

**Consultancy Meeting  
for the  
Coordinated Research Project  
on  
Comparative Analysis of Methods and Tools for Nuclear  
Knowledge Preservation**

21-25 November 2005, Vienna, Austria

***Meeting Report***

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## **Purpose of the meeting**

The propose of this Consultancy Meeting was to advise the International Atomic Energy Agency on the implementation of the newly approved Coordinated Research Project (CRP) on *Comparative Analysis of Methods and Tools for Nuclear Knowledge Preservation*.

## **Background**

In response to long-term energy scenarios, it is necessary to preserve and maintain the accumulated knowledge in nuclear science and the nuclear industry. Within these scenarios is the reality of ageing of the human workforce in the nuclear sector and the sharp decline in the number of entrants to education and training in nuclear science and engineering.

The challenge of the IAEA to this reality is to enhance the capacity of Member States to maintain and preserve the information and knowledge resources related to the peaceful use of nuclear energy. This knowledge could be tacit and/or explicit. Appendix A lists examples of tacit and explicit knowledge that need to be preserved. Finally, the need to manage, access and preserve this knowledge across human generations (30 years) and even nuclear facility lifetimes (over 60) years extends the challenges for the CRP.

Implementation of the recommendations and conclusions from this CRP may be difficult due to resources, legal factors and legacy systems, but nevertheless the goal of nuclear knowledge preservation should be permanent access and knowledge resource interoperability that will allow knowledge sharing for as long as the knowledge remains useful.

This Coordinated Research Project was started in the IAEA Program for the period 2004-2005 and continues for the 2006-2007, Programme C, Capacity Building and Nuclear Knowledge Maintenance for Sustainable Energy Development, Section C.3, Nuclear Knowledge Management and Section C.3.03, Maintenance and preservation of knowledge in specific areas of nuclear science and technology, specifically “a CRP on knowledge preservation technologies leading to archiving of information”.

## **Objectives**

The objectives of the consultancy were:

1. to review the CRP's Terms of Reference, research framework and specific research topics, and
2. to develop the survey form on current status of knowledge preservation to establish a baseline source of information on nuclear knowledge management in IAEA countries; and identify institutions to be surveyed.

## Work done

The meeting was opened by Mr. Workman, SH INIS&NKM Section. Ms. Carroll, USA, was asked to Chair the meeting. Opening remarks and background information were given by senior managers Messrs. Yanev, Tolstenkov, Kosilov and Gowin who are responsible for Knowledge Management and the CRP specifically.

Presentations were given by participants from Canada, EC (JRC Petten), Russian Federation, Bulgaria, Kazakhstan and the USA. An additional presentation was given by Messer. C. Tuniz, International Centre for Theoretical Physics (ICTP), Trieste, Italy. The presentations by the consultants focused on either the proposals already submitted to the CRP or on knowledge management activities more generally. A list of meeting participants is attached to this report (Attachment 1). Presentation materials are available in electronic form from the office of the Scientific Secretaries Messrs Kosilov and Gowin.

The consultants felt that the outcome of the CRP should advance the knowledge preservation for the nuclear community to positively impact on:

- Safety and security;
- Cost reduction (reduce duplication of investment);
- Equity;
- Auditability (legal sense);
- Standardization (both formal and cooperative);
- Quality of operations;
- Awareness of these values that preservation of knowledge helps to achieve.

The consultancy was held in preparation of the formal start of the CRP and also in support of the reviewing the focus of the first proposals that have been submitted by Member States. This would provide guidance to the Agency on whom and in what specific areas it may want to encourage additional proposals. The experts at the preparatory meeting were also asked to prepare the first draft of the survey of the Nuclear Knowledge Preservation which is called for in the CRP.

## General Recommendations

The consultancy advised the Agency on the following items:

### **Create a narrower focus area for the CRP**

The objectives and overall concept of the CRP is an important step in meeting the outcomes. However, because nuclear knowledge is so broad, focusing the CRP on a particular area of the nuclear business would facilitate the likelihood that practical outcomes could be achieved. Given the members of the consultants team and the history of knowledge management initiatives already in progress at the Agency (e.g. Trieste IAEA Workshop on Managing

Nuclear Knowledge held in August 2005 and the upcoming Technical Meeting on Knowledge Management for Nuclear Power Plant Operating Organizations meeting in Vienna to be held 28 November – 2 December 2005), the area “nuclear power and related sciences” was recommended as the initial focus area. To the extent that other applications or more basic R&D can be connected to the knowledge needed by nuclear power organizations, proposals would be helpful. It was also recognized that the results of the CRP should easily be extensible to other areas of the broader area of nuclear knowledge, especially because tools, methods and technologies can be applied to other knowledge domains.

### **Provide examples of types of tacit and explicit knowledge**

As indicated in the CRP, both tacit and explicit knowledge (Appendix A) should be considered. The table was prepared to provide examples, intended to be indicative and not restrictive.

### **Review of the CRP’s terms of reference and topical areas for the CRP**

The terms of reference for the CRP was reviewed in detail (Attachment 2) and the research framework and specific research topics were edited and clarified. Expected contributions to the CRP could include both experience and ongoing work in introducing knowledge preservation and knowledge management tools in an organization, i.e. a process, and in the required IT infrastructure and technology. The CRP can thus comprise both methods (processes and approaches) as well as technologies in the subject area.

The consultants divided the framework into two areas of research to address knowledge management and preservation (descriptions are meant to be indicative and not all inclusive):

1. All aspects of the life cycle of knowledge; and
2. Management processes that are integral to the institutional structure in which the knowledge management systems function.

These recommendations are included in the revised CRP’s terms of reference provided as Attachment 2. Steps in the knowledge preservation life cycle and other factors will be considered that are essential for the successful implementation of nuclear knowledge preservation (Appendix B).

### **Identification of Potential CRP’s Participant Organizations**

Apart from CRP potential participants who have already submitted proposals and those present in the meeting, the Consultants identified other potential participants. This was done by identifying kinds of organizations which have a significant requirement for managing nuclear knowledge, especially in the area of nuclear power. A table was created that shows how the proposals already submitted fit into these categories according to country. The consultants then suggested which countries and example organizations could be encouraged to submit additional proposals. These suggestions are attached to this report (Attachment 3). Consultants agreed to provide Mr. Kosilov names and contact information to complete that list.

### **Survey on current status of knowledge preservation in nuclear and supporting organizations**

As main tool for identifying presently used knowledge preservation methods and tools, participants drafted a model for the survey to be sent to a broad set of institutions included in

Attachment 3 to establish a baseline source of information on nuclear knowledge management in IAEA countries. The model survey form is attached to this report as Attachment 4.

The survey should also serve the purpose of identifying expertise outside the CRP Team for consulting advice. Consideration should be given to asking CRP participants to retake the survey after completion of the CRP to test if there has been any progress made (before and after CRP comparison).

## Results Achieved

The consultancy meeting achieved all objectives stated above. The following products were produced during the Consultants Meeting:

- a modified terms of references, Rev. 1, for the CRP (Attachment 2) including clarification on additional focus and recommendations for areas of research cooperation (Appendix B);
- list of potential participants and questionnaire recipients for the survey (Attachment 3); and
- model survey form for the “Current Status of Knowledge Preservation in Nuclear and Supporting Organizations” (Attachment 4).

Consultants agreed to provide Mr. Kosilov names and contact information for possible participants according to the Table in Attachment 3. The model survey form (Attachment 4) will be sent as soon as possible to a broad set of institutions (Attachment 3) to establish a baseline source of information on nuclear knowledge management in IAEA countries.

## Conclusion and Recommendation

Participants appreciated the opportunity to discuss the topic and felt that they had learned a lot from the discussions. Valuable information was exchanged, and, as a result, some consultants will revise their proposals to better reflect the desired outcomes of the CRP. The participants to this Consultants Meeting believe that work products developed during the consultancy will be helpful in gaining additional CRP participation and in focusing the CRP to advance the understanding and capabilities of nuclear knowledge preservation.

They concluded that the CRP should have as an initial focus area the “nuclear power and related sciences” mainly because other applications or more basic R&D can be connected to the knowledge needed by nuclear power organizations. Steps in the knowledge preservation life cycle and other factors will be considered that are essential for the successful implementation of nuclear knowledge preservation.

The recommendations made by the consultancy should form the basis for the 1<sup>st</sup> CRP Meeting on “Comparative Analysis of Methods and Tools for Nuclear Knowledge Preservation” which will be held in November 2006.

# ATTACHMENT 1

## LIST OF PARTICIPANTS

Mr. Vladimir SIVOKON  
RRC "Kurchatov Institute"  
RUSSIAN FEDERATION

Ms. Marzhan IDRISOVA  
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### **IAEA Participants**

Mr. R. Workman  
Mr. Y. Yanev  
Mr. A. KOSILOV  
Mr. P. GOWIN  
Mr. E. Levine

## **ATTACHMENT 2**

### **Terms of Reference Rev. 1**

#### **1. Title of Co-ordinated Research Project:**

Comparative Analysis of Methods and Tools for Nuclear Knowledge Preservation

#### **2. Executive Summary:**

The objective of the Coordinated Research Project (CRP) on Comparative Analysis of Methods and Tools for Nuclear Knowledge Preservation is to support the preservation of nuclear knowledge in Member States and the IAEA by selection and implementation of appropriate cost-effective technological solutions.

The objective will be reached through coordinated research and analysis by a CRP Team (members from participating organizations) that will identify alternative knowledge preservation methods and the tools necessary to capture, process, organize, store, retrieve, exchange and communicate knowledge. Special consideration must be given to issues associated with multilingualism, version control and knowledge updates, quality assurance and knowledge organization structures.

Various types of information and media will be considered, including numerical, graphical and textual data, databases, computer programs, video and multimedia, as well as tacit knowledge. The IAEA will require research and analysis in multiple disciplines identifying and overcoming the existing incompatibilities among data formats, software systems, methodologies, standards and models in Member States.

Based on the result of the comparative analysis, recommendations/solutions and benchmarks for nuclear knowledge preservation will be developed. Alternative solutions will be indicated due to the technology gaps among Member States. These alternatives will facilitate interoperability, knowledge exchange and integration, improve the present understanding of various technological aspects of nuclear knowledge preservation and increase the efficiency of nuclear knowledge preservation projects in the IAEA and Member States.

Although the output of this CRP should be general applicable to all nuclear knowledge domains, the focus of this CRP will be on nuclear power and supporting sciences. Therefore targeted participants for this CRP will include national nuclear agencies and research institutes, reactor vendors & manufacturers, nuclear power utilities and user groups, nuclear regulatory authorities, universities with nuclear science programs, and the fuel cycle industry.

The CRP Team will compare and evaluate existing methods and technologies and will recommend the most promising/appropriate ones for future knowledge preservation. Subsequently, the CRP Team will document these technologies and applications within their areas of expertise. The results will be disseminated in print and electronic form. Revision could be issued based on changing technology and tools, and evaluation of the results of the recommended solutions.

### 3. Background

In response to long-term energy scenarios, it is necessary to preserve and maintain the accumulated knowledge in nuclear science and the nuclear industry. Within these scenarios is the reality of ageing of the human workforce in the nuclear sector and the sharp decline in the number of entrants to education and training in nuclear science and engineering.

The challenge of the IAEA to this reality is to enhance the capacity of Member States to maintain and preserve the information and knowledge resources related to the peaceful use of nuclear energy. This knowledge could be tacit and/or explicit. Appendix A lists examples of tacit and explicit knowledge that need to be preserved. Finally, the need to manage, access and preserve this knowledge across human generations (30 years) and even nuclear facility lifetimes (over 60) years extends the challenges for the CRP.

Implementation of the recommendations and conclusions from this CRP may be difficult due to resources, legal factors and legacy systems, but nevertheless the goal of nuclear knowledge preservation should be permanent access and knowledge resource interoperability that will allow knowledge sharing for as long as the knowledge remains useful.

This Coordinated Research Project was started in the IAEA Program for the period 2004-2005 and continues for the 2006-2007, Programme C, Capacity Building and Nuclear Knowledge Maintenance for Sustainable Energy Development, Section C.3, Nuclear Knowledge Management and Section C.3.03, Maintenance and preservation of knowledge in specific areas of nuclear science and technology, specifically “a CRP on knowledge preservation technologies leading to archiving of information”.

### 4. Definition

Knowledge Preservation is part of the larger process of Knowledge Management. A variety of concepts and terms are used to describe this overall process, including but not limited to the following: Knowledge Identification, Knowledge Acquisition, Knowledge Development, Knowledge Dissemination, Knowledge Use, Knowledge Preservation, and Knowledge Sharing.

The IAEA has formalized the definition of **Knowledge Management**:

*“As an integrated, systematic approach to identifying, acquiring, transforming, developing, disseminating, using, sharing, and preserving knowledge, relevant to achieving specified objectives. Knowledge Management helps an organization to gain insight and understanding from its own experience. Specific activities in knowledge management help the organization to better acquire, store and utilize knowledge.” (IAEA Management Glossary, 2006).*

The recently released definition of **Knowledge Preservation** is:

*“A process of maintaining an organisational system of knowledge and capabilities that preserves and stores perceptions, actions and experiences over time and secures the possibility of recall for the future.” (IAEA Management Glossary, 2006).*

Knowledge is often used to refer to a body of facts and principles accumulated by humankind over the course of time. *Explicit knowledge* is knowledge that can be easily expressed in documents. *Implicit knowledge* and *tacit knowledge* represent knowledge or know-how that

people carry in their heads. The future in this context is for as long as the knowledge remains useful which in the case of the life of nuclear facilities can be decades.

## **5. Overall Objective**

The objective of the Coordinated Research Project (CRP) on Comparative Analysis of Methods and Tools for Nuclear Knowledge Preservation is to support the preservation of nuclear knowledge for as long as that knowledge remains useful by selection and implementation of appropriate cost-effective technological solutions.

## **6. Specific Research Objectives**

The objectives of the CRP are to advance the knowledge preservation for the nuclear community to positively impact:

- Safety and security;
- Cost reduction (reduce duplication of investment);
- Equity;
- Auditability (legal sense);
- Standardization (both formal and cooperative);
- Quality of operations;
- Awareness of these values that preservation of knowledge helps to achieve.

These objectives will be achieved by research and comparative analysis of policies, methods, practices, tools and technologies for knowledge preservation by the CRP Team during the period of 2005-2008. Concurrently, they will prepare recommendations to be delivered by 2008.

These recommendations will provide benchmarks, lessons learned, and alternative methods and tools that can be used more broadly throughout the nuclear community for nuclear knowledge preservation.

## **7. Research Areas for Cooperation**

The areas of research that have been identified address two aspects of knowledge management and preservation:

- 1) all aspects of the life cycle of knowledge preservation and
- 2) management processes that are integral to the institutional structure in which the knowledge management systems function. Functions, tools, technologies, and methods for the knowledge preservation life cycle will be identified, compared and evaluated.

## Tools and Methods for the Life Cycle of Knowledge Preservation

The following are steps in the life cycle of knowledge preservation:

- Knowledge Identification
- Capture
- Processing and Organizing Knowledge
- Storage
- Retrieval (Including Interoperability)
- Data Exchange
- Communications (Transport Mechanisms):
- Multilingualism
- Version Control and Updating Of Knowledge (Configuration Management)
- Quality Assurance
- Knowledge Organization Structures

The following descriptions are meant to be indicative and not all inclusive:

**Knowledge Identification:** Which knowledge should be captured, processed, maintained and preserved? How will it be identified, and how will changes over time be identified? Bibliometric tools (i.e., citation analysis) might be useful for such analysis.

**Capture:** Capture is related to the processes that bring data and information into a knowledge system. Capture processes will consider the life cycle and should address factors such as media, format, speed, costs, volume and intellectual property issues (see also management). This should also include alternatives for source capture and guidelines for hard copy publication (to enable subsequent imaging), preservation of historical documents, standards and quality control procedures.

**Processing and organizing knowledge:** This process looks at different programming languages as well as software packages (open source and proprietary) for the development of databases and systems. Metadata creation is part of this process but is included below (see also Knowledge Organization Systems)

**Storage:** Alternatives in media technology should consider longevity, robustness, cost, conversion, volume, standards, existing formats, historical data and other factors. This should relate closely to the capture function in the life cycle.

**Retrieval (including interoperability):** Basic to the utilization of nuclear knowledge is the requirement for timely retrieval of all relevant “documents” (includes text, data, drawing, videos, 3-D model, etc.), regardless of their location, format and language. Important concepts to consider include preserving the ability to use advanced retrieval software, interoperability across heterogeneous databases and systems, and multilingualism (etc). The approaches to process retrieved information through development of user interfaces and might include such techniques of adding value to retrieved information as visualization, modelling, simulation, analysis programs (predictive models in different applications areas).

**Data Exchange:** Data which have to be exchanged between databases with complex structures and/or between different parts of applications, which interoperate with each other require standardized protocols and techniques.

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**Communications (Transport Mechanisms):** The requirement to rapidly disseminate and access nuclear knowledge will be dependent on alternative communication systems that are particularly critical considering the technological differences in Member States. These alternatives will vary from near instantaneous knowledge transfer to reliance on postal services. These alternatives will shrink over time, and it is anticipated that during the long term period most facilities would have instantaneous communications. Systems and protocols must take these developments into account for the future.

**Multilingualism:** Cross language information retrieval (CLIR) and multilingual tools (i.e., thesauri) should be considered as part of the knowledge management and preservation life cycle. This will impact several other areas such as Retrieval and Standards. Standards for preserving multi-lingual capacity into the future are of interest.

**Version Control and Updating of Knowledge (Configuration Management):** This includes software tools for tracing and managing the currency of data, documents, drawings, software codes, procedures, etc. and automatically updating and recording changes as appropriate.

**Quality Assurance:** When developing and managing data and information systems, methods and tools for assuring data reliability and quality are critical as we consider its long term preservation. What tools and technologies are available to facilitate the process of assuring the quality of data in systems? Quality process could be applied at various stages the life cycle.

**Knowledge Organization Structures:** As information is preserved for the long term, it is important for that data to be understood in the context of its creation and use. Concept mapping, thesauri, ontologies, meta-registries, and other systems to map and organize knowledge to provide context for long-term use should be considered. Metadata which are integral to other parts of the life cycle factors are highlighted here. Standards and tools for metadata creation are relevant.

## Management Processes

In addition to the steps in the knowledge preservation life cycle, other factors will be considered that are essential for the successful implementation of nuclear knowledge preservation.

- User Identification
- Standards and Regulations
- Knowledge System Integrity
- Human Resource Management (Recruitment, Training, Retention)
- Intellectual Property Administration

**User Identification:** Who are the users and producers, both current and future, and what are their requirements for nuclear knowledge? How will these participants and their requirements be identified over time?

**Standards and Regulations:** Standards and regulations will impact all technologies used in the life cycle processes. Both technical and data (metadata) standards will be considered. The change and adoption of standards are a responsibility of management. Without appropriate standards, interoperability will not be possible. In addition to the standards, identifying nuclear knowledge standards organizations will be a useful part of this cooperative process.

**Work Flow:** The integration of the life cycle processes and the tools in the context of the organization is managed through the workflow processes. As tools and technologies change, how does this impact work flow considerations and vice versa?

**Knowledge System Integrity:** Management procedures should assure that there are appropriate controls on access and use of the system. It includes internal practices which are required for system security, authentication and access rights to prevent loss and unauthorized modifications.

**Human Resource Management:** Much of the tacit knowledge of an organization resides in its human resources. How to capture and preserve this knowledge is critical. The methods and technologies recommended may require training at various levels. Simulators, expert systems, concept mapping of the knowledge of nuclear staff positions, and distance learning could be considered as tools and methods.

**Intellectual Property Administration:** In any knowledge system there is the potential to have information that is freely available as well as information that has restrictions based on intellectual property rights such as copyright, patents or trademarks. It is important to consider how intellectual property rights are handled within knowledge organization systems and how the knowledge of the rights involved are retained over the longer term.

## 9. Needs Analysis

It is necessary to ascertain the current and anticipated environment of participants in nuclear knowledge preservation as well as what approaches, systems, tools, and practices are currently in use. A survey should be conducted of sample groups involved in nuclear knowledge use, management and preservation. The survey results would be compiled and used to provide a baseline environment, support the CRP Team research and analysis, and the development of appropriate benchmarks for comparison.

## 10. Action Plan (Activities)

| Action   | '05                 | '06 | '07 | '08 |
|--|---------------------|-----|-----|-----|
| 1. <u>Complete CRP Proposal.</u><br>Complete CRP Proposal and distribute for approval.   | May<br>(completed)  |     |     |     |
| 2. <u>Approval of CRP Proposal.</u><br>Obtain approval for CRP.  | May<br>(completed)  |     |     |     |
| 3. <u>Send invitations for participation to organizations listed in CRP Proposal as approved or modified.</u><br>Participating organizations will receive an invitation with background material, meeting date and location, funding, tasks and expected outputs.  | June<br>(completed) |     |     |     |
| 4. <u>Establish a website to coordinate the work of the CRP Team and to monitor progress of the project.</u><br>The CRP Team will be able to exchange ideas, references and submit drafts of their work for comments. It will also be used to disseminate changes in technology and standards that will impact nuclear knowledge preservation. |                     | May | X   | X   |

| Action  | '05                      | '06 | '07 | '08 |
|---|--------------------------|-----|-----|-----|
| <p>5. <u>Meetings of the CRP Team from participating organizations.</u></p> <p>The CRP Team will initially meet to:</p> <p>Approve/and modify the proposed technical frames and definition(s); develop the survey form and identify institutions to be surveyed; comment on managerial issues and develop an Action Plan. They will provide a detailed outline of the communication, retrieval, storage media, capture and multilingualism frames (as modified) that can be used for preparation of nuclear knowledge preservation recommendations in future meetings; identify benchmarks to be developed; agree on the assignment of research activities by organizations.</p> <p>Subsequent meetings will be held to review the CRP progress, share information and discuss solutions.</p> | Novtmbber<br>(completed) | X   | X   | X   |
| <p>6. <u>Survey form to selected institutions and compile results.</u></p> <p>The survey form will be sent to institutions identified by the CRP Team. Results of the survey will support preparation of nuclear knowledge preservation recommendations and benchmarks.</p>   |                          | X   | X   |     |
| <p>7. <u>Research Activity within CRP organizations.</u></p> <p>Participating research organizations will prepare specific solutions and benchmarks as tasked at earlier meetings according to the Action Plan and individual contracts/agreements.</p>   |                          | X   | X   | X   |
| <p>8. <u>Disseminate nuclear knowledge preservation guidance.</u></p> <p>Solutions and recommendations will be disseminated in appropriate electronic and conventional documents.</p>   |                          |     | X   | X   |

## 11. Logical Framework

Logical framework for the IAEA Coordinated Research Project on “Comparative Analysis of Methods and Tools for Nuclear Knowledge Preservation”

| Narrative summary  | Objective Verifiable Indicators | Means of verification | Important assumptions   |
|--|---------------------------------|-----------------------|---|
| <p>Overall objective:</p> <p>The objective of the Coordinated Research Project (CRP) on Comparative Analysis of Methods and Tools for Nuclear Knowledge Preservation is to support the preservation of nuclear knowledge in Member States and the IAEA for as long as that knowledge remains useful by selection and implementation of appropriate cost-effective technological solutions.</p> | N/A                             | N/A                   | Acceptance by Member States. This requirement was discussed at the 2004 Board of Governors meeting. |

| Narrative summary  | Objective Verifiable Indicators   | Means of verification   | Important assumptions   |
|--|---|---|---|
| <p>Specific objective:</p> <p>This objective will be achieved by obtaining recommendations/solutions for alternative technological practices, as suggested by the CRP Team, meeting initially in 2005.</p> <p>These recommendations will provide benchmarks, alternative methods and tools that can be used for nuclear knowledge preservation. This includes processes to capture, understand, analyze, retrieve, visualize, archive and disseminate knowledge.</p> | <p>The objective will be reached through coordinated research leading to the development of recommendations/solutions.</p>                        | <p>Feedback from Member States.</p> <p>Interoperability between systems developed by Member States.</p> | <p>Member States will adopt the recommendations/solutions within the scope of resources, legal factors and legacy systems.</p>  |
| <p>Outputs:</p> <ol style="list-style-type: none"> <li>1. Baseline analysis: A survey form designed by the CRP Team and sent to representative producers to determine the current and future nuclear knowledge preservation environment.</li> <li>2. A website to coordinate the work of the CRP Team, to monitor progress of the project, and provide updates to the recommended practices.</li> <li>3. Recommendations/solutions of the CRP Team.</li> </ol>       | <p>A survey form drafted by the CRP Team and the results of the survey.</p> <p>A website established and administered by the IAEA.</p> <p>N/A</p> | <p>N/A</p> <p>Monitor website.</p> <p>N/A</p>   | <p>The survey form will be promptly completed and returned.</p> <p>Member States will have access to the site.</p> <p>IAEA approval of the recommendations/solutions.</p> |
| <p>Outcomes:</p> <ol style="list-style-type: none"> <li>1. Increased awareness and steps to preserve nuclear knowledge in Member States for as long as that knowledge remains useful.</li> <li>2. Development of Methods and Tools to support the preservation of nuclear knowledge in Member States and the IAEA by selection and implementation of appropriate cost-effective technological solutions.</li> </ol>  | <p>Acceptance by Member States.</p>   | <p>Acceptance by Member States.</p>   | <p>Alternative methods will be presented due to the technology gap between Member States.</p>   |
| <ol style="list-style-type: none"> <li>1. <u>Complete CRP Proposal.</u></li> </ol>   | <p>Complete CRP Proposal and distribute for approval.</p>   | <p>CRP proposal submission.</p>   | <p>Consultant and IAEA staff will complete proposal.</p>  |
| <ol style="list-style-type: none"> <li>2. <u>Approval of CRP Proposal.</u></li> </ol> <p>Invite Experts Group to Review CRP and develop the basis for the survey form.</p>   | <p>N/A</p> <p>Get advice on CRP focus areas; help develop the survey form and suggest who should be encouraged to participate</p>                 | <p>Proposal approved.</p> <p>Experts report issued.</p>   | <p>Obtain approval for CRP.</p> <p>Some experts will be from organizations who have submitted proposals and others not. This provides a broadened perspective.</p>        |

| Narrative summary  | Objective Verifiable Indicators  | Means of verification                                     | Important assumptions   |
|--|--|---|---|
| 3. <u>Send invitations for participation to organizations listed in CRP Proposal as approved or modified.</u>  | Participating organizations will receive an invitation with background material, tasks and expected outputs.   | Acknowledge ment of receipt and response.                 | Approval of CRP and funding. Timely response from organizations.                    |
| 4. <u>Survey form to selected organizations.</u>   | Survey form.   | Receipts from mailing.                                    | CRP Team will complete survey form. Forms will be returned in a timely manner.      |
| 5. <u>Establish a website to coordinate the work of the CRP Team selected by organizations and to monitor progress of the project.</u>   | Website.   | Monitor use.  | Approval of CRP and funding. CRP Team will have access.                             |
| 6. <u>Meetings of CRP Team from participating institutions.</u>  | Output from the meetings: CRP Team approve/and modify the proposed technical frames and definitions; prepare survey form and identify institutions to be surveyed; comment on managerial issues; draft detailed outline of the communication, retrieval, storage media, capture and multilingualism frames, as modified. Establish benchmarks. | Minutes of the meetings. Output from the meetings.        | Approval of CRP and funding. Tasks can be completed within the time frame allotted. |
| 7. <u>Research Activity within CRP organizations.</u><br>Participating research organizations will prepare specific solutions and benchmarks as tasked at earlier meetings according to the Action Plan and individual contracts/agreements. | Delivery of the recommendations/solutions and benchmarks.  | Delivery of the recommendations/solutions and benchmarks. | Deadlines will be met.  |
| 8. <u>Disseminate the nuclear knowledge preservation recommendations.</u>  | Recommendations received from CRP Team.  | Dissemination of documents.                               | Dissemination of recommendations in suitable formats.                               |

## ATTACHMENT 3

### List of potential participants and questionnaire recipients

**Table 1. IAEA CM recommendations on CRP's survey and targeted participants of CRP**

|   | <b>Survey and CRP – participants/ users</b>                                   | <b>Countries/International organizations who already submitted proposals</b>  | <b>Countries/International organizations to be involved in the survey and CRP</b>  |
|---|---|---|--|
| 1 | National nuclear agencies<br>(Regulatory or R&D, ministries of science, etc.) | Jordan (Ministry of Water and Irrigate)<br>Vietnam (Atomic Energy Commission)   | France (CEA)<br>Russia (Rosatom)<br>USA (DOE)<br>EU (DG JRC)<br>Japan (JAERI)<br>Korea (KEPRI)<br>China (CNNC)<br>and others   |
| 2 | Nuclear research centres, institutes and laboratories                         | Algeria (Nuclear Research Centre)<br>China (China Nuclear Information Centre)<br>EU (JRC Petten)<br>Pakistan (Institute of Nuclear Science and Technologies)<br>Philippines (Philippines Nuclear Research Centre)<br>Russia (Russian Research Centre “Kurchatov Institute”) | Finland (VTT)<br>France (CERN, CEA)<br>Italy (ICTP)<br>Japan<br>Kazakhstan (NNC)<br>Norway (Halden)<br>Republic of Korea (KAERI)<br>USA (DOE National Laboratories)<br>Netherlands (NRG)<br>UK (Harwell)<br>and others |
| 3 | Nuclear reactors vendors & manufacturers                                      | Canada (AECL)   | Japan (Mitsubishi, Hitachi)<br>France (Framatome)<br>Russia<br>USA (Westinghouse, GE, GA)  |
| 4 | Fuel cycle (mining, enrichment, fabrication, reprocessing, storage)           |   | France<br>Kazakhstan (UMZ)<br>Russia (TVEL)<br>UK (BNG)<br>USA (USEC)<br>South Africa<br>and others  |
| 5 | Nuclear universities  | Bulgaria (Technical University of Sofia)<br>China (Beijing Jiaotong University)   | World Nuclear University<br>Russia (NEPhI)<br>USA (MIT)<br>and others  |

|   | <b>Survey and CRP<br/>– participants/<br/>users</b> | <b>Countries/International<br/>organizations who already<br/>submitted proposals</b> | <b>Countries/International organizations<br/>to be involved in the survey and CRP</b>  |
|---|---|--|--|
| 6 | Nuclear power utilities                             | Republic of Korea (KEPCO)  | Argentina<br>Brazil<br>Bulgaria (Kozloduy)<br>Canada (OPG, BP)<br>China<br>Czech Republic<br>Finland<br>France (EDF)<br>Germany<br>India<br>Kazakhstan<br>Mexico<br>Romania<br>Russia (Rosenergom)<br>Slovakia<br>South Africa<br>Sweden<br>UK<br>Ukraine<br>USA (Dominion Energy/Duke Power, TVA)<br>and others |
| 7 | Regulatory bodies/agencies                          | Kazakhstan (Kazakhstan Atomic Energy Commission)                                     | Finland<br>France<br>Germany (GRS)<br>Sweden<br>USA (NRC)<br>Canada (CNSC)<br>and others   |
| 8 | NPP user groups and other                           |  | Canada (COG)<br>USA (EPRI)<br>INPO<br>WANO<br>and others   |

## **ATTACHMENT 4**

### **MODEL SURVEY FORM**

#### **Current Status of Knowledge Preservation in Nuclear and Supporting Organizations**

##### **Background:**

A Coordinated Research Project (CRP) on Comparative Analysis of Methods and Tools for Nuclear Knowledge Preservation (KP) by selection and implementation of appropriate cost-effective technological solutions was approved in mid-2005 by the IAEA.

The CRP Team (members from participating organizations within the CRP) and other potential participants will identify alternative knowledge preservation methods and the tools necessary to capture, process, organize, store, retrieve, exchange and communicate knowledge. This survey will be used to provide that baseline to support the CRP project. Please attach additional blank sheets if required for the descriptive responses.

##### **Objective:**

- to obtain the information on nuclear knowledge preservation status from selected institutions;
- to get information on applicable methods and tools of knowledge preservation life cycle;
- to get information on management approaches and practices used for knowledge preservation;
- to support preparation CRP recommendations and conclusions on good practices;
- to provide contacts between responsible persons in different organizations.

**Name:** \_\_\_\_\_

**Organization:** \_\_\_\_\_

**Position:** \_\_\_\_\_

**Mailing Address:** \_\_\_\_\_

**Email Address:** \_\_\_\_\_

**Phone:** \_\_\_\_\_

**Your role in your organization in knowledge preservation:**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
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**Please return this survey to**

**Name:** \_\_\_\_\_

**Address for return here:** \_\_\_\_\_

**E-mail:** \_\_\_\_\_

**Phone:** \_\_\_\_\_

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**1. Policy and strategies**

**1.1 Are the KP principles definitely being included in organization policy?**

- Yes  No

**1.2 If yes, which type of strategies has been developed to support implementation of such policy?**

- human performance improvement (self-assessment, training, applying of good practices, etc.);  
 workforce planning (tacit knowledge preservation and succession);  
 identification, keeping and transferring critical knowledge;  
 knowledge preservation and dissemination is a part of organization culture;  
 other (please describe briefly).
- 
- 
- 

**1.3. What approaches are you applying to achieve the strategy objectives?**

- KP activities are provided by sufficient resources (financial, manpower, etc);  
 all level managers are personally involved in KP activities;  
 system for stimulation and encouragement individual contribution in KP is implemented;  
 all KP activities are based on clearly defined criteria and standards;  
 training system guarantees sustainable training process;  
 how KP activities are organized and supervised (please describe briefly)?
- 
- 
- 

**1.4. Do you have written procedures for knowledge management?**

- Yes  No

**1.5. Do you have nominated person/structure responsible for knowledge management?**

- Yes  No

**If no, please describe briefly who/how it is managed:**

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**2. Methods and tools for knowledge life cycle**

**2.1. Knowledge Identification**

**2.1.1. How do you identify which knowledge should be captured, processed, maintained and preserved?**

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**2.1.2. Do you apply graded approach for evaluation of knowledge significance?**

- Yes  No

**If yes, how many grades do you use and what are the criteria for them?**

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**2.1.3. How do you identify changes over time?**

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**2.2. Capture**

**2.2.1. Do you apply specific methods and tools for capture tacit knowledge?**

If yes, please indicate:

- employee interview;
  - questionnaire;
  - knowledge mapping;
  - photo and video;
  - other (please describe briefly):
- 
- 
- 

**2.2.2. What methods and tools do you use for capture of explicit knowledge?**

- physical capture of hard copies;
  - digitization;
  - databases;
  - photo and video;
  - models and simulators;
  - other (please describe briefly):
- 
- 
- 

**2.2.3. What formats do you use for capture information? Please list:**

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**2.2.4. Do you define data quality?**

- Yes                       No

**If yes, what standards/definition do you apply?**

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**2.3. Processing**

**2.3.1. Do you use special techniques for processing captured information? If yes, please indicate:**

- data analysis;
- data structuring;
- digitization;
- compressing;
- creation of metadata;
- statistical processing;
- visualization;
- other (please describe briefly):

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**2.3.2. Do you use standard or specific data models or software?**

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**2.4. Storage media**

**2.4.1. What methods and tools do you use for information storage?**

- archiving of hard copies;
  - archiving of digital information:
    - storage hard discs;
    - optical storage (CD; DVD, etc.)
    - streamers (magnetic tapes);
    - other (please describe briefly):
- 
- 
- 

- film library;
  - other (please describe briefly):
- 
- 
- 

**2.4.2. What format do you use for storage information? Please, list (i.e. ASCII, MS Word, XMC, etc.):**

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**2.4.3. Do you use any specific (unique) format?**

- Yes
- No

**If yes, please identify and describe why.**

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**2.4.4. Do you have plans on refreshment or migration as storage standards changes?**

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**2.5. Retrieval/Access**

**2.5.1. Do you have access control?**

- Yes
- No

**2.5.2. Do you have integrated information system which provides interoperability of different types of information (text, data, drawings, videos, 3-D models, etc.)?**

- Yes
- No

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**2.5.3. Do you use for data retrieval commercial or your specific software?  
Please describe.**

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**2.5.4. What standards do you use for knowledge retrieval?**

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**2.6. Data Exchange**

**2.6.1. Do you exchange information with external organizations?**

- Yes                       No

**2.6.2. What are the conditions of data exchange:**

- free exchange;
- commercial;
- bilateral agreements;
- other (please describe briefly):

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**2.6.3. What formats/standards are used?**

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**2.7. Communication**

**2.7.1. What communication means do you use for information transfer:**

- mail;
- express mail;
- e-mail;
- internet;
- intranet;
- other (please describe briefly):

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**2.7.2. What primary standards/protocols are used?**

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**2.8. Multilingualism**

**2.8.1. How many languages do you use for knowledge preservation?**

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**2.8.2. Do you apply special means (i.e., thesauri) for assure multilingual use of information?**

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**2.8.3. Do you have special procedures for validation of translated information?**

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**2.8.4. Do you use any computer aided or full translation? If so which systems are used?**

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**2.9. Version Control and Updating of Knowledge (Configuration Management)**

**2.9.1. Do you have special procedures for version control and updating of knowledge?**

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**2.9.2. What kind of means do you use for configuration management of knowledge?**

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**2.10. Quality Assurance**

**2.10.1. What QA standards do you apply?**

- IAEA;
- ISO;
- ANSI/ANS;
- other (please describe briefly):

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**2.10.2. Is the QA of knowledge management the part of organization QA guide?**

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**2.11. Knowledge Organization Structures**

**2.11.1. Is your knowledge organization structures formalized in documentation?**

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**2.11.2. What type of knowledge management organization structure do you apply?**

- centralized;
- decentralized;
- other (please describe briefly):

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**2.11.3. Do you use thesauri, taxonomies, ontology or other organizational structures?**

- Yes
- No

**If yes, please describe.**

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**2.11.4. Do you use structured metadata?**

- Yes                       No

**If yes, what standards are used, if any**

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**2.11.5. Do you use any computer aided metadata creation tools?**

- Yes                       No

**If yes, which**

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**3. Management Factors**

**3.1. User Identification**

**3.1.1. Who are the users (current and future) of nuclear knowledge?**

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**3.1.2. Who are the producers (carriers) of nuclear knowledge?**

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**3.1.3. How will these participants and their requirements be identified over time?**

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**3.1.4. How often do you reconsider the list of current and potential participants?**

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**3.2. Standards and Regulations**

**3.2.1. How do you define and consider relevant standards and regulations applied in Knowledge Preservation area?**

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**3.2.2. What standards and regulations do you follow?**

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**3.2.3. Who provide control that considered standards and regulations are properly implemented and followed?**

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**3.2.4. In case of changes who is responsible for the adoption of new standards or regulation?**

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**3.3. Work flow**

**3.3.1. How do you provide integration of knowledge management technologies and tools and workflow process?**

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**3.3.2. As knowledge preservation tools and technologies change, does this impact workflow considerations and vice versa?**

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**3.4. Knowledge Systems Integrity**

**3.4.1. How do you guarantee that there are appropriate controls on access and use of systems?**

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**3.4.2. Do you have specific procedures for:**

- system security
- authentication
- access rights

**3.5. Human Resources**

**3.5.1. Does workforce planning include a knowledge loss risk assessment?**

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**3.5.2. Do you have a list of job positions, respectively individuals who are object of special observation in the context of knowledge preservation?**

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**3.5.3. Have you establish the succession plan for key job positions?**

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## Appendix A. Examples of tacit and explicit knowledge that need to be preserved

| Tacit Knowledge   | Explicit Knowledge  |
|---|---|
| Rationale for design documentation  | Scientific/engineering data   |
| Employee experience: <ul style="list-style-type: none"> <li>• Operating practices and skills</li> <li>• Training practices and skills</li> <li>• Operating experience &amp; safety culture</li> <li>• Maintenance experience</li> <li>• (corporate memory)</li> </ul> | Theories, codes and models  |
|   | Standards and Regulations   |
|   | Design documentation (including rationale)                                      |
|   | Documents, drawings, equipment and materials lists for large nuclear facilities |
|   | Operating procedures  |
|   | Training procedures, curricula & course material                                |
|   | Operating data (temperature, chemistry flows, etc.)                             |
|   | Databases and related user interfaces   |
|   | Results of relevant national & international R&D projects                       |

## Appendix B. Methods and Tools on Topical Area

| Life cycle of knowledge   | Management processes  |
|---|---|
| Knowledge Identification  | User Identification   |
| Capture   |   |
| Processing and Organizing Knowledge                                     | Standards and Regulations                                       |
| Storage   |   |
| Retrieval (Including Interoperability)                                  | Knowledge System Integrity                                      |
| Data Exchange   |   |
| Communications (Transport Mechanisms):                                  | Human Resource Management<br>(Recruitment, Training, Retention) |
| Multilingualism   |   |
| Version Control and Updating of Knowledge<br>(Configuration Management) | Intellectual Property Administration                            |
| Quality Assurance   |   |
| Knowledge Organization Structures                                       |   |