Proposals for Refinements in International Nuclear Knowledge Management Activities

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1. Introduction

Concerns are raised world-wide on the sustainability of nuclear society due to the ageing of nuclear manpower, coming massive retirements of senior workers within the next several years, declination of nuclear education and training, as well as the shortage of nuclear manpower supply. These concerns were reflected in the international activities such as the OECD/NEA report on the nuclear education and training [1] and the IAEA conference on Nuclear Knowledge Management [2]. Many more follow-up activities are currently being formulated and implemented. This paper discusses the nature of the issue, proposes a Four-Season Model of nuclear industry and manpower demand & supply, and raises an issue regarding the possibility of manpower shortage propagation from the advanced countries to the developing countries. The international activities are also reviewed and proposals for further refinements of the nuclear knowledge management activities are made.

2. Manpower Issue and a Four-Season Model

2.1 Nature of Manpower Issue

The nuclear industry has a relatively short history of almost half a century. Rapid growth and massive recruitments in the early stage of industry development resulted in long employments of the first generation of nuclear experts. Too early saturation of industry caused the suppression of new employments [2]. Also, recent trend of consolidation, privatization, economic competitions accelerated re-organization, out-sourcing, and down- sizing, left limited room for new recruitments.
Before the industy reaches an equilibrium, massive manpower demand for a short period and exhaustion of manpower demand for a long period are expected.

Table 1. Four-Season Model [3].

	Spring	Summer	Autumn	Winter
Period	1940-1950	1960-1970	1980	1990-
Title	Fetal	Growing	Saturation	?
Activities	Physical exploitation, Military application	Peaceful use, Massive construction of NPPs	NPT, Regulation, Cancellation of new NPPs	Existing facility operation, Lack of vision, Renaissance
Organizations	Manhattan project	Increase due to industrialization	Decrease or stagnation in number and size	Declination of Educational Org. Research oriented
Manpower	Scientists	Engineers, Massive recruitments	Few new recruitment, Less public support, Less enrollment in Science and Engineering	Retirements of 1st gen. Nuclear experts, Recruit from abroad

Massive retirements, if it happens, will incur a second highest peak of manpower demand in nuclear history. Periodically, these manpower demand peaks will appear in any young fields.

2.2 Four-Season Model

Based upon the history of U.S. nuclear industry, a crude model of manpower demands can be conceived and a Four Season Model proposed by the author [3].

2.3 Propagation Issue

The severity of the issue depends on the country's stage of nuclear development. In most OECD countries, the massive retirements are of grave concern. However, in the country where nuclear programs are still expanding, the manpower issue poses negligible concerns. Thus, some countries are in their winter and others are in other seasons. This difference can be a hope for international cooperation to tackle the issue.
Vast pool of experts could be constructed by the international collaboration. However an important premise for international collaborations is that activities should not be extended too much to such a level of devastating a country's manpower demand and supply structure. Otherwise the workforce crisis issue in the advanced countries will simply move and occur in less developed countries.

3. Review of International Studies

3.1 OECD/NEA

The OECD/NEA published a report concerning the declination of nuclear education and training organizations [1]. Regardless of the accuracy of the statistical data cited, it introduced the issue to the international society in a timely manner.

It investigated into the problem of world-wide

deterioration of nuclear education such as decreasing number and dilution of nuclear programs, decreasing number of students taking nuclear subjects, lack of young faculty members, and ageing research facilities. Also, the report came up with a set of recommendations to the responsible bodies of governments, industries, and universities. However lacking active measures to implement the recommendations such as international policy-making, budget allocation and commitment of the agency, only a few countries have been influenced by the report and many more countries are either still ignorant of or ignoring the recommendations.

3.2 IAEA

The IAEA held the Nuclear Knowledge Management Conference with the premise of massive retirements of the first generation nuclear experts [2]. An immediate need to preserve existing knowledge in nuclear science and technology was recognized and a unanimous consensus was reached on the IAEA's obligations to lead activities towards preservation and enhancement of nuclear knowledge. It also resolved top priority and additional activities. However the activities seemed to have been formulated and their priorities seemed to be given lacking in understanding about the nature of the issue. The IAEA seems to be digressing further. The problem of massive retirements of the first generation nuclear experts was changed to nuclear knowledge preservation, which was changed again to nuclear knowledge management covering almost all of the information related technologies.

3.3 The U.S.A.

In the United States, the National Academy in 1990 and the NEDHO in 2002 published their survey results on nuclear manpower demand and supply [4, 5]. Those two reports lack consistency using different definitions on nuclear engineer but they do present the trend of manpower issue especially on the supply side and there have been positive signs of increasing enrollments and program of nuclear engineering. The NEDHO study seem to have been written from the viewpoint of the universities reflecting the recognitions of the faculties that there comes a crisis point endangering their positions in universities where they could enjoy R&D.

4. Conclusion

International activities regarding the manpower shortage issue and the resulting nuclear knowledge management issue have been summarized and reviewed.

The international activities seem to digress due to both the lack of political strategies and unsound interests of the governing seniors. Without proper involvements of the young generation, the declination of nuclear education and eventually of the society would be a "Standing-concern" for the time being. Also a crude model based upon the history of the U.S. nuclear industry was proposed.

For further refinements of the nuclear knowledge management activities following proposals are suggested:

Firstly, a more precise definition of nuclear knowledge is needed. The nuclear knowledge that can be lost by retirements or lost by layoffs should be differentiated and activities should be devised to tackle the issue directly for the maximum usage of societal resources. Otherwise the nuclear knowledge management activities will have to cover every aspect in the nuclear field with limited resources.

Secondly, a comprehensive and frank review of the current international activities should be followed to see if we are a) preparing for massive retirements, b) seeking nuclear knowledge transfer to the next generation, c) seeking accumulation of all the nuclear knowledge in an ample form, d) attaching our programs to an international program, or e) just increasing the international collaboration activities together with the resources available.

Thirdly, if the problem we are discussing is related to a life cycle model or a Four-Season Model of manpower demand and supply, then we have to devise ways to achieve an equilibrium in manpower demand and supply lest we should discuss the same issue again in 40 years.

Fourthly, in the discussion of the sustainability issue, both experienced seniors and responsible young generation should both be privy to the available information. A good policy would be generated from the blending of different voices instead of listing all the voices from just one party. Thus participation from the young generation should be increased.

Finally, if we are to prepare for massive retirements in the future, then the nuclear knowledge that should be preserved and transferred to the next generation such as the experience, management, supervising skills, and international politics. These cannot be simply documented or uploaded to cyber space. A mentoring program or a shadow delegation program is needed to transfer those knowledge to next generations.

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