International Atomic Energy Agency

Topical Issues:

Nuclear Power – Life Cycle Management
Managing Nuclear Knowledge
Nuclear Security

Scientific Forum

during the 46th Regular Session of the IAEA General Conference

Conference Room C, Austria Center, Vienna

17-18 September 2002

Programme and Synopses

TUESDAY, 17 SEPTEMBER 2002

10:00 – 13:00 hours

Opening statement: **M. ElBaradei, Director General, IAEA**

Session 1: **Nuclear Power – Life Cycle Management**

15:00 – 18:00 hours

Session 2: **Managing Nuclear Knowledge**

WEDNESDAY, 18 SEPTEMBER 2002

10:00 – 13:00 hours

Session 3: **Nuclear Security**

TUESDAY, 17 SEPTEMBER 2002

10:00 – 13:00 hours

Opening Statement: **M. ElBaradei, Director General, IAEA**

Session 1: Nuclear Power – Life Cycle Management

The keynote presentations will be followed by a panel discussion including the keynote speakers and the following panellists: *A.A. Abagyan*, Russian Federation; *J. Ronaky*, Hungary.

Moderator: *V.K. Chaturvedi*, India

Keynote Speakers:

P. Haug, FORATOM, "Policy Issues in Europe on Nuclear Power Plant Life"

J.C. Brons, USA, "U.S. Plant Life Extensions, Policy and Experience"

M. Takuma, Japan, "Japan's Policy on Nuclear Power Plant Life Management"

J. McKeown, UK, "Decommissioning – the Worldwide Challenge"

13:00 – 15: 00 hours Break

TUESDAY, 17 SEPTEMBER 2002

15:00 – 18:00 hours

Session 2: Managing Nuclear Knowledge

Moderator: *D.F. Torgerson*, Canada

The keynote presentations will be followed by a panel discussion including the keynote speakers and the following panellists: *M. Cumo*, Italy; *R. Cirimello*, Argentina; *N. Pelzer*, Germany.

Keynote Speakers:

- *A.E. Waltar*, USA, "Feeding the Nuclear Pipeline: Enabling a Global Nuclear Future"
- *M. Ziakova*, Slovak Republic, "Losing Nuclear Expertise – A Safety Concern"
- *E. O. Adamov*, Russian Federation, "Losing Nuclear Science and Technology – A Real Concern"
- *R. Chidambaram*, India, "Managing Nuclear Knowledge for Sustainable Development"

WEDNESDAY, 18 SEPTEMBER 2002

10:00 – 13:00 hours

Session 3: Nuclear Security

Moderator: *R.A. Meserve*, USA

The keynote presentations will be followed by a panel discussion including the keynote speakers and the following panellists: *A. M. Agapov*, Russian Federation; *M. Ridwan*, Indonesia.

Keynote Speakers:

D. Flory, France, “Risk Assessment – Models and Methodologies”

F. Steinhäusler, USA, “Protecting Nuclear Material and Facilities – Is a New Approach Needed?”

V. Shkolnik, Kazakhstan, “Radioactive Sources – Under Control?”

SYNOPSES

The following summaries are based on information provided by the presenters. The views expressed remain the responsibility of the named authors and do not necessarily reflect those of the government of the Member State(s) or organization of the author. The IAEA cannot be held responsible for any material reproduced in this book.

Policy Issues in Europe on Nuclear Power Plant Life, Management of Nuclear Liabilities and European Green Paper

Dr. Peter Haug
Secretary-General, FORATOM, Brussels

The fleet of nuclear power plants (NPPs) currently in operation in the 15 countries of the European Union and the 10 candidate countries is on average 20 years old. Assuming no life extension programme and no new orders, the current installed capacity will more than halve in 20 years.

If this evolution is not addressed, it will contribute to increase the EU energy dependency to worrying levels in the decades leading up to the year 2030. In this context, the European Commission (EC) issued in 2000 a "Green Paper on the security of supply" to launch a debate on the future energy strategy of the EU. The results of the debate were made public in June 2002. They led the EC to identify a number of prerequisites to keeping the nuclear option open. It then set out to translate these conditions into a package of legislative proposals. The components of this package are the harmonisation of EU safety standards, and regulations regarding the management of spent fuel and radioactive waste and the management of decommissioning funds.

The EC does not consider plant life extension as a concern in its own right. This issue is addressed through the R&D programmes aiming at maintaining at a high level the safety of ageing NPPs. Various projects have been undertaken in successive R&D framework programmes. They focus not only on the physical degradation processes of components but also on the human aspects of plant ageing

At the national level, very diverse policies are implemented by the member states. This statement applies equally to NPP life management, to the management of nuclear liabilities and to the decommissioning of nuclear installations. In some of the countries that opted for a nuclear phase-out, actual plant life will even exceed the initial design lifetime. This outcome is not surprising since life extension provides an important source of additional energy at a cost that is reasonable both in financial and administrative terms. In the medium to long term however, plant life extension alone will not suffice to meet the expected growth in electricity demand.

License Renewal in the United States

Jack Brons,
Special Assistant to the President, Nuclear Energy Institute

Nuclear plants in the United States are licensed for 40 years, a length specified in the Atomic Energy Act of 1954, which laid out much of the regulatory basis for the commercial nuclear industry. The Act, however, made provision for license renewal. The original 40-year license period was chosen arbitrarily by the U.S. Congress because it was the typical period over which utilities recovered their investment in electricity generating plants.

Nuclear plants, however, are subject to a rigorous program of Nuclear Regulatory Commission oversight, maintenance and equipment replacement. In effect, they must be in the same operating condition on the last day of their licenses as they were on the first. As the industry matured, it became apparent that there was no physical limitation on the continued operation of nuclear plants past 40 years. The industry turned its attention toward license renewal.

When the issue was first raised, the NRC considered stringent process equivalent to seeking a new operating license for each plant. The complexity, length and cost of the process made it unlikely that many nuclear plants would seek license renewal. The nuclear industry worked successfully with NRC on the application of generic principles to license renewal, however, and in 1995, the NRC issued an efficient, tightly-focused rule that made license renewal a safe, viable option.

To extend the operating license for a reactor, a company must demonstrate to the NRC that aging effects will be adequately managed during the renewal terms, thus ensuring equipment functionality. The rule allows licensees to apply for extensions of up to 20 years.

The first license renewal application was filed in 1998 by the owner of the two-unit Calvert Cliffs plant. Shortly thereafter, an application was filed for the three-unit Oconee Nuclear Station. The NRC renewed the licenses for all five units in 2000, and since then, five more licenses have been renewed. The NRC has received 37 license renewal applications, and virtually every reactor in the United States is now expected to apply.

License renewal is economically beneficial since the plants are fully amortized and operating and maintenance costs of an efficiently-operating plant is low. Continued operation of nuclear plants, by far the largest source of emission-free electricity generation in the U.S., will also bring environmental benefits. Nuclear plant operations avoided emissions of nearly 175 million metric tons of carbon dioxide in 2000, in addition to millions of tons of sulfur dioxide and nitrogen oxide.

NEI continues to work with the NRC on generic principles and streamlining regulations, with the aim of further reducing both the time and the cost of license renewal.

Japan's Policy on the Nuclear Power Plant Life Management, Life Management for Nuclear Power Plants and Measures to Cope with Aging

Masao Takuma, Executive Managing Director
Japan Atomic Industrial Forum, Inc.

Nuclear Plant is born after a lengthy, multi-year construction period, and ends its life decades later, having generated a vast amount of electricity. Its period of operation is, far longer than its period of construction. "Construction" is the process of "creating something of value", a new nuclear plant, using technology. "Operation" is the process of "raising the child with care " so that its potential can be realized to the fullest over the course of its life.

From the view point of plant life management, it is appropriate to divide the life of a power plant into three stages, "fostering, mature and aging", from the start of operation to the end of its operation. It is important to manage a plant accordingly.

It is recently become important to the Utility companies under the competitive power market to manage aging plants effectively, in order to extend its life with sustained high level of performances, with plant safety in the first place. Whether this is, in fact, possible or not, depends upon how the plant was operated in the prior stages, that means, depends upon how it was "brought up".

This report briefly shows what are important points of management in these 3 stages, and also describes general significances of plant maintenance and inspection, with the practices applied to the plants in Japan.

Currently 52 plants Light Water Reactor Nuclear Plants are in operation in Japan, and 13 plants within next 5 years and 23 plants within 10 years are regarded as aged plants. So the contents of periodic inspections by the government and maintenance requirements on the Utilities will be modified to keep and enhance safe and stable operations of the aged plants.

In the year 1994, Japanese Government released the report "Basic Concepts on the Nuclear Power Plant Aging", the objectives of which was the evaluation of the soundness of major equipment and to establish the concepts of aging measures, assuming the plant to be operated 60 years. Utilities, in response, decided to evaluate the long term soundness of overall plant facilities and issued plans for necessary measures to cope with the plant aging. As the efforts hereafter on the aging measures, implementation of "Long-term Maintenance Programs", issuing"Periodic Safety Reviews" and the establishment of "Nuclear Power Plant Life Engineering Center" (April,2002), are thought to be important in Japan.

Decommissioning – the Worldwide Challenge

John McKeown
Chief Executive, United Kingdom Atomic Energy Authority.

Whatever the future may hold for nuclear power, there are closed or ageing nuclear facilities in many countries around the world. While these may be in safe care and maintenance at present, a sustainable long term solution is required. Facilities need to be decommissioned, contaminated land remediated, and wastes conditioned for safe storage or disposal.

Practical nuclear site restoration has been demonstrated internationally. This experience has revealed generic challenges in dealing with old, often experimental, facilities. These include:

- Facilities not designed for ease of decommissioning
- Records of plant construction and operation, and of the materials utilised and wastes produced, not to modern standards
- Fuels and wastes stored for long periods in less than optimal conditions, leading to deterioration and handling problems
- The historic use of experimental fuels and materials, giving rise to unique waste streams requiring unique waste management solutions
- The application of modern safety and environmental standards to plant which dates from the 1940s, 50s and 60s, requiring investment before decommissioning can even commence.

These problems can be tackled, as examples from UKAEA's own programme will illustrate. But two fundamental issues must be recognised and considered.

First, the costs of decommissioning older facilities are very high, and may place a heavy burden on national budgets, despite using best efforts to control them. We can limit these costs by learning from one another's experience and sharing the development of new techniques and technologies. UKAEA has already initiated a programme of international collaboration, and hopes that other IAEA countries will be encouraged to follow suit.

But whilst the costs of decommissioning may be high, the process normally meets with public acceptance. This is seldom the case for long term waste storage or disposal. Until waste management routes are available – either nationally or internationally – the environmental restoration of nuclear sites can never be fully completed.

Feeding the Nuclear Pipeline: Enabling a Global Nuclear Future

Dr. Alan E. Waltar
Director of Nuclear Energy, Pacific Northwest National Laboratory

There is nothing more vital to the advancement of human civilization than the abundance of useable and affordable energy. It underpins national security, economic prosperity, and global stability.

Nuclear energy, which exhibits a unique combination of environmental and sustainable attributes, appears strongly positioned to play a much larger and more pivotal role in the mix of future global energy supplies than it has played in the past. Unfortunately, after a fairly rapid growth period within the industrialized nations in the 1960 to 1980 time frame, a variety of factors led to a substantial reduction in commercial nuclear power plant construction (with the possible exception of several Pacific Rim countries). This, in turn, led to a serious erosion in the enrollment patterns of nuclear engineering programs—causing alarmingly low enrollment levels in many counties by the turn of the century.

Numerous studies conducted over the past five years have soberly come to the consistent conclusion that the nuclear pipeline cannot keep up with the needs of the nuclear industry. In fact, when combining the aging work force with low matriculation rates in most nuclear engineering academic programs, a huge (and unacceptable) mismatch between needs and supply is strikingly evident. This is further exasperated by the lack of meaningful efforts to capture the knowledge of the "first nuclear era" professionals in a form that can be effectively transferred to the upcoming generation. Methods ***must*** be found to better capture the enormous body of experience already accumulated and both document it and then mentor the new nuclear engineers that do enter the work force to enable them to build upon this experience, rather than having to re-create it.

On the positive side, enrollment patterns in the majority of nuclear engineering programs still in existence within the United States are now generally on the rise, at least at the undergraduate level. Some programs have experienced at least a doubling or more of their undergraduate enrollments in the past half-decade. This has happened as the college generation is being exposed to a "nuclear renaissance" atmosphere in the United States. The excitement associated with new designs and serious renewed construction dialog, the possibility of producing hydrogen to service the huge transportation sector, the drama of deep space exploration, etc.—all combined with attractive scholarship programs and high starting salaries—are playing a significant role in the rebound. A few of the particularly successful efforts initiated by various sectors of the U.S. nuclear infrastructure to stimulate this rebound will be shared in the hope that some of them might be beneficially employed in other global settings.

Losing Nuclear Expertise ─ A Safety Concern

M. Ziakova, PhD.,
UJD SR (Nuclear Regulatory Authority of the Slovak Republic)

Since the mid of eighties several important changes in human beings behaviour, which influence nuclear field, can be observed – the loss of interest in studying technical disciplines (namely nuclear), strong pressure of environmental movements, stagnation of electricity consumption and deregulation of electric markets. All these factors create conditions which are leading to the decrease of job positions related to the nuclear field connected particularly with research, design and engineering. Loss of interest in studying nuclear disciplines together with the decrease of number of job positions has led to the declining of university enrolments, closing of university departments and research reactors.

In this manner just a very small number of appropriately educated new experts are brought up.

In the same moment the additional internal factor – the relative ageing of the human workforce on both sites operators of nuclear facilities and research and engineering organisations can be observed.

All these factors, if not addressed properly, could lead to the loss of nuclear expertise and the loss of nuclear expertise represents the direct thread to the nuclear safety.

The latest studies have shown that at present NPPs cannot be replaced by other kinds of electric sources and in no case by renewable ones in an efficient manner. Therefore it is necessary to carefully manage knowledge gathered in the nuclear field during the years and to keep on the nuclear safety research, education and training to ensure and upgrade safe and reliable operation of existing and future nuclear facilities. This is responsibility of both the governments of the states using nuclear applications and owners of nuclear facilities.

LOSING NUCLEAR KNOWLEDGE – A SAFETY CONCERN AND A THREAT TO DEVELOPMENT

Prof. E.O. Adamov, Russian Federation

In the initial period of nuclear engineering development, the sector enjoyed a strong governmental support and had ample resources at its disposal. It could afford and actually practiced comprehensive verification of computational results and field validation of design parameters.

Completion of the main programmes for creation of nuclear weapons, successful development of nuclear power in the 1970s and its premature shift to the sphere of purely commercial interests, national and international concentration on nonproliferation issues, all these later realities, found in the context of abounding new sources of fossil fuel and aggravated by severe accidents at TMI and Chernobyl, added up to cause stagnation of nuclear technologies and dramatic dwindling of intellectual and experimental resources. With the new challenges seemingly exhausted and with virtually all the effort focused on traditional technologies, engineers became the dominating species in the nuclear sector, while the younger generation of physicists and systems analysts became increasingly more attracted to other spheres of development and application of knowledge in basic science. The early experimentation practice was governed by exclusively utilitarian objectives, and it was not even contemplated that the data might be processed and archived so as to make them available for much broader purposes, other than those dictated by the specific task in hand. Some of the existing databases need to be checked for validity, and access to specific information – via common or commercial channels – has to be improved. The number of research reactors, experimental facilities and test rigs suffered a huge reduction. Vigorous computerisation in the last decade is not a cure-all to make up for the entire loss of the resources that were originally available for nuclear technology progress.

The tendency towards revival of nuclear technology development primarily for energy production, which seems to be emerging in some countries, calls for comprehensive measures to preserve the knowledge acquired earlier and to use it in creating new technologies. Should this be successfully accomplished, nuclear power would be able to fulfill its historical mission of supplying mankind with unlimited energy resources without unjustifiably wiping out the mineral wealth and upsetting the ecological equilibrium. Besides, this course offers a sound promise of making the technology itself serve as a barrier to proliferation of nuclear weapons.

Nuclear Knowledge - Managing for Preservation and Growth

Dr. R. Chidambaram

Principal Scientific Adviser to Government of India
and
DAE-Homi Bhabha Professor, Bhabha Atomic Research Centre

The attitude to nuclear energy development in any country is governed by its energy needs, nuclear fuel and human resource access, and its political inclinations and affiliations. Some countries with an already high level of electricity consumption based on fossil fuels or hydro resources and existing nuclear plants (either in their own country or in a neighbouring country), accompanied by a stable or even decreasing population, have not felt for some time the need for new nuclear plants, though this trend appears to be reversing. On the other hand, many developing countries including India consider the growth of nuclear power as essential and inevitable to satisfy their future energy needs. Nuclear reactors and the accompanying fuel cycle facilities constitute a complex technology ensemble, which cannot be handled on a stop-go basis. Also, some large nuclear-developed countries can perhaps get along on a self-reliant basis, but international cooperation is valuable for sharing of knowledge and resources. There is also the political aspect. Genuine proliferation concerns must be addressed but coercive guidelines for nuclear cooperation , which go beyond these concerns, are harmful for the preservation and growth of nuclear knowledge.

There are nuclear reactor and fuel cycle technologies which have been around for some time but they still need continuous upgradation, in terms of improved performance or increased safety, and there are emerging advanced nuclear reactor designs, which require new technology generation and transfer to industry. Both of them require continuous inputs from R&D laboratories and these have to come from government-sponsored research because private sector industry generally tends to shy away from R&D with long-range pay-offs. There is another aspect. If nuclear industry is seen in a country to be stagnating - fortunately it is not happening in Asia - attraction to youth in a research career in nuclear technology in that country dissipates and so does consequently the base of nuclear knowledge in that country.

The preservation of our precious nuclear heritage and further development of new nuclear technologies are so essential for sustainable development, particularly for developing countries, that I consider them the responsibility of governments and international organizations like IAEA.

Risk Assessment – Models and Methodologies

Denis FLORY, Institut de Radioprotection et de Sûreté Nucléaire

Security of industrial facilities has recently come to the forefront of the News, particularly as concerns nuclear facilities.

Though poorly known to the public, the assessment of the protection of nuclear facilities against malevolent acts, and indeed the protection itself, has been a matter of concern for competent authorities and the industry for decades. In that period, various approaches for assessing the risks, threats or danger, and to regulate this field of activity, have been developed and implemented.

The principles underlying these approaches are debated in the presentation, at the level of a State and of a facility. The actors of risk assessment are reviewed, together with their responsibilities in the process.

Finally, relevance of these approaches to the situation created by the September 11 attacks is debated.

All along the presentation, the similarities and differences with the nuclear safety field are addressed, and the necessary strong link between safety and security is reaffirmed.

PROTECTING NUCLEAR MATERIAL AND FACILITIES:

IS A NEW APPROACH NEEDED?

F. Steinhausler, G. Bunn
Center for International Security and Cooperation,
Stanford University, CA., USA

The main reason why national physical protection (PP) systems for nuclear and other radioactive material need to be strengthened further is that, after the attacks on the US on 11 September 2001, the threat of dangerous, suicidal radiological and nuclear terrorism can no longer be excluded as a possibility. Existing PP systems were not designed to deal with the threat of suicidal terrorists having the numbers, skills, training, and resources available to the commandos attacking on 11 September. Moreover, there are no mandatory international standards for domestic PP systems for nuclear or radioactive material, and this has produced great variation in protection provided from country to country. IAEA recommended standards, while useful, were not designed with the new terrorist threat in mind. Moreover, they are often not followed in practice. The result is inadequate protection against the new form of terrorism in most countries.

The Director General of the IAEA expressed a similar view after 11 September, but achieving a consensus to amend the Convention on the Physical Protection of Nuclear Material (CPPNM) to require specific standards of protection for different amounts and kinds of nuclear material used or stored domestically (not in international transport) has been impossible in the year since 11 September. In the case of radiological materials, a new effort to provide required international standards for protection against the new form of terrorism has not begun.

In the summer of 2001, leaders of the G-8 countries agreed to a Global Partnership to prevent the new terrorists from acquiring nuclear and radiological as well as other materials related to weapons of mass destruction. Perhaps in part because of the failure to date to achieve agreement on an effective amendment to the CPPNM, the first principle of this partnership is to strengthen "multilateral treaties and other instruments whose aim is to prevent the proliferation or illicit acquisition" of nuclear, radiological and other materials relating to weapons of mass destruction. The third principle of the partnership is to "develop and maintain effective physical protection measures" and to "provide assistance to states lacking sufficient resources to protect their facilities." Other principles relate to illicit trafficking , export and border controls and disposition of stocks no longer required for defense purposes. The initial G-8 focus will be on projects in Russia, but its principles are to be applied globally.

We propose a **Global Physical Protection Initiative** consisting of six elements in addition to what the IAEA is now doing to improve PP practices around the world:

- Establish a *Global List of Physical Protection Priorities* beyond those already agreed. The IAEA International Physical Protection Assistance Programme

(IPPAS) has collected information from many countries on needs for better protection and it could prepare an initial list of priorities in cooperation with IAEA safeguards inspectors, with the World Association of Nuclear Operators (WANO) and the Institute of Nuclear Plant Operators (INPO).

- Create a *Multilateral Security Cooperation System* calling for bilateral and multilateral cooperation among those responsible for implementing PP standards. This could start with a more detailed survey of national regulatory standards and practices than those issued by the OECD Nuclear Energy Agency, and with meetings of regulators from various countries to share experiences.

- Create an *International Nuclear Threat Protection Task Force* that would focus on improving cooperation between PP regulators and the police and intelligence agents expected to respond to alarms relating to sabotage or theft of nuclear and radiological materials. This collaboration could range from sharing intelligence on illicit trafficking to identifying links between organized crime and nuclear terrorism.

- Establish an *International Radioactive Material Tracking Centre* that would deploy a system of GPS-based location sensors for fissile material and strong radiation sources.

- Develop a *Nuclear Security Bonus System* to be negotiated by IAEA, WANO, IMPO, and insurance companies. The goal would be to establish that operator compliance with pre-determined PP minimum standards (in IAEA recommendations, etc.) would reduce insurance premiums for a given facility.

- Establish an *IAEA- G-8 Global Partnership Cooperation Committee.* This committee would be composed of experts on IAEA physical protection activities who would meet with G-8 Global Partnership experts to make recommendations to G-8 Global Partnership meetings relating to PP. The G-8 committed themselves to raise up to $20 billion over the next 10 years to carry out the Global Partnership Initiative. The initiative is to be open to other interested states besides the G-8, and assistance is to be provided to other states besides Russia. Providing information to the G-8 experts on what the IAEA is doing, what needs to be done, and what financing is necessary would be a useful function of this Cooperation Committee.

This raises important questions about the future role of the IAEA in this topic area:

If IAEA members cannot implement principles such as those relating to the CPPNM because of lack of agreement, will the G-8 take over in a future meeting? How can the IAEA show the G-8 leaders that it is doing what it needs to do to satisfy the G-8 principles? Should proposals for an amendment of the CPPNM that provides specific requirements and standards for domestic protection be on this list? Given the failure of the efforts to provide new, strong, domestic standards for the CPPNM, would it make sense to work instead on strengthening *recommended* standards for physical protection of nuclear material and providing such standards for strong radiation sources.

Radioactive Sources – Under Control?

V. Shkolnik, Kazakhstan

Radioactive materials, including sources, have lower level of control comparing to, e.g., nuclear materials. Using examples of Kazakhstan some aspects of this problem are going to be discussed – regulatory control, security of facilities using sources, monitoring and physical control of source movements, etc.

Several directions of work can be considered for improvement of control on radioactive sources. First one is enhancement of accountancy of sources focusing on better regulatory framework for bookkeeping, inventory verification, management of movement records and other measures to build an effective quality management system for accountancy eliminating orphaning of registered sources.

Second, physical protection system should be strengthened for facilities having inventories of radioactive sources. Principles of this system can be based of physical protection of nuclear materials.

Third, technical systems should be developed for 'defense in depth' in combating of illicit use and movement of radioactive sources. Here we can consider local systems on a facility level, detection of radioactive materials on most probable transport routes, and boarder control.

Fourth, international co-operation can be improved as well as in combating illicit trafficking of radioactive sources and in tracing of international transfers of the sources that can include development of export/import procedures eliminating risk of loose of control.

Fifth, development of effective response measures in cases of detection of radioactive sources illegally transported or occasionally found.

There can be considered other measures for strengthening of control over radioactive sources, and we have good example of the nuclear material control that can be used as a basis.