NRC FORM 374
(7-94)

U.S. NUCLEAR REGULATORY COMMISSION



Amendment No. 15

ORC

# MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

| Licensee | |
|---|---|
| 1. National Aeronautics & Space Administration | In accordance with letter dated October 24, 1996 |
| 2. Ames Research Center M/S 218-1<br>Moffett Field, California 94035-1000 | 3. License Number 04-07845-04 is amended in its entirety to read as follows: |
| | 4. Expiration Date September 30, 2002 |
| | 5. Docket or Reference No. 030-20435 |

| 6. Byproduct, Source, and/or Special Nuclear Material | 7. Chemical and/or Physical Form | 8. Maximum Amount that Licensee May Possess at Any One Time Under This License |
|---|---|---|
| A. Any byproduct material with Atomic Numbers 3 - 83 and with a half-life of less than 120 days | A. Any, except as sealed sources | A. Not to exceed 200 millicuries per radionuclide and 5 curies total |
| B. Carbon-14 | B. Any | B. 2 curies |
| C. Calcium-45 | C. Any, except as sealed sources | C. 200 millicuries |
| D. Any byproduct material | D. Sealed sources | D. Not to exceed 1 millicurie per source and 1 curie total |
| E. Hydrogen-3 | E. Any | E. 2 curies |
| F. Nickel-63 | F. Foils or plated sources in detector cells | F. Not to exceed 15 millicuries per foil or source and 5 curies total |
| G. Hydrogen-3 | G. Titanium tritide or scandium tritide foils in detector cells | G. Not to exceed 1 curie per foil and 20 curies total |
| H. Cesium-137 | H. Sealed source | H. 1.4 millicuries |
| I. Phosphorus-32 | I. Any | I. 2 curies |
| J. Phosphorus-33 | J. Any | J. 2 curies |
| K. Sulfur-35 | K. Any | K. 2 curies |

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| | | |
|---|---|---|
| L. Chromium-51 | L. Any | L. 2 curies |
| M. Iron-55 | M. Any | M. 2 curies |
| N. Iodine-125 | N. Any, except as sealed sources | N. 2 curies |
| O. Americium-241 | O. Sealed sources | O. Not to exceed 45 millicuries per source and 5 curies total |
| P. Cesium-137 | P. Sealed sources (Troxler Dwg. A-102112) | P. Not to exceed 10 millicuries per source and 100 millicuries total |
| Q. Americium-241 | Q. Sealed neutron sources (Troxler Dwg. A-102451) | Q. Not to exceed 50 millicuries per source and 200 millicuries total |
| R. Cadmium-109 | R. Sealed Source (Isotope Products Laboratories XFB Series) | R. 10 millicuries |
| S. Polonium-210 | S. Any | S. 1 millicurie |
| T. Curium-244 | T. Calibration or reference source | T. 1 microcurie |
| U. Cesium-137 | U. Sealed source (3M Company Model 4D6L) | U. 1.1 curie |

9. Authorized use

A. through N. For research and development as defined in Section 30.4 of 10 CFR Part 30 including instrument calibration, use of gas chromatography units, testing of instrumentation, and laboratory research including animal studies.

O. For use in bone mineral analyzers for bone mineral studies on animals and other laboratory research.

9. Authorized Use (Continued)

P. and Q. For use in Troxler Model 3400 Series Moisture-Density gauges to measure properties of construction materials.

R. and S. For use in an ARACOR laboratory research x-ray instrument for geological and exobiological measurements.

T. For use in conjunction with a Tissue Equivalent Proportional Counter (TEPC) which was custom built by Far West Technology, Inc. The TEPC detector and calibration source will be placed within a Boeing Co. device which will then be mounted in NASA aircraft.

U. For use in a J.L. Shepherd and Associates Model 28-6 instrument calibrator for calibration of the licensee's survey instruments.

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10. Licensed material shall be used only at the licensee's facilities located at Ames Research Center, Moffett Field, California, and other NASA facilities and temporary job sites of the licensee anywhere in the United States as approved by the licensee's Radiation Safety Committee.

11. A. Licensed material shall only be used by, or under the supervision of, individuals designated by the Radiation Safety Committee, Linda L. Jahnke, Chairperson.

B. The Radiation Safety Officer for this license is William R. Vermeere.

12. A. Sealed sources and detector cells shall be tested for leakage and/or contamination at intervals not to exceed 6 months or at such other intervals as specified by the certificate of registration referred to in 10 CFR 32.210.

B. Notwithstanding Paragraph A of this Condition, sealed sources designed to emit alpha particles shall be tested for leakage and/or contamination at intervals not to exceed 3 months.

C. In the absence of a certificate from a transferor indicating that a leak test has been made within 6 months prior to the transfer, a sealed source or detector cell received from another person shall not be put into use until tested.

D. Each sealed source fabricated by the licensee shall be inspected and tested for construction defects, leakage, and contamination prior to any use or transfer as a sealed source.

12. (Continued)

E. Sealed sources need not be leak tested if:

(i) they contain only hydrogen-3; or

(ii) they contain only a radioactive gas; or

(iii) the half-life of the isotope is 30 days or less; or

(iv) they contain not more than 100 microcuries of beta and/or gamma emitting material or not more than 10 microcuries of alpha emitting material; or

(v) they are not designed to emit alpha particles, are in storage, and are not being used. However, when they are removed from storage for use or transferred to another person, and have not been tested within the required leak test interval, they shall be tested before use or transfer. No sealed source or detector cell shall be stored for a period of more than 10 years without being tested for leakage and/or contamination.

F. The leak test shall be capable of detecting the presence of 0.005 microcurie of radioactive material on the test sample. If the test reveals the presence of 0.005 microcurie or more of removable contamination, a report shall be filed with the U.S. Nuclear Regulatory Commission in accordance with 10 CFR 30.50(b)(2), and the source shall be removed immediately from service and decontaminated, repaired, or disposed of in accordance with Commission regulations. The report shall be filed within 5 days of the date the leak test result is known with the U.S. Nuclear Regulatory Commission, Region IV, 611 Ryan Plaza Drive, Suite 400, Arlington, Texas 76011, ATTN: Director, Division of Radiation Safety and Safeguards. The report shall specify the source involved, the test results, and corrective action taken.

G. Tests for leakage and/or contamination shall be performed by the licensee or by other persons specifically licensed by the Commission or an Agreement State to Perform such services.

13. A. The licensee shall not use licensed material in or on human beings except as provided otherwise by specific condition of this license.

B. The licensee shall not use licensed material in field applications where activity is released except as provided otherwise by specific condition of this license.

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14. The licensee is authorized to transport licensed material only in accordance with the provisions of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material."

15. A. Detector cells containing a titanium tritide foil or a scandium tritide foil shall only be used in conjunction with a properly operating temperature control mechanism which prevents the foil temperature from exceeding that specified by the manufacturer and approved by NRC.

B. When in use, detector cells containing a titanium tritide foil or a scandium tritide foil shall be vented to the outside.

16. Sealed sources containing licensed material shall not be opened or sources removed from source holders by the licensee.

17. Maintenance, repair, cleaning, replacement and disposal of foils contained in detector cells shall be performed only by the device manufacturer or other persons specifically authorized by the Commission or an Agreement State to perform such services.

18. The licensee shall conduct a physical inventory every 6 months to account for all sources and/or devices received and possessed under the license.

19. A. When unsealed quantities of I-125 or I-131 are used in excess of 10 millicuries, the licensee shall conduct a bioassay program in accordance with procedures set forth in Regulatory Guide 8.20: "Applications of Bioassay for I-125 and I-131", Revision 1, September 1979.

B. When unsealed quantities of H-3 are used in excess of 100 millicuries, the licensee shall conduct a bioassay program in accordance with procedures set for the in "Applications of Bioassay for Tritium,", dated June 1983.

20. The licensee is authorized to hold radioactive material with a physical half-life of less than 120 days for decay-in-storage before disposal in ordinary trash provided:

A. Radioactive waste to be disposed of in this manner shall be held for decay a minimum of 10 half-lives.

B. Before disposal as ordinary trash, byproduct material shall be surveyed at the container surface with the appropriate meter set on its most sensitive scale and with no interposed shielding to determine that its radioactivity cannot be distinguished from background. All radiation labels shall be removed or obliterated.

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21. Prior to release of premises and equipment used in conjunction with licensed material, the licensee shall conduct a radiation survey to establish that contamination is within the limits specified in Guidelines for Decontamination of Facilities and Equipment prior to Release for unrestricted use of Termination of Licenses for Byproduct, Source, or Special Nuclear Material", dated July 1982.

22. The licensee shall maintain records of information related to decommissioning at Ames Research Center, Moffett Field, California, as specified in 10 CFR 30.35(d) until this license is terminated by the Commission.

23. Except as specifically provided otherwise in this license, the licensee shall conduct its program in accordance with the statements, representations, and procedures contained in the documents, including any enclosures, listed below. The Nuclear Regulatory Commission's regulations shall govern unless the statements, representations and procedures in the licensee's application and correspondence are more restrictive than the regulations.

A. Letter dated January 22, 1990
B. Application dated April 21, 1990, except for the Radiation Safety Guide
C. Letter dated June 23, 1992
D. Letter dated March 18, 1993
E. Letter received June 2, 1993
F. Letter dated January 18, 1994
G. Letter dated February 10, 1994
H. Letter dated Janurary 17, 1995, enclosing Appendices 1-7, including the Radiation Safety Guide.
I. Letter received February 1, 1995
J. Letter dated October 24, 1996
K. Correspondence dated February 3, 1997

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Date FEB - 6 1997

By Beth A. Prange
Materials Branch
Region IV, WCFO
Walnut Creek, California 94596

BETWEEN:

License Fee Management Branch, ARM
and
Regional Licensing Sections

(FOR LFMS USE)
INFORMATION FROM LTS

Program Code: 03610
Status Code: 0
Fee Category: EX 3L
Exp. Date: 20020930
Fee Comments:
Decom Fin Assur Reqd: Y

LICENSE FEE TRANSMITTAL

A. REGION IV UCFO

1. APPLICATION ATTACHED
   Applicant/Licensee: NATIONAL AERONAUTICS & SPACE ADM.
   Received Date: 961101
   Docket No: 3020435
   Control No.: 572425
   License No.: 04-07845-04
   Action Type: Amendment

2. FEE ATTACHED
   Amount: _____
   Check No.: _____

3. COMMENTS

Signed _____
Date _____

B. LICENSE FEE MANAGEMENT BRANCH (Check when milestone 03 is entered /__/)

1. Fee Category and Amount: _____

2. Correct Fee Paid. Application may be processed for:
   Amendment _____
   Renewal _____
   License _____

3. OTHER _____
   _____

Signed _____
Date _____

ORC

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV

Walnut Creek Field Office
1450 Maria Lane
Walnut Creek, California 94596-5368

FEB - 6 1997

National Aeronautics
& Space Administration
ATTN: William R. Vermeere
Radiation Safety Officer
Ames Research Center M/S 218-1
Moffett Field, California 94035-1000

SUBJECT: LICENSE AMENDMENT

Please find enclosed License No. 04-07845-04. You should review this license carefully and be sure that you understand all conditions. If you have any questions, you may contact the reviewer who signed your license at (510) 975-0250.

NRC expects licensees to conduct their programs with meticulous attention to detail and a high standard of compliance. Because of the serious consequences to employees and the public which can result from failure to comply with NRC requirements, you must conduct your program involving radioactive materials in accordance with the conditions of your NRC license, representations made in your license application, and NRC regulations. In particular, note that you must:

1. Operate in accordance with NRC regulations 10 CFR Part 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations," 10 CFR Part 20, "Standards for Protection Against Radiation," and other applicable regulations.

2. Possess radioactive material only in the quantity and form indicated in your license.

3. Use radioactive material only for the purpose(s) indicated in your license.

4. Notify NRC in writing of any change in mailing address (no fee required if the location of radioactive material remains the same).

5. Request and obtain written NRC consent before transferring your license or any right thereunder, either voluntarily or involuntarily, directly or indirectly, through transfer of control of your license to any person or entity. A transfer of control of your license includes not only a total change of ownership, but also a change in the controlling interest in your company whether it is a corporation, partnership, or other entity. In addition, appropriate license amendments must be requested

and obtained for any other planned changes in your facility or program that are contrary to your license or contrary to representations made in your license application, as well as supplemental correspondence thereto, which are incorporated into your license. A license fee may be charged for the amendments if you are not in a fee-exempt category.

6. Maintain in a single document decommissioning records that have been certified for completeness and accuracy listing all the following items applicable to the license:

   - Onsite areas designated or formerly designated as restricted areas as defined in 10 CFR 20.3(a)(14) or 20.1003.

   - Onsite areas, other than restricted areas, where radioactive materials in quantities greater than amounts listed in Appendix C to 10 CFR 20.1001-20.2401 have been used, possessed, or stored.

   - Onsite areas, other than restricted areas, where spills or other unusual occurrences involving the spread of contamination in and around the facility, equipment, or site have occurred that required reporting pursuant to 10 CFR 30.50(b)(1) or (b)(4), including areas where subsequent cleanup procedures have removed the contamination.

   - Specific locations and radionuclide contents of previous and current burial areas within the site, excluding radioactive material with half-lives of 10 days or less, depleted uranium used only for shielding or as penetrators in unused munitions, or sealed sources authorized for use at temporary job sites.

   - Location and description of all contaminated equipment involved in licensed operations that is to remain onsite after license termination.

7. Submit a complete renewal application with proper fee, or termination request at least 30 days before the expiration date on your license. You will receive a reminder notice approximately 90 days before the expiration date. Possession of radioactive material after your license expires is a violation of NRC regulations.

8. Request termination of your license if you plan to permanently discontinue activities involving radioactive material.

You will be periodically inspected by NRC. Failure to conduct your program in accordance with NRC regulations, license conditions, and representations made in your license application and supplemental correspondence with NRC will result in enforcement action against you. This could include issuance of a notice of violation; imposition of a civil penalty; or an order suspending, modifying, or revoking your license as specified in the "General Statement of Policy and Procedure for NRC Enforcement Actions" (Enforcement Policy), 60 FR 34381, June 30, 1995.

Thank you for your cooperation.

Sincerely,

Beth A. Prange

Beth A. Prange
Sr. Health Physicist (Licensing)
Materials Branch

Docket: 030-20435
License: 04-07845-04
Control: 572425

Enclosures: As stated

bcc:

Docket File
WCFO Inspection File
LFDCB, T-9 E10
State of CA (License Only)

DOCUMENT NAME: G:\beth\572425

To receive copy of document, indicate in box: "C" = Copy without enclosures "E" = Copy with enclosures "N" = No copy

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| RIV:MB | N | C:MB | | | | | | | |
| BPrange BGP | | FWenslawski | | | | | | | |
| 02/6/97 | | 02/ /97 | | 02/ /97 | | 02/ /97 | | 02/ /97 | |

OFFICIAL RECORD COPY

Science Applications International Corporation
NASA Ames Research Center
M.S. N-19-21
Moffett Field, CA 94035-1000
Phone: (415) 604-0490 FAX (415) 604-2034



FEB 3 1997

DATE: 2/3/97

TO: Ms. BETH PRANGE

FAX NUMBER: (510) 975-0391

FROM: BILL VERMEERE

TOTAL PAGES: 8 (Including Cover Sheet)

MESSAGE: BETH: ATTACHED IS REQUESTED ADDENDUM MATERIAL FOR SOURCE LICENSE REQUEST

Thanks for your help

BV



572425

CHECKLIST FOR REVIEW OF AN APPLICATION FOR USE OF RADIOACTIVE MATERIALS FOR CALIBRATING RADIATION SURVEY AND MONITORING INSTRUMENTS

1. TYPE OF APPLICATION
   [ ] NEW [ ] RENEWAL [X] AMENDMENT [ ] CONVERSION

   License No: **04-07845-04**
   Docket No: **030-20435**
   Control No: **572425**

2. Name: **NASA**
   Mailing Address: **Moffett Field, CA 94035-1000**
3. Locations of use: **Bldg. 19, Basement**
   Temporary job sites: **N/A**
4. Name of person to be contacted: **Bill Vermeere, RSO**
   Telephone number: **(415)604-3573**
   **-2034 Fax**
5. and 6. Material requested and purpose of use:

| Byproduct, source and/or special nuclear material | Chemical and/or physical form | Maximum amount that licensee may possess at any one time under this license |
|---|---|---|
| **Cs-137** | **SS** | **1.1 Ci** |
| | | |
| | | |

Authorized use:
Identify the range of instrument you wish to calibrate.

**The gamma factor for cesium-137 is 330 mR/hr at 1 meter. Thus we will be effectively limited to working between 0.01 mR/hr to 2,000 mR/hr. The source specification calls for a maximum "dose" rate at 30 cm of 4,400 R/hr for a 1.2 Ci source. Exposure rates are based on having a 1.1 Ci source located in a room that is 56 feet in length and using beam attenuators that will have up to a 100X attenuation for the low doses and having the capability of moving a detector to within 30 cm of the source for exposures at the high end of range.**

**Some of our meters have a maximum scale of 2,000 mR per hour. Eighty percent of the scale will be 1,600 mR which is within our maximum reliable capability. We do not foresee the**

572425

**need to ever work in radiation fields that are at or above this level, thus I feel comfortable that we can calibrate our higher range meters and ignore any higher scales by providing the accurate calibration at the lower ranges and always limiting our equipment to use at those lower ranges.**

7. Individuals responsible for radiation safety:
   RSO: **William R. Vermeere**

   Names of other personnel who will actually perform or supervise the instrument calibration procedures:

   a. **DeWayne R. Holcomb, NRRPT, Naval Nuclear Power School 1983/4 Engineering Laboratory Technician, USS Sargo ( 1 reactor) - 1986**
   b. **Jamie J. King, Naval Nuclear Power School 1985/6 - Nuclear Propulsion Plant Operator USS Enterprise (8 reactors)-1990.**

   **Both technicians help me with our annual radiation training program and have received in depth training in the basic mathematics and calculations basic to the use and measurement of radiation, biological effects of radiation, principles of radiation monitoring, monitoring techniques, and the use of instruments.**

   **Mr. Holcomb conducted equipment calibration for a local company, SSI, during the time period of 1986 through 1989. Mr. Holcomb has worked as a Health Physics technician at SSI, NASA Ames and at the University of California, Berkely since leaving the military. Mr. King, after leaving the nuclear navy became a Radiation surveillance technician at SLAC prior to coming to work at NASA in 1991 as a Health Physics technician. Mr. King will be sitting for the NRRPT examination in May, 1997.**

   **Technicians are actively involved in a continuous training program at NASA that encompasses new equipment techniques, new equipment designs, current health physics topics, and the review of all new manufacturers technical data that pertains to equipment in house or that we are reviewing for acquisition. Training is augmented by the use of manufacturers' most recent service manuals and instruction sheets, which will provide new information on the instrument manufacturer's recommended servicing and calibration procedures and methods.**

Training records are retained at NASA by the EH&S training office for extended periods of time. Records are currently available as hard copy or electronic files back to 1987. Mr. Vermeere, the NASA RSO, is also the manager of the NASA EH&S training program.

9. Facilities and equipment

The security of the facility is unique in that the facility previously served as a naval brig. One outside door into the facility has been latched and padlocked to preclude entry. Daylight enters into the facility through window wells at each end. Surrounding each window well is a three foot steel fence. The south fence has its gate padlocked to preclude entrance into the window well area. The windows are having 1/8 inch steel plates installed to preclude any radiation from reaching outside of the building. The plate will cover the upper half of the window and will be below the grade of the adjacent parking lot. The entrance to the facility is through the building basement. My office has access to the basement via a spiral stair case. There is a double door into the facility. The first door is constructed of steel with a a wire mesh glass insert and is locked. Internal to this door, on the same frame is another door constructed of steel bars. The steel bar will be locked with a security lock and cable/chain.

When the source is exposed the outer door will be locked and a warning circuit will be activated that will announce the presence of a radiation beam.

The collimator will always be installed on the device when it is in our facility. The device will always be padlocked to prevent inappropriate use when not under my staff's direct supervision.

The Xetex monitor will be installed in the room to maximize its efficiency for detecting when the source is in its exposed position. Care will be taken to ensure that the device is located a sufficient distance that the leakage from the source shielding does not precipitate the devices alarm. We plan on permanently mounting the Xetex above the device on a ceiling concrete beam at a distance of 13 from the source. At this point the device will be within the 30 degree penumbra, at a

**height of approximately 5 feet above the device. It will be hard wired into the buildings electrical circuit.**

**The video camera will be placed on the equipment cart that will hold the meter being calibrated. The monitor will be located outside of the penumbra of the beam in an unexposed corner of the room. A desk and other equipment necessary to record information will be located in this position.**

10. Radiation Safety Program

Identify the range of instruments to be calibrated so that it is clear that the 1.1 Ci source will be adequate to calibrate each scale.

**The range will only be used for the calibration of equipment owned by or used at the NASA Ames Research Center. We will not provide calibration services to outside organizations.**

**The source certification calibration is NIST traceable to an accuracy of +/- 5%.**

**A Ludlum Model 6 Gamma Radiation Counter will be retained in the calibration facility on a permanent basis. This meter has a range of 0-1000 mR/hr and is referred to in the literature as a radiographers compensated survey meter. The meter will operate up to an exposure of 200 R/hr at which it will then saturate. The meters energy range is 60 keV - 3 MeV +/– 15%. The detector is an internal G-M detector with a 0.8 mm tin shield**

| Type | Number Available | Radiation Detected | Sensitivity Range | Use |
|---|---|---|---|---|
| Bicron Radiographer | 2 | gamma and X-ray | 0-1000 mR/hr | Radiography surveys |
| Dosimeter 862 | 6 | gamma and X-ray | 0-200 mR/hr | Personnel Dosimeter |
| Eberline E-500B | 2 | B/gamma and X-ray | 0-2000 mR/hr | General area survey/rad receival |
| Eberline Model 6 | 3 | gamma and X-ray | 0-1000 mR/hr | Radiography surveys |
| Eberline RO-3C | 2 | gamma and X-ray | 0-5000 mR/hr | Ion Chamber for area survey |

| | | | | |
|---|---|---|---|---|
| **NDS RA-500** | **4** | **gamma and X-ray** | **Alarming** | **Personnel Dosimeter** |
| **Victoreen 400** | **1** | **gamma and X-ray** | **0-1000 mR/hr** | **General Survey** |
| **Victoreen 450** | **1** | **gamma and X-ray** | **0-500000 mR/hr** | **X-ray survey** |
| **Victoreen 541R** | **6** | **gamma and X-ray** | **0-200 mR/hr** | **Personnel Dosimeter** |
| **Xetex 415BC-1** | **5** | **gamma and X-ray** | **Alarming** | **Personnel Dosimeter** |
| **Xetex 501A-2** | **1** | **gamma and X-ray** | **0-800 mR/hr** | **Area monitor** |

Areas outside of the calibration range will be maintained at background levels. Individual exposure rates outside of the facility will be well below the regulatory level of 100 mR/year. The brig area is below grade except for the window wells. The window wells are protected by a three foot high fence that extends five feet from the buildings wall and totally surrounds the window wells.

Records of all radiation calibration are maintained in the radiation safety office. Records of daily use and reference checks are maintained. We have retained records on meter calibration and daily checks for the past ten years. Our archival records have been maintained since 1987. Attached is a copy of our calibration form that we have developed for use at this facility. We will use this form for our exposure rate calibrated meters as well as our pulse rate calibrated meters. We use a Ludlum 500-3 pulser to calibrate our count rate meters. It is annually returned to the manufacturer for it's annual calibration during March of each year.

The certificate of instrument calibration contains the following information:

a. Authorized users name ( the address for all instruments is our facility. All users records are maintained in the separate authorized radiation user files.

b. Calibration data, such as instrument readings at a point on a given scale versus exposure rated (mR/hr)
c. Any specific comments on the calibration or calibration data.
d. Identification of the calibration source or sources used in calibrating nuclide and exposure rates at specified distances (including calibration accuracy).
e. Identification of the individual performing the calibration. and
f. The date of calibration

# Certificate of Calibration

Science Applications International Corporation
NASA Ames Research Center
Mail Stop 19-21
Moffett Field, California 94035-1000
(415) 604-3573 FAX: (415) 604-2034

**Authorized User:** **Project:**

| | | |
|---|---|---|
| **Inst Mfg:** | **Probe Mfg:** | **Cal Date:** |
| **Inst Model:** | **Probe Model:** | **Cal Due:** |
| **Inst Ser No:** | **Probe Ser No:** | **Cal Interval:** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Operating Voltage** | _____ V | **F/S Response** | ☐ | **Alarm Set** | _____ | | |
| **Threshold Voltage** | _____ mV | **Zero Reset** | ☐ | **Window** | _____ | keV | |
| **Input Voltage** | _____ mV | **Audio** | ☐ | **Bkg Subtract** | _____ | cpm | |
| **Temperature** | _____ C | **Battery** | ☐ | **HV Ref low** | _____ | V | |
| **Relative Humidity** | _____ % | **Mech Check** | ☐ | **HV Inst Low** | _____ | V | |
| **Correction Factor** | _____ mm | **Battery Voltage** | ☐ | **HV Ref Hi** | _____ | V | |
| | | | | **HV Inst Hi** | _____ | V | |

| **Scale** | | **Reference** | **Response** |
|---|---|---|---|
| _____ | 20% | _____ | _____ |
| | 80% | _____ | _____ |
| _____ | 20% | _____ | _____ |
| | 80% | _____ | _____ |
| _____ | 20% | _____ | _____ |
| | 80% | _____ | _____ |
| _____ | 20% | _____ | _____ |
| | 80% | _____ | _____ |

**+/- 10%** ☐ **10-20%** ☐
**Out of Tolerance** ☐ **Requries Repair** ☐
**Pulser** _____
**Pulser SN** _____
**Cal Source** Cs-137, 1.1 Ci
**Cal Source SN** 64465
**Cal Source Spec** +/- 5. %
**Detector Bkg** _____

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Source** | _____ | **SN** | _____ | _____ cpm | **Eff.** | _____ % | **Check Source** | _____ |
| **Source** | _____ | **SN** | _____ | _____ cpm | **Eff.** | _____ % | **Check SN** | _____ |
| **Source** | _____ | **SN** | _____ | _____ cpm | **Eff.** | _____ % | **Check Resp.** | _____ |

**Field Changes** _____

**Comments** _____

Calibrated by :_____ Date:_____

SAIC certifies that the above instrument has been calibrated by instruments and standards Tracable to NIST or to the calibration facilities of other International Standards Organization members or have been derived from accepted values of natural physical constants, or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of MIL-STD-45662A and ANSI N232-1978.

572425

U.S. NUCLEAR REGULATORY COMMISSION
REGION V

.TB 00/00/00 1/28/97

TELEPHONE OR VERBAL CONVERSATION RECORD (MS-15)

TIME 1:15 00:00 am/pm

[ ] INCOMING CALL [ ] OUTGOING CALL [ ] VISIT

| PERSON CALLING: | OFFICE/ADDRESS: | PHONE NUMBER: |
|---|---|---|
| | | |

| PERSON CALLED: | OFFICE/ADDRESS: | PHONE NUMBER: |
|---|---|---|
| Bill Vermeere | NASA | (415) 604-3573 |

CONVERSATION

SUBJECT - ~~Application~~ Letter of October 24, 1996

SUMMARY -

The cesium-137 source is the one currently in the J.L. Shepherd irradiator. They had not planned to change-out the source. They will be using it to calibrate their instruments, only. Bill Vermeere and two technologists with nuclear navy experience will operate the unit. The facility is in ~~an~~ a currently unused prison area. They are adding shielding to the window areas, which are below grade. Security is good, and includes a fence around the building. Keeping doses to less than 100 mrem/yr. is not ~~expected~~ to be a problem. New World Technologies was the former owner of the unit. I explained that I had questions concerning documenting training for personnel, describing the facility, and documenting calibrations, as performed. I will look

| REFERRED TO: | [ ] ADVISE ME OF ACTION TAKEN |
|---|---|
| ACTION REQUESTED: | INITIALS: |
| | DATE: |
| ACTION TAKEN: | INITIALS: |
| | DATE: |

NRC FORM 218 REV-0 8/93 [ET/Ldc-RIV]

U.S. NUCLEAR REGULATORY COMMISSION
REGION V

DATE 00/00/00

TELEPHONE OR VERBAL CONVERSATION RECORD

TIME 00:00 am/pm

[ ] INCOMING CALL [ ] OUTGOING CALL [ ] VISIT

| PERSON CALLING: | OFFICE/ADDRESS: | PHONE NUMBER: |
|---|---|---|
| PERSON CALLED: | OFFICE/ADDRESS: | PHONE NUMBER: |

CONVERSATION

SUBJECT -

SUMMARY -

pertenint information. Mr. Vermeere stated that he would reply promptly.

---

They plan to have only one, 1 uCi Cm-244 source. The "authorized use" condition that I had drafted will be adequate.

– B. Prange

| REFERRED TO: | [ ] ADVISE ME ON ACTION TAKEN |
|---|---|
| ACTION REQUESTED: | INITIALS: |
| | DATE: |
| ACTION TAKEN: | INITIALS: |
| | DATE: |

NRC FORM 218 REV-0 8/83 [ET/Ldc-R1V]

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV

Walnut Creek Field Office
1450 Maria Lane
Walnut Creek, California 94596-5368

NOV - 5 1996

National Aeronautics and
Space Administration
Ames Research Center, Mail Stop DQH 218-1
ATTN: William R. Vermeere
Radiation Safety Officer
Moffett Field, California 94035-1000

SUBJECT: ACKNOWLEDGMENT OF REQUEST FOR LICENSING ACTION

REFERENCE: Letter dated October 24, 1996

We have completed the administrative review and initial processing of your application.

Please note that the technical review may identify additional omissions in the submitted information or technical issues that require additional information.

Amendment actions are normally processed within 90 days, unless the technical review identifies:

- Major technical deficiencies
- Policy issues that require input and coordination with other NRC Regional offices, Agreement State offices, or NRC's Office of Nuclear Materials and Safeguards

Any correspondence about this application should reference the Control number listed below.

Sincerely,

Beth A. Prange

Beth A. Prange
Senior Health Physicist (Licensing)
Materials Branch

Docket No. 030-20435
License No. 04-07845-04
Control No. 572425

bcc:
Docket File

To receive a copy of this document, indicate in the box "C" - Copy without attachment/enclosure "E" - Copy with attachment/enclosure "N" - No Copy

| OFFICE | RIV:AO:NMLB | N | | N | | | | |
|---|---|---|---|---|---|---|---|---|
| NAME | J. Garcia | | B. Prange BP | | | | | |
| DATE | 11/15/96 | | 11/15/96 | | | | | |

Rec'd 11-1-96

Amendment

National Aeronautics and
Space Administration

**Ames Research Center**
Moffett Field, CA 94035-1000


96 OCT 30 PM 12

Reply to Attn of

DQH 218-1

OCT 24 1996

James L. Montgomery
Materials Branch
Nuclear Regulatory Commission
Region IV, WCFO
Walnut Creek, CA 94596

Subject: Amendment of License #04-07845-04
Docket # 030-20435

Dear Mr. Montgomery

The NASA Ames Research Center is requesting a amendment to its NRC Byproduct Materials License No. 04-07845-04.

We would like to add the following two sealed sources to our license.

| 6 Byproduct, source and/or special nuclear material | 7. Chemical and/or physical form | 8. Maximum amount that licensee may possess at any one time under this license |
|---|---|---|
| T. Curium 244 | T. Sealed Source | T. 1 microcurie |
| U. Cesium 137 | T. Sealed Source | T. 1 Curie |

9. Authorized Use

T. For use in a Tissue Equivalent Proportional Counter(TEPC), manufactured for Boeing. The TEPC detector will be be mounted in the Q-Bay vertical rack of a NASA ER2 aircraft.

U. The cesium source will be used in a J.L. Shepherd & Associates Model 28 single source gamma calibrator.

The curium-244 source is part of a device designed by Boeing Co. It will be mounted in a holder and then installed inside a stainless steel canister and is used to calibrate and check a Tissue Equivalent Proportional Counter (TEPC). This assembly is air tight and very robust. The curium-244 source will be moved by a magnet. This will not be a permanently mounted detector. It will be in use for a limited number of experimental flights planned for later in 1996. Attached, please find a copy of a product information sheet from Isotope Products

572425

Laboratories for the source supplied to Far West Technology, Inc., the manufacturer of the TEPC.

The J.L. Shepherd & Associates cesium-137 source will be used in a model 28 calibrator as the calibration source for laboratory survey equipment requiring biannual calibration for exposure rate measurements. The calibration source will be located in the basement of Building 19 at the NASA Ames Research Center. The room is mostly below grade with an area of 28' by 56'. The window boxes at the ends will be shielded to preclude exposure ever exceeding 2 mR in any one hour while the instrument is in use. Our current plan is to obtain the source from New World Technologies. The source is currently stored at the J.L. Shepherd and Associates hot facility. Attached, please find the "Radiation Safety and Operational Manual for the NASA Ames Exposure Rate Calibration Range."

Sincerely,

William R. Vermeere
Radiation Safety Officer
NASA Ames Research Center

David King
Industrial Hygienist
NASA Ames Research Center

Attachments:

cc: C. Burrous
S. Brisbin
S. Olliges
L. Jahnke
R. Reynolds
J. Arvesen
J. Barrileaux

Attachment A

ISOTOPE PRODUCTS LABORATORIES 1800 NORTH KEYSTONE ST. BURBANK, CA. 91504
(818) 843-7000 FAX (818) 843-6168

# Nominal Source Data Sheet

Customer: FAR WEST TECHNOLOGY P.O. No. 3053 Date: NOV. 24, 19

Catalog No. CUSTOM Quantity: 25

Capsule Type: STAINLESS STEEL ROD

Nature of Active Deposit: EVAPORATED AND DIFFUSION BONDED CURIUM OXIDE

Active Diameter/Weight: 0.062" DIA.

Backing: STAINLESS STEEL

Cover: 200 $\mu g/cm^2$ Au CAUTION! DELICATE SURFACE DO NOT WIPE ACTIVE AREA

| Isotope | Source No. | Activity | Date |
|---|---|---|---|
| Cm-244 | 402-SB-1 THRU 4<br>402-SB-6 THRU 6 | 25 x 1 $\mu$Ci | NOVEMBER 15, 19 |

Remarks:
LEAK TEST CERTIFICATE ATTACHED

ISOTOPE PRODUCTS LABORATORIES
Burbank, CA 91504
(818) 843-7000

# LEAK TEST CERTIFICATE

CUSTOMER Far West Technologies P.O.# 3053

CATALOG # Custom CAPSULE TYPE Stainless Steel Rod

RADIONUCLIDE Cm-244 NOMINAL ACTIVITY 1 μCi

SERIAL NUMBER(S) 402-SB-1 thru 4; 402-SB-6 thru 26 NUMBER OF UNITS 25

THE LEAK TESTS INDICATED BY THE CHECKED BOXES WERE APPLIED TO DETERMINE THE INTEGRITY OF THE SOURCES IN THIS SHIPMENT.

☐ STANDARD WIPE TEST

The source is wiped over its entire surface with a moistened paper disk. After drying, the disk is checked for activity using a proportional counter or end-window G.M. tube. Activity levels exceeding 0.001 μCi beta-gamma or 0.0001 μCi alpha are cause for rejection of the source.

☐ SOAK TEST

The source is immersed in distilled water and maintained at 50°C ±10°C for a minimum of four hours. After removal of the source the liquid is a) checked for activity using a liquid scintillation counter, or b) evaporated in a planchet and the residue is checked for activity using a windowless proportional counter or end-window G.M. tube. Activity levels exceeding 0.001 μCi beta-gamma or 0.0001 μCi alpha are cause for rejection of the source.

☐ SOAK TEST--BERYLLIUM WINDOW

The source is immersed in distilled water and maintained at 50°C ±10°C for 20 minutes. The entire surface of the source is then wiped with a moistened cotton swab or filter paper disk. After drying, the swab or disc is checked for activity using a proportional counter or end-window G.M. tube. Activity levels exceeding 0.001 μCi beta-gamma or 0.0001 μCi alpha are cause for rejection of the source.

☐ GAS SOURCE TEST (Radioactive Gas)

The source is placed in a vacuum desiccator and maintained at less than 1 mm Hg for not less than 12 hours. The activity is checked by introducing air into the desiccator and monitoring the air with an end-window G.M. tube. Activity levels exceeding 1000 cpm are cause for rejection of the source.

☐ OTHER LEAK TEST

☑ LEAK TEST NOT APPLICABLE

The active area of this source is uncovered or is protected by a very thin coating. Although the deposit is adherent, it is not designed or certified to pass a standard leak test. The inactive portions of the sources have been checked using the standard wipe test. Levels of removable activity did not exceed 0.001 μCi beta-gamma or ~~0.0001 μCi~~ 22.5 pCi alpha at the time of shipment.

Nov. 24, 1992
Date

Signature

IPL Reference Number 402-SB

Attachment B

# Radiation Safety and Operational Manual for NASA Ames Exposure Rate Calibration Range

NASA Ames Research Center

8/19/1996

**J. Device Certification**
**K. $^{137}$Cs Decay Curve**
**L. Dose Rate vs. Distance Curve for Model 28-6A, Serial Number 10240, Calibrator with 1.2 Ci $^{137}$Cs Source**
**M. Video Monitor System**
**N. Calibration Facility Location in Building 19, Basement Brig Area.**

# Radiation Safety and Operational Manual for NASA Ames Dose Rate Calibration Range

## I. Radiation Safety

### A. Calibration Source

The calibration source emits an intense beam of ionizing radiation in the area subtended by the beamport[1] (cone). A much lower level of scattered ionizing radiation extends in a penumbra surrounding the primary beam[2]. **The operator shall never stand in the direct beam while operating the calibration source.** The operator should also avoid standing in the penumbra adjacent to the primary beam. The unit must be operated at all times from a position behind the calibrator on the opposite side from the beamport. The operator should at all times limit access to the calibration range to only personnel required for the job.

### B. Range Access

1. Only persons on the Calibration Range access list shall have unsupervised access to the calibration device. Only the Radiation Safety Officer (RSO) shall update the list. Personnel who have access will have the proper training and experience documentation on file.

2. The inner cell door gives access to a "High Radiation Area"[3] while the source is in the exposed position. For this reason the outer door shall always be secured while the source padlock is removed. A rope barrier with a "Caution Radiation Area" sign shall be placed

[1] The M-28 Calibrator contained a 1.2 Ci source of $^{137}Cs$ on September 26, 1989, with an exposure rate of 364 mR/hr at a distance of one (1) meter.

[2] The primary beam from the M-28 Calibrator forms a circular cone with a 30° angle or 15° from the center of the beamport. A <30 mR/hr exposure line exists at 30° from the center of the primary beam.

# Radiation Safety and Operational Manual for NASA Ames Exposure Rate Calibration Range

NASA Ames Research Center

8/19/1996

# Radiation Safety and Operational Manual for NASA Ames Dose Rate Calibration Range

## Table of Contents

J. Device Certification
K. $^{137}$Cs Decay Curve
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# Radiation Safety and Operational Manual for NASA Ames Dose Rate Calibration Range

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across the outer doorway to preclude immediate access to the area. A red light will be activated when the source is raised from its shielded position. An electrical circuit is provided to indicate the source position and it will be connected to a revolving red light that will be located above the entrance at the outer door. A XETEX® 501A Radiation Area Monitor will be set alarm when the exposure rate exceeds 2 mR/hr at a controlled boundary.

## C. Personnel Dosimetry

Access to the calibration range requires proper personnel dosimetry[4]. Personnel who enter the range for any reason shall wear a TLD whole body dosimeter. Personnel who are authorized to perform instrument calibration shall wear finger dosimeters in addition to whole body dosimeters. Additionally, prior to access to the calibration range, individuals are required to sign out two (2) zeroed direct reading pocket dosimeters (PD's), with a 0-200 mR range. Upon entering the range, individuals shall sign in the Calibration Range Use Log, recording the PD's serial number and exposure readings on entry and exit of the calibration range. If at any time the PD's read off scale, the person shall halt operations and immediately depart the area. The RSO shall be immediately notified and person's TLD dosimeters shall be taken to Radiation Detection Company for immediate readout. The RSO shall initiate an investigation and take all necessary actions to prevent additional radiation exposure. The RSO shall maintain a written report for review by the Nuclear Regulatory Commission (NRC) auditors.

[4] As required by 10CFR20.1601.

## II. ALARA

All operations shall be conducted as to minimize exposure to personnel at all times. The RSO shall review the operational procedures and make changes as necessary to ensure that all exposures to radiation are maintained as low as reasonably achievable (ALARA)[5]

## III. Leak Test and Quarterly Source Inventories

The Calibration Range source must be leak tested every six (6) months[6].

A. Locate source in "OFF" position

B. Wipe the upper end of the source rod where it exits from the top of the shielded container with a piece of absorbent material. Wiping the area where the operating tower meets the top of the shield is acceptable. The wipes will be analyzed in accordance with acceptable NASA Ames procedures for sealed source leak testing.

C. If contamination is measured in excess of 0.005 μCi, the device shall be removed from service immediately and the manufacturer, J.L. Shepherd®, notified. The RSO shall notify the NRC as required.

---

[5] As defined by 10CFR35.30.
[6] As required by 10CFR35.59.

# IV. Operation Procedures for J.L. Shepherd® Model 28 Calibrator[7]

## A. Unit Operation

1. Remove the padlock which locks the source in the "OFF" position during shipment, using the key provided.

   *Note: This padlock is to be used to lock the source in the "OFF" position at any time the source is not in use.*

2. To expose the source, grasp the black operating knob (while standing outside the calibration range opposite the beam port) and raise it until the spring loaded detent engages the depression on the operating shaft. **The source is now exposed.**

3. To return the source to the "OFF" position, push the operating knob down until the pin on the shaft strikes the stop on the calibrator top. **The source is now fully shielded.**

4. Position indicating lights operate when the Model 28 is plugged into the 117 volt circuit. The "ON" light illuminates whenever the source is removed from the "OFF" position.

[7] Thes instructions are for the basic operation of the unit. For calibration range operation review the attached ANSI N323-1978 Standard "Radiation Protection Instrumentation Test and Calibration.

B. Maintenance

1. **DO NOT** lubricate the source rod at any time, in any way. LUBRICATION OF ANY KIND WILL VOID ALL WARRANTIES.

2. Operate the unit in a clean atmosphere. Do not permit dirt or other particles to fall into the hole at the top of the unit. When not in operation, it is recommended that the unit be covered.

C. **Collimator**

The collimator is attached by installing two screws in the outer bolt circle (in line with the locating pins) at the horizontal midline of the collimator, while grasping the collimator. The top of the collimator is indicated by a "T" stamped into the metal matrix. The collimator may be removed by reversing the procedure.

D. **Attenuators**

The attenuators are installed by sliding the desired attenuator(s) over the two studs provided on the face of the collimator. Verify the Model 28 is in the "OFF" position. **(USE SURVEY METER, DO NOT DEPEND ON THE LIGHTS).**

The attenuators on the unit are cumulative. To provide X-2 attenaution, use the X-2 attenuator. To provide X-4 attenuation, use the X-2 and X-4 attenuator with the X-4 attenuator mounted outboard of the X-2 attenuator. For X-10 attenuation, use the X-2, X-4, and the X-10 attenuators. For X-100 attenuation use X-2, X-4, X-

10, and X-100 attenuators with each higher attenuation plate mounted outboard of the previous plate.

| | |
|---|---|
| X-2 | X-2 |
| X-4 | X-2 + X-4 |
| X-10 | X-2 + X-4 + X-10 |
| X-100 | X-2 + X-4 + X-10 + X-100 |

**All calibrations made with attenuators should be made at a source detector distance of one (1) meter or greater.**

### E. Safety Features

The shield provides for full shielding in all directions at all times, except out the beamport when the source in the "ON" position.

Position indicating lights (green = "OFF", red = "ON"), located at the top of the collimator show the source position at all times. The "ON" light is activated whenever the source is not fully "OFF".

### F. Emergency Procedures

If , at any time, the operation of the source rod becomes difficult, the calibrator shall be removed from service. The RSO shall be immediately notified and the manufacturer, J.L. Shepherd, shall be contacted for further instructions.

## V. J.L. Shepherd® Model 28 Calibrator Appendix

A. Manufacturers data sheet
B. Calibration Certificate
C. American National Standard "Radiation Protection Instrumentation Test and Calibration"

D. Installation and Operation Manual for Model 28 Single Source Gamma Calibrator
E. Leak Test Certification
F. Shipping Documentation
G. Product Warranty
H. Electrical Schematic
I. Attenuator Certification
J. Device Certification
K. $^{137}$Cesium Decay Curve
L. Dose Rate vs. Distance Curve for Model 28-6A, Serial Number 10240, Calibrator with 1.2 Ci $^{137}$Cs Source
M. Video Monitor System
N. Calibration Facility Location in Building 19, Basement Brig Area

# A. Manufacturers data sheet

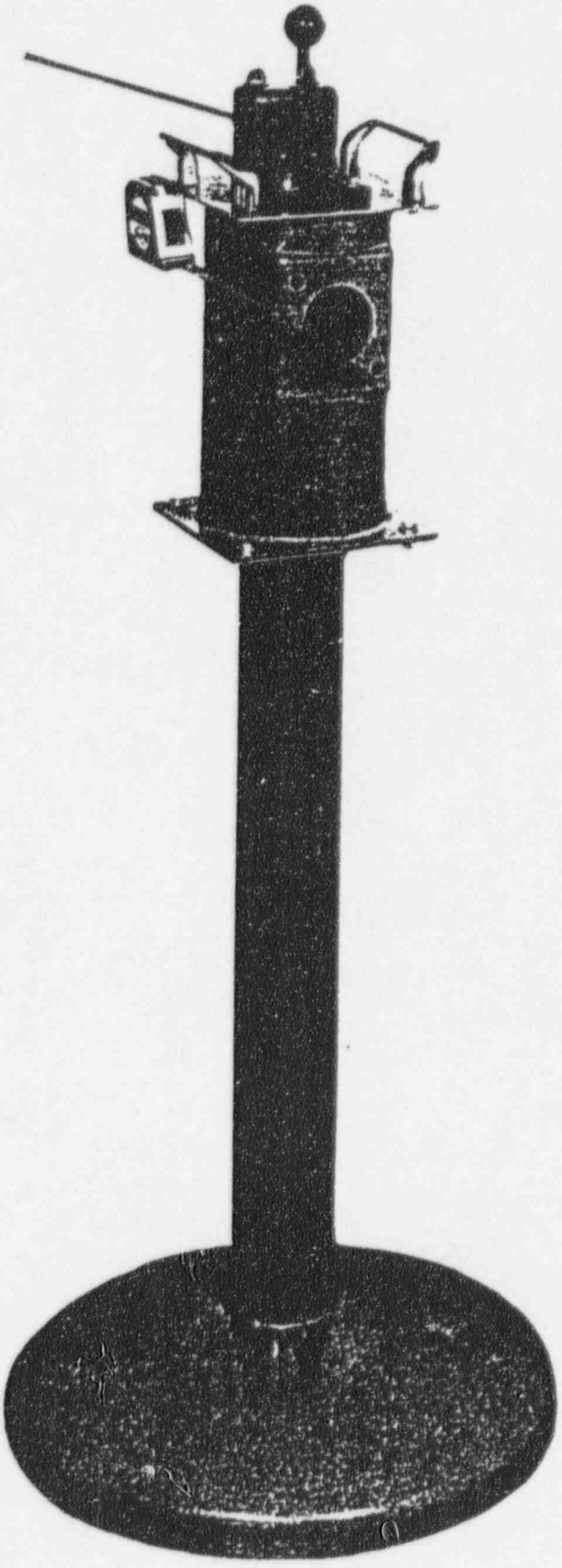
Model 28-5 and 28-6 are manually operated, Beam Calibrators, for calibrating all types of radiation detection instruments. Model 28-5 incorporates either a 120 or a 200 mCi. $^{137}Cs$ source. Model 28-6 incorporates either a 600 mCi. or a 1.2 Ci. $^{137}Cs$ source. A slip-on attenuator (X-10) is provided with all units. For additional details on Model 28's with loadings up to 130 Ci. $^{137}Cs$, see the Beam Calibrator/Irradiator Catalog.

**LOW EXTERNAL RADIATION LEVELS:** $\leqslant 5$ mR/hr (typically $\leqslant 2$ mR/hr) at one foot from the surface, with the source in the "Off" position, and behind the Calibrator with the source in the "On" position.

**OPERATION:** The source is fixed to the end of the shielded operating rod; moved from the completely shielded "Off" position to the exposed "On" position by means of an operating handle, located on top of the unit. Source position indicating lights and a padlock to lock the source in the "Off" position, are provided for all units.

**STAND:** All units include a stand to provide a 36" beam height.

**CC-6 COLLIMATOR OPTION:** For use with Model 28-6A Calibrator. Provides constancy checks for 0.6 cc ionization/therapy chambers placed in contact with source-tube. Dose rate is approximately 10 R/min.



J L SHEPHERD and Associates
1010 Arroyo St., San Fernando, CA 91340

| MODEL | $^{137}Cs$ SOURCE* | DOSE RATE 30 Cm | DOSE RATE 1.0 meter | BEAM PORT** CIRCULAR |
|---|---|---|---|---|
| 28-5 | 120 mCi. | 440 mR/hr | 40 mR/hr | 45° |
| 28-5A | 200 mCi. | 730 mR/hr | 66 mR/hr | 45° |
| 28-6 | 600 mCi. | 2.2 R/hr | 200 mR/hr | 30° |
| 28-6A | 1.2 Ci. | 4.4 R/hr | 400 mR/hr | 30° |

*All sources certified "Special Form".
**Other beam angles: 15°, 20°, and 30° are available upon request. Beam port, as listed, will be supplied unless otherwise instructed.

**CERTIFICATION:** Units are calibrated using National Bureau of Standards traceable Roentgen Meters, accuracy ±5%. Calibration, External Radiation Level and Leak Test Certificates are provided with each unit.

**LICENSING:** These units appear in the "Approved Sources and Devices" Catalog of the USNRC.

**MANUALS:** Provided with each unit.

**SHIPMENT:** All units meet DOT 7A specifications and are shipped with source installed, ready for operation.

**WARRANTY:** Free parts and service for three -months following delivery, with replacement of faulty components for an additional nine months.

# B. Calibration Certificate

J.L. SHEPHERD & ASSOCIATES
1010 ARROYO AVE., SAN FERNANDO, CALIFORNIA 91340-1822
818-898-2361 FAX 818-361-8095

# CALIBRATION CERTIFICATE

TO:

P.O.: 8905-016

SOURCE: 1.2Ci $^{137}Cs$, 3M Type 4D6L Capsule, S.N. 64465
Recycled Source - has been completely tested and is recertified to meet current USNRC requirements.

MOUNTING: J.L. Shepherd & Associates Model 28-6A Calibrator, S.N. 10240

INSTRUMENT: All calibration is done with MDH Industries Model 2025 X-Ray Monitor, S.N. 2806, with 180cc Probe, S.N. 6664. This meter is calibrated by MDH Industries using a Model 10X5-6 modified 3-terminal Ion Chamber, S.N. X2, National Institute of Standards and Technology Report #DG 8640/87. Accuracy ± 5%.

POSITION: Centered in Beamport

| Distance (cm) | Output (mR/hr) |
|---|---|
| 100 | 364 |

DATE: September 26, 1989

J.L. SHEPHERD & ASSOCIATES

By _____

# C. American National Standard "Radiation Protection Instrumentation Test and Calibration"

ATTACHMENT B

ANSI N323-1978

# American National Standard

# radiation protection instrumentation test and calibration

## Contents

# American National Standard Radiation Protection Instrumentation Test and Calibration

## 1. Scope

This standard establishes calibration methods for portable radiation protection instruments used for detection and measurement of levels of ionizing radiation fields or levels of radioactive surface contamination. For purposes of this standard, portable radiation protection instruments are those which are carried by hand to a specific facility or location for use. Although this standard is specific to portable radiation protection instrumentation, the basic calibration principles may be applicable to radiation detection instrumentation in general.

Included within the scope of this standard are conditions, equipment, and techniques for calibration as well as the degree of precision and accuracy required. Alpha, beta, photon, and neutron radiations are considered. Passive integrating dosimetric devices such as film, thermoluminescent, and chemical dosimeters are outside the scope of this standard, but the basic principles and intent may apply. In cases where integrating capability is included along with rate measurement or detection, this standard shall apply.

Throughout these criteria, four verbs have been used to indicate the degree of rigor intended by the specific criterion. "Shall" and "will" indicate a minimum criterion that must be met, while "should" and "would" indicate a criterion that is recommended as good practice and is to be applied when practical.

## 2. Definitions

Technical terminology used in this standard is generally consistent with the definitions in the American National Standard Glossary of Terms in Nuclear Sciences and Technology, N1.1-1976 [1],[1] and ICRU Report 20 [2]. The following terms are defined specifically for use within this standard.

accuracy. The degree of agreement of the observed value with the true or correct value of the quantity being measured.

calibrate. To determine (1) the response or reading of an instrument relative to a series of known radiation values over the range of the instrument or (2) the strength of a radiation source relative to a standard.

check source. A radioactive source, not necessarily calibrated, which is used to confirm the continuing satisfactory operation of an instrument.

decade. Synonymous with power of ten.

detection limit. The extreme of detection or quantification for the radiation of interest by the instrument as a whole or an individual readout scale. The *lower detection limit* is the minimum quantifiable instrument response or reading. The *upper detection limit* is the maximum quantifiable instrument response or reading.

detector. A device or component which produces an electronically measurable quantity in response to ionizing radiation.

effective center. The point within a detector that produces, for a given set of irradiation conditions, an instrument response equivalent to that which would be produced if the entire detector were located at the point.

energy dependence. A change in instrument response with respect to radiation energy for a constant exposure or exposure rate.

---

[1] Numbers in brackets refer to those of the references in Section 7 of this standard.

extracameral. Pertaining to that portion of the instrument exclusive of the detector.

geotropism. A change in instrument response with a change in instrument orientation as a result of gravitational effects.

instrument. A complete system designed to quanitify one or more particular ionizing radiation or radiations.

overload. Response of less than full scale (that is, maximum scale reading) when exposed to radiation intensities greater than the upper detection limit.

photon. A quantum of electromagnetic radiation irrespective of origin.

range. The set of values lying between the upper and lower detection limits.

readout. The device that conveys information regarding the measurement to the user.

reproducibility (precision). The degree of agreement of repeated measurements of the same property expressed quantitatively as the standard deviation computed from the results of the series of measurements.

response. The instrument reading.

sensitivity. The ratio of a change in response to the corresponding change in the field being measured.

standard (instrument or source) (1) national standard. An instrument, source, or other system or device maintained and promulgated by the U.S. National Bureau of Standards as such.

(2) derived or secondary standard. A calibrated instrument, source, or other system or device directly relatable (that is, with no intervening steps) to one or more U.S. National Standards.

(3) laboratory standard. A calibrated instrument, source, or other system or device without direct one-step relatability to the U.S. National Bureau of Standards, maintained and used primarily for calibrated and standardization.

test. A procedure whereby the instrument, component, or circuit is evaluated for satisfactory operation.

transfer instrument. Instrument or dosimeter exhibiting high precision which has been standardized against a *national* or *derived standardized* source.

uncertainty. The estimated bounds of the deviation from the mean value, generally expressed as a percent of the mean value. Ordinarily taken as the sum of (1) the random errors at the 95 percent confidence level and (2) the estimated upper limit of the systematic error.

unwanted radiation. Any ionizing radiation other than that which the instrument is designed to measure.

## 3. General Discussion

The operational requirements of radiation protection instrumentation are set forth in the recommendations of various commissions and committees [2],[3]. Additionally, the user may establish the need for different or more restrictive requirements. The ability to meet these requirements will depend not only on the instrument capabilities but also on periodic recalibration, preventative maintenance, and testing of the instruments.

For the purpose of this standard, new instruments are assumed to have been evaluated by the manufacturer to assure that the instruments are working properly. This evaluation, which is described in more detail by Zuerner and Kathren [4] involves a measurement of the characteristics of the instrument under design conditions. The evaluation includes determination of some or all of the following characteristics.

*Nonradiological Characteristics:*

(1) Physical construction, that is, safety, utility, weight, and ease of decontamination

(2) Effect of shock, sound and vibration, electric transients, RF energy, magnetic fields, high humidity, or other environmental influences

(3) Extent of switching transients, capacitance effects, geotropism, and static charge effects

(4) Power supply, including stability and battery life

*Radiological Characteristics:*

(1) Range, sensitivity, linearity, detection limit, and response to overload conditions*

(2) Accuracy and reproducibility*

(3) Energy dependence*

(4) Angular dependence

(5) Response to ionizing radiations other

than those intended to be measured

(6) Temperature and pressure dependence*

Certain tests from the above list (indicated by *) should be repeated routinely because aging of components, changes in available power (battery aging), and replacement of components may affect the calibration. Since the reproducibility of an instrument is critically important such a test should be performed regularly.

Periodic recalibration is distinct from a field test or simple evaluation with a check source. It includes a precalibration check followed by adjustment and calibration as described in Section 4 and perhaps a recheck of response, if any, to unwanted radiations. During the precalibration check, the instrument is tested to assure that certain operating requirements, specified by the manufacturer, are met. Thus, the instrument is determined to be in proper working order prior to calibration and adjustment.

If the instrument is to be adjusted or used for conditions other than those for which it was designed, such as use outside the designed energy range or under different environmental conditions, calibration for these conditions is necessary. Similarly, if the instrument is physically altered such that the previous calibration result could be invalidated, recalibration is required.

Components may change values with time or even fail. An instrument check must be made prior to use to ensure that (1) the instrument is operating properly, and (2) the response to a given check source is the same as it was immediately following calibration.

Radiation fields used for calibration must be thoroughly understood in terms of quality, quantity, and reproducability. Radiation sources and standard instruments that may be used in calibration are discussed in the appendix. A good review of calibration assemblies [5] should be consulted by those who calibrate instruments. Such problems as charged particle equilibrium, scattered or unwanted radiations from the source, and ambient background radiation must be taken into account quantitatively.

## 4. Inspection, Calibration, and Performance Test Requirements

4.1 Precalibration. The following conditions shall be established prior to exposing the instrument to a source for adjustment and calibration:

(1) The instrument should be free of significant radioactive contamination

(2) The meter shall be adjusted to zero or the point specified by the manufacturer using the adjustment or adjustments provided

(3) The batteries or power supply shall comply with the instrument manufacturer's specification

(4) The instrument shall be turned on and allowed to warm up for the time period specified by the manufacturer

(5) Electronic adjustments such as high voltage shall be set, as applicable, to the manufacturer's specifications

(6) Geotropism shall be known for orientation of the instrument in the three mutually perpendicular planes, and this effect shall be taken into account during calibration and performance testing

(7) The performance of any internal sampling time base in digital readout instruments should be verified as being within the manufacturer's specifications

4.2 Primary Calibration

4.2.1 General. The reproducibility (precision) of the instrument should be known prior to making calibration adjustments. This is particularly important if the instrument failed to pass the source check (see 4.6) or if repairs have been made. To check reproducibility, the instrument should be exposed to a radiation field three or more times under identical conditions. The readings obtained should normally not deviate from the mean value by more than ± 10 percent.

The response of an instrument may vary as a function of such parameters as energy, temperature, pressure, humidity, and source/detector geometry. The primary calibration should be accomplished with known values of these parameters. The calibration should be performed under the conditions specified by the manufacturer. Alternatively, any of these parameters may be fixed to the condition in which the instrument is to be used routinely, and notation made of these values. The steps that constitute the primary calibration when taken in conjunction with 4.1 are described in 4.2.2.

4.2.2 Readout Scale and Linearity Calibration and Adjustment

4.2.2.1 *Linear Readout Instruments.* Linear instruments usually have a scale selection

switch. If controls are provided for each scale, adjustment of each shall be made according to the manufacturer's specifications or at the midpoint of each scale. If only one control is provided, adjustment shall be made either (1) at the point specified by the manufacturer, (2) near the midpoint of the middle scale, or (3) near the midpoint of a scale that is particularly important to the user's requirements.

After adjustment, calibration shall be checked near the ends of each scale (approximately 20 percent and 80 percent of full scale). After an adjustment or adjustments have been completed, instrument readings shall be within ± 10 percent of known radiation values at these two points. However, readings within ± 20 percent shall be acceptable if a calibration chart or graph shall be prepared and made available with the instrument.

4.2.2.2 *Logarithmic Readout Instruments.* Logarithmic readout instruments commonly have a single readout scale spanning several decades with two or more adjustments. The instrument should be adjusted for each scale according to the manufacturer's specifications or, alternatively, at points of particular importance to the user.

After adjustment, calibration shall be performed at a minimum of one point near the midpoint of each decade. After adjustments have been completed, instrument readings shall be within ± 10 percent of the known radiation values at these points. However, readings within ± 20 percent is acceptable if a calibration chart or graph is prepared and made available with the instrument.

4.2.2.3 *Digital Readout Instruments.* Digital instruments may have manual scale switching, automatic scale switching (auto ranging) or no scale switching. For instruments with either manual or automatic scale switching, the calibration shall be performed as in 4.2.2.1. For instruments without scale switching, the calibration shall be performed as in 4.2.2.2.

4.3 Calibration for Special Conditions

4.3.1 General. If the instrument is to be used under conditions (that is, radiation energy, temperature and pressure, or source/detector geometry) which vary significantly from those for which the instrument is designed, the instrument should be adjusted, calibrated, and used only for the special conditions. When an instrument is calibrated for special conditions, a special condition identification label shall be attached (in addition to any required calibration labels) to indicate its applicability *for this special use only*. However, if the instrument is also to be used within its design limits, the adjustments made during primary calibration (see 4.2) shall remain the same, and instrument readings for the special conditions shall be corrected using correction factors obtained from appropriate tables or graphs. Only one parameter should be varied at a time during calibration for the special conditions, but the interrelationships of the variables should be known.

4.3.2 Radiation Energy. Calibration shall be performed with a standard source or sources providing radiation fields similar to those in which the instrument will be used. Where instruments will be used in radiation fields of widely differing energies, the response of the instrument at several energies over the energy range shall be determined.

The response of the instrument to various energies of radiation shall be (1) plotted as a function of energy, or otherwise called out, (2) normalized to the response to a specific energy obtained during primary calibration, and (3) provided with the instrument. This type of graph is commonly called an energy dependence or spectral sensitivity curve.

4.3.3 Temperature, Pressure, and Humidity. Instruments to be used outside the manufacturer's recommended temperature range or at temperatures which differ by more than 30°C from the calibration temperature shall be calibrated over the temperature range at which they will be used. Care should be taken to ensure that instruments are not exposed to temperatures that will damage detector or electronic components.

If the manufacturer has not stated operating limits for humidity or atmospheric pressures, the instruments shall be calibrated at the approximate humidity or pressure expected to be encountered in use. Care should be taken to ensure that an instrument is not damaged by exceeding its pressure or humidity limits.

4.3.4 Detector Directional Dependence. If an instrument is to be used in a detector orientation relative to the source which is different from that used during primary calibration, correction factors should be developed.

4.4 Discrimination Against Unwanted Radia-

might alter the instrument response to unwanted ionizing and nonionizing radiations, the discrimination against unwanted radiation should be determined for all unwanted radiations that may be encountered.

4.5 Calibration Records. A record shall be maintained of all calibration, maintenance, repair, and modification data for each instrument. The record shall be dated and shall identify the individual performing the work. The record shall be filed with previous records on the same instrument in accordance with American National Standard Practice for Occupational Radiation Exposure Records Systems, N13.6-1966(R1972) [6].

Each instrument shall be labeled with the following information:

(1) Date of most recent calibration

(2) Initials or other specific identifying mark of calibrator

(3) Energy correction factors, where required

(4) Graph or table of calibration factors, where necessary, for each type of radiation for which the instrument may be used; this should relate the scale reading to the units required if units are not provided on the scale

(5) Instrument response to an identified check source (to be provided either by calibrator or user)

(6) Unusual or special use conditions or limitations

(7) Date that primary calibration is again required

(8) Special condition identification label (if applicable); see 4.3.1

4.6 Periodic Performance Test. To assure proper operation of the instrument between calibrations, the instrument shall be tested with the check source during operation and prior to each intermittent use.

Reference readings shall be obtained on each instrument when exposed to a check source in a constant and reproducible manner at the time of, or promptly after, primary calibration. If at any time the instrument response to the check source differs from the reference reading by more than ± 20 percent, the instrument shall be returned to the calibration facility for calibration or for maintenance, repair, and recalibration, as required. Reference readings should be obtained for one point on each scale or decade normally used. The check source should accompany the instrument if it is specific to that instrument.

4.7 Calibration and Performance Test Frequency

4.7.1 Primary Calibration Frequency. All instruments shall receive the precalibration inspection described in 4.1 and the primary calibration described in 4.2 prior to first use.

Primary calibration will be required at least annually even when the performance test requirements outlined in 4.6 are met.

Where instruments are subjected to extreme operational conditions, hard usage, or corrosive environments, more frequent primary calibration should be scheduled.

Recalibration shall be scheduled after any maintenance or adjustment of any kind has been performed on the instrument. For this requirement, battery change is not normally considered maintenance.

4.7.2 Calibration Frequency for Special Conditions. Calibration for special conditions need be performed only once unless (1) the instrument is modified or physicially altered, (2) the special conditions are changed, or (3) the primary calibration is altered, providing that the conditions in 4.7.1 are met.

4.7.3 Performance Test Frequency. A performance check shall be made prior to each use, during intermittent use conditions and several times a day during continuous use.

## 5. Calibration Equipment Required

5.1 Calibration Standards. Instruments should be calibrated either against National Standards or with Derived Standards. If National or Derived Standards are not available, Laboratory Standards, obtained in one of the following ways, should be used:

(1) Comparison of the radiation field from a user's source with the radiation field from a National or Derived Standard source in the same geometry, using a "transfer instrument" with a reproducibility of ± 2 percent. The transfer calibration shall utilize a calibration curve for the transfer instrument taken with the National or Derived source over a range that covers both the National or Derived source measurement and the user source measurement. (Such a curve reduces to a single point if the transfer calibration procedure is such

that the transfer instrument readings are identical for both measurements.)

(2) Calibration of a user's transfer instrument with a National or Derived Standard source, followed by evaluation of a user's source with the same transfer instrument. The transfer instrument shall have a reproducibility of ± 2 percent and the procedure shall utilize a calibration curve as in 5.1(1).

(3) Where no National or Derived Standard exists, as in the case of specific energies or unusual sources, by establishment of a standard source or instrument with documented empirical and theoretical output or response characteristics.

A calibration source or sources preferably should be of a radiation energy similar to that with which the instrument will be used and of a radiation exposure rate sufficient to reach full scale of any instrument to be calibrated. If the source is a radionuclide, the half-life should be long, preferably greater than several years to minimize corrections and errors. The uncertainty of source calibration shall be no greater than ± 2 percent with respect to U.S. National Standards.

5.2 Calibration Assemblies. Instrument calibration assemblies shall be mechanically precise to ensure that positioning errors of either instruments or radiation sources do not affect the radiation field values by more than ± 2 percent.

The working conditions in the calibration facility shall not cause excessive radiation exposure of personnel. Personnel exposure shall be kept as low as practicable and shall in no case under normal operating conditions exceed permissible levels permitted by agreement or law (whichever is lower).

To meet this condition, personnel shielding, remote instrument reading and positioning facilities, automatic source handling mechanisms, and other mechanical or remote operations are recommended.

A sufficient range of radiation fields shall be available to satisfy calibration requirements.

5.3 Standard Instruments. An instrument used as a Derived Standard shall have an uncertainty no greater than ± 10 percent. Calibration shall be reestablished after maintenance or repair or at intervals specified by the manufacturer but in no case at intervals greater than three years.

A periodic instrument check procedure shall be established by the user to assure continued proper operation.

5.4 Check Sources. Check sources should provide radiation of the same type or types as provided by those sources used in instrument calibration (as described in 5.1). However, check sources may provide radiation different than that used for calibration if:

(1) The source instrument geometry is well understood and easily reproduced, or

(2) The instrument response to this radiation is well understood and is not critically dependent on instrument adjustment. (For example, the use of a photon source to check instruments sensitive to beta radiation may be acceptable; the use of a photon source to check a detector utilizing a $BF_3$ response to neutrons is not acceptable.)

A reproducible source detector geometry shall be established and used for all performance test measurements.

## 6. Maintenance of Quality of Calibration

6.1 Radiation Field. Either narrow or broad beam geometry may be used to compare the response of similar instruments with that of a standardized instrument.

For calibration of X-ray machines or particle accelerators, a calibrated instrument shall be used. If a continuous monitor is available, it can be calibrated simultaneously and used in subsequent work with periodic checks on its constancy.

Alpha radiation sources shall be standardized in terms of activity or activity per unit area of the source, or both. The reference geometry, $2\pi$ or $4\pi$, shall be stated.

Beta radiation sources shall be standardized in terms of air or soft tissue absorbed dose rate at the surface or at a specified distance from the source, or in terms of activity.

Photon-emitting radionuclide sources shall be standardized in terms of exposure rate (in roentgens per hour) at a specified distance from the source.

Neutron sources shall be standardized in terms of (1) the number of neutrons emitted per unit time and (2) the effective or average neutron energy. Concomitant photon exposure rate should be known and stated.

For photon and neutron monitoring instru-

ment calibrations, the source-to-detector distance shall be the distance measured between the effective center of the radioactive source and the effective center of the radiation detector. Either this distance shall be greater than seven times the maximum dimension of the source or detector, whichever is larger, or suitable corrections shall be used.

The exposure rate or the flux density of the radiation field shall be known with an estimated uncertainty no greater than ± 10 percent. A continuous monitor or other device should be used to determine whether the radiation field has changed.

6.2 Calibration Facility. Free-space geometry should be achieved for photon and neutron instrument calibration. The distance to scattering objects from the source and from the detector should be at least twice the distance between the detector and the source. Where scattering contributions to instrument readings are significant they shall be included in stating the value of the radiation field for all detector positions used for calibration purposes.

The radiation background at the calibration facility shall be low, known, and stable and shall be accounted for during calibration.

Temperature, relative humidity, and atmospheric pressure shall be noted at the time of instrument calibrations. Calibrations should be performed within the temperature range 25 ± 10°C, except when the instrument is to be used outside this temperature range.

6.3 Other. If an instrument may exhibit an extracameral response, the entire instrument should be placed in the radiation field during calibration and the results compared to calibration with just the detector in the field. The fractional contribution, if any, to the instrument reading due to an extracameral response should be determined and noted on the instrument.

A reasonable delay should occur before reading to allow warmup and to accommodate switching transients and the time constant of the instrument.

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[6] ANSI N13.6-1966 (R1972), Practice for Occupational Radiation Exposure Records.

rived Standards suitable for in-house instrument calibration [A46]. On the other hand, since particle accelerators and nuclear reactors cannot be sent out for calibration, they must be standardized for instrument calibration by use of standard neutron instruments or techniques. In addition, the neutron output of these facilities must be monitored continuously during instrument calibrations. Standard neutron instruments and techniques include the precision long counter [A47]–[A49], associated particle counters (for certain accelerators) [A37], nuclear emulsions [A37], fission foils [A37], activation foils [A37], and manganese sulfate bath [A35].

## A5. Facilities for Radiation Instrument Calibration Laboratories

The building space, methods, and staff necessary to properly operate a calibration laboratory depend on the volume and type of work undertaken. Calibration facilities exist that employ from a fraction of one employee's time up to tens of people. The amount of building space needed depends on such diverse factors as volume of business, land and building costs, shielding, scatter, required accuracy, types of radioactive sources and instruments, and energy and strength of sources. Several types of rooms may be necessary including irradiation rooms, storage vaults, and offices. The methods for proper, efficient, and safe operation of the laboratory must be correctly established and should include such functions as receiving and handling of instruments, calibration of test irradiation systems, calibration of instruments and dosimeters, return of calibrated dosimeters and instruments, reporting of results, keeping records of laboratory activities, maintenance and development of calibration procedures. The number of laboratory staff would depend on the volume of business. In any case, the technical integrity of the laboratory should be above reproach. Typical laboratory buildings, staffing requirements, and laboratory facilities have been described in the literature and can be adapted to most needs [A30], [A50].

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# D. Installation and Operation Manual for Model 28 Single Source Gamma Calibrator

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# INSTALLATION AND OPERATION MANUAL FOR MODEL 28 SINGLE SOURCE GAMMA CALIBRATOR

Model 28-6A Calibrator SN: 10240
1.2 Ci, Cs-137
Sept 22, 89

J.L. SHEPHERD & ASSOCIATES
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# INSTALLATION AND OPERATION MANUAL FOR MODEL 28 SINGLE SOURCE GAMMA CALIBRATOR

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# INSTALLATION AND OPERATION MANUL FOR MODEL 28 SINGLE SOURCE GAMMA CALIBRATOR

Model 28-6A
S.N. 10191

NOTICE: IF AT ANY TIME THIS CALIBRATOR MALFUNCTIONS, REMOVE THE UNIT FROM OPERATION IMMEDIATELY AND CALL J.L. SHEPHERD & ASSOCIATES FOR INSTRUCTIONS ON CORRECTIVE PROCEDURES.

## I. RADIATION SAFETY

1. The calibrator emits an intense beam of radiation in the area subtended by the beamport (cone). A much lower level of scattered radiation extends in a penumbra surrounding the primary beam. THE OPERATOR SHOULD NEVER STAND IN THE DIRECT BEAM WHILE OPERATING THE UNIT. The operator should also avoid standing in the penumbra adjacent to the primary beam. The unit must be operated at all times from a position behind the calibrator on the side opposite the beamport. The user should set up exclusion lines for personnel using this calibrator as well as limited room access. This information is ordinarily included as part of the facility operation regulations and is required as part of the user's license to possess the calibrator.

2. Leak Test Procedure

   a. Locate source in "OFF" position.

b. Wipe the upper end of the source rod where it exits from the top of the shielded container with a piece of absorbant material. Wiping the area where the operating tower meets the top of the shield is acceptable.

c. These wipes should be measured on an instrument capable of detecting 0.005 microcuries of Cs-137, Co-60 or Sr-90, depending upon isotope loading of your device.

d. If contamination above this level is detected, remove the device from service immediately and notify the manufacturer.

NOTE: The 0.005 microcurie level is that generally prescribed by regulatory authorities; individual institutions may require more stringent standards.

## II. INSTALLATION

### A. REMOVAL OF MODEL 28 FROM 20WC-5 OVERPACK (AS REQUIRED):

1. Using a 13/16" or 3/4" deep well socket (as required), remove the nuts from the 16 each 1/2" rods located approximately 5" from the outer rim of the top of the overpack.

2. Sling the top chine of the overpack or attach a 1/2-13 eyebolt to the center lift point and lift the top section, using a vertical lift so as not to bend the rods. The top section is approx. 16" high.

3. Remove the wood shoring from the top and sides of the device in the overpack.

4. Attach a cable or chain to the eyebolts provided and lift the device vertically from the overpack.

5. Remove the metal or wood round affixed to the bottom of the device.

### B. MODEL 28 ASSEMBLY

The Model 28 Beam Calibrator is shipped in two parts: Base and Source Shield.

1. Bolt the calibrator to the base provided.

2. Place the calibrator complete with source in the desired location.

3. Plug the control cabinet into a 115v outlet, rated at 10 amps.

4. Attach any external interlocks, warning lights, etc. to the labeled connector on the device.

INSTALLATION IS NOW COMPLETE

## III. OPERATION PROCEDURES FOR MODEL 28

### A. UNIT OPERATION

1. Remove the padlock which locks the source in the "OFF" position during shipment, using the key provided. NOTE: This padlock may be used to lock the source in the "OFF" position at any time that the calibrator is not in use.

2. To expose the source, grasp the black operating know (while standing behind calibrator, opposite beamport) and raise it until the spring loaded detent engages the depression on the operating shaft. The source is now exposed.

3. To return the source to the "OFF" position, push the operating knob down until the pin on the shaft strikes the stop on calibrator top. The source is now fully shielded.

4. Position indicating lights operate when either source is plugged in. The "ON" light illuminates whenever the source is away from the "OFF" position.

### B. MAINTENANCE

1. DO NOT lubricate the source rod at any time, in any way, LUBRICATION OF ANY KIND WILL VOID ALL WARRANTIES.

2. Operate the unit in a clean atmosphere. Do not permit dirt or other particles to fall into the

hole at top of the unit. When not in operation, it is recommended that the unit be covered, i.e., by a plastic bag, etc.

C. COLLIMATOR

The collimator is detached by removing the 2 screws in the outside bolt circle (in line with locating pins) at horizontal midline of the collimator, grasping the collimator, reverse the above procedure. A "T" is stamped at the top of the collimator.

D. ATTENUATOR

To install the attenuators, thread the bolts provided into the upper right and the lower left hole in the front plate through which the beamport extends. Slide desired attenuator(s) over these studs.

E. SAFETY FEATURES

The shield provides for full shielding in all directions at all times, except out the beamport when the source is in the "ON" position.

Position indicating lights (green = OFF, red = On), located at the top of the calibrator show source position at all times. The "ON" light is activated whenever the source is not fully "OFF."

F. EMERGENCY PROCEDURES

If, at any time, the operation of the source rod becomes difficult, the calibrator should be removed from service. It should be taken to a hot cell, the source rod removed and both the source rod and the tube through which it slides should be cleaned. Difficult operation will be caused by dirt or foreign particles falling into the source tube.

J L SHEPHERD and Associates

1010 Arroyo, San Fernando, California 91340 • (818) 898-236;

Irradiation & Calibration Equipment • Lead Shielding • Nuclear Applications

## INSTALLATION AND USE OF SLIP-ON ATTENUATORS

The attenuators on your unit are cumulative. To provide X-2 attenuation, use the X-2 attenuator. To provide X-4 attenuation, use the X-2 and the X-4 (mounted outboard the X-2). For X-10 attenuation, use the X-2 + X-4 +X-10 (mounted outboard on the X-4). For X-100 attenuation, use the X-2 + X-4 +X-10 + X-100 (mounted outboard on the X-10). All calibration values for attenuation were made using this set-up.

| | |
|---|---|
| X-2 | X-2 |
| X-4 | X-2 + X-4 |
| X-10 | X-2 + X-4 + X-10 |
| X-100 | X-1 + X-4 + X-10 + X-100 |

All calibrations made with attenuators should be made at a source detector distance of one meter or greater.

J L SHEPHERD and Associates

1010 Arroyo, San Fernando, California 91340 • (818) 898-2361

Irradiation & Calibration Equipment • Lead Shielding • Nuclear Applications

ADDENDUM
SERIES 28 CALIBRATORS WITH PRESET TIME,
FAIL-SAFE SOURCE RETURN OPTION

I. OPERATION

1. Power cord must be plugged into a 115 volt, 60 Hertz, single phase plug.

2. Connect the Interlock circuit to the amphenol connector provided and labeled.

3. This unit is equipped with a 6 digit preset electronic timer (no display) range 9999.99 seconds.

4. To preset time on timer, use the following procedure:

   a. Rotate the wheels on set of digits until the preset time desired is dialed in.

5. Raise the source to the fully "Exposed" position. At this position, an electromagnet engages the source rod.

6. The source may be automatically returned to the fully "Shielded" position by any of the following methods:

   a. Expiration of the preset time.

   b. Operation of the manual "OFF" switch.

   c. Interruption of power supply and the timer automatically resets the previous time preset.

   d. Opening of an interlock.

II. TIMER RESET

Each time the source is raised or lowered the timer automatically resets to the previous preset time. Timer

may also be manually reset by pressing the black reset button on timer.

NOTE: If preset time is changed press reset button.

## III. SAFETY

The source is returned to the fully "Shielded" position by gravity whenever any of the above listed conditions are met.

## IV. SERVICING

If, for any reason, the sources do not return to the fully "Shielded" position, call the manufacturer for servicing instructions.

## V. EXTERNAL RADIATION LIGHT

A 2-pin amphenol connector is provided and labeled. This provides power for an external radiation lamp or buzzer connected to the external irradiate connector, which should not exceed 3 amps. If power consumption is greater than 3 amps, a relay will need to be connected to the external light or buzzer; of which the coil will be operated by the power from the unit.

# E. Leak Test Certification

J.L. SHEPHERD & ASSOCIATES
1010 ARROYO AVE., SAN FERNANDO, CALIFORNIA 91340-1822
818-898-2361 FAX 818-361-8095

# LEAK TEST CERTIFICATION

TO: SAFETY SPECIALISTS, INC.

SOURCE: 1.2Ci $^{137}Cs$, 3M Type 4D6L Capsule, S.N. 64465
Recycled Source - has been completely tested and is recertified to meet current USNRC requirements.

MOUNTING: J.L. Shepherd & Associates Model 28-6A Calibrator, S.N. 10240

LEAK TEST:

$\leq 5 \times 10^{-5}$ $\mu$Ci

DATE: September 26, 1989

J.L. SHEPHERD & ASSOCIATES

By

# F. Shipping Documentation

J.L. SHEPHERD & ASSOCIATES
1010 ARROYO AVE., SAN FERNANDO, CALIFORNIA 91340-1822
818-898-2361 FAX 818-361-8095

**SHIPPING DOCUMENT**

DATE: September 28, 1989

CUSTOMER: SAFETY SPECIALISTS, INC.

LICENSE: #2946-43, Amendment #12, issued by the State of California

SOURCE: 1.2Ci $^{137}Cs$, 3M Type 4D6L Capsule, S.N. 64465

SHIPPING CONTAINER: DOT 7A, J.L. Shepherd & Associates Model 28-6A Calibrator, S.N. 10240

RADIATION LEVEL AT SURFACE: ≤ 8.0 mR/hr (SPECIAL FORM) ON ARRIVAL

RADIATION LEVEL AT ONE METER FROM SURFACE: ≤.35 mR/hr _____

SURFACE CONTAMINATION: ≤100dpm/100cm$^2$ _____

INSTRUMENT: Eberline E-520, S.N. 4895 _____

LEAK TEST: ≤ 5 x $10^{-5}$ μCi

DOT CLASS II LABEL REQUIRED

TRANSPORT INDEX: .35

TRUCK PLACARDS REQUIRED: NO

SHIPPING WEIGHT: 200 lbs.

FREIGHT CLASSIFICATION:
Empty containers: NMFC 100D, Item 41070, Class 60
Radioactive: 40 cents per pound valuation;
NMFC 100D, Item 164900, Sub 1, Class 70

J.L. SHEPHERD & ASSOCIATES

By _____

# G. Product Warranty

J.L. SHEPHERD & ASSOCIATES
1010 ARROYO AVE., SAN FERNANDO, CALIFORNIA 91340-1822
818-898-2361 FAX 818-361-8095

**J.L. SHEPHERD & ASSOCIATES**

**PRODUCT WARRANTY**

**MODEL 28 SINGLE SOURCE GAMMA CALIBRATOR**

A. THIS WARRANTY CONSTITUTES THE ENTIRE UNDERSTANDING BETWEEN SAFETY SPECIALISTS, INC., HEREINAFTER REFERRED TO AS "BUYER", AND J.L. SHEPHERD & ASSOCIATES, HEREINAFTER REFERRED TO AS "SELLER", RELATING TO WARRANTIES, GUARANTEES, OR PROVISIONS IN BUYER'S TERMS AND CONDITIONS OF PURCHASE.

B. SELLER WARRANTS THAT ALL PRODUCTS DELIVERED UNDER PURCHASE ORDERS ISSUED BY BUYER, OR UNDER PURCHASE ORDERS ISSUED DIRECTLY BY BUYER'S CUSTOMERS WILL CONFORM TO APPLICABLE SPECIFICATIONS AND DRAWINGS; WILL BE FREE FROM DEFECTS IN MATERIAL AND WORKMANSHIP; WILL BE FREE FROM DEFECTS ARISING FROM THE PROCESS OF MANUFACTURE, WHICH PROCESS IS DICTATED BY THE REQUIREMENTS OF THE BUYER'S DESIGN; AND WILL BE FREE FROM DEFECTS ARISING FROM SELLER'S ROUTINE SELECTION OF MATERIALS. BUYER AND SELLER RECOGNIZE THAT CERTAIN METHODS AND MATERIALS USED IN THE MANUFACTURE OF THE PRODUCTS ARE PROPRIETARY TO OR THE SOLE RESPONSIBILITY OF SELLER. SELLER THEREFORE WARRANTS THAT DEFECTS OR FAILURES ARISING FROM THE PROPRIETARY PROCESSES OF MANUFACTURE AND THE SELECTION OF MATERIAL NOT CALLED OUT IN THE SPECIFICATIONS OR DRAWINGS OR WHERE OPTION MATERIAL REQUIREMENTS ARE ALLOWED WILL BE THE RESPONSIBILITY OF SELLER.

THE WARRANTIES OF THIS SECTION SHALL BE APPLICABLE AS FOLLOWS:

1. FREE PARTS AND SERVICES WILL BE ALLOWED FOR THREE MONTHS.

2. FREE PARTS FOR AN ADDITIONAL NINE MONTHS.

C. THERE SHALL BE NO WARRANTY PY SELLER FOR DEFECTS ATTRIBUTABLE IN WHOLE OR IN PART TO FACTORS BEYOND SELLER'S CONTROL, INCLUDING, BUT NOT LIMITED TO, BUYER'S DESIGN, FAILURE OF BUYER OR ITS CUSTOMERS TO PROPERLY PRESERVE, STORE, INSTALL, OPERATE, OR MAINTAIN PARTS MADE BY SELLER.

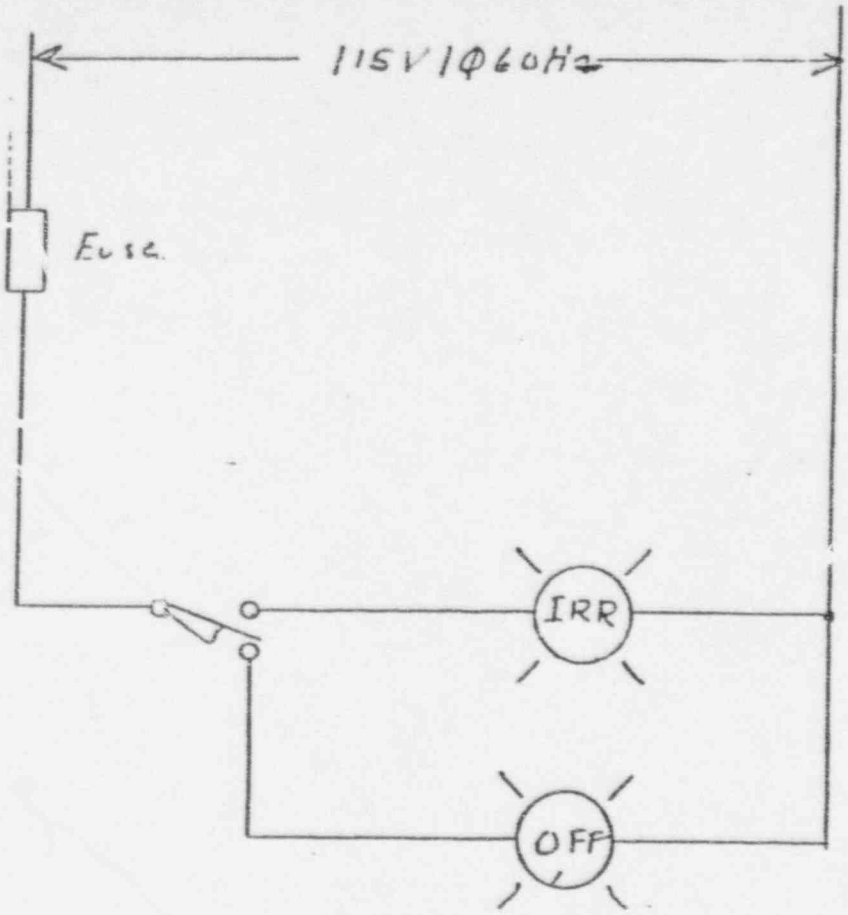
SELLER ALSO DENIES LIABILITY FOR ANY FAILURE OR DETERIORATION OF PARTS ATTRIBUTABLE TO EXTENDED STORAGE UNDER CONDITIONS OR EXCESSIVE TEMPERATURE OR HUMIDITY, AND FOR MALFUNCTION OR DESIGN DEFICIENCY OCCURRING IN OTHER SYSTEMS OR INSTALLATIONS THAT WOULD IN TURN EFFECT THE PERFORMANCE OF THE PART.

SELLER FURTHER DENIES LIABILITY FOR PERFORMANCE OF THE PARTS WHEN ABNORMAL ENVIRONMENTAL OPERATING CONDITIONS ARE ENCOUNTERED.

D. ANY PART MADE BY SELLER WHICH BUYER CLAIMS TO HAVE FAILED OR TO BE DEFECTIVE AND COVERED BY THIS WARRANTY SHALL BE PRESENTED TO SELLER AT THE SELLER'S FACILITY, FOR EXAMINATION AND DISPOSITION BY SELLER. THE SELLER SHALL DETERMINE CAUSE AND RESPONSIBILITY OF FAILURE, AND SHALL NOTIFY BUYER WITHIN 30 DAYS OF THE RESULTS OF THIS EXAMINATION. IF IT IS POSSIBLE TO REWORK THE FAILED UNIT TO THE ORIGINAL QUALITY, IT IS THE SELLER'S OPTION TO PERFORM THE REWORK OR SUPPLY A NEW PRODUCT.

E. THE WARRANTIES SET FORTH HEREIN ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, AND THE LIABILITY OF SELLER UNDER THESE WARRANTIES SHALL BE LIMITED TO THE REPAIR OR REPLACEMENT OF NONCONFORMING OR DEFECTIVE PARTS. OTHER THAN EXPRESSLY STATED ABOVE, SELLER SHALL ASSUME NO LIABILITY OF WHATSOEVER NATURE, INCLUDING LIABILITY FOR CONSEQUENTIAL DAMAGES, NOR MAKES ANY REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, AND SPECIFICALLY, THERE IS NO WARRANTY OF MERCHANTABILITY OR OF FITNESS, ARISING BY LAW OR OTHERWISE, WITH RESPECT TO THE MANUFACTURE OR USE OF SAID PARTS.

# H. Electrical Schematic




# J. L. SHEPHERD and Associates

| | | |
|---|---|---|
| SCALE: - | APPROVED BY: | DRAWN BY |
| DATE: | | REVISED |

ELECTRICAL SCHEMATIC FOR SERIES

DRAWING NUMBER

28 CALIBRATORS

# I. Attenuator Certification

J.L. SHEPHERD & ASSOCIATES
1010 ARROYO AVE., SAN FERNANDO, CALIFORNIA 91340-1822
818-898-2361 FAX 818-361-8095

# ATTENUATOR CERTIFICATION

TO: SAFETY SPECIALISTS, INC.

DEVICE: J.L. Shepherd & Associates Model 28-6A Calibrator, S.N. 10240

| NOMINAL | ACTUAL |
|---|---|
| X2 | 2.05 |
| X4 | 4.06 |
| X10 | 9.97 |
| X100 | 95.0 |

All calibration using attenuators should be made at greater than or equal to one (1) meter source detection distance.

DATE: September 26, 1989

J.L. SHEPHERD & ASSOCIATES

By

J.L. SHEPHERD & ASSOCIATES
1010 ARROYO AVE., SAN FERNANDO, CALIFORNIA 91340-1822
818-898-2361 FAX 818-361-8095

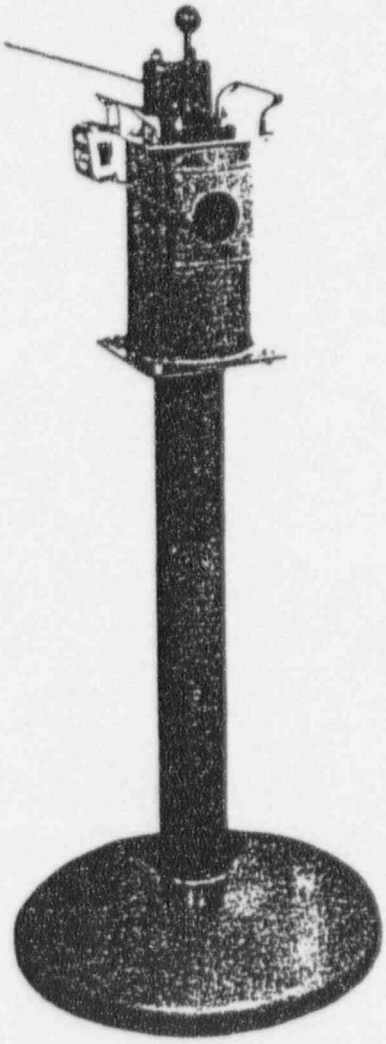
# DEVICE CERTIFICATION

## MODEL 28 SINGLE SOURCE GAMMA CALIBRATOR

J.L. SHEPHERD AND ASSOCIATES CERTIFIES THAT THIS DEVICE MEETS ALL APPLICABLE D.O.T. SHIPPING REGULATIONS RELATED TO EXTERNAL RADIATION LEVELS FOR CONTAINERS OF RADIOACTIVE MATERIALS.

THIS DEVICE MEETS ALL UNDERWRITER'S LABORATORY SPECIFICATIONS, INCLUDING FIRE CODE REGULATIONS.

THIS DEVICE MEETS REQUIREMENTS FOR A STANDARD INDUSTRIAL FIRE WITHOUT RELEASING RADIATION OR RADIOACTIVE MATERIALS TO ENVIRONS.



# J. Device Certification

J.L. SHEPHERD & ASSOCIATES
1010 ARROYO AVE., SAN FERNANDO, CALIFORNIA 91340-1822
818-898-2361 FAX 818-361-8095

# EXTERNAL RADIATION LEVELS

TO: SAFETY SPECIALISTS, INC.

SOURCE: 1.2Ci $^{137}Cs$, 3M Type 4D6L Capsule, S.N. 64465
Recycled Source - has been completely tested and is recertified to meet current USNRC requirements.

MOUNTING: J.L. Shepherd & Associates Model 28-6A Calibrator, S.N. 10240

SOURCE IN "OFF" POSITION:

≤ 30 mR/hr at 30 cm from surface

SOURCE IN "ON" POSITION: (180° behind beam port)

≤ 30 mR/hr at 30 cm from surface

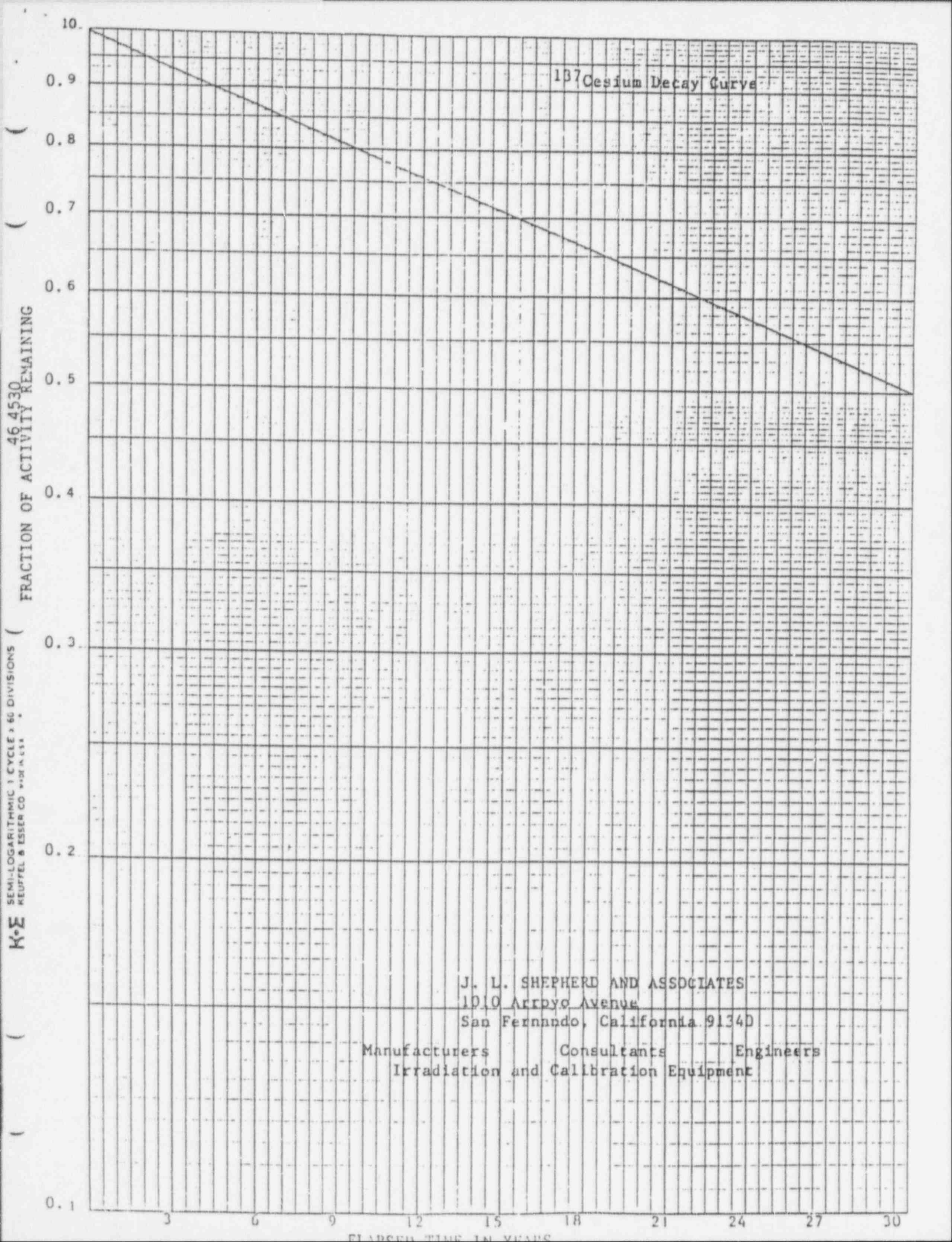
INSTRUMENT: Eberline E-520, S.N. 4895

DATE: September 26, 1989

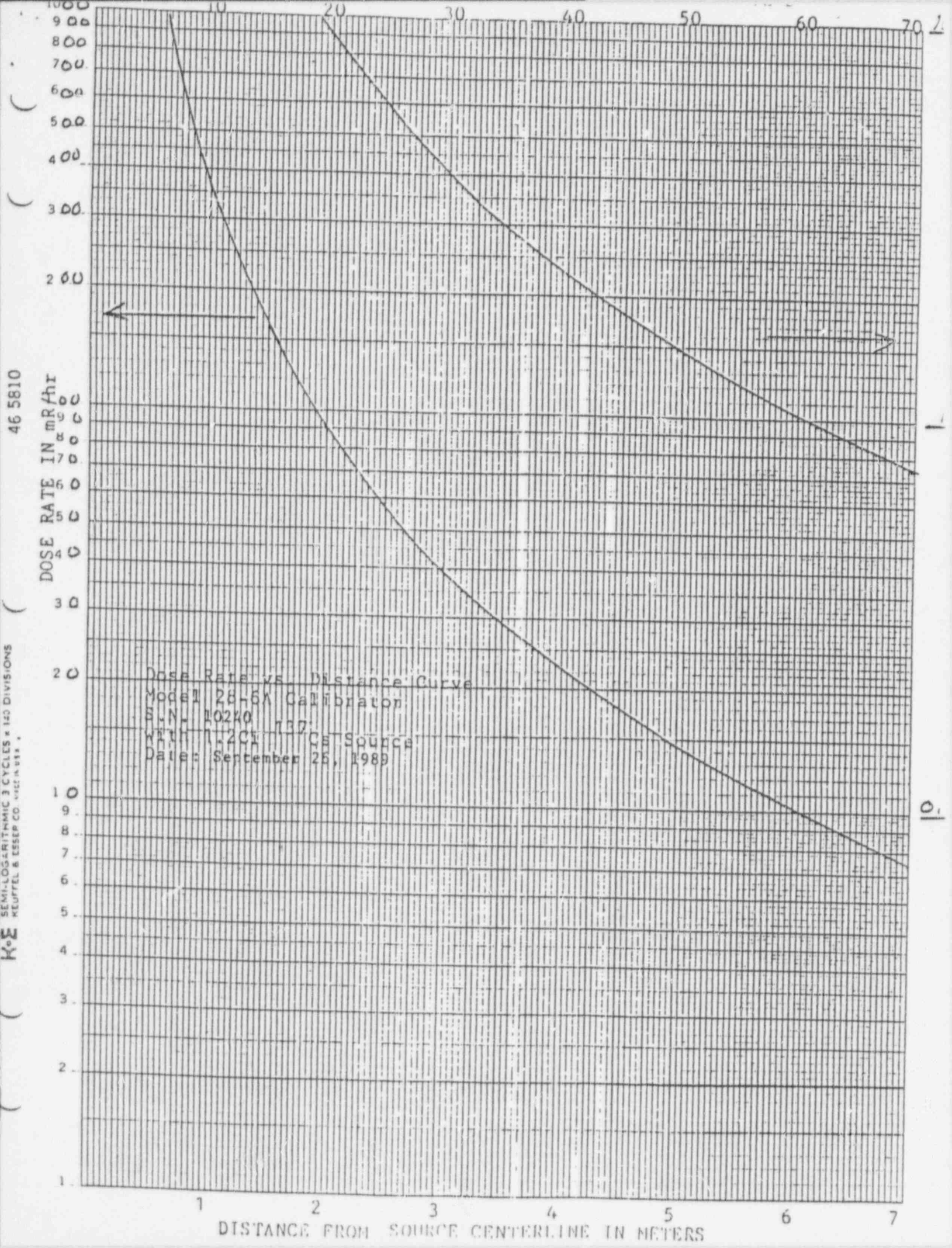
J.L. SHEPHERD & ASSOCIATES

By _____

# K. $^{137}$Cesium Decay Curve

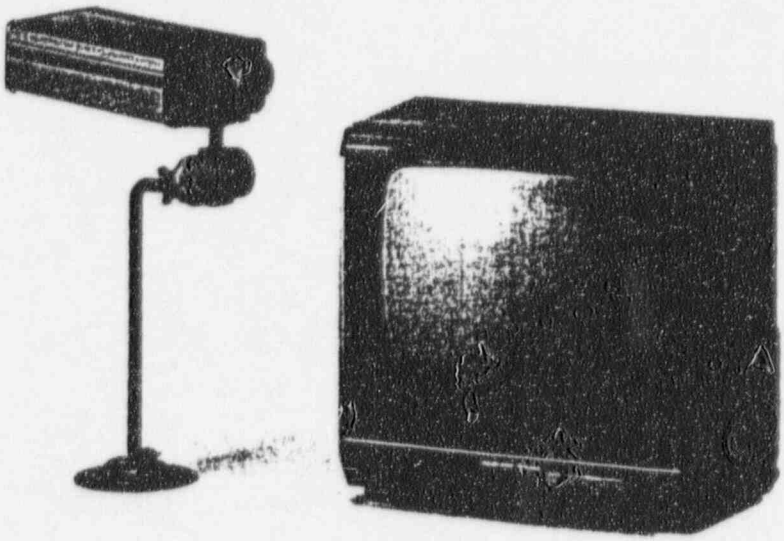

137Cesium Decay Curve
FRACTION OF ACTIVITY REMAINING
ELAPSED TIME IN YEARS
10
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
3
6
9
12
15
18
21
24
27
30
46 4530
K·E SEMI-LOGARITHMIC 1 CYCLE x 60 DIVISIONS
KEUFFEL & ESSER CO
J. L. SHEPHERD AND ASSOCIATES
1010 Arroyo Avenue
San Fernando, California 91340
Manufacturers Consultants Engineers
Irradiation and Calibration Equipment

# L. Dose Rate vs. Distance Curve for Model 28-6A, Serial Number M. 10240, Calibrator with 1.2 Ci $^{137}Cs$ Source


DOSE RATE IN mR/hr
DISTANCE FROM SOURCE CENTERLINE IN METERS
Dose Rate vs. Distance Curve
Model 28-6A Calibration
S.N. 10240
With 1.2Ci 137Cs Cal Source
Date: September 26, 1989
46 5810
SEMI-LOGARITHMIC 3 CYCLES x 140 DIVISIONS
KEUFFEL & ESSER CO.

# M. Video Monitor System

# MAGNAVOX MC3510-AL01 MONITOR SYSTEM



**Magnavox Observation System MC3510-AL01**

consisting of:
12" Black and White Television Monitor
Black and White Camera with support bracket and mounting hardware
57ft.(17.5meter) Connecting Coaxial Cable
3 male and 1 female Euro-type Connectors
TV Antenna/Monitor Switch Box and Connecting Cable

TABLE OF CONTENTS



MONITOR-OBSERVATION SYSTEM

RECORD THE MODEL NUMBERS AND SERIAL NUMBERS OF YOUR SYSTEM BELOW. THE NUMBERS ARE ON THE REAR OR BOTTOM PANEL OF EACH ITEM.

| UNIT | MODEL | SERIAL |
|---|---|---|
| MONITOR | _____ | _____ |
| CAMERA | _____ | _____ |

KEEP THESE NUMBERS FOR FUTURE USE.

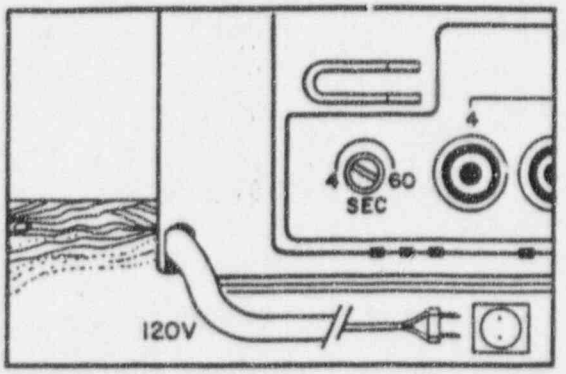
MAGNAVOX
USA Limited Warranty
Registration

| MC3510 AL | 53102648 |
|---|---|
| MODEL NUMBER | SERIAL NUMBER |

## Connecting Observation System

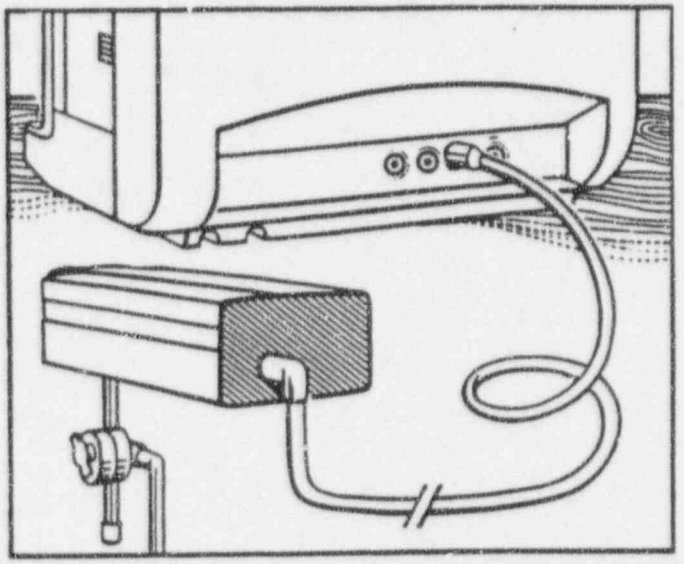
### Power Connection

The lightweight combination system operates on 120V, 60Hz, AC power outlet. As a safety feature the line cord plug is "polarized", (one wide blade and one narrow blade), designed to fit into standard AC outlets in one direction only. Never attempt to force the plug into an outlet the wrong way, turn it over and reinsert the plug again. Power for the camera unit is supplied by the observation monitor. When connected and the monitor is turned ON, the camera is also turned ON.




### Camera connection

A standard 57ft. coaxial cable is supplied with the camera for connecting to the monitor. The coaxial cable provided has one straight male 75 ohm coaxial connector plug on one end and one squared male 75 ohm coaxial antenna connector plug on the other end. The right-angled plug goes into the socket on the rear of the camera; the straight plug goes into one of the four labeled camera sockets marked on the rear of the TV monitor. Once you have connected the camera to the monitor, you must set the predetermined output channel (CH 3 or 4) on which the camera will broadcast its signal to the monitor. Locate the channel selector switch on the front (next to the lens) of the camera and on the rear of the monitor; and set them to the same channel.

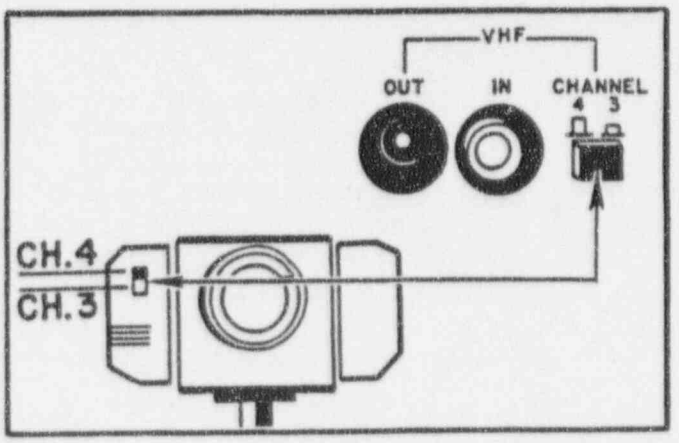


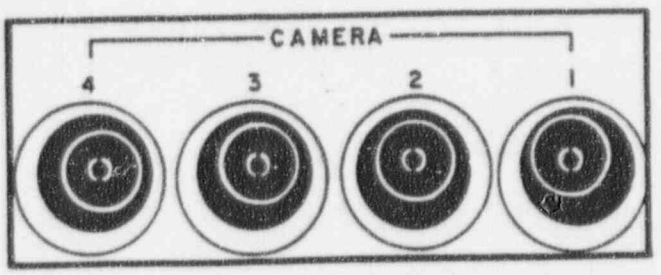
Four camera input sockets, numbered 1 to 4, are provided on the rear of the monitor for possible multi-camera observation systems. Any of the four camera input sockets may be used with a one camera system, as long as the corresponding manual camera selection pushbutton (on front of monitor) is selected.

If you wish to span distances greater than 50ft. several options are available:

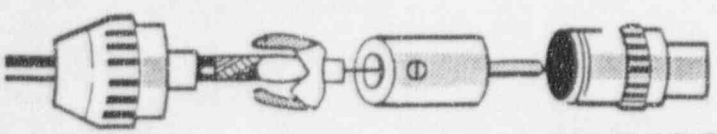
1) An extension cable MC3514-AL01 is available from Magnavox, allowing for a maximum 114 ft.

2) A custom cable can be assembled to the exact length required by using the Euro-type connectors provided with the observation system and 75 ohm coaxial cable (RG59-U).

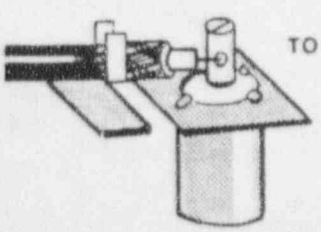


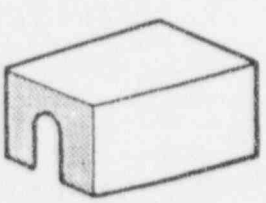

CAMERA INPUT SOCKETS

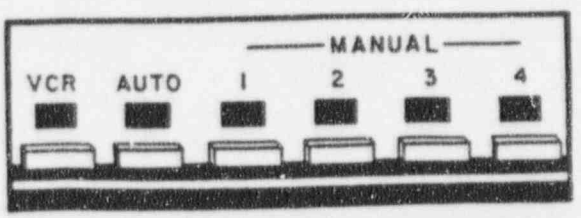


TO CAMERA INPUT SOCKETS ON MONITOR



TO CAMERA PLUG






CAMERA SELECTION PUSHBUTTONS

# N. Calibration Facility Location in Building 19, Basement Brig Area

# BUILDING 19

## Basement Brig Area