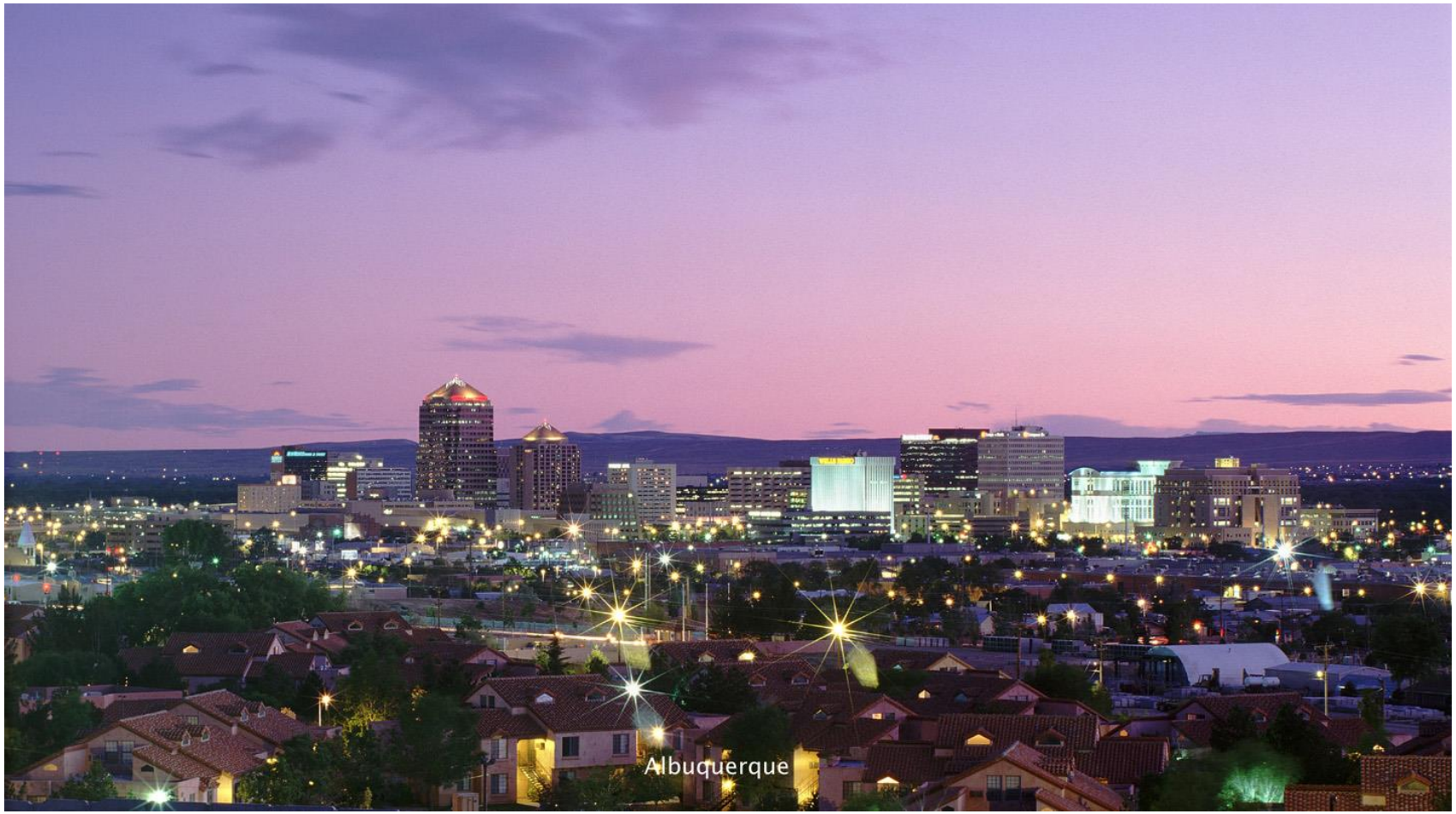
Air Sampling in Nuclear Facilities



DAY 2

James Tom Voss, NRRPT, CHP

jtvoss@newmexico.com

WWW.VOSS-ASSOCIATES.COM

Technical Management Services

WWW.TMSCOURSES.COM

CLASS SCHEDULE

DAY 1 – Fundamentals of Air Monitoring

DAY 2 – DOE, EPA, and NRC Standards

DAY 3 – Methods of Extracting Representative Samples from Stacks and Ducts, the Work Area, and the Environment

DAY 4 – Types of Air Samplers and Monitors

DAY 5 – Hands-On Use of Air Samplers and Monitors

CECs for Recertification by AAHP
NRRPT will also accept these CECs

2015-00-014	Air Sampling in Nuclear Facilities During Routine and Emergency Situations	Technical Management Services	4 yr credit (2015-2018)	40
2015-00-015	HP Survey Instrument Calibration and Selection	Technical Management Services	4 yr credit (2015-2018)	24
2013-00-110	Health Physics Instrumentation Committee Meeting		4 yr credit (2013-2016)	20+

Review of DAY 1

DAY 2 – DOE, EPA, and NRC Standards

Requirements from the CFRs and
Other Regulatory Documents

Many of the Requirements
Are Also Apparent From
Their Definitions

Appendix A to Part 835—Derived Air Concentrations (DAC) for Controlling Radiation Exposure to Workers at DOE Facilities

Appendix C to Part 835—Derived Air Concentration (DAC) for Workers From External Exposure During Immersion in a Cloud of Airborne Radioactive Material

Appendix D to Part 835—Surface Contamination Values

10CFR835 Requirements

(a) A DOE activity shall be conducted in compliance with a documented radiation protection program (RPP) as approved by the DOE.
(b) The DOE may direct or make modifications to a RPP.
(c) The content of each RPP shall be commensurate with the nature of the activities performed and shall include formal plans and measures for applying the as low as reasonably achievable (ALARA) process to occupational exposure.

(d) The RPP shall specify the existing and/or anticipated operational tasks that are intended to be within the scope of the RPP. Except as provided in §835.101(h), any task outside the scope of a RPP shall not be initiated until an update of the RPP is approved by DOE.
(e) The content of the RPP shall address, but shall not necessarily be limited to, each requirement in this part.
(f) The RPP shall include plans, schedules, and other measures for achieving compliance with regulations of this part.

(g) An update of the RPP shall be submitted to DOE:

(1) Whenever a change or an addition to the RPP is made;

(2) Prior to the initiation of a task not within the scope of the RPP; or

(3) Within 180 days of the effective date of any modifications to this part.

§835.102 Internal audits.
Internal audits of the radiation protection program, including examination of program content and implementation, shall be conducted through a process that ensures that all functional elements are reviewed no less frequently than every 36 months.

§835.103 Education, training and skills.
Individuals responsible for developing and implementing measures necessary for ensuring compliance with the requirements of this part shall have the appropriate education, training, and skills to discharge these responsibilities.

§835.104 Written procedures.

Written procedures shall be developed and implemented as necessary to ensure compliance with this part, commensurate with the radiological hazards created by the activity and consistent with the education, training, and skills of the individuals exposed to those hazards.

§835.203 Combining internal and external equivalent doses.

(a) The total effective dose during a year shall be determined by summing the effective dose from external exposures and the committed effective dose from intakes during the year.

(b) Determinations of the effective dose shall be made using the radiation and tissue weighting factor values provided in §835.2.

§835.209 Concentrations of radioactive material in air.

(a) The derived air concentration (DAC) values given in appendices A and C of this part shall be used in the control of occupational exposures to airborne radioactive material.

(b) The estimation of internal dose shall be based on bioassay data rather than air concentration values unless bioassay data are:

(1) Unavailable;

(2) Inadequate; or

(3) Internal dose estimates based on air concentration values are demonstrated to be as or more accurate.

§835.603 Radiological areas and radioactive material areas.

Each access point to radiological areas and radioactive material areas (as defined at §835.2) shall be posted with conspicuous signs bearing the wording provided in this section.

(d) *Airborne radioactivity area.* The words “Caution, Airborne Radioactivity Area” or “Danger, Airborne Radioactivity Area” shall be posted at each airborne radioactivity area.

§835.701 General provisions.

(a) Records shall be maintained to document compliance with this part and with radiation protection programs required by §835.101.

(b) Unless otherwise specified in this subpart, records shall be retained until final disposition is authorized by DOE.

§835.702 Individual monitoring records.

(a) Except as authorized by §835.702(b), records shall be maintained to document doses received by all individuals for whom monitoring was conducted and to document doses received during planned special exposures, unplanned doses exceeding the monitoring thresholds of §835.402, and authorized emergency exposures.

(b) Recording of the non-uniform equivalent dose to the skin is not required if the dose is less than 2 percent of the limit specified for the skin at §835.202(a)(4). Recording of internal dose (committed effective dose or committed equivalent dose) is not required for any monitoring result estimated to correspond to an individual receiving less than 0.01 rem (0.1 mSv) committed effective dose. The bioassay or air monitoring result used to make the estimate shall be maintained in accordance with §835.703(b) and the unrecorded internal dose estimated for any individual in a year shall not exceed the applicable monitoring threshold at §835.402(c).

(c) The records required by this section shall:
(1) Be sufficient to evaluate compliance with subpart C of this part;
(2) Be sufficient to provide dose information necessary to complete reports required by subpart I of this part;
(3) Include the results of monitoring used to assess the following quantities for external dose received during the year:
(i) The effective dose from external sources of radiation (equivalent dose to the whole body may be used as effective dose for external exposure);
(ii) The equivalent dose to the lens of the eye;
(iii) The equivalent dose to the skin; and
(iv) The equivalent dose to the extremities.

(4) Include the following information for internal dose resulting from intakes received during the year:
(i) Committed effective dose;
(ii) Committed equivalent dose to any organ or tissue of concern; and
(iii) Identity of radionuclides.
(5) Include the following quantities for the summation of the external and internal dose:
(i) Total effective dose in a year;
(ii) For any organ or tissue assigned an internal dose during the year, the sum of the equivalent dose to the whole body from external exposures and the committed equivalent dose to that organ or tissue; and
(iii) Cumulative total effective dose.

(6) Include the equivalent dose to the embryo/fetus of a declared pregnant worker.

(d) Documentation of all occupational doses received during the current year, except for doses resulting from planned special exposures conducted in compliance with §835.204 and emergency exposures authorized in accordance with §835.1302(d), shall be obtained to demonstrate compliance with §835.202(a). If complete records documenting previous occupational dose during the year cannot be obtained, a written estimate signed by the individual may be accepted to demonstrate compliance.

(e) For radiological workers whose occupational dose is monitored in accordance with §835.402, reasonable efforts shall be made to obtain complete records of prior years occupational internal and external doses.
(f) The records specified in this section that are identified with a specific individual shall be readily available to that individual.
(g) Data necessary to allow future verification or reassessment of the recorded doses shall be recorded.
(h) All records required by this section shall be transferred to the DOE upon cessation of activities at the site that could cause exposure to individuals.

§835.703 Other monitoring records.

The following information shall be documented and maintained:

(a) Results of monitoring for radiation and radioactive material as required by subparts E and L of this part, except for monitoring required by §835.1102(d);

(b) Results of monitoring used to determine individual occupational dose from external and internal sources;

(c) Results of monitoring for the release and control of material and equipment as required by 835.1101; and

(d) Results of maintenance and calibration performed on instruments and equipment as required by §835.401(b).

§835.901 Radiation safety training.

(a) Each individual shall complete radiation safety training on the topics established at §835.901(c) commensurate with the hazards in the area and the required controls:

(1) Before being permitted unescorted access to controlled areas; and

(2) Before receiving occupational dose during access to controlled areas at a DOE site or facility.

(b) Each individual shall demonstrate knowledge of the radiation safety training topics established at §835.901(c), commensurate with the hazards in the area and required controls, by successful completion of an examination and performance demonstrations:
(1) Before being permitted unescorted access to radiological areas; and
(2) Before performing unescorted assignments as a radiological worker.

(c) Radiation safety training shall include the following topics, to the extent appropriate to each individual's prior training, work assignments, and degree of exposure to potential radiological hazards:
(1) Risks of exposure to radiation and radioactive materials, including prenatal radiation exposure;
(2) Basic radiological fundamentals and radiation protection concepts;
(3) Physical design features, administrative controls, limits, policies, procedures, alarms, and other measures implemented at the facility to manage doses and maintain doses ALARA, including both routine and emergency actions;

(4) Individual rights and responsibilities as related to implementation of the facility radiation protection program;
(5) Individual responsibilities for implementing ALARA measures required by §835.101; and
(6) Individual exposure reports that may be requested in accordance with §835.801.

(d) When an escort is used in lieu of training in accordance with paragraph (a) or (b) of this section, the escort shall:
(1) Have completed radiation safety training, examinations, and performance demonstrations required for entry to the area and performance of the work; and
(2) Ensure that all escorted individuals comply with the documented radiation protection program.

(e) Radiation safety training shall be provided to individuals when there is a significant change to radiation protection policies and procedures that may affect the individual and at intervals not to exceed 24 months. Such training provided for individuals subject to the requirements of §835.901(b)(1) and (b)(2) shall include successful completion of an examination.

§835.1001 Design and control.

(a) Measures shall be taken to maintain radiation exposure in controlled areas ALARA through engineered and administrative controls. The primary methods used shall be physical design features (e.g., confinement, ventilation, remote handling, and shielding). Administrative controls shall be employed only as supplemental methods to control radiation exposure.

(b) For specific activities where use of engineered controls is demonstrated to be impractical, administrative controls shall be used to maintain radiation exposures ALARA.

§835.1002 Facility design and modifications.
During the design of new facilities or modification of existing facilities, the following objectives shall be adopted:
(a) Optimization methods shall be used to assure that occupational exposure is maintained ALARA in developing and justifying facility design and physical controls.

(b) The design objective for controlling personnel exposure from external sources of radiation in areas of continuous occupational occupancy (2000 hours per year) shall be to maintain exposure levels below an average of 0.5 millirem (5 μSv) per hour and as far below this average as is reasonably achievable. The design objectives for exposure rates for potential exposure to a radiological worker where occupancy differs from the above shall be ALARA and shall not exceed 20 percent of the applicable standards in §835.202.

(c) Regarding the control of airborne radioactive material, the design objective shall be, under normal conditions, to avoid releases to the workplace atmosphere and in any situation, to control the inhalation of such material by workers to levels that are ALARA; confinement and ventilation shall normally be used.
(d) The design or modification of a facility and the selection of materials shall include features that facilitate operations, maintenance, decontamination, and decommissioning.

§835.1003 Workplace controls.

During routine operations, the combination of engineered and administrative controls shall provide that:

(a) The anticipated occupational dose to general employees shall not exceed the limits established at §835.202; and

(b) The ALARA process is utilized for personnel exposures to ionizing radiation.

§835.1101 Control of material and equipment.

(a) Except as provided in paragraphs (b) and (c) of this section, material and equipment in contamination areas, high contamination areas, and airborne radioactivity areas shall not be released to a controlled area if:

(1) Removable surface contamination levels on accessible surfaces exceed the removable surface contamination values specified in appendix D of this part; or

(2) Prior use suggests that the removable surface contamination levels on inaccessible surfaces are likely to exceed the removable surface contamination values specified in appendix D of this part.

(b) Material and equipment exceeding the removable surface contamination values specified in appendix D of this part may be conditionally released for movement on-site from one radiological area for immediate placement in another radiological area only if appropriate monitoring is performed and appropriate controls for the movement are established and exercised.

(c) Material and equipment with fixed contamination levels that exceed the total contamination values specified in appendix D of this part may be released for use in controlled areas outside of radiological areas only under the following conditions:
(1) Removable surface contamination levels are below the removable surface contamination values specified in appendix D of this part; and
(2) The material or equipment is routinely monitored and clearly marked or labeled to alert personnel of the contaminated status.

§835.1102 Control of areas.

(a) Appropriate controls shall be maintained and verified which prevent the inadvertent transfer of removable contamination to locations outside of radiological areas under normal operating conditions.

(b) Any area in which contamination levels exceed the values specified in appendix D of this part shall be controlled in a manner commensurate with the physical and chemical characteristics of the contaminant, the radionuclides present, and the fixed and removable surface contamination levels.

(c) Areas accessible to individuals where the measured total surface contamination levels exceed, but the removable surface contamination levels are less than, corresponding surface contamination values specified in appendix D of this part, shall be controlled as follows when located outside of radiological areas:

(1) The area shall be routinely monitored to ensure the removable surface contamination level remains below the removable surface contamination values specified in appendix D of this part; and

(2) The area shall be conspicuously marked to warn individuals of the contaminated status.

(d) Individuals exiting contamination, high contamination, or airborne radioactivity areas shall be monitored, as appropriate, for the presence of surface contamination.
(e) Protective clothing shall be required for entry to areas in which removable contamination exists at levels exceeding the removable surface contamination values specified in appendix D of this part.

Appendix A to Part 835—Derived Air Concentrations (DAC) for Controlling Radiation Exposure to Workers at DOE Facilities

The data presented in appendix A are to be used for controlling individual internal doses in accordance with §835.209, identifying the need for air monitoring in accordance with §835.403, and identifying and posting airborne radioactivity areas in accordance with §835.603(d).

The DAC values are given for individual radionuclides. For known mixtures of radionuclides, determine the sum of the ratio of the observed concentration of a particular radionuclide and its corresponding DAC for all radionuclides in the mixture. If this sum exceeds unity (1), then the DAC has been exceeded. For unknown radionuclides, the most restrictive DAC (lowest value) for those isotopes not known to be absent shall be used. For any single radionuclide not listed in appendix A with decay mode other than alpha emission or spontaneous fission and with radioactive half-life greater than two hours, the DAC value shall be 4 E-11 µCi/mL (1 Bq/m3).

For any single radionuclide not listed in appendix A that decays by alpha emission or spontaneous fission the DAC value shall be 2 E-13 µCi/mL (8 E-03 Bq/m3).

The DACs for limiting radiation exposures through inhalation of radionuclides by workers are listed in this appendix. The values are based on either a stochastic (committed effective dose) dose limit of 5 rems (0.05 Sv) or a deterministic (organ or tissue) dose limit of 50 rems (0.5 Sv) per year, whichever is more limiting.

NOTE: The 15 rems (0.15 Sv) dose limit for the lens of the eye does not appear as a critical organ dose limit.

The columns in this appendix contain the following information: (1) Radionuclide; (2) inhaled air DAC for type F (fast), type M (moderate), and type S (slow) materials in units of μCi/mL; (3) inhaled air DAC for type F (fast), type M (moderate), and type S (slow) materials in units of Bq/m3; (4) an indication of whether or not the DAC for each class is controlled by the stochastic (effective dose) or deterministic (organ or tissue) dose. The absorption types (F, M, and S) have been established to describe the absorption type of the materials from the respiratory tract into the blood.

The range of half-times for the absorption types correspond to: Type F, 100% at 10 minutes; Type M, 10% at 10 minutes and 90% at 140 days; and Type S 0.1% at 10 minutes and 99.9% at 7000 days. The DACs are listed by radionuclide, in order of increasing atomic mass, and are based on the assumption that the particle size distribution of 5 micrometers AMAD is used. For situations where the particle size distribution is known to differ significantly from 5 micrometers AMAD, appropriate corrections may be made to both the estimated dose to workers and the DACs.

Radionuclide	Absorption type[3]			Absorption type[3]			Stochastic or organ or tissue[1]
	µCi/mL			Bq/m^3			(F/M/S)
	F	M	S	F	M	S	
H-3 (Water)[2]	2 E−05	2 E−05	2 E−05	7 E+05	7 E+05	7 E+05	St/St/St
H-3 (Elemental)[2]	2 E−01	2 E−01	2 E−01	9 E+09	9 E+09	9 E+09	St/St/St
STCs (Insoluble)[4]	1 E−05	6 E−06	2 E−06	3 E+05	2 E+05	8 E+04	St/St/St
STCs (Soluble)	1 E−05	1 E−05	1 E−05	5 E+05	5 E+05	5 E+05	St/St/St

Appendix C to Part 835—Derived Air Concentration (DAC) for Workers From External Exposure During Immersion in a Cloud of Airborne Radioactive Material

a. The data presented in appendix C are to be used for controlling occupational exposures in accordance with §835.209, identifying the need for air monitoring in accordance with §835.403 and identifying the need for posting of airborne radioactivity areas in accordance with §835.603(d).

b. The air immersion DAC values shown in this appendix are based on a stochastic dose limit of 5 rems (0.05 Sv) per year. Four columns of information are presented: (1) Radionuclide; (2) half-life in units of seconds (s), minutes (min), hours (h), days (d), or years (yr); (3) air immersion DAC in units of µCi/mL; and (4) air immersion DAC in units of Bq/m3. The data are listed by radionuclide in order of increasing atomic mass. The air immersion DACs were calculated for a continuous, nonshielded exposure via immersion in a semi-infinite cloud of airborne radioactive material. The DACs listed in this appendix may be modified to allow for submersion in a cloud of finite dimensions.

c. The DAC values are given for individual radionuclides. For known mixtures of radionuclides, determine the sum of the ratio of the observed concentration of a particular radionuclide and its corresponding DAC for all radionuclides in the mixture. If this sum exceeds unity (1), then the DAC has been exceeded. For unknown radionuclides, the most restrictive DAC (lowest value) for those isotopes not known to be absent shall be used.

For any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life less than two hours, the DAC value shall be 6 E-06 µCi/mL (2 E+04 Bq/m3).

DOE ORDER 458.1, RADIATION PROTECTION OF THE PUBLIC AND THE ENVIRONMENT

The objectives of this Order are:
(1) To conduct DOE radiological activities so that exposure to members of the public is maintained within the dose limits established in this Order;
(2) To control the radiological clearance of DOE real and personal property;
(3) To ensure that potential radiation exposures to members of the public are as low as is reasonably achievable;

(4) To ensure that DOE sites have the capabilities, consistent with the types of radiological activities conducted, to monitor routine and non-routine radiological releases and to assess the radiation dose to members of the public; and
(5) To provide protection of the environment from the effects of radiation and radioactive material.

Public Dose Limit.
(1) DOE radiological activities, including remedial actions and activities using Technologically Enhanced Naturally Occurring Radioactive Material (TENORM), must be conducted so that exposure of members of the public to ionizing radiation will:
(a) Not cause a total effective dose (TED) exceeding 100 mrem (1mSv) in a year, an equivalent dose to the lens of the eye exceeding 1500 mrem (15 mSv) in a year, or an equivalent dose to the skin or extremities exceeding 5000 mrem (50 mSv) in a year, from all sources of ionizing radiation and exposure pathways that could contribute significantly to the total dose excepting:

1 Dose from radon and its decay products in air [Radon is regulated separately e.g., under Paragraphs 4.f. and 4.h.(1)(d) in this Order and under Title 40 Code of Federal Regulations (CFR) Part 61, Subparts Q and T];
2 Dose received by patients from medical sources of radiation, and by volunteers in medical research programs;
3 Dose from background radiation;
4 Dose from occupational exposure under NRC or Agreement State license or to general employees regulated under 10 CFR Part 835, and
Comply with ALARA requirements in paragraph 4.d. of this Order.

(2) The public dose limit applies to members of the public located off DOE sites and on DOE sites outside of controlled areas, and to those exposed to residual radioactive material subsequent to any remedial action or clearance of property.

Demonstrating Compliance with the Public Dose Limit.
(1) Dose evaluations to demonstrate compliance with the public dose limit in paragraph 4.b.(1) of this Order and to assess collective dose must include the following:
(a) The TED to members of the public from exposure to radiation, airborne effluents, and liquid effluents, of DOE origin.
1 Compliance may be demonstrated by calculating dose to the representative person or to the maximally exposed individual (MEI).
2 Determination of the representative person or the MEI must include members of the public both on DOE sites outside of controlled areas and off DOE sites.

3 If it is suspected that any of the dose limits specified in paragraph 4.b.(1)(a) of this Order may be exceeded or the estimated TED for members of the public exceeds 25 mrem (0.25 mSv) in a year, then dose to the lens of the eye, skin and extremities must be evaluated.

(b) Analytical models that consider likely exposure pathways, such as:
1 Direct external radiation from sources located on-site;
2 External radiation from airborne radioactive material;
3 External radiation from radioactive material deposited on surfaces off-site;
4 Internal radiation from inhaled airborne radioactive material;
5 Internal radiation from radioactive material ingested with water, and with food from terrestrial crops or animal products (e.g., meat, eggs, milk);

6 Internal radiation from radioactive material ingested with aquatic food products such as fish, shellfish, crustaceans (e.g., crayfish, shrimp, crab, lobsters), and aquatic plants and algae;
7 External or internal radiation due to residual radioactive material on, or in, cleared real property; and
8 Any other pathway unique to the DOE site or activity.

(c) The dose to members of the public from DOE-related exposure sources only, if the projected DOE-related dose to the representative person or MEI is 25 mrem (0.25mSv) in a year or less. If the DOE-related dose is greater than 25 mrem in a year, the dose to members of the public must include both major non-DOE sources of exposure (excluding dose from radon and its decay products in air, background radiation dose, occupational doses and doses due to medical exposures) and dose from DOE-related sources.

(d) Collective dose for members of the public resulting from radiation emitted and radioactive materials released from DOE radiological activities only (not including radon and its decay products). Collective dose for members of the public must be representative of the total dose and of adequate quality for supported comparisons, trending or decisions.

Consistent with the graded approach, collective dose estimates may be truncated by distance (e.g., 50 miles) or individual dose level (e.g., 10 microrem) when integration of doses beyond such thresholds does not significantly affect data quality objectives. Where it is of concern, collective dose for members of the public resulting from radon and its decay products released by DOE radiological activities needs to be calculated separately from other radionuclides.

(2) The estimated individual dose to the MEI or representative person that is representative of the persons or group likely to receive the most dose and is based on pathway and exposure parameters that are not likely to underestimate or substantially overestimate the dose, and, the collective dose (population dose) that is a realistic as practicable estimate of the sum of the doses to all members of the actual exposed population.

(3) Site-specific information on radiation source dispersion patterns, location and demography of members of the public in the vicinity of DOE radiological activities, land use, food supplies, and exposure pathway information must be updated, as necessary, to document significant changes that could affect dose evaluations.

(4) Values of assumed default or site-specific parameters used in calculations must be identified and included with the documentation of the calculations.

(5) Direct measurements must be made, to the extent practicable, to obtain information characterizing source terms, exposures, exposure modes, and other information needed in evaluating dose.

(6) Dose evaluation models that are codified or approved for use by DOE must be used. Alternative dose evaluation models, including those used by other regulatory agencies, national organizations or international organizations, must be approved for use by the Chief Health, Safety and Security Officer, or by the DOE Field Element Manager with the concurrence of a Cognizant Secretarial Officer and the Chief Health, Safety and Security Officer, or for NNSA sites by the NNSA Field Element Manager with the concurrence of the NNSA Cognizant Secretarial Officer in consultation with the Chief Health, Safety and Security Officer.

(7) DOE-approved dose coefficients must be used to evaluate doses resulting from DOE radiological activities. Use of alternative dose coefficients must be approved by the Chief Health, Safety and Security Officer or by a Cognizant Secretarial Officer in consultation with the Chief Health, Safety and Security Officer.

(8) Doses to members of the public from airborne effluents must be evaluated with the CAP-88 model or another EPA-approved model or method to demonstrate compliance with applicable subparts of 40 CFR Part 61, *National Emission Standards for Hazardous Air Pollutants*.

(9) Environmental monitoring must be conducted to characterize routine and non-routine releases of radioactive material from radiological activities, estimate the dispersal pattern in the environs, characterize the pathway(s) of exposure to members of the public and estimate the doses to individuals and populations in the vicinity of the site or operation commensurate with the nature of the DOE radiological activities and the risk to the public and the environment. Radiological monitoring must be integrated with the general environmental and effluent monitoring. Environmental monitoring must include, but is not limited to:

(a) Effluent Monitoring
(b) Environmental Surveillance
(c) Meteorological Monitoring. Meteorological monitoring must be commensurate with the level of site radiological activities, the site topographical characteristics, and the distance to critical receptors. The scope must be sufficient to characterize atmospheric dispersion and model the dose to members of the public over distances commensurate with the magnitude of potential source terms and possible pathways to the atmosphere.

(d) Pre-operational Monitoring. Prior to the startup of a new site, facility or process with the potential to expose the public or environment to radiation or radioactive material, it is necessary to ensure that adequate knowledge exists to understand: 1) radiological background; 2) pertinent environmental and ecological parameters; and 3) potential pathways for human exposures or ecological/natural resource impacts either from existing data or documents (for example, NEPA evaluations or existing monitoring and surveillance programs, etc.) or from the conduct of a pre-operational study initiated at least one year prior to startup of a new operation.

(10) Site-specific environmental monitoring criteria must be established to ensure that representative measurements of quantities and concentrations of radiological contaminants are conducted and that the effects from DOE radiological activities on members of the public and the environment are monitored sufficiently to demonstrate compliance with this Order.

f. Airborne Radioactive Effluents. Radiological activities must be conducted in a manner such that the release of radioactive material to the atmosphere will:

(1) Be evaluated using the ALARA process established in paragraph 4.d. of this Order;

(2) Not cause radon-222 flux rates to exceed 20 pCi (0.7 Bq) m-2 sec-1 averaged over the surface area overlaying waste, including the covering or other confinement structures, wherever radium-226 wastes are accepted for storage or disposal (See 40 CFR Part 61, Subparts Q and T);

(3) Meet compliance agreements under 40 CFR Part 61, Subparts H, Q, and T;
(4) Not cause the radon-220 and radon-222 decay product concentration, including background, to exceed 0.03 WL in buildings that are being released from DOE control. Further, a reasonable effort must be made to meet a 0.02WL generic guideline for annual average radon-220 and radon-222 decay product concentration, including background, in such buildings; and
(5) Not exceed 3 pCi/L annual average radon-220 and radon-222 concentration, not including background, at the site boundary if DOE activities release radon-220 and radon-222 or their decay products.

40CFR61 - National Emission Standards for Hazardous Air Pollutants (NESHAPS)

Subpart I—National Emission Standards for Radionuclide Emissions From Federal Facilities Other Than Nuclear Regulatory Commission Licensees and Not Covered by Subpart H

§61.102 Standard.

(a) Emissions of radionuclides, including iodine, to the ambient air from a facility regulated under this subpart shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/yr.

(b) Emissions of iodine to the ambient air from a facility regulated under this subpart shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 3 mrem/yr.

§61.103 Determining compliance.

(a) Compliance with the emission standard in this subpart shall be determined through the use of either the EPA computer code COMPLY or the alternative requirements of appendix E. Facilities emitting radionuclides not listed in COMPLY or appendix E shall contact EPA to receive the information needed to determine dose. The source terms to be used for input into COMPLY shall be determined through the use of the measurement procedures listed in §61.107 or the emission factors in appendix D or through alternative procedures for which EPA has granted prior approval; or,

(b) Facilities may demonstrate compliance with the emission standard in this subpart through the use of computer models that are equivalent to COMPLY, provided that the model has received prior approval from EPA headquarters. Any facility using a model other than COMPLY must file an annual report. EPA may approve an alternative model in whole or in part and may limit its use to specific circumstances.

§61.105 Recordkeeping requirements.

The owner or operator of any facility must maintain records documenting the source of input parameters including the results of all measurements upon which they are based, the calculations and/or analytical methods used to derive values for input parameters, and the procedure used to determine compliance.

This documentation should be sufficient to allow an independent auditor to verify the accuracy of the determination made concerning the facility's compliance with the standard, and, if claimed, qualification for exemption from reporting. These records must be kept at the site of the facility for at least five years and upon request be made available for inspection by the Administrator, or his authorized representative.

§61.106 Applications to construct or modify.

(a) In addition to any activity that is defined as construction under 40 CFR part 61, subpart A, any fabrication, erection or installation of a new building or structure within a facility is also defined as new construction for purposes of 40 CFR part 61, subpart A.

(b) An application under §61.07 does not need to be filed for any new construction of or modification within an existing facility if one of the following conditions is met:

(1) The effective dose equivalent calculated by using methods described in §61.103, that is caused by all emissions from the facility including those potentially emitted by the proposed new construction or modification, is less than 10% of the standard prescribed in §61.102.
(2) The effective dose equivalent calculated by using methods described in §61.103, that is caused by all emissions from the new construction or modification, is less than 1% of the limit prescribed in §61.102. A facility is eligible for this exemption only if the facility, based on its last annual report, is in compliance with this subpart.

§61.107 Emission determination.

(a) Facility owners or operators may, in lieu of monitoring, estimate radionuclide emissions in accordance with appendix D, or other procedure for which EPA has granted prior approval.

(b) Radionuclide emission rates from existing point sources (stacks or vents) shall be measured in accordance with the following requirements or within the requirements of paragraph (d) of this section, or other procedures for which EPA has granted prior approval:

(1) Effluent flow rate measurements shall be made using the following methods:
(i) Reference Method 2 of appendix A to part 60 of this chapter shall be used to determine velocity and volumetric flow rates for stacks and large vents.
(ii) Reference Method 2A of appendix A to part 60 of this chapter shall be used to measure flow rates through pipes and small vents.
(iii) The frequency of the flow rate measurements shall depend upon the variability of the effluent flow rate. For variable flow rates, continuous or frequent flow rate measurements shall be made. For relatively constant flow rates only periodic measurements are necessary.

(2) Radionuclides shall be directly monitored or extracted, collected, and measured using the following methods:
(i) Reference Method 1 of appendix A part 60 of this chapter shall be used to select monitoring or sampling sites.

(ii) The effluent stream shall be directly monitored continuously using an in-line detector or representative samples of the effluent stream shall be withdrawn continuously from the sampling site following the guidance presented in ANSIN13.1-1969 “Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities” (including the guidance presented in appendix A of ANSIN13.1) (incorporated by reference—see §61.18).

The requirements for continuous sampling are applicable to batch processes when the unit is in operation. Periodic sampling (grab samples) may be used only with EPA's prior approval. Such approval may be granted in cases where continuous sampling is not practical and radionuclide emission rates are relatively constant. In such cases, grab samples shall be collected with sufficient frequency so as to provide a representative sample of the emissions.

(iii) Radionuclides shall be collected and measured using procedures based on the principles of measurement described in appendix B, Method 114. Use of methods based on principles of measurement different from those described in appendix B, Method 114 must have prior approval from the Administrator. EPA reserves the right to approve alternative measurement procedures in whole or in part.

(iv) A quality assurance program shall be conducted that meets the performance requirements described in appendix B, Method 114.

(3) When it is impractical to measure the effluent flow rate at an existing source in accordance with the requirements of paragraph (b)(1) of this section or to monitor or sample an effluent stream at an existing source in accordance with the site selection and sample extraction requirements of paragraph (b)(2) of this section, the facility owner or operator may use alternative effluent flow rate measurement procedures or site selection and sample extraction procedures provided that:

(i) It can be shown that the requirements of paragraphs (b) (1) and (2) of this section are impractical for the effluent stream.
(ii) The alternative procedure will not significantly underestimate the emissions.
(iii) The alternative procedure is fully documented.
(iv) The owner or operator has received prior approval from EPA.

(4)(i) Radionuclide emission measurements in conformance with the requirements of paragraph (b) of this section shall be made at all release points which have a potential to discharge radionuclides into the air in quantities which could cause an effective dose equivalent in excess of 1% of the standard. All radionuclides which could contribute greater than 10% of the potential effective dose equivalent for a release point shall be measured. For other release points which have a potential to release radionuclides into the air, periodic confirmatory measurements should be made to verify the low emissions.

(ii) To determine whether a release point is subject to the emission measurement requirements of paragraph (b) of this section, it is necessary to evaluate the potential for radionuclide emissions for that release point. In evaluating the potential of a release point to discharge radionuclides into the air, the estimated radionuclide release rates shall be based on the discharge of the uncontrolled effluent stream into the air.

(5) Environmental measurements of radionuclide air concentrations at critical receptor locations may be used as an alternative to air dispersion calculations in demonstrating compliance with the standards if the owner or operator meets the following criteria:
(i) The air at the point of measurement shall be continuously sampled for collection of radionuclides.
(ii) Those radionuclides released from the facility, which are the major contributors to the effective dose equivalent must be collected and measured as part of the environmental measurements program.

(iii) Radionuclide concentrations which would cause an effective dose equivalent greater than or equal to 10% of the standard shall be readily detectable and distinguishable from background.
(iv) Net measured radionuclide concentrations shall be compared to the concentration levels in Table 2 of appendix E to determine compliance with the standard. In the case of multiple radionuclides being released from a facility, compliance shall be demonstrated if the value for all radionuclides is less than the concentration level in Table 2 and the sum of the fractions that result when each measured concentration value is divided by the value in Table 2 for each radionuclide is less than 1.

(v) A quality assurance program shall be conducted that meets the performance requirements described in appendix B, Method 114.
(vi) Use of environmental measurements to demonstrate compliance with the standard is subject to prior approval of EPA. Applications for approval shall include a detailed description of the sampling and analytical methodology and show how the above criteria will be met.

(d) Radionuclide emission rates from new point sources (stacks or vents) as defined in subpart A shall be measured in accordance with the following requirements, or other procedures for which EPA has granted prior approval:
(1) Effluent flow rate measurements shall be made using the following methods:
(i) ANSI/HPS N13.1-1999 “Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities” (incorporated by reference—see §61.18) shall be used to determine velocity and volumetric flow rates for stacks and large vents.

(ii) ANSI/HPS N13.1-1999 shall be used to measure flow rates through pipes and small vents.
(iii) The frequency of the flow rate measurements shall depend upon variability of the effluent flow rate. For variable flow rates, continuous or frequent flow rate measurements shall be made. For relatively constant flow rates only periodic measurements are necessary.

(2) Radionuclide shall be directly monitored or extracted, collected and measured using the following methods:
(i) ANSI/HPS N13.1-1999 shall be used to select monitoring or sampling sites.

(ii) The effluent stream shall be directly monitored continuously with an in-line detector or representative samples of the effluent stream shall be withdrawn continuously from the sampling site following the guidance presented in ANSI/HPS N13.1-1999. The requirements for continuous sampling are applicable to batch processes when the unit is in operation. Periodic sampling (grab samples) may be used only with EPA's prior approval. Such approval may be granted in cases where continuous sampling is not practical and radionuclide emission rates are relatively constant. In such cases, grab samples shall be collected with sufficient frequency so as to provide a representative sample of the emissions.

(iii) Radionuclides shall be collected and measured using procedures based on the principles of measurement described in appendix B, Method 114 of this part. Use of methods based on principles of measurement different from those described in appendix B, Method 114 of this part must have prior approval from the Administrator. EPA reserves the right to approve measurement procedures.
(iv) A quality assurance program shall be conducted that meets the performance requirements described in ANSI/HPS N13.1-1999.

(e) When it is impractical to measure the effluent flow rate at a source in accordance with the requirements of paragraph (b)(1) or (d) of this section or to monitor or sample an effluent stream at a source in accordance with the site selection and sample extraction requirements of paragraph (b)(2) or (d) of this section, the facility owner or operator may use alternative effluent flow rate measurement procedures or site selection and sample extraction procedures provided that:

(1) It can be shown that the requirements of paragraph (b)(1) or (2) or (d) of this section are impractical for the effluent stream.
(2) The alternative procedure will not significantly underestimate the emissions.
(3) The alternative procedure is fully documented.
(4) The owner or operator has received prior approval from EPA.

(f) Radionuclide emission measurements in conformance with the requirements of paragraph (b) or (d) of this section shall be made at all release points that have a potential to discharge radionuclides into the air in quantities that could cause an effective dose equivalent in excess of 1% of the standard. All radionuclides that could contribute greater than 10% of the potential effective dose equivalent for a release point shall be measured. With prior EPA approval, DOE may determine these emissions through alternative procedures. For other release points that have a potential to release radionuclides into the air, periodic confirmatory measurements shall be made to verify the low emissions.

(g) To determine whether a release point is subject to the emission measurement requirements of paragraph (b) or (d) of this section, it is necessary to evaluate the potential for radionuclide emissions for that release point. In evaluating the potential of a release point to discharge radionuclides into the air for the purposes of this section, the estimated radionuclide release rates shall be based on the discharge of the effluent stream that would result if all pollution control equipment did not exist, but the facilities operations were otherwise normal.

(h) Environmental measurements of radionuclide air concentrations at critical receptor locations may be used as an alternative to air dispersion calculations in demonstrating compliance with the standard if the owner or operator meets the following criteria:

(1) The air at the point of measurement shall be continuously sampled for collection of radionuclides.

(2) Those radionuclides released from the facility that are the major contributors to the effective dose equivalent must be collected and measured as part of the environmental measurement program.

(3) Radionuclide concentrations that would cause an effective dose equivalent of 10% of the standard shall be readily detectable and distinguishable from background.
(4) Net measured radionuclide concentrations shall be compared to the concentration levels in Table 2 of appendix E of this part to determine compliance with the standard. In the case of multiple radionuclides being released from a facility, compliance shall be demonstrated if the value for all radionuclides is less than the concentration level in Table 2 of appendix E of this part, and the sum of the fractions that result when each measured concentration value is divided by the value in Table 2 of appendix E of this part for each radionuclide is less than 1.

(5) A quality assurance program shall be conducted that meets the performance requirements described in appendix B, Method 114 of this part.
(6) Use of environmental measurements to demonstrate compliance with the standard is subject to prior approval of EPA. Applications for approval shall include a detailed description of the sampling and analytical methodology and show how the above criteria will be met.

29CFR1910 – OCCUPATIONAL SAFETY AND HEALTH STANDARDS

Subpart G – Occupational Health and Environmental Control
§1910.94 Ventilation
§1910.95 Occupational Noise Exposure

Subpart I – Personal Protective Equipment
§1910.134 Respiratory Protection

Air-purifying respirator means a respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

Assigned protection factor *(APF)* means the workplace level of respiratory protection that a respirator or class of respirators is expected to provide to employees when the employer implements a continuing, effective respiratory protection program as specified by this section.

Atmosphere-supplying respirator means a respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere, and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.

Demand respirator means an atmosphere-supplying respirator that admits breathing air to the facepiece only when a negative pressure is created inside the facepiece by inhalation.

Fit factor means a quantitative estimate of the fit of a particular respirator to a specific individual, and typically estimates the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.

Fit test means the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual. (See also Qualitative fit test QLFT and Quantitative fit test QNFT.)

***High efficiency particulate air** (HEPA) filter* means a filter that is at least 99.97% efficient in removing monodisperse particles of 0.3 micrometers in diameter. The equivalent NIOSH 42 CFR 84 particulate filters are the N100, R100, and P100 filters.

***Immediately dangerous to life or health** (IDLH)* means an atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.

Negative pressure respirator *(tight fitting)* means a respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.

Oxygen deficient atmosphere means an atmosphere with an oxygen content below 19.5% by volume.

Positive pressure respirator means a respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

Powered air-purifying respirator *(PAPR)* means an air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

Pressure demand respirator means a positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.

Self-contained breathing apparatus *(SCBA)* means an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

Supplied-air respirator *(SAR) or airline respirator* means an atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

NOT DEFINED IN 29CFR1910
BUBBLE SUITS

Bubble suits are typically worn where there is potential exposure to skin or where a full exclusion of the outside atmosphere is needed. A bubble suit will enclose the entire body and have supplied air. Bubble suits are used when working with high air concentrations of tritium and transuranics.

Table 1—Assigned Protection Factors[5]

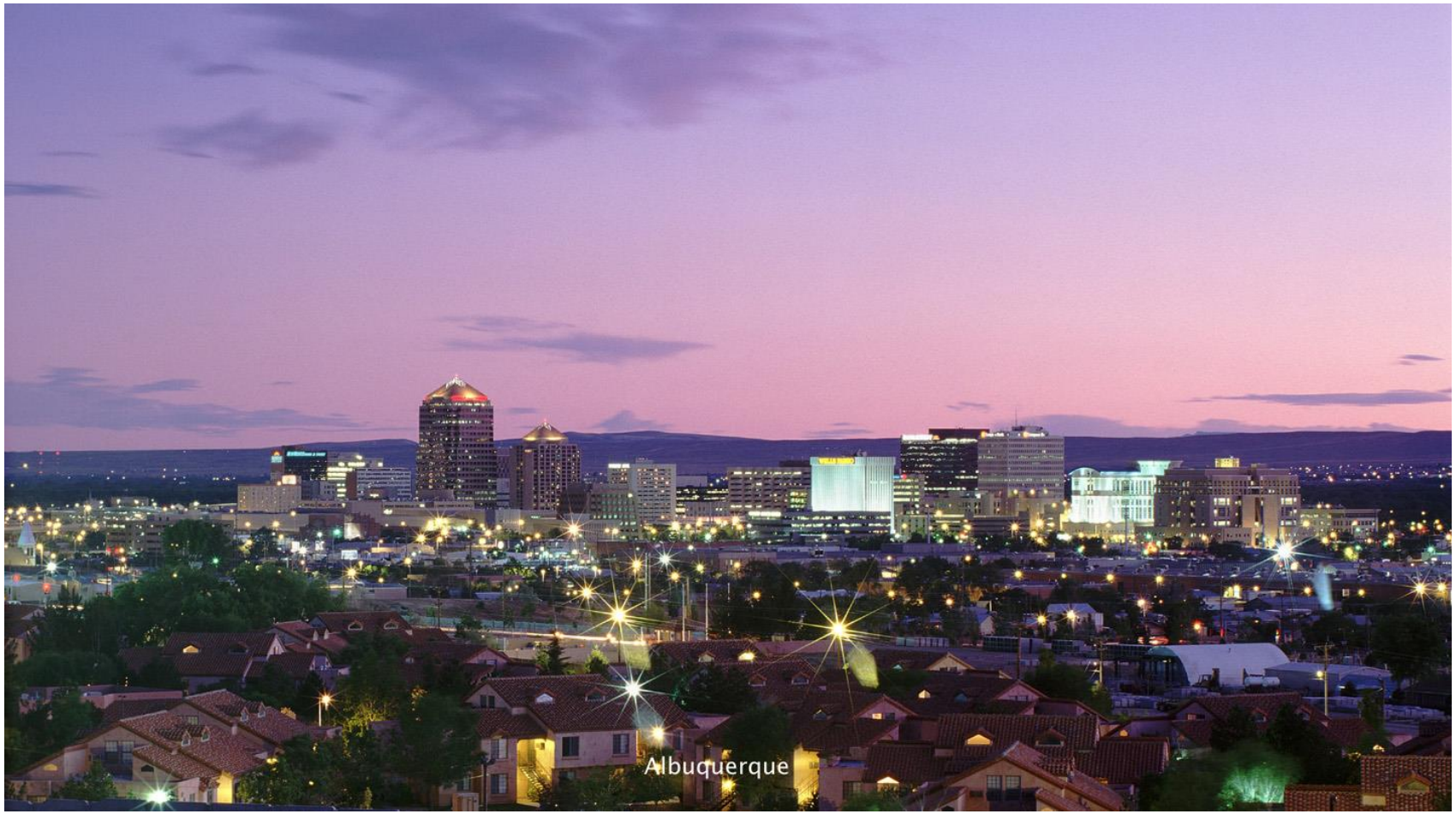
Type of respirator[1 2]	Quarter mask	Half mask	Full facepiece	Helmet/hood	Loose-fitting facepiece
1. Air-Purifying Respirator	5	[3]10	50		
2. Powered Air-Purifying Respirator (PAPR)		50	1,000	[4]25/1,000	25
3. Supplied-Air Respirator (SAR) or Airline Respirator					
• Demand mode		10	50		
• Continuous flow mode		50	1,000	[4]25/1,000	25
• Pressure-demand or other positive-pressure mode		50	1,000		
4. Self-Contained Breathing Apparatus (SCBA)					
• Demand mode		10	50	50	
• Pressure-demand or other positive-pressure mode (e.g., open/closed circuit)			10,000	10,000	

RESPIRATORY PROTECTION FACTORS 10CFR20

Device	Mode	Particulates	Vapors	PF
Air-purifying half-mask	D	Y	N	10
Air-purifying full-face	D	Y	N	50
Air-purifying full-face	PP	Y	N	1000
Supplied-air hood	PP	Y	Y	1000*
Supplied-air full-face	PP	Y	Y	2000
SCBA	D	Y	N	50
SCBA	PD	Y	Y	10,000

* 2000 for supplied-air hood if run at max flow with calibrated flow gauge.
Bubble suits have been used in Pu atmospheres as high as 1,000,000 DAC. Supplied-air respirators are worn inside the bubble suits and real-time air monitoring INSIDE the bubble suits is performed.

Air Sampling in Nuclear Facilities



DAY 2 – Standards – DOE and EPA CFRs