



IAEA

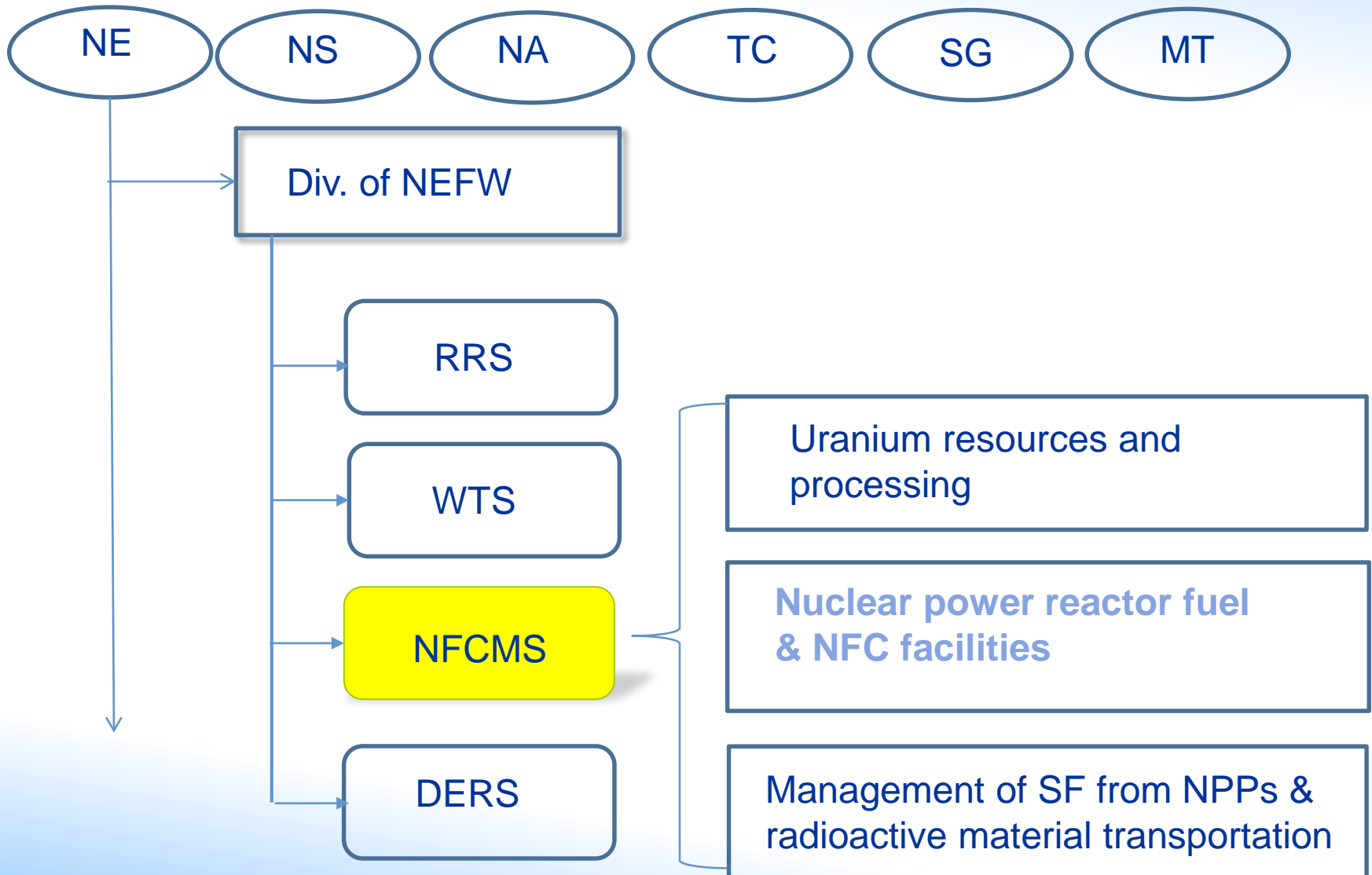
International Atomic Energy Agency
Atoms for Peace and Development

IAEA ACTIVITIES ON FUEL IRRADIATION TESTS, POST IRRADIATION EXAMINATION (PIE) AND PIE FACILITIES DATABASE

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Who we are



IAEA Sub-programme 1.2.2

- Supports activities on nuclear power reactor fuel in order for MSs to understand and address factors affecting the design, fabrication and in-pile behaviour of currently operated and innovative nuclear fuels and materials for power reactors.
- Support IAEA Member States to technically implement new safety standards when operating or upgrading existing nuclear fuel cycle facilities, and to understand and address factors affecting the ageing of these facilities (improvement of I&C, quality control measurements, environmental impact, etc.)
- Activities on irradiation tests and PIE of power reactor fuels are supported by sub-programme 1.2.2.
- These activities are implemented via conferences, CRPs, TMs, publication of technical documents (e.g. TECDOC).

CRPs to Support PIE Techniques of Power Reactor Fuel

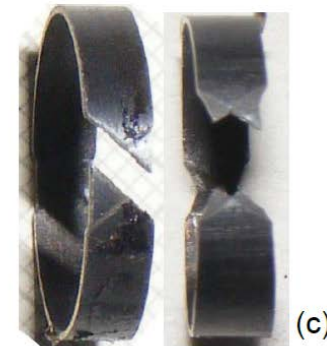
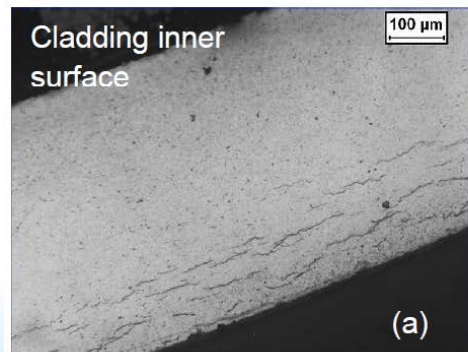
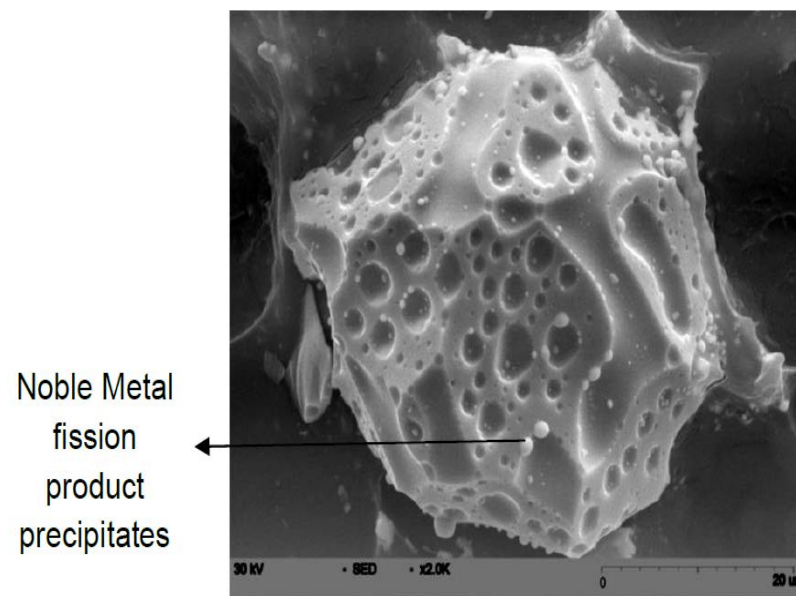


- Guidebook on non-destructive (ND) examination of water reactor fuel, Technical Report Series No. 322, published in 1991
 - A survey of ND techniques available in the spent fuel pool and hot cells, as a supplement to IAEA-TECDOC-245
 - Defect surveillance and detection, visual inspection, dimensional measurements, oxide layer thickness and crud measurements, gamma scanning, neutron radiography and X-ray radiography, fission gas determination, etc.
- Guidebook on destructive examination of water reactor fuel, Technical Report Series No. 385, published in 1996
 - A survey of destructive techniques to perform microstructural examinations, elemental and isotopic analyses and measurement of physical, chemical and mechanical properties of irradiated fuel and structural materials, re-fabrication and instrumentation techniques.

CRP(s) that Include PIE of Irradiated Power Reactor Fuel

- CRP T12027 (Reliability of High Power, Extended Burnup and Advanced PHWR Fuels) included two sets of fuel irradiations and PIEs:
 - NU fuel bundle in a power reactor for 3 times NU burnup
 - (Th,U)O₂ fuel rods and sibling UO₂ fuel rods in a TRIGA material test reactor
 - Non-destructive and destructive tests at hot cells, including: visual examination, leak testing, profilometry, ultrasonic testing, gamma scanning, fuel element puncturing and fission gas release measurement, microscopic examination and mechanical testing of cladding.

Examples of Hot Cell Examination



TMs on PIE Techniques for Water Reactor Fuel

TMs in 1981, 1984, 1990, 1994, 2001, 2006, 2011

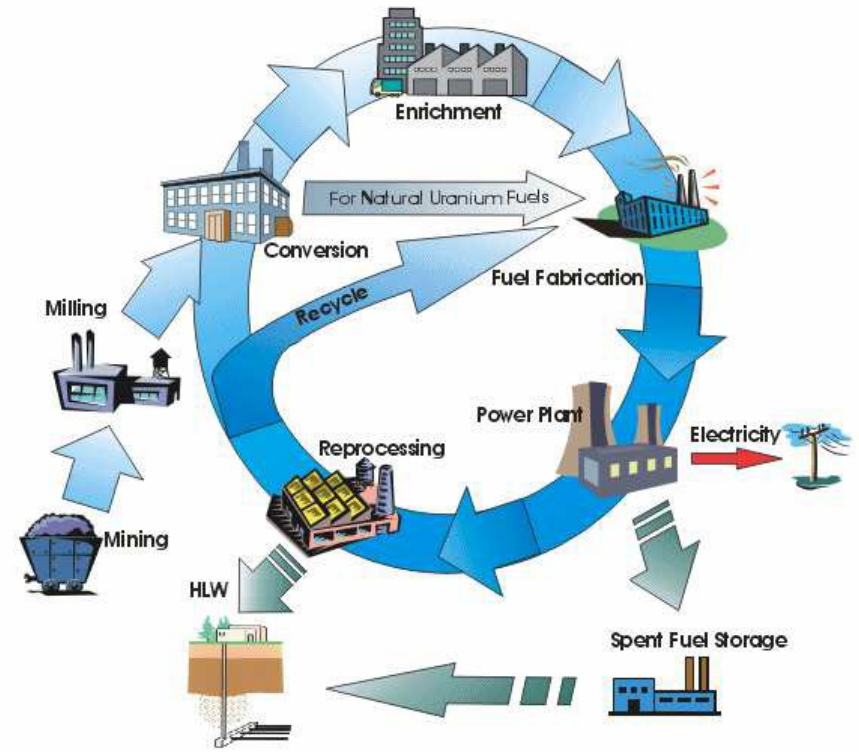
- ITWGFPT-37 (1991): PIE techniques for reactor fuel
- IAEA-TECDOC-1277 (2002): Advanced PIE techniques for water reactor fuel
- IAEA-TECDOC-CD-1635 (2009): PIE and in-pile measurement techniques for water reactor fuels
- IAEA-TECDOC-CD-1693 (2013): Hot cell PIE and poolside inspection of nuclear fuel
- Plan to have a TM in 2020/21 biennium



- Designed as "one stop" resource for technical and statistical information about nuclear fuel cycle activities worldwide: <http://inficis.iaea.org>
- Includes:
 - World Distribution of Uranium Deposits Database (UDEPO),
 - World Thorium Deposits and Resources (ThDEPO),
 - Nuclear Fuel Cycle Information System (NFCIS),
 - Post Irradiation Examination Facilities Database (PIE),
 - Minor Actinide Property Database (MADB).

NFCIS

- A computerized database designed to provide information on commercial civilian nuclear fuel cycle worldwide.
- Includes information on:
 - Uranium ore processing,
 - Conversion,
 - Enrichment,
 - Fuel fabrication,
 - Reprocessing,
 - Spent fuel storage,
 - Heavy water production,
 - Zirconium alloy and Zircaloy tube production facilities.



PIE Database



- Catalogue of PIE facilities (42 hot labs from 22 countries)
- Developed in cooperation with HOTLAB

Country ▲	Facility Name ◆	#-of-DE Techniques	#-of-NDE Techniques
Argentina	CELCA	3	4
Belgium	LHMA - Laboratory for High and Medium Activity - SCK-CEN, Belgium	25	9
Belgium	SCK•CEN - Chemical and Radiochemical Measurements	3	2

- Each facility data includes:
 - General & cell characteristics
 - Acceptance information
 - Available NDE, DE and other techniques
 - Availability of rod re-fabrication & instrumentation
 - Available Storage and conditioning capabilities
 - Reference documents.

Some Details

General

Facility Name

Country

Address

Contact Person

Second Contact Person

Phone

Email

Web Address

Additional Information

Cell Characteristics

Purpose

Gamma Activity Limit (Concrete) (TBq)

Gamma Activity Limit (Steel) (TBq)

Gamma Activity Limit (Lead) (TBq)

Cell Atmosphere

Largest Cell Width (m)

Largest Cell Length (m)

Largest Cell Height (m)

Acceptance Information

Acceptance Type

Transfer Mode

Maximum Cask Weight (t)

Max. Fissile Enrichment (%)

Failed Rod Acceptance

Accepted Casks

Comment

Acceptance Condition

Maximum Cask Length (m)

Max. Fissile Weight (kg)

Protective Tube

Available Techniques

Technique

[Visual Examination](#)

[Length and Diameter](#)

[Gamma Scanning](#)

[Oxide Thickness](#)

[Oxide Thickness](#)

[Rod Puncture](#)

[Optical Microscopy](#)

[Image Analysis](#)

[Micro Gamma Scanning](#)

[TEM](#)

Storage and Conditioning

Intermediate Storage	Yes
Encapsulation for Reinsertion	No
Encapsulation for Other	No
Connection to Reprocessing	No
Connection to Long Term Storage	No
References	

Administration Page

List of PIE Facilities in Admin Page









[Add New Facility](#)

[Edit Casks](#)

[Administrative Manual](#)

Results 1-18 of 54



Facility Name	Country	Publish?	Operation	Data Status
AREVA NP GmbH NTCRH-G Hot Cells	Germany	Yes		 OK
ATALANTE-alpha workshop, lab., analyses, transuraniens, reprocessing studies	France	Yes		 OK
Bhabha Atomic Research Centre - PIE Division	India	Yes		 EDIT
Canadian Nuclear Laboratories	Canada	Yes		 REVIEW

- Data update directly by contact points (Coordinators)
- Operation – Add, Delete, Edit
- Status – OK, Edit, Review
- Role: Administrator, Coordinator, Reviewer
- Note:
 - No updates for few years
 - Need to reactivate the updating process

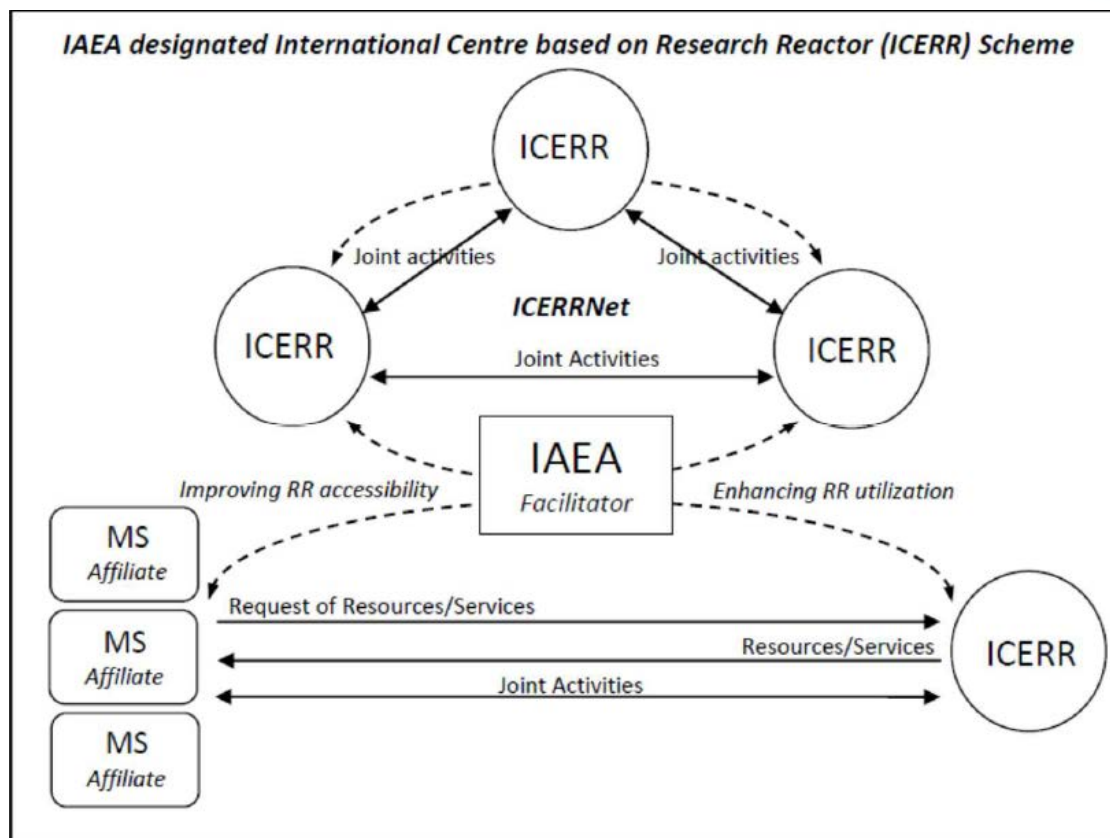
Present Situations

- Irradiation tests and PIE are necessary to demonstrate the acceptable performance of power reactor fuels and to justify the specified maximum burnup for a new design.
- The cost of fuel irradiation tests and PIE is continuously increasing, while the availability of facilities for such activities has steadily decreased in the last decades, resulting in a need for their more efficient use via international collaboration.
- Current collaboration to maintain PIE facilities database could be extended to allow MSs' access to existing facilities. Example → IAEA's ICERR scheme

ICERR (International Centre based on Research Reactors): Overview

Objective:

- To facilitate MSs gain timely access to relevant nuclear infrastructure (e.g. facilities, resources) based on research reactors and their ancillary facilities



ICERR: Scheme



- Designated ICERRs:
 - MSs' organizations that meet designation criteria (logistic, technical, sustainability criteria)
 - Limited to specific areas for which the designation is requested
 - Designation period of 5 years
- Facilitator: IAEA
 - Designate dedicated ICERRs (awarded by DG)
 - Promote enhancing utilization of facilities
 - Foster the collaboration among ICERRs
 - Maintain a network (ICERRNet) that is a gateway to exchange information between ICERRs, Affiliates, IAEA and other MSs)
- Affiliate (users):
 - Use a facility on contractual basis (commercial or in-kind) through bilateral arrangements

Conclusions

- Traditionally, IAEA has supported irradiation tests and PIEs for power reactor fuels via various activities. As part of it, IAEA maintains PIE facilities database.
- Next step for further collaboration in this area may include facilitating MSs' access to existing facilities for training or research purpose.
- Link: <https://infcis.iaea.org/>



IAEA

International Atomic Energy Agency
Atoms for Peace and Development

Thank you!

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