2016 Rio norm VIII

Eighth International Symposium on Naturally Occurring Radioactive Material – NORM VIII
Rio de Janeiro, Brazil, October 18 -21, 2016

CHALLENGES AND SOLUTIONS

Impacts of regulation on NORM management

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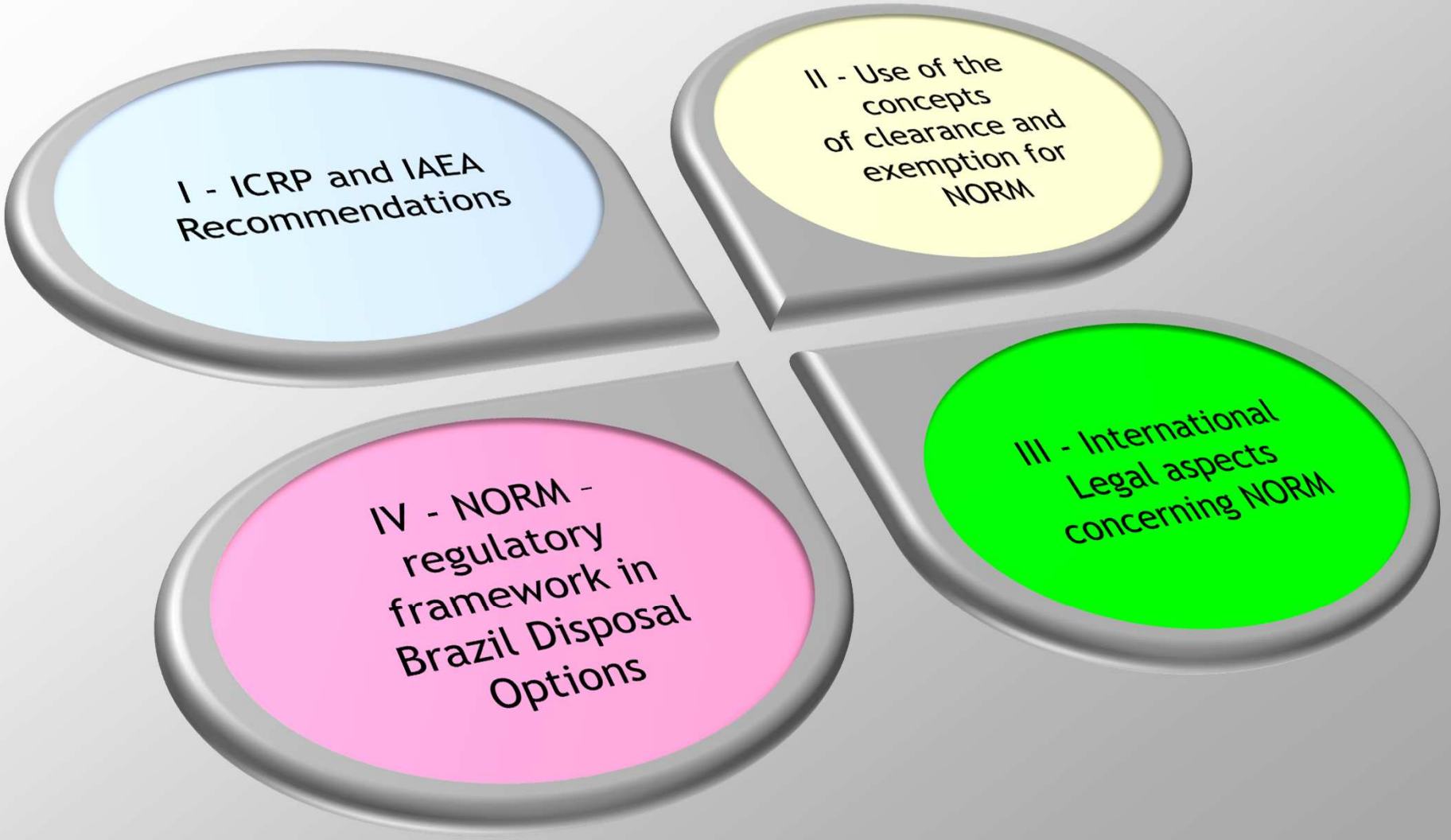
Summary


I - ICRP and IAEA Recommendations
II - Use of the concepts of clearance and exemption for NORM
III - International Legal aspects concerning NORM
IV - NORM – regulatory framework in Brazil Disposal Options

ICRP Recommendations - 2007

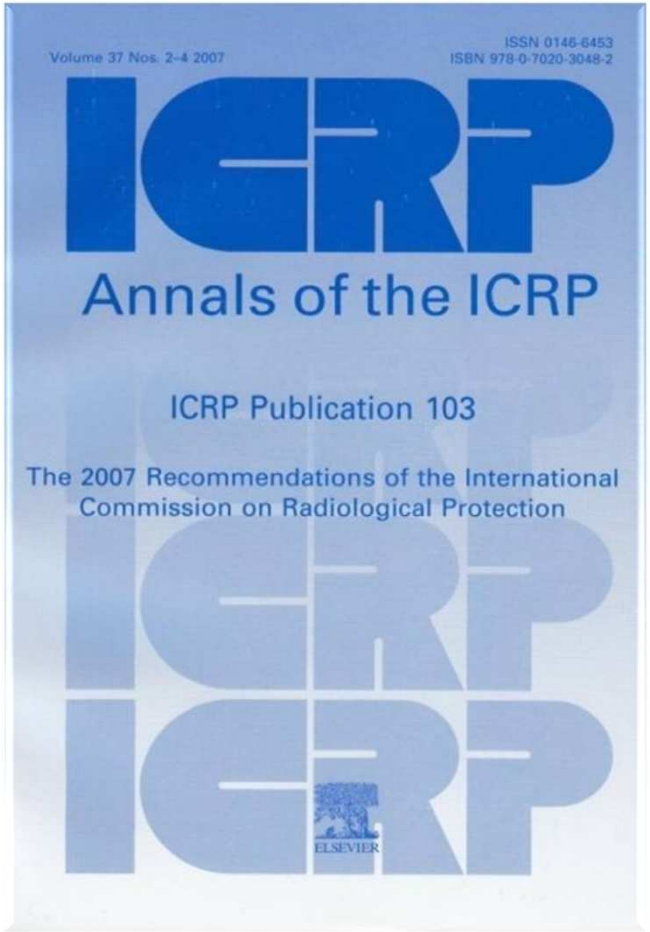


Tabla 6. Limites de dosis recomendados en situaciones de exposición planificadas[a]

Tipo de límite	Ocupacional	Público
Dosis efectiva	20 mSv por año promediada en periodos definidos de 5 años[e]	1 mSv en un año[f]
Dosis equivalente anual en:		
Cristalino[b]	150 mSv	15 mSv
Piel [c,d]	500 mSv	50 mSv
Manos y pies	500 mSv	---

[a] *Los límites de dosis efectivas son para la suma de las dosis efectivas de relevancia procedentes de exposiciones externas en el periodo de tiempo especificado y la dosis efectiva comprometida de la incorporación de radionucleidos en el mismo periodo. Para adultos, la dosis efectiva comprometida se calcula para un periodo de 50 años tras la incorporación, mientras que para niños se calcula para el periodo de hasta 70 años de edad.*

[b] *Este límite está actualmente siendo revisado por un Grupo de Trabajo de la ICRP.*

[c] *La limitación de dosis efectiva proporciona una protección suficiente para la piel frente a efectos estocásticos.*

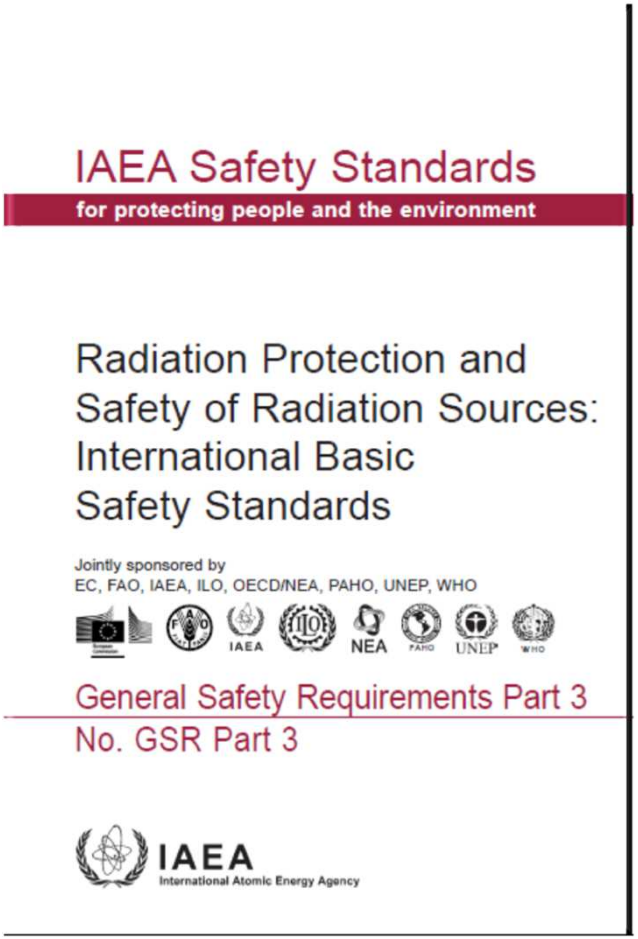
[d] *Promediado en un área de 1 cm² de piel, independientemente del área expuesta.*

[e] *Con la condición adicional de que la dosis efectiva no debe exceder los 50 mSv en ninguno de los años individuales. En el caso de la exposición ocupacional de mujeres embarazadas se aplican restricciones adicionales.*

[f] *En circunstancias especiales, se puede permitir un nivel superior de dosis efectiva en un único año, a condición de que la media durante 5 años no exceda 1 mSv por año.*

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION, The 2007 Recommendations of the International Commission on Radiological Protection, Publication 103, Elsevier, Amsterdam (2007)

IAEA – BSS 2014



5. EXISTING EXPOSURE SITUATIONS

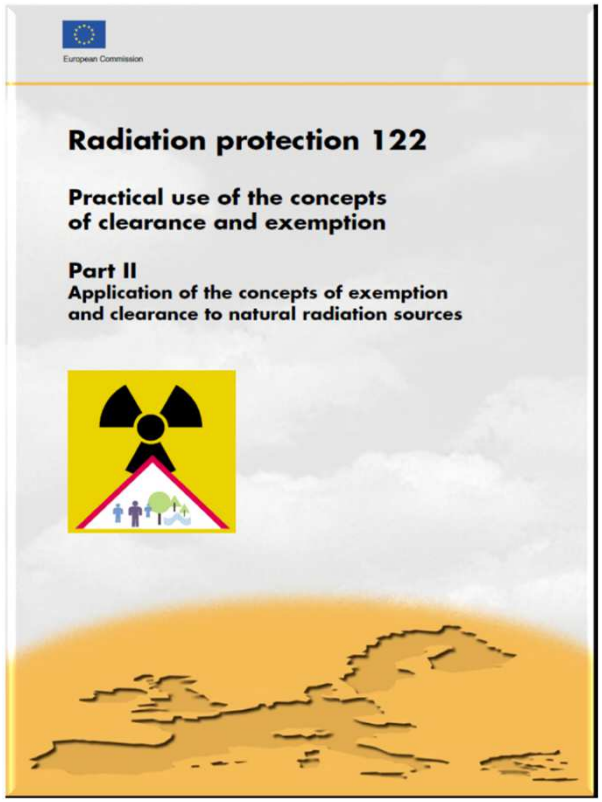
(c) Exposure due to natural sources, including:

(iii) Materials, other than those stated in (c)(ii) above, in which the activity concentration of no radionuclide in either the uranium decay chain or the thorium decay chain exceeds 1 Bq/g and the activity concentration of 40K does not exceed 10 Bq/g;

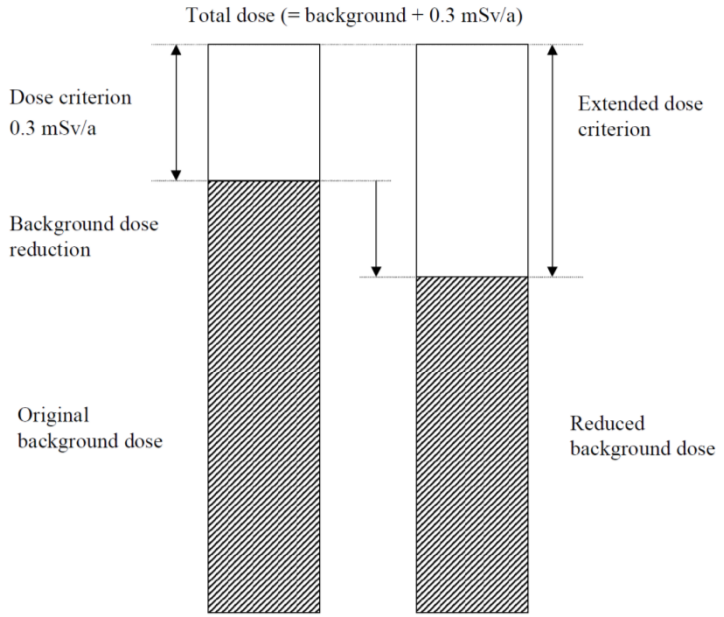
TABLE I.3. LEVELS FOR CLEARANCE OF MATERIAL: ACTIVITY CONCENTRATIONS OF RADIONUCLIDES OF NATURAL ORIGIN

Radionuclide	Activity concentration (Bq/g)
K-40	10
Each radionuclide in the uranium decay chain or the thorium decay chain	1

Use of the concepts of clearance and exemption for NORM



Reference: European Commission, 'Practical Use of the Concepts of Clearance and Exemption – Part II Application of the Concepts of Exemption and Clearance to Natural Radioactive Sources', Radiation Protection 122, European Commission, 2001



Scheme for the application of the concept of background dose reduction

Using the concepts of clearance and exemption could reduce the background dose

Results for oil and gas sludge scenarios

Table 31: Results of the calculation of exemption/clearance levels for sludge type NORM (oil and gas industry) in [kBq/kg]

Scenario	4.2.1	4.2.2	4.2.3a	4.2.3b	4.2.4	4.2.5	4.2.6	4.2.7	4.2.8	4.3.1	4.3.2	4.3.3	4.3.4	Min-Work.	Min-Public	Min-All
U-238sec	55	47	**5.6**	7		60					70			**5.6**	**70**	**5.6**
U nat	5900	5100	**85**	490		860					1900			**85**	**1900**	**85**
Th-230	4.0E6	3.4E6	**150**	58000		1500					2000			**150**	**2000**	**150**
Ra-226+	55	48	**7**	7.1		77					130			**7**	**130**	**7**
Pb-210+	6.9E13	6E13	**200**	32000		2000					390			**200**	**390**	**200**
Po-210	1.2E7	1.0E7	**110**	1.5E6		1100					290			**110**	**290**	**110**
U-235sec	390	330	**9.2**	27		90					140			**9.2**	**140**	**9.2**
U-235+	2400	2000	**69**	100		660					1600			**69**	**1600**	**69**
Pa-231	7100	6200	**54**	530		540					590			**54**	**590**	**54**
Ac-227+	490	430	**13**	39		130					220			**13**	**220**	**13**
Th-232sec	36	31	**4.9**	4.7		44					53			**3.9**	**53**	**3.9**
Th-232	2.3E7	2.0E7	**100**	150000		1000					290			**100**	**290**	**100**
Ra-228+	110	91	**12**	13		140					100			**12**	**100**	**12**
Th-228+	54	47	**6.1**	7.2		69					130			**6.1**	**130**	**6.1**
K-40	550	480	**78**	**78**		860					1700			**78**	**1700**	**78**

Risk Scenarios analyzed for oil and gas sludge

4.2.1 Transport – Long distances

4.2.2 Transport – Short distances

4.2.3 Storage – Moderate quantities, indoors

4.2.4 Storage – Large quantities, outdoors

4.2.5 Disposal on a heap / landfill

4.2.6 Road construction

4.2.7 Building construction with NORM containing building materials

4.2.8 Building construction using undiluted NORM as unshielded surface cover

NORM IN THE OIL AND GAS INDUSTRY

A substance or material with a NOR-activity concentration exceeding 1 Bq/g, where the NOR should be a member of the 232Th- or 238U-decay series, may be defined as NORM.

It is advised always to check the NORM regulations with the competent authority, but in absence of such NORM regulations, the BSS activity concentrations for out of scope and exemption for moderate amounts may be applied as a best practice

NOR in secular/transient equilibrium with (relevant NOR denoted as NOR_{eq})		Bq/g
$^{232}Th_{nat}$	full natural decay series	
$^{228}Ra_{eq}$	^{228}Ac	10
$^{228}Th_{eq}$	^{224}Ra, ^{220}Rn, ^{216}Po, ^{212}Pb, ^{212}Bi, $^{212}Po/^{208}Tl$	1
$^{238}U_{nat}$	full natural decay series	
$^{238}U_{eq}$	^{234}Th, ^{234m}Pa, ^{234}U, ^{230}Th	10
$^{226}Ra_{eq}$	^{222}Rn, ^{218}Po, ^{214}Pb, ^{214}Bi, ^{214}Po	10
$^{210}Pb_{eq}$	^{210}Bi, ^{210}Po	10

Table 6: Exempt activity concentrations for moderate amounts of material without further consideration

"Managing Naturally Occurring Radioactive Material (NORM) in the Oil and Gas Industry" (PDF). IOGP - International Association of Oil and Gas Producers. 1 March 2016. Retrieved 3 October 2016

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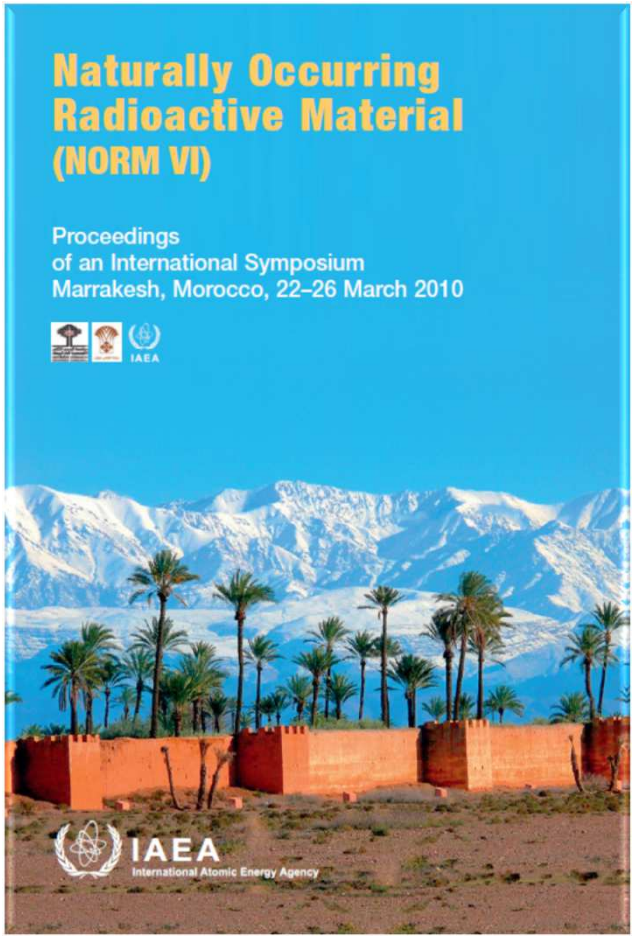
International Legal aspects concerning NORM



LEGAL ASPECTS OF TENORM REGULATION IN THE USA
C.T. SIMMONS

DEVELOPMENT OF NORM MANAGEMENT IN AUSTRALIA
R.S. O'Brien, A.J. Melbourne, A. Johnston

CANADIAN GUIDELINES FOR THE MANAGEMENT OF NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM) Revised 2011

Radiation Dose Limits
1 mSv/y – for Public Individuals

Exemption levels
USA – 0,185 -1,85 Bq/g (5 – 50 pCi/g)
CANADA - 0.296 Bq/g (8 pCi/g)
UK - 0.37 Bq/g (10 pCi/g)

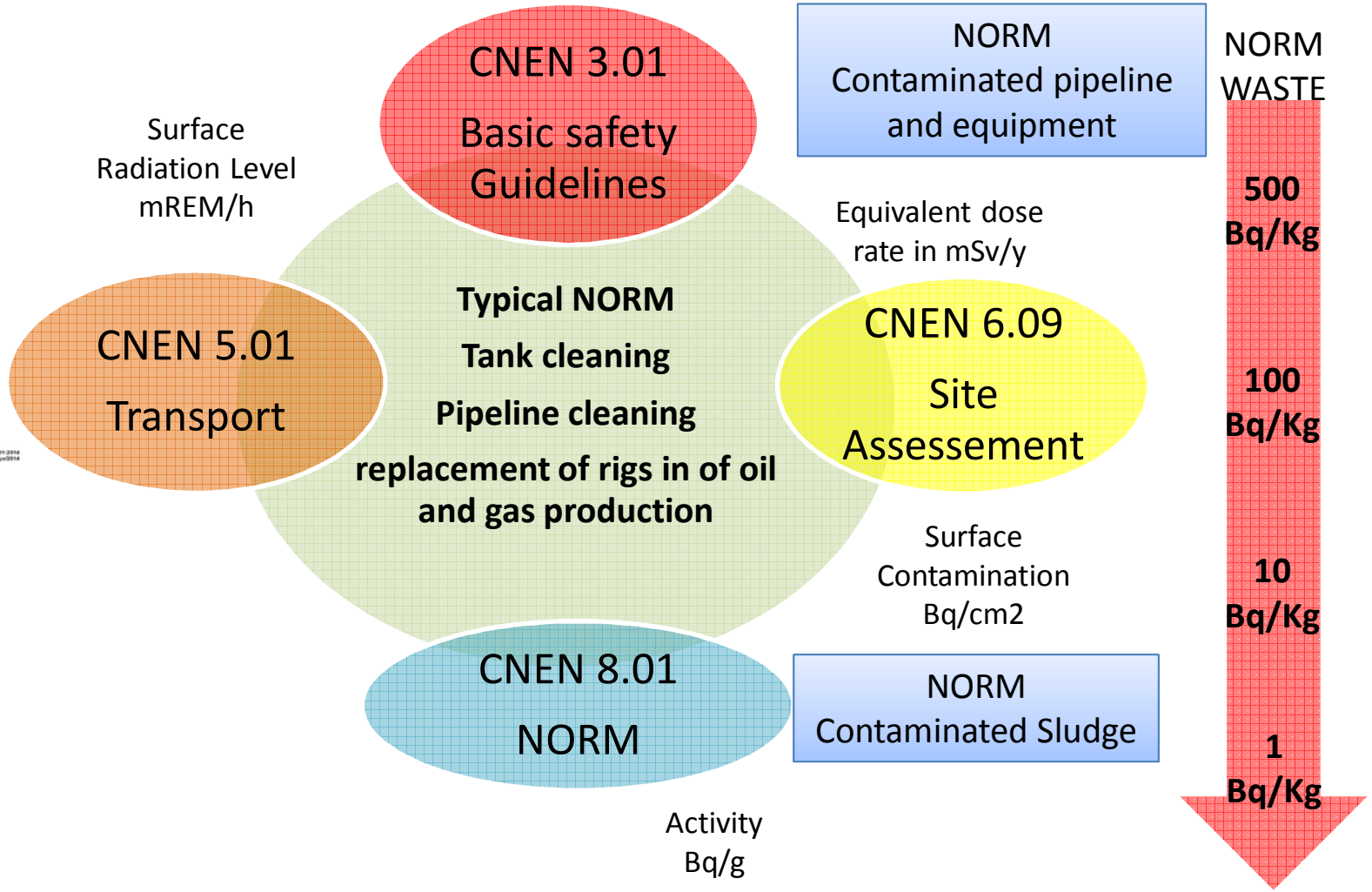
Regulations establish
Exemption levels,
Management requirements, and
Disposal requirements

Recommended Radiation Dose Limits
Incremental Dose
Effective Dose
Dose Constraint

Exemption standards or action levels
Licensing for possessing, handling, or disposing of NORM
Release criteria
Worker protection
NORM waste disposal

Naturally Occurring Radioactive Material (NORM Vi) Marrakesh, Morocco, 22–26 March 2010 International Atomic Energy Agency Vienna, 2011
www-pub.iaea.org/MTCD/Publications/PDF/Pub1497_web.pdf

NORM – regulatory framework in Brazil



CNEN - Diretrizes Básicas de Proteção Radiológica. Rio de Janeiro, Brasil: CNEN, (2005)

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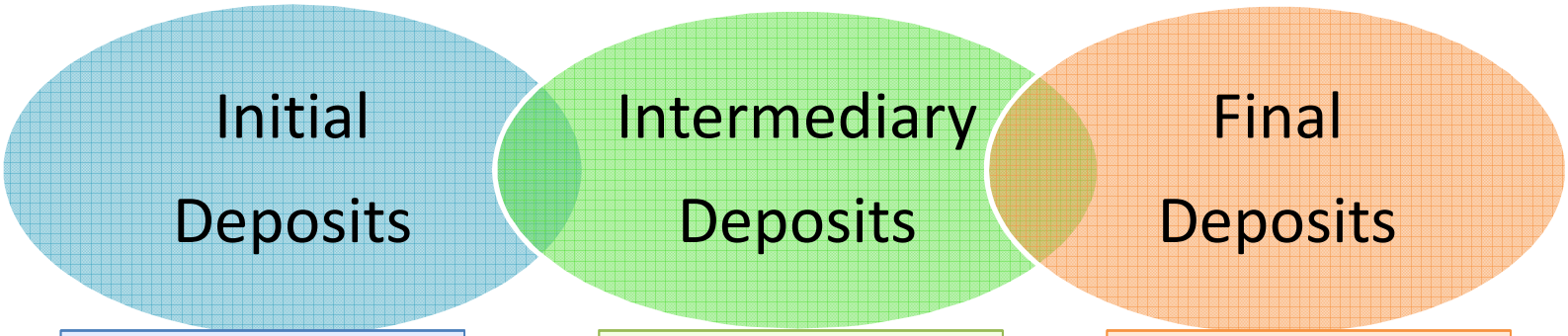
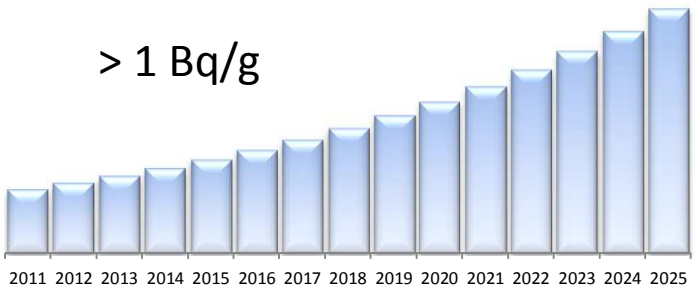
NORM waste principles and responsibility





No disposal options will increase the demand for more initial deposits

NORM DISPOSAL OPTIONS

"Managing Naturally Occurring Radioactive Material (NORM) in the Oil and Gas Industry" (PDF). IOGP - International Association of Oil and Gas Producers. 1 March 2016. Retrieved 3 October 2016

Disposal Method	Description
Land spreading	Land spreading involves disposal by spreading sludge and scale on the surface/open lands in an area where NORM was not originally present above background levels.
Land spreading with dilution (land farming)	Land Spreading with dilution involves mixing of the applied NORM thoroughly within the top 8 inch (20.3 cm) layer of soil using agricultural equipment in an area where NORM was not originally present above background levels.
Non-retrieved line (surface) pipe	Buried line pipe used at a facility could be abandoned in place after being flushed to remove any oil or gas present.
Burial with unrestricted site use	Burial with unrestricted site use involves burial of NORM with at least 15 feet (4.6m) of cover that is level with the surrounding terrain, minimising erosion potential.
Commercial oil industry waste facility	Disposal in a commercial oil industry waste facility assumes burial with other oilfield wastes where NORM represents less than 7% of the total waste volume.
Commercial NORM waste facility	A NORM waste disposal site is designed to contain NORM for long periods and its control may revert to a national authority for permanent monitoring and restricted future use after closure.
Commercial low level radioactive waste facility	A low-level radioactive waste disposal is defined and licensed under national regulations with numerous protective features and restrictions.
Plugged and abandoned well	Well abandonment operations provide an opportunity to dispose of NORM.
Well injection and hydraulic fracturing	Sludge and scale wastes could be injected or fractured into formations that are isolated geologically and mechanically.
Equipment release to smelter	Smelting may be a viable option for NORM contaminated tubulars and other equipment.

FINAL DISPOSAL OF NORM - DISPOSAL OPTIONS

Table 5-3. Summary of disposal option ranking

Option	Acceptability
Sea disposal offshore discharge	Good
Re-injection	Good
In situ downhole abandonment	Good
Sea disposal nearshore discharge	Fair
Encapsulation and downhole disposal	Fair
Onshore built disposal facility	Fair
Onshore landfill	Fair
Smelting	Fair
Disposal in salt caverns	Fair
Export	Fair
Landspreading	Unacceptable
Incineration	Unacceptable
Disused mine disposal	Unacceptable
Sewer	Unacceptable

 # 1 Choice

 # 2 Choice

 # 3 Choice

Sniffer – 2005 Technical Summary Report Project UKRSR07 Identification and assessment of alternative disposal options for radioactive oilfield wastes

Thank You

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