



**IAEA**

International Atomic Energy Agency  
*Atoms for Peace and Development*

# IAEA RTA KEY Element 7: Environmental Impact

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*Nuclear Power Technology Development Section*

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**IAEA Regional Workshop on Technology Assessment of SMRs**

**VIC, 10 – 14 JUN 2019**

# OUTLINE

- Environmental Impact
- RTA Key Element 7: Environmental Impact
- **RTA TABLE FOR KEY ELEMENT 7**
  - **How to complete?**
  - **Examples**

Day 3: Wednesday, 12 June 2019		
15:00	<b>IAEA RTA Key Element 7: Environmental Impact</b> [IAEA NP-T-1.10, Pg. 44]	Ms Tatjana Jevremovic IAEA
	<b>Case Study</b>	<b>Teams</b>

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# Environmental Impact of NPP

- NPP as a source term: radiation dispersion during normal and accident conditions (air, water, soil) and radiation dose to humans
- NPP as new addition to the environment: people and society, economy, archeology
- NPP as a thermal source: heat discharge, use of water

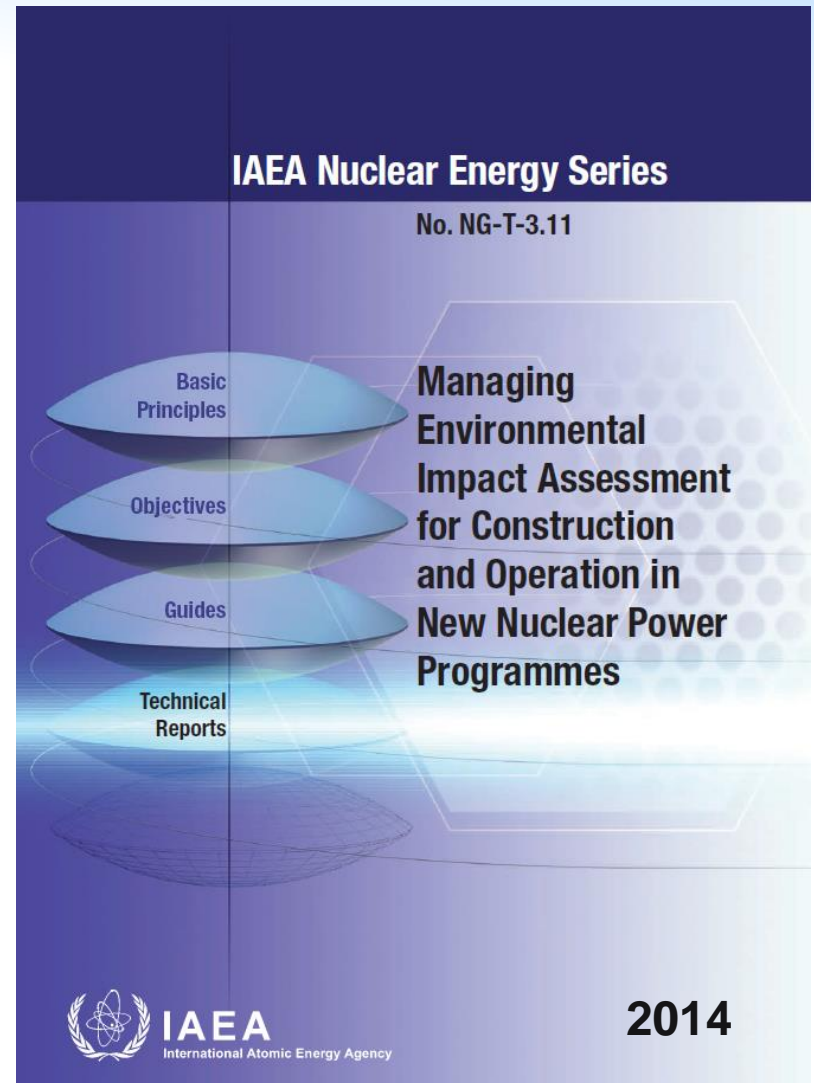


TABLE 2. SOME IMPACT MODEL APPROACHES USED IN NUCLEAR ENVIRONMENTAL IMPACT ASSESSMENT REPORTS

Impact	Model approach	Disciplines involved	Input	Output	Model specifics
Radiation dispersion	Dispersion and dose modelling <sup>a</sup>	Defining source terms Dispersion modelling Radioactive decay products Radioecology Dose calculations	Source term Pathways <sup>b</sup> Impact receivers	Radioactive releases and nuclide types Dispersion Concentrations and doses caused	Due to its importance, approval of the model should be granted by the competent authority and may require more time
Thermal impacts (once-through cooling systems)	Mathematical dispersion modelling	Dispersion modelling	Discharge temperature and quantity, location and technology	Assessment of impacts on water temperatures and thermal stratification	Model calibration may require time consuming measurements
Aquatic biota (impingement, entrainment, changes in the ecosystem)	Demographic approaches	Hydrobiology Oceanography Fisheries, hydrodynamic and water quality modelling	Aquatic field studies Species population data Ecosystem structure	Impacts on aquatic species Biodiversity changes	Aquatic field studies through the seasonal variations may be very laborious
Terrestrial, marine and freshwater biota (radiological risk)	Integrated exposure/dose/effect assessment with risk characterization	Radioecology	Environmental concentrations Dose conversion coefficient Concentration ratios Distribution coefficients	Dose rates Risk quotients	Tiered approach Selected animals and plants
Regional economy (employment, revenues, economy of the region)	Economic modelling	Economic modelling, analysis and projections	Regional economy data Development plans Project financial parameters	Prediction of the economic impacts on the region	Financial risks may influence the model output
People and society (migration, quality of life, culture, environmental justice)	Expert opinion Social trend projections Computer modelling	Socioeconomic impact assessment Communications Resident surveys Media analysis	Socioeconomic characteristics of the population Personal perceptions, opinions and fears	Social impacts from migration and revenue change Environmental justice and cultural heritage considerations Increased communication	Needs to be carefully coordinated with stakeholder Involvement processes

<sup>a</sup> For more information on the types of model, see Refs [13, 14].

<sup>b</sup> Data from baseline meteorology, oceanography, hydrology and groundwater surveys in the investigated area.

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# KEY ELEMENT 7: Environmental impact

**The adverse effects of the nuclear power plant on its surrounding environment during the plant lifetime.**

*Importance factor range:* **Low**

Individual components within the environmental impact evaluations **may show important variance among designs**; however, in the **general environmental assessment, the differentiation is expected to be in the low to moderate range.**

*Evaluation expectations and relative comparisons:* Compare and contrast the features provided for each of the key topics.

## ***Key topics:***

— Water usage, impact on aquatic life, birds, plants and animals;

**Related to Key Element 1**

— Visual impact expectations versus projections;

— Impacts on wetland and natural terrain;

— Radiological releases to the environment (normal operation and accident); →

**Related to Key Element 1**

— Effect on local industry and economy;

— Archaeological impact assessment (owner/operator responsibility).

# KEY ELEMENT 7: Environmental impact

## ***Key topics:***

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Related to Key Element 1

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— Archaeological impact assessment (owner/operator responsibility).

(a) What are the off-site release limits during normal operation?

(b) What are the effects on the site and its environs during construction?

(c) What are the environmental effects during operation, including radiological and thermal discharge?

- NPP as a source term: radiation dispersion during normal and accident conditions (air, water, soil) and radiation dose to humans
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The **environmental impact of nuclear power** results from the **nuclear fuel cycle**, plant normal operation, and the effects of **nuclear accidents**.

The greenhouse gas emissions from **nuclear fission power** are much smaller than those associated with coal, oil and gas, and the routine health risks are much smaller than those associated with coal.

## Key topics:

— Water usage, impact on aquatic life, birds, plants and animals;

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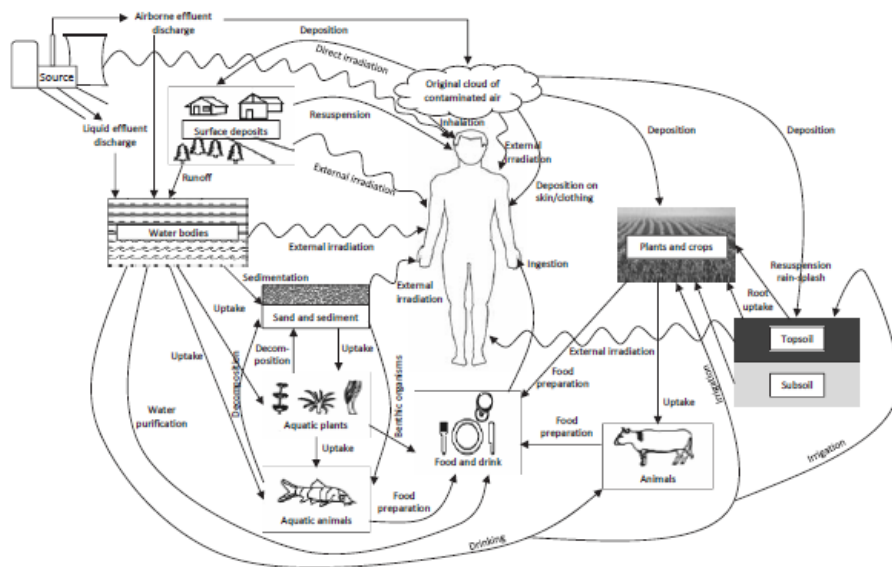
— Visual impact expectations versus projections;

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*Potential exposure pathways of radionuclide release to the public and environment*

- NPP as a source term: radiation dispersion during normal and accident conditions (air, water, soil) and radiation dose to humans
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- Planned releases of radionuclides below prescribed limits from NPPs do occur during normal operation
- NPPs are designed to prevent accidental releases, but radiation consequences are estimated

**Retasland site specifics & how SMR designs differ**

# Radiological Releases to the Environment (Normal Operation and Accidents)



## Common facts:

Radiation dose to individual inhabitants in the NPP vicinity caused by its normal operation may not exceed 0.1 mS/Y.

- This limit value is the basis for determining the limits for emissions of radioactive substances during normal operation.
- Emission limits are established for iodine and inert gas emissions. The emission limits are separately specified for each nuclear power plant. In addition to iodine and inert gas emissions, the NPP releases tritium, carbon-14, and aerosols into the air.



EXAMPLE

Frequency of significant release:

AP1000: 1.95E-08/yr well below the 1E-06/yr utility requirement

APR1400: 1E-06/yr

VVER1200(V-491): 1E-07/yr

EPR: 10E-07/yr [? 1E-07 or 1E-06]

HPR1000: 6.09E-08

NUREG-1765

The EPR™ is designed for low releases during normal operation. The radiological targets in terms of releases are:

- Liquid w/o tritium : 0.1 T Bq/y
- Gases : 800 T Bq/y

For Design Basis Accidents the radiological targets in terms of doses are:

- Effective dose < 10 mSv
- Organ dose < 100 mSv

**Key topics:**

— **Water usage, impact on aquatic life, birds, plants and animals;**

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— **Radiological releases to the environment (normal operation and accidents); → Related to Key Element 1**

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**The effect on the environment in terms of flora and fauna**

Setting up of a nuclear plant requires a large area, preferably situated near a natural water body

*For example:* accompanied with clearing of forests which disturbs the natural habitat of several creatures and gradually upsets the ecological balance of the region

Studies have shown that due to the heat rejected into the water bodies, there have been significant drops in the populations of several species of fish in certain regions of US.

Heat rejection: water body or cooling towers

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**Retasland site specifics & how SMR designs differ**



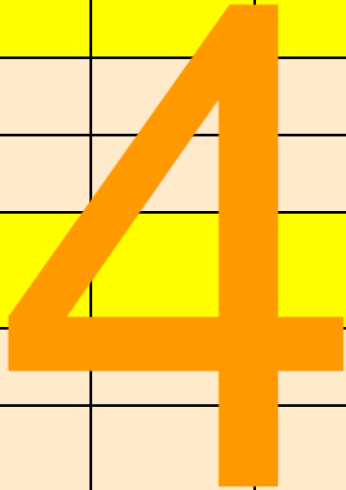
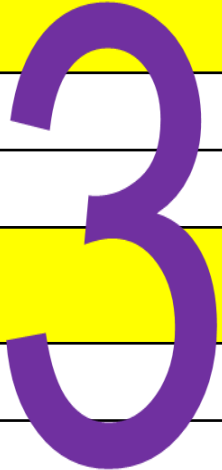
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# RTA Key Element 7: Table

Key element: 7. Environmental Impact (Importance per Key Topic) 

%

6 Key topics	%	Rationale for percentage	HTR-PM	NuScale	SMART	Rationale for score	
Water usage, impact on aquatic life, birds, plants and animals							
Visual impact expectations versus projections							
Impacts on wetland and natural terrain							
Radiological releases to the environment (normal operation and accident)							
Effect on local industry and economy							
Archaeological impact assessment (owner/operator responsibility)							

%

**Rationale for percentage**

**Rationale for score**

Represents the importance of the key topic

Requires explanation for quantified importance

Requires explanation of the scoring range:

- 5 High achievement of criteria
- 3 Medium achievement of criteria
- 1 Low or no achievement of criteria, or no information available

# RTA Key Element 7: Table

Key element: 7. Environmental Impact (Importance per Key Topic)						%
Key topics	%	Rationale for percentage	HTR-PM	NuScale	SMART	Rationale for score
Water usage, impact on aquatic life, birds, plants and animals		<ul style="list-style-type: none"> <li>Water is available (river)</li> <li>Importance of aquatic life</li> <li>No significant birds, plants or animals within the site area</li> </ul>				
Radiological releases to the environment (normal operation and accident)		<ul style="list-style-type: none"> <li>Environmental conditions for estimating the radiological release pathways (air, water, land) for dose estimates: strong wind and sand storms; river</li> <li>100000 population area 10 km from the site</li> </ul>				

1

# RTA Key Element 7: Table

Key element: 7. Environmental Impact (Importance per Key Topic)						%
Key topics	%	Rationale for percentage	HTR-PM	NuScale	SMART	Rationale for score
Water usage, impact on aquatic life, birds, plants and animals	20	<ul style="list-style-type: none"> <li>Water is available (river)</li> <li>Importance of aquatic life</li> <li>No significant birds, plants or animals within the site area</li> </ul>				
Radiological releases to the environment (normal operation and accident)	25	<ul style="list-style-type: none"> <li>Environmental conditions for estimating the radiological release pathways (air, water, land) for dose estimates: strong wind and sand storms; river</li> <li>100000 population area 10 km from the site</li> </ul>				

2

1



# RTA Key Element 7: Table

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2

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*Thank you!*

