Use of the ICRP System for the Protection of Marine Ecosystems

An assessment procedure developed by IAEA

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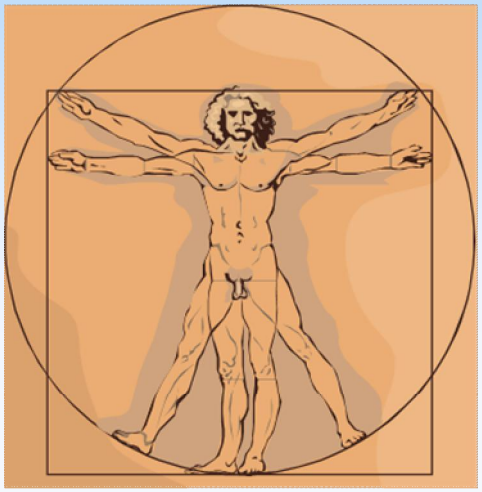
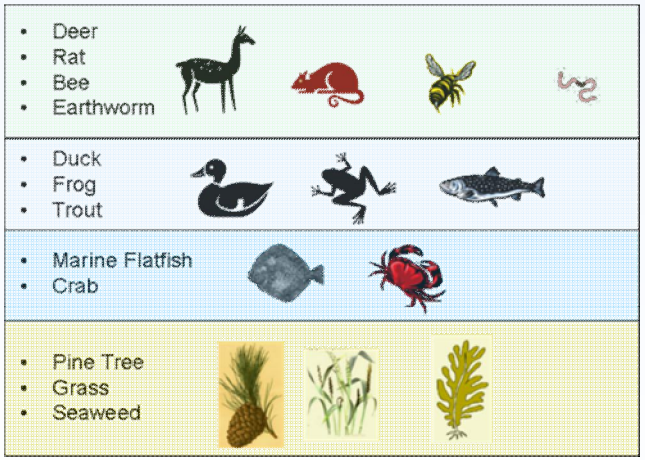
ICRP INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

The use of a ‘reference approach’ for protection of humans and flora and fauna

Objects of protection

Assessment reference





Estimation of Radiation dose

Source

+

Exposure pathways

+

Dosimetric models

The use of a 'reference approach' for protection of humans and flora and fauna

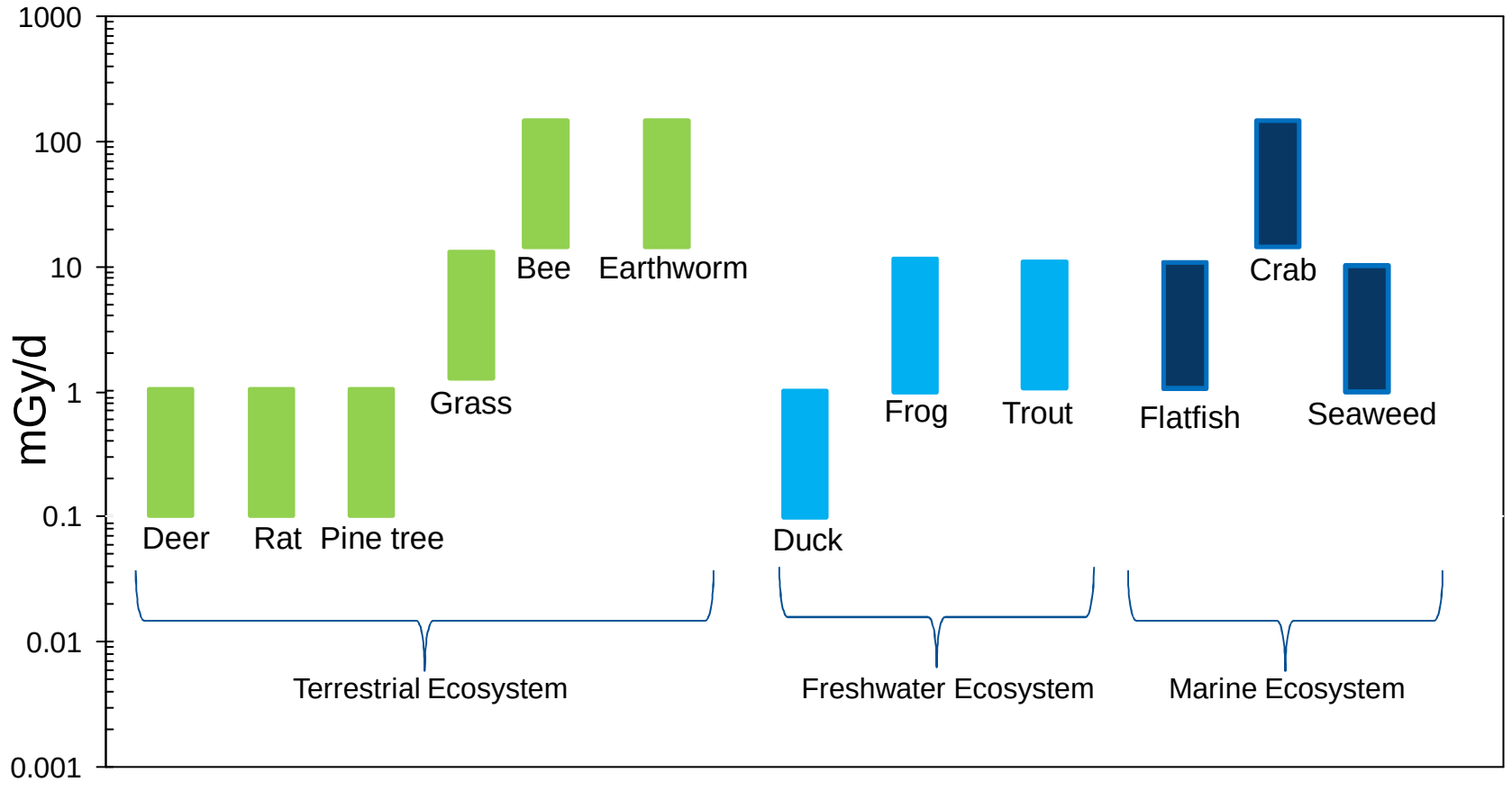
Exposure conditions (location and habit data) representative of those most highly exposed → **Effective Dose to Representative Person** Vs. **Radiological Criteria**

(based on data of radiation effects: Dose Limit, Constraints, Reference levels)

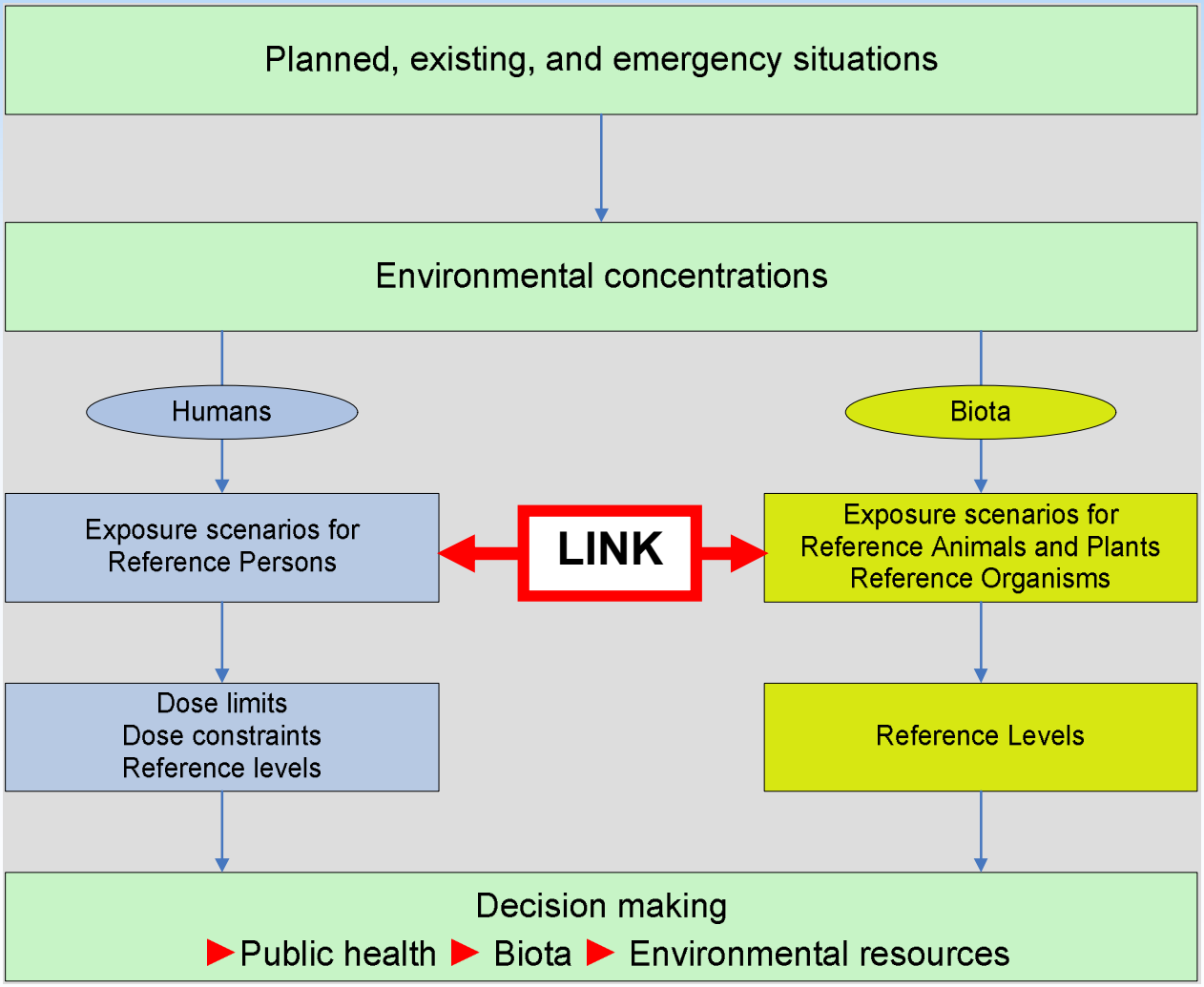
Exposure conditions (location, occupation factors) representative of those most highly exposed → **Absorbed Dose Rates to Representative Organisms (RAPs or equivalents)** Vs. **Radiological Criteria**

(based on data of radiation effects: DCRLs)

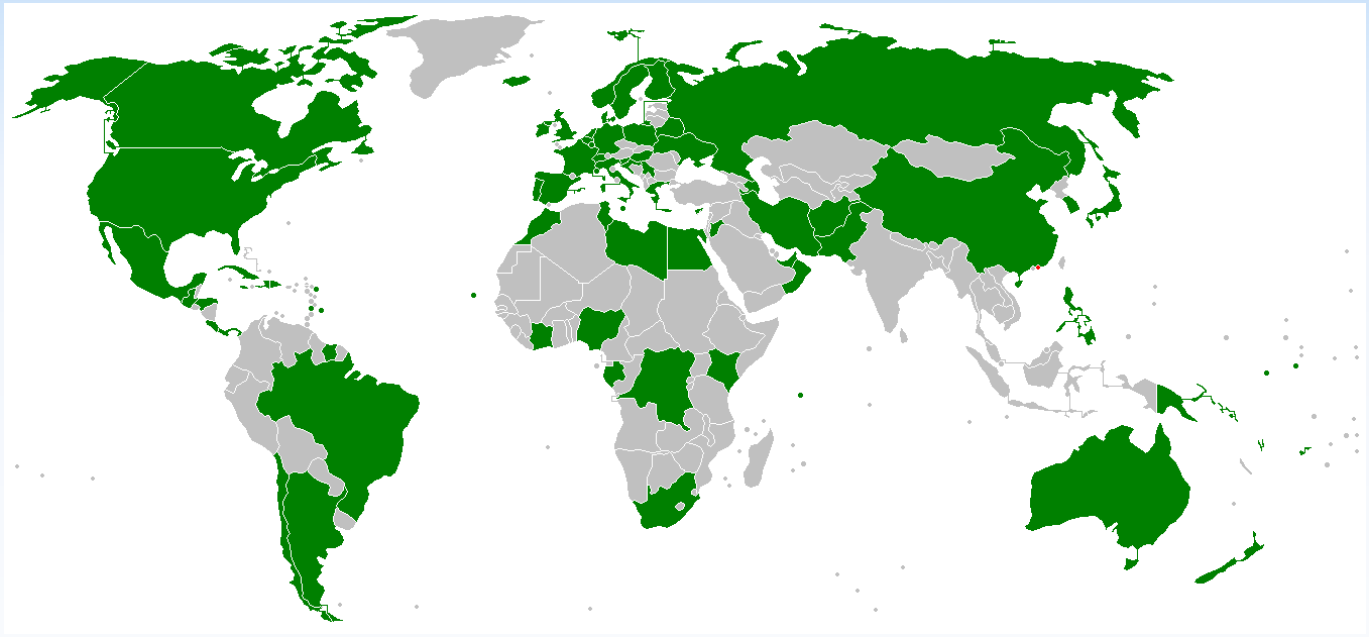
ICRP RAPs and Derived Reference Consideration Levels for major ecosystems



Integration of human and environmental protection (IAEA 2011 Basic Safety Standards)



1972 London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (LC)



(87 Parties to the London Convention)

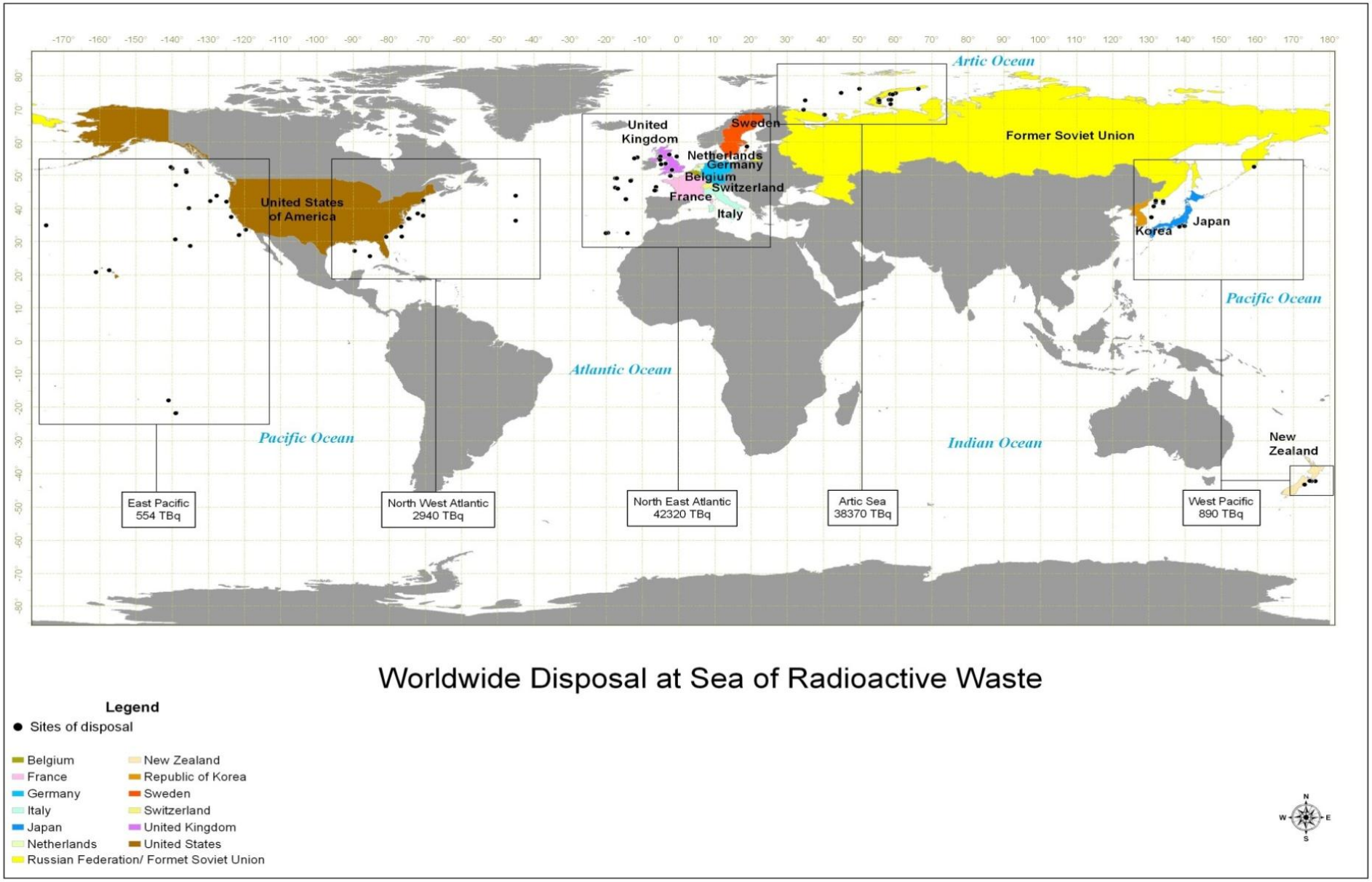
Objective:

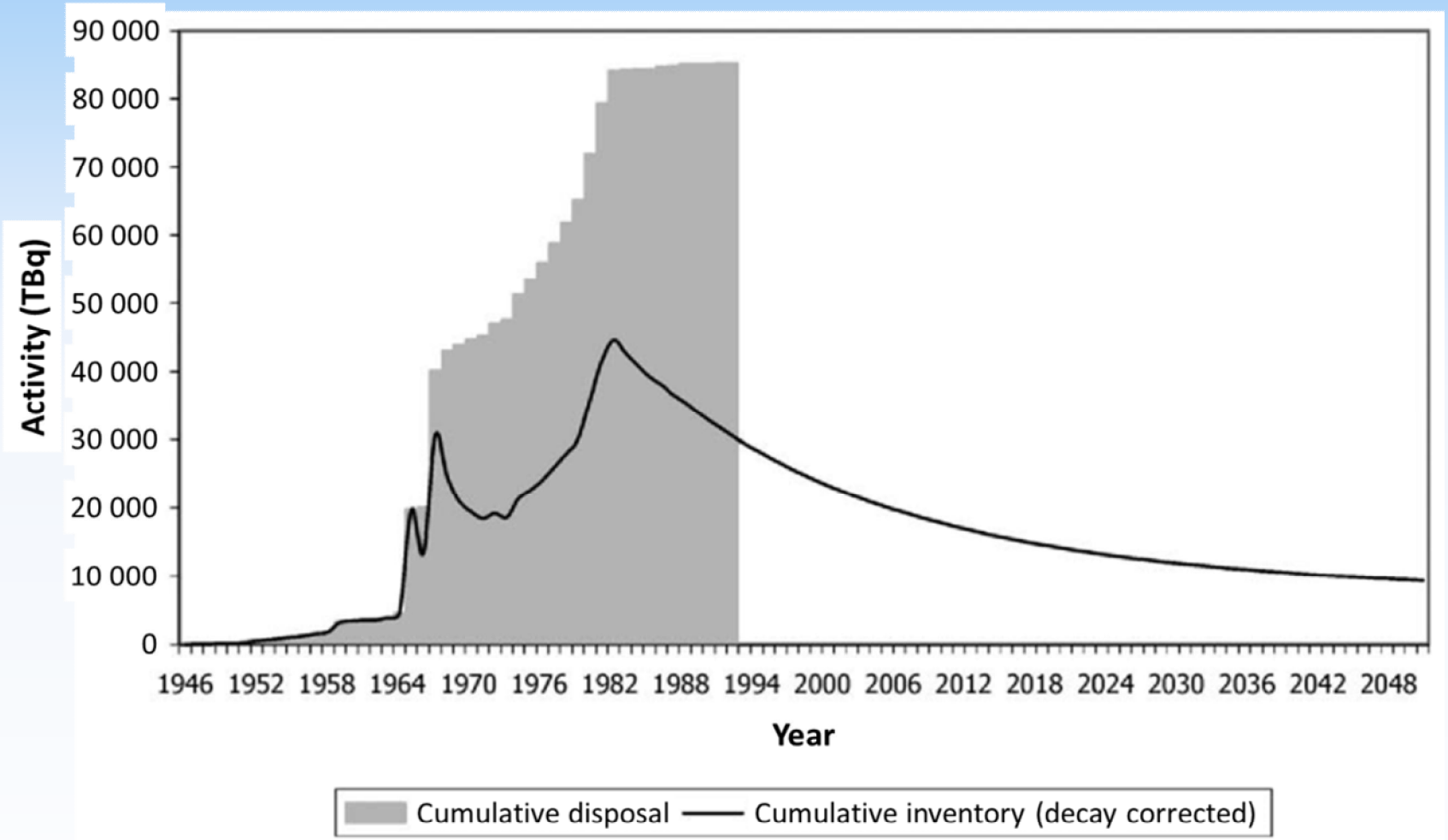
to promote the effective control of all sources of marine pollution and to take all practicable steps to prevent pollution of the sea by dumping of wastes and other matter.

More information can be found at http://www.imo.org

1972 London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter

- IAEA is the international technical advisor in matters related to radioactive materials.
- With the advice of IAEA in 1975 dumping of radioactive waste at sea was limited and regulated (low level waste, special packages).
- Since 1993, any type of radioactive waste was fully prohibited (a decision by the contracting parties of the convention).


Artic Ocean
United Kingdom
Sweden
Former Soviet Union
Netherlands
Germany
Belgium
Switzerland
France
Italy
United States of America
Korea
Japan
Pacific Ocean
Atlantic Ocean
Pacific Ocean
Indian Ocean
New Zealand
East Pacific 554 TBq
North West Atlantic 2940 TBq
North East Atlantic 42320 TBq
Artic Sea 38370 TBq
West Pacific 890 TBq
Worldwide Disposal at Sea of Radioactive Waste
Legend
Sites of disposal
Belgium
France
Germany
Italy
Japan
Netherlands
Russian Federation/ Formet Soviet Union
New Zealand
Republic of Korea
Sweden
Switzerland
United Kingdom
United States


90 000
80 000
70 000
60 000
50 000
40 000
30 000
20 000
10 000
0
Activity (TBq)
1946 1952 1958 1964 1970 1976 1982 1988 1994 2000 2006 2012 2018 2024 2030 2036 2042 2048
Year
Cumulative disposal
Cumulative inventory (decay corrected)

So, what was the problem?

- Radioactivity is almost everywhere.
- Many materials candidate for dumping have traces of radionuclides.

An example:

- Material which is dredged from harbors, cannot be dumped at sea if it has a few bequerels per kilogram of radionuclides.

Recent work by IAEA related to dumping of material for the LC (1)

- In 1997 the LC requested to IAEA to provide guidance for making judgments on whether materials planned to be dumped could be cleared from the radioactive content perspective (concept and criteria for *de minimis*).
- In 1999 an assessment procedure to declare *de minimis* to be incorporated in the LC Guidelines was requested.
- In 2003, the assessment procedure developed by IAEA (IAEA TECDOC 1375) was approved by LC and, afterward, incorporated in their Guidelines.

Recent work by IAEA related to dumping of material for the LC (2)

- In 2003, the IAEA was ñurgedòto complement the assessment procedure adding marine flora and fauna (Before, only humans were considered in the assessment and, in line with the increase of the interest on environmental issues, this addition of flora and fauna was noted as fundamental).
- In 2013 (after ICRP Publications 103 (2007), 108 (2009) and 124 (in printing) and the update of the IAEA Basic Safety Standards (2011)) the IAEA made the final proposal for an assessment procedure to authorize dumping (a new TECDOC), based both on humans and marine flora and fauna considerations.

Basis for the radiological judgment of candidate materials for dumping (1): *de minimis*

- *De minimis* concept comprises two quite different situations:
  - A situation that is outside the regulation because it is unnameable to control by the regulation irrespective of the magnitude of the dose (*de minimis non curat lex*).
  - A situation of no concern to the regulator, because of its triviality, even though it is of relevance to the regulation (*de minimis non curat praetor)*

Details can be found in IAEA TECDOC-1068

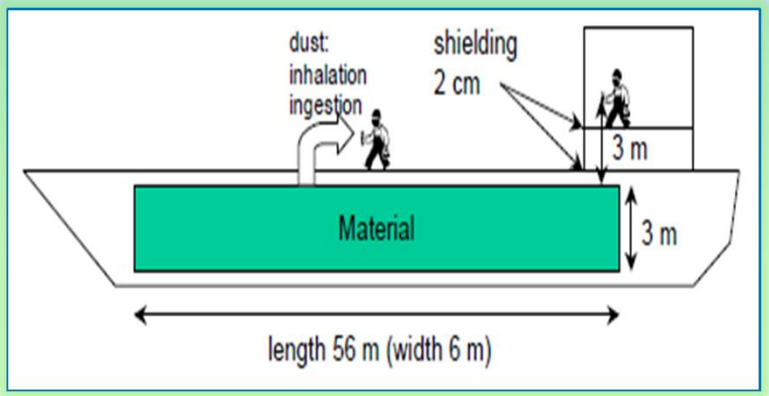
Basis for the radiological judgment of candidate materials for dumping (2): exclusion; exemption

- The *de minimis* concept was related to the radiation protection concepts of "exclusion" and "exemption":
  - Materials are *de minimis* if can be excluded from radiological control (unnameable to control; for example unmodified concentrations of natural radionuclides). In general exclusion applies identically to humans and flora and fauna.
  - If not excluded, a radiological assessment should be done to determine if materials can be exempted (radiological risk is trivial). This implies an assessment of the impact to humans and an assessment of the impact to flora and fauna.

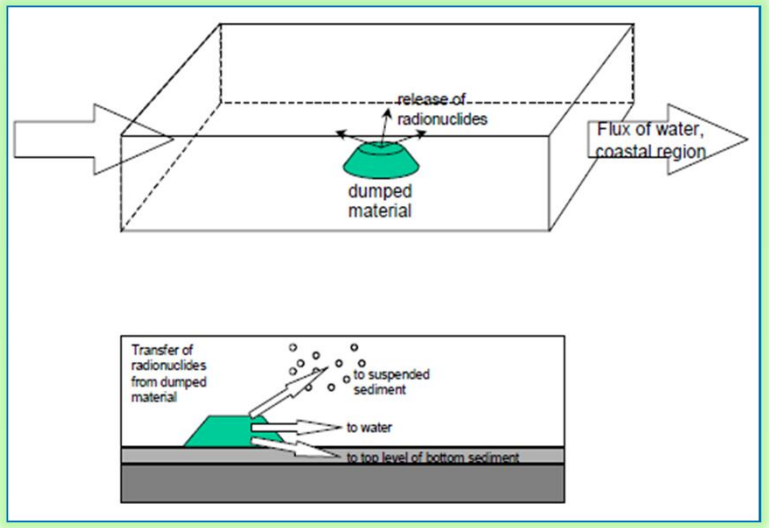
Basis for the radiological judgment of candidate materials for dumping (3): criteria

- If not excluded, materials are *de minimis* only if 3 radiological criteria are verified:
  - the effective dose to humans is of the order of 10 μSv or less in a year;
  - the collective effective dose committed to humans is not more than about 1 man Sv;
  - The absorbed dose rates to flora and fauna are below DCRLs;
- Alternative,
  - an assessment for the optimization of protection shows that exemption is the optimum option.

Generic exposure scenarios defined by IAEA for LC



Crew



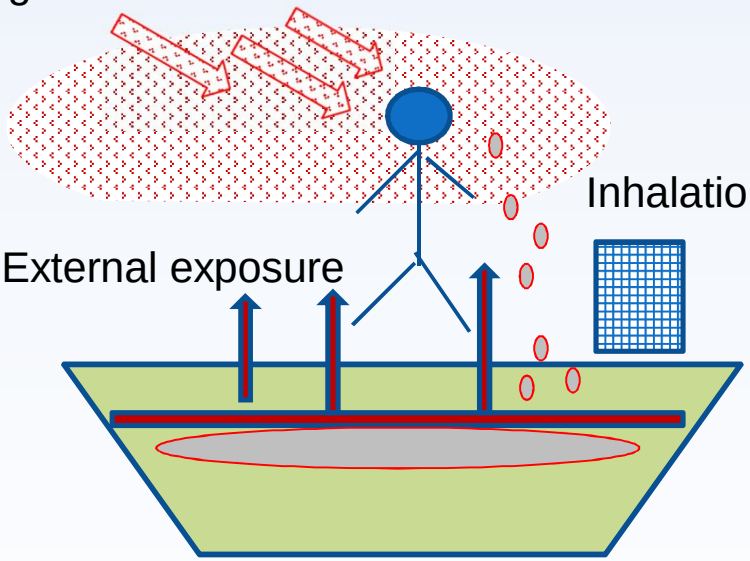
Members of the public and flora and fauna

Details can be found in IAEA TECDOC-1375

Exposure pathways during shipment, loading and disposal operation

Members of the crew

Inadvertent ingestion of candidate material

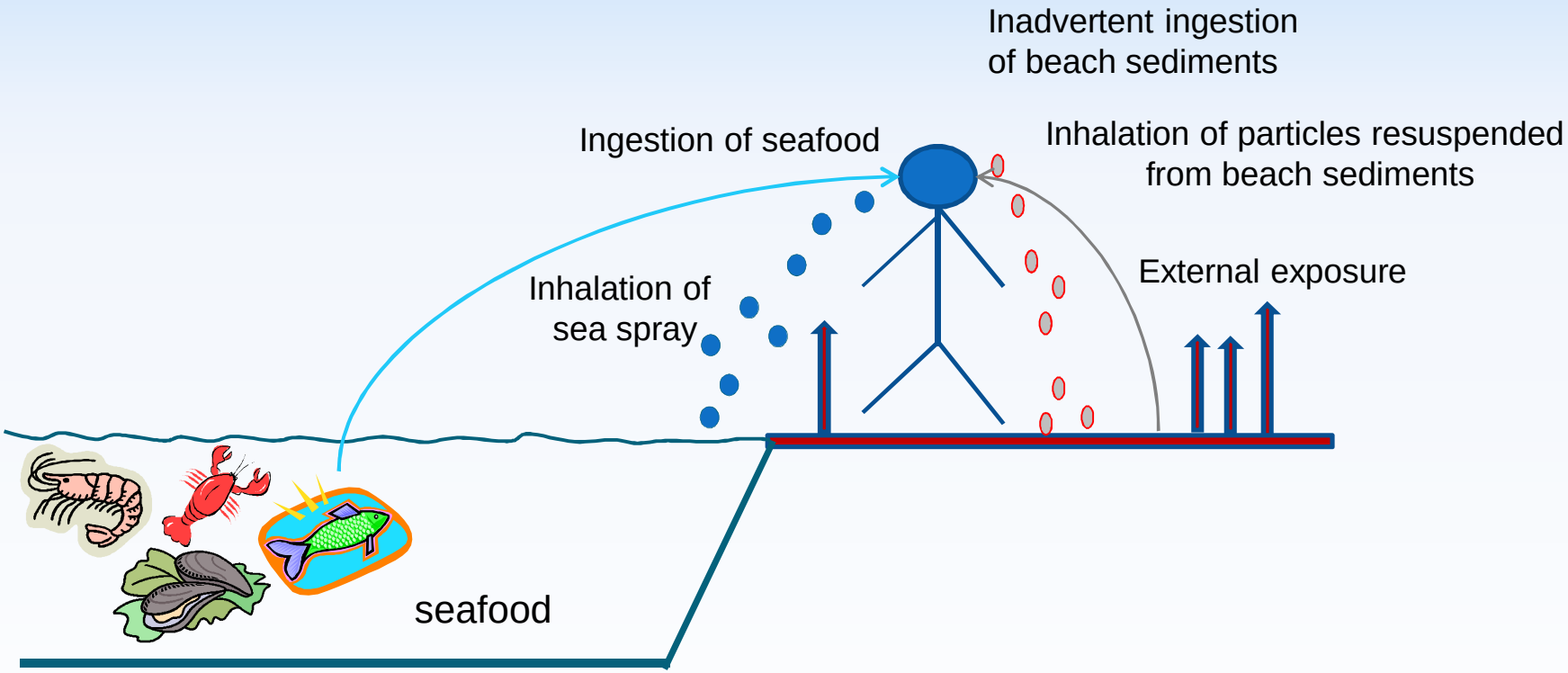


Inhalation of resuspended particles

External exposure

Exposure pathways arising from exposure to the sea

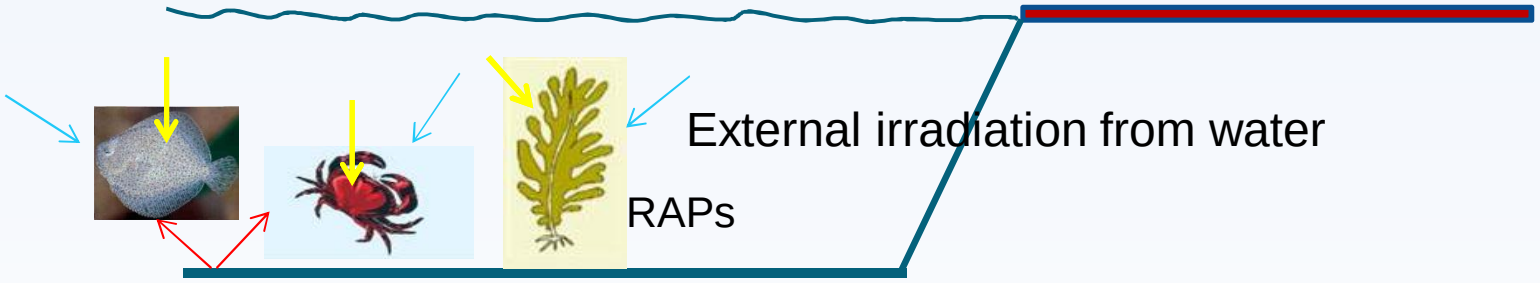
Members of the public



Exposure pathways arising from exposure to the sea

Marine flora and fauna

Internal irradiation from incorporation of radioactivity



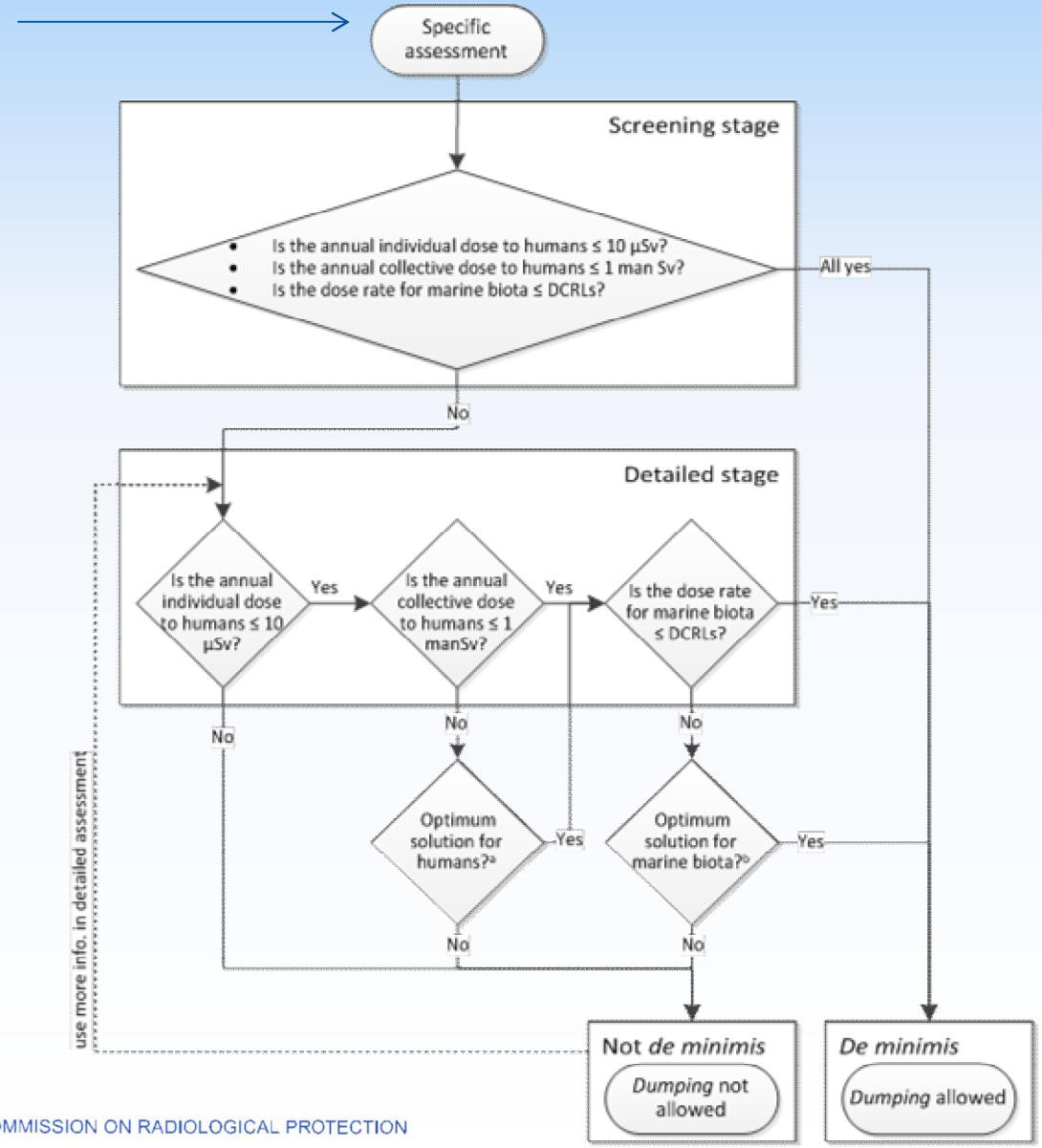
External irradiation from sediments

Collective doses

- Crew collective doses: individual doses multiplied by the number of crew necessary for the dumping activity.
- Public collective doses are assessed using the external and internal pathways and generic factors determining the number of individuals affected (length of the coastline affected by the dumping, annual amount of seafood caught in the area affected by a single dumping, etc.)
- Total collective dose results from the sum of crew and public collective doses.

Specific assessment for determining *de minimis* for LC

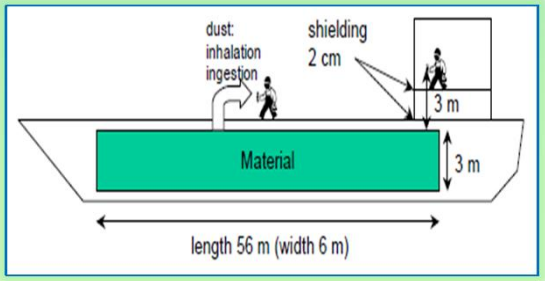
If candidate materials are not excluded from regulatory control



Procedure to assess doses to crew (screening stage)

Standard activity/mass of the candidate material in the ship → Generic crew exposure scenario → Normalized dose [TECDOC] → Actual data [measurements/ estimations] →

1 Bq / kg
1×10^8 kg



Tables of Dose per unit activity to crew (individual and collective)

✖

Activity concentration and annual amount for **candidate** materials

→ Dose Assessment → Radiological criteria

Dose to crew (individual and collective*)

<

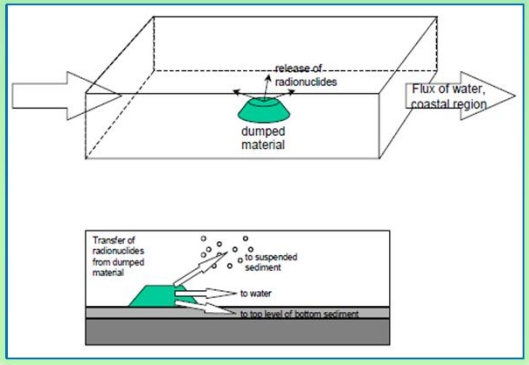
10 µSv/a
1 man Sv/a

*Collective doses to public and crew are summed

Procedure to assess doses to public and flora and fauna (screening stage)

Normalized dumping → Generic dilution scenario → Normalized dose [TECDOC] → Actual data [measurements/ estimations] →

1 Bq / kg
1×10^8 kg



Tables of Dose per unit activity to public (individual and collective)

Table of Dose per unit activity to reference animals and plants (RAPs)

×

Activity concentration and annual amount for **candidate** materials

→ Dose Assessment → Radiological criteria

Dose to public (individual and collective)	<	10 μSv/a 1 man Sv/a
Dose to RAPs	<	ICRP DCRLs

Conclusions from technical meeting with experts representatives of the LC contracting parties (in 2012)

- *The method developed by IAEA is technically sound and robust. The addition of flora and fauna has not altered the complexity of and the efforts needed to apply the approach.*
- *The method proposed by IAEA responds to the request from LC and appears to satisfy their requirements. The meeting suggested a period of testing and review. After that period, subject to the test being satisfactory, the governing bodies of LC will be in a position to formally adopt the proposal.*

Results of 35th Consultative Meeting of Contracting Parties to LC (14-18 October 2013)

- At that meeting the IAEA concluded that:
  - *The proposed assessment procedure is based on the state of the art in radiological protection of the environment, in line with ICRP International recommendations and IAEA International Safety Standards.*
  - *The use of these procedures would be useful to protect the marine environment, use the marine resources in a sustainable manner and without imposing unnecessary burden to the potential users.*
- The Meeting approved the IAEA new proposal and will include it in the LC updated Guidelines, ASAP.

Use of the ICRP System for the Protection of Marine Ecosystems

The IAEA procedure to assess the radiological impact of materials candidate to be dumped at sea, in connection with the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, is the first international application of the ICRP approach to demonstrate protection of flora and fauna.

Determining the suitability of materials for disposal at sea under the London Convention and London Protocol: A Radiological Assessment Procedure

2013 Edition, including an assessment procedure for protection of people and the environment

Final Draft IAEA-TECDOC

Submitted in March 2013 by IAEA for consideration by the Contracting Parties to the LC/LP and approval during the Consultative Meeting in October 2013.

Thanks

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www.icrp.org

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