5th Joint ICTP-IAEA Workshop on Physics and Technology of Innovative Nuclear Energy Systems, 13 - 17 July 2026, Trieste

Nuclear Reactor Technology Assessment

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Nuclear Power Technology Development Section

Department of Nuclear Energy -> Division of Nuclear Power -> NPTDS

Fostering collaboration and development for advanced nuclear reactor technologies.

Providing information to the IAEA's Member States on technology status and development trends for advanced reactor systems and their applications.

Nuclear Power Technology Development Section | IAEA

Advanced Water-Cooled Reactors

Fast Reactors

Small and medium-sized or modular reactors

Non-electric applications of Nuclear Power

Fusion

Learning Objectives

After successful completion of this lecture, participants shall be able to:

- Comprehend RTA concept
- Explain RTA applicability
- Familiarize with main Key Elements (KE) and Key Topics (KT)
- Get ready for the Group Activity 1 on RTA

Content

Methodology

Training approach

Group Activity

What is

Reactor Technology Assessment (RTA) for Near Term Deployment?

Purpose

- **Determines reactor technology to fulfil national energy delivery needs using a systematic assessment process**

Primary users

- **nuclear energy programme implementing organization (NEPIO), utilities/operator organizations, or others who are responsible for, or involved in, the process of selecting NPP technology.**

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

RTA Methodology - a base for decision making

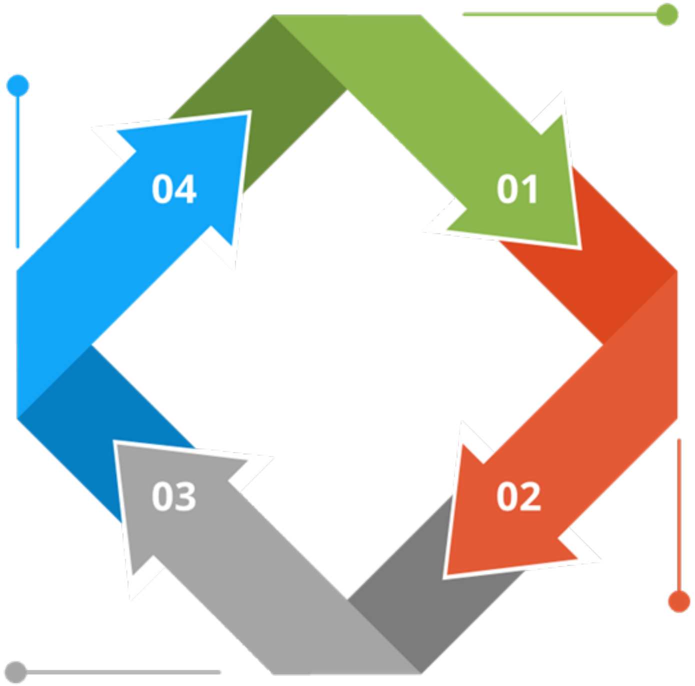
RTA supports the Member States to evaluate and assess Key Elements and Key Topics quantitatively as part of feasibility studies and eventually select the reactor technology that is consistent with national requirements, needs and objectives.

01 Large water cooled reactors (WCRs)

02 Small and medium sized or modular reactors (SMRs)

03 and their broad applications (electricity production, non-electric applications, hybrid energy systems)

Decision Making Methodology



Analytical Framework

Nuclear reactor technology decision analysis process: RTA (KEs/KTs)

National goals; electricity and heat needs

Identify

Specific qualitative considerations (regulatory and institutional aspects, including security, safety and safeguards)

Evaluate

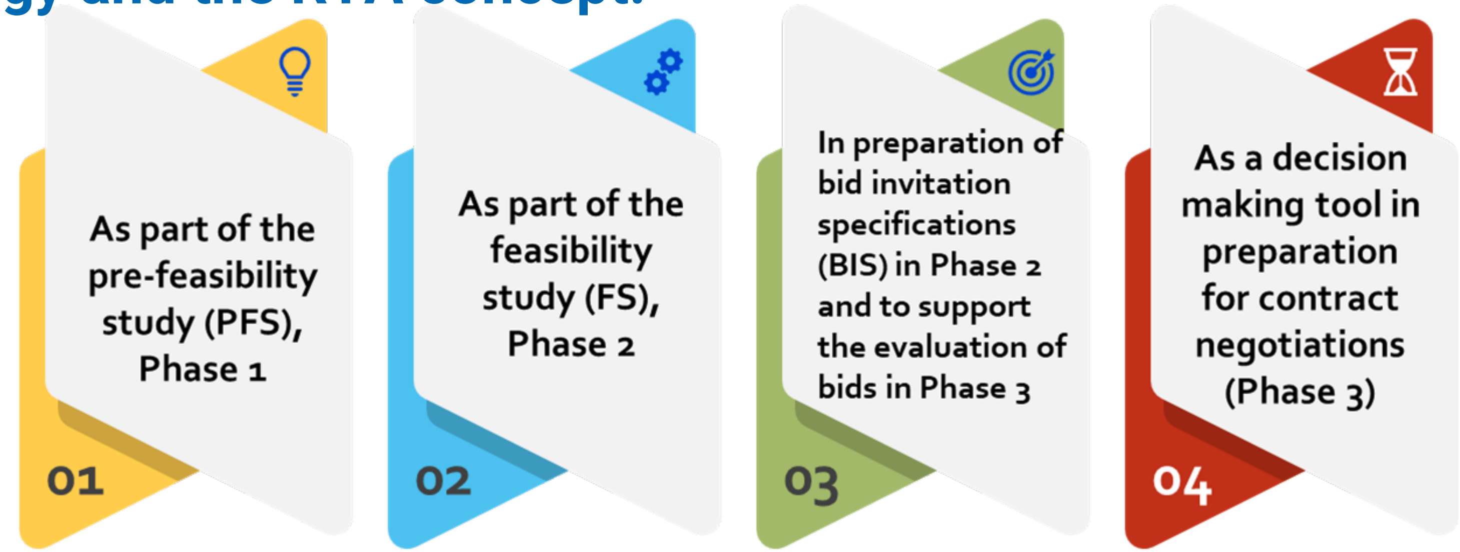
Evaluate NPPs using decision analysis process (KE,KTs) and perform the RTA

Outputs

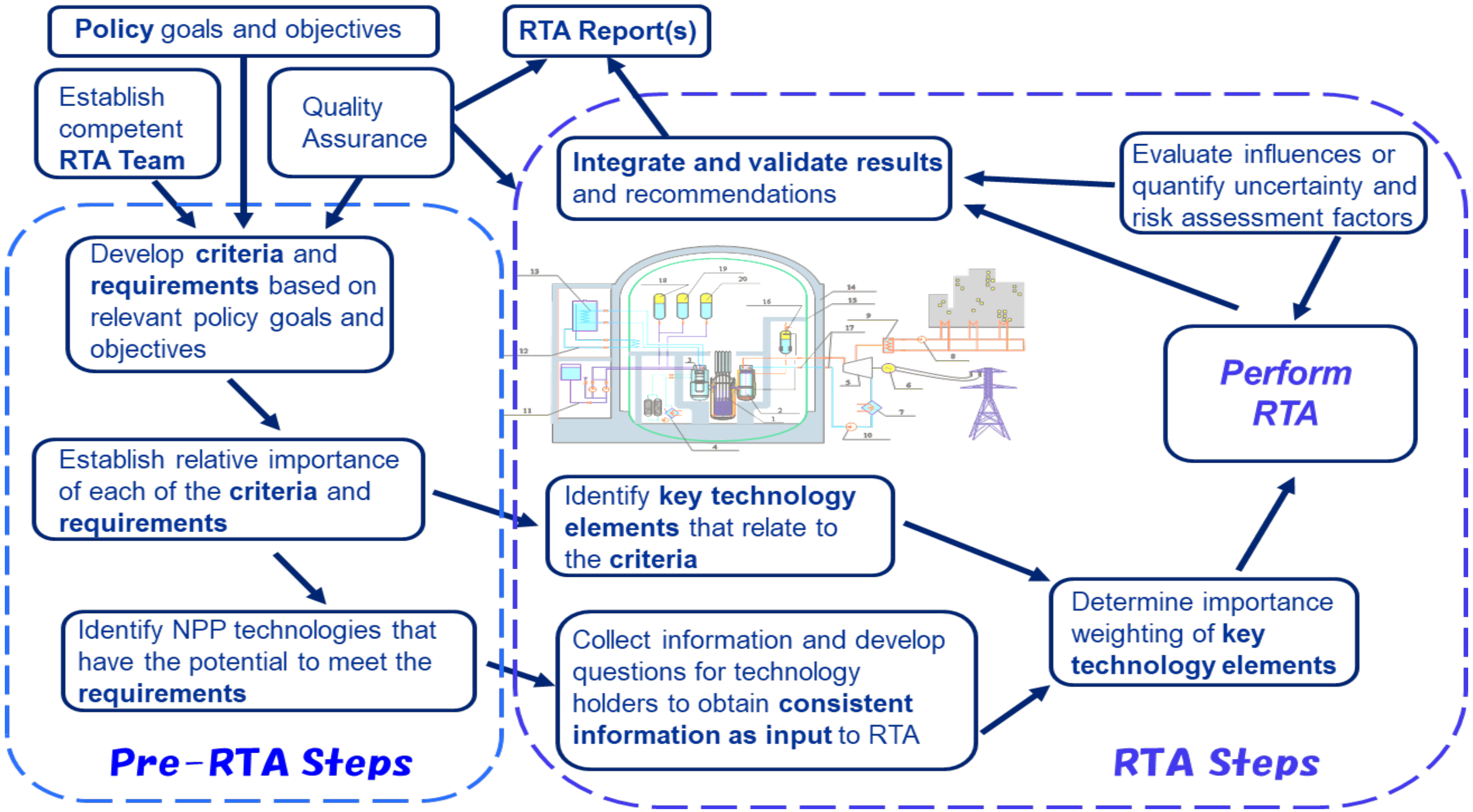
Quantitative assessment of general reactor technology risks in meeting technical, cost and schedule requirements

When is RTA Useful?

- ❑ During Phase 1 as a part of the Pre-feasibility Study to identify technologies that are consistent with national needs, requirements and criteria.
- ❑ RTA continues from the end of Phase 1, where the national policy objectives for the nuclear power programme are defined, up to the selection of the reactor technology.
- ❑ **Prior to pre-feasibility study, Member States are encouraged to include in their programmes capacity building to ensure understanding of the available reactor technology and the RTA concept.**



What are the pre-RTA steps?

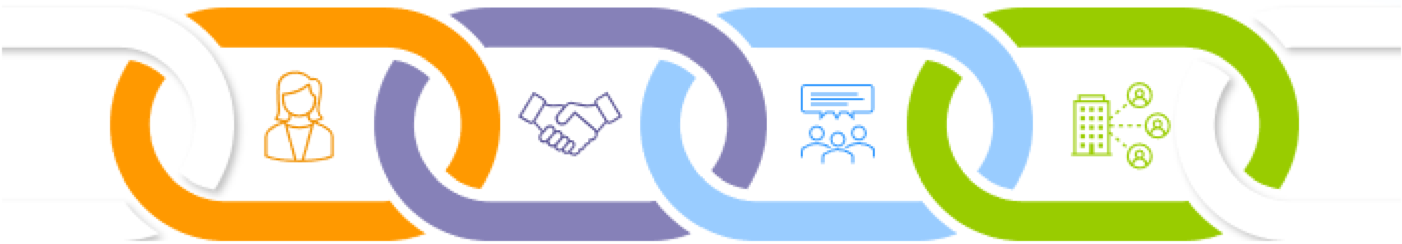


The pre-RTA steps consist of:

- ➔ Developing criteria and requirements based on relevant national policy, goals and objectives;
- ➔ Establishing relative importance for each of the criteria and requirements;
- ➔ Identifying the NPP technologies that have potential to meet the requirements.

RTA Team

- To gather credible and consistent information for different reactor technologies of interest
- To use the importance weighting structure of the policy objectives
- To understand the technology and RTA methodology components and structure
- To ask the right questions to the technology holders
- To gather or develop methods to evaluate the technology holders’ critical data and responses to key questions



- ❑ **Owner / Operator** takes full responsibility for the conduct and results of the RTA.
- ❑ **Technical / Managerial Technology Assessment Task Team** is assembled with its mission to perform the RTA and report the results to the (top) decision-maker(s).
- ❑ **Task Team** needs full expertise in design, engineering, construction, and operation of the nuclear facility and its environment.
- ❑ **Consultants** should be used as required to supplement the Task Team with specific expertise, reporting to the Task Team Management.

RTA IT-Toolkit

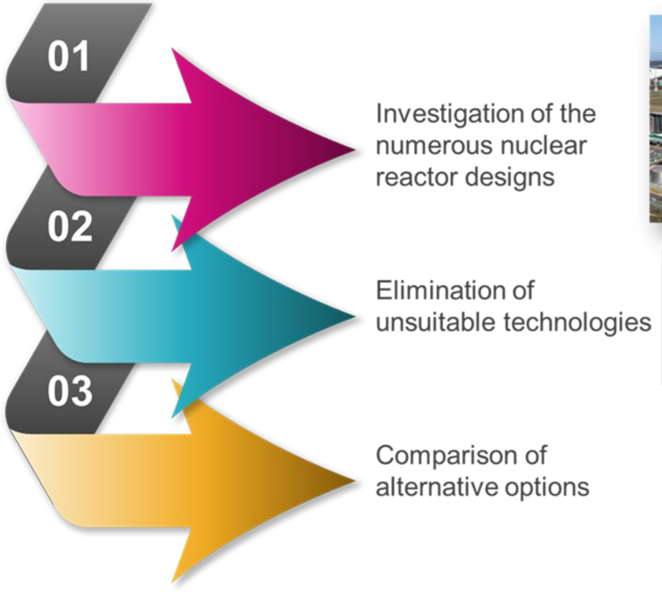
- ✓ Decision-making supporting tool useful when determining which reactor is most suitable for the national nuclear power programme.
- ✓ Supporting the IAEA reactor technology assessment methodology users.
- ✓ Platform to conduct detailed comparative assessment of reactor designs.
- ✓ Convenient, online resource.

IRIS (iaea.org)

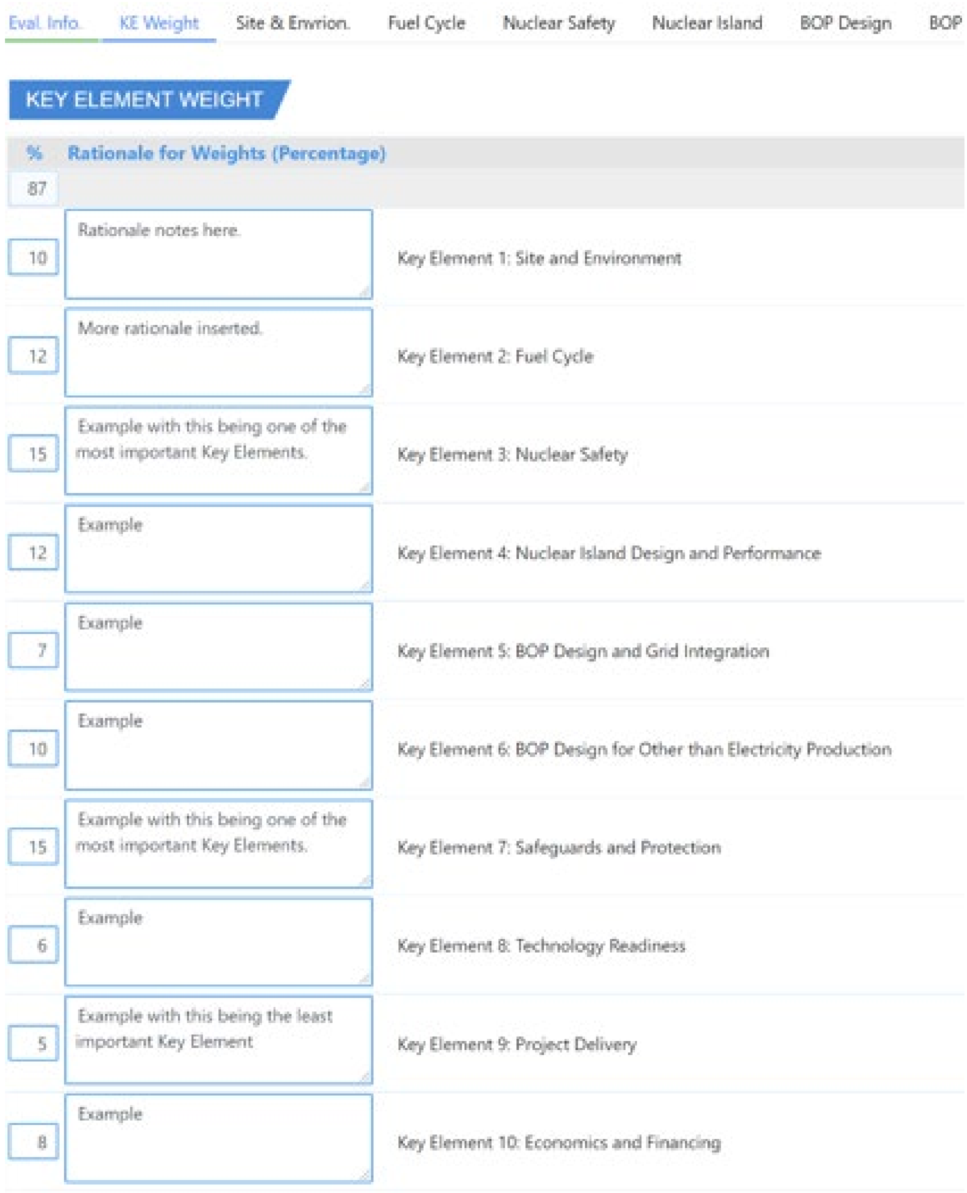
RTA Methodology Key Elements

RTA methodology Key Elements (KE) are:

- 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 IT-Toolkit



- The user needs to determine how important each of these Key Elements are by assigning percentage values, where the total sum is 100%.
- For example, if each Key Element is equally as important as the others, then each one is assigned a 10% weight (10% x 10 Key Elements = 100%).
- Input the assigned percentages in the small boxes under the “%” sign and input the rationale for those percentage values in the bigger text boxes next to them.
- The grayed-out bar at the top will show the cumulative value of each percentage.
- The user should ensure this box reads ‘100’ when all percentages are entered for all key elements.

KE2: FUEL CYCLE

- **Description:** All operations associated with the production of nuclear energy, including mining and processing and enrichment of uranium; manufacture of nuclear fuel; operation of nuclear reactors; reprocessing of spent fuel; all waste management activities; and any related research and development activities.
- **Importance rationale:** the performance of the fuel and the fuel cycle and the in-plant management of fuel have a major impact on NPP operation and operating costs. Therefore, the comparative offerings and technology holder experience regarding fuel and fuel cycle performance may be considered with high importance in some cases.

- KT2.1: Fuel materials and components
- KT2.2: Fuel product supply chain
- KT2.3: Fuel unit fabrication
- KT2.4: Fuel operating experience
- KT2.5: Refuelling outage
- KT2.6: Fuel flexibility
- KT2.7: Suitability to indigenous fuel fabrication
- KT2.8: Medium-term spent fuel storage
- KT2.9: Long-term spent fuel storage

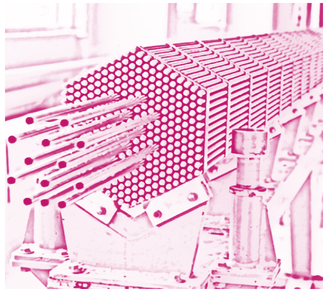
KT2.1: FUEL MATERIALS AND COMPONENTS

KT2.1 focuses at the availability of required fuel materials and components for solid fuel designs that may differentiate among the assessing technology designs.

Liquid fuel designs, such as in molten salt reactors, are not covered within this key topic.

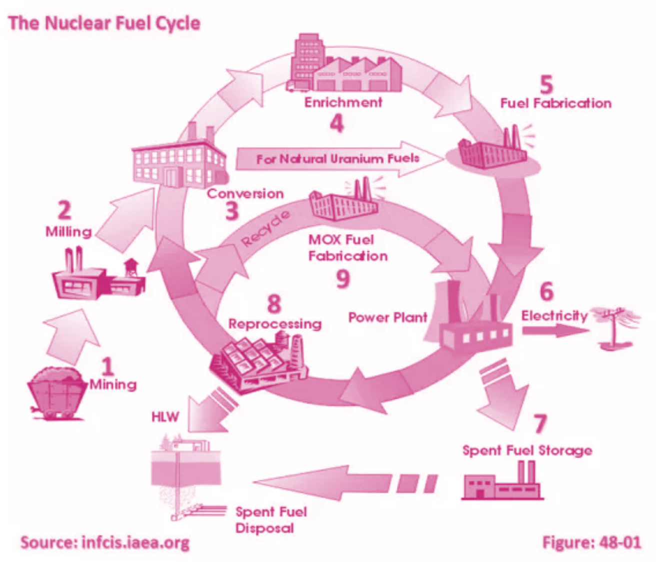
Considerations

- Fuel enrichment
- Accident tolerant fuels
- Fuel assembly alloys
- High assay low enriched uranium (HALEU)



KT2.2: FUEL PRODUCT SUPPLY CHAIN

KT2.2 discusses the fuel supply chain which consists of manufacturers of fuel assembly components (e.g. pellets, rods, grids, springs), fuel assemblies, transporters and transport flasks.

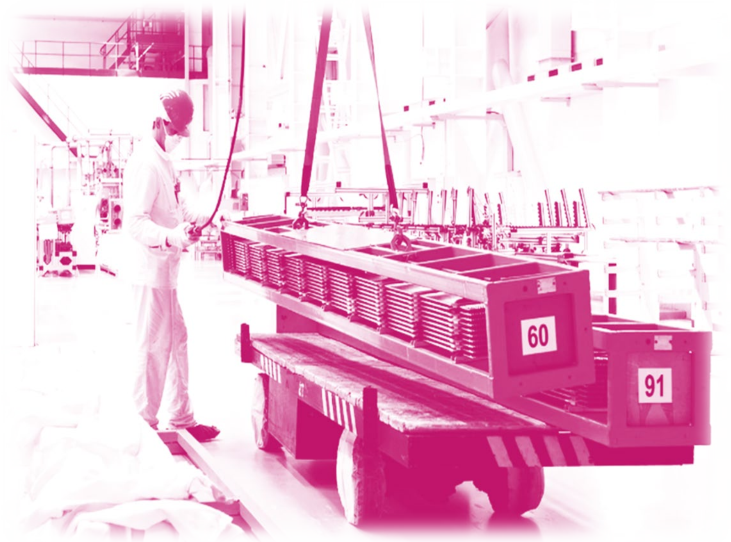


Considerations

- Historical experience and agreements with suppliers
- Past in-reactor performance of the fuel design
- Status of fuel design relative to the reactor design
- Diversity of fuel material sources
- Security of fuel supply and current stockpile

KT2.3: FUEL UNIT FABRICATION

KT2.3 discusses demonstrated ability of technology holder to manufacture fuel units (e.g. assemblies, bundles, or TRISO fuel) and how this may differentiate the designs under assessment.



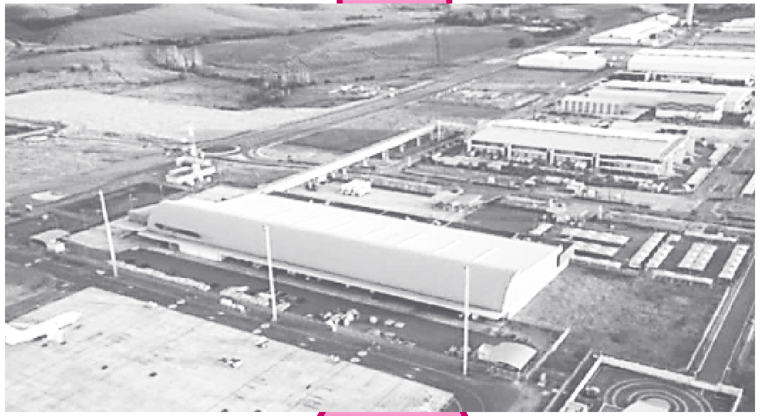
Considerations

- Number of potential fuel suppliers
- Capacity of fuel assembly fabrication
- Flexibility to adapt production facility to new fuel designs

KT2.4: FUEL OPERATING EXPERIENCE

KT2.4 addresses the vendor's operating experience for the nuclear fuel materials, fabrication, operational expectations and experience.

Operators and vendors have decades of fuel operating experience regarding the large WCRs. This is not the case for SMRs.

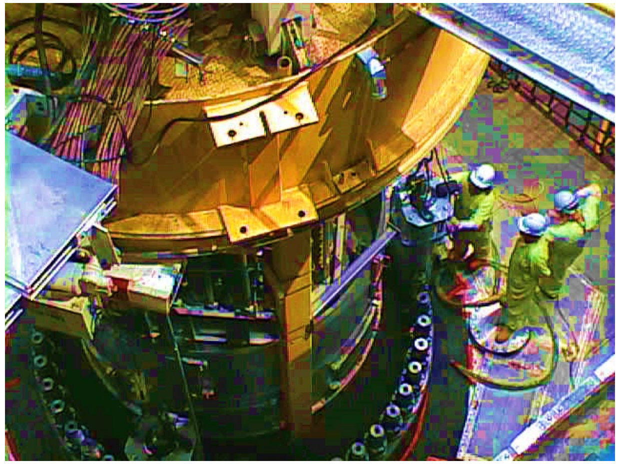


Considerations

- Industry experience with this fuel type and design
- Deviations from established fuel design
- Availability of simulation tools for optimizing fuel performance

KT2.5: REFUELLING OUTAGES

KT2.5 addresses all aspects of fuel refuelling, based on which the technology holders are to be assessed. Outages are necessary for refuelling but also for maintenance operations. Having the possibility of choosing the outage date allows for adaptations to forecast in the changes of electricity demand.



Considerations

- Fuel cycle length and refuelling outage duration
- Capacity factor during operation
- Additional maintenance outages
- Ability to examine fuel assemblies during outage
- Industry experience base

KT2.6: FUEL FLEXIBILITY

KT2.6 addresses the level of flexibility of NPP operation with respect to different fuel types, including higher uranium enrichment levels, HALEU or MOX fuel and availability and competitiveness of different fuel materials and components for NPP design. Fuel flexibility could also mean flexibility in the use of different fuel enrichments.

Considerations

- Flexibility for different fuel enrichment levels
- Flexibility for using MOX or thorium fuel
- Average and peak fuel burnup values

KT2.7: SUITABILITY TO INDIGENOUS FUEL FABRICATION

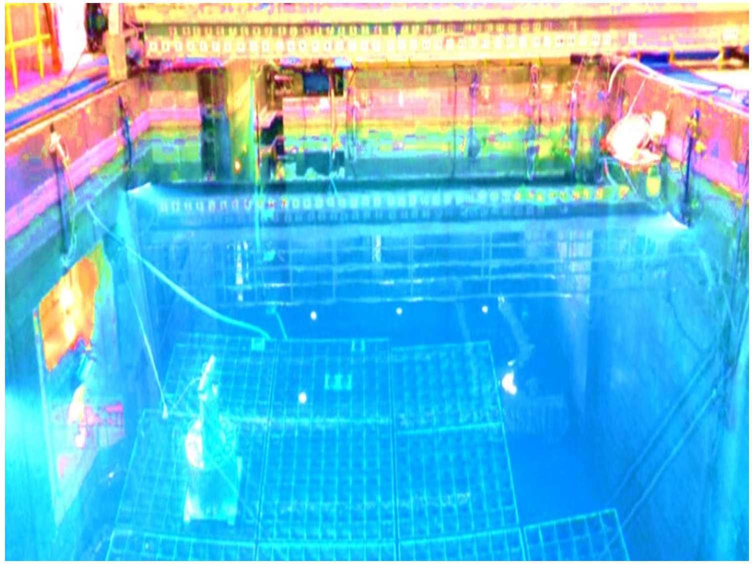
KT2.7 addresses suitability to indigenous fuel fabrication that is for large WCRs an oligopolistic market, while the fuel fabrication plants for very specific fuel assemblies for SMRs do not exist.

Considerations

- Technology transfer for fuel production
- Costs for building a fuel fabrication plant
- Possibility to produce fuel components locally

KT2.8: MEDIUM-TERM SPENT FUEL STORAGE

KT2.8 describes how technology holders differentiate regarding solutions for the medium-term spent fuel storage capacity and potential for its increase.



Considerations

- Spent fuel pool capacity (years of full power operation)
- Possibility to increase storage capacity
- Duration of medium-term spent fuel storage
- Inspection means and requirements
- Fuel transport complexity

KT2.9: LONG-TERM SPENT FUEL STORAGE

KT2.9 describes how technology holders differentiate regarding solutions for the long term spent fuel storage capacity and potential for increases in the future.

Considerations

- Long-term storage capacity (years of full power operation)
- Possibility to increase storage capacity
- Duration of long-term spent fuel storage prior to transfer into deep geological repository
- Inspection means and requirements
- Fuel transport complexity
- Possibility to reprocess spent fuel

RTA TABLE FOR KEY ELEMENT 2

- **How to complete?**
- **Example**

RTA Key Element 2: Annex

Key Element: 2. Fuel Cycle (Suggested Importance _______________)						_________%
8 Key topics	%	Rationale for percentage	NPP1 score	NPP2 score	NPP3 score	Rationale for score
KT 1 Fuel materials and components						
KT 2 Fuel product supply chain						
KT 3 Fuel unit fabrication						
KT 4 Fuel operating experience						
KT 5 Refuelling outage						
KT 6 Fuel flexibility						
KT 7 Suitability to indigenous fuel fabrication						
KT 8 Medium term spent fuel storage capacity						
KT 9 Long term spent fuel storage						

%	Represents the importance of the key topic
Rationale for percentage	Requires explanation for quantified importance
Rationale for score	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 2: Annex

Key Element 2: Fuel Cycle (________________________Importance) →	________%

Key topics	%	Rationale for weight	NPP1	NPP2	NPP3	Rationale for score
KT 1 Fuel materials and components		The capacity of the technology to use different fuel materials and components produced in several countries and provided by different suppliers is important for security of supply				
KT 4 Fuel operating experience		Fuel operating experience brought by the vendors in many reactors for a long time provides many guarantees				
KT 5 Refuelling outage		The country is interconnected and renewables are increasing. The maximum planned outage is 15 days (only in spring)				
KT 8 Medium term spent fuel storage capacity		Spent fuel will be stored on the nuclear power plant site Solutions for medium term spent fuel storage are anticipated 1				

RTA Key Element 2: Annex

Key Element 2: Fuel Cycle (________________________Importance) →	________%

Key topics	%	Rationale for weight	NPP1	NPP2	NPP3	Rationale for score
KT 1 Fuel materials and components	10	The capacity of the technology to use different fuel materials and components produced in several countries and provided by different suppliers is important for security of supply				
KT 4 Fuel operating experience	15	Fuel operating experience brought by the vendors in many reactors for a long time provides many guarantees				
KT 5 Refuelling outage	15	The country is interconnected and renewables are increasing. The maximum planned outage is 15 days (only in spring)				
KT 8 Medium term spent fuel storage capacity	5 2	Spent fuel will be stored on the nuclear power plant site Solutions for medium term spent fuel storage are anticipated 1				

RTA Key Element 2: Annex

Key Element 2: Fuel Cycle (_______________________Importance)	________%

Key topics	%	Rationale for weight	NPP1	NPP2	NPP3	Rationale for score
KT 1 Fuel materials and components	10	The capacity of the technology to use different fuel materials and components produced in several countries and provided by different suppliers is important for security of supply				5: The technology can use enriched uranium, enriched reprocessed uranium and MOX; alloys of fuel assemblies are made with broadly available materials 4: The technology can use enriched uranium and enriched reprocessed uranium; alloys of fuel assemblies are made with broadly available materials 2. The technology can use only enriched uranium >10%
KT 4 Fuel operating experience	15	Fuel operating experience brought by the vendors in many reactors for a long time provides many guarantees				5: The vendor has experience with a similar fuel in a large number of reactors for a long time 4: The vendor has indirect or partial experience with a similar fuel in a large number of reactors for a long time 1: The vendor has no experience of this fuel
KT 5 Refuelling outage	15	The country is interconnected and renewables are increasing. The maximum planned outage is 15 days (only in spring)				5: The vendor can provide training for outages; and refuelling outages can be chosen and are infrequent: 10 years and short: 15 days 4: Refuelling outages are infrequent and short: 12 days 3: The vendor can provide training for outages; and refuelling outages are infrequent and long: 18 days 2: Refuelling outages are infrequent and long: 22 days 1: Refuelling outages are frequent and long: 22 days
KT 8 Medium term spent fuel storage capacity	5	Spent fuel will be stored on the nuclear power plant site Solutions for medium term spent fuel storage are anticipated				5: Wet or dry storage can be proposed for several decades 4: Wet or dry storage can be easily increased 3: Wet or dry storage can be increased 2: Dry storage can be increased 1: Increasing medium term spent fuel storage is difficult and very costly

RTA Key Element 2: Annex

Key Element 2: Fuel Cycle (________________________Importance)	________%

Key topics	%	Rationale for weight	NPP1	NPP2	NPP3	Rationale for score
KT 1 Fuel materials and components	10	The capacity of the technology to use different fuel materials and components produced in several countries and provided by different suppliers is important for security of supply				5: The technology can use enriched uranium, enriched reprocessed uranium and MOX; alloys of fuel assemblies are made with broadly available materials 4: The technology can use enriched uranium and enriched reprocessed uranium; alloys of fuel assemblies are made with broadly available materials 2. The technology can use only enriched uranium >10%
KT 4 Fuel operating experience	15	Fuel operating experience brought by the vendors in many reactors for a long time provides many guarantees	Ask the vendor			5: The vendor has experience with a similar fuel in a large number of reactors for a long time 4: The vendor has indirect or partial experience with a similar fuel in a large number of reactors for a long time 1: The vendor has no experience of this fuel
KT 5 Refuelling outage	15	The country is interconnected and renewables are increasing. The maximum planned outage is 15 days (only in spring)	Ask the vendor			5: The vendor can provide training for outages; and refuelling outages can be chosen and are infrequent: 10 years and short: 15 days 4: Refuelling outages are infrequent and short: 12 days 3: The vendor can provide training for outages; and refuelling outages are infrequent and long: 18 days 2: Refuelling outages are infrequent and long: 22 days 1: Refuelling outages are frequent and long: 22 days
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RTA Key Element 2: Annex

Key Element 2: Fuel Cycle (______________________Importance) →	________%

Key topics	%	Rationale for weight	NPP1 score	NPP2 score	NPP3 score	Rationale for score
KT 1 Fuel materials and components	10	The capacity of the technology to use different fuel materials and components produced in several countries and provided by different suppliers is important for security of supply	5	2	4	5: The technology can use enriched uranium, enriched reprocessed uranium and MOX; alloys of fuel assemblies are made with broadly available materials 4: The technology can use enriched uranium and enriched reprocessed uranium; alloys of fuel assemblies are made with broadly available materials 2. The technology can use only enriched uranium >10%
KT 4 Fuel operating experience	15	Fuel operating experience brought by the vendors in many reactors for a long time provides many guarantees	5	1	4	5: The vendor has experience with a similar fuel in a large number of reactors for a long time 4: The vendor has indirect or partial experience with a similar fuel in a large number of reactors for a long time 1: The vendor has no experience of this fuel
			Ask the vendor			
KT 5 Refuelling outage	15	The country is interconnected and renewables are increasing. The maximum planned outage is 15 days (only in spring)	3	5	4	5: The vendor can provide training for outages; and refuelling outages can be chosen and are infrequent: 10 years and short: 15 days 4: Refuelling outages are infrequent and short: 12 days 3: The vendor can provide training for outages; and refuelling outages are infrequent and long: 18 days 2: Refuelling outages are infrequent and long: 22 days 1: Refuelling outages are frequent and long: 22 days
			Ask the vendor			
KT 8 Medium term spent fuel storage capacity	5 2	Spent fuel will be stored on the nuclear power plant site Solutions for medium term spent fuel storage are anticipated 1	5	3	3 4	5: Wet or dry storage can be proposed for several decades 4: Wet or dry storage can be easily increased 3: Wet or dry storage can be increased 2: Dry storage can be increased 1: Increasing medium term spent fuel storage is difficult and very costly 3

RTA Key Element 2: Annex

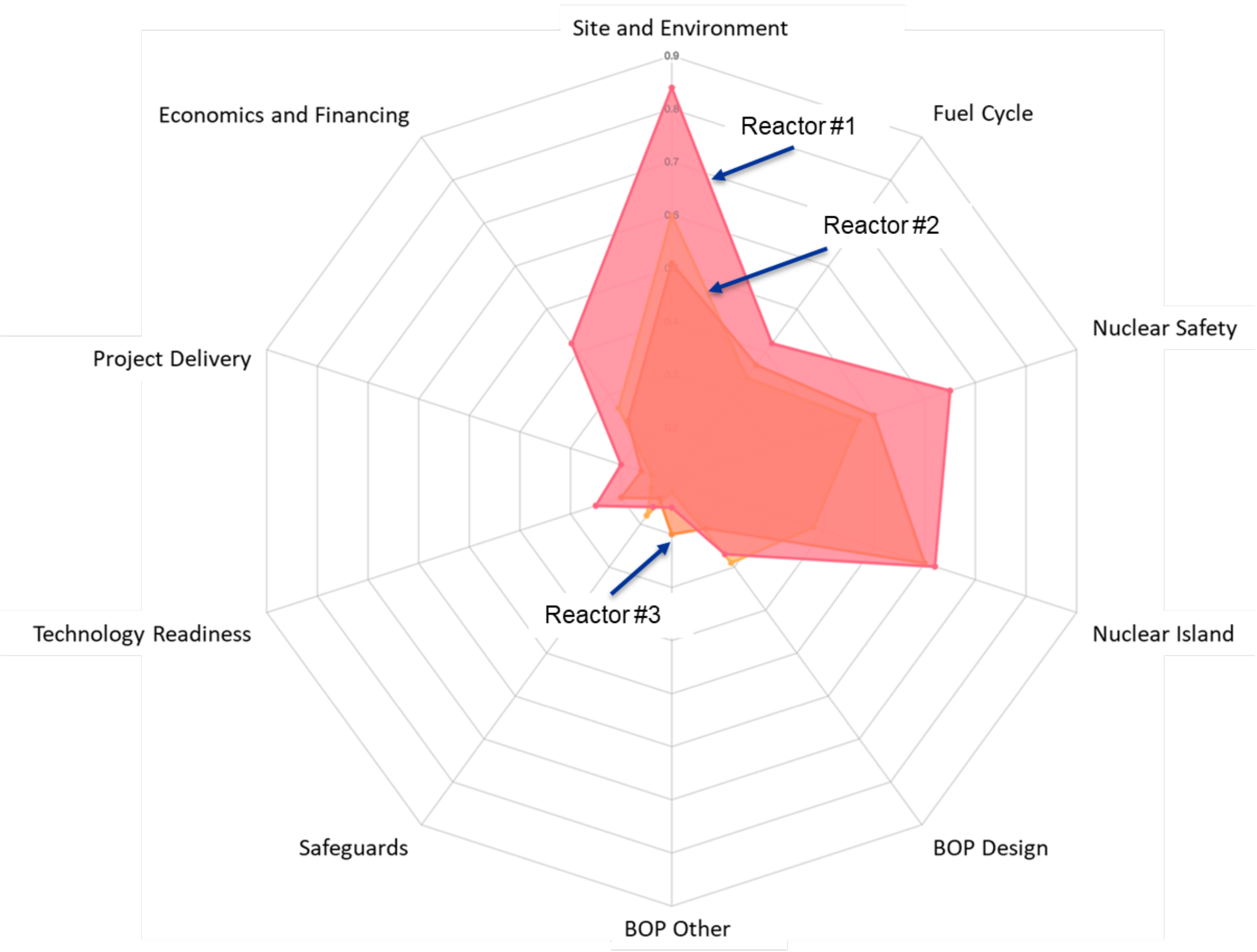
Key Element 2: Fuel Cycle **(______________________Importance)**	**________%**

Ask the vendor: examples

- 2.4 Question NPP1: What guarantees can you provide on your experience with a similar fuel?
- 2.5 Question NPP1: What are the prospects of reducing the duration of stops to 20 days?

RTA: Assessment Results

STEP 4: Analyze final assessment



Information Sources

IAEA
International Atomic Energy Agency

IAEA.ORG | NUCLEUS | Contact

Home | Technical Data | Characteristics | Publications | Archive

- Plant / Site
- Reactor Unit
- Nuclear Steam Supply System
- Reactor Coolant System
- Reactor Core
- Core Materials
- Reactor Pressure Vessel

Plant / Site 11 Reactors

Search by Acronym | Search | Core Size | Type | Size | Country | Status | More Filters | Ma

PWR × Large ×

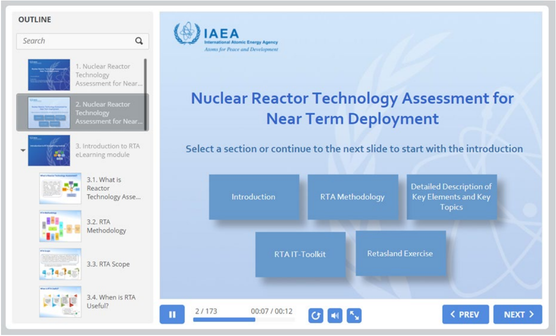
Acronym	Full name	Design Org	Coolant	Moderator	Type	Size	Purpose	Design Status	Country
AP 1000	Advanced Passive PWR	Westinghouse	H2O	H2O	PWR	Large	Commercial – Electric/Non-Electric	Operational	United States of America
APR+	Advanced Power Reactor Plus	KHNP	H2O	H2O	PWR	Large	Commercial – Electric/Non-Electric	Detailed Design	Korea, Republic of
APR1000	Advanced Power Reactor	KEPCO/KHNP	H2O	H2O	PWR	Large	Commercial – Electric/Non-Electric	Conceptual Design	Korea, Republic of
APR1400	Advanced Power Reactor 1400	KEPCO/KHNP	H2O	H2O	PWR	Large	Commercial – Electric/Non-Electric	Operational	Korea, Republic of

https://aris.iaea.org/TechnicalData/

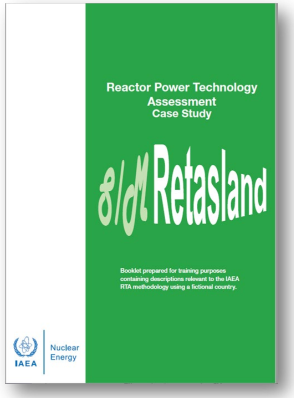
RTA Methodology training approach

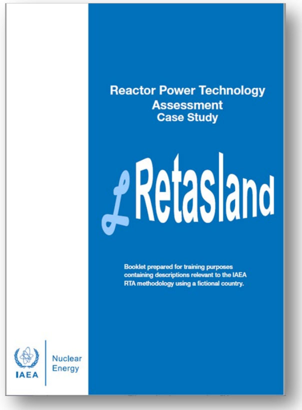
E-Learning

OPEN-LMS: All courses (iaea.org)



Retasland country





Toolkit

RTA Trainings

Regional INPRO School on Strategic Planning for Sustainable Nuclear Energy, hosted by the Government of Republic of Korea, 07–18 July 2025, Daejeon*

(*Note: **RTA is part of the lectures**)

Interregional Training Course on Nuclear Reactor Technology Assessment, hosted by IAEA, 10-14 November 2025

RTA Trainings

*Joint Republic of Korea–IAEA INPRO School on Strategic Planning for Sustainable Nuclear Energy, hosted by the Government of Republic of Korea, 16–26 June 2026, Gyeongju***

*(**Note: **RTA is part of the lectures and hands on practical group exercises**)*

IAEA GC70 Side Event

Purpose:

To present practical experience from Member States applying INPRO KIND and NPTDS Reactor Technology Assessment (RTA) methodologies and tools

Participation:

Member States to deliver presentation on the experience applying KIND and RTA to support informed, structured, and nationally driven decision making

RTA Group Activity

Learning Objectives

- Hands-on RTA implementation Group Activity
- RTA Team work
- Presenting RTA results
- Having fun ☺

Starting point

Country: **Retasland**

Reactor technologies to compare:

- **NuScale and BREST-OD-300**

RTA Kes to assess:

- **KE2 Fuel Cycle**

Sources:

- **IAEA NES n NR-T-1.10 (Rev. 1)**
- **ARIS website**

Tasks

1. Form RTA Team: 1 Captain, 1 Deputy (**nucleus account holder**), 2 Technology Leads (x each technology), 1 Retasland Lead, 1 RTA Annex Table A Lead. **Give a name to your team ☺**

2. Open RTA https://iris.iaea.org/public/survey?cdoc=UTZ10103

3. Complete **KE2**

4. Use button "Generate PDF file" **prior submitting the results**

5. Hit submit RTA button

6. Prepare presentation

7. Happy to hear your group activity presentation on the RTA results on Friday 17th July ☺

PS: Don't forget each and everyone of your Dream Team deserves 2 min public speaking glory!

Presentation structure

1. The Team
2. Retasland considerations
3. KE2 (assumptions, results and questions to vendor)
4. RTA result
5. Feedback on improvements of RTA

Thank you!

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