to a measured dose rate from reference 6 of 2.5 millirem/hr ±0.5. All of the dose rate at this point was bremsstrahlung and was produced primarily by the three 50 millicurie sources in the discharge well with the major contribution being the 50 millicurie source located directly under the 125 microcurie source.

The dose rate calculated at the handle closest to the doserate meter assembly was 1.8 millirem/hr and the measured value from reference 6 was 2 millirem/hr ±0.5 with the major contributor being the 50 millicurie source in the doserate meter assembly which was attenuated at an angle to the handle on the case through the tungsten wheel, aluminum drawer and assembly housing and the case. The bremsstrahlung was produced totally in the two 10 mill windows of the source.

Task 2 (Figures 9 and 10)

Along the centerline of the opening in the discharge well to approximately 21 inches above the opening the 125 micro-curie source is visible with the top of the source opening gradually covering the source from view until totally hidden. The partially visible source was divided into two portions with the visible protion being attenuated only through the two 10 mil windows and the hidden portion including the attenuation through the upper housing. The visible area of the source was calculated for each point along the centerline.

The three 50 millicurie sources are not visible along the centerline with the platform depressed but can be partially visible along the edge of the opening. Only at the edge is the angle small enough through the two 10 mil windows to allow for uncollided beta flux. At the centerline the dose rate is totally bremsstrahlung and the beta flux is negligible. The material of the 125 microcurie source was included in the attenuation for the 50 millicurie source located beneath it. The photon flux and dose rate along the centerline include contributions from all four soruces.

Task 3 (Figures 11, 12 and 13)

The exposed surface area is approximately one-half the total source surface area on the doserate meter assembly with the cover plate removed and the shutter rotated to the 100 Rad/hr position. For the portion exposed, the beta dose rate was calculated through the assembly and out to a distance of 91 cm above the assembly. The beta dose rate 3 cm above the source was calculated to be 102 Rad/hr which is comparable to the location and dose rate that would be measured by a TLD chip.

Bremsstrahlung flux was calculated by dividing the source area into two parts, the portion being generated in the 20 mil windows with no attenuation in the shutter and the portion attenuated by the tungsten.

Task 4

Task 4 calculated the doserate to a man standing on the ground enveloped in a semi-infinite cloud equal in radius of one mean free path. This calculation represented the total airborne dispersion of the four 50 millicurie Sr-90 sources and the 125 microcurie source. The geometry generated a hemi-spherical cloud and only the beta dose was a factor.

Task 5 Figures 14 and 15)

The total dose rate was due to bremsstrahlung. The additional attenuation through the brass platform by the three 50 millicurie sources required each to be divided into two portions, the portion attenuated only through the materials of the housing and the portion that also included the platform. The photon flux and dose rate along the centerline include contributions from all four sources.

Task 6 (Figures 16 and 17)

With the spacer block removed from the doserate meter assembly, a portion of the 50 millicurie source through the 100 Rad position hole in the wheel is visible through the opening in the drawer. The largest portion of the source visible is at the upper edge of the drawer opening. This point is where the maximum doserate was calculated. The source was divided into four portions to accommodate the various shielding materials and thicknesses. Beta dose rate at that angle was negligible. The seven photon flux energy groups and the dose rate were carried to the case along the same line.

The measured dose rate from reference 6 was much higher than the calculated dose rate. This assembly adjusts the source strength by moving the source within its opening. There are no stops to prevent the source from extending beyond the opening and space does exist between this opening in the doserate meter assembly and the tungsten wheel. Since bremsstrahlung is produced in the two windows of the source, any extension of the windows past the opening would provide a direct shine through this space. It should be noted that the doserate from an uncovered source at 5 cm is approximately 70 millirem/hr, which is the value measured in reference 6.

General

In almost every case the angle of the source to the operating personnel minimized the beta flux to the personnel, making it negligible. Only in two instances would the beta be measureable to personnel, at the edge of the discharge well opening directly across from a 50 millicurie source with the platform depressed, and directly over the ratemeter opening with the warning cover removed. All beta flux is from the Y-90 with the majority of the bremsstrahlung generated in the two 10 mil windows.

The dose rate in both the discharge well and the ratemeter would be much higher if the windows of the sources extend beyond their openings.

Section 5

REFERENCES

1. Department of the Army, Operators and Organizational Maintenance Manual, TM11-6665-227-12, June, 1975

2. Case, F. N., (Letter Report to R. G. Rast), Determination of Strontium-90 Activity in the Sources Removed from U. S. Army Calibration Devices, October 7, 1980

3. Brodsky, A. and Beard, G. V., A Compendium of Information for Use in Controlling Radiation Emergencies, TID-88206 (Rev)

4. Evans, R. D., The Atomic Nucleus, McGraw Hill, New York, New York, 1955

5. Fitzgerald, J. J., Brownell, G. L., and Mahoney, F. J., Mathematical Theory of Radiation Dosimetry, Gordon and Brench Science Publishers, Inc., New York, New York, 1967

6. McDermott, Frank E., Col., MSC, "Radiation Protection Special Study No. 28-43-0910-81", HSE-RH/WP, March 25 - October 17, 1980

APPENDIX A

A Technique for Calculating Bremsstrahlung Contribution to Dose Rates by Empirical Methods

In most shielding calculations, the contribution of bremsstrahlung radiation to dose rate is neglected, based on the assumption that energy loss by beta interactions went into ionizing and exciting atoms in the neighborhood of the interaction site. This is a sound assumption so long as radiation losses comprise no more than a small fraction of the total energy loss.

In considering beta-radiation shielding, one cannot dismiss bremsstrahlung so lightly since sources of beta radiation, even though adequately shielded against beta penetration, can be significant sources of photon radiation. The problem of bremstrahlung radiation is further complicated by the somewhat theoretical explanations found in most texts on radiation shielding. It is for this reason that an empirical technique is discussed here, allowing direct calculation of dose rates due to bremsstrahlung. There are two fairly well accepted semi-empirical techniques to determine the fraction of the beta-ray energy dissipated as external bremsstrahlung (3,4). The one used in the calculations presented in this report from reference 3 is as follows:

$$f = 1.23 \times 10^{-4}(\bar{Z} + 3)\, E^2_{max} \qquad \text{(A-1)}$$

where f = fraction resulting in bremsstrahlung per beta absorbed [MeV/$_\beta$]

E_{max} = maximum beta energy [MeV]

$\bar{Z}$ = effective atomic number, given by

$$\bar{Z} = \frac{\Sigma f_a Z_a^{2}}{\Sigma f_a Z_a} \qquad \text{(A-2)}$$

where:

f_a = fraction of number of atoms of atomic number A_a

Z_a = Atomic number of element in material under consideration

Thus, the above relationships (A-1 and A-2) allow computation of the total bremsstrahlung generated per total absorbed. Since the fraction of initial ionization measured after the beta particles have penetrated through a thickness X of absorbing medium is virtually exponential in behavior for approximately 99% of the beta particle range, the intensity may be expressed as:

$$I(X) = I(0)e^{-(\mu/\rho)X} \qquad \text{(A-3)}$$

where:

μ/ρ = apparent mass absorption coefficient [cm^2/gm]

X = mass distance [gm/cm^2]

The most reliable source of information on these coefficients is empirical in nature. The mass absorption coefficient is nearly independent of the atomic weight of the absorbing medium and increases only slightly with its atomic mass number, (3). The functional dependence of μ/ρ upon E_{max} can be represented by the expression

$$\mu/\rho = 17E_{max}^{-1.14} \qquad \text{(A-4)}$$

where:

E_{max} = max beta particle energy [MeV]

μ/ρ = apparent mass absorption coefficient [cm^2/gm]

For simplicity, total mass absorption curves, i.e., I/I_o are given in Figures A-1 through A-7 for a variety of shield materials.

Now that the total bremsstrahlung fraction has been determined through the use of Figures A-1 through A-7 and Equation A-1, the bremsstrahlung spectrum from beta absorption can be determined from the following table (3):

BREMSSTRAHLUNG SPECTRUM FROM BETA ABSORPTION

Photon Energy Intervals in Fraction of the Maximum Beta Energy	Percent of Total Intensity Contributed by Photons in Energy Intervals
0.0 to 0.1	43.5
0.1 to 0.2	25.8
0.2 to 0.3	15.2
0.3 to 0.4	8.3
0.4 to 0.5	4.3
0.5 to 0.6	2.0
0.6 to 0.7	0.7
0.7 to 0.8	0.2
0.8 to 0.9	0.03
0.9 to 1.0	< 0.01

The problem can now be solved utilizing the well established techniques for gamma-ray shielding found in the literature.

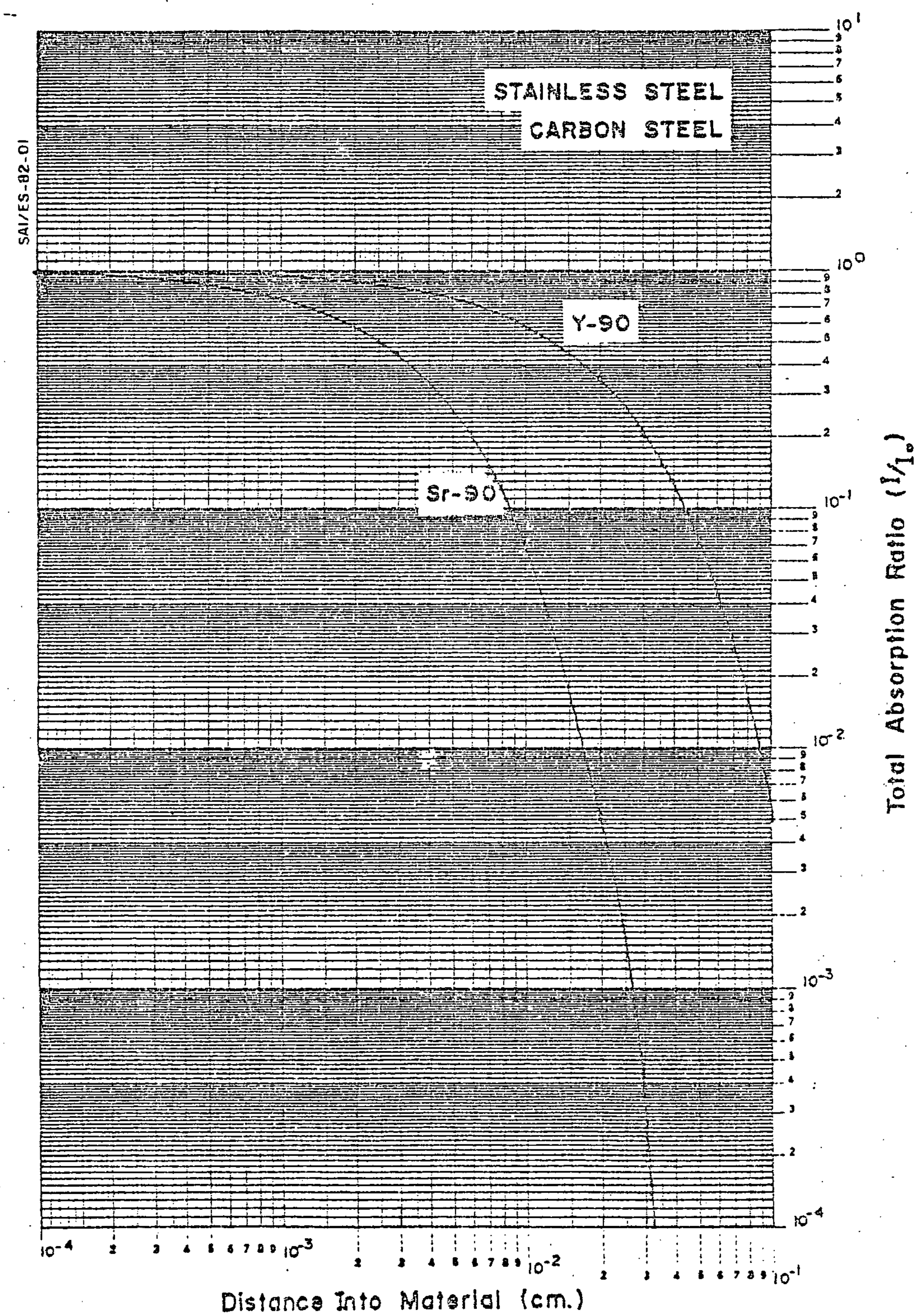

Figure A-1
Beta Total Absorption Ratio for
Stainless & Carbon Steels

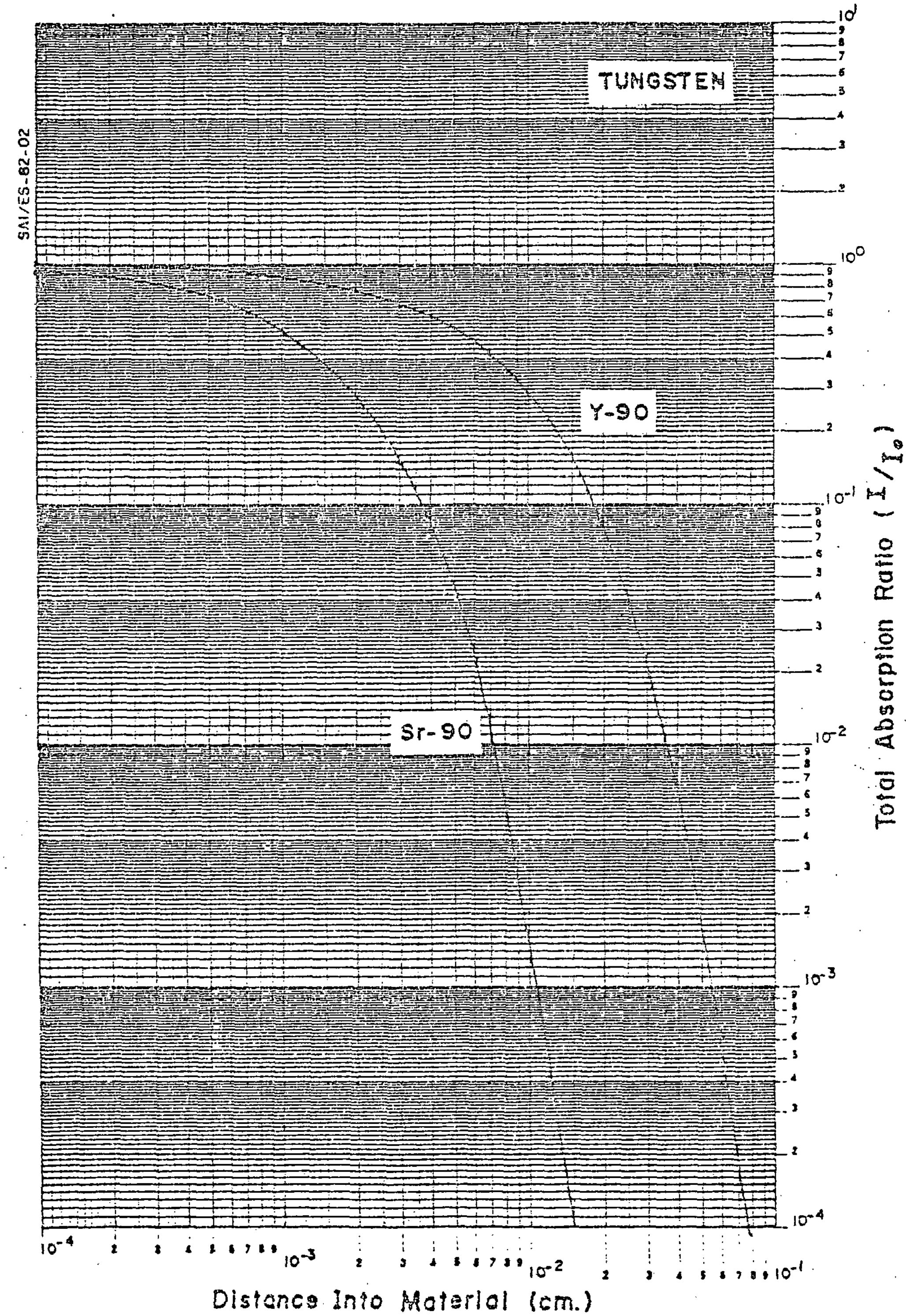

Figure A-2

Beta Total Absorption Ratio for Tungsten

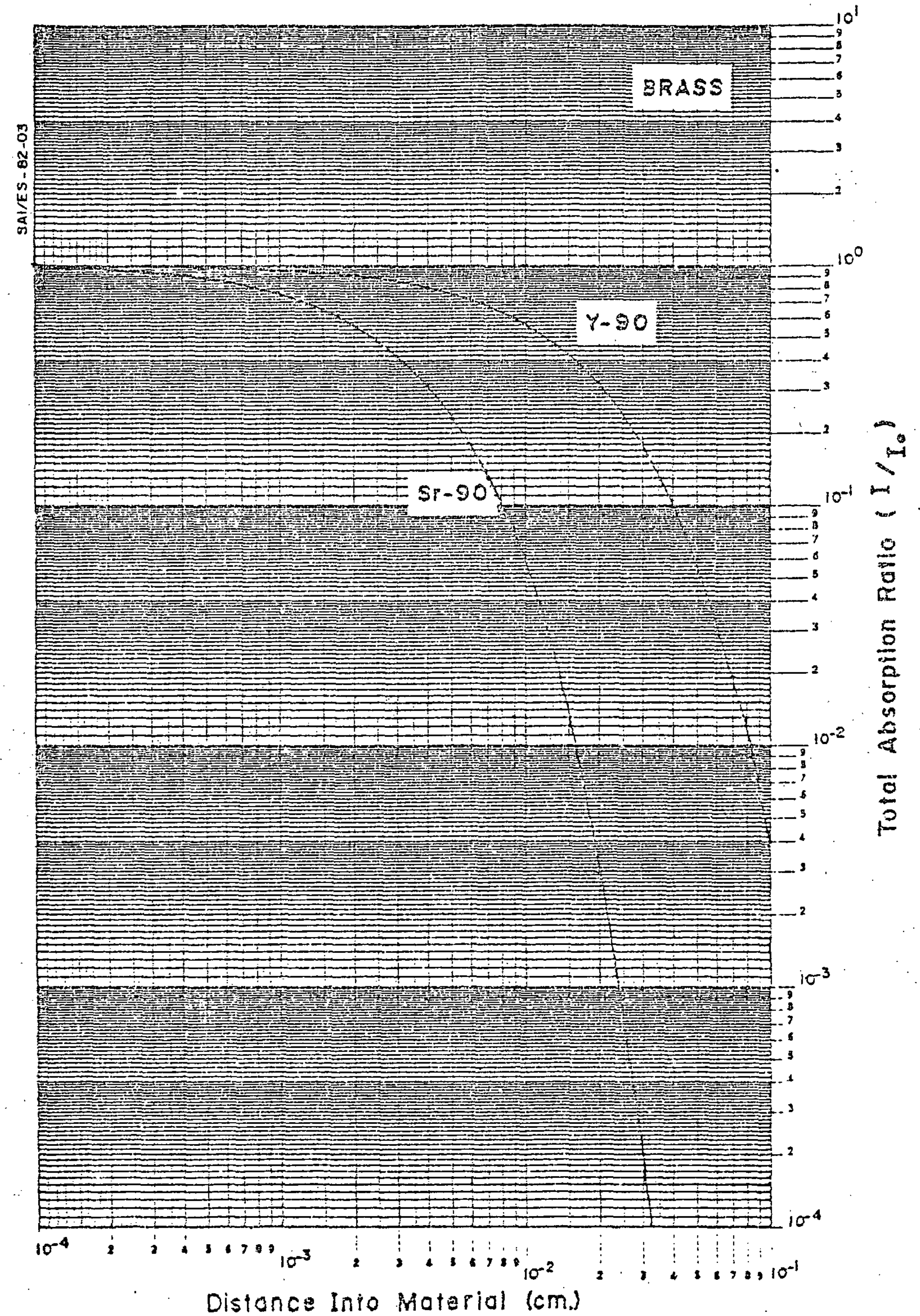

Figure A-3

Beta Total Absorption Ratio for Brass

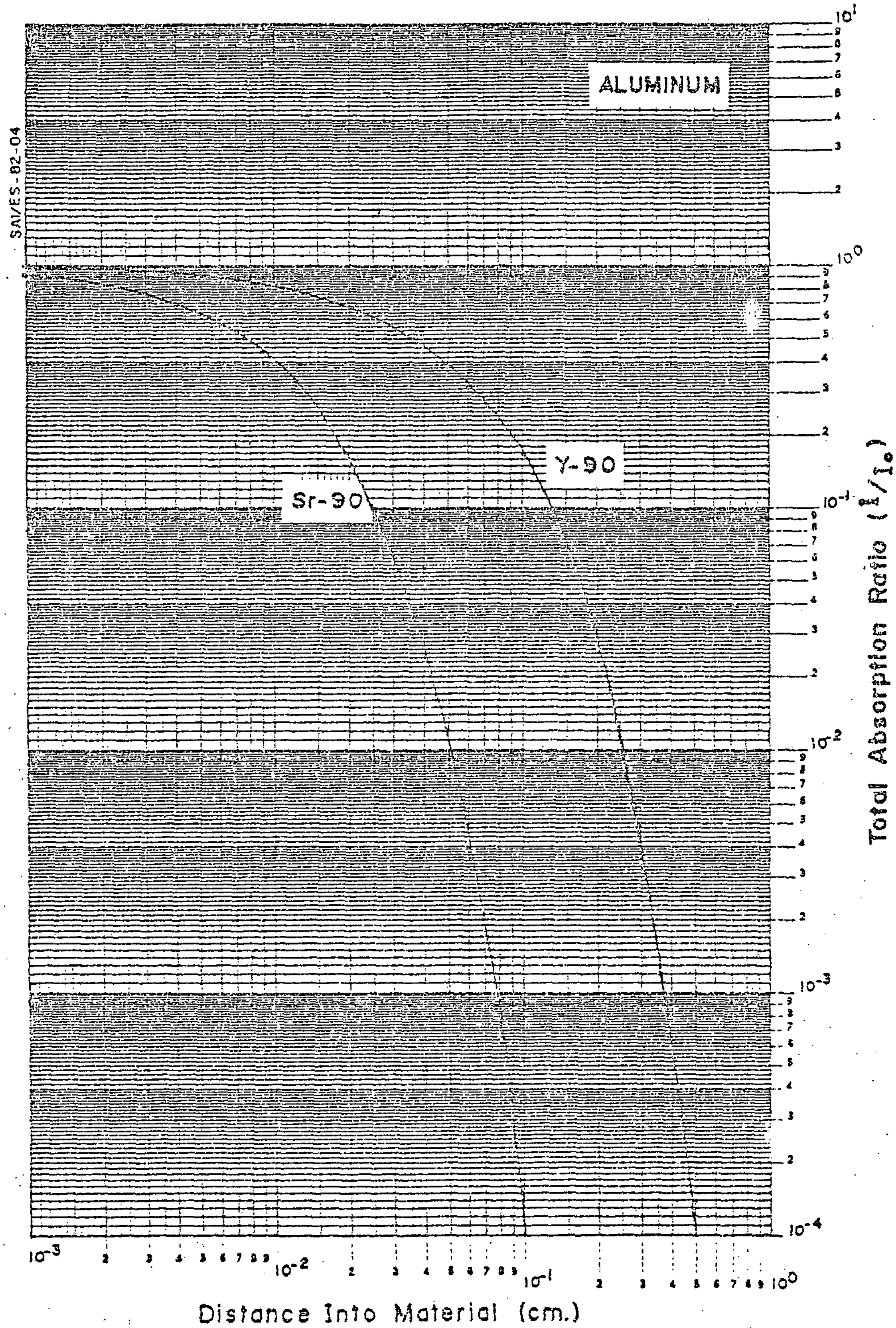

Figure A-4

Beta Total Absorption Ratio for Aluminum

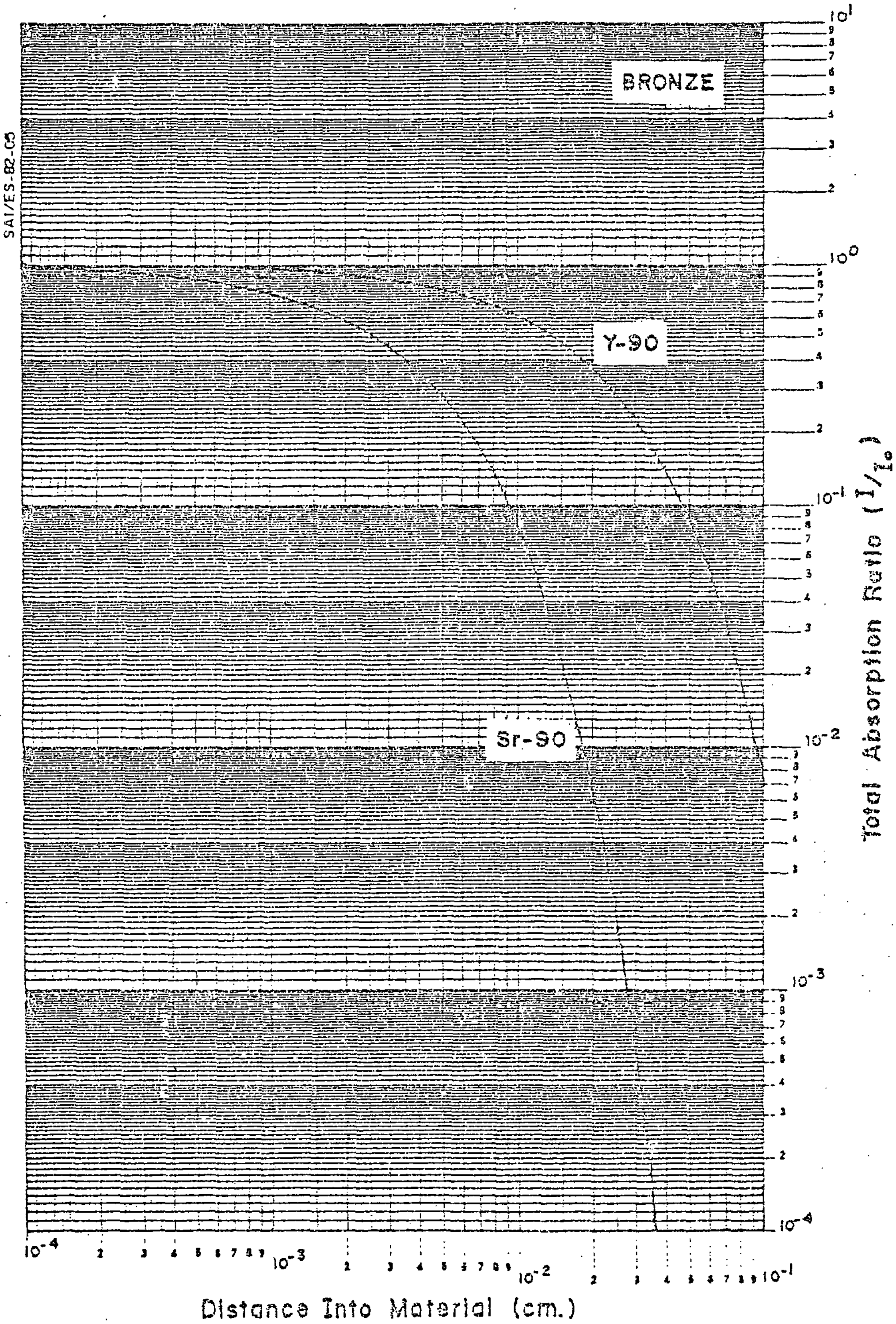

Figure A-5

Beta Total Absorption Ratio for Bronze

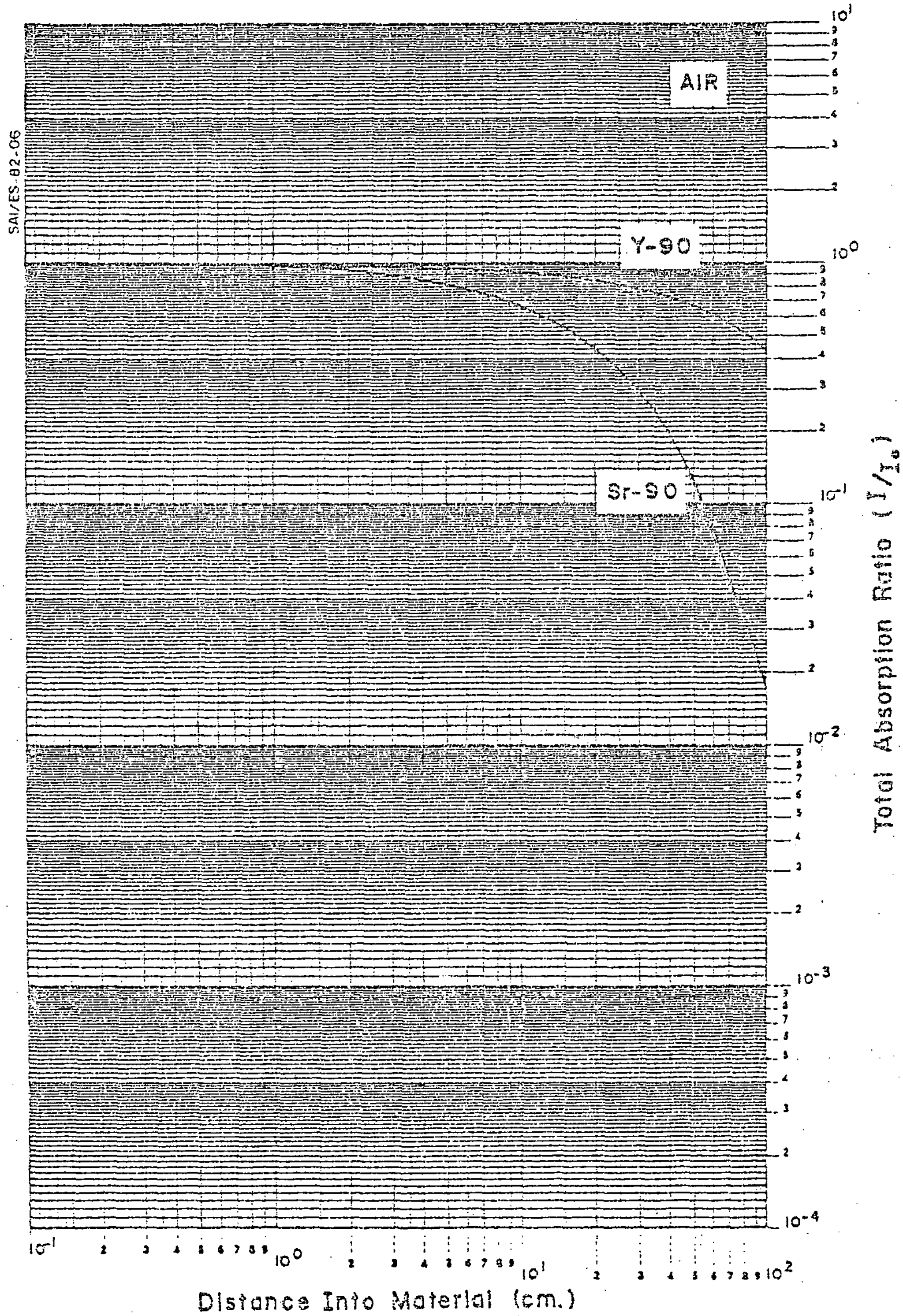

Figure A-6
Beta Total Absorption Ratio
for Air (10^{-1} - 10^{2} cm)

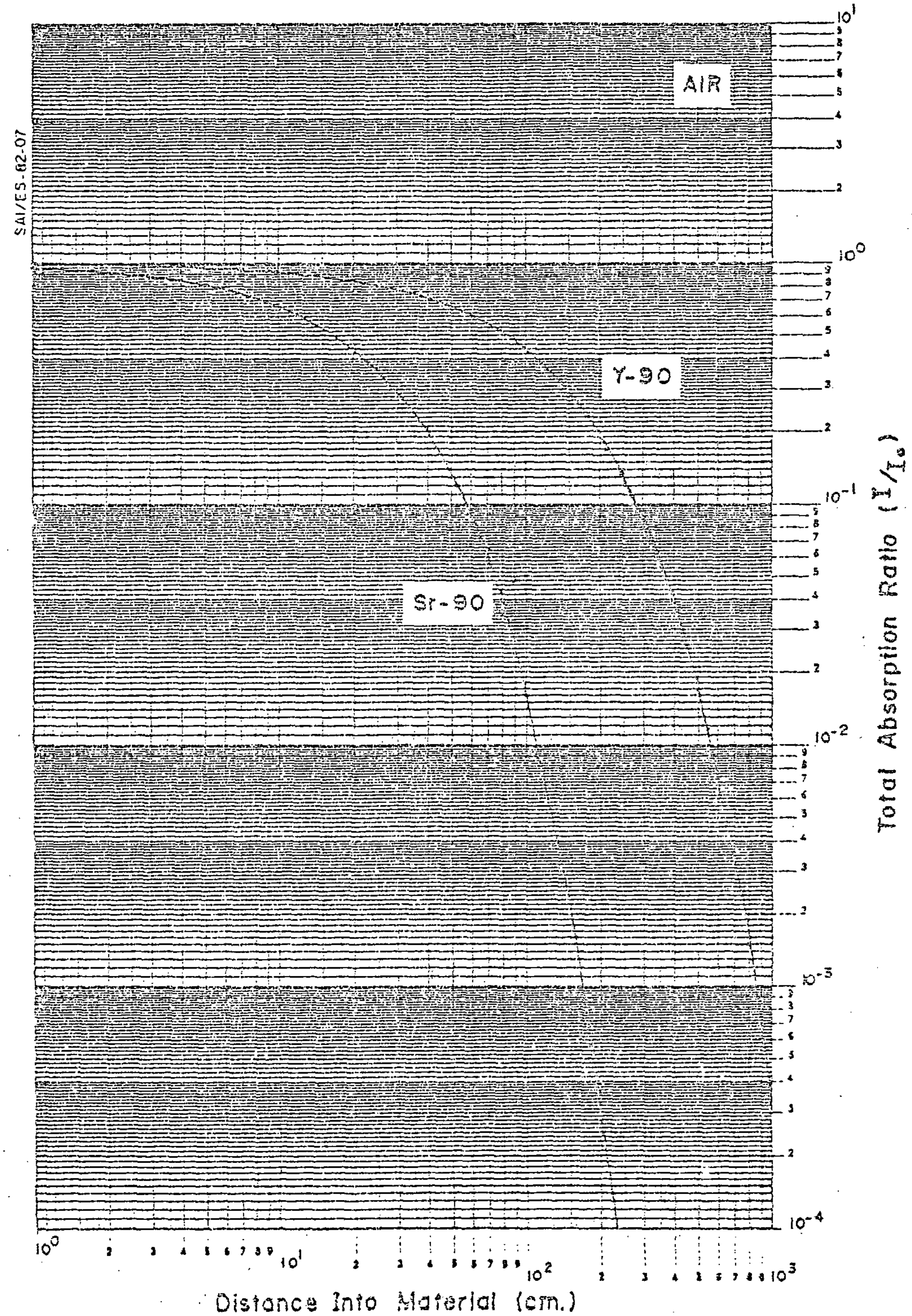

Figure A-7
Beta Total Absorption Ratio

Air (10^0 - 10^3cm)

APPENDIX B

Use of the Exponential Inverse Square Formulation in Beta Radiation Dosimetry

The absorption curve for continuous-spectrum electrons is often remarkably close to exponential over most of its range. The actual shape of such a curve is somewhat dependent upon experimental conditions, but apparently is due to the result of a fortuitous interplay of the pertenent variables. Specifically, through ionization measurements, the fraction of initial ionization measured after the beta particles penetrated through a thickness X of absorbing medium was found to be exponential in behavior for approximately 99% of the beta particle range (5).

Thus, beta-radiation dosimetry may be treated analogous to gamma-ray dosimetry, over short ranges, i.e., distances less than the maximum range of the beta particle.

The beta-point-source dose rate formula for exponential inverse-square formulation is given by:

$$D = \frac{1.7 \times 10^5 \rho^2 (\mu/\rho) E_{av} C e^{-(\mu/\rho) r}}{r^2}$$

where:

D = Beta Dose Rate [Rad/Hr]

μ/ρ = Apparent Absorption Coefficient [cm^2/gm]

E_{av} = Average Beta Energy [Mev]

C = Source Strength [Ci]

r = Source to Receptor Distance [gm/cm^2]

The difficulty in employing the exponential inverse square formulation lies in making an appropriate choice of apparent absorption coefficient. Note that (μ/ρ) is an absorption, not attenuation, coefficient, therefore there is no need for considering buildup factors.

The apparent absorption coefficient can be fairly well represented by:

$$\mu/\rho = \frac{17}{(E_{max})^{1.14}} \qquad \text{(B-2)}$$

where: E_{max} is in MeV

The above formulation is an acceptable method of calculating beta dose rates for distances less than the maximum beta-particle range.

SAI-139-82-RV

Revision 1

CALCULATION OF DOSE RATES DURING OPERATION OF RADIAC AN/UDM-2 CALIBRATOR SET

October 14, 1983

Contract Number

DAAB08-83-MJ838

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Encl 3

ABSTRACT

This report contains the results of dose rate calculations to operating personnel using the RADIAC AN/UDM-2 calibrator. The calibrator contains four 35 millicurie ±20% and one 30 ±20% microcurie Sr-90 sources with each source containing two 2 mil stainless steel windows. Five locations on the calibrator assembly and one hypothetical semi-infinite cloud were calculated for personnel exposure. Contribution to dose rate due to bremsstrahlung was included.

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LIST OF TABLES

SECTION 1

INTRODUCTION

Realistic upper-bound dose rates were calculated for personnel operating the RADIAC AN/UDM-2 Calibrator Set which contains four 35 ±20% millicurie Sr-90 sources and one 30 ±20% microcurie Sr-90 source, with each source containing two 2 mil stainless steel windows.

The RADIAC AN/UDM-2 Calibrator Set consists of two major assemblies, the RADIAC TS-3495/UDM-2 calibrator assembly, and the RADIAC TS-3494/UDM-2 calibrator assembly, shown in Figures 1.1 and 1.2, respectively. Each major assembly is housed in one-half of a waterproof aluminum case. A handle is provided on each assembly to facilitate handling. (Ref. 1)

Figure 1.3 is a sectional view of the RADIAC TS-3495/UDM-2 discharge well assembly, which contains four Sr/Y-90 sources; three 35 ±20% millicurie sources in the lower cavity and one 30 ±20% microcurie source in the upper cavity. The lower field of radiation (due to the three 35 microcurie sources) is closed off from the access hole by a spring loaded platform. The lower field is exposed when a dosimeter is inserted deep into the access hole by depressing the spring loaded platform. A spring loaded cover (not shown) attached to the top of the discharge well assembly covers the access hole.

Figure 1.4 is a sectional view of the RADIAC TS-3494/UDM-2 doserate meter assembly, which contains a single 35 ±20% millicurie Sr/Y-90 source. Access to the radiation field is gained through a sliding drawer in the assembly. A rotating shutter is located between the sliding drawer and the encapsulated source. The shutter has two holes which provide radiation fields for calibration purposes.

Figure 1.5 is a sectional view of the source assembly showing the location of the microsphere sources inside the stainless steel capsule. Each source assembly is double encapsulated, employing a 2 mil thick 304 ss outer window and a 2 mil thick 304 ss inner window.

Section 2 of this report describes the calculational tasks performed and all relevant assumptions. Section 3 presents the results of the calculations performed and Section 4 is a discussion of the results. References used in the preparation of this report are tabulated in Section 5. Appendices A and B describe the mathematical techniques used to calculate the dose rates from bremsstrahlung and beta radiation.

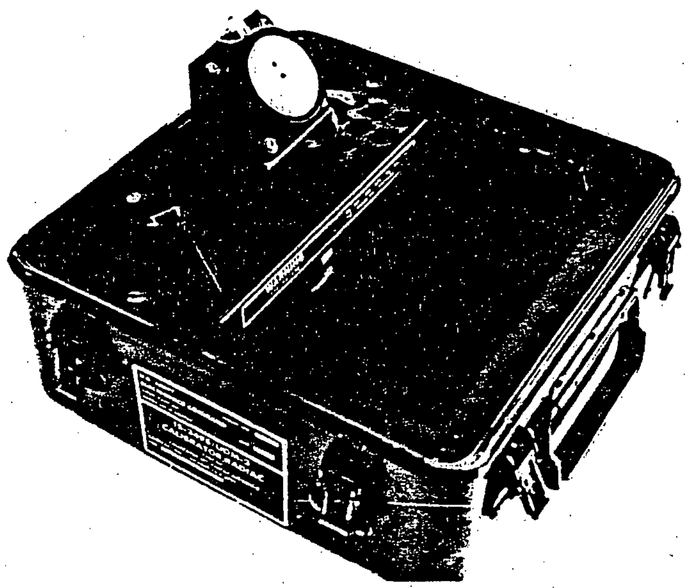

Figure 1.1 - Radiac 3495/UDM-2 Calibrator Assembly

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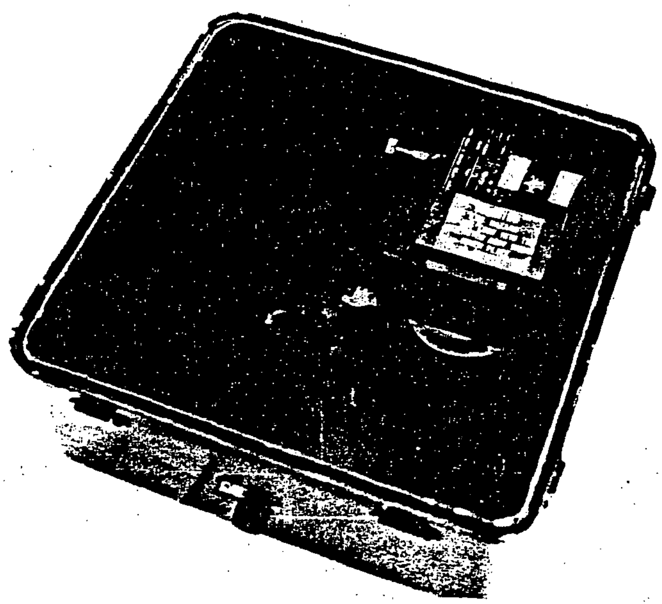
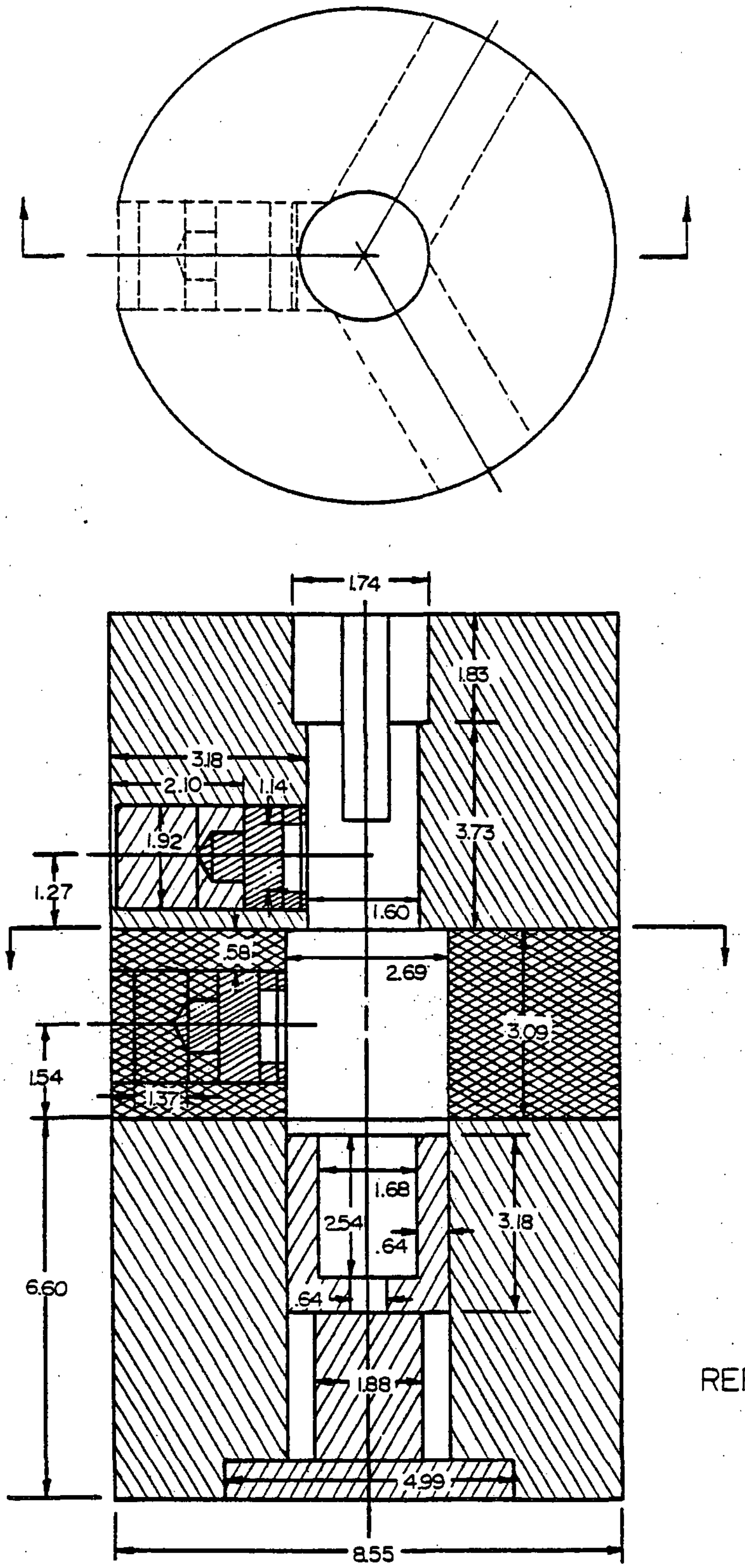
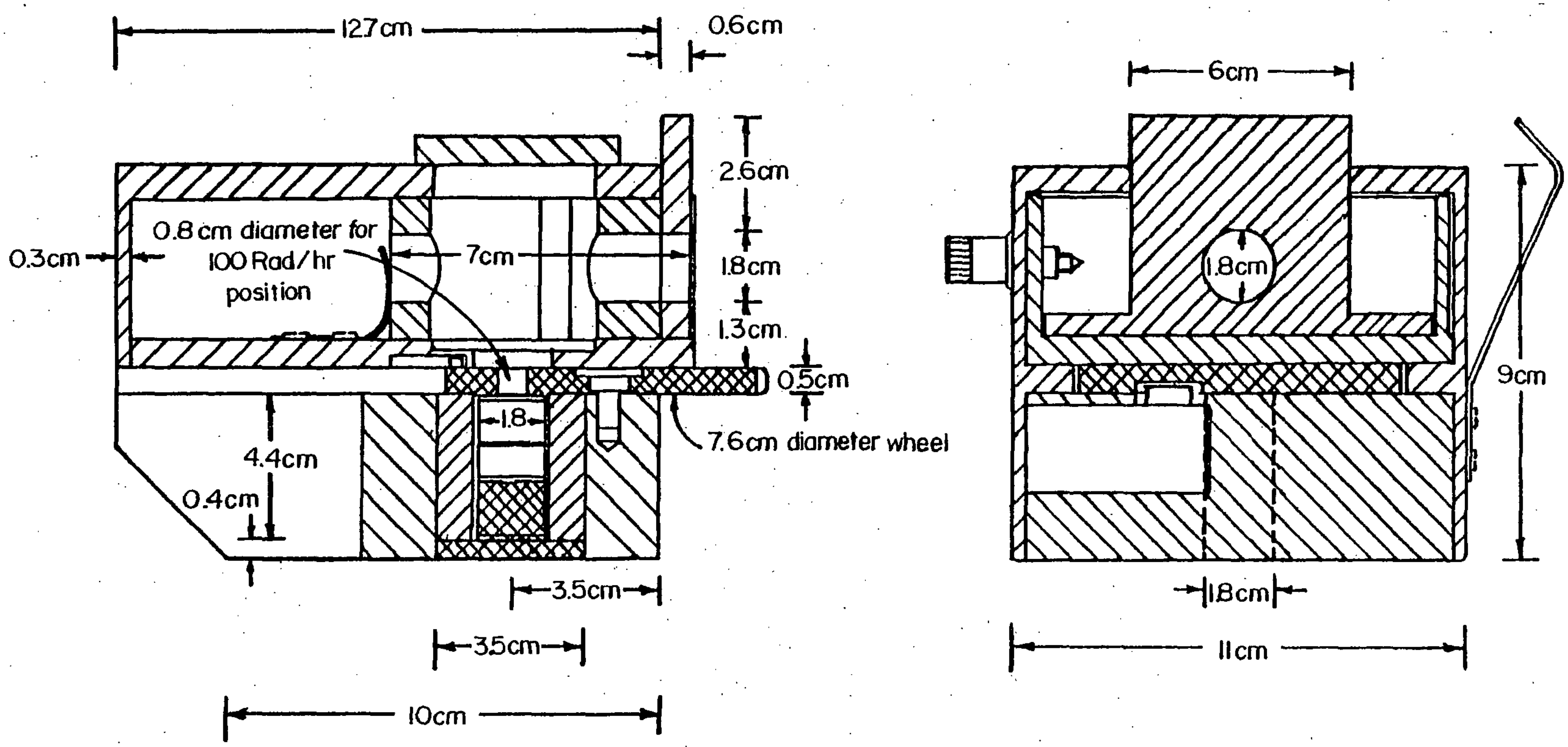


Figure 1.2 - Radiac 3494/UDM-2 Calibrator Assembly



REFERENCE DRAWINGS:
SM-D-508975
SM-D-508981

FIGURE 1.3 : DISCHARGE WELL ASSEMBLY



REFERENCE DRAWING SM-D-508994

FIGURE 1.4 DOSE RATE METER ASSEMBLY

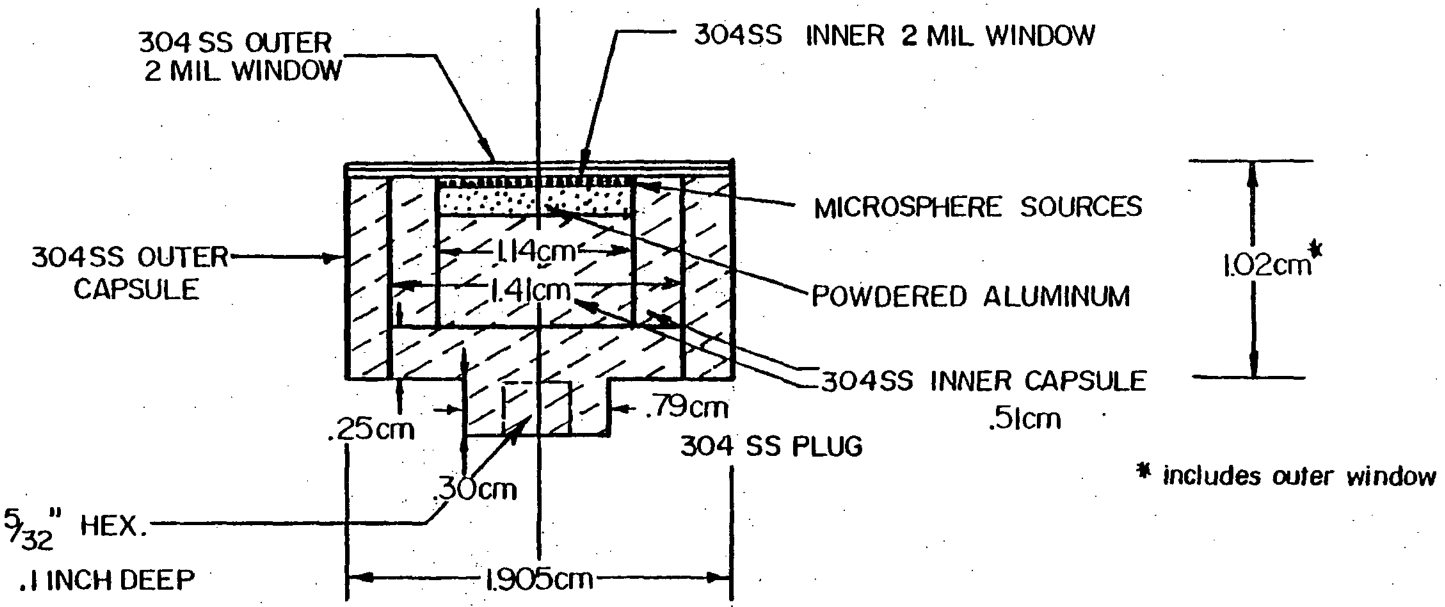


FIGURE 1.5 SOURCE ASSEMBLY

SECTION 2

CALCULATIONAl TASKS AND ASSUMPTIONS

Five locations were selected as primary areas of concern for personnel exposure, and one hypothetical case was selected to provide a worst-case upper bound. Each location selected was designated as a unique task, and calculations were performed to determine resultant dose rates. These tasks are described below with relative assumptions identified. General assumptions for Tasks 1, 2, 3, 5 and 6 are that the Sr/Y-90 was uniformly distributed on the source assemblies, and that the powdered aluminum supporting the source has a compaction factor of 0.8.

Task 1

The dose rates to operating personnel at the handles of the subassemblies were calculated. Tables 3.1, 3.2 and 3.4 and figures 3.1, 3.2, 3.3 and 3.4 show flux and dose rates calculated from contact at the handles to a distance of 91 centimeters (≈ 3 ft.). It was assumed that the spacer block was in place, the brass components consisted of 65% copper and 35% zinc, the discharge well platform was depressed and empty, and that all sources were inserted until their windows were aligned with (but not protruding from) the openings in their shields.

Task 2

The dose rates to operating personnel using the TS-3495/UDM-2 calibrator were calculated assuming the swivel cover was open, the spring loaded dosimeter platform was fully depressed, and no dosimeter was in the well. Dose rates were calculated to a distance of 91 centimeters (≈ 3 ft.) above the horizontal plane at the centerline of the well opening. The same assumptions as Task 1 were also made in Task 2. Tables 3.5, 3.6 and 3.7 and figures 3.5, 3.6 and 3.7 show flux and dose rates as a function of distance for this configuration.

Task 3

The dose rates to operating personnel using the TS-3494/UDM-2 calibrator assembly were calculated assuming the cover plate removed and the shutter rotated to expose the source. Dose rates were calculated to a distance of 91 centimeters (≈ 3ft.) above the opening perpendicular to the horizontal plane of the opening. The spacer block was assumed to be removed. Tables 3.8 3.9 and 3.10 show the flux and dose rates present for this configuration. Figures 3.8, 3.9 and 3.10 present the same data in graphical form.

Task 4

A hypothetical case was calculated in which an individual was enveloped in a 140.030 ± 20% millicurie Sr/Y-90 semi-infinite cloud equal in radius to the mean range of the Sr-90 beta particle. This calculation represents the total airborne dispersion of the four 35 millicurie and the one 30 microcurie Sr/Y-90 sources. The results of this calculation is presented in Section 3.

Task 5

The dose rate as a function of distance to operating personnel using the TS-3495/UDM-2 calibrator was calculated assuming that the swivel cover on the discharge well was open, the spring-loaded dosimeter platform was in its raised position and the dosimeter well was empty. Dose rates were calculated to a distance of 91 centimeters (≈ 3 ft.) above the well perpendicular to the horizontal plane of the well opening. The same assumptions made in Task 1 were also made in Task 5. Tables 3.11 and 3.12 and Figures 3.11 and 3.12 present flux and dose respectively for this configuration.

Task 6

The dose rate to operating personnel using the TS-3494/UDM-2 calibrator was calculated at the opening in the drawer to the point on the case in line with this geometry, assuming that the shutter was rotated to the 100 Rad setting and that the spacer block was removed from the drawer. It was also assumed that the source was inserted in the tungsten shield with the windows with (but not protruding from) the opening in the shield. Tables 3.13, 3.14 and 3.15 present the results of these calculations in tabular form and Figures 3.13, 3.14 and 3.15 present the results in graphical form.

SECTION 3

RESULTS OF CALCULATIONS

Task 1

Photon flux from bremsstrahlung for seven energy groups (0.0 - 1.6 MeV) are presented in Table 3.1 and in Figure 3.1 for contact with the case at the handle located nearest the discharge well to 91 cm perpendicular to the case. The energies shown in Table 3.1 are the average energy for each energy group. The total dose rate due to bremsstrahlung is shown in Table 3.2 and Figure 3.2 for the same configuration.

Photon flux from bremsstrahlung for seven energy groups (0.0 - 1.6 MeV) are shown in Table 3.3 and Figure 3.3 for contact with the case at the handle located nearest the doserate meter to 91 cm perpendicular to the case. The total dose rate from bremsstrahlung is shown in Table 3.4 and Figure 3.4 for the same configuration.

Task 2

Table 3.5 and Figure 3.5 present the photon flux from bremsstrahlung for seven energy groups (0.0 - 1.6 MeV) for the centerline perpendicular to the horizontal plane at the opening on the discharge well with the platform fully depressed and no dosimeter in the well. Table 3.6 and Figure 3.6 present the total photon dose rate from bremsstrahlung for this same configuration. Both figures are from 0.0 cm to 9.1 cm above the opening on the discharge well. The beta dose rate as a function of height above the discharge well is tabulated in Table 3.7 and shown graphically in Figure 3.7. The beta dose is due to the 39 microcurie source near the top of the assembly.

Task 3

Table 3.8 and Figure 3.8 present the photon flux from the bremsstrahlung for seven energy groups (0.0 - 1.6 MeV) for the centerline perpendicular to the horizontal plane at the opening in the doserate meter assembly beneath the plate that bears the "warning" label. It is assumed that the plate has been removed. The total dose rate from bremsstrahlung is shown in Table 3.9 and Figure 3.9 for this same configuration. Table 3.10 and Figure 3.10 provide the beta dose rate.

Task 4

Calculations were performed for the beta dose rate to a man standing on the ground in a semi-infinite 168.036 millicurie cloud equal in radius to one mean free path. The concentration of Sr/Y-90 in the cloud was 2.89×10^{-2} Ci/m^3 each, for a total concentration of 5.78×10^{-2} Ci/m^3. The dose rate was calculated to be 26.24 Rad/hr. This dose rate includes the additional 20% uncertainty in source strength.

Task 5

Table 3.11 and Figure 3.11 present the photon flux from bremsstrahlung for seven energy groups (0.0 - 1.6 MeV) from the centerline perpendicular to the horizontal plane at the opening on the discharge well with the platform fully released and no dosimeter in the well. Table 3.12 and Figure 3.12 present the total dose rate due to bremsstrahlung for this same configuration. Both figures are from 0.0 cm to 100 cm above the opening on the discharge well.

Task 6

Table 3.13 and Figure 3.13 present the photon flux from bremsstrahlung for seven energy groups (0.0 - 1.6 MeV) beginning at the upper edge of the 1.8 cm hole in the doserate meter drawer up to the case at a 45° angle to the centerline of the hole.

Table 3.14 and Figure 3.14 present the total dose rate from bremsstrahlung for the same configuration.

Table 3.15 and Figure 3.15 present the dose rate from beta for the same configuration.

Table 3.1

FLUX PERPENDICULAR TO CASE AT HANDLE

NEAR DISCHARGE WELL

Distance From Case (cm)	AVERAGE ENERGY ($\bar{E}$)						
	.12 MeV	.34 MeV	.57 MeV	.80 MeV	1.03 MeV	1.26 MeV	1.49 MeV
.1	7.35-03	1.43+01	1.37+02	2.03+02	1.82+02	1.18+02	5.05+01
.2	7.15-03	1.40+01	1.34+02	1.98+02	1.77+02	1.15+02	4.83+01
.3	6.96-03	1.38+01	1.31+02	1.93+02	1.73+02	1.12+02	4.71+01
.4	6.78-03	1.35+01	1.28+02	1.88+02	1.69+02	1.10+02	4.60+01
.5	6.60-03	1.33+01	1.25+02	1.84+02	1.65+02	1.07+02	4.56+01
.7	6.27-03	1.28+01	1.19+02	1.75+02	1.57+02	1.02+02	4.27+01
1.0	5.81-03	1.22+01	1.12+02	1.64+02	1.45+02	9.53+01	3.99+01
2.0	4.60-03	1.05+01	9.20+01	1.33+02	1.19+02	7.72+01	3.23+01
3.0	3.74-03	9.22+00	7.75+01	1.11+02	9.87+01	6.39+01	2.67+01
4.0	3.09-03	8.20+00	6.70+01	9.40+01	8.36+01	5.40+01	2.25+01
5.0	2.60-03	7.37+00	5.81+01	8.11+01	7.18+01	4.63+01	1.93+01
7.0	1.92-03	6.11+00	4.58+01	6.26+01	5.81+01	3.53+01	1.48+01
10.0	1.30-03	4.80+00	3.41+01	4.54+01	3.95+01	2.52+01	1.05+01
15.0	7.81-04	3.46+00	2.31+01	2.97+01	2.54+01	1.61+01	6.66+00
20.0	5.19-04	2.63+00	1.69+01	2.13+01	1.79+01	1.13+01	4.65+00
30.0	2.77-04	1.68+00	1.03+01	1.25+01	1.04+01	6.47+00	2.60+00
40.0	1.72-04	1.17+00	6.99+00	8.35+00	6.83+00	4.22+00	1.73+00
50.0	1.17-04	8.66-01	5.07+00	5.98+00	4.85+00	2.99+00	1.22+00
70.0	6.41-05	5.29-01	3.03+00	3.51+00	2.82+00	1.72+00	7.05-01
100.0	3.32-05	3.00-01	1.69+00	1.93+00	1.54+00	9.35-01	3.81-01

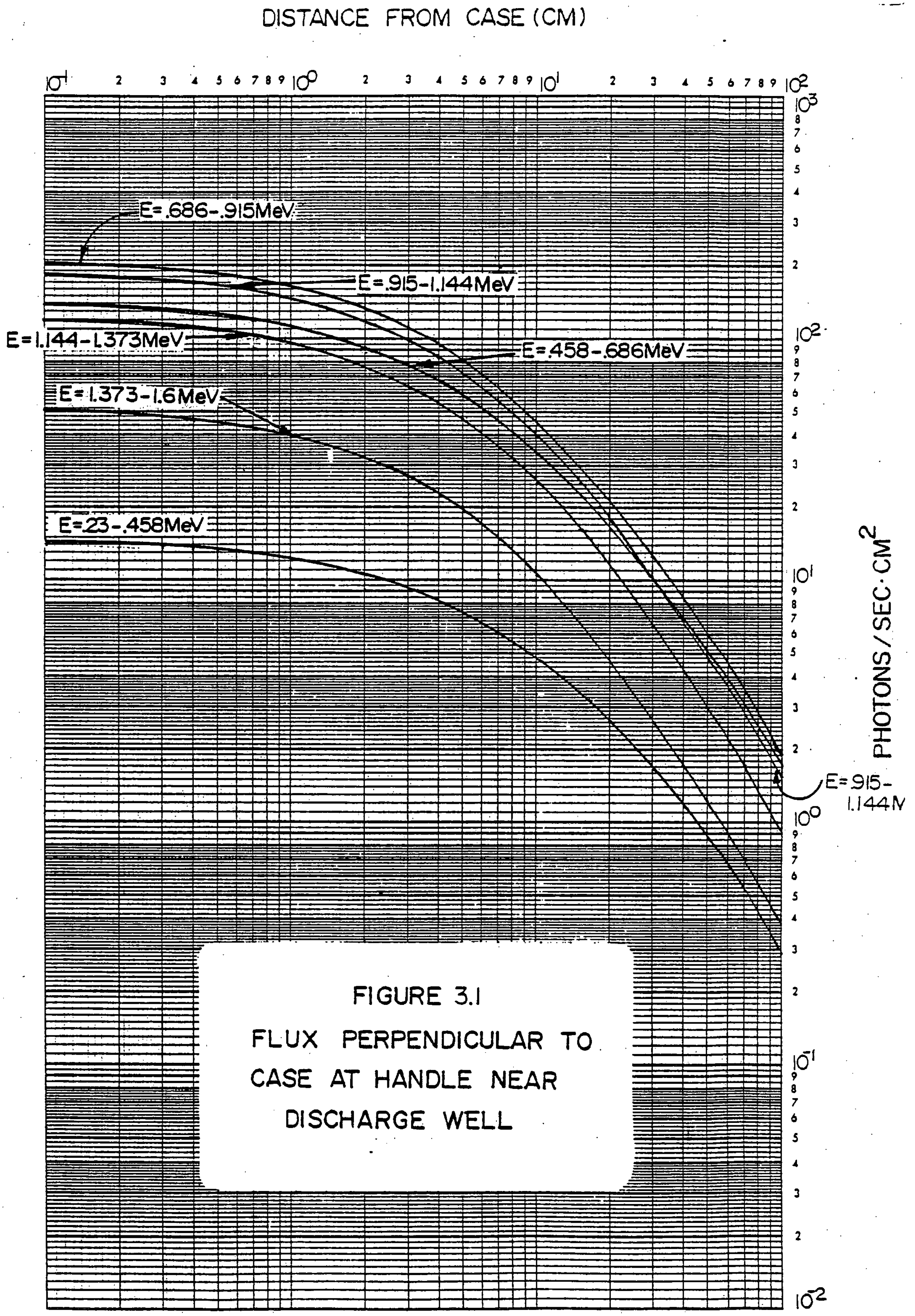


FIGURE 3.1
FLUX PERPENDICULAR TO CASE AT HANDLE NEAR DISCHARGE WELL

Table 3.2

DOSE RATE PERPENDICULAR TO CASE
AT HANDLE NEAR DISCHARGE WELL

Distance From Case (cm)	Dose Rate (mR/hr)
.1	[1.25±.25] E-00
.2	[1.22±.24] E 00
.3	[1.19±.24] E 00
.4	[1.16±.23] E 00
.5	[1.13±.23] E 00
.7	[1.08±.22] E 00
1.0	[1.01±.20] E 00
2.0	[8.20±1.64] E-01
3.0	[6.83±1.37] E-01
4.0	[5.79±1.16] E-01
5.0	[5.24±1.05] E-01
7.0	[3.85±.77] E-01
10.0	[2.78±.56] E-01
15.0	[1.80±.36] E-01
20.0	[1.28±.26] E-01
30.0	[7.51±1.50] E-02
40.0	[4.98±1.00] E-02
50.0	[3.56±.71] E-02
70.0	[2.08±.42] E-02
100.0	[1.14±.23] E-02

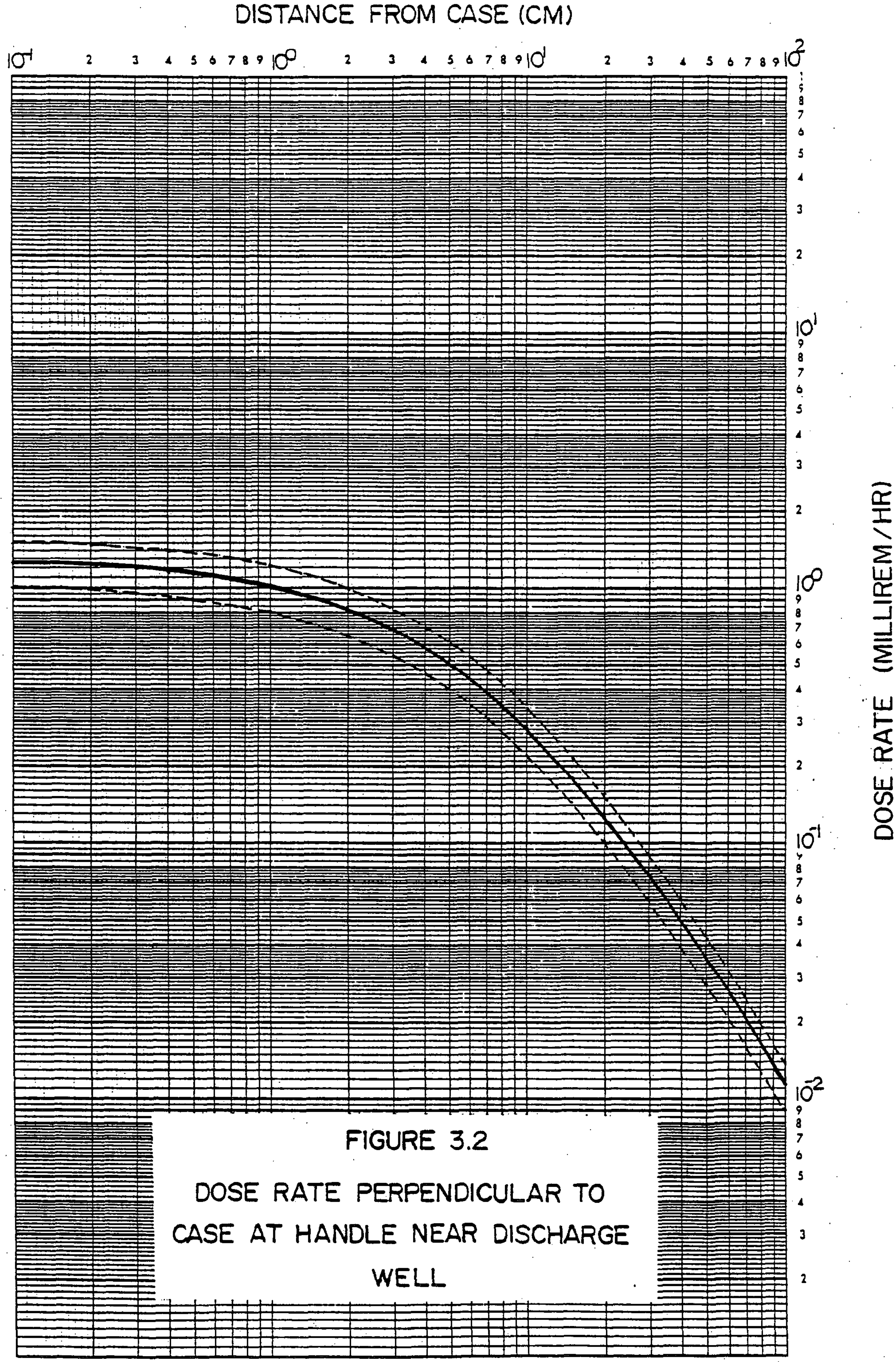


FIGURE 3.2

DOSE RATE PERPENDICULAR TO CASE AT HANDLE NEAR DISCHARGE WELL

Table 3.3

FLUX PERPENDICULAR TO CASE AT HANDLE

NEXT TO RATEMETER

Distance From Case (cm)	AVERAGE ENERGY ($\bar{E}$) .12 MeV	.34 MeV	.57 MeV	.80 MeV	1.03 MeV	1.26 MeV	1.49 MeV
.1	1.65-01	1.81+01	9.97+01	1.00+02	7.50+01	4.46+01	1.84+01
.2	1.64-01	1.77+01	9.73+01	9.85+01	7.33+01	4.36+01	1.80+01
.3	1.62-01	1.71+01	9.49+01	9.58+01	7.17+01	4.27+01	1.76+01
.4	1.61-01	1.68+01	9.26+01	9.36+01	7.02+01	4.18+01	1.73+01
.5	1.60-01	1.64+01	9.04+01	9.15+01	6.87+01	4.10+01	1.69+01
.7	1.56-01	1.56+01	8.62+01	8.76+01	6.58+01	3.94+01	1.63+01
1.0	1.51-01	1.46+01	8.05+01	8.21+01	6.19+01	3.71+01	1.54+01
2.0	1.40-01	1.17+01	6.50+01	6.73+01	5.12+01	3.10+01	1.28+01
3.0	1.28-01	9.61+00	5.37+01	5.64+01	4.33+01	2.63+01	1.10+01
4.0	1.18-01	8.03+00	4.52+01	4.60+01	3.59+01	2.28+01	9.49+00
5.0	1.10-01	6.82+00	3.85+01	4.15+01	3.23+01	1.99+01	8.32+00
7.0	9.47-02	5.08+00	2.91+01	3.20+01	2.52+01	1.57+01	6.96+00
10.0	7.75-02	3.51+00	2.03+01	2.30+01	1.85+01	1.17+01	4.91+00
15.0	5.77-02	2.14+00	1.26+01	1.49+01	1.22+01	7.79+00	3.30+00
20.0	4.46-02	1.44+00	8.62+00	1.04+01	8.68+00	5.63+00	2.40+00
30.0	2.89-02	7.80-01	4.78+00	6.03+00	5.11+00	3.36+00	1.44+00
40.0	2.03-02	4.89-01	3.04+00	3.95+00	3.39+00	2.25+00	9.64-01
50.0	1.50-02	3.35-01	2.11+00	2.79+00	2.42+00	1.61+00	6.93-01
70.0	9.15-03	1.81-01	1.19+00	1.61+00	1.41+00	9.49-01	4.08-01
100.0	5.19-03	9.67-02	6.28-01	8.74-01	7.72-01	5.23-01	2.25-01

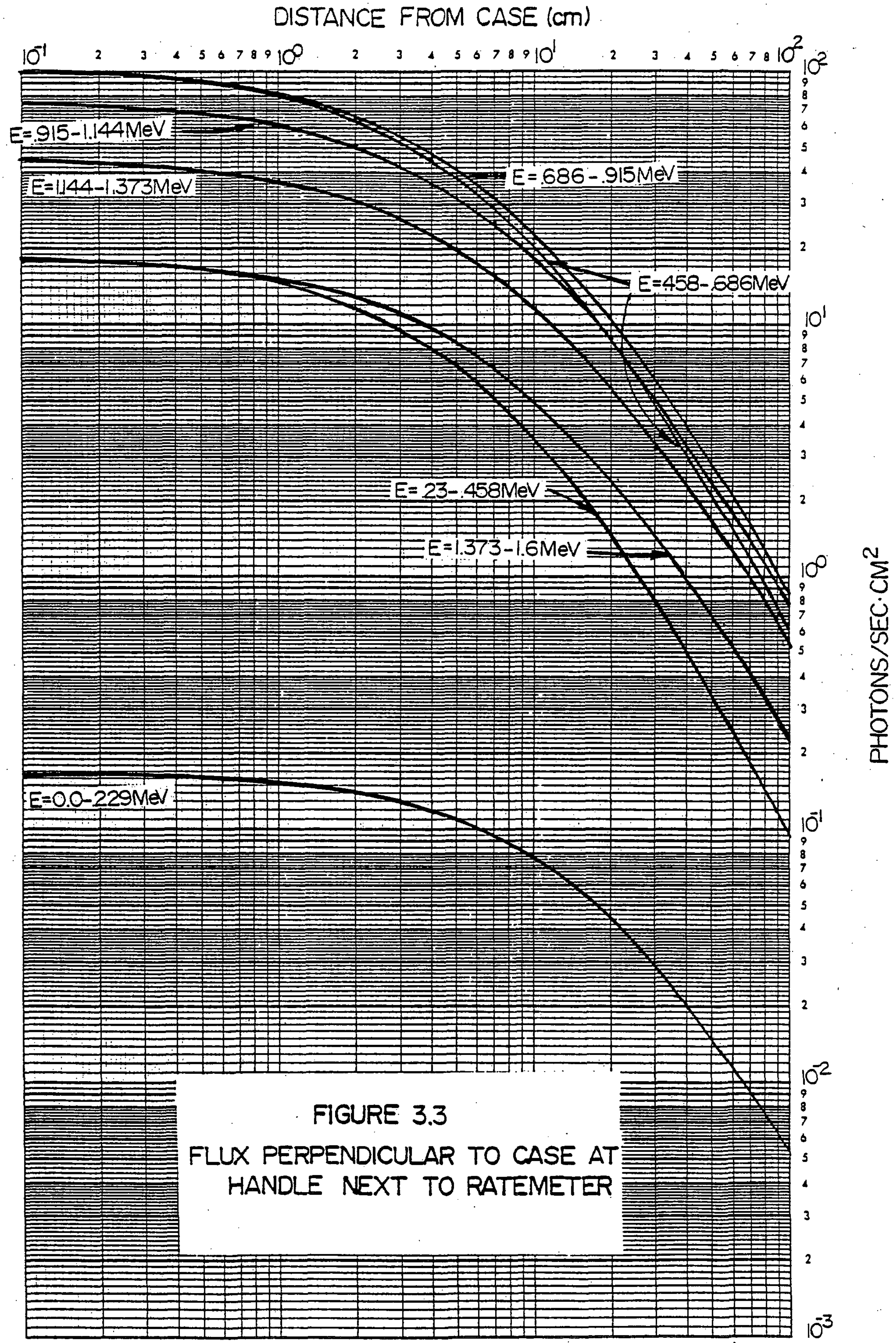


FIGURE 3.3
FLUX PERPENDICULAR TO CASE AT HANDLE NEXT TO RATEMETER

Table 3.4

DOSE RATE PERPENDICULAR TO CASE
AT HANDLE NEXT TO RATEMETER

Distance From Case (cm)	Dose Rate (mR/hr)
.1	[5.84±1.17] E-01
.2	[5.71±1.14] E-01
.3	[5.56±1.11] E-01
.4	[5.45±1.09] E-01
.5	[5.33±1.07] E-01
.7	[5.11±1.02] E-01
1.0	[4.79±.96] E-01
2.0	[3.95±.79] E-01
3.0	[3.32±.66] E-01
4.0	[2.84±.57] E-01
5.0	[2.46±.49] E-01
7.0	[1.91±.38] E-01
10.0	[1.38±.28] E-01
15.0	[9.00±1.80] E-02
20.0	[6.38±1.28] E-02
30.0	[3.72±.74] E-02
40.0	[2.45±.49] E-02
50.0	[1.74±.35] E-02
70.0	[9.71±1.94] E-03
100.0	[5.49±1.10] E-03

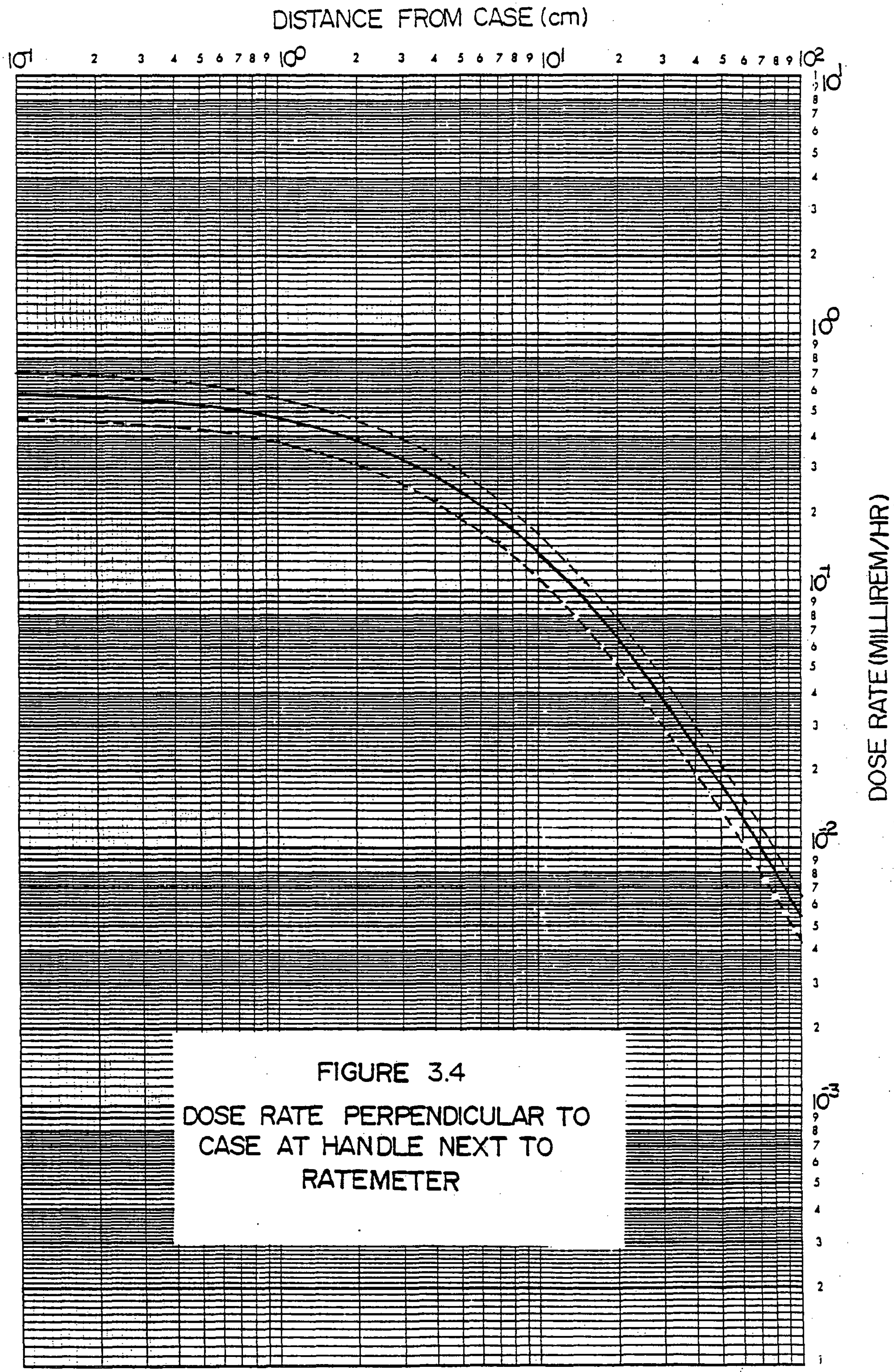


FIGURE 3.4

DOSE RATE PERPENDICULAR TO CASE AT HANDLE NEXT TO RATEMETER

Table 3.5

FLUX AT CENTERLINE OF DISCHARGE WELL

WITH PLATFORM DEPRESSED

Distance Above Opening (cm)	AVERAGE ENERGY ($\bar{E}$) .12 MeV	.34 MeV	.57 MeV	.80 MeV	1.03 MeV	1.26 MeV	1.49 MeV
.1	9.49+03	7.80+03	5.0+03	2.98+03	1.61+03	7.71+02	2.79+02
.2	9.47+03	7.69+03	4.94+03	2.95+03	1.58+03	7.56+02	2.75+02
.3	8.97+03	7.35+03	4.74+03	2.81+03	1.53+03	7.29+02	2.64+02
.4	8.55+03	7.07+03	4.56+03	2.72+03	1.47+03	7.05+02	2.55+02
.5	8.16+03	6.78+03	4.39+03	2.63+03	1.42+03	6.81+02	2.46+02
.7	7.44+03	6.25+03	4.07+03	2.44+03	1.32+03	6.35+02	2.30+02
1.0	6.38+03	5.82+03	3.97+03	2.12+03	1.16+03	5.57+02	2.03+02
2.0	4.24+03	4.20+03	2.93+03	1.57+03	8.62+02	4.16+02	1.53+02
3.0	2.96+03	3.24+03	2.20+03	1.16+03	6.44+02	3.14+02	1.16+02
4.0	2.03+03	2.51+03	1.73+03	9.15+02	5.11+02	2.49+02	9.24+01
5.0	1.44+03	1.96+03	1.34+03	7.17+02	4.03+02	1.98+02	7.40+01
7.0	8.97+02	1.31+03	9.16+02	4.96+02	2.81+02	1.39+02	5.20+01
10.0	4.23+02	7.26+02	5.15+02	2.91+02	1.68+02	8.31+01	3.16+01
15.0	2.08+02	3.45+02	2.79+02	1.57+02	8.5+01	4.69+01	1.85+01
20.0	1.16+02	2.06+02	1.58+02	9.28+01	5.49+01	2.77+01	1.07+01
30.0	5.25+01	1.03+02	8.01+01	4.76+01	2.82+01	1.43+01	5.54+00
40.0	2.75+01	6.04+01	4.72+01	2.84+01	1.69+01	8.59+00	3.35+00
50.0	1.60+01	3.87+01	3.04+01	1.86+01	1.11+01	5.66+00	2.21+00
70.0	6.29+00	1.89+01	1.52+01	9.45+00	5.68+00	2.93+00	1.15+00
100.0	2.0+00	8.13+00	6.63+00	4.34+00	2.63+00	1.37+00	5.44-01

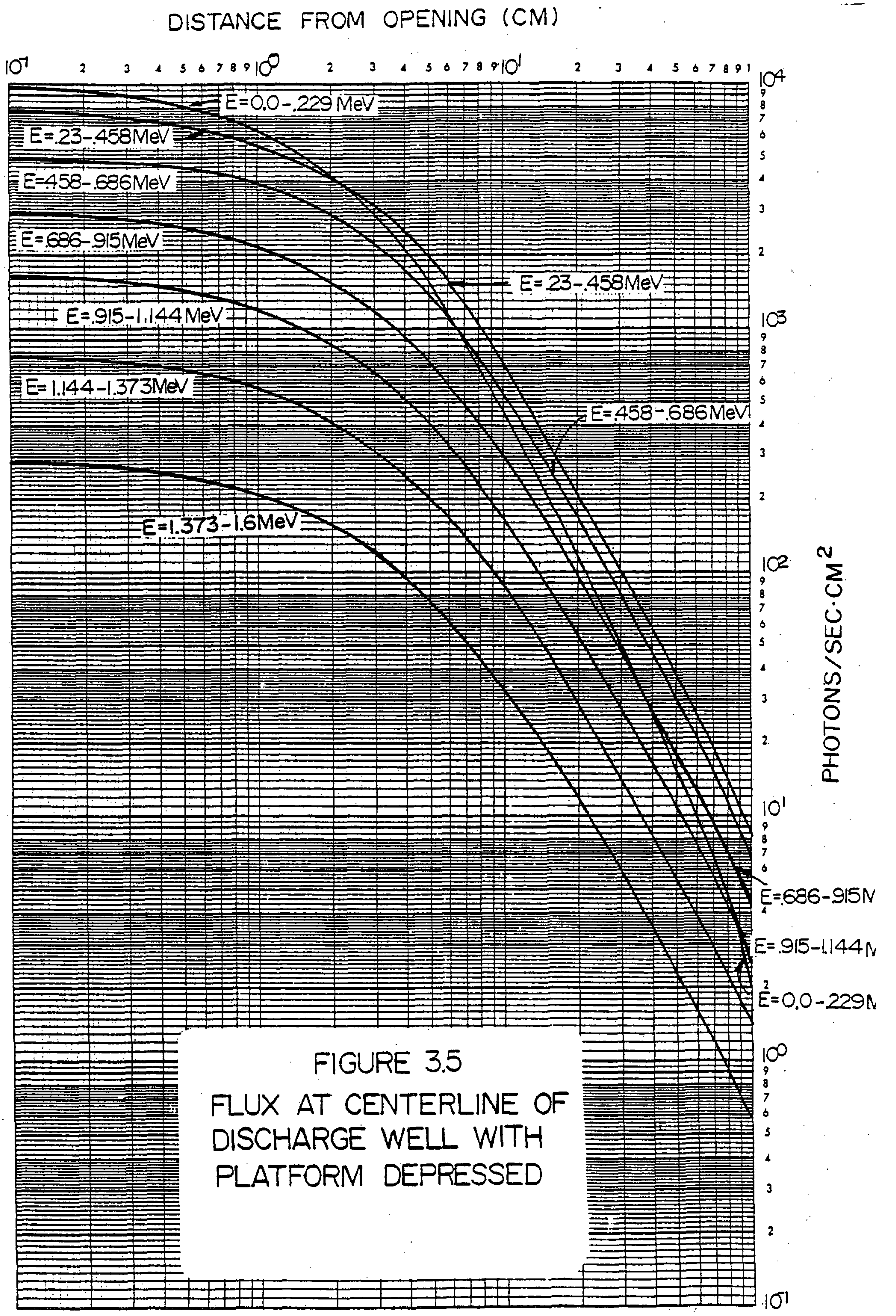


FIGURE 3.5
FLUX AT CENTERLINE OF DISCHARGE WELL WITH PLATFORM DEPRESSED

Table 3.6

DOSE RATE AT CENTERLINE OF DISCHARGE WELL

WITH PLATFORM DEPRESSED

Distance Above Opening (cm)	Dose Rate (mR/hr)
.1	[2.42±.48] E+01
.2	[2.40±.48] E+01
.3	[2.22±.44] E+01
.4	[2.14±.43] E+01
.5	[2.06±.41] E+01
.7	[1.91±.38] E+01
1.0	[1.73±.35] E+01
2.0	[1.27±.25] E+01
3.0	[9.52±1.9] E 00
4.0	[7.43±1.49] E 00
5.0	[5.77±1.15] E 00
7.0	[3.94±.79] E 00
10.0	[2.25±.45] E 00
15.0	[1.07±.21] E-01
20.0	[6.95±1.39] E-01
30.0	[3.53±.71] E-01
40.0	[2.09±.42] E-01
50.0	[1.35±.27] E-01
70.0	[6.78±1.36] E-02
100.0	[3.73±.75] E-02

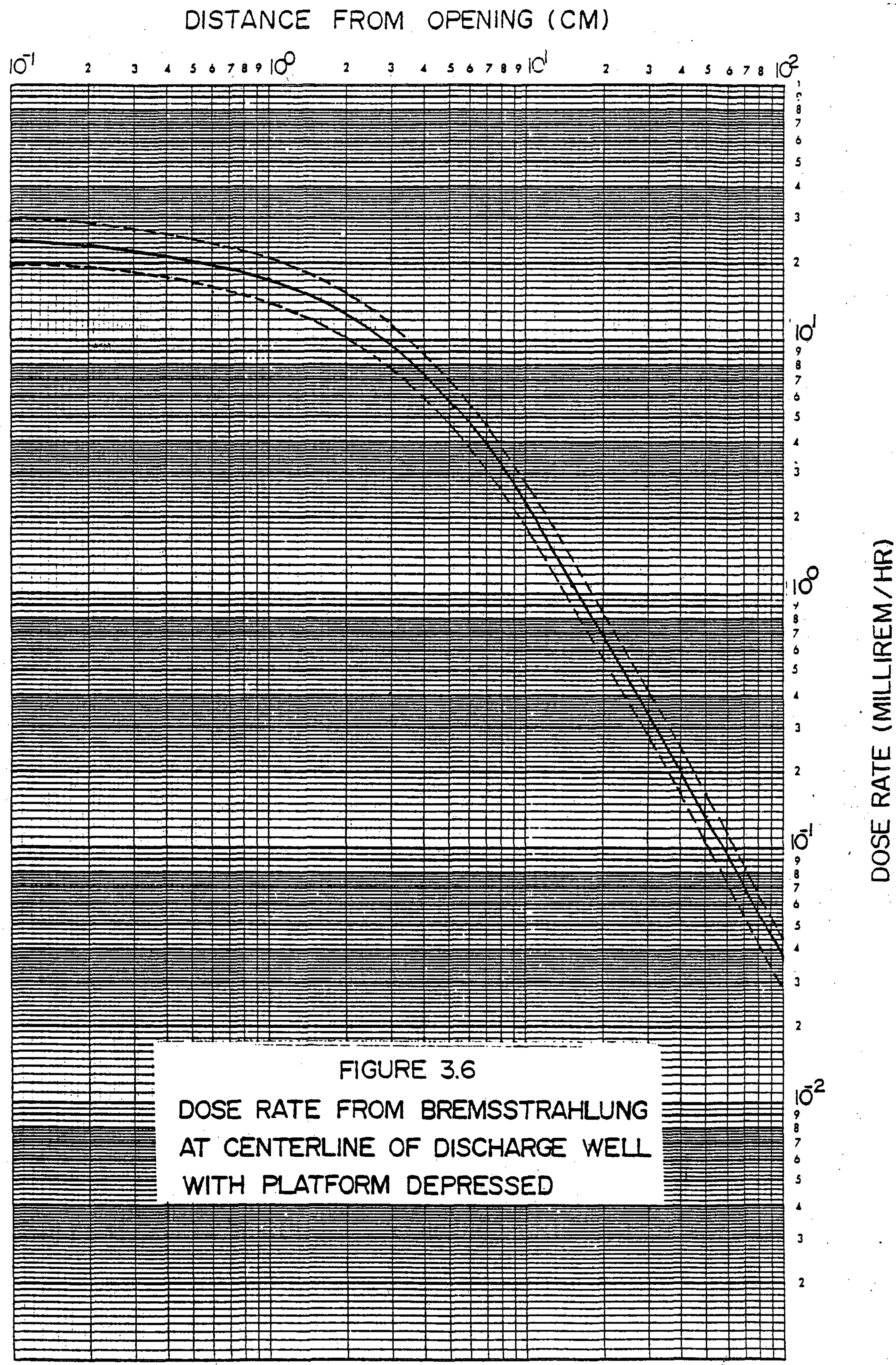


FIGURE 3.6
DOSE RATE FROM BREMSSTRAHLUNG AT CENTERLINE OF DISCHARGE WELL WITH PLATFORM DEPRESSED

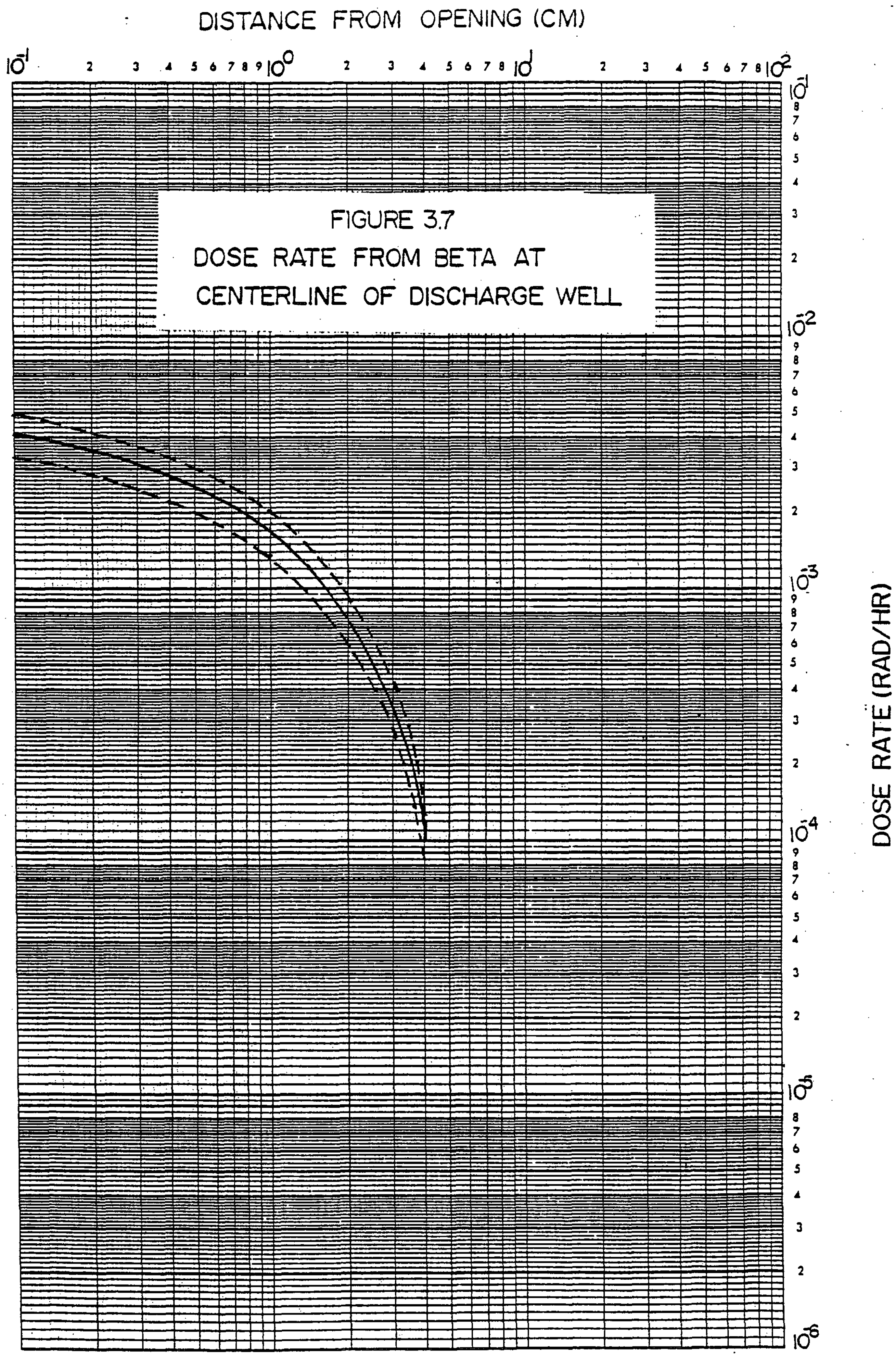
Table 3.7

DOSE RATE FROM BETA AT CENTERLINE OF DISCHARGE WELL

Distance Above Opening (cm)	Dose Rate (Rad/hr)
.1	[4.06±.81] E-03
.2	[3.51±.70] E-03
.3	[3.10±.62] E-03
.4	[2.74±.55] E-03
.5	[2.50±.50] E-03
1.0	[1.70±.34] E-03
2.0	[7.50±1.50] E-04
3.0	[3.41±.68] E-04
4.0	[1.05±.21] E-04
5.0	N.D.

Note:

N.D. = Not Detected


DISTANCE FROM OPENING (CM)
FIGURE 3.7
DOSE RATE FROM BETA AT
CENTERLINE OF DISCHARGE WELL
DOSE RATE (RAD/HR)

FLUX AT CENTERLINE OVER RATEMETER

OPENING WITHOUT COVER

Distance Above Opening (cm)	AVERAGE ENERGY ($\bar{E}$) .12 MeV	.34 MeV	.57 MeV	.80 MeV	1.03 MeV	1.26 MeV	1.49 MeV
.1	5.90+03	3.89+03	4.18+03	2.83+03	1.62+03	8.06+02	2.91+02
.2	5.64+03	3.72+03	4.00+03	2.71+03	1.54+03	7.69+02	2.78+02
.3	5.39+03	3.55+03	3.82+03	2.59+03	1.48+03	7.36+02	2.66+02
.4	5.16+03	3.40+03	3.66+03	2.48+03	1.42+03	7.04+02	2.54+02
.5	4.94+03	3.26+03	3.50+03	2.37+03	1.36+03	6.74+02	2.44+02
.7	4.55+03	3.00+03	3.22+03	2.18+03	1.25+03	6.20+02	2.24+02
1.0	4.04+03	2.66+03	2.86+03	1.94+03	1.11+03	5.51+02	1.99+02
2.0	2.84+03	1.87+03	2.01+03	1.36+03	7.79+02	3.87+02	1.40+02
3.0	2.11+03	1.39+03	1.49+03	1.01+03	5.77+02	2.87+02	1.04+02
4.0	1.63+03	1.07+03	1.15+03	7.79+02	4.45+02	2.21+02	7.99+01
5.0	1.29+03	8.50+02	9.13+02	6.19+02	3.53+02	1.76+02	6.34+01
7.0	8.71+02	5.74+02	6.16+02	4.17+02	2.38+02	1.18+02	4.28+01
10.0	5.42+02	3.57+02	3.83+02	2.60+02	1.51+02	7.37+01	2.66+01
15.0	2.97+02	1.95+02	2.09+02	1.42+02	8.11+01	4.03+01	1.46+01
20.0	1.87+02	1.23+02	1.32+02	8.93+01	5.10+01	2.54+01	9.16+00
30.0	9.35+01	6.15+01	6.60+01	4.47+01	2.55+01	1.27+01	4.59+00
40.0	5.60+01	3.68+01	3.95+01	2.68+01	1.53+01	7.60+00	2.75+00
50.0	3.72+01	2.45+01	2.63+01	1.78+01	1.02+01	5.05+00	1.82+00
70.0	1.99+01	1.31+01	1.40+01	9.50+00	5.43+00	2.70+00	9.74-01
100.0	1.01+01	6.63+00	7.11+00	4.82+00	2.75+00	1.37+00	4.94-01

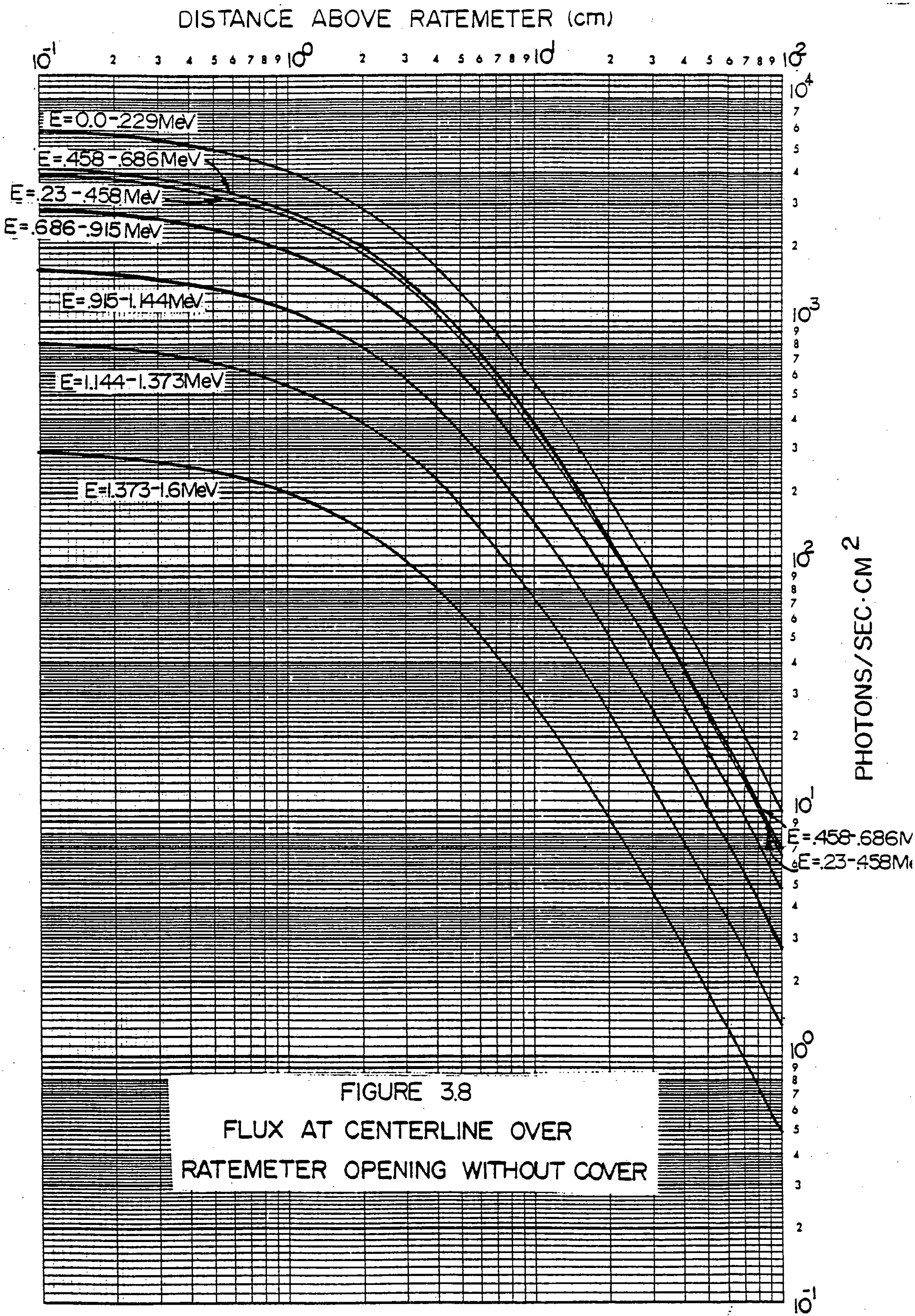


FIGURE 3.8
FLUX AT CENTERLINE OVER RATEMETER OPENING WITHOUT COVER

Table 3.9

DOSE RATE AT CENTERLINE OVER
RATEMETER OPENING WITHOUT COVER

Distance Above Opening (cm)	Dose Rate (mR/hr)
.1	[1.90±.38] E+01
.2	[1.81±.36] E+01
.3	[1.73±.35] E+01
.4	[1.66±.33] E+01
.5	[1.59±.32] E+01
.7	[1.46±.29] E+01
1.0	[1.30±.26] E+01
2.0	[9.04±1.81] E+00
3.0	[6.76±1.35] E+00
4.0	[5.21±1.04] E+00
5.0	[4.14±.83] E+00
7.0	[2.79±.56] E+00
10.0	[1.74±.35] E+00
15.0	[9.50±1.9] E-01
20.0	[5.98±1.20] E-01
30.0	[2.99±.60] E-01
40.0	[1.79±.36] E-01
50.0	[1.19±.24] E-01
70.0	[6.36±1.27] E-02
100.0	[3.22±.64] E-02

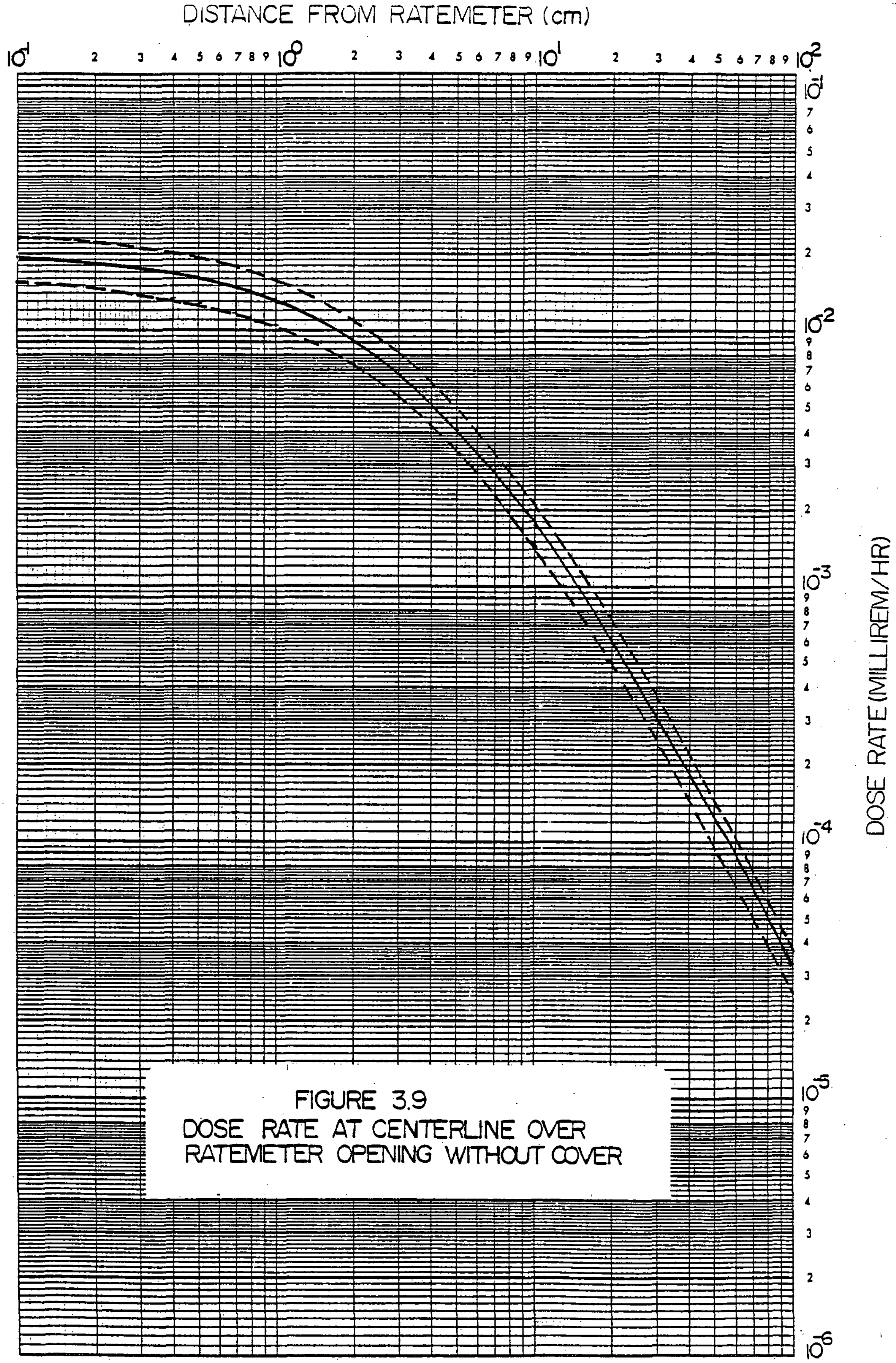


FIGURE 3.9
DOSE RATE AT CENTERLINE OVER
RATEMETER OPENING WITHOUT COVER

Table 3.10

DOSE RATE FROM BETA AT CENTERLINE
OVER RATEMETER OPENING WITHOUT COVER

Distance Above Opening (cm)	Dose Rate (Rad/hr)
.1	[4.17±.83] E+01
.2	[3.98±.80] E+01
.3	[3.80±.76] E+01
.4	[3.66±.73] E+01
.5	[3.47±.69] E+01
.7	[3.19±.64] E+01
1.0	[2.83±.57] E+01
2.0	[1.97±.39] E+01
3.0	[1.45±.29] E+01
4.0	[1.11±.22] E+01
5.0	[8.77±1.75] E+00
7.0	[5.81±1.16] E+00
10.0	[3.65±.73] E+00
15.0	[1.80±.36] E+00
20.0	[1.12±.22] E+00
30.0	[5.19±1.04] E-01
40.0	[2.86±.57] E-01
50.0	[1.73±.35] E-01
70.0	[7.83±1.57] E-02
100.0	[3.09±.62] E-02

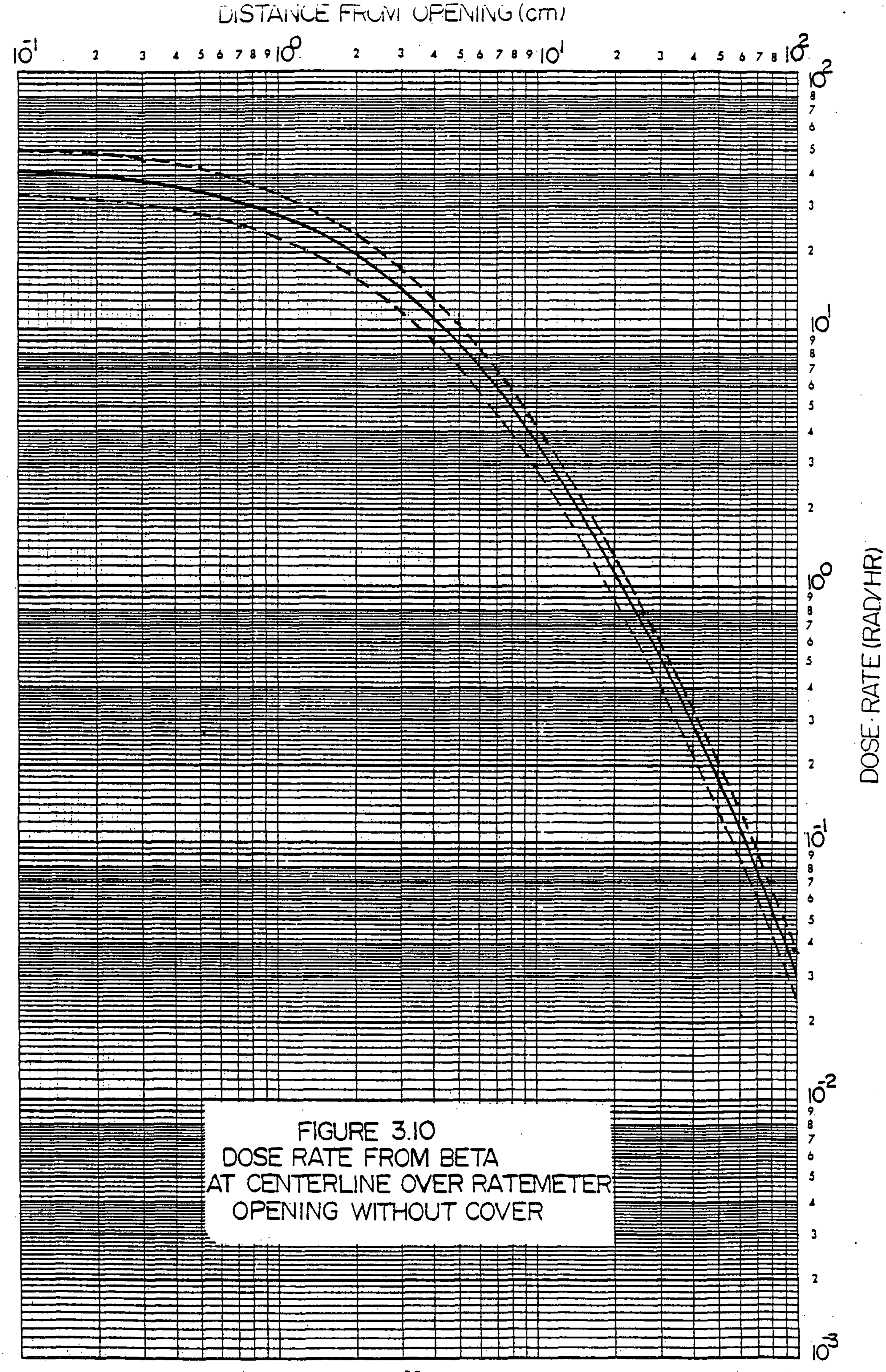

DISTANCE FROM OPENING (cm)
DOSE RATE (RAD/HR)
FIGURE 3.10
DOSE RATE FROM BETA
AT CENTERLINE OVER RATEMETER
OPENING WITHOUT COVER

Table 3.11

FLUX AT CENTERLINE OF DISCHARGE WELL

WITH PLATFORM RELEASED

Distance Above Opening (cm)	AVERAGE ENERGY ($\bar{E}$) .12 MeV	.34 MeV	.57 MeV	.80 MeV	1.03 MeV	1.26 MeV	1.49 MeV
.1	3.4+02	2.16+03	1.88+03	1.30+03	7.69+02	3.97+02	1.52+02
.2	3.22+02	2.08+03	1.81+03	1.26+03	7.42+02	3.84+02	1.47+02
.3	3.07+02	1.99+03	1.74+03	1.21+03	7.15+02	3.69+02	1.42+02
.4	2.96+02	1.92+03	1.68+03	1.16+03	6.92+02	3.57+02	1.37+02
.5	2.82+02	1.84+03	1.62+03	1.13+03	6.66+02	3.45+02	1.33+02
.7	2.61+02	1.69+03	1.49+03	1.05+03	6.22+02	3.22+02	1.24+02
1.0	2.26+02	1.47+03	1.31+03	9.13+02	5.46+02	2.84+02	1.09+02
2.0	1.53+02	1.05+03	9.61+02	6.77+02	4.03+02	2.13+02	8.28+01
3.0	1.07+02	7.71+02	7.21+02	5.03+02	3.04+02	1.60+02	6.27+01
4.0	7.63+01	5.88+02	5.64+02	3.96+02	2.41+02	1.27+02	4.99+01
5.0	5.49+01	4.43+02	4.37+02	3.08+02	1.90+02	1.0+02	3.99+01
7.0	3.50+01	2.99+02	2.98+02	2.15+02	1.33+02	7.07+01	2.81+01
10.0	1.72+01	1.64+02	1.72+02	1.27+02	7.98+01	4.26+01	1.77+01
15.0	6.80+00	8.50+01	9.50+01	6.85+01	4.20+01	2.35+01	9.25+00
20.0	4.19+00	4.89+01	5.43+01	4.15+01	2.68+01	1.45+01	5.94+00
30.0	1.98+00	2.61+01	2.87+01	2.22+01	1.43+01	7.74+00	3.18+00
40.0	1.29+00	1.66+01	1.79+01	1.38+01	8.89+00	4.82+00	1.97+00
50.0	8.5-01	1.13+01	1.21+01	9.45+00	6.06+00	3.28+00	1.35+00
70.0	4.68-01	6.28+00	6.63+00	5.21+00	3.35+00	1.81+00	7.42-01
100.0	2.32-01	3.31+00	3.41+00	2.73+00	1.74+00	9.44-01	3.87-01

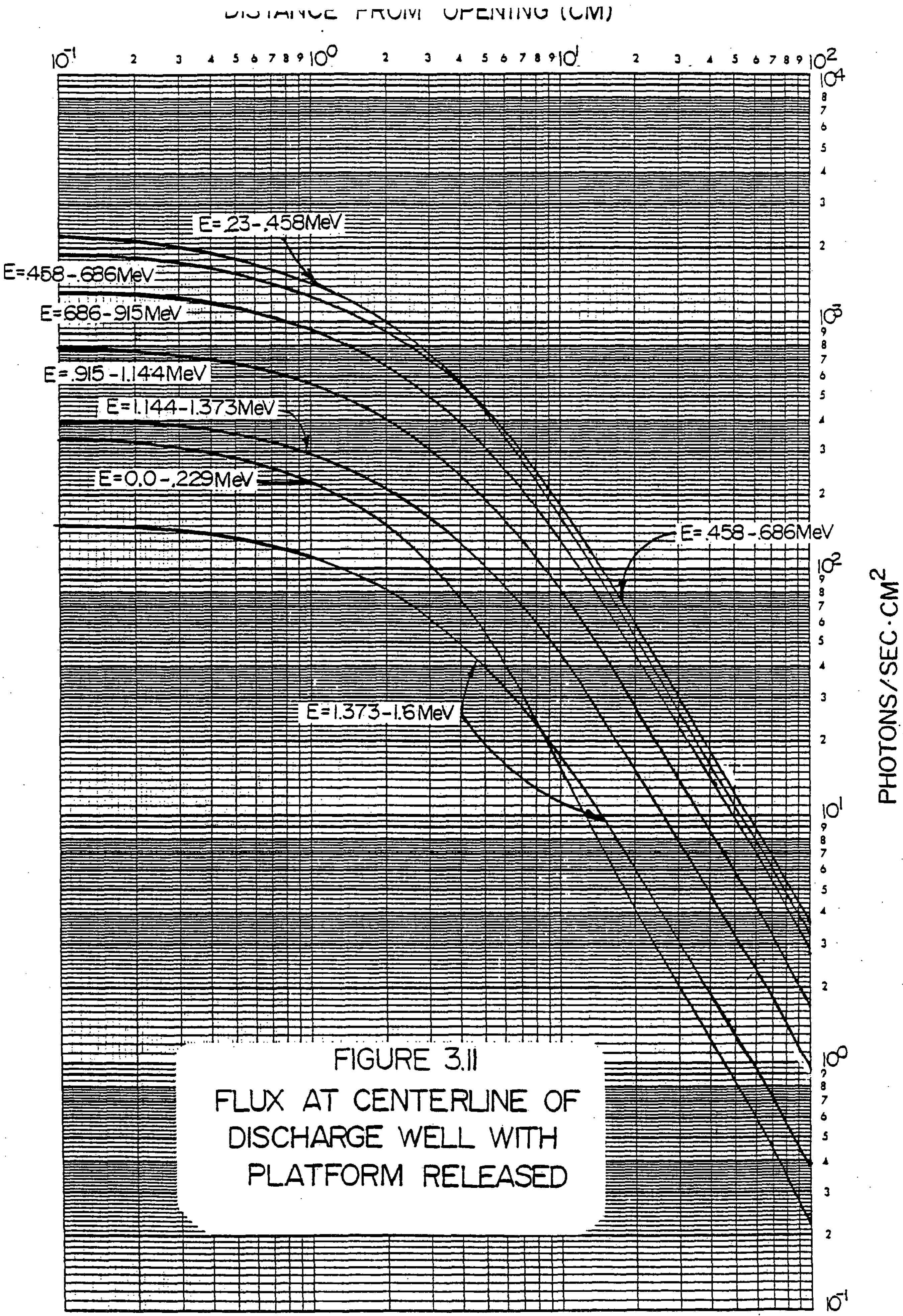


FIGURE 3.11
FLUX AT CENTERLINE OF DISCHARGE WELL WITH PLATFORM RELEASED

Table 3.12

DOSE RATE AT CENTERLINE OF DISCHARGE

WELL WITH PLATFORM RELEASED

Distance Above Opening (cm)	Dose Rate (mR/hr)
.1	[8.89±1.78] E 00
.2	[8.52±1.70] E 00
.3	[8.27±1.65] E 00
.4	[7.81±1.56] E 00
.5	[7.43±1.49] E 00
.7	[6.90±1.38] E 00
1.0	[6.04±1.21] E 00
2.0	[4.45±.89] E 00
3.0	[3.31±.66] E 00
4.0	[2.58±.52] E 00
5.0	[2.03±.41] E 00
7.0	[1.40±.28] E 00
10.0	[8.16±1.63] E-01
15.0	[4.25±.85] E-01
20.0	[2.64±.53] E-01
30.0	[1.41±.28] E-01
40.0	[8.81±1.76] E-02
50.0	[6.00±1.20] E-02
70.0	[3.31±.66] E-02
100.0	[1.72±.34] E-02

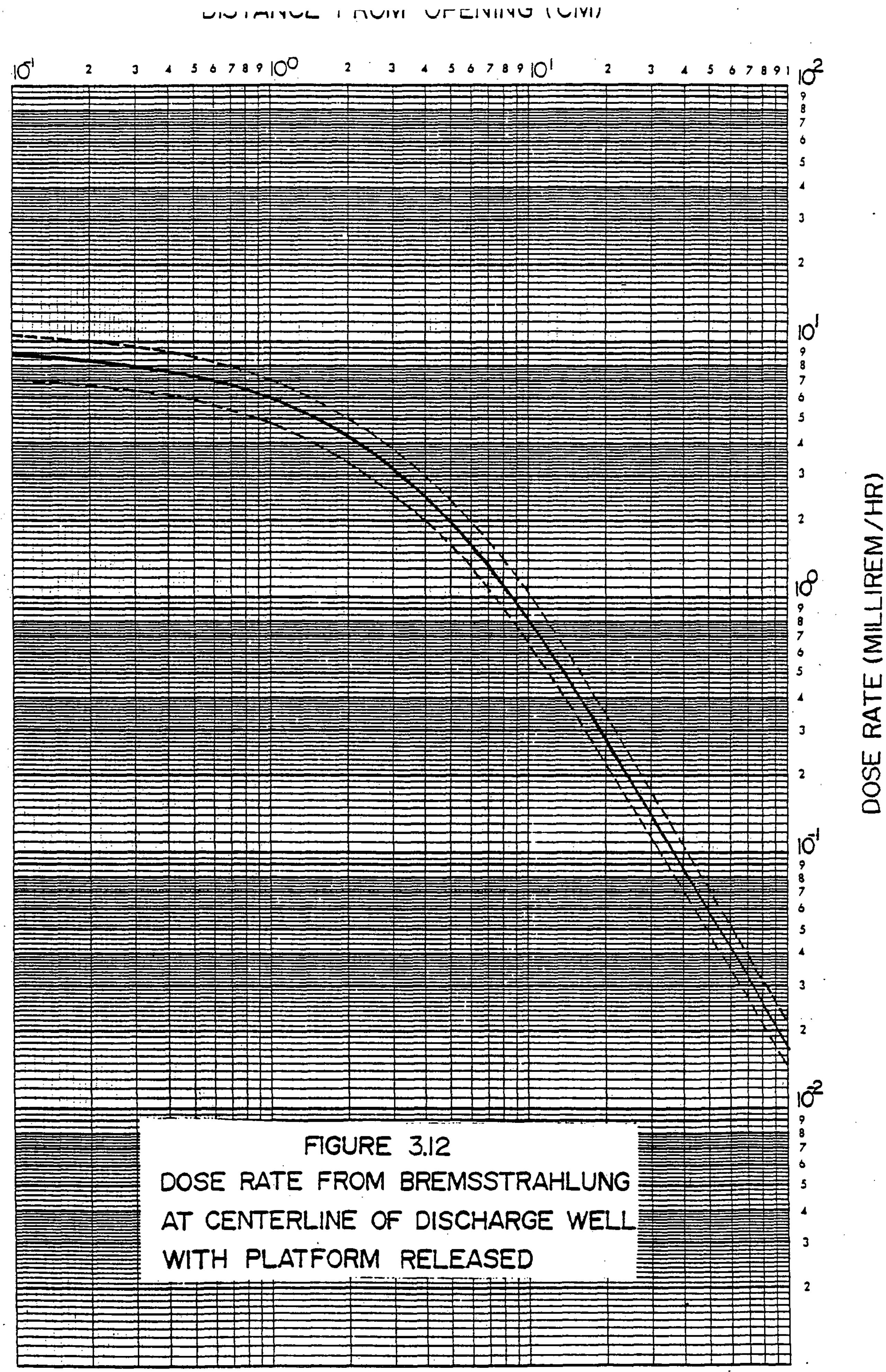


FIGURE 3.12
DOSE RATE FROM BREMSSTRAHLUNG AT CENTERLINE OF DISCHARGE WELL WITH PLATFORM RELEASED

Table 3.13

FLUX THROUGH HOLE IN RATEMETER DRAWER

Distance from Opening (cm)	.12 MeV	.34 MeV	.57 MeV	.80 MeV	1.03 MeV	1.26 MeV	1.49 MeV
	AVERAGE ENERGY ($\bar{E}$)						
.1	1.10+03	1.12+03	2.04+03	1.61+03	9.82+02	5.09+02	1.89+02
.2	1.06+03	1.08+03	1.96+03	1.55+03	9.46+02	4.91+02	1.82+02
.3	1.02+03	1.04+03	1.89+03	1.49+03	9.12+02	4.74+02	1.75+02
.4	9.83+02	1.01+03	1.83+03	1.44+03	8.80+02	4.57+02	1.69+02
.5	9.49+02	9.72+02	1.77+03	1.39+03	8.49+02	4.41+02	1.63+02
.7	8.86+02	9.07+02	1.65+03	1.30+03	7.93+02	4.12+02	1.52+02
1.0	8.03+02	8.22+02	1.49+03	1.18+03	7.19+02	3.73+02	1.38+02
2.0	5.96+02	6.11+02	1.11+03	8.73+02	5.34+02	2.77+02	1.02+02
3.0	4.60+02	4.71+02	8.55+02	6.74+02	4.12+02	2.14+02	7.91+01
4.0	3.66+02	3.75+02	7.05+02	5.36+02	3.27+02	1.70+02	6.29+01
5.0	2.98+02	3.05+02	5.53+02	4.36+02	2.66+02	1.38+02	5.12+01
7.0	2.08+02	2.13+02	3.87+02	3.05+02	1.86+02	9.68+01	3.58+01
10.0	1.34+02	1.38+02	2.50+02	1.97+02	1.16+02	6.24+01	2.31+01
15.0	7.61+01	7.80+01	1.42+02	1.12+02	6.82+01	3.54+01	1.31+01
20.0	4.90+01	5.01+01	9.10+01	7.17+01	4.38+01	2.27+01	8.42+00
25.0	3.41+01	3.49+01	6.34+01	4.99+01	3.05+01	1.58+01	5.86+00

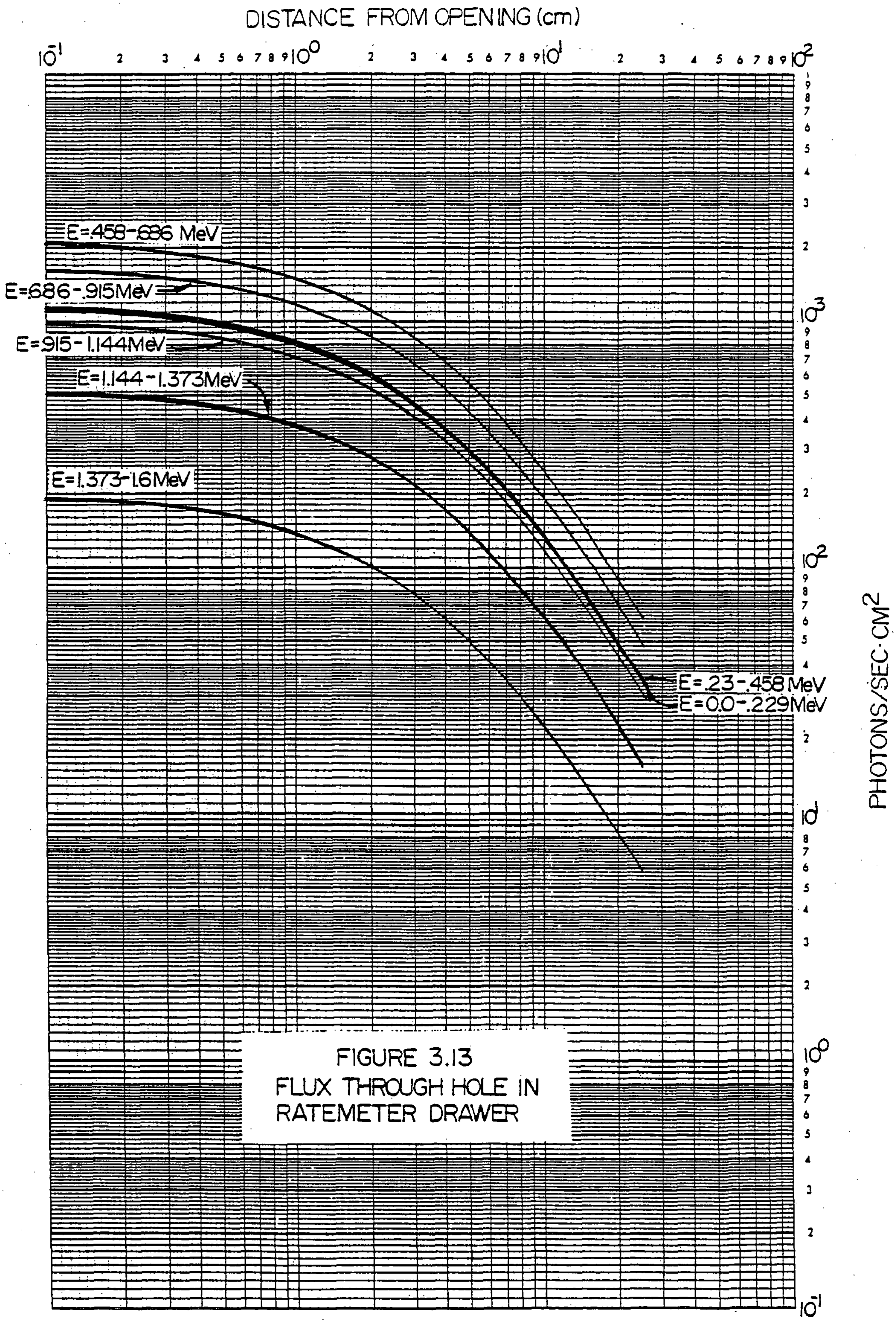


FIGURE 3.13
FLUX THROUGH HOLE IN
RATEMETER DRAWER

Table 3.14

DOSE RATE FROM BREMSSTRAHLUNG
THROUGH HOLE IN RATEMETER DRAWER

Distance from Opening (cm)	Dose Rate (mR/hr)
.1	[9.47±1.89] E+00
.2	[9.12±1.82] E+00
.3	[8.78±1.76] E+00
.4	[8.48±1.70] E+00
.5	[8.19±1.64] E+00
.7	[7.65±1.53] E+00
1.0	[6.93±1.39] E+00
2.0	[5.14±1.03] E+00
3.0	[3.97±.79] E+00
4.0	[3.16±.63] E+00
5.0	[2.57±.51] E+00
7.0	[1.80±.36] E+00
10.0	[1.16±.23] E+00
15.0	[6.57±1.31] E-01
20.0	[4.22±.84] E-01
25.0	[2.94±.59] E-01

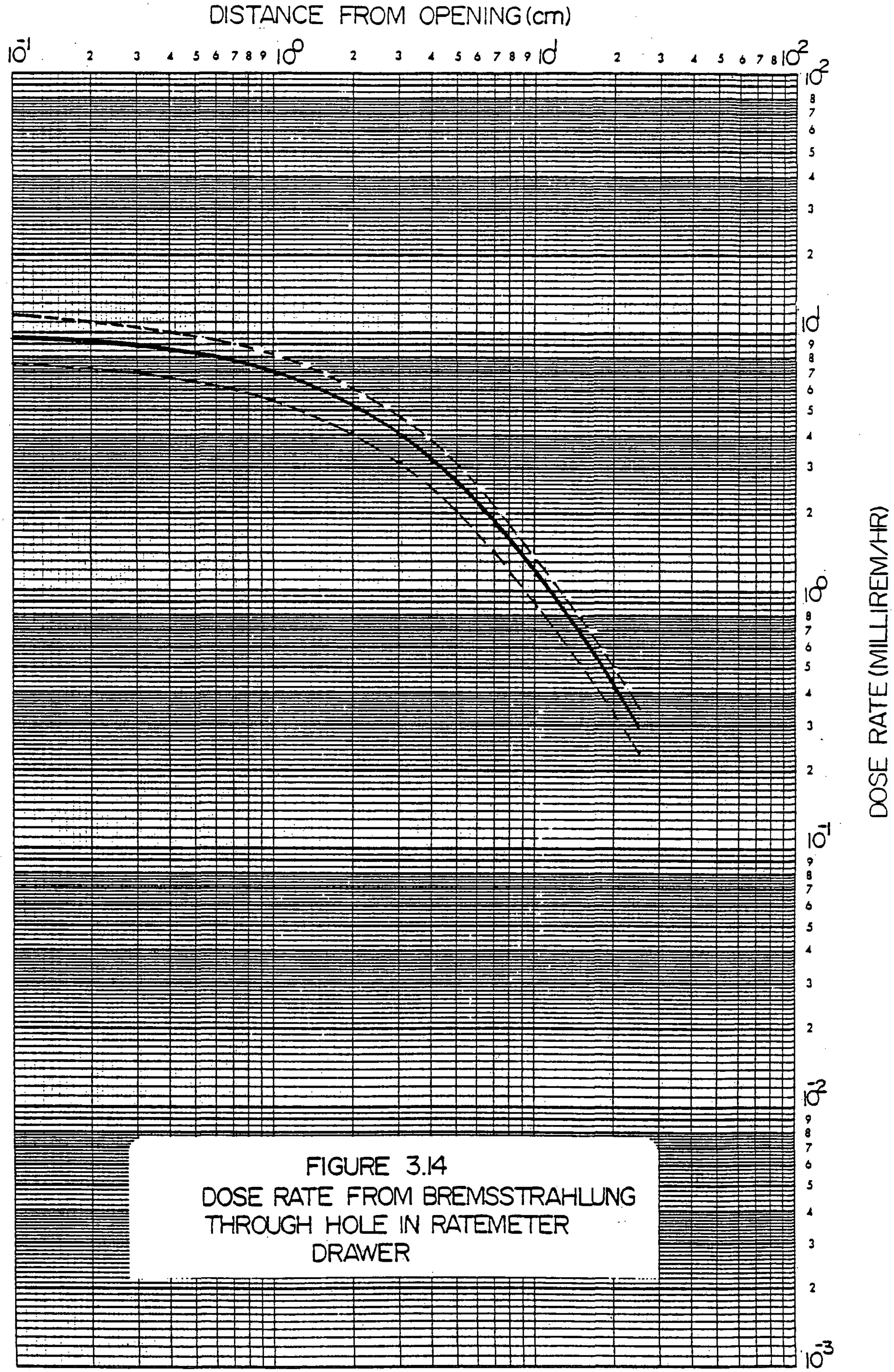


FIGURE 3.14
DOSE RATE FROM BREMSSTRAHLUNG THROUGH HOLE IN RATEMETER DRAWER

Table 3.15

BETA DOSE RATE FROM HOLE
IN RATEMETER DRAWER

Distance from Hole in Ratemeter Drawer	Dose Rate (Rad/hr)
.1	[3.74±.75] E+00
.2	[3.60±.72] E+00
.3	[3.46±.69] E+00
.4	[3.34±.66] E+00
.5	[3.22±.64] E+00
.7	[3.00±.60] E+00
1.0	[2.71±.54] E+00
2.0	[2.00±.40] E+00
3.0	[1.53±.31] E+00
4.0	[1.21±.24] E+00
5.0	[9.73±1.95] E-01
7.0	[6.69±1.34] E-01
10.0	[4.21±.84] E-01
15.0	[2.28±.46] E-01
20.0	[1.41±.28] E-01
25.0	[9.40±1.88] E-02

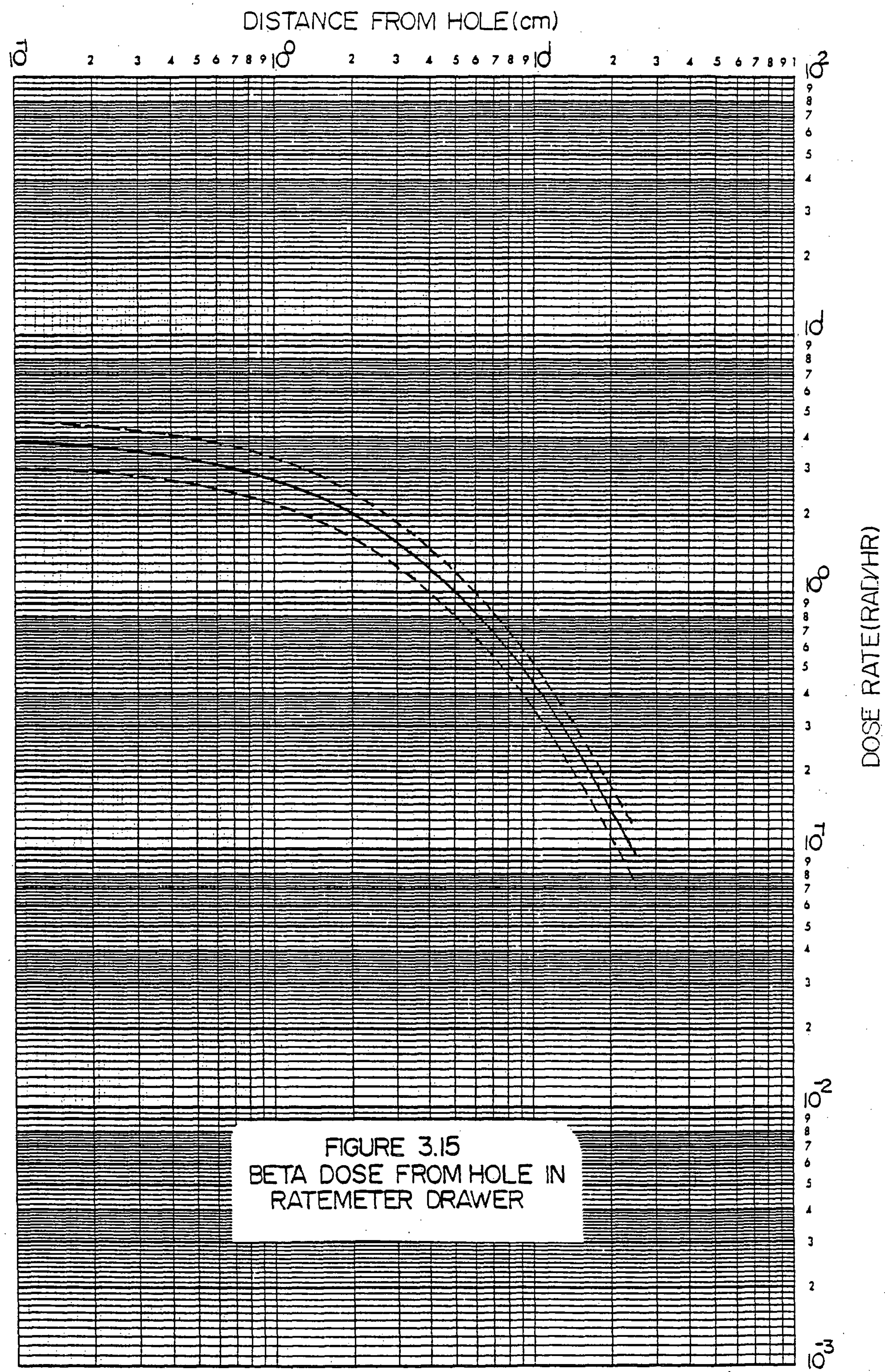


FIGURE 3.15
BETA DOSE FROM HOLE IN
RATEMETER DRAWER

SECTION 4

DISCUSSION OF RESULTS

Task 1 - Tables 3.1, 3.2, 3.3, and 3.4 - Figures 3.1, 3.2, 3.3, and 3.4

This task required the determination of the amount of bremsstrahlung produces by all five sources. The photon flux for each of the seven energy groups were attenuated through the multi-materials to the outside of the case. The contact dose rate on the case at the handle closest to the discharge well was calculated to be 1.25 millirem/hr. All of the dose rate at this point was bremsstrahlung and was produced primarily by the three 35 millicurie sources in the discharge well with the major contribution being the 35 millicurie source located directly under the 30 microcurie source.

The dose rate calculated at the handle closest to the doserate meter assembly was 0.58 millirem/hr. The major contributor to this dose rate was the 35 millicurie source in the doserate meter assembly which was attenuated at an angle to the handle on the case through the tungsten wheel, aluminum drawer and assembly housing, and the case.

Task 2 - Tables 3.5, 3.6 and 3.7 - Figures 3.5, 3.6 and 3.7

Along the centerline of the opening in the discharge well to approximately 21 inches above the opening, the 30 microcurie source window is visible with the top of the source opening gradually covering the source from view until it is totally hidden. The partially visible source was divided into two portions for calculational purposes. The visible portion was attenuated only through the two 2 mil windows and the hidden portion was attenuated through the upper housing. The visible area of the source was calculated for each point along the centerline. The beta contribution was totally from the visible portion of the 30 microcurie source.

The three 35 millicurie sources are not visible along the centerline with the platform depressed but can be partially visible along the edge of the opening. Only at the edge is the angle small enough through the two 2 mil windows to allow for uncollided beta flux from the 35 millicurie. At the centerline the dose rate from the three 35 millicurie sources is due to bremsstrahlung and the beta dose is due to the single 30 microcuries source. The material of the 30 microcurie source capsule was included in the attenuation for the 35 millicurie source located beneath it. The photon flux and corresponding dose rate along the centerline include contributions from all four sources.

Task 3 - Tables 3.8, 3.9, and 3.10 - Figures 3.8, 3.9, and 3.10

The exposed surface area of the source is approximately one-half the total source surface area on the doserate meter assembly with the cover plate removed and the shutter rotated to the 100 Rad/hr position. For the portion exposed, the beta dose rate was calculated through the assembly and out to a distance of 100 cm above the assembly.

Bremsstrahlung flux was calculated by dividing the source area into two parts; the portion being generated in the two 2 mil windows with no attenuation in the shutter, and the portion attenuated by the tungsten.

Task 4

Task 4 calculated the dose rate to a man standing on the ground enveloped in a semi-infinite cloud equal in radius of one mean free path. This calculation represented the total airborne dispersion of the four 35 millicurie Sr/Y-90 sources and the 30 microcurie source. The geometry considered a hemishperical cloud and only the beta dose was a factor. For conservation, the uncertainty of the source strength was taken as an upper bound, i.e., an additional 20% was assumed for each source.

Task 5 - Tables 3.7, 3.11, and 3.12 - Figures 3.7, 3.11, and 3.12

This task differs from Task 2 in that the platform is considered to be in the raised position. The additional attenuation through the brass platform by the three 35 millicurie sources required each to be divided into two portions; the portion attenuated only through the materials of the housings, and the portion that also included the platform. The photon flux and dose rate along the centerline include contributions from all four sources. Beta dose rate from Task 2 was identical for this task since the platform in its raised position is located beneath the 30 microcurie source.

Task 6 - Tables 3.13, 3.14, and 3.15 - Figures 3.13, 3.14, and 3.15

With the spacer block removed from the doserate meter assembly, a portion of the 35 millicurie source is visible through the opening in the drawer with the wheel in the 100 Rad position. The largest portion of the source visible is at the upper edge of the drawer opening. This point is where the maximum dose rates for beta and bremsstrahlung were calculated. The source was divided into four portions to accommodate the various shielding materials and thicknesses. Beta dose rate at that angle was calculated from the exposed portion of the source. The seven photon flux energy groups and the two dose rates were carried to the case along the same line.

SECTION 5

REFERENCES

1. Department of the Army, Operators and Organizational Maintenance Manual, TM11-6665-227-12, June, 1975

2. Case, F. N., (Letter Report to R. G. Rast), Determination of Strontium-90 Activity in the Sources Removed from U. S. Army Calibration Devices, October 7, 1980

3. Brodsky, A. and Beard, G. V., A Compendium of Information for Use in Controlling Radiation Emergencies, TID-88206 (Rev)

4. Evans, R. D., The Atomic Nucleus, McGraw Hill, New York, New York, 1955

5. Fitzgerald, J. J., Brownell, G. L., and Mahoney, F. J., Mathematical Theory of Radiation Dosimetry, Gordon and Brench Science Publishers, Inc. New York, New York, 1967

APPENDIX A

A Technique for Calculating Bremsstrahlung Contribution to Dose Rates by Empirical Methods

In most shielding calculations, the contribution of bremsstrahlung radiation to dose rate is neglected, based on the assumption that energy loss by beta interactions went into ionizing and exciting atoms in the neighborhood of the interaction site. This is a sound assumption so long as radiation losses comprise no more than a small fraction of the total energy loss.

In considering beta-radiation shielding, one cannot dismiss bremsstrahlung so lightly since sources of beta radiation, even though adequately shielded against beta penetration, can be significant sources of photon radiation. The problem of bremstrahlung radiation is further complicated by the somewhat theoretical explanations found in most texts on radiation shielding. It is for this reason that an empirical technique is discussed here, allowing direct calculation of dose rates due to bremsstrahlung. There are two fairly well accepted semi-empirical techniques to determine the fraction of the beta-ray energy dissipated as external bremsstrahlung (3,4). The one used in the calculations presented in this report from reference 3 is as follows:

$$f = 1.23 \times 10^{-4} (\bar{Z} + 3)\, E^2_{max} \qquad \text{(A-1)}$$

where f = fraction resulting in bremsstrahlung per beta absorbed [MeV/$_\beta$]

E_{max} = maximum beta energy [MeV]

$\bar{Z}$ = effective atomic number, given by

$$\bar{Z} = \frac{\Sigma f_a Z_a^2}{\Sigma f_a Z_a} \quad \text{(A-2)}$$

where:

f_a = fraction of number of atoms of atomic number A_a

Z_a = Atomic number of element in material under consideration

Thus, the above relationships (A-1 and A-2) allow computation of the total bremsstrahlung generated per total absorbed. Since the fraction of initial ionization measured after the beta particles have penetrated through a thickness X of absorbing medium is virtually exponential in behavior for approximately 99% of the beta particle range, the intensity may be expressed as:

$$I(X) = I(0)e^{-(\mu/\rho)X} \quad \text{(A-3)}$$

where:

μ/ρ = apparent mass absorption coefficient [cm^2/gm]

X = mass distance [gm/cm^2]

The most reliable source of information on these coefficients is empirical in nature. The mass absorption coefficient is nearly independent of the atomic weight of the absorbing medium and increases only slightly with its atomic mass number, (3). The functional dependence of μ/ρ upon E_{max} can be represented by the expression

$$\mu/\rho = 17E_{max}^{-1.14} \quad \text{(A-4)}$$

where:

E_{max} = max beta particle energy [MeV]

μ/ρ = apparent mass absorption coefficient [cm^2/gm]

For simplicity, total mass absorption curves, i.e., I/I_o are given in Figures A-1 through A-7 for a variety of shield materials.

Now that the total bremsstrahlung fraction has been determined through the use of Figures A-1 through A-7 and Equation A-1, the bremsstrahlung spectrum from beta absorption can be determined from the following table (3):

BREMSSTRAHLUNG SPECTRUM FROM BETA ABSORPTION

Photon Energy Intervals in Fraction of the Maximum Beta Energy	Percent of Total Intensity Contributed by Photons in Energy Intervals
0.0 to 0.1	43.5
0.1 to 0.2	25.8
0.2 to 0.3	15.2
0.3 to 0.4	8.3
0.4 to 0.5	4.3
0.5 to 0.6	2.0
0.6 to 0.7	0.7
0.7 to 0.8	0.2
0.8 to 0.9	0.03
0.9 to 1.0	< 0.01

The problem can now be solved utilizing the well established techniques for gamma-ray shielding found in the literature.

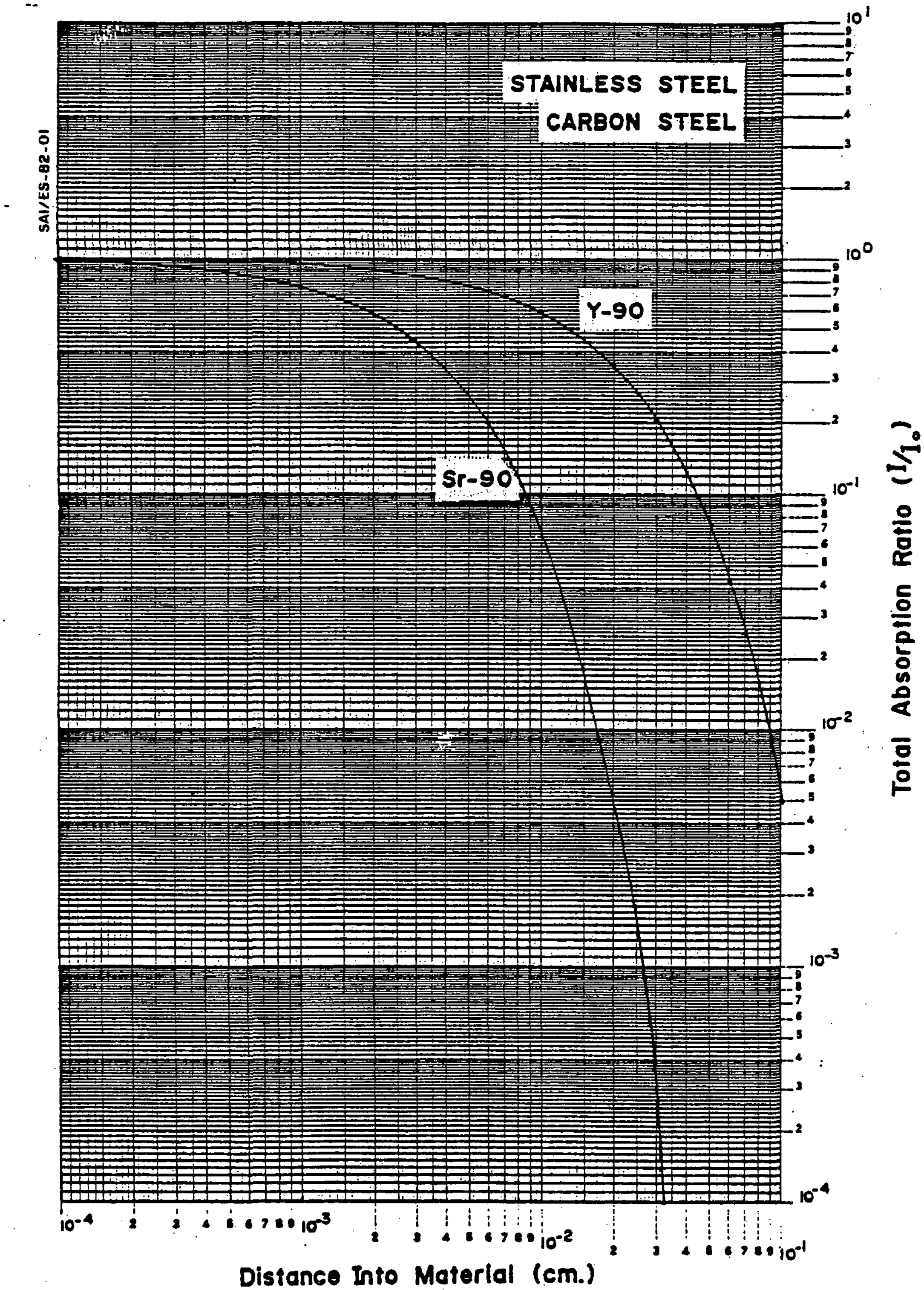


Figure A-1
Beta Total Absorption Ratio for
Stainless & Carbon Steels

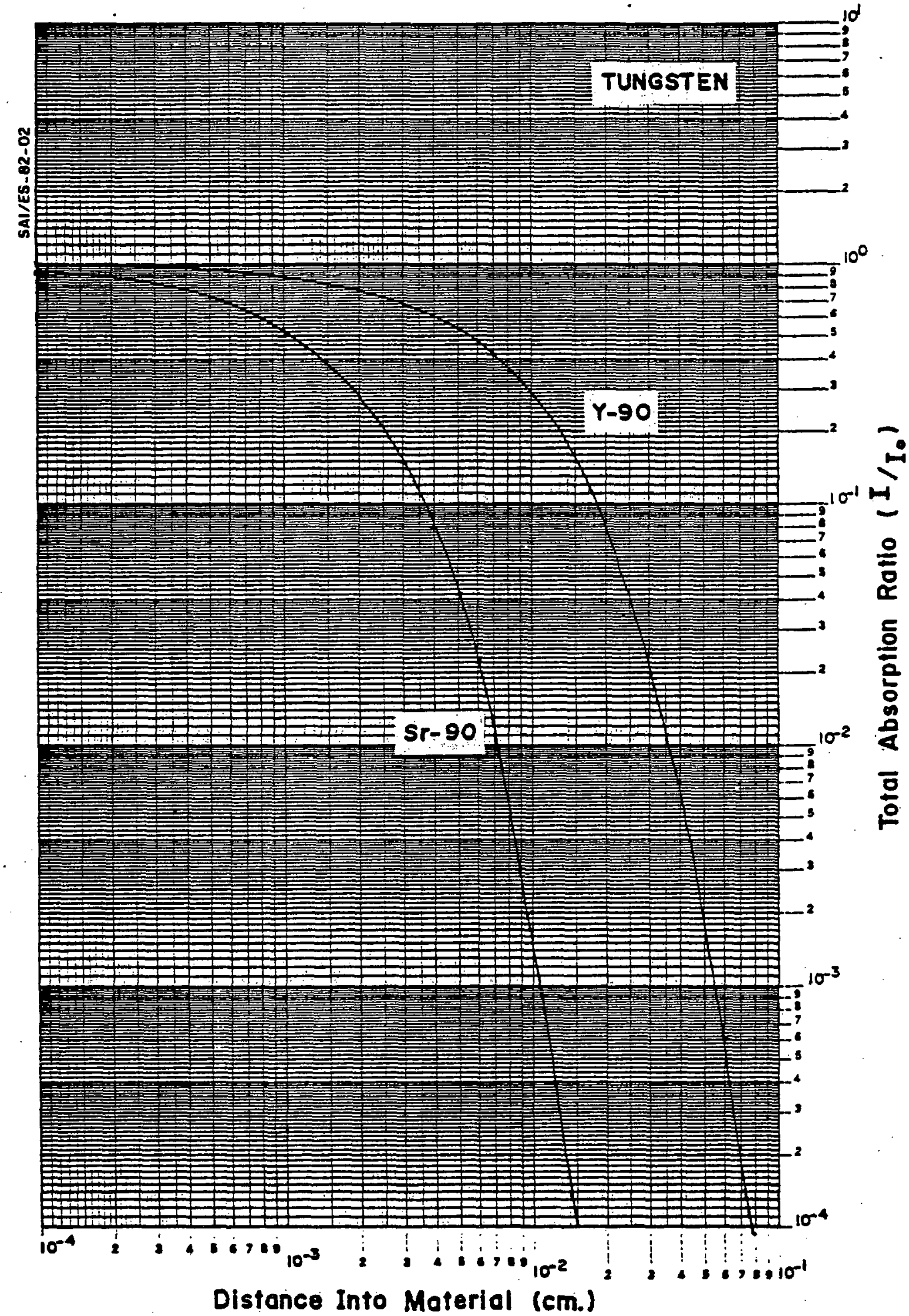


Figure A-2

Beta Total Absorption Ratio for Tungsten

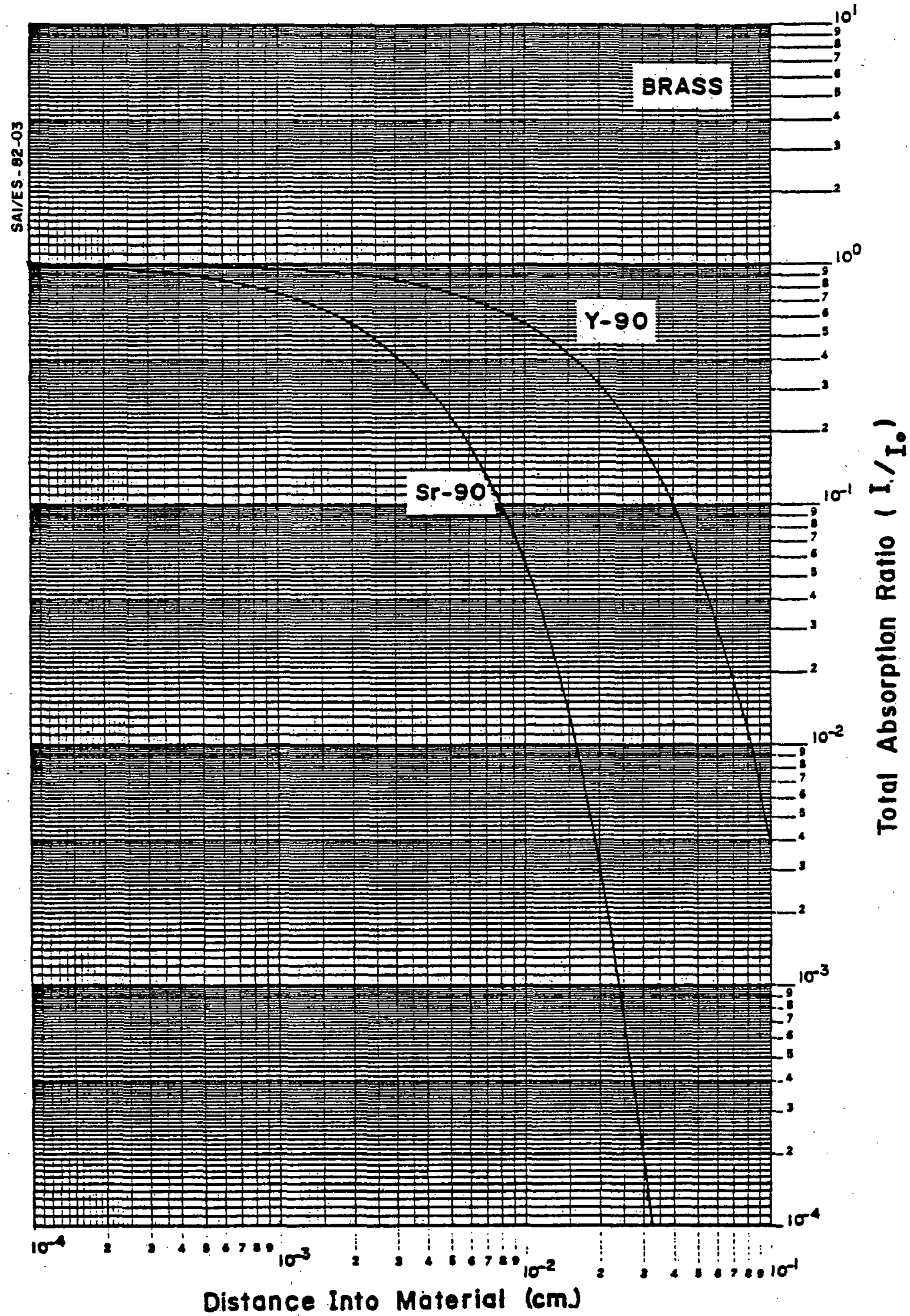


Figure A-3

Beta Total Absorption Ratio for Brass

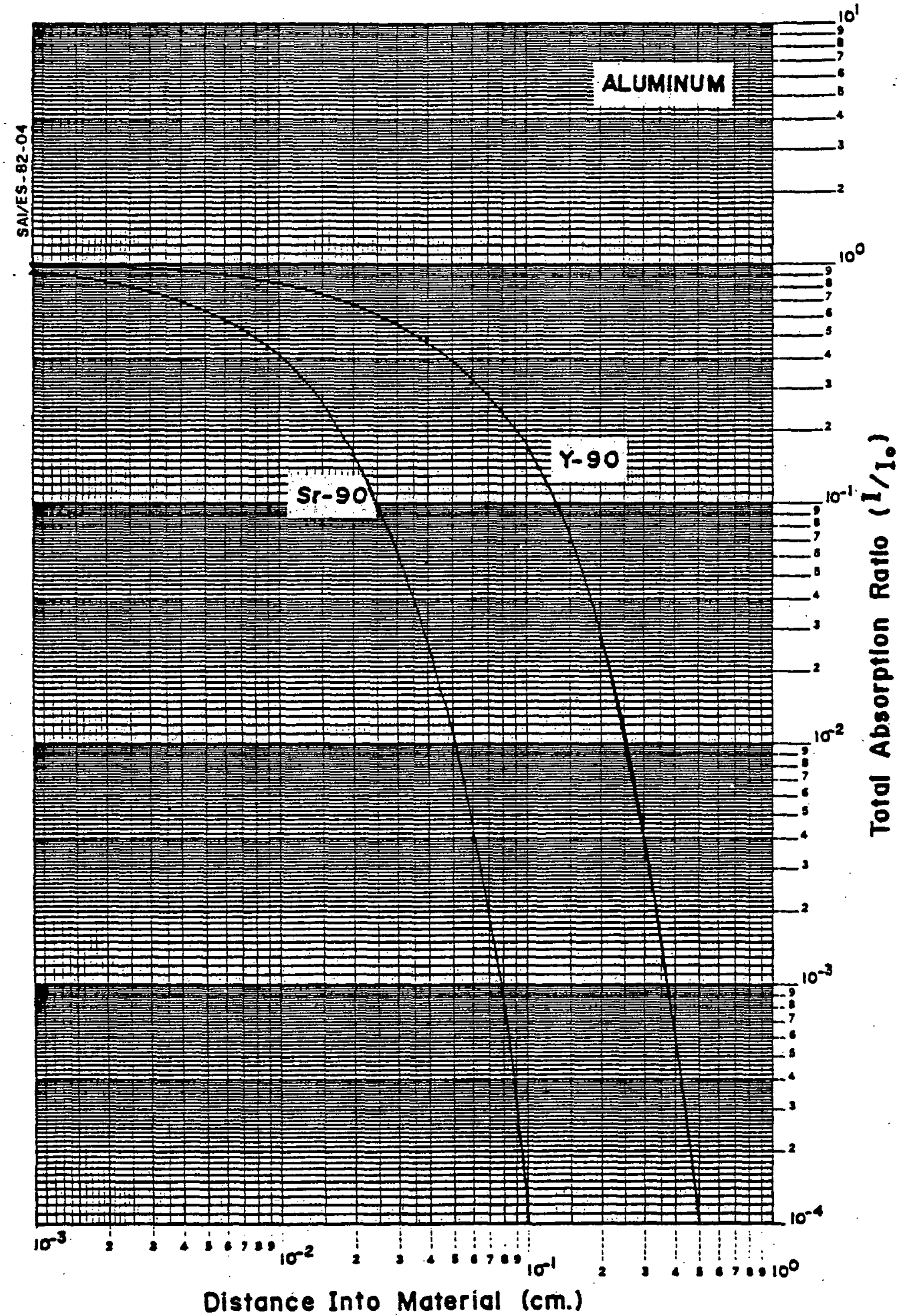


Figure A-4

Beta Total Absorption Ratio for Aluminum

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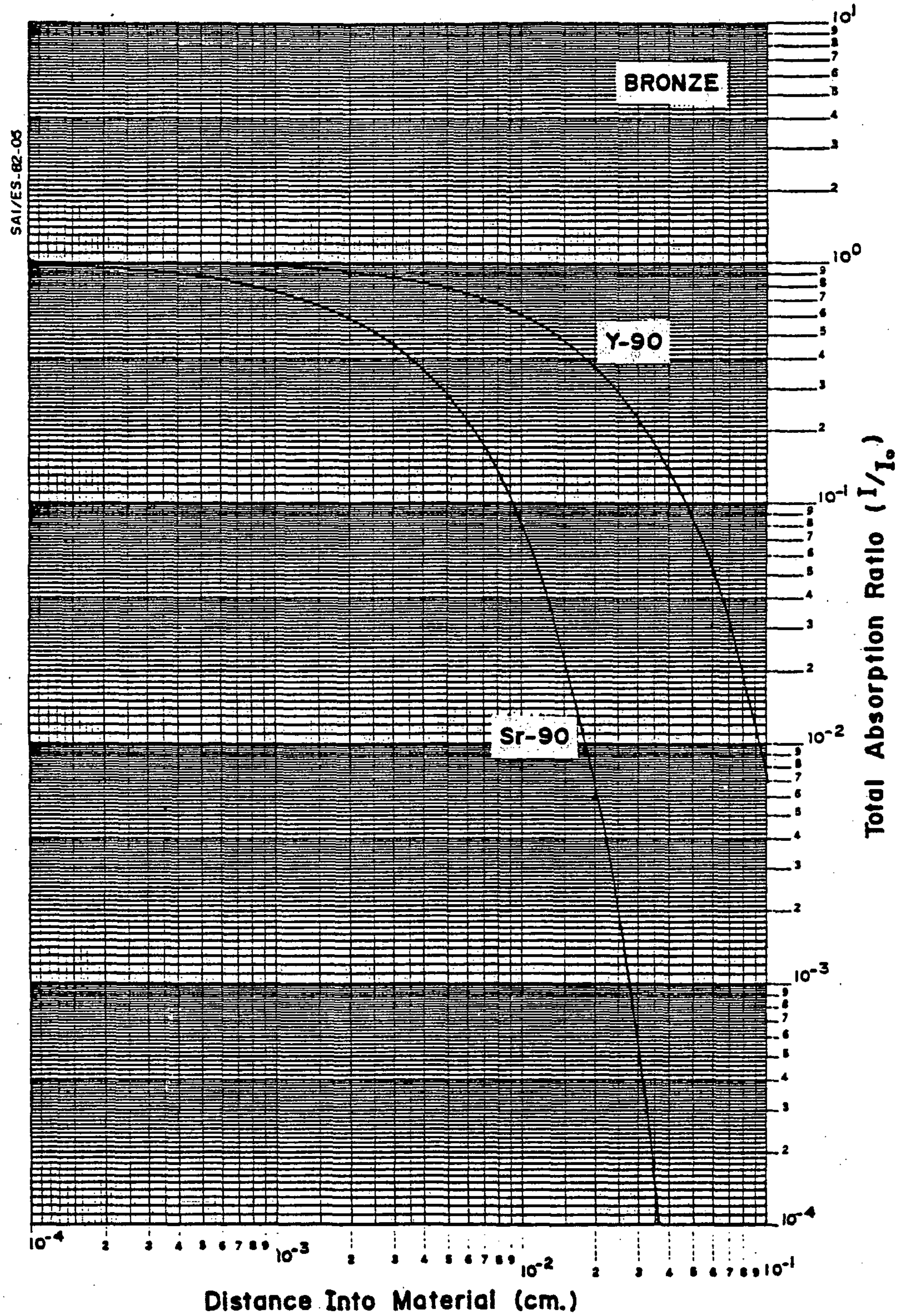

Figure A-5

Beta Total Absorption Ratio for Bronze

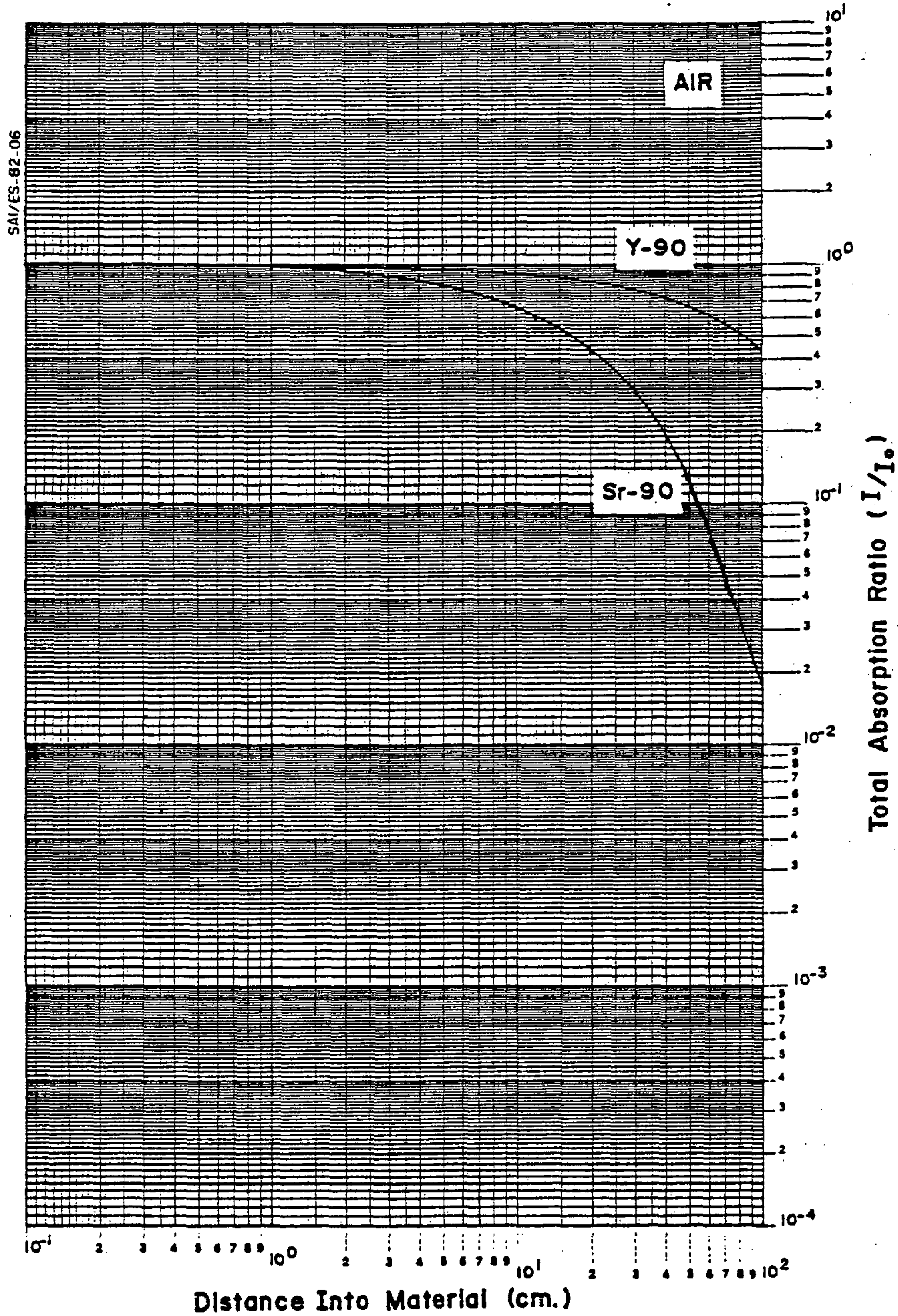

Figure A-6
Beta Total Absorption Ratio
for Air (10^{-1} - 10^{2} cm)

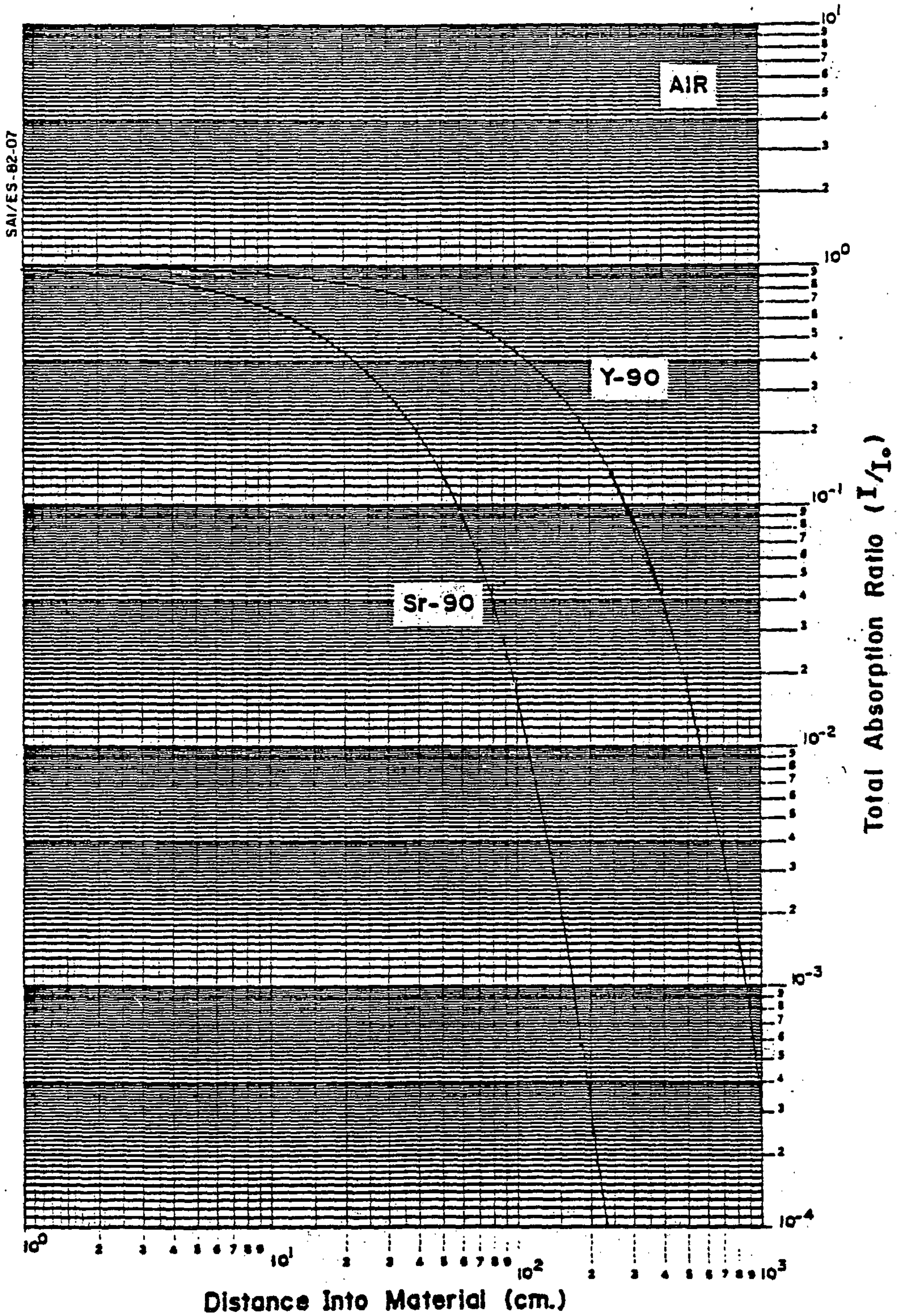

Figure A-7
Beta Total Absorption Ratio

Air (10^0 - 10^3 cm)

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