DEPARTMENT OF THE ARMY
U.S. Army Yuma Proving Ground
Yuma, Arizona 85365

USAYPG REGULATION
NUMBER 385-12

14 OCT 81

SAFETY

IONIZING - RADIATION PROTECTION PROGRAM

1. PURPOSE: This regulation implements DARCOM Regulation 385-25 and AR 385-11, and also prescribes responsibilities, policies and procedures for the establishment and administration of the Radiation Protection Program for all sources of ionizing radiation. It establishes criteria for the operation of all ionizing radiation producing equipment and for all transportation, handling, storage, possession, and disposal of radioactive materials on Yuma Proving Ground.

*This regulation supersedes USAYPG R 385-12, dtd 8 Dec 70.

2. SCOPE: This regulation applies to all organizations and individuals who procure, possess, use, store, transfer, or dispose of radiation sources, i.e., radioactive material with an activity of one microcurie or greater, and ionizing radiation producing devices. Specifically excepted is the USAYPG Health Clinic which operates under the auspices of Health Services Command.

3. GENERAL: Nothing in this regulation is intended to reduce or bypass NRC standards or procedures. Wherever a conflict may exist, the more stringent standards or procedures will apply. Radiation sources will be used in a fashion which will protect personnel from unwarranted radiation exposure. All radiation exposure will be kept as low as reasonably achievable.

4. THE RADIATION CONTROL COMMITTEE:

a. This committee acts as an advisory committee to the Commanding Officer for the supervision and control of all matters pertaining to the radiation protection program. This committee will also act as an action committee to fulfill the responsibilities delineated in paragraph 5(a) below.

b. The membership of this committee will include:

(1) Chief, Safety Office

(2) Installation Surgeon

(3) Installation Radiation Protection Officer

(4) Installation NBC Officer

(5) Responsible individual of organizations using sources of radiation.

(6) Commander's Representative

(7) Preventive Medicine Officer

c. Each using organization working with sources of ionizing radiation will select a member and an alternate to serve on the committee.

d. The committee will meet to transact business as deemed necessary at the call of the chairman.

5. RESPONSIBILITIES:

a. The Committee is responsible for:

(1) Review and approval of rules and procedures to minimize hazards due to ionizing radiation.

(2) Review, approval and authentication of applications for USNRC licenses and DA authorizations and DA permits.

(3) Review and approval of YPG permits, SOP's and directives for the use of sources of ionizing radiation (Appendix B).

(4) Reviewing and approving the qualifications of users of radiation.

(5) Reviewing reports of radiation accidents and incidents to determine the cause and recommending appropriate action to the Commander.

(6) Forwarding minutes of each meeting to higher headquarters.

b. Directors, Division, Branch and Section Chiefs involved in the use of radioactive material or other sources of ionizing radiation are responsible for implementing radiation protection measures by:

(1) Insuring that procedural manuals are prepared as required (Appendix 3).

(2) Officially designating a qualified individual to serve as a member of the Radiation Control Committee.

c. The Chief, Safety Office, will:

(1) Call special meetings as required.

(2) Act for the Committee as specified in this regulation.

(3) Exercise staff supervision over the Radiation Protection Program including the temporary suspension of hazardous operations.

(4) Consult with Installation Radiation Protection Officer and others on matters concerning ionizing radiation protection.

(5) Maintain formal records for the Committee including minutes of meetings and records of action taken involving approvals for use of sources and related transactions, communications and reports.

(6) Maintain cognizance of all regulations and directives from higher authorities and provide copies of pertinent material to committee members, and alternate members.

(7) In cooperation with Installation Radiation Protection Officer and members of the committee, assist personnel of the US Army Environmental Hygiene Agency, US Nuclear Regulatory Commission, and higher commands in inspections of ionizing radiation facilities and the Radiation Protection Program.

(8) Assure that the Radiation Control Committee, The Radiation Protection Officer, the Alternate Radiation Protection Officer and the custodian of the dosimetry records, DD Form 1141, are appointed on orders.

d. The Installation Radiation Protection Officer is responsible for:

(1) As Chairman, presiding at Radiation Control Committee Meetings.

(2) Providing the Commander, Radiation Control Committee, and radiation users with advice and assistance on all matters pertaining to radiation safety. Advice includes instructing and training of workers, visitors and emergency personnel in the safe use of protective equipment and procedures (Appendix C).

(3) Implementing the radiation protection safety program.

(4) Reviewing radiological operations to determine compliance with regulations and approved procedures.

(5) Maintaining an accurate record of the inventory (Appendix J) of sources of radiation possessed by the installation or activity in accordance with AR 385-11. The record for each item should include: Federal stock number and nomenclature, manufacturer's model number, description and serial number, the isotope, type of radioactivity and date radioactivity was determined, chemical and physical form, whether sealed or unsealed, date received, and using organization and location. Provide the Chief, Fire Prevention and Protection Branch and the Installation Surgeon with a current inventory of all radioactive sources with their locations.

(6) Maintaining radiation protection records and at least once each quarter, reviewing all Form DD 1141 for proper posting and recording.

(7) Performing radiation surveys (Appendix I) and leak tests (Appendix D), or causing such surveys and tests to be performed. The accuracy of tests and surveys if performed by others remains the responsibility of the Radiological Protection Officer.

(8) Evaluating the hazard potential and adequacy of protective measures for existing and proposed operations.

(9) Reviewing Standing Operating Porcedures (SOP's) for operations involving sources of radiation prior to review by the Radiation Control Committee.

(10) Investigating radiation accidents and incidents.

(11) Reporting the findings of investigations in accordance with USAYPG R 385-11.

(12) Maintaining a library of current regulations pertinent to the radiation protection program which will be furnished to persons covered by this regulation on request.

(13) Notifying users of any changes in regulations that are pertinent to their operations.

(14) Assuring that all sources are secured against unauthorized use.

(15) Origination of all applications for NRC licenses or DA authorizations and submission of those applications to the Radiation Control Committee for approval.

(16) Assuring that disposal of radioactive material is in conformance with Appendix E, and assuring that procurement, shipment and receipt of radioactive material is in conformance with Appendix A.

(17) Assuring that radiation detection instruments are properly calibrated and are available to radiation workers.

(18) Monitoring incidents wherein unusual levels of radiation or contamination are suspected (Appendix K).

(19) Posting appropriate warning signs and notices.

(20) Prior to being relieved of his duties, the Radiation Protection Officer will have taken the following action with regard to radioactive materials and equipment for which he is responsible.

(a) Secure all material and equipment in such a manner as to preclude use or removal during the period for which there is no Radiation Protection Officer appointed; or

(b) Turn over to a properly qualified and authorized individual, all materials and records for which he is responsible. Such an authorized individual will have the qualifications and training required of a Radiation Protection Officer.

e. The responsible individual is the senior person closely associated with the particular utilization of ionizing radiation and has supervision over project personnel. He is responsible for:

(1) Making applications for the YPG permit, and developing Standing Operating Procedures (Appendix B) with assistance from the Installation Radiation Protection Officer.

(2) Insuring compliance with requirements specified by the YPG permit or procedural manual.

(3) Preparing special emergency instructions for inclusion in YPG permit applications when required by Radiation Control Committee.

(4) Advising the Installation Radiation Protection Officer of the location and change of location of all sources of ionizing radiation.

(5) Maintaining a current inventory of all sources of radiation for which he is responsible.

(6) Knowing the exact location of all sources of radiation for which he is responsible.

(7) Assuring the Radiation Protection Committee that their personnel have received adequate instructions and experience prior to using or being exposed to radiation.

(8) Controlling contamination.

(9) Assuring sources are secured against unauthorized use.

(10) Controlling personnel exposures.

f. The Installation Surgeon is responsible for providing:

(1) Advice on matters pertaining to the health of personnel who are occupationally exposed to, or who utilize isotopes, or devices which produce ionizing radiation.

(2) Medical support to the Radiation Protection Program as outlined in Appendix F and G.

g. Installation NBC Officer is responsible for sources of ionizing radiation used in connection with training military personnel or the NBC team.

h. Workers in areas where radiation sources are used are responsible for strict compliance with all provisions of the procedural manual of the facility and any other pertinent SOP's.

6. RADIATION WORKER:

a. The term "radiation worker" is synonymous with the term "occupationally exposed individual." A radiation worker is an individual who might be exposed to more than 10 percent of the basic radiation protection standards adopted by DA and DSA for the control of occupational exposures to ionizing radiation as a result of his employment or duties in a controlled area.

b. Basic radiation protection standards for the control of occupational exposures to ionizing radiation include-

(1) The accumulated dose equivalent of radiation to the whole body, head and trunk, active blood-forming organs, gonads, or lens of the eye will not exceed-

(a) 1.25 rems in any calendar quarter, nor

(b) 5 rems in any 1 calendar year.

(2) The accumulated dose equivalent of radiation to the skin of the whole-body (other than hands and forearms), cornea of the eye, and bone will not exceed-

(a) 7.50 rems in any calendar quarter, nor

(b) 30 rems in any 1 calendar year.

(3) The accumulated dose equivalent of radiation to the hands and wrists or feet and ankles will not exceed-

(a) 18.75 rems in any calendar quarter, nor

(b) 75 rems in any 1 calendar year.

(4) The accumulated dose equivalent of radiation to the forearms will not exceed-

(a) 10 rems in any calendar quarter, nor

(b) 30 rems in any 1 calendar year.

(5) The accumulated dose equivalent of radiation to the thyroid, other organs, tissues, and organ system will not exceed-

(a) 5 rems in any calendar quarter, nor

(b) 15 rems in any 1 calendar year.

7. EMERGENCIES: Emergencies involving sources of ionizing radiation will be reported immediately to the Radiation Protection Officer. Procedures for emergencies are detailed in APPENDIX H.

8. RECEIPT OF RADIOACTIVE MATERIALS:

(a) The Radiation Protection Officer will coordinate with Receiving to assure that he is notified immediately upon receipt of radioactive materials.

(b) Upon receipt of radioactive materials, Receiving will immediately notify the Radiation Protection Officer.

c. The Radiation Protection Officer will survey all incoming packages of radioactive materials within three hours of receipt if receipt is during normal working hours and within 18 hours if reciept is not during normal working hours.

9. IMPLEMENTATION OF 10 CFR 21: Implementation of Title 10, Code of Federal Regulations, Part 21, is detailed in Appendix L.

10. REFERENCE:

a. NRC Code of Federal Regulations, Title 10, Parts 19, 20, 21, 30-34, 40-50, 70-72.

b. AR 40-14

c. AR 385-11

d. AR 385-40

e. AR 700-64

f. AMCR 385-9

g. DARCOM 385-25

h. TECR 385-9

i. TM 55-315

PROCURING, SHIPPING AND RECEIVING RADIOACTIVE MATERIAL

1. PROCUREMENT: All requisitions or contracts for items that contain radioactive materials will be coordinated with the Radiation Protection Officer. Each request for radiation sources will include a covering Disposition Form (DA 2496) stating the need for the material and citing the area where the sources will be used. Procurement of radioactive materials will not be initiated until proper coverage under a Nuclear Regulatory Commission license or DA Authorization is issued, and the procurement has been authorized by the RCC.

2. SHIPPING:

a. The shipper is responsible for the proper packaging and labeling of radioactive materials for shipping. The shipper will initiate a Radioactive Material Movements form which will then be completed by the Radiation Protection Officer. The Radiation Protection Officer will assure that the shipment is properly packaged and labeled.

b. The Radiation Protection Officer will assure that the organization receiving the radioactive material has the proper NRC License or DA Authorization and that the requirements of Title 10, Code of Federal Regulations are met.

c. The Radiation Protection Officer will affix and sign the shippers certification to the shipping document (DD Form 1149 or 1348-1) prior to releasing item(s) to the Movements Services Division for shipment, pursuant to AR 385-11 and Title 49, Code of Federal Regulations, Parts 170-189.

3. RECEIVING:

a. The Movements Service Division will immediately notify the Radiation Protection Officer when any radioactive material is received. The Movement Service Division will also notify the Radiation Protection Officer when any radioactive material leaves the Supply Warehouse (movement to user area).

b. The Radiation Protection Officer will survey all radioactive material when it arrives. He will complete a Radioactive Movements Form, then notify the user to pick up the radioactive material. Leak tests will be performed, when required, and the results will be furnished the user and kept on file.

c. Packages containing radioactive materials will only be opened under the supervision of the Radiation Protection Officer or designated alternates. (NRC radiographic sources will only be opened by individuals named as Radiographers on the NRC License). No material will be transferred to the designated area for test or use until specifically authorized by the Radiation Protection Officer.

IONIZING RADIATION PERMITS OR PROCEDURAL MANUALS

1. WHEN RECEIVED: A permit and, when necessary, a procedural manual is required before the procurement and use of:

a. Unsealed Polonium 210 (^{210}Po) or Strontium 90 (^{90}Sr) in amounts exceeding 0.1 microcurie and all radioisotopes, sealed or unsealed, in amounts exceeding 1 microcurie except that the Committee may exempt those which are:

(1) Exempt from NRC Licensing pursuant to 10 CFR 30.14, 30.15 or 30.16.

(2) Under a general license pursuant to 10 CFR 31.3 or 31.7.

b. All machines which produce ionizing radiation (x-ray machines, accelerators, etc.).

2. MAKING APPLICATION FOR IONIZING RADIATION YPG PERMIT:

a. Persons having a responsibility for work for which a permit is required will make application in orginal and one copy on Disposition Form (DA 2496) and submit to Radiation Protection Officer.

b. Application will include the following information:

(1) Name, location and organization of responsible individuals (usually the requestor).

(2) For radioisotopes, the elements, mass number, chemical and/or physical form, whether sealed or unsealed, and maximum activity required.

(3) For electrical sources, the maximum (or peak) voltage and current.

(4) Locations of storage and use.

(5) Purpose for which the source will be used.

(6) Training and experience of authorized users.

(7) Special provisions for control of access, if necessary.

(8) A copy of Standing Operating Procedures and/or Procedural Manual as required by Radiation Protection Officer.

c. The Radiation Protection Officer will:

(1) After reviewing the application for adequacy, present application for YPG permit to the Committee for review and approval.

(2) Upon Committee approval, assign YPG permit number, sign YPG permit, procure signature of Radiation Protection Control Committee Chairman and forward to orginator.

3. PROCESSING PROCEDURAL MANUAL:

a. The person having responsibility for developing a procedural manual will, after coordinating with all participating organizations, forward draft in original and one copy to the Radiation Protection Officer.

b. The Radiation Protection Officer will:

(1) After reviewing the manual for adequacy, present draft of procedural manual to the Committee for review and approval.

(2) Upon Committee approval, assign procedural manual a number and forward to originator for publication and distribution.

4. RECORDS: A complete file of all procedural manuals and YPG permits will be maintained by the Radiation Protection Officer.

5. AMENDMENT: An amendment is required for any significant changes (personnel, location, etc.) in the program covered by a YPG permit or procedural manual. Application for amendment will refer to the appropriate YPG permit or procedural manual number and will be addressed the same as initial applications. Processing will be as for initial applications.

6. SUSPENSION:

a. The Radiation Control Committee may suspend a YPG permit or procedural manual at anytime. Also, the Chairman, Radiation Control Committee or the Installation Radiation Protection Officer may temporarily suspend operations under a YPG permit or procedural manual in order to maintain health physics control. Suspension of a YPG permit or procedural manual may result from:

(1) Noncompliance with requirements of NRC, Army or Yuma Proving Ground regulations or facility SOP.

(2) Any situation which, in the opinion of the Chairman, Radiation Control Committee or Installation Radiation Protection Officer, could result in unnecessary or excessive exposure of personnel or loss of control of the sources of ionizing radiation.

b. Radiological operations covered by a YPG permit or procedural manual which have been suspended may be resumed only after the conditions which led to suspension have been corrected. The affected agency will request that the suspension be lifted by indicating corrective action taken in triplicate, on Disposition Form (DA 2496) to the Radiation Protection Officer. Reply will be made by the Radiation Protection Officer as Comment 2.

RADIATION SAFETY TRAINING

1. Installation Radiation Protection Officer will have received, as a minimum, training equivalent to the two-week Basic Radiological Health Course plus the two-week Occupational Radiation Protection Course given by the U.S. Health Service, prior to appointment.

2. Responsible individual and operations personnel named in a procedural manual for the first time will be give a radiation safety orientation prior to approval of the procedural manual. The orientation will be given on an informal basis. Material already familiar to the worker may be omitted.

3. All personnel will be familiar with all special conditions in each procedural manual prior to their commencing work on that activity.

4. YPG Fire Prevention and Protection Branch personnel and Security personnel will be given training at least annually in radiation safety by the Radiation Protection Officer or a designated Alternate.

5. All personnel named in procedural manual and all fire fighting personnel will be given training in the use of protective clothing and equipment.

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LEAK TESTING SEALED SOURCES

1. DEFINITIONS:

a. Sealed Source (herein referred to as source): Any radioisotope that is permanently encased in a capsule designed to prevent leakage or escape of the radioisotope.

b. Direct Leak Test: A leak test performed on the surface of the capsule.

c. Indirect Leak Test: A leak test not performed on the surface of the capsule, but on surfaces in contact or closest to the source during storage or use. The indirect leak test is performed on sources when direct leak testing is impracticable, either because the source is permanently or semi-permanently housed in a device or because direct leak testing would result in a high dose to the operator.

2. APPLICABILITY: This procedure applies to all sealed sources except those meeting one or more of the following conditions:

a. Contains not more than one microcurie.

b. Is exempt from NRC licensing pursuant to 10 CFR 30.14, 30.15, or 30.16.

c. Is under a general license pursuant to 10 CFR 31.3 or 31.7.

d. Contains by-product material in quantities not exceeding those listed in 10 CFR 31.100, Schedule A, Column II.

e. Contains special nuclear material in quantities not exceeding those listed in 10 CFR 20, Appendix C.

f. Contains only natural thorium, natural uranium or uranium 238.

3. RESPONSIBILITY: The Radiation Protection Officer will insure that required leak test procedures are followed.

4. Each source for which this procedure applies shall be monitored for removable contamination within three hours of receipt during normal duty hours or within 18 hours after normal duty hours. Thereafter, the following leak tests are required:

a. Sources containing beta and/or gamma emitting radioisotopes shall be leak tested at intervals not to exceed six months or at those times specified in NRC license.

b. Sources containing alpha emitting radioisotopes shall be leak tested at intervals not to exceed three months or at those times specified in the NRC license.

c. In addition, a leak test shall be performed prior to further use on any source:

(1) Which has been subjected to treatment which could be expected to cause the capsule to rupture.

(2) For which there is indication that the source may be leaking; e.g., contamination of equipment or area where the source has been used or evidence of a bend, crack, or discoloration due to overheating.

5. PRECAUTIONS:

a. The area dose rate shall be monitored with an appropriate survey meter prior to and upon conclusion of the test.

b. Calibrated direct reading dosimeters or pocket chambers and film badges shall be worn during the test.

c. Remote handling equipment and/or shielding shall be used as necessary to reduce exposure to personnel.

d. When direct leak testing of the source would result in a high dose to the operator, an indirect leak test shall be used.

e. Sources shall immediately be returned to the storage container after being leak tested.

f. Following the test, a smear survey shall be performed on all surfaces which could have become contaminated if the source was leaking.

g. Durable plastic or rubber gloves will be worn during the test.

h. Appropriate respirators shall be worn at the discretion of the Installation Radiation Protection Officer during tests on sources that could release radioactive gas or dust if ruptured.

i. Shoe coverings and protective outer garments will be worn during tests when the nature of the source plus other conditions present a splash hazard.

6. LEAK TEST PROCEDURES:

a. The direct leak test shall be used unless the indirect leak test is justified by paragraph 1c above.

b. A smear is taken by wiping a piece of filter paper over the surface used for the test.

c. The Installation Radiation Protection Officer will direct appropriate and required action when the test reveals the presence of 0.005 microcuries or more of removable contamination. The source must be withdrawn from use and not returned to use until decontamination, repair and negative leak test results are obtained following at least seven days storage. Decontamination, repair, and disposal procedures shall be in accordance with the applicable NRC license (if any) and other applicable regulations, including AR 385-11 for disposal. The Installation Radiation Protection Officer shall notify the Committee Chairman of the positive test on the day it is evaluated, identifying the source, including authority under which it is held, and describing the equipment involved, test results and corrective action taken. When the source is held under an NRC license, he is responsible for submitting any report required by the NRC license.

d. Minimum data recorded and maintained for inspection for each required leak test will include.

(1) Source identification.

(2) Source location.

(3) Type of leak test, viz., direct or indirect.

(4) Specific identification of counting equipment used (if performed locally).

(5) Count rate and factors used to obtain activity value.

(6) Result in microcuries.

(7) Date of test.

(8) Identity of person performing test.

(9) When result is 0.005 microcuries or more.

(a) Action taken, including dispositon of source.

(b) Signature of Installation Radiation Protection Officer.

DISPOSAL OF RADIOACTIVE MATERIAL

1. Disposal of unwanted radioactive material in solid and/or concentrated liquid form will be accomplished as directed by ARRCOM in accordance with AR 385-11, and TM 3-261.

2. Land burial of radioactive materials on Army installation is not authorized.

3. Incineration of radioactive material is not authorized except by units issued a specific NRC license for that purpose.

4. Committee approval must be obtained prior to disposing of liquid waste through the sanitary sewerage system. Disposal will then be in accordance with 10 CFR 20.303, with the entire installation being considered as one licensee.

PERSONNEL DOSIMETERY

1. ISSUE OF PERSONNEL MONITORING DEVICES: Issue of appropriate personnel monitoring devices * is the responsibility of the Installation Radiation Protection Officer. When personnel monitoring is indicated, body film badges will be issued. In addition, other devices such as wrist badges, film rings, pocket dosimeters, etc., may be required as determined by the Radiation Protection Officer.

2. LOSS OF PERSONNEL MONITORING DEVICES: Loss of any personnel monitoring devices will be reported immediately to the Installation Radiation Protection Officer by the individual to whom it is issued. The individual will furnish a written statement describing the circumstances surrounding the loss to the Installation Radiation Protection Officer within five days. Copies of the statement with an exposure evaluation for the period by the Installation Radiation Protection Officer will be sent to the Occupational Health Nurse.

3. FILM BADGES:

a. The Installation Radiation Protection Officer will insure that the film packets are used only during the period specified and are mailed to:

U.S. Army
Ionizing Radiation Dosimetry Center
ATTN: DRSMI-MCI-DCS
Lexington, KY 40511

b. A copy of film badge readings will be forwarded to Occupational Health Nurse for recording on DD Form 1141's and a copy retained by the Radiation Protection Officer. The custodian of the health records will evaluate the DD Form 1141's at the end of each calendar quarter and immediately notify the Installation Radiation Protection Officer of any exposure exceeding 300 mrem in the calendar quarter.

4. POCKET DOSIMETERS: Pocket dosimeter readings will be recorded. The Installation Radiation Protection Officer will determine which form is to be used and who is to perform the reading and recording in each case.

5. PERMANENT RECORDS AND REPORTING:

a. The Installation Radiation Protection Officer will keep permanent records of reports of investigations of indicated overexposures.

b. The Post Surgeon will keep the following records in individual health record folders or show in the folder where the record can be located:

(1) Form DD 1141's kept current by posting from DA Form 3484.

(2) Form DD 1952 for each individual on film badge service.

*for all non-medical radiation uses.

(3) Reports of investigations of indicated overexposure.

c. The Installation Radiation Protection Officer will inform by letter, the home installation of each government employee visiting this installation of film badge readings if a positive reading is reported.

d. High readings will be reported as follows:

(1) A daily dosimeter reading exceeding 50 mR will be reported immediately to the Installation Radiation Protection Officer by the individual making the reading.

(2) The following will be reported immediately by the Installation Radiation Protection Officer to the Committee Chairman who will immediately inform the Installation Surgeon.

(a) An indicated dose exceeding 300 mrem for one week.

(b) A film badge exposure resulting in special notification from Lexington Blue Grass Depot Activity.

(c) Any incident requiring notification of USNRC under 10 CFR 20.403 or 20.405.

(3) The Installation Radiation Protection Officer will prepare and submit, after coordination with Committee Chairman, all notifications and reports required by 10 CFR 20.403 and 20.405.

RADIOLOGICAL HISTORY AND MEDICAL EXAMINATIONS

1. STATEMENT OF PREVIOUS EXPOSURE: Personnel named on an ionizing radiation permit application who have not previously done so, will, at the time the application is presented to the Installation Radiation Protection Officer, complete and sign a DD Form 1952.

2. MEDICAL EXAMINATIONS: The Installation Radiation Protection Officer will provide the USA Health Clinic, Occupational Health Nurse, the names and telephone extension number of personnel for whom radiological medical examinations are required. The Health Clinic will contact the individual workers and arrange appointments for physical examinations.

a. Medical Requirements:

(1) Women known to be pregnant and persons under the age of eighteen will not be occupationally exposed to ionizing radiation.

(2) The following may disqualify personnel from being radiation workers at the discretion of the Installation Surgeon:

(a) Abnormal hematology.

(b) A history or the presence of abnormal amounts of radioactive materials in the body as determined by bioassay.

(c) A morbid fear of radiation.

b. Preplacement Medical Examinations: Personnel named on permit applications (except those named on other currently valid permits) will have a radiological preplacement examination prior to commencing work under the permit. (If a similar examination has been conducted within the past six months, it will be accepted, provided a record of such examination is available as part of the individuals medical records). The examination will consist of the following:

(1) Complete medical examination, including chest x-ray. Examiners will be alert for symptoms which could be attributed to ionizing radiation. Personnel whose assignment involves possible neutron exposure and/or with a history of neutron exposure or acute exposure to other ionizing radiation exceeding 25 rems will be given slit lamp examinations of the lenses of the eyes for opacities.

(2) Two or more blood studies separated by one month intervals which include:

(a) White cell count and differential.

(b) Hemoglobin, hematocrit and red cell count.

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(c) Bioassay as required by the permit, requested by the Radiation Protection Officer or as deemed appropriate by the Installation Surgeon. Bioassays will be performed by AEHA or other facilities designated by the Surgeon General.

c. Special Medical Examination:

(1) A "radiation casualty", is defined as a person who:

(a) Has received or is suspected of having received an acute external dose exceeding 25 rems or,

(b) Has received or is suspected of having received an internal dose via ingestion, inhalation, absorption through the broken skin or contamination of wound.

(2) A "Radiation Casualty" will be subjected to special medical examinations directed by the Installation Surgeon. Those responsible for controlling and/or evaluating internal exposures are referred to Annex B of 10 CFR 20, NBS Handbook 60 and Section 2.3 of NBS Handbook 92.

(3) Where a routine follow-up or special medical examination of an individual results in abnormal findings, that individual will be removed from further exposure to radiation when so determined by the Installation Surgeon. An exhaustive study, including appropriate bioassay examination, will then be conducted to determine the extent, if any, that radiation has contributed to the abnormal findings. Under no circumstances will the individual concerned be permitted to return to duties involving ionizing radiation exposure without specific authorization of the Installation Surgeon.

(4) The Installation Radiation Protection Officer may request special (complete or limited) medical examinations at his discretion.

d. Periodic Medical Examinations: All personnel listed on ionizing radiation permits will be given medical examinations at least once every three years. In addition, some permits may require more frequent examination of operational personnel; such examinations may be limited; e.g., to radiochemical urinalysis for personnel working with unsealed tritium.

e. Final Medical Examinations: With the termination of work involving ionizing radiation (individual no longer on an active permit) personnel will be given a final medical examination similar to the preplacement examination.

f. Recording of Examinations: Results of medical examinations will be entered within the appropriate medical records. United States Army Hospital will complete required entries for military personnel, within the pertinent medical health records, and complete required entries for civilian personnel within the pertinent medical 201 files.

EMERGENCY PROCEDURES

1. DEFINITION: The term "emergency" as used herein shall mean an event or set of events occurring in such a manner which is not normally expected and where the lack of immediate action would endanger life, health or property. Such emergencies may be caused by involvement of radioactive material in fire, explosion or collision, loss of control of radioactive material such as theft, and spillage or leakage. (SEE YPG Disaster Control Plan - YPG-DCP for incidents involving Nuclear Weapons near or on USAYPG).

2. EMERGENCY ACTIONS:

a. The person first recognizing an emergency will:

(1) Alert endangered personnel and instruct them to get away from the danger area.

(2) Make telephone report by dialing 2110 to alert emergency personnel.

(3) Remain in a nearby safe location to provide additional information and assistance.

b. The Military Police Desk Sergeant will:

(1) Upon notification of a radiological incident, the Military Desk Sergeant will take the following action.

(2) Notify the following activities in the order listed.

(a) Fire Department

(b) Medical Clinic

(c) Provost Marshal Division

(d) Safety Officer (normal duty hours).

(e) Laguna Army Airfield (operational hours).

(f) KOFA/Cibola Range Control Tower (operational hours).

(g) Notify the Radiation Protection Officer

(h) Contact the responsible individual or his designated agent by the fastest means of communication at hand.

(i) During after duty hours, the Staff Duty Officer will be notified.

(3) Dispatch patrols to secure the area, as instructed by the responsible individual at the scene and the sensitivity of the item, secure the immediate area from all public access. Emergency personnel will be the only personnel authorized in the area.

(4) Aid in the evacuation of personnel to a specific area determined by the Radiation Protection Officer to be a "Safe Zone".

c. The Responsible Individual will insure that:

(1) Personnel stay out of smoke, mist, dust, and other visible airborne substances and remain at a safe distance on the upwind side of the danger area until permission to leave or return to duty is obtained.

(2) When possible, all building portals are closed and all ventilation and air exhaust systems are turned off when airborne radioactivity is known or suspected to be present.

(3) Radiation detection equipment available at the scene is appropriately utilized and that additional equipment is requested when needed.

(4) All personnel who could have become contaminated are monitored and necessary personnel decontamination procedures are instituted.

(5) Personnel suspected of external exposure exceeding an acute dose of 25 rem or receiving or suspected of having received an internal dose via ingestion, inhalation, absorption through the broken skin or contamination of a wound are immediately investigated.

(6) All equipment leaving the emergency scene is monitored for contamination.

d. The Radiation Protection Officer will:

(1) Advise and assist the emergency personnel.

(2) Following the emergency, monitor the area and determine the protective devices necessary for safe decontamination.

(3) Decontaminate.

(4) Monitor all persons who were in the emergency area and those who were involved in combating the emergency.

(5) Monitor downwind, delineate all contaminated areas, and restrict access as necessary.

e. Fire Fighting Personnel will: Admit radiological and medical personnel at the emergency area, and support the responsible individual directing emergency operations in minimizing exposure of personnel to radiation hazards.

4. IMMEDIATE NOTIFICATION AND REPORTS: External notification and reports will be accomplished as follows:

a. Assure that decontamination of property is completed in accordance with the procedures outlined in Appendix K.

b. Arrange for special processing of the film badges worn by individuals who are known to have received or are suspected of having received an external exposure exceeding one rem.

c. Take corrective action following an incident that will insure against the occurrence of another incident from the same or similar set of circumstances.

d. Prepare and submit to the Committee Chairman for approval a report of the incident. As a minimum, this report will contain:

(1) Name of the organization processing the source at the time to the incident.

(2) Location of incident.

(3) Number of the applicable permit.

(4) Name and service number or Social Security number of each individual who received or may have received an overexposure.

(5) Source of the ionizing radiation, giving the element, isotope, chemical and physical form and activity for radioisotopes.

(6) Résumé of the incident resulting in the overexposure.

(7) Corrective steps which have been and will be taken to prevent a recurrence of the incident.

(8) A signed statement from each individual who received or may have received an overexposure, telling of his action prior to, during and immediately after the incident.

RADIATION PROTECTION SURVEYS

1. Records of all surveys will be kept by the Radiation Protection Officer.

a. Routine: Routine surveys will be made at least monthly of all radioisotope areas by the Installation Radiation Protection Officer. These surveys will be directed toward detection of contamination, excessive radiation levels, and poor health physics practices such as inadequate control of sources and/or exposure areas and infraction of regulations.

b. Special: The Installation Radiation Protection Officer will perform special surveys during particularly hazardous operations and following spills, loss of control, suspected or known overexposures or other accidents. A special survey shall also be performed by the Installation Radiation Protection Officer for each radioactive material shipment and receipt in accordance with AR 385-11.

2. In addition to these surveys, the Chairman and members of the Committee may direct special surveys of all facilities where materials or devices, which emit ionizing radiation, are utilized.

3. Inspections will also be conducted by the U.S. Nuclear Regulatory Commission and Army organizations having authority and responsibility to do so.

4. Periodic surveys and special studies are also conducted by the US Army Environmental Hygiene Agency.

INVENTORY OF RADIOACTIVE MATERIAL

1. RADIOISOTOPE INVENTORY LOGBOOKS: Using organizations will maintain a logbook of all transactions involving radioactive material. Entries will be kept current at all times and will indicate receipts, withdrawals, disposal and related information.

2. INVENTORY CHANGE: Immediately following receipt, shipment, disposal, etc., of radioactive material which changes authorized quantities, using organizations will prepare an inventory report indicating the change and will forward two copies to the Radiation Protection Officer.

3. SEMIANNUAL INVENTORY REPORT:

a. Using organizations will furnish to the Radiation Protection Officer, a semiannual inventory report showing all radioactive material in their possession and current activity of each source. Included within this category are all items included in APPENDIX E.

b. The Radiation Protection Officer will review the inventory for compliance with applicable regulations, licenses, approvals and permits.

c. The Radiation Protection Officer will conduct a physical inventory of all radioactive materials at least every 12 months. Key emergency personnel, such as Provost Marshal, Fire Chief, Medical Officer and Safety Officer will be kept currently informed of the receipt, storage, use, disposal, or transfer of radiation sources by the Radiation Protection Officer.

CONTAMINATION CONTROL AND DECONTAMINATION

1. Contamination control and decontamination procedures recommended in NBS Handbook 48 and Sections 5.4, 5.5 and 5.6 of NBS Handbook 92, and DARCOM 385-25, will be followed.

2. The responsible individual named in the permit (APPENDIX B) is responsible for developing and effecting specific contamination control procedures for his particular operation. These procedures will be shown in the permit or procedural manual. Decontamination procedures, when required, will be developed by the responsible individual in cooperation with the Installation Radiation Protection Officer. Decontamination will be performed by project personnel at the discretion of the Radiation Protection Officer.

3. All waste generated will be disposed of as required by APPENDIX E.

IMPLEMENTATION OF 10 CFR PART 21

1. Yuma Proving Ground organizations affected by 10 CFR Part 21 are as follows:

a. All those to which an NRC license has been issued.

b. All YPG elements packaging radioactive material for transport.

c. All YPG elements which receive, store, use, distribute or dispose of radioactive commodities authorized by a specific NRC license.

d. All YPG organizations which evaluate radiation safety defects, hazards, or noncompliance.

2. Commanding Officers, Directors and Chiefs of all applicable YPG elements shall:

a. Implement or assure coverage under the installation 10 CFR Part 21 program.

b. Establish written procedures for ensuring notification, investigation, and reporting of suspected safety defects and/or noncompliance.

c. Make a determination of whether or not a defect or noncompliance requires reporting. Sufficient information for this determination must be supplied by the Radiation Protection Officer and a memorandum concerning the basis for this decision should be maintained in the license file.

d. Report defects or noncompliance telephonically to the applicable NRC Regional Office of Inspection & Enforcement listed in Appendix D of 10 CFR Part 20, within two days after determining that a substantial safety hazard exists. A memorandum of the above report should be provided HQ, DA, (DAPE-HRS) through the YPG Safety Office. Following initial notification to the NRC, a follow-up written notification must be forwarded to the same NRC Regional Office within five days following the determination. A copy of this correspondence should be provided HQ, DA (DAPE-HRS) through the Yuma Proving Ground Safety Office.

e. Ensure through the Radiation Protection Officer or designated individual that the following items are posted in a conspicuous position on the premises where NRC licensed activities are conducted:

(1) A copy of 10 CFR Part 21.

(2) A copy of Section 206 of the Energy Reorganization Act of 1974.

(3) Written procedures adapted for implementing the regulations in 10 CFR Part 21.

If posting all of these items above is not practical, in addition to posting item (2), a notice may be posted describing the regulations/procedures including the name of the individual to whom reports may be made and stating where items (1) and (3) may be examined.

3. The Installation Radiation Protection Officer (RPO) shall:

a. Implement the requirements of 10 CFR Part 21 in the form of a written document. This document should provide the Radiation Protection Officer as the point of contact for reporting defects or items of noncompliance but should also indicate to the workers that they may report directly to the NRC if they so desire.

b. Keep the YPG Commander informed concerning the posture of the Installation Radiological Health Program to include reports of defects or noncompliance under Title 10 CFR, Part 21.

c. Include "Responsibilities Under Part 21" as a topic of discussion in annual retraining.

d. Assure posting of documents referred to in paragraph 2e.

e. Provide sufficient documentation to the responsible officers to enable the responsible officer to make a determination regarding reporting. Notification under 10 CFR Part 21 requires first, a knowledge of a defect or a failure to comply and second, the defect or failure to comply must constitute a substantial safety hazard. If there is uncertainty as to whether the defect or failure to comply is significant, the TECOM Radiation Protection Officer should be queried. The following constitutes the criteria utilized in making a determination of the existence of a substantial safety hazard.

(1) Moderate exposure to or release of licensed material.

(2) Major degradation of essential safety related equipment; or

(3) Major deficiencies involving design construction, inspection, test or use of licensed materials and/or facilities.

4. Supervisors are responsible for:

a. Assuring that any potential defects or items of noncompliance of which he is knowledgeable are brought to the attention of the Radiation Protection Officer, the Commander, Director, or Chief, or to the NRC.

b. Providing a climate suitable for worker reporting of potential defects or items of noncompliance without fears of reprisal.

c. Assuring posting of documents indicated in paragraph 2e.

d. Assuring that workers are annually retrained and cognizant of the requirements of 10 CFR Part 21.

5. Workers are responsible for strict compliance with the regulations of 10 CFR Part 21 to insure notification of defects and items of noncompliance to the Radiation Protection Officer, Commander, Director, Chief or to the NRC.

6. Contracting Officers who write contracts for purchasing radioactive commodities, supplies of safety related parts, services, or consultation for NRC licensed facilities should insert in these contracts the following statement; "Title 10 Code of Federal Regulations, Part 21, applies to this contract."

USAYPGR 385-12

14 OCT 81

The proponent of this regulation is the Safety Office. Users are invited to send comments to C, Safety Office, ATTN: STEYP-SAF, Yuma,AZ 85364

FOR THE COMMANDER:

ALAN G. PUMPHREY
1LT, AGC
Adjutant

DISTRIBUTION:
C+
DRSTE-SG-A (1)
DRSTE-ST (1)
STEYP-SAF (50)
STEYP-AD-P (25)

Form NRC-313(I),item 16, Formal Training in Radiation Safety.

EDWARD MATZKANIN
RADIATION PROTECTION OFFICER

"Radiation Safety Using Industrial Isotopes"; 1½ weeks, Picker Technical Service Center, Cleveland, Ohio; March 1962.

"Radiological Monitor Instructor Training"; 72 hours (two classes) Civil Defense, November 1963 and November 1965.

"Occupational Radiation Protection"; 80 hours, Public Health Service, Rockville, Maryland; October 1966.

Special course in Radiation Safety and Neutron Radiography; 3 semester hours, May- August, 1973; University of Arizona.

Basic course in Health Physics; 40 hours;Louisiana State University May 1978.

Radiation Safety in NDT Topical Conference; 24 hours; San Francisco, August 1978.

Radiation Safety and Neutron Gauging, 16 hours; Yuma Arizona, April 1981.

Instructed courses in "Radiological Monitor Training"; 64 hours (four classes); Yuma City/County Civil Defense Office, 1964-1967.

Experience with 140 Kvp, 2 MA X-ray; 19 years, YPG Industrial Radiography.

Experience with Cobalt 60, 95 curies effective; 17 years; YPG Industrial Radiography.

Experience with Iridium 192, 100 curies effective; 12 years; YPG Industrial Radiography.

Alternate Radiation Protection Officer, US Army Yuma Proving Ground, November 1971 to 5 May 1978.

Radiation Protection Officer, US Army Yuma Proving Ground, 5 May 1978 to present time.

Neutron Gauge certification Course, 16 Hrs, Yuma, AZ (Troxler Electronics) April 1981; Fire Radiation and Explosive Hazards Course, 32 Hrs, US Army Defense Ammunition Center and School, Savanna, IL, June 1981.

Laser-Microwave Hazards Course, 40 Hrs, US Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD, March 1982.

JAMES E. WERNER
ALTERNATE RADIATION PROTECTION OFFICER

"Introduction to Nuclear Engineering"; 2 semester hours, August-May, 1974-1975; University of Arizona

"Nuclear Materials"; 3 semester hours, August-December, 1975; University of Arizona

"Basic Nuclear Processes"; 3 semester hours, January-May, 1976; University of Arizona

"Elements of Nuclear Reactor Theory"; 4 semester hours, August-December, 1976; University of Arizona

"Structure of Matter"; 3 semester hours, August-December, 1976; University of Arizona

"Radiation Detection and Isotope Applications"; 3 semester hours, January-May, 1977; University of Arizona

"Radiation Detection and Isotope Applications Laboratory"; 1 semester hour, January-May, 1977; University of Arizona

"Nuclear Engineering Laboratory"; 3 semester hours, August-December, 1976; University of Arizona

"Nuclear Fuel Cycles"; 3 semester hours, August-December, 1977; University of Arizona

"Contemporary Nuclear Power Systems"; 3 semester hours, August-December, 1977; University of Arizona

"Energy System Design"; 3 semester hours, January-May, 1978; University of Arizona

"Radiation Effects"; 3 semester hours, January-May, 1978; University of Arizona

"Dynamics of Nuclear Systems"; 3 semester hours, January-May, 1978, University of Arizona

"Principles of Radiological Safety"; 3 semester hours, January-March, 1977; DARCOM Intern Training Center

"Radiological Safety and Hazards Evaluation"; 3 semester hours, April-June, 1979, DARCOM Intern Training Center

"Health Physics Laboratory Training"; 32 hours, June 4-8 1979; Texas A&M University

"Laser Safety"; 40 hours, Oct 15-20, 1979; DARCOM Field Safety Activity

"Alternate Radiation Protection Officer"; US Army Aberdeen Proving Ground, January 15-October 1, 1981

"Alternate Radiation Protection Officer"; US Army Yuma Proving Ground, March 15, 1982 to present

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JAMES D. MORAVEC

Chief Radiographer and Alternate RPO

"Radiation Monitoring"- 24 hours - Yuma City/County Civil Defense - 1966

"Radiation Safety Using Industrial Isotopes" - 80 hours - Picker Technical Service Center, Cleveland, Ohio - April 1967

On-the-job-training in Industrial Radiography - 3 years - Yuma Proving Ground, Yuma, AZ - 140 KVP X-ray, Cobalt 60 and Iridium 192

Public Health Service, Course 211, "Basic Radiological Health"-Southwestern Radiological Health Laboratory, Las Vegas, Nev. - 80 hours- March 1972

"Radiological Safety Course - APG, MD - 144 hours - April 1974

Neutron Radiography - San Diego, CA - 32 hours - November 1974

ASNT Innovative and Advance NDT Radiography Conference - Wilmington, Del. - 32 hours - July 1977

Alternate Radiation Protection Officer - USAYPG - effective date - May 1978

Member of the USAYPG Penetrating Radiation Committee-13 years

Industrial Radiographer - 16 years

On-the-job-training - Neutron Radiography - General Atomic/CTI Nuclear

16 hrs - Oct 1977
32 hrs - Jan 1978
32 hrs - May 1978

Neutron Radiography - Vought Corp - 40 hours - August 1980

Neutron Radiographic System Evaluation Test - 320 hours - October-November 1981

International Neutron Conference - 40 hours - San Diego, CA - December 1981

WILLIAM E. DOEBBLER

CHIEF, MATERIAL ANALYSIS SECTION

Trinity University, San Antonio, Texas, B. S. Chemistry, 1950.

Trinity University, San Antonio, Texas, 6 Semester Hours, 1951

Southwest Research Institute, San Antonio, Texas, 1955-1956; Observer on engine and gear wear studies using irradiated piston rings and gears.

"Radiological Monitor Training," 24 Hours, Yuma City/County Civil Defense Office, 1964.

Experience using Staticmaster Model 1U400, Nuclear Products Company, 400 micro curies of polonium-210 each, 11 Years.

Radiation Safety in NDT Topical Conference; 24 Hours, San Francisco, California, August 1978.

Radiological Defense Officer Training; 40 Hours, State of Arizona Division of Emergency Services, 1979.

DAVID D. GARDNER

PHYSICAL SCIENCE TECHNICIAN

Arizona Western College, Yuma AZ, 8 Semester Hours, Introduction to Chemistry, 1981-1982.

"Radiological Safety and Gauge Operation," 16 Hours, presented by Troxler Electronic Laboratories, Inc. 22, 23 April 1981.

Form NRC-313(I), item 17, Experience.

See item 16.

Form NRC-313(I), item 11, Calibration Procedures.

YPG73C57-9

USAYPG CALIBRATION PROCEDURE

FOR

SCALER

Model 161A

1. CALIBRATION SITE: Calibration Laboratory

2. INSTRUMENT IDENTIFICATION:

Nomenclature: Scaler

Model No.: 161A

Manufacture: Nuclear Chicago (now Searle)

TEST INSTRUMENT PARAMETER	PERFORMANCE SPECIFICATIONS
H. V. Meter Range	0-2500 VDC (standardize at midscale)
G. M. input Pulse Height Sensitivity	≥0.25V
Timer Accuracy	± 2% Rdg
Operating Plateau	Plot of G. M. tube update each calibration
Instrument Operational Reliability Factor	Determined by Chi-Square test

3. DATA REFERENCES: Manufacturer's manuals.

4. CALIBRATION TIME: 4 hours.

5. INTERVAL 180 Days

6. EQUIPMENT REQUIRED.

ITEM #	COMMON NAME	MINIMUM USE SPECIFICATIONS	SUGGESTED MANUFACTURER & MODEL #
A1	Time Mark Generator	1KHz ± 0.5% >0.25V, <25V	Tektronix 2901
A2	Digital Voltmeter & H. V. Adapter	0-2500VDC ± 0.5%	Fluke 8300A & 80F-15
A3	Pulse Generator	60Hz rate, 30 NS width, 0 to 0.5V negative pulse	Hewlett Packard 8002A
A4	Oscilloscope		Tektronix 7904
A5	Counter	5 digit display ± 0.2% accuracy	Systron Donner. 1037M-2
	LEADS		
B1	one BNC to double	Banana plugs	
B2	two BNC to BNC		
B3	BNC Tee adapter		
B4	50 ohm BNC load		
B5	50 ohm BNC attenuator		

7. CALIBRATION PROCESS

a. CHECK ACCURACY OF METER (DC VOLTAGE)

(1) Use Fluke 8300A and adapter 80F-15 voltage divider, and check voltage vetween "grnd" terminal and "H.V." terminal (Back Panel of Scaler).

(2) Meter will indicate a 1 to 1000 ratio; or it will show 1 volt for every 1000 VDC it is sensing.

(3) Check meter (by adjusting H.V. knob below meter) at 1000, mid-scale, 1500 and 2000.

(4) Standardize meter (adjust) at midscale.

b. PULSE HEIGHT OF SENSITIVITY

(1) Hook up a pulse generator (HP-8002A) directly to "G.M.IN" terminal (do not energize H.V. switch). Monitor pulse generator with oscilloscope (Tek 7904) for a negative pulse (0.25v) with a width of about one micro second and a sixty cycle repetition rate.

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Control Settings: Rep Rate - 300 Pulse width - 30NS
Rise/Fall - 10NS Rise/Fall vernier - CCW
Amplitude - .5V

(2) The sensitivity of the scaler 161A should be such that at 0.25 volts and above the scaler will not respond. Be sure that timer is running or scaler will not respond at all.

c. TIMER CHECK

(1) Use Time Mark Generator (Tektronics Model 2901) and feed a 1K Hz signal thru a 50 (ohm) and termination to the "GM IN" terminal on the backside of the scaler 161A. Settings - 1MS, Output .25V/1KΩ.

(2) DO NOT ENERGIZE HIGH VOLTAGE SWITCH.

(3) Use counter (Systron-Donner Model 1037M-2) and connect to scope terminals on front of scaler 161A. (Set counter controls: Time Base 10-5 Function - "Count C".) Then run timer five times at one minute intervals. Find the average deviation from 60000 counts (1000 Hz x 60 sec). Then find the percentage error between timer and standard time (Mark Generator) - this gives percentage error of timer. Error will be within 2% (61200 to 58800).

d. DETERMINATION OF OPERATING PLATEAU

(1) Place the Master Switch and the High Voltage Switch in the off position and connect the G-M tube by means of the high voltage cable supplied with the 161A to the "GM IN". Connector at rear of the instrument. Turn the master and H.V. switches on, turn the H.V. Control fully counterclockwise (minimum voltage) and place a radioactive sample on the shelf nearest the G.M. tube (in lead shield). When the high voltage meter indicates that the high voltage section has warmed-up, place the scale selection switch at 256, ~~put the stop-count switch at 256,~~ put the stop-count switch at count, and slowly turn up the H.V. Control until counting begins (as evidenced by the flicker of the neon lamp). The G.M. tube is now at its "Starting Potential".

(2) With the voltage set at the "Starting Potential" of the Geiger tube, set the count-stop switch to stop, depress the reset switch to turn out the neons and manually reset the register to zero.

(3) Place the stop-count switch in the count position and set the timer to run for three minutes. When timer stops, the scaler will also stop. Plot the voltage versus the number of counts recorded in the three minute time interval. File the plot in the calibration reports file under Model number 161A.

(4) To obtain the number of counts recorded, multiply the reading on the register by the scaling factor (as determined by the position of the scale selection switch). To this figure add the interpolation (the sum of

the numbers above the neon lamps that remain glowing). For example: Suppose the register reads 15, the scale selection switch is at 256, and the neons 1, 4, 16 and 32 are lit when the timer stops the scaler.

Multiply 256 x 15 ----------	3840
Add 1, 4, 16 and 32 ----------	53
Total number of counts ----------	3893

(5) After establishing the "Starting Potential" of the G.M. tube increase the high voltage in 50 volt steps and take a three minute count at each step until the plateau is determined. The plateau is a region wherein the count rate per minute is substantially constant with change in voltage and is proportional to sample activity. At the high end of the plateau a region will be reached where a slight increase in voltage will cause a large increase in the counting rate (voltage proportional region).

(6) The point of operation for the particular G.M. tube used is approximately one-third of the way into the plateau region. Denote this value on the front of the test instrument for operator's use.

e. CHI-SQUARE TEST

NOTE: See attached typed pages
Remove sample from sample chamber. Count only background noise. Set H.V. at operating potential. (1/3 way of operating plateau.

ORIGINATOR Guadalupe Garcia Date 7 Mar. 77
Mr. GARCIA

REVIEWED Delon D Dalke
DELON DALKE

APPROVED R F Perrine
ROBERT PERRINE
YP's Calibration Coordinator

Date: 18 August 1975

Routine: CHI - SQUARE TEST

Author: Peter J. Haywood

$$\chi^2 = \frac{(n - 1)\, S^2}{\overline{Xi}}$$

Xi = CPM rate of each sample
n-1 = Degrees of freedom
S^2 = Standard deviation^2
$\overline{Xi}$ = Mean of sum of Xi

NOTE: The only data necessary for this calculation is X_i (CPM for each of the 10 counts), entered individually into $\Sigma+$ function as outlined below.

LINE	DATA	OPERATIONS	DISPLAY	REMARKS
1		Gold Clear		
2	X_i	$\Sigma+$		Perform 2 for each count
3		Gold $\overline{X}$,S		
4		$X\leftrightarrow Y$ χ^2 RCL 5 1		
5		- X $X\leftrightarrow Y$ ÷	χ^2	See CHI-SQUARE-Record Valve

CHI-SQUARE TEST

The Chi-square determines instrument reliability in accordance with the formula $X^2 = \frac{\sum (Xi-\bar{X})^2}{\bar{X}}$ where $\bar{X}$ is the arithmetric average, CPM rate, and Xi is the CPM rate of successive counts, usually taken for one or two minutes. The procedure is to take at least ten one-minute counts, compute $\bar{X}$ and Chi-square. Then enter the Chi-square table shown below to determine whether this Chi-square value falls within authorized limits.

1 Min. Counts Xi	Average of 10 Counts $\bar{X}$	= $(Xi-\bar{X})$	$(Xi-\bar{X})^2$
29	25.2	3.8	14.44
36	25.2	10.8	116.64
19	25.2	6.2	38.44
26	25.2	0.8	0.64
24	25.2	1.2	1.44
14	25.2	11.2	125.44
21	25.2	4.2	17.64
32	25.2	6.8	46.24
24	25.2	1.2	1.44
27	25.2	1.8	3.24
Total 252			365.60

$$\bar{X} = \frac{252}{10} = 25.2$$

$$\chi^2 = \frac{(Xi-\bar{X})^2}{\bar{X}} = \frac{365.60}{25.20} = 14.51$$

TABLE OF CHI-SQUARE	
NO. OF DETERMINATIONS	VALUE MUST BE BETWEEN
10	2 and 22
20	7 and 36

Since the value of Chi-square 14.51 is between 2 and 22 for these ten determinations, we can say that the instrument is functioning properly

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only for these low counting rates; i. e., 14-36 cpm. When higher count rates are encountered, it will be necessary to Chi-square test the instrument with such higher count rates. If the above Chi-square values do not lie between 2 and 22, it will then be necessary to take twenty counts and, if the Chi-square value does not lie between 7 and 36, then there is a 99% probability that the instrument is not functioning properly.

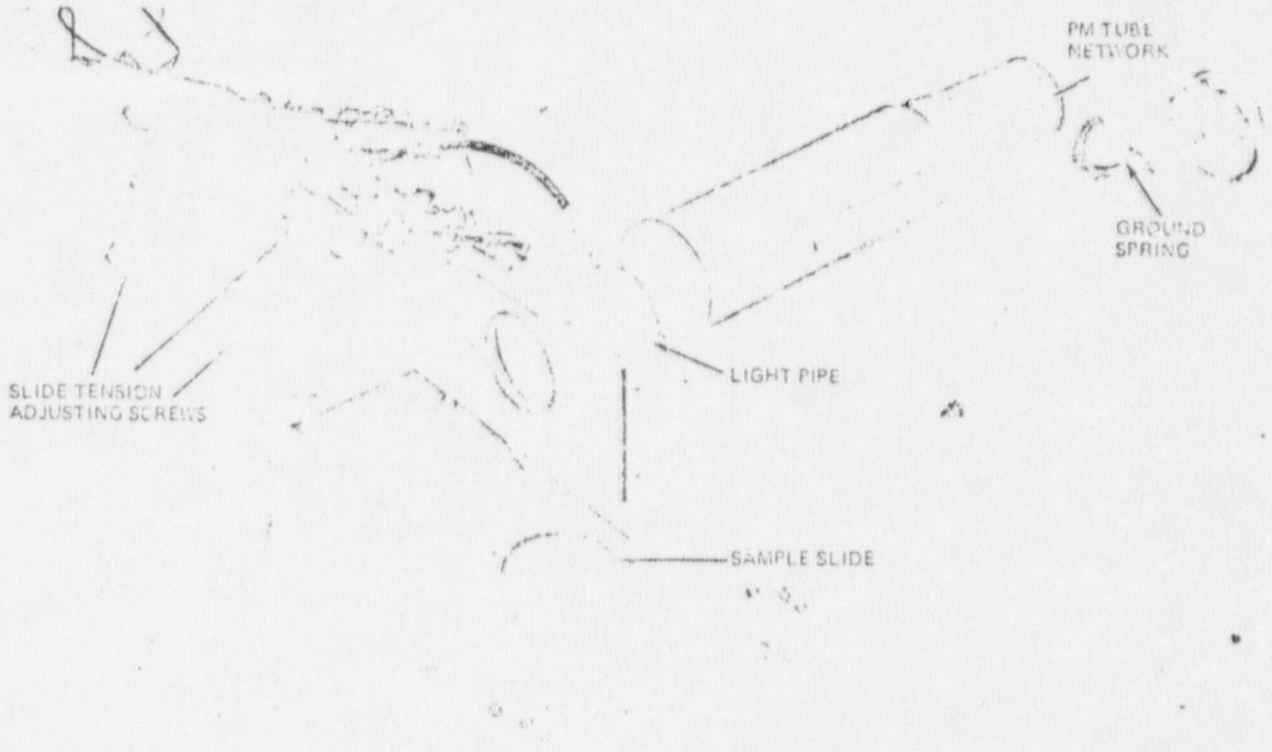

Figure 4-5. Detector Disassembled

D. CALIBRATION AND SET UP

1. Amplifier Gain

The gain of the amplifier is set at the factory for approximately 1.25 volt output for 12.5 millivolts input. The high voltage also controls the overall gain, so the gain adjustment is arbitrary. Generally, the gain should be set toward maximum counterclockwise.

2. High Voltage Operating Point

NOTE

Use an electrostatic voltmeter for high voltage measurement.

a. Place a source of known activity in the sample holder and adjust its height so it is as high as possible but not extending above the drawer surface.

b. Close drawer and run a plateau of counts per minute vs high voltage. (See Figure 4-6.)

c. Remove source and repeat step b. for background.

d. Set high voltage to a point on the plateau just below the upswing of the background.

e. Replace the source and determine the counting efficiency by dividing the observed counts per minute by the 2π source value. This should be 0.8 (80%) or greater. If it is less than this, it indicates that the phosphor needs to be replaced.

f. Remove the source and check the background count rate. This should be less than 3 counts in ten minutes. If it is higher it indicates that the slide and/or phosphor is contaminated.

3. Timer

The timer can be modified to run synced on a 50 Hz line or to run with no sync input at all. The following describes the changes to be made.

a. Synced with 50 Hz line: This modification may be accomplished by removing A203 from the timer board and replacing it with a type 7490 integrated circuit. If this interchange is made you must check to see that pins 2 and 3 of XA203 are jumpered to ground.

b. No external sync signal: To modify the timer to run on its own oscillator with no external sync signal remove the wire from tie point 6 of the timer board. The line sync

feature is then disconnected.

c. Calibration of oscillator: Two methods.

(1) Using an oscilloscope and monitoring at tie point 7 of the timer board, adjust R205 for 60 Hz (16-2/3 milliseconds period) if the timer board is not modified or if it is modified according to part b above.

If the timer board is modified for syncing with a 50 Hz line then adjust R205 for 50 Hz (20 milliseconds period).

(2) An alternate method is to connect a pulse generator with an accurate base (such as EIC Model MP-1) to the amplifier input. Preset a time and adjust R205 for the correct reading on the scaler.

E. DETECTOR MAINTENANCE

1. DECONTAMINATION

a. Remove slide and phototube housing per A-6a and 6b above.

b. Remove sample holder from slide and wash the slide and sample holder thoroughly in warm soapy water. Rinse and dry completely before reassembly.

c. Remove light pipe from phototube. Remove and discard phosphor. Wash the light pipe thoroughly in warm soapy water. Rinse and dry completely before reassembly. See 2 below for re-phosphor operation.

2. CHANGING PHOSPHOR

The SAC-4 may use either a prepared ZnS(Ag) phosphor disk or it may have the ZnS(Ag) phosphor adhered to the light pipe. If the prepared disk is used, simply remove it from the detector top plate and replace it with a new disk. If the adhered phosphor is used, proceed as follows.

a. Remove the phosphor and tape from the light pipe. Apply double sticky tape to the light pipe starting at one edge and working across the surface to eliminate air bubbles.

b. Remove protective cover from tape and sprinkle the phosphor powder evenly on sticky surface. Press into surface for a uniform coating. Brush off excess phosphor and reassemble.

F. TROUBLESHOOTING

Typical voltage and waveforms are given on the schematic. Use of the schematic, along with the Theory of Operation section and its waveforms and diagrams should help to isolate and pinpoint problems. Component locations are shown in Section VI.

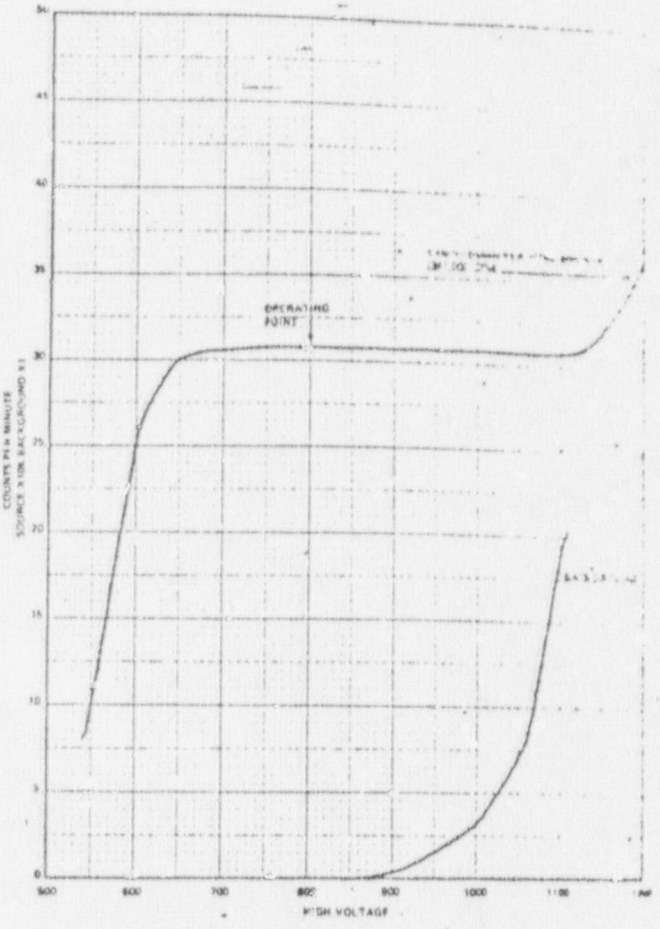

Figure 4-6. Plateau, CPM vs High Voltage

Voltages, except the high voltage, are measured with a 20,000 ohms per volt, or greater, voltmeter. An electrostatic voltmeter should be used to measure the high voltage.

If an electrostatic voltmeter is not available for measuring high voltage, the voltmeter used for the other voltages may be used to give an indication of high voltage. It must be remembered, however, that this is an indication only.

SUPPLEMENT A

RADIATION DETECTION INSTRUMENTS

TYPE OF INSTRUMENTS (Include make and model)	NUMBER AVAILABLE	RADIATION DETECTED	SENSITIVITY RANGE (mr/hr)	WINDOW THICKNESS (mg/cm^2)	USE (Monitor, Survey, Measure)
AN/PDR 27R	3	Beta Gamma	0.01 to 500	Mica 0.0005 in.	Survey & Monitor
Nuclear Chicago 2650	1	Beta Gamma	0.01 to 100	30	Survey & Monitor
Eberline E 400	1	Beta Gamma	0.02 to 2 50	unk	Survey & Monitor
Eberline PAC 4S	2	Alpha	n/a	n/a	Survey & Monitor
Eberline SAC 4	1	Alpha	n/a	n/a	Evaluate Wipes
Nuclear Chicago 161A	1	Alpha, Beta, Gamma	0-6000 cpm	1.9	Evaluate Wipes
Ludlum Model 15	2	Alpha,Beta, Gamma, Neutron	0-5000 cpm	1.5-2.0	Monitor & Survey
Eberline PRM 5-3	1	Alpha, Beta, Gamma	0-5000 cpm	n/a	Monitor & Survey

All US Army Yuma Proving Ground Radiation Detection (Survey) instruments are calibrated every three months by US Army White Sands Missle Range, New Mexico.

The Eberline SAC 4 and Nuclear Chicago 161A are calibrated every 180 days by the Calibration Branch at US Army Yuma Proving Ground, Arizona.