



10 CFR 835 Amendment

Peter V. O'Connell, CHP

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About DOE



Environmental clean up post cold war and nuclear weapons programs

From 2006 Exposure Report

- **34 sites across complex reporting**
- **813 person Rem**
- **120,000 workers**
- **13,000 with measurable radiation dose**



What Did We Do?



**In 2007 DOE adopted the
system of radiation
dosimetry recommended
in ICRP Publication 60.**



Why Did We Do It?



To assess and record radiation dose received by DOE workers in accordance with updated accepted methods.



What We Changed



- Specified new dosimetric terminology based on ICRP 60/68 in place of ICRP 26/30 based dosimetric terminology
- Specified ICRP 60 Tissue Weighting Factors in place of ICRP 26 Weighting Factors
- Specified ICRP 60 Radiation Weighting Factors in place of ICRP 26 Quality Factors
- **Amended other parts of the regulation that changed as a result of adopting ICRP 60 dosimetry system and the resultant ICRP 68 dose conversion factors**



Dosimetric Terms



Old Dosimetric Term	New Dosimetric Term
Committed effective dose equivalent	Committed effective dose
Committed dose equivalent	Committed equivalent dose
Cumulative total effective dose equivalent	Cumulative total effective dose
Dose equivalent	Equivalent dose
Effective dose equivalent	Effective dose
Quality factor	Radiation weighting factor
Weighting factor	Tissue weighting factor
Total effective dose equivalent	Total effective dose



Quality Factors to Radiation Weighting Factors



Radiation Type	Quality Factor	Radiation Weighting Factor
Neutrons, energy < 10 keV	3	5
Neutrons, energy 10 keV to 100 keV	10	10
Neutrons, energy > 100 keV to 2 MeV	10	20
Neutrons, energy > 2 MeV to 20 MeV	10	10
Neutrons, energy > 20 MeV	10	5
Neutrons, unknown energy	10	20
Spectral data are sufficient to identify the energy of the neutrons	Table titled "Quality Factors for Neutrons" (10 CFR 835 section 2(b))	Formula taken from ICRP 60., appendix A, paragraph A12.



Quality Factors to Radiation Weighting Factors (continued)



Radiation Type	Quality Factor	Radiation Weighting Factor
X-rays, gamma rays, positrons, electrons (including tritium beta particles)	1	
Photons, electrons and muons, all energies		1
Protons and singly-charged particles of unknown energy with rest mass greater than one atomic unit	10	
Protons, other than recoil protons, energy > 2 MeV		10
Alpha particles and multiple-charged particles (and particles of unknown charge) of unknown energy	20	
Alpha particles, fission fragments, heavy nuclei		20



Weighting Factors to Tissue Weighting Factors



Tissue/Organ	Weighting Factors	Tissue Weighting Factors
Gonads	0.25	0.20
Red bone marrow	0.12	0.12
Colon		0.12
Lungs	0.12	0.12
Stomach		0.12
Bladder		0.05
Breast	0.15	0.05
Liver		0.05
Esophagus		0.05
Thyroid	0.03	0.05
Skin		0.01



Weighting Factors to Tissue Weighting Factors (continued)



Tissue/Organ	Weighting Factors	Tissue Weighting Factors
Bone surface	0.03	0.01
Remainder	0.30	0.05
Whole body	1.00	1.00

Weighting Factor Remainder: The five other organs or tissues, excluding the skin and lens of the eye, with the highest dose (e.g., liver, kidney, spleen, thymus, adrenal, pancreas, stomach, small intestine, and upper large intestine). The weighting factor for each remaining organ or tissue is 0.06.

Tissue Weighting Factor Remainder: The following additional tissues and organs and their masses, in grams, following parenthetically: adrenals (14), brain (1400), extrathoracic airways (15), small intestine (640), kidneys (310), muscle (28,000), pancreas (100), spleen (180), thymus (20), and uterus (80). The equivalent dose to the remainder tissues (H_{rem}), is normally calculated as the mass-weighted mean dose to the preceding ten organs and tissues. In those cases in which the most highly irradiated remainder tissue or organ receives the highest equivalent dose of all the organs, a weighting factor of 0.025 (half of remainder) is applied to that tissue or organ and 0.025 (half of remainder) to the mass-weighted equivalent dose in the rest of the remainder tissues and organs to give the remainder equivalent dose.



Other Changes



- Appendices A (DAC values for inhalation), C (DAC values for immersion) and E (sealed source accountability values) revised for consistency with ICRP 68 dose conversion factors and 5 μm default AMAD for particles.
- Replaced the following terms:

Deleted terms: Not defined in ICRP 60 or 68	Replacement Terms (Not added to definitions because the meaning is clear)	Depth in tissue (cm)
Deep dose equivalent	Equivalent dose to the whole body	1.000
Shallow dose Equivalent	Equivalent dose to the skin or to an extremity	0.007
Lens of the eye dose equivalent	Equivalent dose to the lens of the eye	0.300



Other Changes



- Clarify transportation exclusion
 - Radioactive material transportation not performed by DOE or a DOE contractor is excluded
 - Posting and access control not needed for radioactive material transportation performed by DOE or a DOE contractor under continuous control or labeled per DOT
 - Receipt monitoring not required for onsite shipments which have been under continuous control
- Exclude material, equipment, and real property approved for release in accordance with DOE approved authorized limits
 - HS-20 developing guidance



Other Changes (cont)



- Lowers the maximum amount of radioactive material which need not be labeled
 - 0.1 Ci
 - labeling threshold would otherwise be 15 Ci for tritium
- Allows use of thresholds for recording internal occupational exposures
 - less than 10 mrem per result
 - less than monitoring threshold per year



Other Changes (cont)



- Establishes DAC default values for radionuclides not listed in the rule
 - **Non alpha emitters and with radioactive half-life greater than two hours - $4 \text{ E-}11 \text{ } \mu\text{Ci/mL}$**
 - **Alpha emitters - $2 \text{ E-}13 \text{ } \mu\text{Ci/mL}$**
- Appendix D – not significantly changed
 - **Considered adding intermediate level for Sr-90 mixtures**



Important Dates



- Effective Date: July 9, 2007
- Submit RPP: Up to 180 days after effective date (January 4, 2008)
- DOE Approves RPP: Up to 180 days after submission to DOE (July 3, 2008)
- Full compliance: Three years after effective date (July 9, 2010)