IAEA

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Safeguards and Protection – an important Key Element from IAEA Reactor Technology Assessment Methodology

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Content

What is

Reactor Technology Assessment (RTA) for Near Term Deployment?

Decision making with:

 Purpose

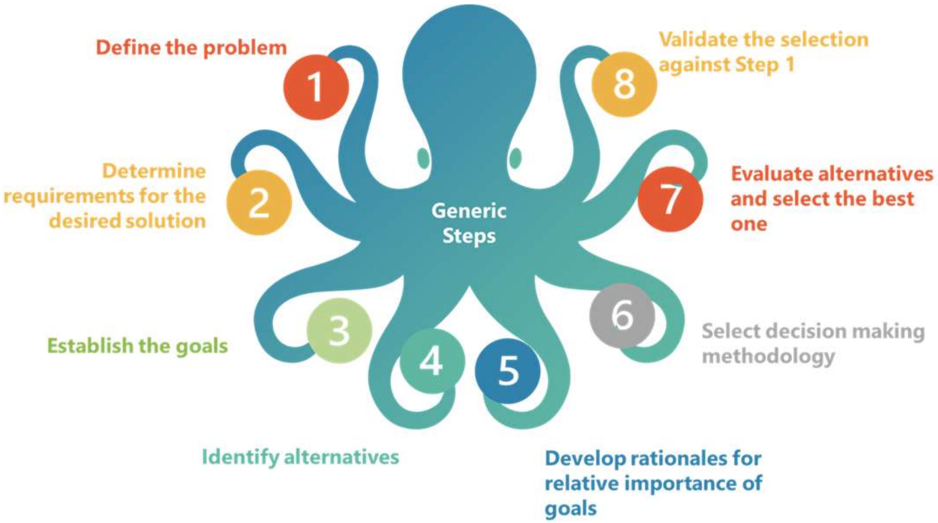
- **Determines NPP technology to fulfil national energy delivery needs using a systematic assessment process beginning with national policy objectives**
- Assists in refining infrastructure development
- Develops specific questions to obtain the information from vendors that is required to perform the RTA
- Develops technical requirements for the bid specification
- Delivers documented decision-making rationale for the technology choice

What is

Reactor Technology Assessment (RTA) for Near Term Deployment?

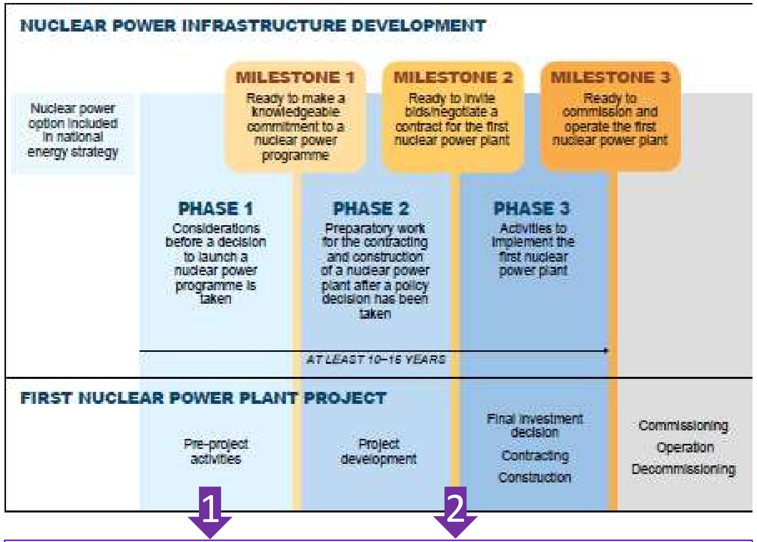
 Content

- Structured technical evaluation documenting the policy objectives and requirements and how well they will be met



- ❑ Multi Criteria Decision Making (MCDM)
- ❑ IAEA NE Series No. NR-T-1.10
- ❑ Ner Term Deployment of Reactor Technology
- ❑ Two –level Hierarchy: Predefined Key Elements and Key Topics
- ❑ Table structure
- ❑ Web-based

RTA - FRAMEWORK



IAEA RTA is a decision-making process for the evaluation of (nuclear) power plant technologies for selection and near term deployment

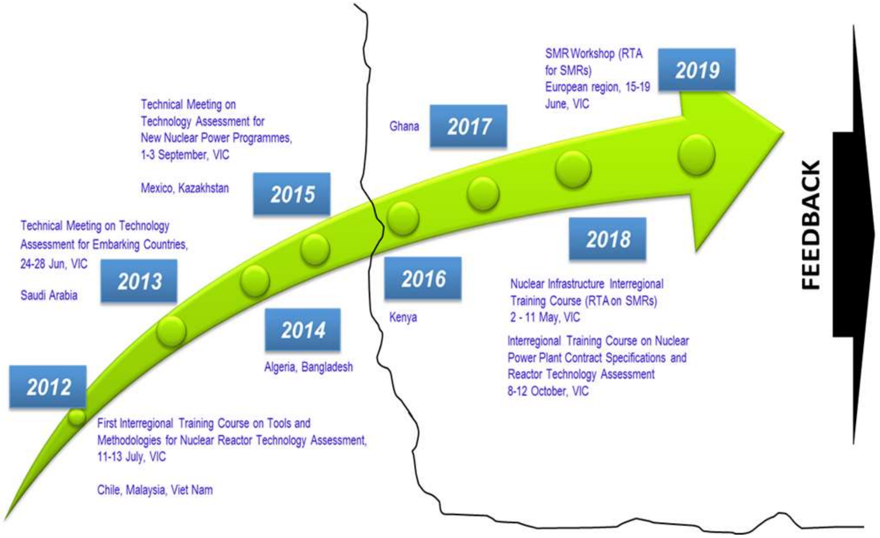
IAEA Milestones Framework

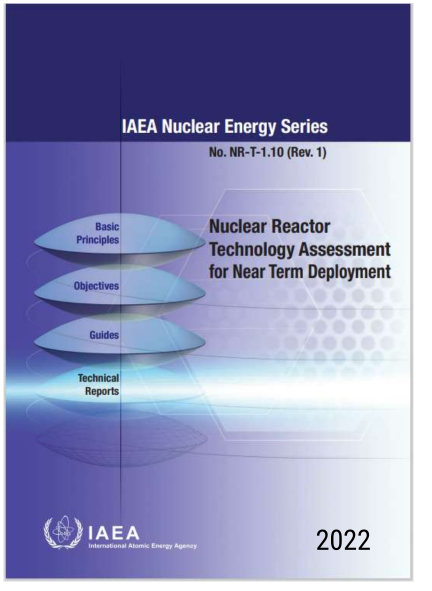
The introduction of nuclear power requires long term commitments, both nationally and internationally. A time frame in the order of 100 years should be considered for a nuclear power plant, with waste disposal obligations extending significantly longer. The initial implementation period will be at least 10–15 years. It is of the utmost importance to fully understand these long term programmatic commitments before even considering a specific nuclear power plant project.

Milestone 1 — Ready to make a knowledgeable commitment to a nuclear power programme

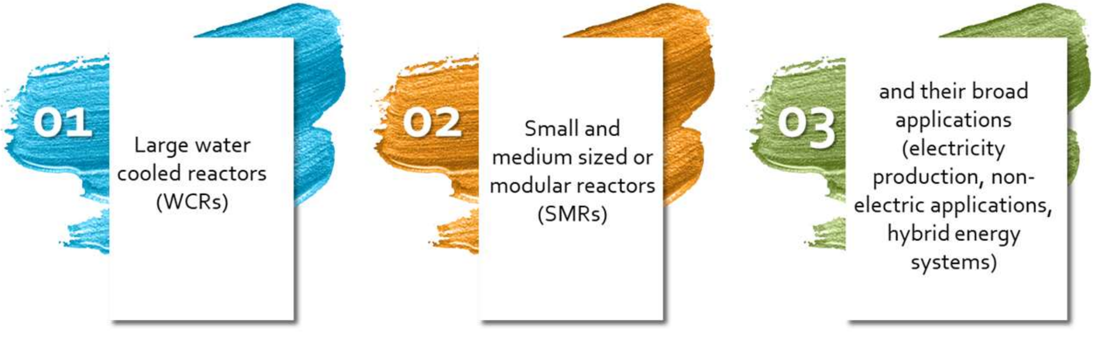
RTA - NEW PUBLICATION

Nuclear reactor technology assessment for near term deployment (iaea.org)

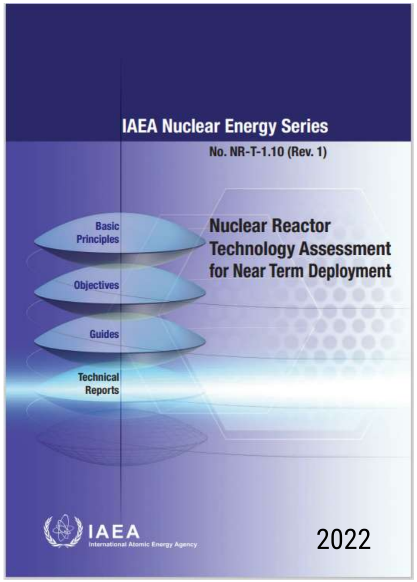


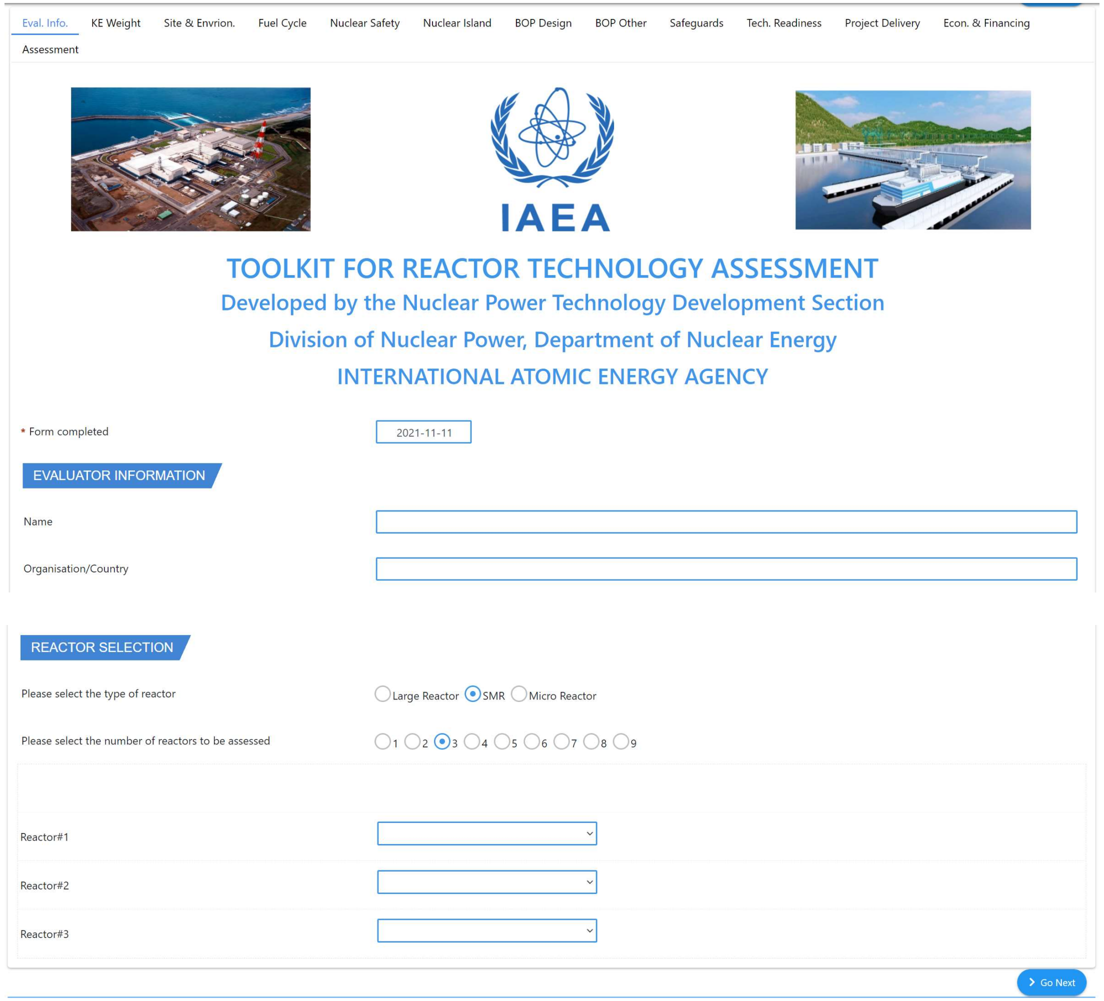


RTA supports the process of identifying, assessing and selecting available technology options. It can be applied to:



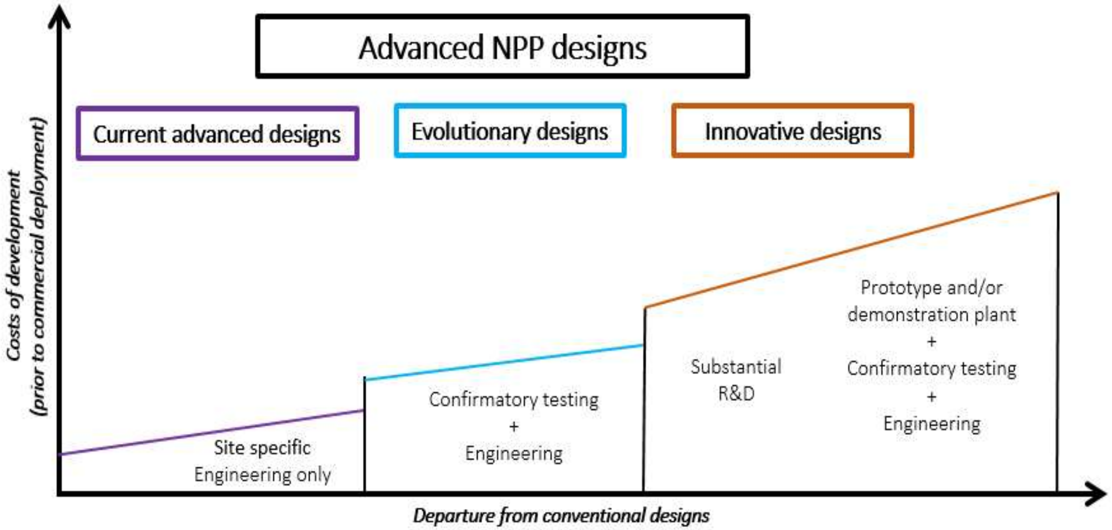
RTA IT-Toolkit

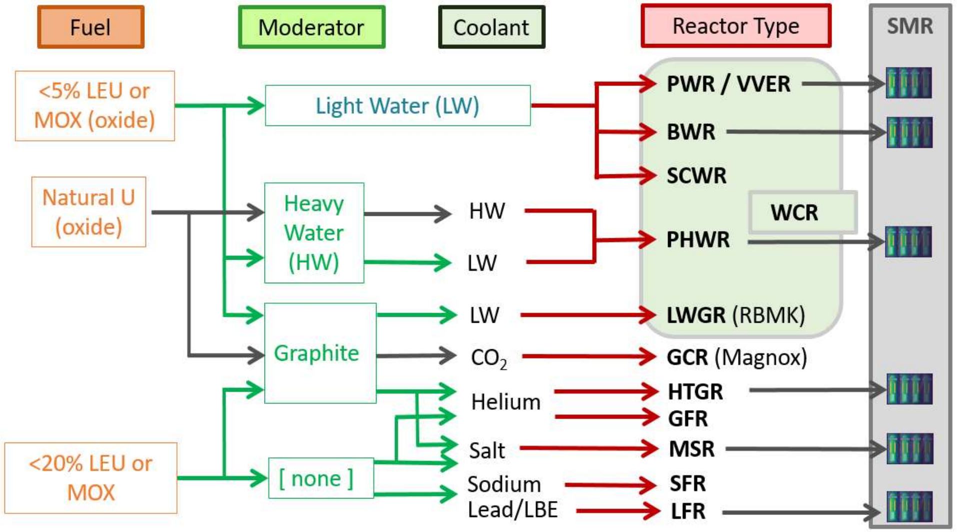




[IRIS (iaea.org)]

Which designs can be objectively compared in RTA?



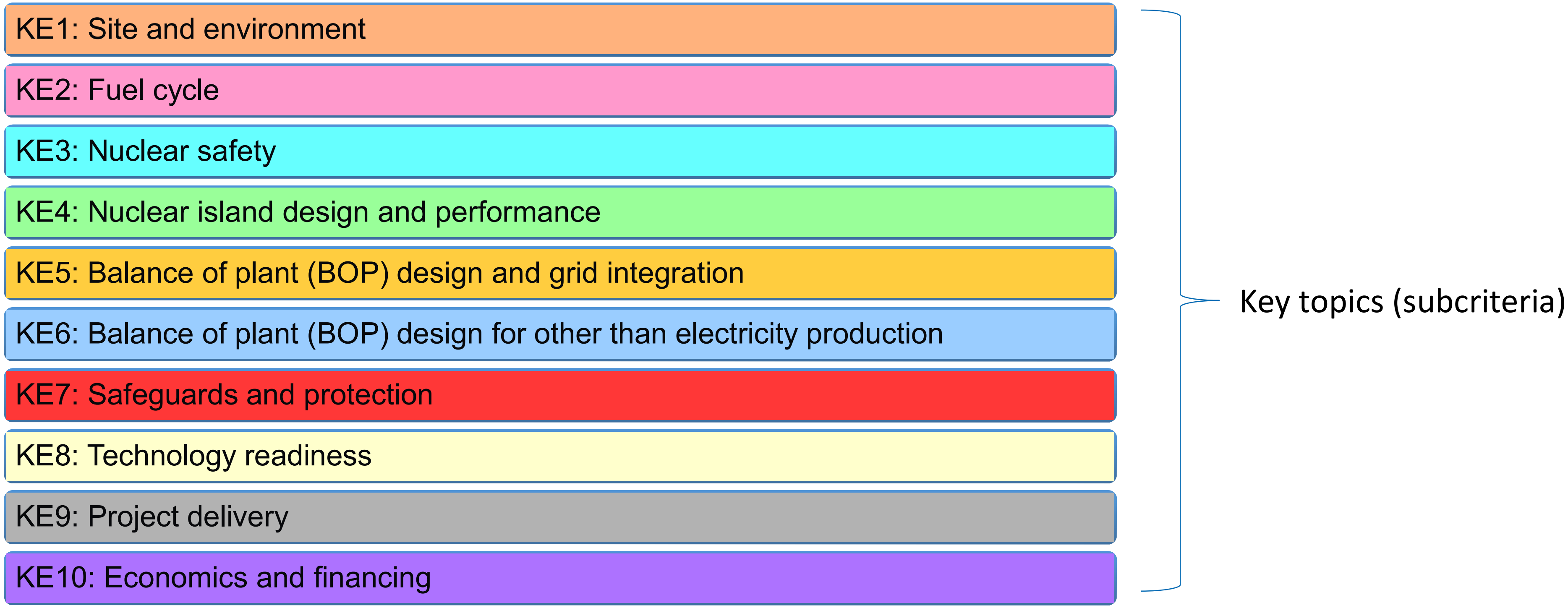


…any of these, but NOT all at once!

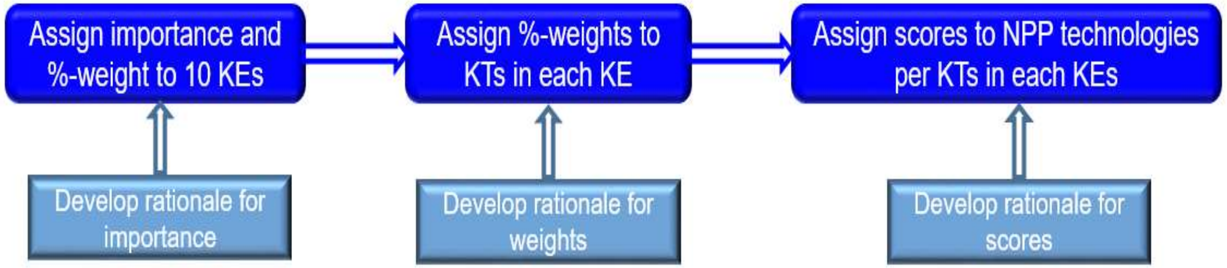
RTA - CRITERIA

IAEA REFINED RTA CRITERIA (KEY ELEMENTS)

- KE1: Site and environment
- KE2: Fuel cycle
- KE3: Nuclear safety
- KE4: Nuclear island design and performance
- KE5: Balance of plant (BOP) design and grid integration
- KE6: Balance of plant (BOP) design for other than electricity production
- KE7: Safeguards and protection
- KE8: Technology readiness
- KE9: Project delivery
- KE10: Economics and financing



RTA: Methodology & Scoring



Where to find information?

IAEA | ARIS Advanced Reactors Information System

Contacting vendors, designers

- Significant design information on advanced WCRs, as well as SMRs and non-water cooled reactors, is available in the IAEA ARIS database.
- Reliable public sources that can provide further details, or even more up-to-date information, can be found in third party studies, on vendor web sites, through direct inquiries to the vendor, and most importantly, any licensing submissions or environmental impact assessments that have been published by the regulatory authority of any country.

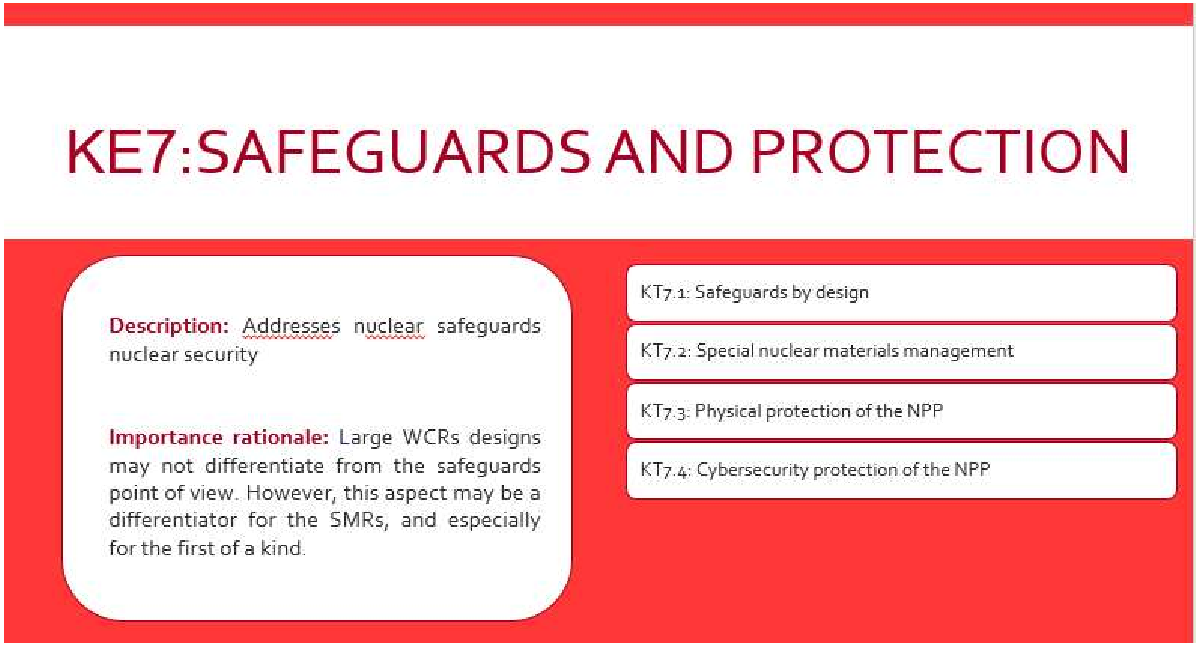
IAEA Safeguards

IAEA Safeguards are a set of technical measures that the IAEA uses to independently verify that nuclear facilities are not misused and nuclear material (NM) is not diverted. On-site inspections, visits and monitoring and evaluation support the above.

The IAEA verifies countries' reports of declared NM and activities via:

- Information provided by the country on the type, quantities, locations and movements of NM
- Seals on containers or locations holding NM
- Cameras recording Key Areas with NM stored or moved though
- Inspections to validate NM quantities and locations correspond to the declared
- Containment and surveillance records confirm no undeclared movements of NM
- Import Export Control measures – transfer of equipment (technology and intellectual property)

Key Element 7



This KE should not be a differentiator for well established NPP technologies that have operating units under safeguards but could be an important consideration when evaluating evolutionary or innovative NPP concepts or designs.
In the latter case, it would be highly desirable if the concept is covered under existing IAEA safeguards principles and procedures, or at least that it has been discussed with IAEA safeguards department experts.

Description:
This key element addresses the safeguards and prevention and detection of, and response to, theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear materials, other radioactive substances or their associated facilities.

<u>How to assess technologies?</u>

IAEA safeguards are:
- Embedded in legally binding agreements and provide the basis for the IAEA to implement effective verification,
- Applied to materials and facilities placed under IAEA safeguards.

Key Topic 7.1 SG by Design

KT7.1: SAFEGUARDS BY DESIGN

KT7.1 addresses safeguards by design. Safeguards activities are performed to verify the Member State's declarations about nuclear material quantities, locations and movements at a facility .

The complexity of a safeguards approach will tend to increase with increasing inventory and flow, and with decreasing discreteness and distinctness of fuel items.

Considerations

- Ease of design verification during construction
- Consideration of IAEA safeguards equipment installation and power requirements
- Considerations for SMR designs

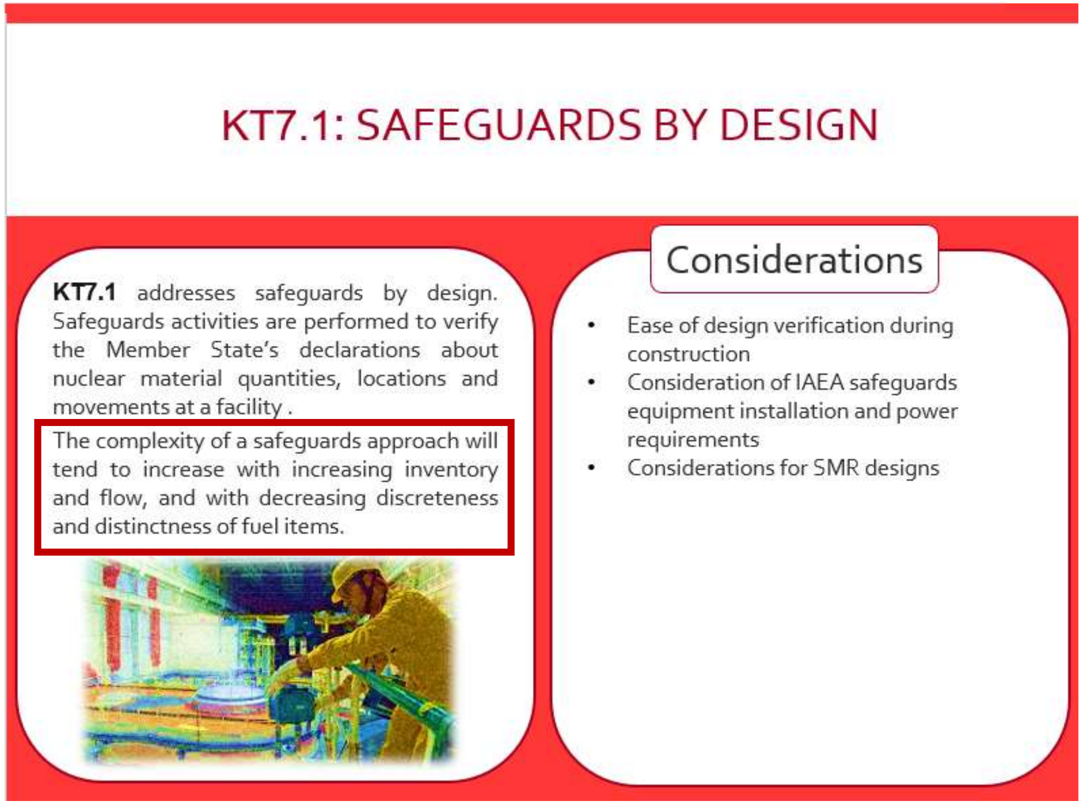
IAEA safeguards activities are performed to verify the Member State's declarations about nuclear material quantities, locations and movements at a facility.

Safeguards by design refers to NPP design features that are incorporated at the reactor design stage to facilitate the implementation of these IAEA safeguards monitoring and verification activities.

Verification consists of two types:

- *Verification of design information* through on-site physical examination during the construction and subsequent phases of the facility's life cycle against the design, and
- *Verification of the nuclear material accountancy* during NF operation.

Key Topic 7.1 SG by Design



Since IAEA safeguards generally involve the independent verification of nuclear material inventory and flow, the complexity of a safeguards approach tend to increase with increasing inventory and flow, and with decreasing discreteness and distinctness of fuel items.

Historically, reactor fuels have been relatively large and distinct (i.e. identifiable) objects that could be verified either visually or with standard radiation detection equipment in a straightforward manner.

New designs with liquid fuel for example will present a conceptually similar challenge to IAEA safeguards to that found historically in fuel fabrication and reprocessing facilities, where verification might require additional chemical and statistical analysis, or other inference techniques that rely upon IAEA installed or operator equipment.

Key Topic 7.4 Cybersecurity

KT7.4: CYBERSECURITY PROTECTION OF THE NPP

KT7.4 addresses cybersecurity protection of a NPP, i.e. the measures taken to protect computer based systems, networks and other digital systems that are critical for the safe and secure operation of the facility and for preventing theft, sabotage and other malicious acts.

Considerations

- Access control measures
- Confidentiality, integrity and availability of information
- Support systems, and equipment and emergency preparedness functions
- Plan to periodically assess vulnerability

This key topic addresses a cybersecurity of a NPP, that refers to the measures taken to protect computer based systems, networks and other digital systems that are critical for the safe and secure operation of the facility and for preventing theft, sabotage and other malicious acts.

The cyber security is basically concerned with all components that may be susceptible to electronic compromise of sensitive information. Cyber security is considered a subset of information security, which has the overarching role of taking the appropriate measures to ensure the confidentiality, integrity and availability of information.

Key Topic 7.4 Cybersecurity How to Assess?

KT7.4: CYBERSECURITY PROTECTION OF THE NPP

KT7.4 addresses cybersecurity protection of a NPP, i.e. the measures taken to protect computer based systems, networks and other digital systems that are critical for the safe and secure operation of the facility and for preventing theft, sabotage and other malicious acts.

Considerations

- Access control measures
- Confidentiality, integrity and availability of information
- Support systems, and equipment and emergency preparedness functions
- Plan to periodically assess vulnerability

<u>How to assess technologies?</u>

Although there may be differences in the details of the cybersecurity protection of a NPP and its security plan and systems, it is expected that cybersecurity will be achieved by the responsible authorities.

This KT is not expected to be a strong differentiator, unless the security provisions are significantly deficient or will not be amended to conform.

HOW TO START?

STEP 1: Analyze and develop rationales for 10 KEs to assign the importance and % weight

Large WCR

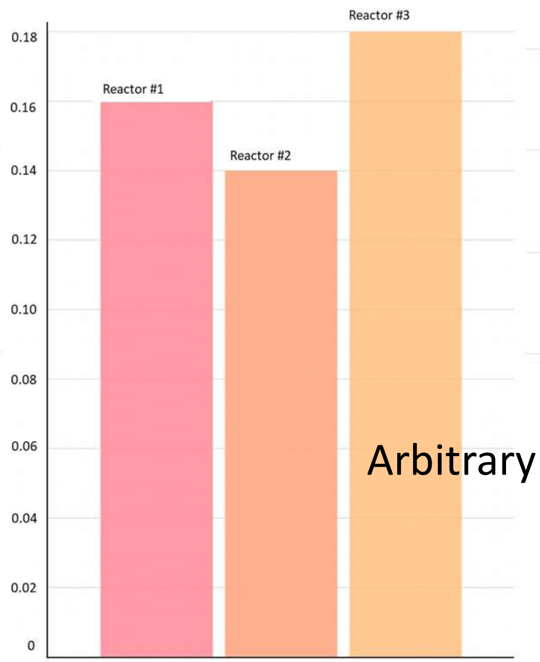
KE	**Rationale**	**Importance**	**Weight**
1: Site and Environment	The site and environment are of prime importance because they synergistically define the conditions or constraints that cause the NPP to be financially and technically attractive.	High	20
2: Fuel Cycle	Fuel costs are small in comparison to capital costs of the NPP. However, the fuel, the fuel cycle and the in-plant management of fuel have a major impact on plant operation and operating costs.	High	10
3: Nuclear Safety	Nuclear safety is expected to be included at the policy objectives level or the highest key element contribution level. It has the potential to be a strong differentiator.	High	15
4: Nuclear island design and performance	The nuclear island design and performance can be an importance differentiator in all or some of the KTs.	High	15
5: Balance of plant design and grid integration	Unique or challenging features of the grid arrangement for the balance of plant (BOP) interface in both initial and lifetime operation is critical to the plant's safe, economic, and reliable operation. However, BOP performance is secondary to nuclear reactor performance.	Medium	10
6: Balance of plant design for other than electricity production	Large WCRs are assumed to be needed only for electricity production in this example, but this may change in the future. Therefore,the overall importance of KE 6 in this case is low.	Low	5
7: Safeguards and protection	IAEA safeguards will be applied to materials and facilities by Member State or Member States. The large WCRs designs may not differentiate from safeguards point of view. Although there may be differences in the details of the security plan and systems, it is expected that site security will be achieved by the responsible authorities.	Low	5
8: Technology readiness	Not a strong differentiator since all large WCRs under consideration are at a high level of technological readiness.	Low	5
9: Project delivery	This KE is very relevant in Phase 2 and details should be available from the technology holders or need to be obtained. Importance ranking would be lower (even Zero) during Phase 1. This is a major national project of high priority and visibility.	Low	5
10: Economics and financing	The nuclear island design and performance can be an importance differentiator in all or some of the KTs and it is more pronounced for SMRs than for large WCRs	Medium	10
	Total		**100**

HOW to SCORE?

STEP 2: Analyze and develop rationales for KTs per each KE to assign the importance and % weight
STEP 3: Analyze and develop rationales to score technologies (1 to 5)

SAFEGUARDS AND PROTECTION

Key topics	%	Rationale for percentage	R#1	R#2	R#3	Rationale for score
Safeguards by design	25	Should not be a differentiator for well established NPP technologies that have	5	5	5	All information provided and allign with the IAEA SG by design.
Special nuclear materials management	30	Should not be a differentiator for well established NPP technologies that have	3	4	5	Highly desirable if the concept is covered under existing IAEA safeguards principles.
Physical protection of the NPP	25	Not expected to be a strong differentiator, unless the security provisions are	4	4	3	Site security is design specific and will be mainly achieved by the responsible authorities.
Cybersecurity protection of the NPP	20	Not expected to be a strong differentiator, unless the security provisions are	3	5	5	Cybersecurity will be achieved by the responsible authorities

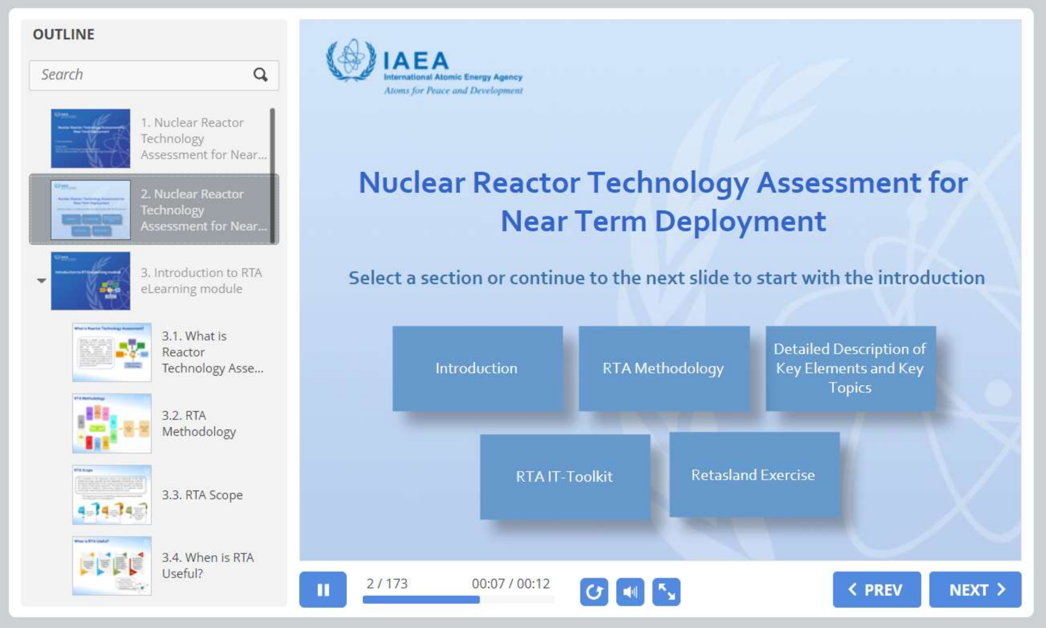


STEP 4: Analyze final assessment

Arbitrary numbers not related to any particular reactor design

RTA E-Learning

[OPEN-LMS: All courses (iaea.org)]



Thank you!

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