Office for Nuclear Regulation

INTERIM POSITION STATEMENT

Interpretation of “bulk quantities” in relation to the storage of radioactive matter

for the purposes of section 1 of the Nuclear Installations Act 1965

and the Nuclear Installations Regulations 1971

Purpose

This statement describes the Office for Nuclear Regulation (ONR) approach to the interpretation of “bulk quantities” in relation to the storage of radioactive matter for the purposes of section 1 of the Nuclear Installations Act 1965 (NIA 1965) and the Nuclear Installations Regulations 1971.

This statement provides clarity for ONR inspectors and prospective operators of installations designed or adapted for the storage of radioactive matter who may be considering whether they require a licence under section 1 of the NIA 1965 to operate that installation.

Interim Status

ONR is aware that the Government is involved in work under the Paris Convention discussing the potential exclusion from the Convention of installations presenting small risks . Depending on the outcome of such work, it may be that such exclusions provide a better basis for making decisions on the interpretation of bulk quantities than the current position.

ONR will keep the position under review, and if appropriate, reconsider this statement in the light of any such developments.

Scope

A site may only be used to install or operate an installation designed or adapted for the storage of bulk quantities of radioactive matter (that is matter which has been produced or irradiated in the course of production or use of nuclear fuel) if a licence has been granted for that site under section 1 of the NIA 1965 and remains in force.

This statement sets out how ONR will determine whether an installation is designed or adapted to store “bulk quantities” of such matter for the purposes of licensing under the NIA 1965.

ONR Objective

In interpreting the phrase “bulk quantities”, ONR aims to:

- ensure a robust, targeted, proportionate, consistent, and transparent approach to regulating the management of radioactive matter;

- focus on maintaining a licensing regime on those hazards that require it, without imposing inappropriate or disproportionate obligations on industry when there is adequate regulatory oversight in place;
- secure public confidence; and
- continue to protect people and society from the hazards of the nuclear industry.

Interim interpretation of "bulk quantities"

For these purposes, ONR will interpret "bulk quantities" as meaning:

- quantities of radioactive matter at or above 100 times the levels set out in Schedule 2 to the Radiation (Emergency Preparedness and Public Information) Regulations 2001 (REPPIR).

So, a site licence will be required for the installation and operation of the storage facility if it is designed or adapted to store quantities of radioactive matter at or above 100 times the REPPIR level set out above.

Table 1 in the Appendix gives the bulk quantity level (being 100 times Schedule 2 of REPPIR) for each isotope.

In determining which "radioactive matter" (that is matter which is produced or irradiated in the course of production or use of nuclear fuel) is to be included in this calculation, ONR will disregard:

(a) any quantity of irradiated nuclear fuel – installations designed or adapted for storage of such material require a site licence by virtue of section 1(1)(b) NIA 1965 and regulation 3(6)(b) of NIR 1971;

(b) in accordance with NIR regulation 3(6), any radioactive matter which is stored incidental to carriage; and

(c) sealed sources as defined in the Ionising Radiations Regulations 1999 (see regulation 2(1)).

When calculating the quantity of radioactive matter, it will be broken down where possible into individual isotopes or groups of isotopes. For groups of isotopes, the most restrictive value in Table 1 should be used. For a mixture of isotopes, the formula in the appendix should be used.

Office for Nuclear Regulation

Redgrave Court
Merton Road
Bootle
L20 7HS

November 2012

Appendix

Bulk quantity values for individual radionuclides

Table 1 gives the quantity of individual radionuclides that ONR consider to constitute a bulk quantity. These are one hundred times the values set out in Schedule 2 of the Radiation (Emergency Preparedness and Public Information) Regulations 2001 No. 2975.

Table 1

Radionuclide	***Radionuclide form***	***Bulk Quantity (Bq)***
Actinium		
Ac-224		$2\ 10^{13}$
Ac-225		$3\ 10^{11}$
Ac-226		$2\ 10^{12}$
Ac-227		$4\ 10^{9}$
Ac-228		$5\ 10^{13}$
Aluminium		
Al-26		$7\ 10^{12}$
Americium		
Am-237		$4\ 10^{14}$
Am-238		$6\ 10^{14}$
Am-239		$2\ 10^{14}$
Am-240		$4\ 10^{14}$
Am-241		$3\ 10^{10}$
Am-242		$1\ 10^{14}$
Am-242m		$3\ 10^{10}$
Am-243		$3\ 10^{10}$
Am-244		$2\ 10^{14}$
Am-244m		$2\ 10^{16}$
Am-245		$2\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Am-246		$1\ 10^{14}$
Am-246m		$2\ 10^{14}$
Antimony		
Sb-115		$2\ 10^{14}$
Sb-116		$2\ 10^{14}$
Sb-116m		$2\ 10^{14}$
Sb-117		$1\ 10^{15}$
Sb-118m		$7\ 10^{14}$
Sb-119		$1\ 10^{15}$
Sb-120	(long lived isotope)	$3\ 10^{14}$
Sb-120	(short lived isotope)	$2\ 10^{14}$
Sb-122		$2\ 10^{14}$
Sb-124		$4\ 10^{13}$
Sb-124m		$4\ 10^{14}$
Sb-125		$4\ 10^{13}$
Sb-126		$1\ 10^{14}$
Sb-126m		$2\ 10^{14}$
Sb-127		$2\ 10^{14}$
Sb-128	(long lived isotope)	$2\ 10^{14}$
Sb-128	(short lived isotope)	$1\ 10^{14}$
Sb-129		$2\ 10^{14}$
Sb-130		$1\ 10^{14}$
Sb-131		$2\ 10^{14}$
Argon		
Ar-37	(gas)	$4\ 10^{19}$
Ar-39	(gas)	$2\ 10^{18}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Ar-41	(gas)	$4\ 10^{15}$
	Arsenic	
As-69		$7\ 10^{13}$
As-70		$1\ 10^{14}$
As-71		$3\ 10^{14}$
As-72		$9\ 10^{13}$
As-73		$8\ 10^{14}$
As-74		$2\ 10^{14}$
As-76		$9\ 10^{13}$
As-77		$2\ 10^{14}$
As-78		$7\ 10^{13}$
	Astatine	
At-207		$4\ 10^{14}$
At-211		$2\ 10^{13}$
	Barium	
Ba-126		$2\ 10^{15}$
Ba-128		$1\ 10^{15}$
Ba-131		$6\ 10^{14}$
Ba-131m		$3\ 10^{14}$
Ba-133		$4\ 10^{13}$
Ba-133m		$2\ 10^{14}$
Ba-135m		$2\ 10^{14}$
Ba-139		$1\ 10^{14}$
Ba-140		$2\ 10^{14}$
Ba-141		$1\ 10^{14}$
Ba-142		$2\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Berkelium		
Bk-245		$3\ 10^{14}$
Bk-246		$6\ 10^{14}$
Bk-247		$3\ 10^{10}$
Bk-249		$2\ 10^{13}$
Bk-250		$2\ 10^{14}$
Beryllium		
Be-7		$2\ 10^{14}$
Be-10		$6\ 10^{13}$
Bismuth		
Bi-200		$2\ 10^{14}$
Bi-201		$2\ 10^{14}$
Bi-202		$3\ 10^{14}$
Bi-203		$4\ 10^{14}$
Bi-205		$2\ 10^{14}$
Bi-206		$2\ 10^{14}$
Bi-207		$1\ 10^{13}$
Bi-210		$2\ 10^{13}$
Bi-210m		$6\ 10^{11}$
Bi-212		$7\ 10^{13}$
Bi-213		$7\ 10^{13}$
Bi-214		$1\ 10^{14}$
Bromine		
Br-74		$8\ 10^{13}$
Br-74m		$6\ 10^{13}$
Br-75		$2\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Br-76		$1\ 10^{14}$
Br-77		$4\ 10^{15}$
Br-80		$1\ 10^{14}$
Br-80m		$5\ 10^{14}$
Br-82		$3\ 10^{14}$
Br-83		$2\ 10^{14}$
Br-84		$7\ 10^{13}$
Cadmium		
Cd-104		$1\ 10^{15}$
Cd-107		$4\ 10^{14}$
Cd-109		$2\ 10^{14}$
Cd-113		$2\ 10^{13}$
Cd-113m		$1\ 10^{13}$
Cd-115		$2\ 10^{14}$
Cd-115m		$2\ 10^{14}$
Cd-117		$2\ 10^{14}$
Cd-117m		$2\ 10^{14}$
Caesium		
Cs-125		$2\ 10^{14}$
Cs-127		$1\ 10^{15}$
Cs-129		$2\ 10^{15}$
Cs-130		$2\ 10^{14}$
Cs-131		$6\ 10^{15}$
Cs-132		$9\ 10^{14}$
Cs-134		$7\ 10^{12}$
Cs-134m		$4\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Cs-135		$9\ 10^{13}$
Cs-135m		$8\ 10^{14}$
Cs-136		$8\ 10^{13}$
Cs-137		$1\ 10^{13}$
Cs-138		$8\ 10^{13}$
Calcium		
Ca-41		$3\ 10^{15}$
Ca-45		$3\ 10^{14}$
Ca-47		$2\ 10^{14}$
Californium		
Cf-244		$2\ 10^{14}$
Cf-246		$5\ 10^{12}$
Cf-248		$2\ 10^{11}$
Cf-249		$3\ 10^{10}$
Cf-250		$7\ 10^{10}$
Cf-251		$3\ 10^{10}$
Cf-252		$1\ 10^{11}$
Cf-253		$2\ 10^{12}$
Cf-254		$4\ 10^{10}$
Carbon		
C-11		$2\ 10^{14}$
C-11	(vapour)	$1\ 10^{16}$
C-11	(dioxide gas)	$1\ 10^{16}$
C-11	(monoxide gas)	$1\ 10^{16}$
C-14		$3\ 10^{14}$
C-14	(vapour)	$4\ 10^{15}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
C-14	(dioxide gas)	$3\ 10^{17}$
C-14	(monoxide gas)	$1\ 10^{18}$
Cerium		
Ce-134		$1\ 10^{15}$
Ce-135		$2\ 10^{14}$
Ce-137		$2\ 10^{15}$
Ce-137m		$2\ 10^{14}$
Ce-139		$2\ 10^{14}$
Ce-141		$2\ 10^{14}$
Ce-143		$2\ 10^{14}$
Ce-144		$3\ 10^{13}$
Chlorine		
Cl-36		$2\ 10^{14}$
Cl-38		$6\ 10^{13}$
Cl-39		$1\ 10^{14}$
Chromium		
Cr-48		$4\ 10^{15}$
Cr-49		$2\ 10^{14}$
Cr-51		$3\ 10^{15}$
Cobalt		
Co-55		$2\ 10^{14}$
Co-56		$2\ 10^{13}$
Co-57		$1\ 10^{14}$
Co-58		$6\ 10^{13}$
Co-58m		$2\ 10^{15}$
Co-60		$6\ 10^{12}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Co-60m		$7\ 10^{14}$
Co-61		$2\ 10^{14}$
Co-62m		$9\ 10^{13}$
Copper		
Cu-60		$1\ 10^{14}$
Cu-61		$2\ 10^{14}$
Cu-64		$4\ 10^{14}$
Cu-67		$3\ 10^{14}$
Curium		
Cm-238		$5\ 10^{14}$
Cm-240		$7\ 10^{11}$
Cm-241		$5\ 10^{13}$
Cm-242		$4\ 10^{11}$
Cm-243		$4\ 10^{10}$
Cm-244		$4\ 10^{10}$
Cm-245		$2\ 10^{10}$
Cm-246		$2\ 10^{10}$
Cm-247		$3\ 10^{10}$
Cm-248		$7\ 10^{9}$
Cm-249		$2\ 10^{14}$
Cm-250		$1\ 10^{9}$
Dysprosium		
Dy-155		$1\ 10^{15}$
Dy-157		$1\ 10^{16}$
Dy-159		$8\ 10^{14}$
Dy-165		$2\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Dy-166		$3\ 10^{14}$
Einsteinium		
Es-250		$1\ 10^{15}$
Es-251		$6\ 10^{14}$
Es-253		$8\ 10^{11}$
Es-254		$2\ 10^{11}$
Es-254m		$5\ 10^{12}$
Erbium		
Er-161		$6\ 10^{14}$
Er-165		$2\ 10^{16}$
Er-169		$3\ 10^{14}$
Er-171		$2\ 10^{14}$
Er-172		$3\ 10^{14}$
Europium		
Eu-145		$4\ 10^{14}$
Eu-146		$3\ 10^{14}$
Eu-147		$4\ 10^{14}$
Eu-148		$4\ 10^{13}$
Eu-149		$8\ 10^{14}$
Eu-150	(long lived isotope)	$1\ 10^{13}$
Eu-150	(short lived isotope)	$2\ 10^{14}$
Eu-152		$1\ 10^{13}$
Eu-152m		$2\ 10^{14}$
Eu-154		$1\ 10^{13}$
Eu-155		$2\ 10^{14}$
Eu-156		$2\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Eu-157		$2\ 10^{14}$
Eu-158		$1\ 10^{14}$
Fermium		
Fm-252		$7\ 10^{12}$
Fm-253		$6\ 10^{12}$
Fm-254		$3\ 10^{13}$
Fm-255		$9\ 10^{12}$
Fm-257		$3\ 10^{11}$
Fluorine		
F-18		$2\ 10^{14}$
Francium		
Fr-222		$1\ 10^{14}$
Fr-223		$2\ 10^{14}$
Gadolinium		
Gd-145		$2\ 10^{14}$
Gd-146		$2\ 10^{14}$
Gd-147		$5\ 10^{14}$
Gd-148		$9\ 10^{10}$
Gd-149		$6\ 10^{14}$
Gd-151		$5\ 10^{14}$
Gd-152		$1\ 10^{11}$
Gd-153		$2\ 10^{14}$
Gd-159		$2\ 10^{14}$
Gallium		
Ga-65		$1\ 10^{14}$
Ga-66		$9\ 10^{13}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Ga-67		$5\ 10^{14}$
Ga-68		$2\ 10^{14}$
Ga-70		$1\ 10^{14}$
Ga-72		$2\ 10^{14}$
Ga-73		$2\ 10^{14}$
Germanium		
Ge-66		$3\ 10^{14}$
Ge-67		$7\ 10^{13}$
Ge-68		$1\ 10^{14}$
Ge-69		$2\ 10^{14}$
Ge-71		$7\ 10^{16}$
Ge-75		$2\ 10^{14}$
Ge-77		$1\ 10^{14}$
Ge-78		$2\ 10^{14}$
Gold		
Au-193		$7\ 10^{14}$
Au-194		$1\ 10^{15}$
Au-195		$3\ 10^{14}$
Au-198		$2\ 10^{14}$
Au-198m		$2\ 10^{14}$
Au-199		$3\ 10^{14}$
Au-200		$1\ 10^{14}$
Au-200m		$2\ 10^{14}$
Au-201		$2\ 10^{14}$
Hafnium		
Hf-170		$4\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Hf-172		$5\ 10^{13}$
Hf-173		$6\ 10^{14}$
Hf-175		$2\ 10^{14}$
Hf-177m		$2\ 10^{14}$
Hf-178m		$4\ 10^{12}$
Hf-179m		$2\ 10^{14}$
Hf-180m		$2\ 10^{14}$
Hf-181		$1\ 10^{14}$
Hf-182		$7\ 10^{12}$
Hf-182m		$2\ 10^{14}$
Hf-183		$2\ 10^{14}$
Hf-184		$2\ 10^{14}$
Holmium		
Ho-155		$2\ 10^{14}$
Ho-157		$4\ 10^{14}$
Ho-159		$6\ 10^{14}$
Ho-161		$1\ 10^{15}$
Ho-162		$5\ 10^{14}$
Ho-162m		$4\ 10^{14}$
Ho-164		$2\ 10^{14}$
Ho-164m		$4\ 10^{14}$
Ho-166		$1\ 10^{14}$
Ho-166m		$8\ 10^{12}$
Ho-167		$2\ 10^{14}$
Hydrogen		

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
H-3	(tritiated water)	$7\ 10^{15}$
H-3	(organically bound tritium)	$1\ 10^{16}$
H-3	(tritiated water vapour)	$1\ 10^{17}$
H-3	(gas)	$1\ 10^{20}$
H-3	(tritiated methane gas)	$1\ 10^{19}$
H-3	(organically bound tritium gas/ vapour)	$6\ 10^{16}$
	Indium	
In-109		$7\ 10^{14}$
In-110	(long lived isotope)	$2\ 10^{15}$
In-110	(short lived isotope)	$1\ 10^{14}$
In-111		$9\ 10^{14}$
In-112		$2\ 10^{14}$
In-113m		$5\ 10^{14}$
In-114		$1\ 10^{14}$
In-114m		$9\ 10^{13}$
In-115		$6\ 10^{12}$
In-115m		$3\ 10^{14}$
In-116m		$2\ 10^{14}$
In-117		$2\ 10^{14}$
In-117m		$2\ 10^{14}$
In-119m		$9\ 10^{13}$
	Iodine	
I-120		$6\ 10^{13}$
I-120	(elemental vapour)	$2\ 10^{15}$
I-120	(methyl iodide vapour)	$2\ 10^{15}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
I-120m		$7\ 10^{13}$
I-120m	(elemental vapour)	$2\ 10^{15}$
I-120m	(methyl iodide vapour)	$2\ 10^{15}$
I-121		$4\ 10^{14}$
I-121	(elemental vapour)	$1\ 10^{16}$
I-121	(methyl iodide vapour)	$1\ 10^{16}$
I-123		$9\ 10^{14}$
I-123	(elemental vapour)	$5\ 10^{15}$
I-123	(methyl iodide vapour)	$6\ 10^{15}$
I-124		$2\ 10^{14}$
I-124	(elemental vapour)	$9\ 10^{13}$
I-124	(methyl iodide vapour)	$1\ 10^{14}$
I-125		$1\ 10^{13}$
I-125	(elemental vapour)	$1\ 10^{14}$
I-125	(methyl iodide vapour)	$1\ 10^{14}$
I-126		$8\ 10^{13}$
I-126	(elemental vapour)	$5\ 10^{13}$
I-126	(methyl iodide vapour)	$6\ 10^{13}$
I-128		$1\ 10^{14}$
I-128	(elemental vapour)	$2\ 10^{16}$
I-128	(methyl iodide vapour)	$5\ 10^{16}$
I-129		$1\ 10^{12}$
I-129	(elemental vapour)	$2\ 10^{13}$
I-129	(methyl iodide vapour)	$2\ 10^{13}$
I-130		$3\ 10^{14}$
I-130	(elemental vapour)	$5\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
I-130	(methyl iodide vapour)	$6\ 10^{14}$
I-131		$9\ 10^{12}$
I-131	(elemental vapour)	$6\ 10^{13}$
I-131	(methyl iodide vapour)	$7\ 10^{13}$
I-132		$2\ 10^{14}$
I-132	(elemental vapour)	$2\ 10^{15}$
I-132	(methyl iodide vapour)	$3\ 10^{15}$
I-132m		$2\ 10^{14}$
I-132m	(elemental vapour)	$4\ 10^{15}$
I-132m	(methyl iodide vapour)	$5\ 10^{15}$
I-133		$2\ 10^{14}$
I-133	(elemental vapour)	$2\ 10^{14}$
I-133	(methyl iodide vapour)	$3\ 10^{14}$
I-134		$2\ 10^{14}$
I-134	(elemental vapour)	$3\ 10^{15}$
I-134	(methyl iodide vapour)	$4\ 10^{15}$
I-135		$2\ 10^{14}$
I-135	(elemental vapour)	$9\ 10^{14}$
I-135	(methyl iodide vapour)	$1\ 10^{15}$
Iridium		
Ir-182		$1\ 10^{14}$
Ir-184		$2\ 10^{14}$
Ir-185		$3\ 10^{14}$
Ir-186	(long lived isotope)	$3\ 10^{14}$
Ir-186	(short lived isotope)	$2\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Ir-187		$6\ 10^{14}$
Ir-188		$5\ 10^{14}$
Ir-189		$9\ 10^{14}$
Ir-190		$2\ 10^{14}$
Ir-190m	(long lived isotope)	$3\ 10^{14}$
Ir-190m	(short lived isotope)	$1\ 10^{15}$
Ir-192		$6\ 10^{133}$
Ir-192m		$4\ 10^{13}$
Ir-193m		$4\ 10^{14}$
Ir-194		$1\ 10^{14}$
Ir-194m		$1\ 10^{13}$
Ir-195		$2\ 10^{14}$
Ir-195m		$2\ 10^{14}$
Iron		
Fe-52		$2\ 10^{14}$
Fe-55		$8\ 10^{14}$
Fe-59		$8\ 10^{13}$
Fe-60		$4\ 10^{12}$
Krypton		
Kr-74	(gas)	$5\ 10^{15}$
Kr-76	(gas)	$1\ 10^{16}$
Kr-77	(gas)	$6\ 10^{15}$
Kr-79	(gas)	$2\ 10^{16}$
Kr-81	(gas)	$7\ 10^{17}$
Kr-81m	(gas)	$5\ 10^{16}$
Kr-83m	(gas	$3\ 10^{18}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Kr-85	(gas)	$1\ 10^{18}$
Kr-85m	(gas)	$4\ 10^{16}$
Kr-87	(gas)	$7\ 10^{15}$
Kr-88	(gas)	$3\ 10^{15}$
Lanthanum		
La-131		$2\ 10^{14}$
La-132		$2\ 10^{14}$
La-135		$2\ 10^{16}$
La-137		$2\ 10^{14}$
La-138		$2\ 10^{13}$
La-140		$2\ 10^{14}$
La-141		$1\ 10^{14}$
La-142		$1\ 10^{14}$
La-143		$7\ 10^{13}$
Lead		
Pb-195m		$2\ 10^{14}$
Pb-198		$4\ 10^{14}$
Pb-199		$6\ 10^{14}$
Pb-200		$3\ 10^{14}$
Pb-201		$8\ 10^{14}$
Pb-202		$6\ 10^{13}$
Pb-202m		$4\ 10^{14}$
Pb-203		$9\ 10^{14}$
Pb-205		$1\ 10^{15}$
Pb-209		$2\ 10^{14}$
Pb-210		$3\ 10^{11}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Pb-211		$2\ 10^{14}$
Pb-212		$1\ 10^{13}$
Pb-214		$1\ 10^{14}$
Lutetium		
Lu-169		$6\ 10^{14}$
Lu-170		$3\ 10^{14}$
Lu-171		$4\ 10^{14}$
Lu-172		$3\ 10^{14}$
Lu-173		$2\ 10^{14}$
Lu-174		$1\ 10^{14}$
Lu-174m		$3\ 10^{14}$
Lu-176		$3\ 10^{13}$
Lu-176m		$2\ 10^{14}$
Lu-177		$3\ 10^{14}$
Lu-177m		$3\ 10^{13}$
Lu-178		$1\ 10^{14}$
Lu-178m		$1\ 10^{14}$
Lu-179		$2\ 10^{14}$
Magnesium		
Mg-28		$5\ 10^{14}$
Manganese		
Mn-51		$1\ 10^{14}$
Mn-52		$2\ 10^{14}$
Mn-52m		$8\ 10^{13}$
Mn-53		$1\ 10^{16}$
Mn-54		$3\ 10^{13}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Mn-56		$1\ 10^{14}$
Mendelevium		
Md-257		$9\ 10^{13}$
Md-258		$4\ 10^{11}$
Mercury		
Hg-193	(organic)	$3\ 10^{14}$
Hg-193	(inorganic)	$3\ 10^{14}$
Hg-193	(vapour)	$2\ 10^{15}$
Hg-193m	(organic)	$2\ 10^{14}$
Hg-193m	(inorganic)	$2\ 10^{14}$
Hg-193m	(vapour)	$6\ 10^{14}$
Hg-194	(organic)	$3\ 10^{13}$
Hg-194	(inorganic)	$1\ 10^{14}$
Hg-194	(vapour)	$6\ 10^{13}$
Hg-195	(organic)	$5\ 10^{14}$
Hg-195	(inorganic)	$5\ 10^{14}$
Hg-195	(vapour)	$1\ 10^{15}$
Hg-195m	(organic)	$3\ 10^{14}$
Hg-195m	(inorganic)	$3\ 10^{14}$
Hg-195m	(vapour)	$3\ 10^{14}$
Hg-197	(organic)	$7\ 10^{14}$
Hg-197	(inorganic)	$7\ 10^{14}$
Hg-197	(vapour)	$5\ 10^{14}$
Hg-197m	(organic)	$2\ 10^{14}$
Hg-197m	(inorganic)	$2\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Hg-197m	(vapour)	$4\ 10^{14}$
Hg-199m	(organic)	$2\ 10^{14}$
Hg-199m	(inorganic)	$2\ 10^{14}$
Hg-199m	(vapour)	$1\ 10^{16}$
Hg-203	(organic)	$3\ 10^{14}$
Hg-203	(inorganic)	$3\ 10^{14}$
Hg-203	(vapour)	$3\ 10^{14}$
Molybdenum		
Mo-90		$2\ 10^{14}$
Mo-93		$2\ 10^{14}$
Mo-93m		$4\ 10^{14}$
Mo-99		$2\ 10^{14}$
Mo-101		$2\ 10^{14}$
Neodymium		
Nd-136		$4\ 10^{14}$
Nd-138		$5\ 10^{15}$
Nd-139		$2\ 10^{14}$
Nd-139m		$3\ 10^{14}$
Nd-141		$2\ 10^{15}$
Nd-147		$2\ 10^{14}$
Nd-149		$2\ 10^{14}$
Nd-151		$1\ 10^{14}$
Neon		
Ne-19	(gas)	$6\ 10^{15}$
Neptunium		
Np-232		$3\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Np-233		$2\ 10^{16}$
Np-234		$5\ 10^{14}$
Np-235		$2\ 10^{15}$
Np-236	(long lived isotope)	$3\ 10^{11}$
Np-236	(short lived isotope)	$3\ 10^{14}$
Np-237		$5\ 10^{10}$
Np-238		$2\ 10^{14}$
Np-239		$1\ 10^{14}$
Np-240		$7\ 10^{13}$
Nickel		
Ni-56		$4\ 10^{14}$
Ni-56	(carbonyl vapour)	$1\ 10^{15}$
Ni-57		$2\ 10^{14}$
Ni-57	(carbonyl vapour)	$2\ 10^{15}$
Ni-59		$4\ 10^{15}$
Ni-59	(carbonyl vapour)	$2\ 10^{15}$
Ni-63		$1\ 10^{15}$
Ni-63	(carbonyl vapour)	$1\ 10^{15}$
Ni-65		$1\ 10^{14}$
Ni-65	(carbonyl vapour)	$4\ 10^{15}$
Ni-66		$5\ 10^{14}$
Ni-66	(carbonyl vapour)	$1\ 10^{15}$
Niobium		
Nb-88		$7\ 10^{13}$
Nb-89	(long lived isotope)	$1\ 10^{14}$
Nb-89	(short lived isotope)	$8\ 10^{13}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Nb-90		$2\ 10^{14}$
Nb-93m		$1\ 10^{15}$
Nb-94		$1\ 10^{13}$
Nb-95		$2\ 10^{14}$
Nb-95m		$2\ 10^{14}$
Nb-96		$2\ 10^{14}$
Nb-97		$2\ 10^{14}$
Nb-98		$1\ 10^{14}$
Nitrogen		
N-13	(gas)	$6\ 10^{15}$
Osmium		
Os-180		$1\ 10^{15}$
Os-181		$3\ 10^{14}$
Os-182		$6\ 10^{14}$
Os-185		$7\ 10^{13}$
Os-189m		$1\ 10^{15}$
Os-191		$4\ 10^{14}$
Os-191m		$7\ 10^{14}$
Os-193		$2\ 10^{14}$
Os-194		$2\ 10^{13}$
Palladium		
Pd-100		$7\ 10^{14}$
Pd-101		$8\ 10^{14}$
Pd-103		$4\ 10^{15}$
Pd-107		$3\ 10^{15}$
Pd-109		$2\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Phosphorus		
P-32		$1\ 10^{13}$
P-33		$3\ 10^{14}$
Platinum		
Pt-186		$9\ 10^{15}$
Pt-188		$6\ 10^{14}$
Pt-189		$6\ 10^{14}$
Pt-191		$7\ 10^{14}$
Pt-193		$1\ 10^{16}$
Pt-193m		$3\ 10^{14}$
Pt-195m		$3\ 10^{14}$
Pt-197		$2\ 10^{14}$
Pt-197m		$2\ 10^{14}$
Pt-199		$2\ 10^{14}$
Pt-200		$2\ 10^{14}$
Plutonium		
Pu-234		$1\ 10^{14}$
Pu-235		$2\ 10^{15}$
Pu-236		$6\ 10^{10}$
Pu-237		$1\ 10^{15}$
Pu-238		$2\ 10^{10}$
Pu-239		$2\ 10^{10}$
Pu-240		$2\ 10^{10}$
Pu-241		$1\ 10^{12}$
Pu-242		$2\ 10^{10}$
Pu-243		$2\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Pu-244		$2\ 10^{10}$
Pu-245		$2\ 10^{14}$
Pu-246		$2\ 10^{14}$
Polonium		
Po-203		$3\ 10^{14}$
Po-205		$7\ 10^{14}$
Po-206		$1\ 10^{13}$
Po-207		$8\ 10^{14}$
Po-208		$2\ 10^{11}$
Po-209		$2\ 10^{11}$
Po-210		$4\ 10^{11}$
Potassium		
K-40		$2\ 10^{14}$
K-42		$7\ 10^{13}$
K-43		$2\ 10^{14}$
K-44		$6\ 10^{13}$
K-45		$9\ 10^{13}$
Praseodymium		
Pr-136		$1\ 10^{14}$
Pr-137		$2\ 10^{14}$
Pr-138m		$2\ 10^{14}$
Pr-139		$7\ 10^{14}$
Pr-142		$1\ 10^{14}$
Pr-142m		$2\ 10^{17}$
Pr-143		$2\ 10^{14}$
Pr-144		$2\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Pr-145		$1\ 10^{14}$
Pr-147		$1\ 10^{14}$
Promethium		
Pm-141		$1\ 10^{14}$
Pm-143		$9\ 10^{13}$
Pm-144		$2\ 10^{13}$
Pm-145		$3\ 10^{14}$
Pm-146		$2\ 10^{13}$
Pm-147		$4\ 10^{14}$
Pm-148		$1\ 10^{14}$
Pm-148m		$5\ 10^{13}$
Pm-149		$2\ 10^{14}$
Pm-150		$1\ 10^{14}$
Pm-151		$2\ 10^{14}$
Protactinium		
Pa-227		$3\ 10^{13}$
Pa-228		$3\ 10^{13}$
Pa-230		$3\ 10^{12}$
Pa-231		$2\ 10^{10}$
Pa-232		$2\ 10^{14}$
Pa-233		$2\ 10^{14}$
Pa-234		$5\ 10^{13}$
Radium		
Ra-223		$3\ 10^{11}$
Ra-224		$7\ 10^{11}$
Ra-225		$3\ 10^{11}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Ra-226		$2\ 10^{11}$
Ra-227		$2\ 10^{14}$
Ra-228		$1\ 10^{11}$
Rhenium		
Re-177		$2\ 10^{14}$
Re-178		$2\ 10^{14}$
Re-181		$3\ 10^{14}$
Re-182	(long lived isotope)	$2\ 10^{14}$
Re-182	(short lived isotope)	$4\ 10^{14}$
Re-184		$1\ 10^{14}$
Re-184m		$7\ 10^{13}$
Re-186		$2\ 10^{14}$
Re-186m		$1\ 10^{14}$
Re-187		$5\ 10^{16}$
Re-188		$1\ 10^{14}$
Re-188m		$3\ 10^{14}$
Re-189		$2\ 10^{14}$
Rhodium		
Rh-99		$4\ 10^{14}$
Rh-99m		$9\ 10^{14}$
Rh-100		$4\ 10^{14}$
Rh-101		$7\ 10^{13}$
Rh-101m		$2\ 10^{15}$
Rh-102		$1\ 10^{13}$
Rh-102m		$6\ 10^{13}$
Rh-103m		$3\ 10^{17}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Rh-105		$2\ 10^{14}$
Rh-106m		$2\ 10^{14}$
Rh-107		$2\ 10^{14}$
Rubidium		
Rb-79		$1\ 10^{14}$
Rb-81		$2\ 10^{14}$
Rb-81m		$4\ 10^{14}$
Rb-82m		$3\ 10^{14}$
Rb-83		$1\ 10^{14}$
Rb-84		$1\ 10^{14}$
Rb-86		$2\ 10^{13}$
Rb-87		$4\ 10^{14}$
Rb-88		$5\ 10^{13}$
Rb-89		$9\ 10^{13}$
Ruthenium		
Ru-94		$1\ 10^{16}$
Ru-94	(tetroxide vapour)	$1\ 10^{16}$
Ru-97		$3\ 10^{15}$
Ru-97	(tetroxide vapour)	$1\ 10^{16}$
Ru-103		$2\ 10^{14}$
Ru-103	(tetroxide vapour)	$1\ 10^{15}$
Ru-105		$2\ 10^{14}$
Ru-105	(tetroxide vapour)	$6\ 10^{15}$
Ru-106		$3\ 10^{13}$
Ru-106	(tetroxide vapour)	$8\ 10^{13}$
Samarium		

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Sm-141		$1\ 10^{14}$
Sm-141m		$2\ 10^{14}$
Sm-142		$9\ 10^{14}$
Sm-145		$3\ 10^{14}$
Sm-146		$2\ 10^{11}$
Sm-147		$3\ 10^{11}$
Sm-151		$6\ 10^{14}$
Sm-153		$2\ 10^{14}$
Sm-155		$2\ 10^{14}$
Sm-156		$2\ 10^{14}$
Scandium		
Sc-43		$2\ 10^{14}$
Sc-44		$2\ 10^{14}$
Sc-44m		$9\ 10^{14}$
Sc-46		$3\ 10^{13}$
Sc-47		$3\ 10^{14}$
Sc-48		$2\ 10^{14}$
Sc-49		$1\ 10^{14}$
Selenium		
Se-70		$2\ 10^{14}$
Se-73		$2\ 10^{14}$
Se-73m		$2\ 10^{14}$
Se-75		$2\ 10^{13}$
Se-79		$5\ 10^{12}$
Se-81		$2\ 10^{14}$
Se-81m		$4\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Se-83		$2\ 10^{14}$
Silicon		
Si-31		$2\ 10^{14}$
Si-32		$2\ 10^{13}$
Silver		
Ag-102		$1\ 10^{14}$
Ag-103		$2\ 10^{14}$
Ag-104		$3\ 10^{14}$
Ag-104m		$2\ 10^{14}$
Ag-105		$2\ 10^{14}$
Ag-106		$2\ 10^{14}$
Ag-106m		$2\ 10^{14}$
Ag-108m		$1\ 10^{13}$
Ag-110m		$3\ 10^{12}$
Ag-111		$2\ 10^{14}$
Ag-112		$7\ 10^{13}$
Ag-115		$9\ 10^{13}$
Sodium		
Na-22		$1\ 10^{13}$
Na-24		$2\ 10^{14}$
Strontium		
Sr-80		$1\ 10^{16}$
Sr-81		$9\ 10^{13}$
Sr-82		$2\ 10^{14}$
Sr-83		$3\ 10^{14}$
Sr-85		$1\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Sr-85m		$3\ 10^{15}$
Sr-87m		$7\ 10^{14}$
Sr-89		$1\ 10^{14}$
Sr-90		$8\ 10^{12}$
Sr-91		$2\ 10^{14}$
Sr-92		$2\ 10^{14}$
Sulphur		
S-35	(inorganic)	$1\ 10^{14}$
S-35	(organic)	$2\ 10^{13}$
S-35	(carbon disulphide vapour)	$2\ 10^{15}$
S-35	(vapour)	$2\ 10^{16}$
S-35	(dioxide gas)	$1\ 10^{16}$
Tantalum		
Ta-172		$2\ 10^{14}$
Ta-173		$2\ 10^{14}$
Ta-174		$2\ 10^{14}$
Ta-175		$2\ 10^{14}$
Ta-176		$3\ 10^{14}$
Ta-177		$1\ 10^{15}$
Ta-178	(long lived isotope)	$3\ 10^{14}$
Ta-179		$6\ 10^{14}$
Ta-180		$9\ 10^{13}$
Ta-180m		$6\ 10^{14}$
Ta-182		$3\ 10^{13}$
Ta-182m		$2\ 10^{14}$
Ta-183		$2\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Ta-184		$2\ 10^{14}$
Ta-185		$1\ 10^{14}$
Ta-186		$9\ 10^{13}$
Technetium		
Tc-93		$5\ 10^{15}$
Tc-93m		$4\ 10^{14}$
Tc-94		$6\ 10^{14}$
Tc-94m		$1\ 10^{14}$
Tc-95		$4\ 10^{15}$
Tc-95m		$1\ 10^{14}$
Tc-96		$4\ 10^{14}$
Tc-96m		$2\ 10^{15}$
Tc-97		$9\ 10^{14}$
Tc-97m		$5\ 10^{14}$
Tc-98		$1\ 10^{13}$
Tc-99		$5\ 10^{12}$
Tc-99m		$1\ 10^{15}$
Tc-101		$2\ 10^{14}$
Tc-104		$6\ 10^{13}$
Tellurium		
Te-116		$6\ 10^{14}$
Te-116	(vapour)	$2\ 10^{16}$
Te-121		$4\ 10^{14}$
Te-121	(vapour)	$3\ 10^{15}$
Te-121m		$1\ 10^{14}$
Te-121m	(vapour)	$3\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Te-123		$6\ 10^{14}$
Te-123	(vapour)	$2\ 10^{14}$
Te-123m		$2\ 10^{14}$
Te-123m	(vapour)	$5\ 10^{14}$
Te-125m		$2\ 10^{14}$
Te-125m	(vapour)	$8\ 10^{14}$
Te-127		$2\ 10^{14}$
Te-127	(vapour)	$2\ 10^{16}$
Te-127m		$1\ 10^{14}$
Te-127m	(vapour)	$2\ 10^{14}$
Te-129		$2\ 10^{14}$
Te-129	(vapour)	$4\ 10^{16}$
Te-129m		$1\ 10^{14}$
Te-129m	(vapour)	$3\ 10^{14}$
Te-131		$1\ 10^{14}$
Te-131	(vapour)	$1\ 10^{16}$
Te-131m		$2\ 10^{14}$
Te-131m	(vapour)	$5\ 10^{14}$
Te-132		$3\ 10^{14}$
Te-132	(vapour)	$2\ 10^{14}$
Te-133		$1\ 10^{14}$
Te-133	(vapour)	$7\ 10^{15}$
Te-133m		$1\ 10^{14}$
Te-133m	(vapour)	$2\ 10^{15}$
Te-134		$3\ 10^{14}$
Te-134	(vapour)	$7\ 10^{15}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Terbium		
Tb-147		$2\ 10^{14}$
Tb-149		$2\ 10^{14}$
Tb-150		$2\ 10^{14}$
Tb-151		$4\ 10^{14}$
Tb-153		$7\ 10^{14}$
Tb-154		$4\ 10^{14}$
Tb-155		$1\ 10^{15}$
Tb-156		$3\ 10^{14}$
Tb-156m	(long lived isotope)	$1\ 10^{15}$
Tb-156m	(short lived isotope)	$4\ 10^{14}$
Tb-157		$1\ 10^{15}$
Tb-158		$2\ 10^{13}$
Tb-160		$5\ 10^{13}$
Tb-161		$2\ 10^{14}$
Thallium		
Tl-194		$1\ 10^{15}$
Tl-194m		$2\ 10^{14}$
Tl-195		$4\ 10^{14}$
Tl-197		$5\ 10^{14}$
Tl-198		$7\ 10^{14}$
Tl-198m		$2\ 10^{14}$
Tl-199		$6\ 10^{14}$
Tl-200		$1\ 10^{15}$
Tl-201		$7\ 10^{14}$
Tl-202		$7\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Tl-204		$2\ 10^{14}$
Thorium		
Th-226		$4\ 10^{13}$
Th-227		$2\ 10^{11}$
Th-228		$6\ 10^{10}$
Th-229		$1\ 10^{10}$
Th-230		$2\ 10^{10}$
Th-231		$2\ 10^{14}$
Th-232		$2\ 10^{10}$
Th-234		$3\ 10^{14}$
Thulium		
Tm-162		$2\ 10^{14}$
Tm-166		$3\ 10^{14}$
Tm-167		$4\ 10^{14}$
Tm-170		$2\ 10^{14}$
Tm-171		$1\ 10^{15}$
Tm-172		$2\ 10^{14}$
Tm-173		$2\ 10^{14}$
Tm-175		$2\ 10^{14}$
Tin		
Sn-110		$6\ 10^{15}$
Sn-111		$2\ 10^{14}$
Sn-113		$5\ 10^{14}$
Sn-117m		$3\ 10^{14}$
Sn-119m		$5\ 10^{14}$
Sn-121		$3\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Sn-121m		$4\ 10^{14}$
Sn-123		$2\ 10^{14}$
Sn-123m		$2\ 10^{14}$
Sn-125		$1\ 10^{14}$
Sn-126		$5\ 10^{13}$
Sn-127		$2\ 10^{14}$
Sn-128		$2\ 10^{14}$
Titanium		
Ti-44		$2\ 10^{13}$
Ti-45		$2\ 10^{14}$
Tungsten		
W-176		$5\ 10^{14}$
W-177		$3\ 10^{14}$
W-178		$6\ 10^{15}$
W-179		$1\ 10^{15}$
W-181		$1\ 10^{15}$
W-185		$4\ 10^{14}$
W-187		$2\ 10^{14}$
W-188		$3\ 10^{14}$
Uranium		
U-230		$2\ 10^{11}$
U-231		$7\ 10^{14}$
U-232		$6\ 10^{10}$
U-233		$3\ 10^{11}$
U-234		$3\ 10^{11}$
U-235		$3\ 10^{11}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
U-236		$3\ 10^{11}$
U-237		$2\ 10^{14}$
U-238		$3\ 10^{11}$
U-239		$2\ 10^{14}$
U-240		$2\ 10^{14}$
Vanadium		
V-47		$1\ 10^{14}$
V-48		$1\ 10^{14}$
V-49		$2\ 10^{16}$
Xenon		
Xe-120	(gas)	$1\ 10^{16}$
Xe-121	(gas)	$3\ 10^{15}$
Xe-122	(gas)	$1\ 10^{17}$
Xe-123	(gas)	$9\ 10^{15}$
Xe-125	(gas)	$2\ 10^{16}$
Xe-127	(gas)	$2\ 10^{16}$
Xe-129m	(gas)	$2\ 10^{17}$
Xe-131m	(gas)	$4\ 10^{17}$
Xe-133	(gas)	$1\ 10^{17}$
Xe-133m	(gas)	$2\ 10^{17}$
Xe-135	(gas)	$2\ 10^{16}$
Xe-135m	(gas)	$1\ 10^{16}$
Xe-138	(gas)	$5\ 10^{15}$
Ytterbium		
Yb-162		$1\ 10^{15}$
Yb-166		$8\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Yb-167		$4\ 10^{14}$
Yb-169		$3\ 10^{14}$
Yb-175		$4\ 10^{14}$
Yb-177		$2\ 10^{14}$
Yb-178		$2\ 10^{14}$
Yttrium		
Y-86		$2\ 10^{14}$
Y-86m		$1\ 10^{15}$
Y-87		$2\ 10^{15}$
Y-88		$2\ 10^{13}$
Y-90		$2\ 10^{14}$
Y-90m		$7\ 10^{14}$
Y-91		$2\ 10^{14}$
Y-91m		$2\ 10^{15}$
Y-92		$6\ 10^{13}$
Y-93		$8\ 10^{13}$
Y-94		$6\ 10^{13}$
Y-95		$6\ 10^{13}$
Zinc		
Zn-62		$1\ 10^{15}$
Zn-63		$1\ 10^{14}$
Zn-65		$5\ 10^{12}$
Zn-69		$2\ 10^{14}$
Zn-69m		$2\ 10^{15}$
Zn-71m		$2\ 10^{14}$

Radionuclide	*Radionuclide form*	*Bulk Quantity (Bq)*
Zn-72		$3\ 10^{14}$
	Zirconium	
Zr-86		$2\ 10^{15}$
Zr-88		$1\ 10^{14}$
Zr-89		$4\ 10^{14}$
Zr-93		$8\ 10^{13}$
Zr-95		$8\ 10^{13}$
Zr-97		$2\ 10^{14}$
Other radionuclides not listed above (see note)		$4\ 10^{9}$

Note

In any case where the isotopic composition of a radioactive substance is not known, or is only partially known, the figure for `*other radionuclides not listed above*' shall be used unless the employer can show that the use of some other value is appropriate in the circumstances of a particular case, when he may use that value.

Bulk quantity values for a combination of radionuclides

For a combination of radionuclides, ONR considers there to be a bulk quantity if the sum of the quotients of the quantity of a radionuclide present Qp divided by the quantity of that radionuclide specified in table 1 Q_{BQ} exceeds 1. Namely—

$$\sum \frac{Qp}{Q_{BQ}} > 1$$