Office of Environment, Health, Safety and Security
Operating Experience Level 3

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Implementation of Pre-Approved Authorized Limits for Release and Clearance of Volumetric Radioactivity of Personal Property at DOE Field Elements

PURPOSE

This Operating Experience Level 3 (OE-3) document describes a recently issued memorandum from the Department of Energy (DOE) Associate Under Secretary for Environment, Health, Safety, and Security (AU-1), *Pre-Approved Authorized Limits for Release and Clearance of Volumetric Radioactivity of Personal Property at DOE Field Elements,* which may be useful in implementing clearance of personal property in a manner compliant with the requirements of DOE Order (O) 458.1, Chg. 4, *Radiation Protection of the Public and the Environment*.

BACKGROUND

DOE has long-standing pre-approved authorized limits for surface contamination, dating back multiple decades with the issuance of guidance memorandum, *Unrestricted Release of Radioactively Contaminated Personal Property* (1984). The authorized limits were included in DOE O 5400.5 (1990) and in associated guidance memorandum, *Application of DOE 5400.5 Requirements for Release and Control of Property Containing Residual Radioactive Material* (1995). DOE had not established pre-approved authorized limits for release and clearance of materials potentially containing volumetric contamination, rather it required case-by-case analyses and DOE approval of site-specific authorized limits by DOE program offices and AU predecessor organizations.

All authorized limits require justification and DOE approval, including pre-approved, site-specific or material-specific authorized limits. However, the approval authority for implementation of pre-approved limits, as well as the responsibility for ensuring they are used appropriately, is delegated to the DOE Field Element Manager. DOE Headquarters assistance for implementation and application remains available but is not formally required. If pre-approved authorized limits do not meet their needs, sites retain the option to request site-specific authorized limits, illustrating compliance with the dose constraints using site-specific parameters in conjunction with the use of DOE-approved computer modeling codes, such as RESidual RADioactivity (RESRAD). Formal documentation and appropriate record keeping of the approval and use of all authorized limits remain unchanged.

DOE previously considered establishing volumetric pre-approved authorized limits in line with the criteria published in national consensus standard, ANSI/HPS N13.12 (1999) *Surface and Volume Radioactivity Standards for Clearance* but opted against doing so at that time. A revision to ANSI/HPS N13.12 was published in 2013, and while a majority of the recommendations and values were carried forward to the new standard, certain important volumetric criteria were revised.

In subsequent years, several DOE sites received DOE program office approval for use

of volumetric authorized limits for a variety of personal property utilizing the values and technical justification provided in ANSI/HPS N13.12-2013. In each case, the supporting analyses demonstrated a reasonable expectation that the DOE O 458.1 dose constraints (1 mrem/yr) for clearance and release of personal property would be achieved. For example, in a 2020 authorized limit approval request for the release of personal property at an Environmental Management (EM) site, Argonne National Laboratory performed a peer-review of the technical aspects of the ANSI/HPS N13.12-2013 criteria, including RESRAD code modeling of the expected exposure pathway scenarios, utilizing the ANSI/HPS N13.12-2013 criteria, and found the resulting doses met the DOE O 458.1 dose constraints in all scenarios.

Additionally, DOE Standard 6004-2016, *Clearance and Release of Personal Property from Accelerator Facilities*, was developed to support the control, clearance, and release of personal property from accelerators, accelerator facilities, and modules thereof. This standard used ANSI/HPS N13.12-2013 to derive and establish the screening levels for the clearance of materials that contain, or may contain, residual volume radioactivity from radiological control which generally satisfies the criteria set for in DOE O 458.1. In 2016, AU issued an Operating Experience Level 3 document, *Clearance and Release of Personal Property from Accelerator Facilities, DOE-STD-6004,* concluding that the standard established property disposition clearance processes that are compliant with DOE requirements and protective of the public and the environment.

Use of the ANSI/HPS N13.12-2013 screening values is also consistent with direction in Public Law (P.L.) 112-239, the National Defense Authorization Act of 2013, Sec. 3161 which requires that DOE, including NNSA, "…ensure that the methods for assessing, certifying, and overseeing nuclear safety at the facilities ... use national and international standards and nuclear industry best practices…" Use of ANSI/HPS N13.12-2013 is also consistent with Office of Management and Budget (OMB) Circular No. A-119, Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities, and P.L. 104-113, the National Technology Transfer and Advancement Act of 1995, which direct DOE to promote the use of Voluntary Consensus Standards (VCS), except where inconsistent with law or otherwise impractical.

PATH FORWARD

DOE O 458.1, (paragraph 4.k.6.(f) 2.) states new pre-approved authorized limits must be approved by the Chief Health, Safety and Security Officer (now AU-1) or the responsible Cognizant Secretarial Officer in consultation with the Chief Health, Safety and Security Officer. The Order allows new pre-approved authorized limits to be approved by memorandum but must be included in a DOE Directive or Technical Standard within eighteen (18) months of issuance.

DOE previously issued for use and comment draft DOE G 441.1-xx, *Control and Release of Property with Residual Radioactive Materials*, in 2002, and DOE-HDBK-xxxx-97, *Draft Handbook for Controlling Release of Reuse or Recycle of Non-Real Property Containing Residual Radioactive Material,* in 1997, to serve as clearance of property guidance supporting Order DOE 5400.5 requirements. These documents are currently being incorporated into a single technical standard within the DOE Technical Standards Program development and review process, intended to provide updated guidance for implementing DOE O 458.1 clearance of property requirements.

Additionally, the new standard will serve as the required publication for newly approved volumetric pre-approved authorized limits, as well as provide a current resource which

consolidates all previously published pre-approved authorized limits.

In the meantime, current pre-approved authorized limits for release and clearance of property remain unmodified and appropriate for use. Sites should continue to utilize established site-approved procedures for implementing all pre-approved authorized limits.

DISCUSSION

DOE pre-approved authorized limits for release and clearance of volumetric radioactivity of personal property are specified in the AU-1 memo, Subject: *Pre-Approved Authorized Limits for Release and Clearance of Volumetric Radioactivity of Personal Property at DOE Field Elements* and the table is included in Attachment 1. The issuance of these pre-approved authorized limits meets the requirements of DOE O 458.1. Issuance of the pre-approved limits does not create a new requirement.

The volumetric criteria in Attachment 1 provides a reasonable expectation that the dose constraint of an effective dose of 1 mrem (0.01 mSv) in any calendar year of exposure to the public are met, as required by DOE Order 458.1. *These pre-approved authorized limits apply to the clearance of personal property only,* including recycling or reuse of process gases, liquids and residue, but not the discharge of air or liquid effluent releases that are controlled by other requirements.

It is important to note the approval of these health- and safety-based volumetric pre-approved authorized limits does not alter the January 12, 2000, moratorium on the release of volumetrically contaminated metals and the Secretary's direction contained in the July 13, 2000, suspension on the unrestricted release of scrap metals from radiation areas within DOE facilities.

Although ANSI/HPS N13.12-2013 values are conservative and may be too restrictive or inappropriate for certain radionuclides in certain situations, establishing these as pre-approved authorized limits will not inhibit a site's opportunity to seek approval for more realistic and appropriate site-specific values should the need arise. Procedures for requesting site specific authorized limits are provided in DOE O 458.1, and the process is well-established.

Appropriate records of the released materials must be maintained and public notification must be conducted consistent with the requirements of DOE Order 458.1, incorporating information on use of pre-approved authorized limits, and property control and clearance programs into effective site public notification and communications programs.

The adoption of the ANSI/HPS N13.12-2013 volumetric screen values as pre-approved authorized limits does not change the current pre-approved authorized limits for surface contamination. However, DOE is reviewing possible approaches for improving the surface criteria.

IMPLEMENTATION

DOE O 458.1 provides for the use of pre-approved authorized limits, instead of developing site-specific authorized limits, if their use is documented in the environmental radiological protection program and the specific application is approved through the responsible DOE Field Element Manager.

The requirements for performing radiological monitoring and surveys in support of clearance of property are defined in DOE O 458.1, section 4.k.(8). Surveys must:

- Use methodologies sufficient to meet measurement objectives, such as those in Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), the Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual

(MARSAME) or other methodologies approved by DOE;
- Meet measurement quality objectives;
- Use DOE-approved sampling and analysis techniques, if applicable; and
- Include an evaluation of non-uniformly distributed residual radioactive material, if applicable.

Instruments used for radiological monitoring or surveys must be capable of detecting and quantifying residual radioactive material consistent with the applicable authorized limits. In addition, instruments must be:
- Periodically maintained and calibrated on an established frequency;
- Appropriate for the types(s), levels, and energies of the radiation(s) encountered; and
- Appropriate for existing environmental conditions and routinely tested for operability.

When mixtures of radionuclides are present, clearance using the pre-approved authorized limits must follow the sum of fraction procedure outline in ANSI/HPS N13.12-2013, section 4.4. When a mixture contains radionuclides from the same group or more than one group, the ratio of the total activity concentration of each group to the associated screening level for that group is summed over all of the groups in the mixture. The sum of the ratios must be less than or equal to one in order to utilize the authorized limits.

Measurements for proxy radionuclides may be necessary to characterize levels of all radionuclides of interest, including hard-to-detect radionuclides. The use of proxy measurements should be justified and described in supporting technical basis documents.

DOE O 458.1 requires the implementation of a documented ALARA process, where ALARA is not a level or limit to be achieved in controlling radiation exposures or doses, but rather an optimization process that ensures appropriate factors are taken into consideration in arriving at decisions that affect the degree of protection against radiation for the public. DOE-HDBK-1215-2014, *Optimizing Radiation Protection of the Public and the Environment for use with DOE O 458.1, ALARA Requirements,* provides guidance on implementing an ALARA process which utilizes a graded approach that is commensurate with the risk to the public. As with pre-approved authorized limits for surface activity, if pre-approved authorized limits for volumetric activity are used, a qualitative ALARA analysis may be appropriate.

Field Element Managers should ensure a graded approach to independent verification is established to confirm that survey and evaluation processes are in place and properly implemented.

SUMMARY

AU-1 has approved these pre-approved authorized limits for release and clearance of volumetric radioactivity of personal property, via signed memorandum. The authorized limits table is included as Attachment 1. Approval for use of these pre-approved authorized limits for radiological activities conducted under the control of the Department of Energy, as well as ensuring the authorized limits are used appropriately, is the responsibility of the appropriate Field Element Manager, and this approval must be documented and made available to the public.

Pre-approved authorized limits for release and clearance of personal property with the potential of surface contamination, included in Attachment 2, remain unmodified and appropriate for continued use consistent with the processes described in DOE O 458.1.

AU has developed a Technical Standards Program Project Justification Statement to consolidate the appropriate guidance of DOE G 441.1-xx and DOE-HDBK-xxxx-97 into a single Technical Standard, supporting current DOE O 458.1 clearance of property

requirements. This new Technical Standard will also include the new pre-approved volumetric authorized limits, in accordance with the publication requirements set forth in DOE O 458.1, paragraph 4.k.6.(f) 2.

REFERENCES

DOE O 458.1, Chg. 4, *Radiation Protection of the Public and the Environment*

DOE G 441.1-xx, *Control and Release of Property with Residual Radioactive Materials*, in 2002

DOE STD 6004-2016, *Clearance and Release of Personal Property from Accelerator Facilities*

DOE-HDBK-1215-2014, *Optimizing Radiation Protection of the Public and the Environment for use with DOE O 458.1, ALARA Requirements*

DOE-HDBK-xxxx-97, *Draft Handbook for Controlling Release for Reuse or Recycle of Non-Real Property Containing Residual Radioactive Material,* in 1997

DOE Guidance Memorandum, Subject: Unrestricted Release of Radioactively Contaminated Personal Property, in 1984

DOE Guidance Memorandum, Subject: Application of DOE 5400.5 requirements for release and control of property containing residual radioactive material, in 1995

DOE Memo, Subject: Pre-Approved Authorized Limits for Release and Clearance of Volumetric Radioactivity of Personal Property at DOE Field Elements, in 2021

ANSI/HPS N13.12-2013, *Surface and Volume Radioactivity Standards for Clearance*

Operating Experience Level 3 (OE-3), Clearance and Release of Personal Property from Accelerator Facilities, DOE-STD-6004

National Council on Radiation Protection and Measurements (NCRP), Report No. 123 – Screening Models for Releases of Radionuclides to Atmosphere, Surface Water, and Ground – Volume 1 (1996)

Yu, C., et al; 2001. User's Manual for RESRAD Version 6

P.L. 112-239, the National Defense Authorization Act of 2013, Sec. 3161

P.L. 104-113, the National Technology Transfer and Advancement Act of 1995

OMB Circular No. A-119, Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities

ADDITIONAL SOURCES OF INFORMATION

Questions regarding pre-approved authorized limits for release and clearance of volumetric radioactivity of personal property at DOE Field Elements may be directed to Mike Stewart, Office of Public Radiation Protection (AU-22), 202-586-6444 or email mike.stewart@hq.doe.gov.

This OE-3 document requires no follow-up report or written response.

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Attachment 1. Screening levels for volumetric clearance[a]

Radionuclide groups[b]	SI units Volume (Bq/g)	Conventional units Volume (pCi/g)
Group 0 Special Case: ^{129}I[c]	0.01	0.3
Group 1 High-energy gamma, radium, thorium, transuranics, and mobile beta-gamma emitters: ^{22}Na, ^{46}Sc, ^{54}Mn, ^{56}Co, ^{60}Co, ^{65}Zn, ^{94}Nb, ^{106}Ru, ^{110m}Ag, ^{125}Sb, ^{134}Cs, ^{137}Cs, ^{152}Eu, ^{154}Eu, ^{182}Ta, ^{207}Bi, ^{210}Po, ^{210}Pb, ^{226}Ra, ^{228}Ra, ^{228}Th, ^{229}Th, ^{230}Th, ^{232}Th, ^{232}U, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{244}Pu, ^{241}Am, ^{243}Am, ^{245}Cm, ^{246}Cm, ^{247}Cm, ^{248}Cm, ^{249}Cf, ^{251}Cf, ^{254}Es, and associated decay chains[d], and others[b]	0.1	3
Group 2 Uranium and selected beta-gamma emitters: ^{14}C, ^{36}Cl, ^{59}Fe, ^{57}Co, ^{58}Co, ^{75}Se, ^{85}Sr, ^{90}Sr, ^{95}Zr, ^{99}Tc, ^{105}Ag, ^{109}Cd, ^{113}Sn, ^{124}Sb, ^{123m}Te, ^{139}Ce, ^{140}Ba, ^{155}Eu, ^{160}Tb, ^{181}Hf, ^{185}Os, ^{190}Ir, ^{192}Ir, ^{204}Tl, ^{206}Bi, ^{233}U, ^{234}U, ^{235}U, ^{238}U, natural uranium[e], ^{237}Np, ^{236}Pu, ^{243}Cm, ^{244}Cm, ^{248}Cf, ^{250}Cf, ^{252}Cf, ^{254}Cf, and associated decay chains[d], and others[b]	1	30
Group 3 General beta-gamma emitters: ^{7}Be, ^{74}As, ^{93m}Nb, ^{93}Mo, ^{93}Zr, ^{97}Tc, ^{103}Ru, ^{114m}In, ^{125}Sn, ^{127m}Te, ^{129m}Te, ^{131}I, ^{131}Ba, ^{144}Ce, ^{153}Gd, ^{181}W, ^{203}Hg, ^{202}Tl, ^{225}Ra, ^{230}Pa, ^{233}Pa, ^{236}U, ^{241}Pu, ^{242}Cm, and others[b]	10	300
Group 4 Low-energy beta-gamma emitters: ^{3}H, ^{35}S, ^{45}Ca, ^{51}Cr, ^{53}Mn, ^{59}Ni, ^{63}Ni, ^{86}Rb, ^{91}Y, ^{97m}Tc, ^{115m}Cd, ^{115m}In, ^{125}I, ^{135}Cs, ^{141}Ce, ^{147}Nd, ^{170}Tm, ^{191}Os, ^{237}Pu, ^{249}Bk, ^{253}Cf, and others[b]	100	3,000
Group 5 Low-energy beta emitters: ^{55}Fe, ^{73}As, ^{89}Sr, ^{125m}Te, ^{147}Pm, ^{151}Sm, ^{171}Tm, ^{185}W, and others[b]	1,000	30,000

[a]The screening levels for clearance have been rounded to one significant figure and are assigned for volume radioactivity.

[b]To determine the specific group for radionuclides not shown, a comparison of the screening factors, by exposure scenario, listed in Tables B. 1, C.1, and D.1 of NCRP Report No. 123I (NCRP 1996) for the radionuclides in question and the radionuclides in the general groups above will be performed and a determination of the proper group made, as described in ANSI/HPS N13.12-2013, Annex A.

[c]Because of potential ground-water concerns, the volume radioactivity values for ^{129}I when disposal to landfills or direct disposal to soil is anticipated is assigned to Group 0.

[d]For decay chains, the screening levels represent the total activity (i.e., the activity of the parent plus the activity of all progeny) present.

[e]The natural uranium screening levels for clearance *shall* be lowered from Group 2 to Group 1 if decay-chain progeny are present (i.e., uranium ore versus process or separated uranium, for example, in the form of yellowcake). The natural uranium activity equals the activity from uranium isotopes (48.9% from ^{238}U, plus 48.9% from ^{234}U, plus 2.2% from ^{235}U). This approach is consistent with summing radionuclide fractions discussed in ANSI/HPS N13.12-2013, Section 4.4.

Attachment 2. DOE Total Residual Surface Activity Guidelines:
Allowable Total Residual Surface Activity (dpm/100 cm^2)[a, b]
(From: DOE O 5400.5)

Radionuclides[c]	Avg[d,e]	*Max*[d,e]	Removable[f]
Group 1—Transuranics, ^{125}I, ^{129}I, ^{227}Ac, ^{226}Ra, ^{228}Ra, ^{228}Th, ^{230}Th, ^{231}Pa	100	300	20
Group 2—Th-natural, ^{90}Sr, ^{126}I, ^{131}I, ^{133}I, ^{223}Ra, ^{224}Ra, ^{232}U, ^{232}Th	1,000	3,000	200
Group 3—U-natural, ^{235}U, ^{238}U, associated decay products, alpha emitters	5,000	15,000	1,000
Group 4—Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except ^{90}Sr and others noted above[g]	5,000	15,000	1,000
Tritium (applicable to surface and subsurface)[h]	N/A	N/A	10,000

a The values in this table (except for tritium) apply to radioactive material deposited on but not incorporated into the interior or matrix of the property. No generic concentration guidelines have been approved for release of material that has been contaminated in depth, such as activated material or smelted contaminated metals (e.g., radioactivity per unit volume or per unit mass). Authorized limits for residual radioactive material in volume must be approved separately.

b As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by counts per minute measured by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

c Where surface contamination by both alpha-emitting and beta-gamma-emitting radionuclides exists, the limits established for alpha-emitting and beta-gamma-emitting radionuclides should apply independently.

d Measurements of average contamination should not be averaged over an area of more than 1 m^2. Where scanning surveys are not sufficient to detect levels in the table, static counting must be used to measure surface activity. Representative sampling (static counts on the areas) may be used to demonstrate by analyses of the static counting data. The maximum contamination level applies to an area of not more than 100 cm^2.

e The average and maximum dose rates associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 millirad per hour (mrad/h) and 1.0 mrad/h, respectively, at 1 cm.

f The amount of removable material per 100 cm^2 of surface area should be determined by wiping an area of that size with dry filter or soft absorbent paper, applying moderate pressure, and measuring the amount of radioactive material on the wiping with an appropriate instrument of known efficiency. When removable contamination of objects on surfaces of less than 100 cm^2 is determined, the activity per unit area should be based on the actual area, and the entire surface should be wiped. It is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate the total residual surface contamination levels are within the limits for removable contamination.

g This category of radionuclides includes mixed fission products, including the ^{90}Sr that is present in them. It does not apply to ^{90}Sr that has been separated from the other fission products or mixtures where the ^{90}Sr has been enriched.

h Measurement should be conducted by a standard smear measurement but using a damp swipe or material that will readily absorb tritium, such as polystyrene foam. Property recently exposed or decontaminated should have measurements (smears) at regular time intervals to prevent a buildup of contamination over time. Because tritium typically penetrates material it contacts, the surface guidelines in group 4 do not apply to tritium. Measurements demonstrating compliance of the removable fraction of tritium on surfaces with this guideline are acceptable to ensure nonremovable fractions and residual tritium in mass will not cause exposures that exceed DOE dose limits and constraints