International Fast Reactor Knowledge Organization System

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International Conference on Fast Reactors and Related Fuel Cycles (FR09): Challenges and Opportunities
7-11 December 2009, Kyoto, Japan
To capture, preserve, maintain and share with interested Member States knowledge on Fast Reactors which exists on national level and complement current and future Member States’ nuclear knowledge capacity.
Fast Reactor Knowledge Partnership

Data, Information and Knowledge Holders
- IAEA
- Japan
- USA
- India
- Germany
- France
- Russia
- UK
- China

General Principles:
- Electronic Documents Access
- Sharing and commercial access
- Taxonomy

Links to other Knowledge Resources

END USER

IAEA FR KOS
KNOW WHAT
and
KNOW WHERE

Information and/or metadata
To develop a Knowledge Organization System into which existing national knowledge and information systems will fit, and which will complement and integrate current and future Member States’ efforts to preserve fast reactor data and knowledge.
FR KOS Motivation factors

- Continuing knowledge loss over decades
- Research and Development
- Nuclear Education, scientists and students
- From Nuclear Renaissance to Fast Reactors Innovative Renaissance, FR09
- Developed countries, Developing countries, Nuclear Newcommers
FR Knowledge Preservation Initiative

- **Contributors:**
  - Participating Member States: China, France, Germany, Japan, Russia, UK, USA, India

  - Role of the IAEA

  - New members are welcome

- **Common approach:**
  - System requirements and implementation
  - FR Knowledge Domain
Fast Reactors Knowledge

Technology development

R& D
- Reactor Physics
- Fuel and Materials
- Heat Transfer System Testing
- Pipe Integrity Testing
- Seismic Design
- Accident analysis
- Sodium Fire Testing
- Beyond design Basis Events

Design & Licensing
- General System Criteria
- Standards
- Core design
- Dynamic Analysis
- System design Description
- Demonstration of Safety
- Project Cost analysis

Manufacturing & Construction
- Site Development
- Plant Assembly
- Components Manufacturing
- Balance of plant

Operation
- Cold Start up
- Low power commissioning
- Fuel power operations
- Maintenance
- Off-normal and emergency operation

Decommissioning
- Planning
- Experience
NE Series Report NG-T-6.3 defines
- Taxonomy
- Basic Requirements
for
Fast Reactor Knowledge Organization System
Fast Reactor Taxonomy

- **Fast Reactor Taxonomy** is
  - a hierarchical model
  - of knowledge domain
  - in the field of Fast Reactor Science and Technology
Fast Reactor Taxonomy

- Covers
  - all possible types of fast reactors
  - all aspects of fast reactors
  - all stages of implementation of fast reactor technology

- Based on 2 dimensional matrix (2 top levels):
  - stages of implementation
  - technology elements
- **Fast Reactor Topic Trees** are digital implementation (in knowledge organization system) of Fast Reactor Taxonomy.
- **Topic trees**
  - are predefined queries
  - organized in tree-like form
  - with the purpose of searching on Fast Reactor (FR) Knowledge Base (KB)
  - are available to end users as a shared resource
  - encapsulate a hierarchical structure the expert’s knowledge
Fast Reactors Knowledge – Where to get?

- **WHAT?**
  - we know what we want to find
    (Topic Trees)

- **WHERE?**
  - where can we search for that knowledge?
    (KR)
Sources of the FR Knowledge
- Member States
- INIS and other Information and Knowledge Systems
- Topical events
- Internet
- NuArch (future prospective)

Information types
- Limited to Metadata
- Full texts or availability in metadata
Fast Reactor Knowledge Repository

Groups in Repository
- Metadata
- Full texts
- Language
- Sources/MS
- Type of sources

Can be selected individually for further processing
- Topic trees include intellectual rules how to filter documents based on the selected
  - Topic Tree
  - Document repositories
### Document Search – How it works?

#### Selected Repositories
- KfK-Karlsruhe-English
- KfK-Karlsruhe-French
- KfK-Karlsruhe-German
- IAEA-Fast-Research
- IAEA-KRNH
- Abstract
- Full Text
- IAEA-Technical-Document

#### Metadata
- Query: 
  - Required: Yes
  - Max Number of Documents: 400
  - Minimal Score: 0
  - Query Type: Simple Query

#### Results: Documents found

<table>
<thead>
<tr>
<th>Rank</th>
<th>Score T</th>
<th>Title</th>
<th>Date</th>
<th>Source</th>
</tr>
</thead>
</table>
| 1    | 0.59    | Advanced heavy water reactor (AHWR) | 2006-01-01 | IAEA-Technical-Doc-Abs
| 2    | 0.58    | LHWR core and heat exchanger thermohydraulic design: former USSR and present | 1999-01-01 | IAEA-Technical-Doc-Abs
| 3    | 0.56    | System-integrated design | 2006-01-01 | IAEA-Technical-Doc-Abs
| 4    | 0.56    | Fast reactor core design | 2000-01-01 | IAEA-Technical-Doc-Abs
| 5    | 0.56    | Final design status of fast reactor | 1992-01-01 | IAEA-Technical-Doc-Abs
| 6    | 0.56    | Fast reactor core design | 1992-01-01 | IAEA-Technical-Doc-Abs
| 7    | 0.56    | R and D VHRP thermal-hydraulic core design | 2004-01-01 | IAEA-Technical-Doc-Abs
| 8    | 0.56    | Thermal-hydraulic core design | 2004-01-01 | IAEA-Technical-Doc-Abs
| 9    | 0.55    | HELIOS for thermal-hydraulic behavior of PWR cooled fast reactor PEACER | 2006-01-01 | IAEA-Technical-Doc-Abs
| 10   | 0.55    | Thermal-hydraulic core design | 2006-01-01 | IAEA-Technical-Doc-Abs
| 11   | 0.54    | Neutronics and thermal hydraulics of the CANDU reactor | 1999-01-01 | IAEA-Technical-Doc-Abs
| 12   | 0.54    | Experimental and numerical studies of thermal-hydraulics of reactor elements | 2003-01-01 | IAEA-Technical-Doc-Abs
| 13   | 0.54    | Development strategy of advanced and future PWR | 2003-01-01 | IAEA-Technical-Doc-Abs
| 14   | 0.53    | PACTEL passive safety injection experiments and APRS code analysis | 2002-01-01 | IAEA-Technical-Doc-Abs
| 15   | 0.53    | Preserving safety margins with planned power uprates at Paris BPR | 2004-01-01 | IAEA-Technical-Doc-Abs
| 16   | 0.53    | The MPR integral reactor: Maintenance and cost evaluation for ship application | 1997-01-01 | IAEA-Technical-Doc-Abs
| 17   | 0.52    | An autonomous nuclear power plant with integrated nuclear steam supply system | 1997-01-01 | IAEA-Technical-Doc-Abs
| 18   | 0.52    | Fast reactor core design | 1995-01-01 | IAEA-Technical-Doc-Abs
| 19   | 0.52    | Research reactor core conversion from the use of highly enriched uranium to the use | 1985-01-01 | IAEA-Technical-Doc-Abs
| 20   | 0.51    | Fast reactor database | 2006-01-01 | IAEA-Technical-Doc-Abs
| 21   | 0.51    | Flows calculations for BWR | 2003-01-01 | IAEA-Technical-Doc-Abs

**Total number of documents:**

**Documents found:**

**Documents found !!!**
Documents from the result list can be:

- exported in different format (XML, HTML, text) which can be analysed further
- made available for Member States
- used by subject matter experts (SME)
FR KOS – Knowledge Mining and Analytics

List of matched words (highlighted) in the selected document

Query in Time – Distribution of the retrieved documents in function of time (year)
FR KOS – Summary Graph

Visualisation of the results of the queries in combination with different metadata (Source or Date), e.g. queries within years.
### FR KOS – Cross Matrix

<table>
<thead>
<tr>
<th>Title</th>
<th>Date</th>
<th>b-2</th>
<th>b-2-2-manufactu</th>
<th>b-2-1-basic-pri</th>
<th>b-2-6-operation</th>
<th>b-2-5-decommis</th>
<th>b-23-design-an</th>
<th>b-23-design-ed</th>
<th>b-22-operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>FENNEC: A fast and simple computing code for FEM calculations</td>
<td>1992-01-01</td>
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<td>Pressing safety margins with planned power unit</td>
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<tr>
<td>An autonomous nuclear power plant with integrated control system</td>
<td>1997-01-01</td>
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<td>0.40</td>
<td>0.40</td>
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<td>System integrated modular advanced reactor (SIMARR)</td>
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<td>Fast reactor core thermal hydraulic analysis during</td>
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</tr>
<tr>
<td>A review on the Indian fast reactor programme</td>
<td>1995-01-01</td>
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</tr>
<tr>
<td>Experimental and numerical studies on thermal hydrodynamic</td>
<td>2003-01-01</td>
<td>0.45</td>
<td>0.40</td>
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<td>0.40</td>
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<tr>
<td>Advanced heavy water reactor (AHWR)</td>
<td>2006-01-01</td>
<td>0.45</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
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</tr>
</tbody>
</table>

**Number of documents matching all the possible permutations by two queries (or topics):**

- b-2 [214]
- b-2-1-basic-pri [3]
- b-2-2-manufactu [22]
- b-2-6-decommis [1]
- b-2-5-operation [21]
- b-23-design-an [184]
- b-23-design-ed [10]
- b-2-2-operation [71]

**Documents matching the selected element of the Cross Matrix:**

- b-2-1-basic-pri
- b-2-2-manufactu
- b-2-5-operation
- b-2-6-decommis
- b-23-design-an
- b-23-design-ed
- b-2-2-operation
FR KOS – Knowledge Mining and Analytics
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Number of Documents per Topics per Repositories
FR KOS – Knowledge Mining and Analytics

Number of Records per Country
FR KOS – Knowledge Mining and Analytics

Number of Records per Author
FR KOS – Knowledge Mining and Analytics

Authors and Presentations
Contributions to FR KOS (Content)

- IAEA Contribution
  - 3 collections:
    - KNK-II, IAEA-TECDOCS, INIS Fast Reactors records
    - 50 000 metadata records, 9 000 full texts

- Member States
  - China, France, Germany, India, Japan, Russia, UK, USA
  - ?
Fast Reactors Knowledge Preservation (FRKP)
  - A unique experience to preserve comprehensive knowledge for future generations
  - International innovation in knowledge management technology

Fast Reactor Knowledge Taxonomy
  - Unique and Single in the Nuclear World
  - 2,000 elements cover R&D, Design, Operation, Maintenance, Decommissioning and all fast reactor technology elements as well;

IAEA contribution to Knowledge Base
  - 50,000 metadata records; 9,000 full texts

Contribution from Member States
  - Russia submitted more than 500 records; format is a challenge
  - Contribution from other Member States is being encouraged

Interest for Countries introducing Nuclear Power
  - Capacity building and Intellectual Capital

Available for all participating members
Future KOS Opportunities

Nuclear Power Knowledge System

IAEA

- GCR
- PWR
- BWR
- WWER
- CANDU

Fast Reactors
Prepared by

Nuclear Knowledge Management Unit (NKM Unit),
INIS&NKM Section,
Department of Nuclear Energy,
International Atomic Energy Agency

http://www.iaea.org/NuclearKnowledge/