

Operational Intervention Levels (OILs)

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Biography

Experiences

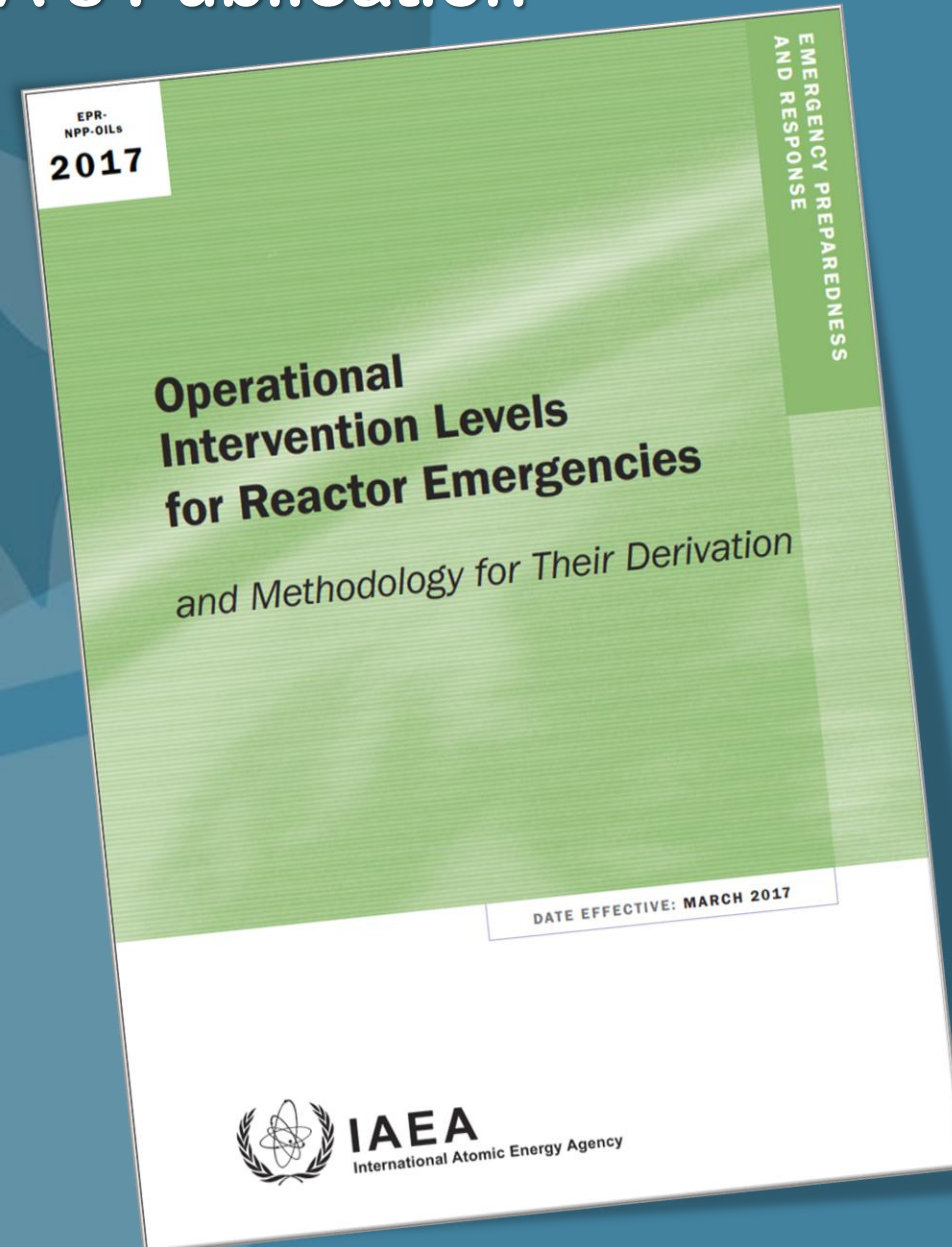
- Study on Environmental Radionuclide Analysis and Instrument Analysis, IAEA, JAPAN, 2006.
- Training on Marine Environment and Coastal Zone Management, Marine Environment Laboratory, MONACO, 2010.
- Regional Workshop on Long Term Issues Following a Nuclear or Radiological Emergency, MALAYSIA, 2014.
- RTC on Emergency Preparedness and Response in Severe Accidents, Fuzhou, CHINA, 2014.
- Regional Workshop on an Effective National Emergency Centre for Radiological and Nuclear Emergencies, Including the Establishment of an Off-Site Centre, REPUBLIC OF KOREA, 2015.
- Regional Workshop on Information Exchange during Radiation Emergencies and Cooperation regarding Coordination of Emergency Preparedness and Response, Vienna, AUSTRIA, 2017.
- Technical Meeting on “Twenty Years of EPREV: Building on Two Decades of Experience”, Vienna, AUSTRIA, 2019.
- IAEA/RCA RTC on Development and Use of Operational Intervention Levels (OILs) for Reactor Emergencies, Bangkok, THAILAND, 2022.
- Mid-term Review Meeting IAEA/RCA RAS9092 Strengthening the Capacity to Respond to Radiological Emergencies of Category II and III Facilities in the RCA Region, MALAYSIA, 2023.

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IAEA's Publication



For determining the values during the oil spill to an

OIL CHART FOR GROUND MONITORING [LWRs]

ATTENTION: Only use this OIL if the answer to all the following questions is 'yes'.

Has there been a release of radioactive material from an LWR or its spent fuel?

Are you avoiding the ambient dose equivalent rate of 1 mSv above ground level?

Is the measurement representative of an area inhabited or frequented by the public or of an area where the public consumes or distributes local produce (e.g. mushrooms or berries), milk from grazing animals, wild-growing local plants or animal feed?

To be used to identify areas (beyond those for response actions) that have been taken based on the emergency declaration where the ground deposition of radioactive material warrants:

- provision of the public (frequency of living in the area) by using OIL-1 for immediate urgent response actions and OIL-2 for long-term response actions;
- restriction of the consumption, distribution and sale of non-essential local produce, wild-growing plants or animal feed, milk from grazing animals, and other products, which may result in radiation induced health effects.

Avoid delays in decision making and implement response actions as soon as possible.

Living in areas exceeding OIL-1 or OIL-2 may require a large fraction of the annual dose in the first month. Consuming local produce, wild-growing plants, milk from grazing animals, drarily collected material or local animals from an area exceeding OIL-2, may result in radiation induced health effects.

GROUND MONITORING

Obtain dose equivalent rate at 1 m above ground level in a populated area (e.g. in a village or town) or in an area used for farming, or in an area with low or no vegetation and away from roads, trees and buildings.

MONITORING TYPE

DEFAULT OIL VALUE

RESPONSE ACTIONS BASED ON GENERAL EMERGENCY

SKIN MONITORING [LWRs] - GAMMA

CAUTION: Only use this OIL if the answer to all the following questions is 'yes'.

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Is the measurement representative of an area inhabited or frequented by the public or of an area where the public consumes or distributes local produce (e.g. mushrooms or berries), milk from grazing animals, wild-growing local plants or animal feed?

To be used to identify areas (beyond those for response actions) that have been taken based on the emergency declaration where the ground deposition of radioactive material warrants:

- provision of the public (frequency of living in the area) by using OIL-1 for immediate urgent response actions and OIL-2 for long-term response actions;
- restriction of the consumption, distribution and sale of non-essential local produce, wild-growing plants or animal feed, milk from grazing animals, and other products, which may result in radiation induced health effects.

SKIN MONITORING

Obtain dose equivalent rate at 1 m above ground level in a populated area (e.g. in a village or town) or in an area used for farming, or in an area with low or no vegetation and away from roads, trees and buildings.

MONITORING [LWRs] - BETA

CAUTION: Only use this OIL if the answer to all the following questions is 'yes'.

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To be used to identify areas (beyond those for response actions) that have been taken based on the emergency declaration where the ground deposition of radioactive material warrants:

- provision of the public (frequency of living in the area) by using OIL-1 for immediate urgent response actions and OIL-2 for long-term response actions;
- restriction of the consumption, distribution and sale of non-essential local produce, wild-growing plants or animal feed, milk from grazing animals, and other products, which may result in radiation induced health effects.

OIL, MILK AND DRINKING WATER SAMPLES [LWRs]

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To be used to identify areas (beyond those for response actions) that have been taken based on the emergency declaration where the ground deposition of radioactive material warrants:

- provision of the public (frequency of living in the area) by using OIL-1 for immediate urgent response actions and OIL-2 for long-term response actions;
- restriction of the consumption, distribution and sale of non-essential local produce, wild-growing plants or animal feed, milk from grazing animals, and other products, which may result in radiation induced health effects.

OIL CHART FOR THYROID MONITORING [LWRs]

CAUTION: Only use this OIL if the answer to all the following questions is 'yes'.

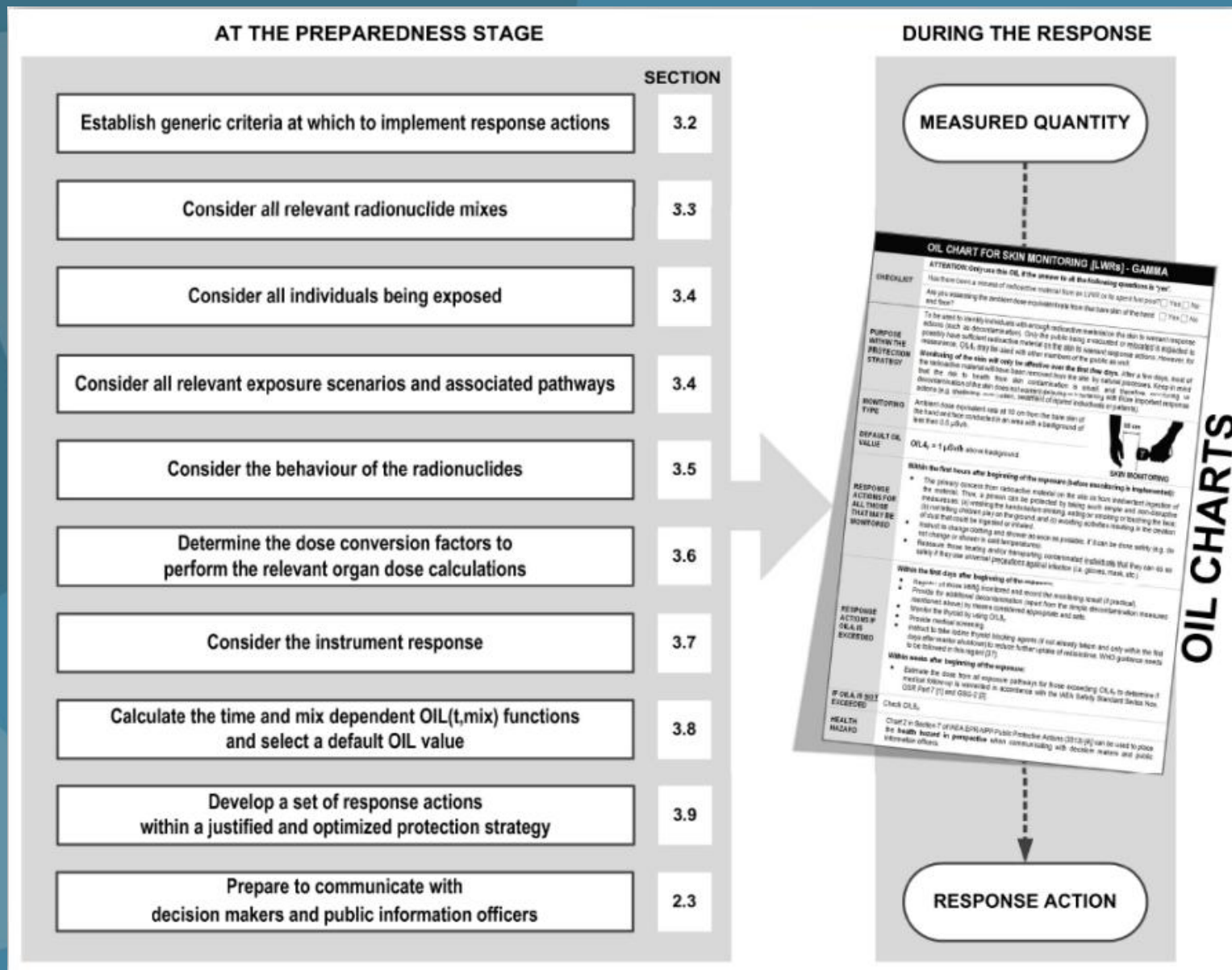
Is there a release of radioactive material from an LWR or its spent fuel?

Is the measurement representative of an area inhabited or frequented by the public or of an area where the public consumes or distributes local produce (e.g. mushrooms or berries), milk from grazing animals, wild-growing local plants or animal feed?

To be used to identify areas (beyond those for response actions) that have been taken based on the emergency declaration where the ground deposition of radioactive material warrants:

- provision of the public (frequency of living in the area) by using OIL-1 for immediate urgent response actions and OIL-2 for long-term response actions;
- restriction of the consumption, distribution and sale of non-essential local produce, wild-growing plants or animal feed, milk from grazing animals, and other products, which may result in radiation induced health effects.

Basis for OILs Default Values



IAEA's Generic Criteria

Generic criteria		Examples of protective actions and other response actions ^a
Projected dose that exceeds the following generic criteria: Take urgent protective actions and other response actions		
E^d	100 mSv in the first 7 days	Sheltering ^e ; evacuation; prevention of inadvertent ingestion; restrictions on food, milk and drinking water ^g and restrictions on the food chain and water supply; restrictions on commodities other than food; contamination control; decontamination; registration; reassurance of the public
H_{fetus}^f	100 mSv in the first 7 days	

Generic Criteria

Actions ^a	Generic criterion	Used for	References
Take <u>urgent</u> response actions to reduce the risk of stochastic effects	$GC(Urgent, E, 7d) = 0.1 \text{ Sv}$ total ^d effective ^c dose to the <u>representative person^b</u> in the first 7 days	OIL1 _γ OIL4 _γ OIL4 _β	Table II.2 of Ref. [1]
	$GC(Urgent, H_{\text{fetus}}, 7d) = 0.1 \text{ Sv}$ total ^e equivalent dose to the <u>fetus^f</u> in the first 7 days	OIL1 _γ OIL4 _γ OIL4 _β	Table II.2 of Ref. [1]
	$GC(Urgent, h_{\text{thyroid, thy-burden}}) = 0.1 \text{ Sv}^g$ committed equivalent dose to the thyroid from radioiodine in the thyroid (thyroid burden)	OIL8 _γ	Ref. [1] ^h

Keeping the dose to the fetus below 100 mSv will ensure that GC for severe deterministic effects for **any** organ or tissue will not be exceeded

Generic Criteria

Actions ^a	Generic criterion	Used for	References
Take <u>early</u> response actions to reduce the risk of stochastic effects	$GC(Early, E, 1a) = 0.1 \text{ Sv}$ total ^d effective ^c dose to the representative person ^b in the first year	OIL2 _γ	Table II.2 of Ref. [1]
	$GC(Early, H_{\text{fetus}}, 9mo) = 0.1 \text{ Sv}$ total ^e equivalent dose to the fetus ^f in the full period of in utero development	OIL2 _γ	Table II.2 of Ref. [1]

Generic Criteria

Actions ^a	Generic criterion	Used for	References
Take response actions to reduce the risk of stochastic effects due to the <u>ingestion of food, milk or drinking water</u>	$GC(\text{Ingestion}, e_{\text{ing}}, 1a) = 0.01 \text{ Sv}^g$ committed effective ^c dose to the <u>representative person^b</u> from ingestion of food, milk and drinking water during the first year	OIL3 _γ OIL7	Table II.3. of Ref. [1]
	$GC(\text{Ingestion}, h_{\text{fetus, ing}}, 9mo) = 0.01 \text{ Sv}^g$ committed equivalent dose to the <u>fetus^f</u> from ingestion of food, milk and drinking water during the full period of in utero development	OIL3 _γ OIL7	Table II.3. of Ref. [1]

Generic Criteria

Actions ^a	Generic criterion	Used for	References
Take response actions <u>under any circumstance</u> to avoid or minimize severe deterministic effects	$GC(acute, AD_{skin-ext}, 10h) = 10 \text{ Gy}$ RBE weighted absorbed dose to 100 cm ² of the skin dermis of the representative person ^b from acute external exposure in the first 10 hours	OIL4 _γ OIL4 _β	Table II.1 of Ref. [1]
Take <u>urgent</u> response actions to reduce the risk of stochastic effects	$GC(Urgent, E, 7d) = 0.1 \text{ Sv}$ total ^d effective ^c dose to the representative person ^b in the first 7 days	OIL1 _γ OIL4 _γ OIL4 _β	Table II.2 of Ref. [1]
	$GC(Urgent, H_{fetus}, 7d) = 0.1 \text{ Sv}$ total ^e equivalent dose to the fetus ^f in the first 7 days	OIL1 _γ OIL4 _γ OIL4 _β	Table II.2 of Ref. [1]
	$GC(Urgent, h_{thyroid, thy-burden}) = 0.1 \text{ Sv}^g$ committed equivalent dose to the thyroid from radioiodine in the thyroid (thyroid burden)	OIL8 _γ	Ref. [1] ^h

Radionuclide Mixes

Consider all relevant radionuclide mixes

The OILs are calculated for all the radionuclide mixes expected to be released from an LWR or its spent fuel during a severe emergency.

These may be significant contributors to the dose of the public or to the instrument response.

Consider all relevant radionuclide mixes.

Rads.	RF _i (mix1) [unitless]	RF _i (mix2) [unitless]	RF _i (mix3) [unitless]	RF _i (mix4) [unitless]	RF _i (mix5) [unitless]	RF _i (mix6) [unitless]	RF _i (mix7) [unitless]
Rb-86	5.0E-02	2.0E-01	3.6E-01	2.5E-01	4.5E-01	2.0E-03	1.3E-01
Sr-89	0.0E+00	2.0E-02	1.0E-01	2.0E-02	1.0E-01	0.0E+00	5.0E-03
Sr-90+	0.0E+00	2.0E-02	1.0E-01	2.0E-02	1.0E-01	0.0E+00	5.0E-03
Sr-91	0.0E+00	2.0E-02	1.0E-01	2.0E-02	1.0E-01	0.0E+00	5.0E-03
Y-91	0.0E+00	2.0E-04	5.0E-03	2.0E-04	5.0E-03	0.0E+00	1.4E-07
Zr-95+	0.0E+00	2.0E-04	5.0E-03	2.0E-04	5.0E-03	0.0E+00	1.3E-07
Zr-97+	0.0E+00	2.0E-04	5.0E-03	2.0E-04	5.0E-03	0.0E+00	1.3E-07
Mo-99+	0.0E+00	2.5E-03	2.5E-03	2.5E-03	2.5E-03	0.0E+00	2.0E-02
Ru-103+	0.0E+00	2.5E-03	2.5E-03	2.5E-03	2.5E-03	0.0E+00	2.7E-03
Ru-105	0.0E+00	2.5E-03	2.5E-03	2.5E-03	2.5E-03	0.0E+00	2.7E-03
Ru-106+	0.0E+00	2.5E-03	2.5E-03	2.5E-03	2.5E-03	0.0E+00	2.7E-03
Rh-105	0.0E+00	2.5E-03	2.5E-03	2.5E-03	2.5E-03	0.0E+00	2.7E-03
Te-127m+	0.0E+00	5.0E-02	2.6E-01	5.0E-02	2.6E-01	2.0E-03	3.9E-01
Te-127	0.0E+00	5.0E-02	2.6E-01	5.0E-02	2.6E-01	2.0E-03	3.9E-01
Te-129m+	0.0E+00	5.0E-02	2.6E-01	5.0E-02	2.6E-01	2.0E-03	3.9E-01
Te-131m	0.0E+00	5.0E-02	2.6E-01	5.0E-02	2.6E-01	2.0E-03	3.9E-01
Te-132+	0.0E+00	5.0E-02	2.6E-01	5.0E-02	2.6E-01	2.0E-03	3.9E-01
I-131	5.0E-02	2.5E-01	3.1E-01	3.5E-01	3.5E-01	2.0E-03	4.7E-01
I-133	5.0E-02	2.5E-01	3.1E-01	3.5E-01	3.5E-01	2.0E-03	4.7E-01
I-134	5.0E-02	2.5E-01	3.1E-01	3.5E-01	3.5E-01	2.0E-03	4.7E-01
I-135	5.0E-02	2.5E-01	3.1E-01	3.5E-01	3.5E-01	2.0E-03	4.7E-01
Cs-134	5.0E-02	2.0E-01	3.6E-01	2.5E-01	4.5E-01	2.0E-03	1.3E-01
Cs-136	5.0E-02	2.0E-01	3.6E-01	2.5E-01	4.5E-01	2.0E-03	1.3E-01
Cs-137+	5.0E-02	2.0E-01	3.6E-01	2.5E-01	4.5E-01	2.0E-03	1.3E-01
Ba-140+	0.0E+00	2.0E-02	1.0E-01	2.0E-02	1.0E-01	0.0E+00	5.0E-03
Ce-141	0.0E+00	5.0E-04	5.0E-03	5.0E-04	5.0E-03	0.0E+00	1.3E-07
Ce-143	0.0E+00	5.0E-04	5.0E-03	5.0E-04	5.0E-03	0.0E+00	1.3E-07
Ce-144+	0.0E+00	5.0E-04	5.0E-03	5.0E-04	5.0E-03	0.0E+00	1.3E-07
Pr-143	0.0E+00	2.0E-04	5.0E-03	2.0E-04	5.0E-03	0.0E+00	1.4E-07
Nd-147	0.0E+00	2.0E-04	5.0E-03	2.0E-04	5.0E-03	0.0E+00	1.4E-07
Np-239	0.0E+00	5.0E-04	5.0E-03	5.0E-04	5.0E-03	0.0E+00	1.3E-07
Pu-238	0.0E+00	5.0E-04	5.0E-03	5.0E-04	5.0E-03	0.0E+00	1.3E-07
Pu-239	0.0E+00	5.0E-04	5.0E-03	5.0E-04	5.0E-03	0.0E+00	1.3E-07
Pu-240	0.0E+00	5.0E-04	5.0E-03	5.0E-04	5.0E-03	0.0E+00	1.3E-07
Pu-241	0.0E+00	5.0E-04	5.0E-03	5.0E-04	5.0E-03	0.0E+00	1.3E-07
Am-241	0.0E+00	2.0E-04	5.0E-03	2.0E-04	5.0E-03	0.0E+00	1.4E-07
Cm-242	0.0E+00	2.0E-04	5.0E-03	2.0E-04	5.0E-03	0.0E+00	1.4E-07
Cm-244	0.0E+00	2.0E-04	5.0E-03	2.0E-04	5.0E-03	0.0E+00	1.4E-07

Exposed Individuals

Consider all individuals being exposed

Past experience: Not considering all members of the public may result in unwarranted actions being taken that **do more harm than good**.

All members of the public (including the most sensitive) have been considered in the calculation of the OILs by taking response actions based on the dose projected or received by the **representative person**.



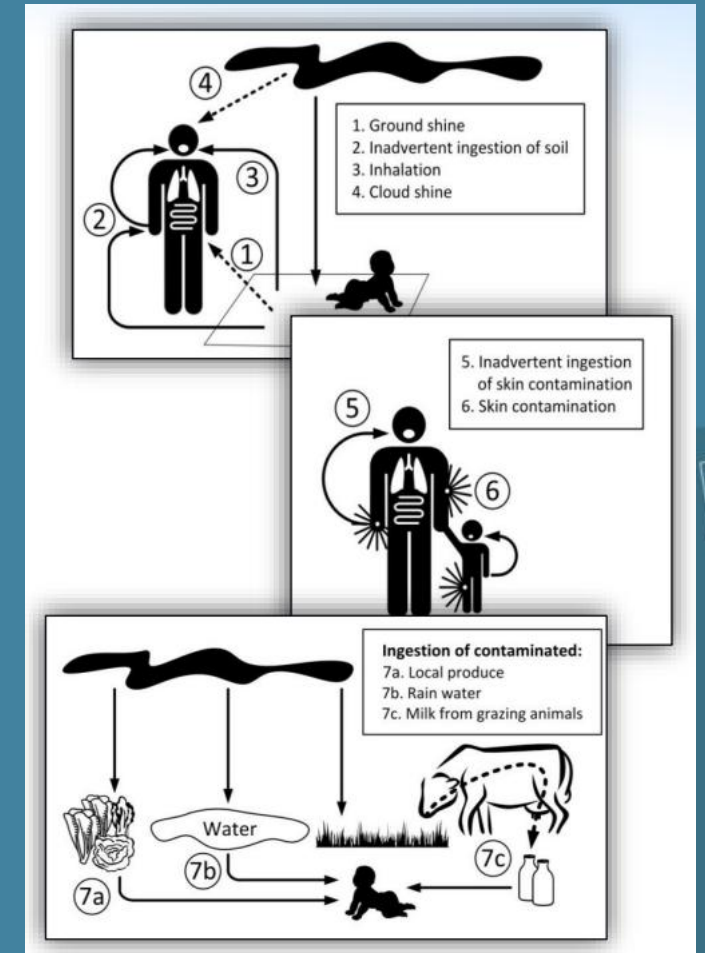
Exposure Scenarios and Pathways

Consider all relevant exposure scenarios and associated pathways.

Five exposure scenarios resulting from deposited radioactive material are considered:

- 'ground' scenario;
- 'food pre-analysis' scenario;
- 'skin' scenario;
- 'food post-analysis' scenario;
- 'thyroid' scenarios;

For each exposure scenario, different exposure pathways are taken into account.



Radionuclide Behaviour

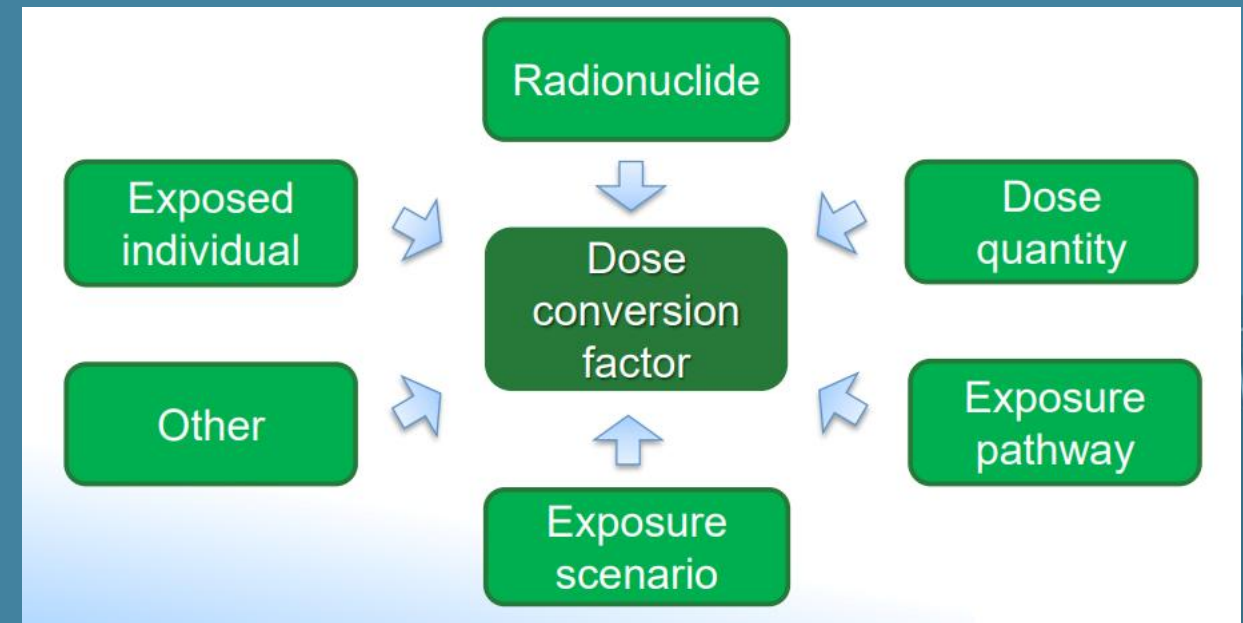
Consider the behavior of the radionuclides

- Decay and ingrowth;
- Weathering (ground, skin, vegetation);
- Resuspension;
- Inadvertent ingestion from the ground;
- Transfer from the skin to gastrointestinal tract;
- Transfer to the food, milk and drinking water.
- Etc.

Dose Conversion Factors

Determine the dose conversion factors required to perform the relevant organ dose calculations

Dose conversion factors relate the activity of a certain radionuclide with the projected dose, which is needed to determine if the generic criteria may be exceeded.



Instrument Response

The instrument response will affect the default OIL values and needs to be considered in the calculations.

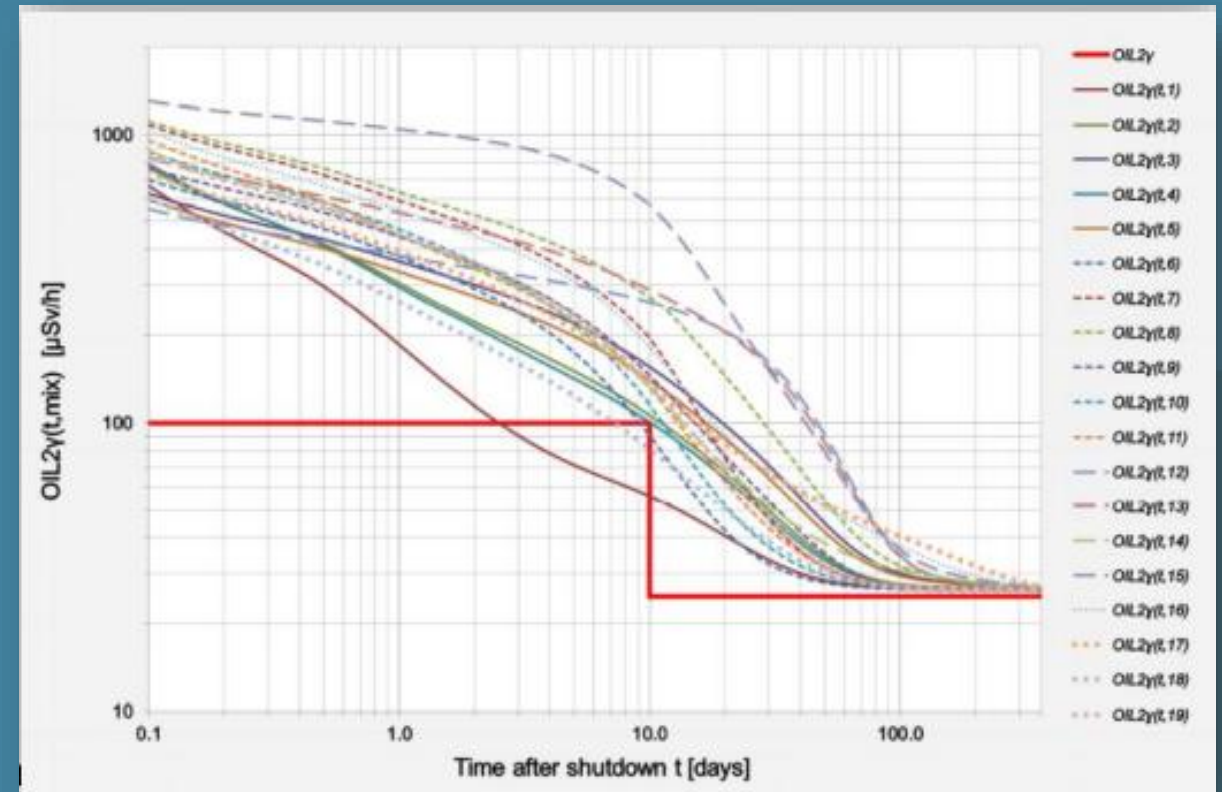


OIL(t, mix) Functions & Default OIL Values

Calculate the time and mix dependent $OIL(t, mix)$ functions and select a default OIL value.

OIL values depend on the radionuclide mix which will vary over time.

For each OIL a set of time and mix dependent $OIL(t, mix)$ functions is calculated, based on which a default OIL value is chosen.





Discussion

Thank You

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