REMPOR Web Application for Access to Site and Technology Information

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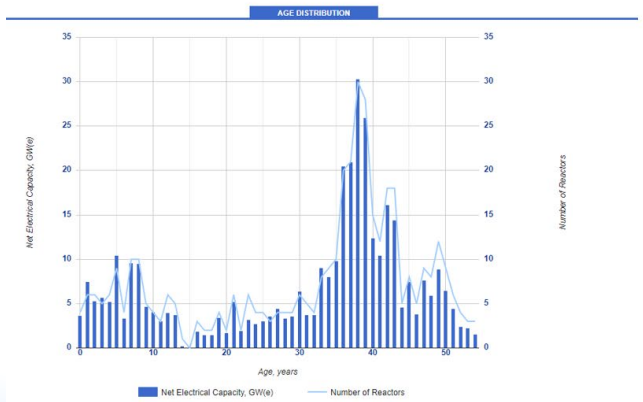
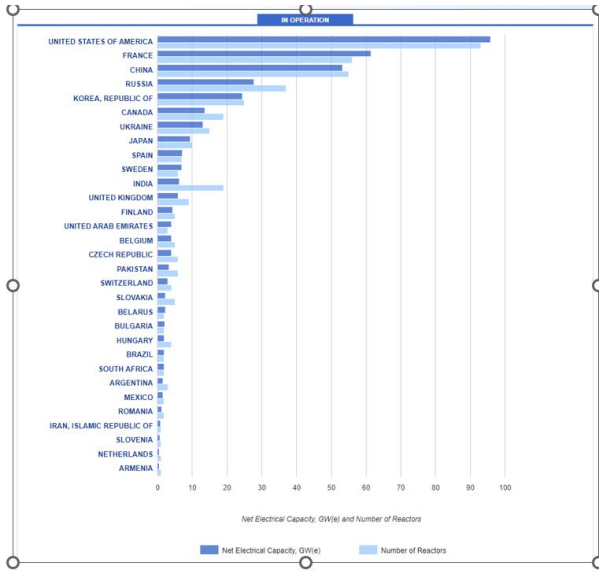
Global Status of Radioactively Contaminated Site Remediation?

- If one asks about the situation regarding the number of nuclear reactors in the world, we know the answer.





- But what about the situation on sites that need remediation?
  - Nuclear or Radiological Accident
  - Test Sites
  - Legacy Sites
    - I.e., without a regulatory framework and which led to the contamination of land, imposing present or potential radiological risks to the public
    - These include:
      - Sites affected by NORM industries
      - Uranium Mining and Milling operations
      - Nuclear Sites (related to nuclear fuel cycle operations, military operations, research operations)

Why is This Information Important?

Multiple reasons:

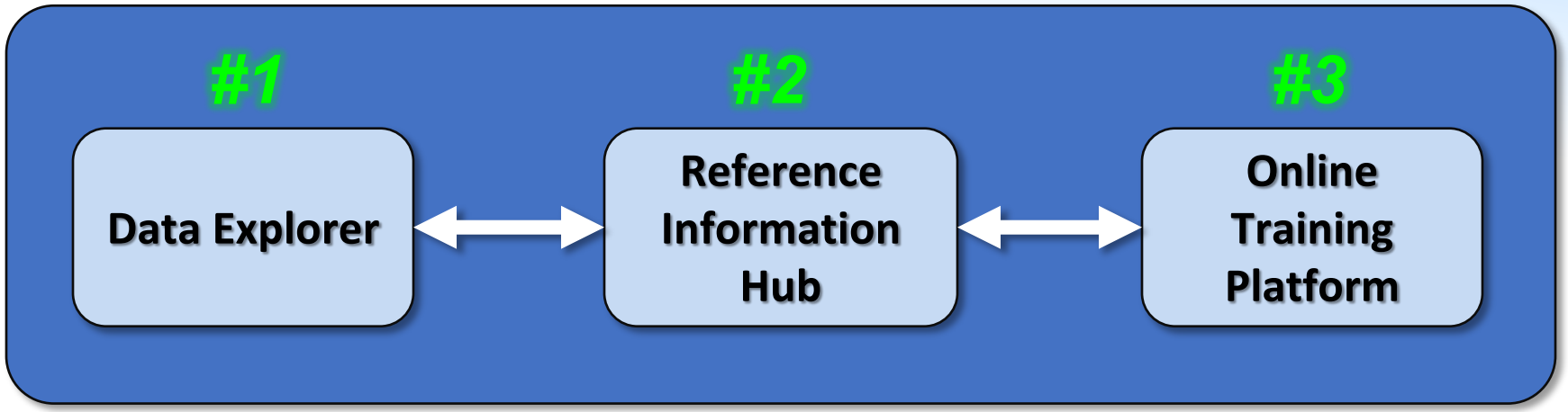
- **Follow-up the long-term progress** of the remediation of these sites
- **Enable communication and collaboration** efforts on all levels
- Facilitate the **prioritization of planning and implementation** (by national institutions and international organizations)
- **Raise awareness** of decision makers
- Assist in **driving global progress** in addressing environmental remediation issues and challenges

REMPOR… Rationale

- Former nuclear fuel cycle activities have left significant environmental footprints (also called legacies)
- There is a need to document the extent of legacy sites worldwide
- Member States need resources/guidance on how to deal with legacy environmental liabilities

Main paradigm: No need to create new information. Rather, can make existing, authoritative information and data available from a central one-stop-shop source…

REMPOR… Concept and Main Components



- **Integration**… Single portal to access data from different sources
- **Interactivity**… Users may share experiences and knowledge
- **Reliability**… Curated data and information collection will direct users to trusted sources, both internal and external to IAEA
- **Learning experience**… Capacity building could be done through high quality content and proper technological solutions

REMPOR… What Is It?

- Portal for remediation related data and resources
- Designed to build Member State capacity for responding to environmental liabilities resulting from uranium mining/processing, nuclear facility operations, accidents, etc
- Envisioned as a multi-element interactive platform...
  - World map and database that can be queried for relevant sites and associated characteristics
  - Information on applied remediation technologies, techniques, costs, challenges, solutions, and supporting scientific information
  - Wide range of resources
    - Technical reports/publications, videos, mathematical models, etc.
  - Training platform with room for interactive exercises
    - eLearning material

REMPOR Data and Linked Databases

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Selection

Layers on/off

Users comments

Charting

Query

Cross-checking

Filtering

Exporting

Adding more databases might be considered (e.g. Safeguards)

API — **Geology** — *World Geology Map*

API — **RBDB** — *Red Book DataBase*

API — **RACSI*** — *RAdioactively Contaminated SIte*s

API? — **UDEPO** — *Uranium & Thorium DEPOsits*

API? — **NFCIS** — *Integrated Nuclear Fuel Cycle Information Systems*

*In development (currently exist as an excel sheet)

Example of RACSI Data

Group	Parameter
Relation	Identification number in RACSI
	Identification number in UDEPO, if exists
	Identification number in NFCIS, if exists
Location	Region
	Country
	Province
	Latitude
	Longitude
Basic information	Site Name
	Synonym Names
	Type
	Size
	Size range
	Start of operation
	End of operation
	Status
Remediation data	Description of environmental contamination and impacts
	Description and comments on remediation strategies
	Contaminants of concern (COCs)
	Impact to environment
	Number of people potentially affected
	Remediation strategies
	Annual cost estimate of environmental remediation efforts
	Total cost estimate of environmental remediation efforts
	Cost range of environmental remediation efforts

SITE ID	ID IN UDEPO	ID IN URS	ID IN NFCIS	NAME	SYNONYM	REGION	COUNTRY	PROVINCE
67	242	256	210	Mounana mine		Central Africa	Gabon	Haut-Ogoué

LATITUDE	LONGITUDE	TYPE	STATUS	SIZE (KM2)	SIZE RANGE	START OF OPERATION	END OF OPERATION
-1.3995	13.1542	Uranium mine	Fully remediated	3.50	1-100km2	1956	1999

TYPE:

- Uranium mine
- Other mine
- Uranium mining region
- Other mining region
- Ore processing plant
- Nuclear power plant
- Other NFC facility
- Defence-related facility
- Nuclear testing site
- Radiological accident site
- Landfill
- Research Facility
- Others

STATUS:

- In operation
- Operational stand by
- Closed
  - Under Decommissioning
  - Decommissioned
  - Under remediation
  - Partially remediated
  - Fully remediated
  - No actions taken
- Orphan

Example of RACSI Data

Group	Parameter
Relation	Identification number in RACSI
Location	Latitude
	Longitude
Basic information	Site
	Syn
	Typ
	Size
	Size
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DESCRIPTION	COCS
Between 1961 and 1999, in the mining district of Mounana in South-East Gabon, the Uranium Mining Company of Franceville, "COMUF", extracted 7.5 Million tonnes of uranium ore with an average grade of 0.38%, from opencast and underground mines. The dynamic processing of this ore in two plants brought into service successively in 1961 and in 1982, produced about 28,000 tonnes of uranium and generated about 7.5 million tonnes of tailings stored in one of the opencast mines (Mounana) after extraction, and in a valley (Gamamboungou) and a thalweg near the factory.	uranium-239, thorium-230, radium-226

DESCRIPTION OF REMEDIATION STRATEGIES	
The remediation and monitoring work on the Mounana site was carried out in three stages: 1. Evaluation of the radiological state of the environment of the installations before remediation (1997); 2. Definition and execution of the work on the areas defined to be decontaminated and restored (1998 - 2000); 3. Setting up radiological monitoring after closure (post 2000).	Engineered Solu

IMPACT TO ENVIRONMENT:

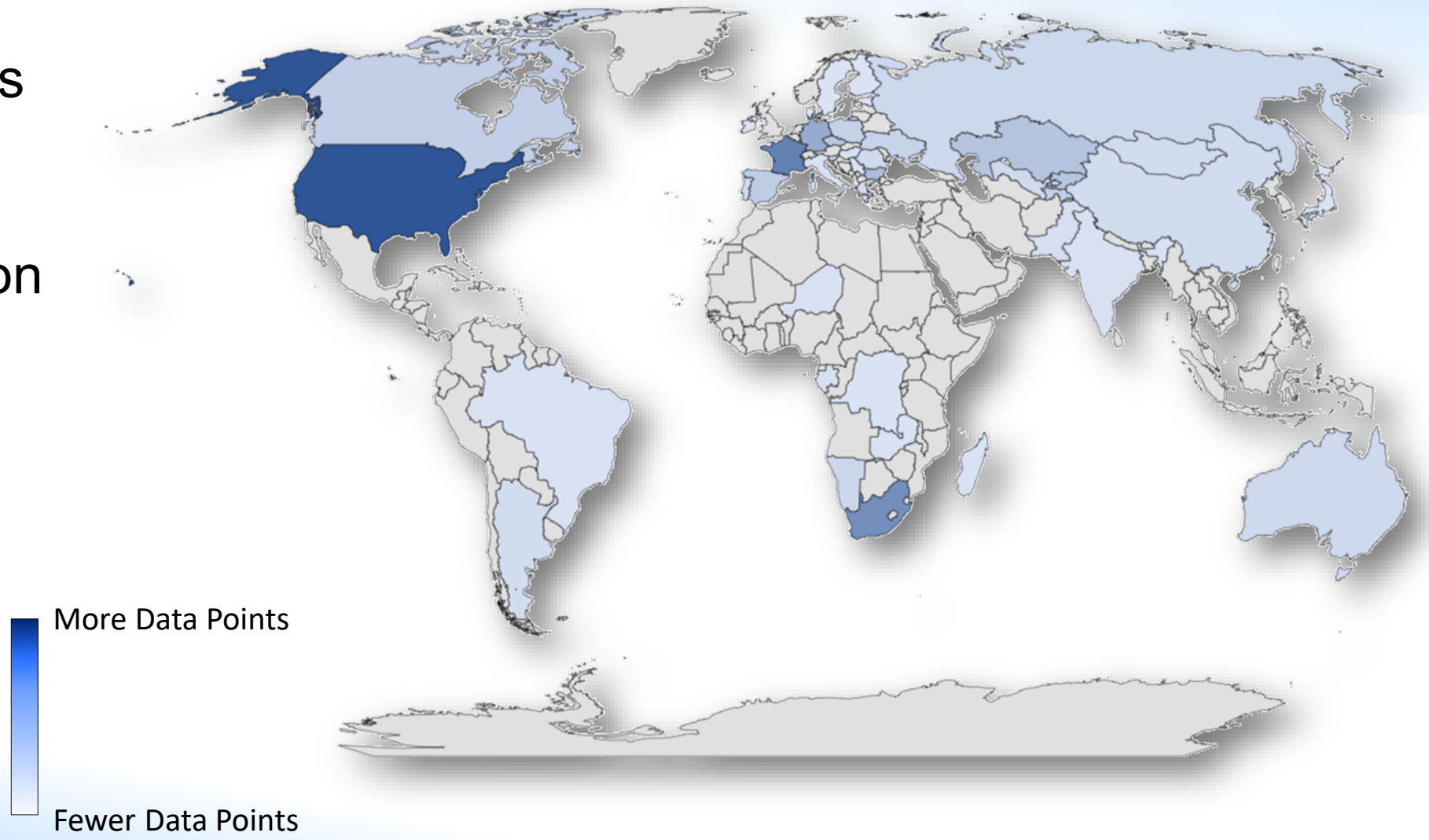
- Soil
- Surface water and sediments
- Marine and seabed
- Groundwater
- Air
- Fauna and flora
- Under analysis
- Biodiversity loss

REMEDIATION STRATEGY:

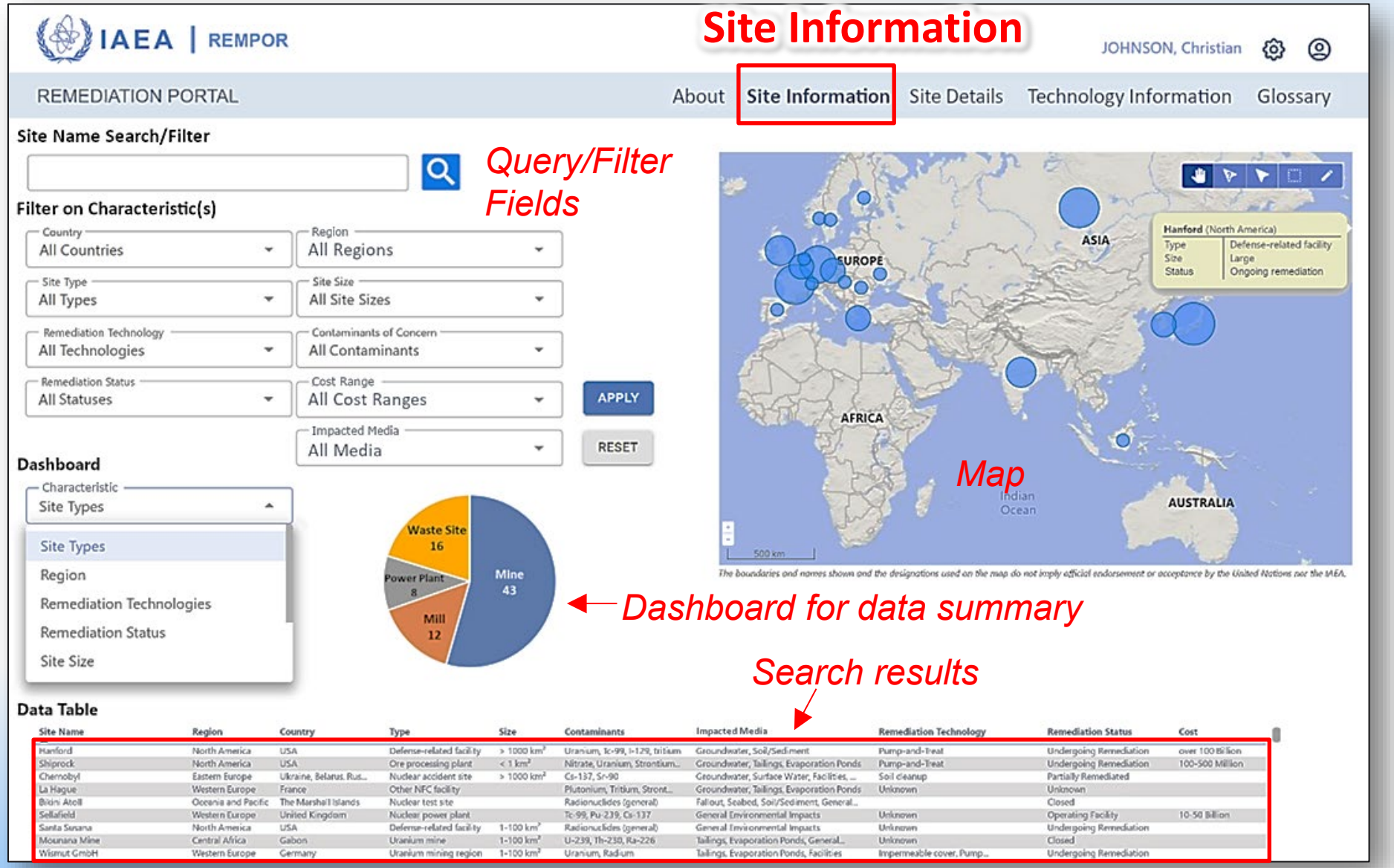
- Ex-situ (Physical/Chemical)
  - sediment capping
  - surface capping
  - dredging
  - soil washing
  - groundwater pump and treat
- In-situ (Biological)
  - monitored natural attenuation
  - phytoremediation
- In-situ (Physical/Chemical)
  - permeable barriers
  - in-situ pH control
  - monitored natural recovery
  - solidification and stabilization
  - soil flushing
  - soil mixing
- Other
  - excavation and off-site disposal

REMPOR… Density of Data Sites Per Country

- Currently, the database includes over 500 site entries, with ongoing expansion



Interface Mock-up – Site Information Query



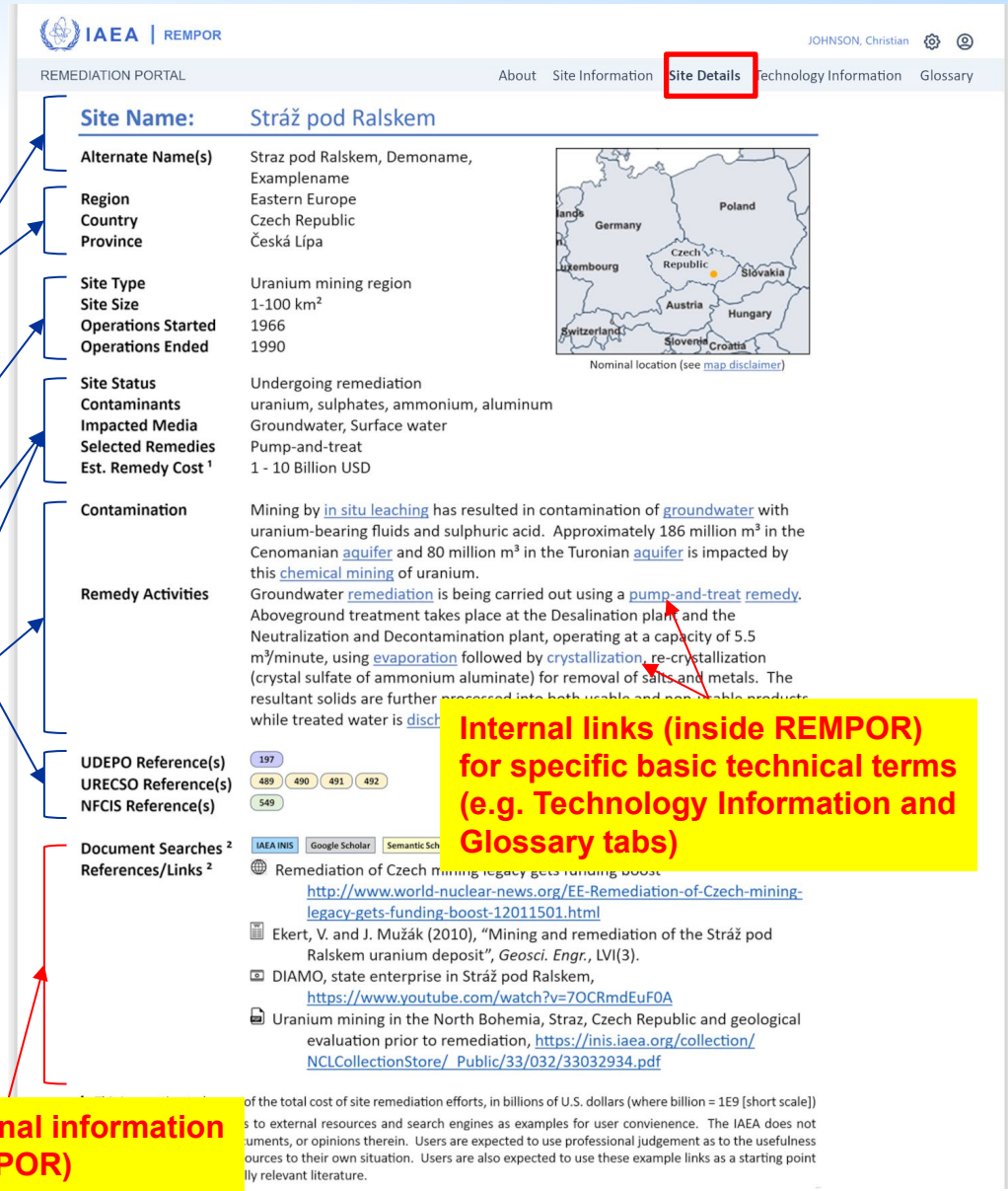
Key features:

- ✓ **Filtering/query** function
  - Select sites via map (e.g. rectangular selection area)
  - Filter based on characteristics
- ✓ Map
  - Site locations displayed as bubbles to indicate the nominal location
  - Pop-up with key summary info
- ✓ Table of site summary information and links to site details
- ✓ Dashboard to summarize site characteristics

Interface Mock-up – Site Details (from RACSI)

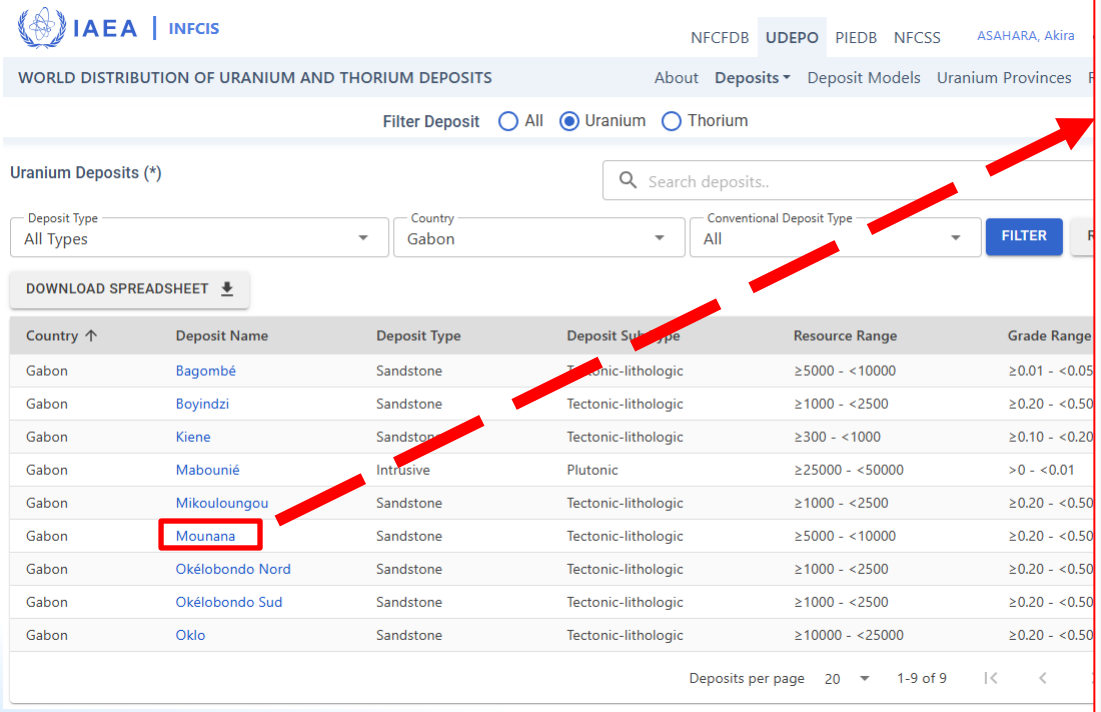
RACSI dataset

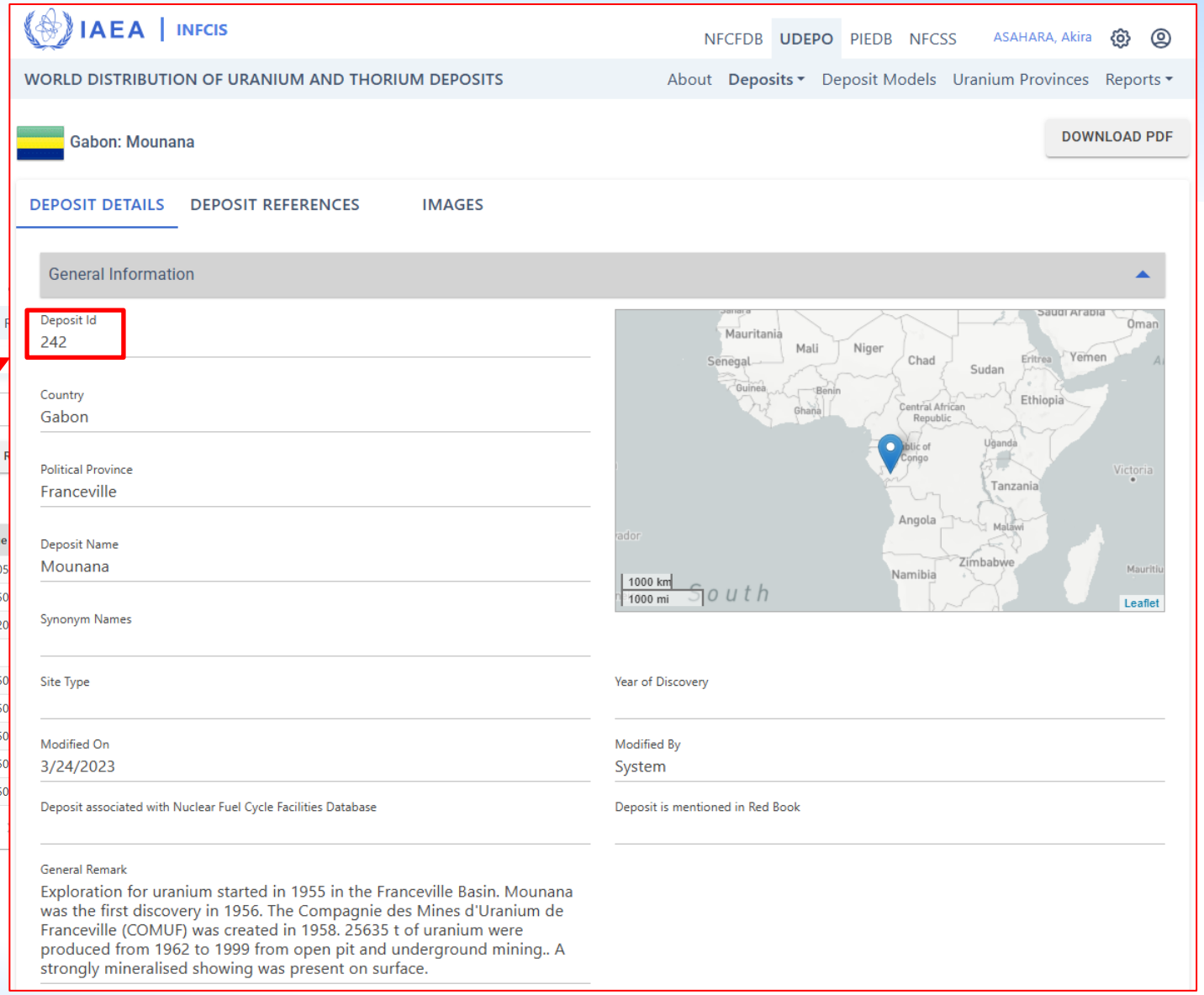
Group	RACSI column name	Parameter for Mock-up
Relation	ID_REMPOR	Identification number in RACSI
	ID_UDEPO	Identification number in UDEPO, if exists
	ID_NFCIS	Identification number in NFCIS, if exists
Location	REGION	Region
	COUNTRY	Country
	PROVINCE	Province
	LATITUDE	Latitude
	LONGITUDE	Longitude
Basic information	NAME	Site Name
	SYNONYM	Alternate Name(s)
	TYPE	Site Type
	SIZE	Site Size *actual data
	SIZE_RANGE	Site Size *range
	OP_START	Operation Started
	OP_END	Operation Ended
	STATUS_RS	Site Status
Remediation data	DESC_CONT	Contamination (descriptions)
	DESC_REM	Remedy Activities (descriptions)
	COCS	Contaminants of concern (COCs)
	IMP_ENVIRO	Impacted Media
	IMP_PPL_AFF	Number of people potentially affected
	REM_STRAT	Selected Remedies
	COST_YEAR	Estimated Annual Cost
	COST_TOTAL	Estimated Remedy Cost (Total) * actual data
	COST_RANGE	Estimated Remedy Cost (Total) *range



UDEPO – Uranium/Thorium Deposits

Example: Mounana Mine (ID: 242)





NFCIS – Nuclear Fuel Cycle Facilities

Example: Mounana Mine (ID: 210)

IAEA | INFCIS

NFCFDB UDEPO PIEDB NFCSS ASAHA

NUCLEAR FUEL CYCLE FACILITIES DATABASE

About Facilities Statistics Cour

List of Nuclear Fuel Cycle Facilities (*)

Search facility..

Country: All | Facility Type: Uranium Ore Processing | Facility Status: Decommissioned | Facility Scale: All

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Country	Facility Name	Facility Type	Fuel Type	Facility Status	Scale	Design Capacity	Start of Operation
Canada	Stanrock	Uranium Ore Processing		Decommissioned	Commercial	300 t U/year	
Czech Republic	MAPE Mydlovary Processing Plant	Uranium Ore Processing		Decommissioned	Commercial	0 t U/year	962
France	Bessines	Uranium Ore Processing		Decommissioned	Commercial	00 t U/year	1958
France	L'Ecarpiere	Uranium Ore Processing		Decommissioned	Commercial	650 t U/year	1957
France	Le Cellier	Uranium Ore Processing		Decommissioned	Commercial	300 t U/year	1977
France	Le Bernardan (Jouac)	Uranium Ore Processing		Decommissioned	Commercial	600 t U/year	1979
France	St. Martin Du Bosc (L...e)	Uranium Ore Processing		Decommissioned	Commercial	1000 t U/year	1981
Gabon	Mounana	Uranium Ore Processing		Decommissioned	Commercial	1500 t U/year	1977
Germany	Crossen Uranium Ore Processing Plant	Uranium Ore Processing		Decommissioned	Commercial	2000 t U/year	1951
Germany	Seelingstaedt Uranium Ore Processing Plant	Uranium Ore Processing		Decommissioned	Commercial	3000 t U/year	1960

Facilities per page 10 | 11-20 of 60

(*) Please note that the list might not include all of the facilities in the world due to the unavailability of the data.

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NFCFDB UDEPO PIEDB NFCSS ASAHARA, Akira

NUCLEAR FUEL CYCLE FACILITIES DATABASE

About Facilities Statistics Country Reports Help

Mounana

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FACILITY DETAILS REFERENCES ATTACHMENTS

General Information

Country: Gabon

AEA Ref No: 210 - MILL

Province: Haut Ogooue

Site: Franceville

Last updated data source: 01 January 2002

Last Update: 31 December 2003

Data Source: OECD/IAEA Uranium 2001: (Redbook)

Technical Information

Facility Category Type: Mining and Milling

Facility Type: Uranium Ore Processing

Scale: Commercial

Status: Decommissioned

Operation Start Year: 1977

Operation End year: 1999

Remark:

Design Capacity: 1500 *t U/year*

Process: Open Pit and Underground, Acid Leaching / SX

Feed Material: Uranium Ore

Product Material: Yellow Cake

By Product:

URECSO – Reclaimed Uranium Inventories

(e.g. Waste rock, Mill tailings, Sludges etc.)

Example: Mounana Mine (ID:256)

Database ID	Region	Country	No.DataPnt	MineSite	UDEPODepName	UDEPODepID	MineSiteStatus	Details
256	Africa	Gabon	1	Mounana	Mounana	242	Remediation Ongoing	Open pit, Underground

Mass	Unit (mass)	TailingMax	HeapLeachVol	OtherWast	UWasteInfo	UCntnt	Unit	UraniumStoc	Mineralogy	Source	FurtherRef	Initial Database ID
6.5	10^6 tons				NO					WISE (2020	http://www.wise-uranium.org/uddafr.html#CDTAILINGS	

OreGrade(%)	ProdTot [tU	ProdDets	WasteSite	GPS coordinates (	GPS coordinates	WasteStatus	WasteStatusDetails	RprtdWasteType
0.37	5760			-1.24306	13.093085	Remediation Ongoing		Mill Tailings

Interface Mock-up – Technology Information & Glossary

Technology Information

IAEA | REMPOR

JOHNSON, Christian

REMEDIATION PORTAL | About | Site Information | Site Details | **Technology Information** | Glossary

Remediation Technology Search

Remediation Technology Information

This page provides information on remediation technologies. The information here is intended as a summary to help inform the user and point to potentially useful resources external to the IAEA.

The IAEA is providing links to external resources and search engines as examples for user convienence. The IAEA does not endorse specific tools, documents, or opinions therein. See full Disclaimer.

Technology Name: Pump-and-Treat

Description

Pump-and-treat (P&T) is a widely applied remedy for groundwater remediation at many types of sites for multiple types of contaminants. Decisions regarding major changes in the remediation approach are an important element of environmental remediation management for a site using P&T. While existing guidance documents provide information on design, operation, and optimization for P&T systems, these documents do not provide specific technical guidance to support remedy decisions regarding when to transition to a new remedy or to initiate closure of the P&T remedy. A structured approach for P&T performance assessment was developed and is described herein, using analysis of three example P&T systems. These examples highlight key aspects of the performance assessment decision logic and represent assessment outcomes associated with optimizing the P&T system, transitioning from P&T to natural attenuation, and supplementing P&T with another technology to hasten transition to natural attenuation.

REMPOR Site Database

See a list of sites that use this technology: Site Query

Publications and Publication Searches

Searches: IAEA INIS | Google Scholar | Semantic Scholar | Science Direct

- J.W. Mercer, D.C. Skipp, and D. Giffin (1990). *Basics of Pump-and-Treat Ground-Water Remediation Technology*, U.S. Environmental Protection Agency, EPA/600/8-90/003. https://semspub.epa.gov/work/11/174485.pdf
- M. Truex, C. Johnson, T. Macbeth, D. Becker, K. Lynch, D. Giaudrone, A. Frantz, and H. Lee (2017), "Performance Assessment of Pump-and-Treat Systems," *Groundwater Monitoring & Remediation*, 37(3):28-44. https://doi.org/10.1111/gwmr.12218
- ITRC (2023), *Performance-Based Optimization of Pump and Treat Systems*. https://pt-1.itrcweb.org/introduction/
- ScienceDirect Topic Overview, "Pump and Treat." https://www.sciencedirect.com/topics/earth-and-planetary-sciences/pump-and-treat

Web Pages

- FRTR, "Groundwater Pump and Treat," https://frtr.gov/matrix/Groundwater-Pump-and-Treat/
- Public Services and Procurement Canada, "Fact sheet: Pump and Treat," https://gost.tpsgc-pwgsc.gc.ca/tfs.aspx?ID=44&lang=eng

Glossary

IAEA | REMPOR

REMEDIATION PORTAL | About | Site Information | Site Details | Technology Information | **Glossary**

Glossary

This page provides a glossary of terms related to environmental remediation in the context of IAEA. Terms are taken from the following sources.

[1] IAEA Nuclear Safety and Security Glossary, 2022 (Interim) Edition

[2] External sources were used for this term, such as the Federal Remediation Technologies Roundtable (http://www.frtr.gov), the U.S. Environmental Protection Agency CLU-IN (https://www.clu-in.org/), Enviro Wiki (https://www.enviro.wiki), and other similar resources.

Remediation [1]

Any measures that may be carried out to reduce the radiation exposure due to existing contamination of land areas through actions applied to the contamination itself (the source) or to the exposure pathways to humans.

- Complete removal of the contamination is not implied.
- The use of the terms cleanup, rehabilitation and restoration as synonyms for remediation is discouraged. Such terms may be taken to imply that the conditions that prevailed before the ...ved again and unconditional use of the land areas can be restored, ...e (e.g. owing to the effects of the remedial action itself). Often ...remediation is used to restore land areas to conditions suitable for limited use under institutional control.
- Remediation can entail activities that are similar to decommissioning; both remediation and decommissioning activities are typically performed under an authorization. Abandoned and presently unauthorized industrial sites, such as former uranium mines and mills and former radium processing facilities, may have buildings and structures that are taken down by actions consistent with the decommissioning process (e.g. decontamination and dismantling); however, such activities are considered to be a part of site remediation. [1] In some contexts (e.g. the wider chemical industry), the terms remediation and restoration are used to describe different parts of overall recovery.
- The term cleanup is used in the context of decommissioning.

Federal Remediation Technologies Roundtable (FRTR) [2]

...e atmosphere ...lished in 1990 to ...munity ...ir impact on the ...ograms, and

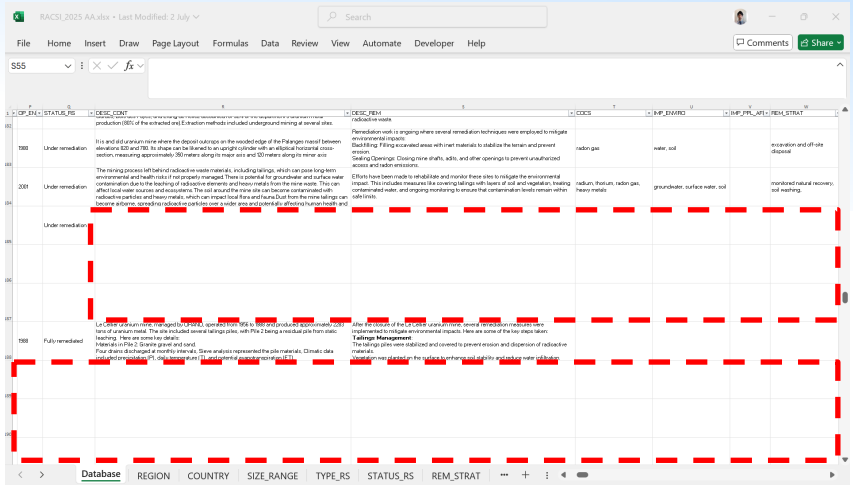
What sites use this technology?

Links to select publications, publication searches (e.g., IAEA INIS, Science Direct), 'reliable' external websites (e.g., FRTR, CLU-IN, Nuclear Wiki) and e-learning resources (e.g., IAEA CONNECT, YouTube)

Ongoing Tasks and Future Plans

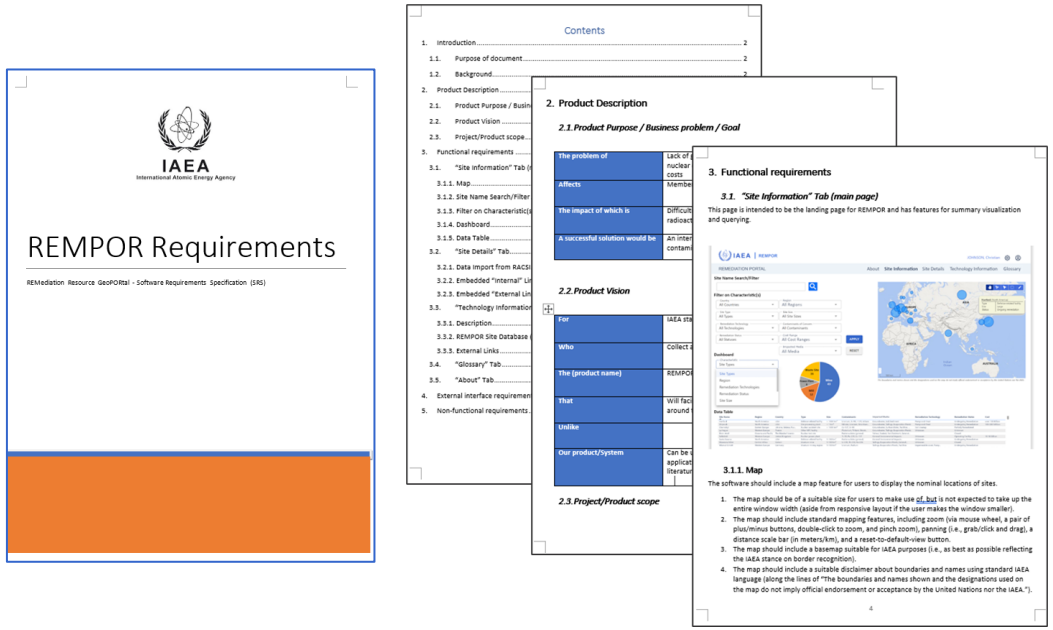
1) Compiling and cleaning data for current and additional sites

- Adding more sites, using AI to help collect data, with human data curation
- Improving quality of current dataset with respect to completeness and consistency



2) Developing the Prototype Web Application

- IAEA IT infrastructure team is developing the web application based on the design, requirements, and database structure



3) Conceptualization of AI/ML applications

- Refined collection of site information
  - Customizable retrieval augmented generation
  - Semantic filters and decision trees for site comparisons