

# U.S. Department of Energy

Washington, D.C.

## PAGE CHANGE

DOE 5480.1 Chg 6

8-13-81

SUBJECT: ENVIRONMENTAL PROTECTION, SAFETY, AND HEALTH  
PROTECTION PROGRAM FOR DOE OPERATIONS

1. PURPOSE. This Page Change revises Chapter XI of DOE 5480.1A.
2. EXPLANATION OF CHANGE. Changes have been made to correct definitions and add requirements for internal audits.
3. FILING INSTRUCTIONS.

a. <u>Remove</u>	<u>Dated</u>	<u>Insert</u>	<u>Dated</u>
Pages XI-1 through XI-4	4-29-81	XI-1 through XI-4	8-13-81
Page XI-5	4-29-81	XI-5	4-29-81
XI-6	4-29-81	XI-6	8-13-81
XI-13	4-29-81	XI-13	8-13-81
XI-14	4-29-81	XI-14	4-29-81
XI 19 (and 20)	4-29-81	XI 19 (and 20)	8-13-81

- 
- 
- b. After filing the attached pages, this transmittal may be discarded.



William S. Heffelfinger  
Assistant Secretary  
Management and Administration

DISTRIBUTION:  
All Departmental Elements  
Federal Energy Regulatory Commission

INITIATED BY:  
Operational and Environmental  
Safety Division

## CHAPTER XI

### REQUIREMENTS FOR RADIATION PROTECTION

1. PURPOSE. This chapter establishes radiation protection standards and requirements for Department of Energy and Department of Energy contractor operations based upon the recommendations of the Environmental Protection Agency and the National Council on Radiation Protection and Measurement.
2. DEFINITIONS.
  - a. Controlled Area. Any area to which access is controlled in order to protect individuals from exposure to radiation and radioactive materials.
  - b. Dose Commitment. The dose equivalent (rem) received by specific organs during a period of one calendar year, that was the result of uptakes of radionuclides by a person occupationally exposed.
  - c. First Collision Dose. A measure of radiation dose at a certain point, based on the incident energy transferred to secondary charged particles, per gram of absorbing materials, by primary particles that suffer only one collision in the medium.
  - d. Neutron Spectrum. A description of a neutron radiation field in terms of the number of neutrons per unit energy interval.
  - e. Primary Unit. A nuclear accident dosimetry unit placed in a position near a potential accident site.
  - f. Screening. A method for rapidly selecting those individuals involved in a nuclear accident and subjected to acutely serious radiation exposure.
3. RESPONSIBILITIES AND AUTHORITIES.
  - a. Heads of Field Organizations shall:
    - (1) Review and approve emergency plans for rescue and recovery operations.
    - (2) Act, where immediate decisions and actions are required, on requests for exemptions from the requirements of this chapter and immediately report and justify such action to the Deputy Assistant Secretary for Environmental Safety and Health (EP-30). Contractors may be authorized to take all appropriate measures in emergency situations. See page XI-9, paragraph 4e.
    - (3) Assure that Department employees, Department contractor personnel, and the general public are protected against unnecessary radiation exposure and comply with the provisions of this chapter.

Vertical line denotes change.

- b. The Deputy Assistant Secretary for Naval Reactors shall assume the same responsibilities as Heads of Field Organizations for Naval Reactors activities.

4. REQUIREMENTS.

- a. Occupationally Related Exposure of Individuals in Controlled Areas.  
Radiation exposures shall be limited to levels reasonably achievable within the standards prescribed below.

- (1) Radiation Protection Standards for External and Internal Exposures.  
(See Figure XI-1.)

- (2) Procedural Requirements.

- (a) Restrictions.

1 An individual under age 18 shall neither be employed in, nor allowed to enter, controlled areas in such a manner that he or she will receive doses of radiation in amounts exceeding one-tenth the standards in paragraph 4a(1) above.

2 Dose to students under age 18 exposed to radiation during educational activities shall not exceed 0.1 rem/year. This exposure shall be considered a part of the 0.5 rem/year limit for workers under age 18 and not supplemental to it.

- (b) Combining Internal and External Dose. Current year whole body internal dose commitment from radionuclides for which the whole body is the critical organ must be combined with the external whole body dose. Where both the external penetrating dose and internal dose to critical organ are known, they shall be combined for that organ.

- (c) Emergency or Accidental Exposure. Radiation doses received in emergency or accidental situations will be chargeable to the radiation exposure records of the exposed individuals. However, the decision as to whether an individual exposed to radiation in excess of the standards in subparagraph a(1) above will continue to work in a radiation area will be made on a case-by-case basis by operating contractor management in accordance with the advice of the contractor's health physics and occupational medical departments and subject to the approval of the Head of Field Organization. The operating contractor shall assure the head of the responsible field office that the unsafe conditions under which the emergency or accidental exposures were received

Vertical line denotes change.

<u>Type of Exposure</u>	<u>Exposure Period</u>	<u>Dose Equivalent (Dose or Dose Commitment<sup>1/</sup> rem)</u>
Whole body, head and trunk, gonads, lens of the eye <sup>2/</sup> , red bone marrow, active blood-forming organs.	Year Calendar Quarter	$\frac{5}{3}$ <sup>3/</sup>
Unlimited areas of the skin (except hands and forearms). Other organs, tissues, and organ systems (except bone).	Year Calendar Quarter	$\frac{15}{5}$
Bone.	Year Calendar Quarter	$\frac{30}{10}$
Forearms <sup>4/</sup>	Year Calendar Quarter	$\frac{30}{10}$
Hands <sup>4/</sup> and feet.	Year Calendar Quarter	$\frac{75}{25}$

- 1/ To meet the above dose commitment standards, operations must be conducted in such a manner that it would be unlikely that an individual would assimilate in a critical organ, by inhalation, ingestion, or absorption, a quantity of radionuclide or mixture of radionuclides that would commit the individual to an organ dose that exceeds the limits specified in the above table.
- 2/ A beta exposure below a maximum energy of 700 KeV will not penetrate the lens of the eye; therefore, the applicable limit for these energies would be that for the skin (15 rem/year).
- 3/ In special cases, with the approval of EP-30, a worker may exceed 5 rem/year, provided his or her average exposure per year since age 18 will not exceed 5 rem per year. This does not apply to emergency situations.
- 4/ All reasonable effort shall be made to keep exposures of forearms and hands to the general limit for the skin.

FIGURE XI-1  
RADIATION PROTECTION STANDARDS FOR  
OCCUPATIONALLY RELATED EXTERNAL AND INTERNAL EXPOSURES

Vertical line denotes change.

have been eliminated. The decision to resume operations following an emergency or accidental radiation exposure shall be subject to the approval of the head of the responsible field office.

- (d) Monitoring Requirements. Monitoring is required where the potential exists for the individual to receive a dose or dose commitment in any calendar quarter in excess of 10 percent of the quarterly standards stated in paragraphs 4a(1) and 4a(2)(a)2 above. Monitoring requirements as specified for the following conditions shall include:

- 1 External Radiation. Personnel monitoring equipment for each individual.
- 2 Internal Radiation. Periodic (monthly, quarterly, annually, etc.) bioassay analysis or in vivo counting or evaluation of air concentration to which the individual is exposed, or a combination of all methods.

- (e) Methods of Estimating Dose Commitment. Methods of estimating dose commitment to the organ of interest should be suitable to the existing conditions and consistent with assumptions and recommendations of the Environmental Protection Agency, the National Council on Radiation Protection and Measurement, and the International Commission on Radiological Protection.

(3) Concentration Guides.

- (a) Air. Concentration Guides in Attachment 1, Table I, Column 1, were derived for the most part from the yearly standards in paragraph 4a(1) above (assume a 40 hour workweek). They should be used in evaluating the adequacy of health protection measures against airborne radioactivity in occupied areas.
- (b) Water. The Concentration Guides in Attachment 1, Table I, Column 2, are applicable to the discharge of liquid effluents to sanitary sewage systems (see paragraph 4b(5) on page XI-6). Drinking water concentrations in controlled areas shall be maintained within the concentration guides specified in Table II, Column 2.

- b. Exposure of Individuals and Population Groups in Uncontrolled Areas. Exposures to members of the public shall be as low as reasonably achievable levels within the standards prescribed below.

Vertical line denotes change.

<u>Type of Exposure</u>	<u>Annual Dose Equivalent or</u> <u>Dose Commitment (rem)<sup>1/</sup></u>	
	<u>Based on dose to</u> <u>individuals at</u> <u>points of maximum</u> <u>probable exposure</u> <u>(rem)</u>	<u>Based on average dose</u> <u>to a suitable sample</u> <u>of the exposed</u> <u>population</u> <u>(rem)</u>
Whole body, gonads, or bone marrow	0.5	0.17
Other organs	1.5	0.5

- 
- 1/ In keeping with Department of Energy policy on lowest practicable exposures, exposures to the public shall be limited to as small a fraction of the respective annual dose limits as is reasonably achievable.
- 2/ See Paragraph 5.4, Federal Radiation Council Report No. 1, for discussion on concept of suitable sample of exposed population.

FIGURE XI-2  
RADIATION PROTECTION STANDARDS FOR EXTERNAL AND  
INTERNAL EXPOSURE OF MEMBERS OF THE PUBLIC

- (1) Radiation Protection Standards for External and Internal Exposure.  
(See Figure XI-2.)
- (2) Monitoring Requirements. To assure that doses to the public are maintained as low as reasonably achievable consistent with dose standards set forth in paragraph 4b(1) above, effluents to the environment, and other parameters shall be monitored and documented in accordance with DOE 5484.1.
- (3) Concentration Guides.
  - (a) Concentration Guides in Attachment XI-1, Table II, were derived for the most part from the dose standards for individuals in paragraph 4b(1) above (assume 168 hours of exposure per week). These guides shall be reduced by a factor of three when applied to a suitable sample of the population. Where transient exposures can be calculated, the concentration guides other than those in Attachment XI-1, Table II, may be used to evaluate compliance with the dose commitment standard.
  - (b) There may be situations where it is not feasible or desirable to evaluate the exposure of individuals and samples of exposed populations to effluents to assure compliance with standards in paragraph 4b(1) above. In those cases, effluent releases to uncontrolled areas shall be such that average concentrations of radioactivity at the point of release are within the concentration guides and are as low as reasonably achievable. The point of release shall be considered to be the point at which the effluents pass beyond the site boundary. Radioactivity concentrations may be averaged over periods up to 1 year.
- (4) Further Limitations on Effluent Discharges. In any situation in which the effluents discharged by one or more activities of the Department, Department contractors, or others cause exposure to approach the standards specified in subparagraph b(1) above, appropriate effluent discharge limits may be set for these operations. In such cases, the manager of the field organization may take the necessary corrective action if all activities concerned are within his or her area of responsibility. Otherwise, each case will be referred to EP-30 for appropriate action including, where appropriate, coordination with actions taken by the Nuclear Regulatory Commission under the Code of Federal Regulations, Title 10, Part 20.106(e).
- (5) Discharge to Sanitary Sewage Systems.
  - (a) Effluents may be discharged to public sanitary sewage systems provided:

Vertical line denotes change.

- 1 When the person in charge of emergency action onsite deems it essential to reduce a hazard potential to acceptable levels or to prevent a substantial loss of property, a planned exposure up to, but not to exceed, 12 rem for the year may be received by the individuals participating in the operation. The person in charge of emergency action under special circumstances could waive these limits and permit volunteers to receive an exposure up to, but not to exceed, 25 rem.
- 2 Where the potential risk of radiation hazard is such that life would be in jeopardy, or that there would be severe effects on health of the public or loss of property inimical to the public safety, the criteria for saving human life shall apply.

f. Guidance on Maintaining Exposures to As Low As Reasonably Achievable.

- (1) Introduction. Exposures to radiation shall be maintained as low as reasonably achievable and within the guidelines provided in paragraphs 4a and b. Assurance that worker and public exposures do not exceed the exposure guidelines (e.g., 3 rem per quarter, 5 rem per year for radiation workers) is, in itself, insufficient in that Department policy is that operations shall be conducted in a manner to assure that radiation exposure to individuals and population groups is limited to the lowest levels reasonably achievable. The guidelines contained herein suggest several factors to consider in each operation to assure compliance with Department policy. They are by no means exhaustive. The DOE publication, "A Guide to Reducing Radiation Exposures to As Low As Reasonably Achievable (ALARA)," DOE/EV/1830-T5, represents a more complete guidance on useful practices and potential areas of concern in satisfying this policy. To the extent feasible, the considerations outlined in this document shall be implemented to insure a comprehensive approach toward assuring that radiation exposure is maintained as low as reasonably achievable. Basic to following these guidelines is the premise that exposures can be maintained as low as reasonably achievable through considerations in the design or modification to a facility and equipment, reducing the errors in radiation exposure assessments through the application of state-of-the-art instrumentation maintenance and calibration, and by the institution of appropriate procedures and training.
- (2) Considerations Toward Maintaining Radiation Exposures As Low As Reasonably Achievable. When applying the following guidelines, changes in processes or modifications to existing facilities should be considered on the merits of the specific case.

Vertical line denotes change.



(a) Facility Considerations.1 Design.

- a Exposure rates in work areas should be reduced as low as reasonably achievable by proper facility design and equipment layout. Design factors to consider are: occupancy time, source terms, spacing, processes, equipment, and shielding. Onsite personnel exposure levels less than one-fifth of the permissible dose equivalent limits prescribed in this chapter should be used as a design objective.
- b Primary means for assuring protection should be through physical safeguards, e.g., remote handling, equipment, shielding, etc. Administrative controls should be regarded as secondary means.
- c The general concept in the design facility for purposes of high level contamination confinement should be primary, secondary, and tertiary confinement. Primary confinement would be the process enclosures and their ventilation and air cleaning systems, secondary confinement would be the operating area compartments and their ventilation and air cleaning systems, and the tertiary confinement would be the structure and its ventilation and air cleaning systems.
- d Compartmentalization should be provided to isolate high risk areas.
- e Decommissioning requirements should be considered in the design of a facility. The avoidance of rough surfaces, cracks, and crevices in potential contamination areas should be considered in this context.
- f The use of protective coating in radiation areas should comply with the specifications contained in American National Standards Institute Standard N512-1974, "Protective Coating for Nuclear Industry."
- g Interior surfaces, as well as layout of ducts and pipes, should be designed to minimize buildup of contamination and exposure to personnel, and to facilitate cleanup.

plant releases as low as reasonably achievable. Training programs should be on a continuing basis to enable training of replacement personnel as well as retraining to assure that personnel remain proficient, and should include a means to determine that the trainees have attained the necessary qualification status. A radiation safety training program should include but not be limited to:

- i Principles of design operation and maintenance of the plant, project equipment, or experiment.
- ii Potential problem areas from the radiological viewpoint.
- iii Basic characteristics of radiation and contamination.
- iv Methods (procedures, equipment) for exposure and contamination control.
- v Basic understanding of biological dose and methods of assessment.
- vi Emergency procedures and systems.

b Operations supervision should have a good understanding of the radiological characteristics and potential safety problem areas associated with their program including all the training elements covered under paragraph 4f(2)(b)1 a above. This would permit a proper assessment of the adequacy of controls instituted to maintain exposures as low as reasonably achievable.

g. Internal Audits

- (1) Internal audits shall be conducted of the radiation control program.
- (2) In conducting such audits, the guidelines set forth in DOE 5482.1 shall be used.