

Senior Level Meeting on Managing Nuclear Knowledge
Introductory Discussion Paper

Managing Nuclear Knowledge

Introduction

1. Like any highly technical endeavor, the use of nuclear technology relies heavily on a vast accumulation of *knowledge* — volume upon volume of scientific research, engineering analysis, design documentation, operational data, maintenance records, regulatory reviews and countless other pieces of technical information — combined with an immense and complex reservoir of *people* (scientists, engineers and technicians of many disciplines) with the requisite educational background, expertise and acquired insight to apply that body of knowledge safely and effectively. The effective management of nuclear knowledge includes ensuring the continued availability of this essential reservoir of qualified personnel. The management of nuclear knowledge is critical to ensuring safety and security, encouraging innovation, and making certain that the benefits of nuclear energy — related to human health, food and agriculture, water management, electricity supply, and a host of other applications — remain available for future generations.

2. In recent years, a number of trends have drawn attention to the need for better management of nuclear knowledge. The nuclear workforce is aging — that is, more and more nuclear workers are approaching retirement age, without a corresponding influx of appropriately qualified younger personnel to replace them. Fewer young people are studying nuclear science, nuclear engineering and related fields at the university level, and a growing number of universities are giving up their nuclear education programmes altogether. In recognition of these and other trends, a number of IAEA advisory committees¹, as well as the IAEA Board of Governors and General Conference², have called for measures to better identify the nature and scope of the problem, to understand what Member States are doing to address it, and to determine what co-operative international actions might be appropriate.

3. To increase awareness and understanding of this emerging concern, the IAEA is hosting a senior level meeting of representatives from academia, national governments and the nuclear industry to highlight the issues of knowledge management — to present the known facts, pose questions and engender discussion. Through this meeting, we hope to better comprehend the scale and severity of concerns related to knowledge management, to learn what countries are already doing to deal with these concerns and to consider how the international community might work together to provide further remedy. The meeting would also discuss the respective roles falling to

¹ Including the Senior Expert Group, the Standing Advisory Group for Nuclear Energy (SAGNE), the International Nuclear Safety Advisory Group (INSAG), and the Standing Advisory Group on Technical Co-operation (SAGTAC).

² See GC(44)/RES/21.

the major players in the nuclear community (academia, government industry, the IAEA and other relevant organisations).

4. This paper sets out the issues of knowledge management relevant in the nuclear sphere to help prospective conference participants prepare. The ideas and questions that follow are intended to highlight gaps in understanding and to stimulate discussion, but do not as yet reflect any conclusions as to what action should be taken.

The Issues

5. A primary issue is one of “*succession planning*” for the nuclear workforce — ensuring that, as nuclear scientists, engineers and technicians retire, a younger generation of workers with appropriate educational backgrounds and career aspirations becomes available to take their place. Renewing the nuclear workforce is an issue with potential safety, security and other implications. Technical competence for safe operation and regulatory oversight of existing nuclear installations — as well as for nuclear material safeguards, research and development, waste management and transport, and facility decommissioning — will be an essential feature for decades to come, regardless of whether any future expansion of nuclear energy usage occurs or does not occur.

6. A related concern involves the potential loss of “institutional memory” as nuclear employees retire. Based on their work experience, these employees may possess essential but previously undocumented facts and insights (also referred to as “skill of the craft”) that could be lost. Preserving knowledge has safety/security implications, particularly as facilities age or if their owners seek to perform subsequent engineering modifications. Although “*knowledge preservation*” might be seen as a management issue for facility operators, it may be the case that some operators need training and/or assistance in how to record and retain such information as their employees retire.

7. Another preservation of knowledge issue is the retention of valuable data and other information (e.g. documentation, scientific and engineering studies, research results and related data) in countries where the motivation and/or the resources to preserve this material are no longer present. More investigation is needed to determine the relative scale and significance of this problem.

Understanding the Current Status

8. Regarding the renewal of the nuclear workforce, the first step is to understand more clearly the current status of the problem. A number of national and international studies have been performed in recent years³ — each concluding that the reservoir of qualified nuclear personnel is shrinking and that the problem requires immediate attention — yet considerable gaps remain in understanding the scale and severity of

³ NEA/NDC 1998; NEDHO 1998/99; DOE/NERAC 2000; refer also to national studies in a number of countries.

the problem. To gain a more complete understanding of the current status, answers to the following questions may serve as a starting point:

- What is the cross-section of expertise (based on degree fields, skill level, and required experience) *currently* utilized across the fuel cycle and across non-power nuclear applications? Are there any gaps in our understanding of the situation that still need to be filled?
- Given the current nuclear workforce mix as a baseline, what can be projected in terms of *future* personnel needs in specific areas (e.g. power operation, waste management, regulation/oversight, non-power applications)?⁴
- What are the current educational trends in nuclear and nuclear related fields, and how do they support these projections of future personnel need?
- What are the national and regional variations in the current and projected picture?

9. The second step is to understand what is already being done to respond to and correct these trends. Who are the primary actors — educators, industry leaders or government representatives — and to what extent are they working together to achieve common goals? In Canada, for example, the government has begun to work together with universities and the nuclear industry to address this issue through fellowships, cross career training and other approaches. The Republic of Korea has proposed the creation of an international university devoted to teaching and research in nuclear technology. These actions are likely to vary widely from country to country, but the successes and lessons learned so far will likely be useful for all concerned.

10. Regarding “preservation of knowledge” issues, the views and experience of Member State experts would be especially helpful. Some nuclear companies have already launched extensive programmes to document the insights of retiring employees, and it would be useful to learn from their experience. What are the economic and safety benefits of this practice? How important is it for other nuclear companies to follow a similar approach? And regarding the potential loss of nuclear records in some countries — scientific research results, engineering analyses, and the like — what is the extent of this problem, and what level of importance should be given to finding a remedy?

Mechanisms for Addressing the Issues

11. Once the nature and current status of knowledge management issues are understood, the bottom line will be to determine where the efforts of the nuclear community should be focused. As suggested earlier, it may also be useful to discuss

⁴ Answers to this question will be contingent on assumptions regarding the future use of nuclear power and other nuclear technologies. The best way to answer therefore might be to give a range of projected personnel needs, based on a corresponding range of assumptions.

the knowledge management related roles and responsibilities that should be assumed by the major players within the nuclear community (academia, government and industry) — but even more importantly, concrete ways for these groups to work together to achieve common goals.

12. One area with considerable room for improvement may lie in better public and political outreach. A specific strategy might be to broaden student awareness of career opportunities in the nuclear field, through mechanisms such as advertising, job fairs, and other co-operative industry–university efforts. A second strategy would be to target government decision makers to draw attention to the need for greater national investments in nuclear-related education. What other strategies should be considered?

13. Another arena for action may lie in initiating and/or expanding programmes that assist students entering nuclear fields. A simple approach would be for such programmes to provide grants for qualified students to complete degrees in nuclear science and related disciplines. Internships for qualified students could also be arranged at sponsoring nuclear organizations, related to both nuclear power and non-power applications. And job placement assistance networks could be developed to assist graduates in nuclear science and related degree fields. What other possibilities for providing “assistance” need to be considered?

The IAEA’s Role in Knowledge Management

14. Knowledge management related to nuclear science and nuclear technology is not a new area of activity at the Agency. Many of the Agency’s regular budget and technical co-operation programmes support activities that are aimed at developing and sustaining the technical competence needed to apply nuclear technologies and operate nuclear facilities in Member States. Extensive training, mentoring and fellowship activities — as well as activities focused on preserving, archiving and making available for retrieval vast amounts of scientific and technical data and documentation — have always been a visible, vigorous part of the Agency’s programme, although these activities have not necessarily been highlighted as part of an overall “knowledge management” agenda.

15. The Agency is well positioned to serve as an international hub for information exchange and co-operation on nuclear matters. Within its modest resources, the Agency intends to continue its knowledge management efforts, with each of the Agency’s major programmes placing greater stress on the sustainable education, training and qualification of the nuclear workforce. We are open to suggestions as to how these and other activities could more effectively serve the knowledge management needs of Member States.

16. Within the Agency’s major programme on *Nuclear Science and Technology*, the subprogramme on *Maintenance and Preservation of Knowledge* is working to create an Agency Nuclear Information Resource System. This service would build on the Agency’s existing databases of nuclear scientific and technological documents, while

networking with other libraries and electronic information centers to provide an enhanced nuclear information resource. Are there other specific initiatives that this Agency should consider? What should be the priorities?

Concluding Remarks

17. Article 11.2 of the Convention on Nuclear Safety requires each contracting party to “take the appropriate steps to ensure that sufficient numbers of qualified staff with appropriate education, training and retraining are available for all safety-related activities in or for each nuclear installation, throughout its life.” The renewal of the nuclear workforce and the preservation of nuclear knowledge are issues that should be of concern to all Member States — both in their safety implications and in recognition of their importance if we are to make the benefits of nuclear technology available to future generations. As stated in General Conference Resolution (44)/RES/21: “the development and management of safe nuclear power, science and applications in those Member States which have chosen or will choose the nuclear option require the preservation of knowledge and experience and the maintenance of an adequate technologically and scientifically competent human resource potential in the nuclear sphere.”

18. It is our hope that the upcoming meeting on “Maintaining Nuclear Knowledge” will help lay the groundwork for increased understanding and effective action on these important issues.