

Manpower development: Moving to meet challenges

An overview of demands and IAEA's role in the field

by B.J. Csik

It is expected that nuclear power will remain a viable option for energy production, and will continue to increase its share in supplying the world's energy demand. These expectations, however, can only be fulfilled if national nuclear power programmes are well planned and efficiently implemented, and if nuclear power plants are designed, constructed, and operated in a safe, reliable, and economic manner.

All activities and tasks involved in nuclear power require adequately qualified manpower and excellence in human performance, and every country with an ongoing nuclear power programme, or intending to initiate one, has to meet the challenge of providing its own qualified manpower. This has been widely recognized and major efforts have effectively been undertaken worldwide.

In the fields of energy, electricity generating system expansion, and nuclear power planning, not only more and more sophisticated planning tools and methods have been developed, but also a growing recognition of the need for national planning capabilities has been achieved. Experience has shown that realistic and detailed assessment of national needs, capabilities, and constraints are prerequisites for successful implementation of nuclear power development programmes. It also has shown that one essential input to such assessments is the contribution of national planners who have a thorough knowledge of their country's situation and prospects.

The competence factor

The design, construction, erection, testing, and commissioning of nuclear power projects is very much influenced by the competence levels of the managers, professionals, technicians, and craftsmen involved. Quality is essential for nuclear power, and it can only be achieved through excellence in human performance. Schedule delays and cost overruns, as well as low plant availability factors, can usually be traced back — at least in part — to deficiencies in human competence and performance.

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Safety and reliability of nuclear power plant operation must be achieved and maintained. It is a recognized fact that public perception of the nuclear risk goes far beyond what may be termed as the real risk. Also, a nuclear accident or incident in any nuclear power plant has a worldwide impact and affects the whole nuclear industry. These lessons have been painfully learned during the last decade, emphasized at Three Mile Island (TMI) in 1979, and more recently at Chernobyl. It has been found that human failure is very often either the direct cause of accidents or incidents, or at least a contributing factor.

Manpower needs

Throughout the world, the total number of operations personnel (including direct operation, maintenance, and technical support functions) of the 374 operating nuclear power plants (as of end of 1985) can be estimated at about 100 000. In addition, the 157 nuclear units under construction will require some 40 000 technically qualified people to properly operate and maintain them. This represents a substantial training and retraining load.

Achievement of high standards has always been a concern, but since TMI, efforts to upgrade qualification standards of nuclear power plant operations personnel and to improve training have been especially intensive. Prevailing national requirements and utility practices have been reassessed everywhere, and many improvements have been proposed and implemented. This trend is still continuing, and it can be assumed that in the aftermath of Chernobyl, further upgrading will be promoted to reduce the risk of human error and thus improve plant performance.

Evolution of activities

During the 1960s, Agency activities in the field of manpower development for nuclear power mainly consisted of granting fellowships when requested by Member States. Most of the fellowships in this field were for studies in reactor engineering, with more academic than practical orientations.

As developing Member States started introducing nuclear power, the importance of the availability of

qualified manpower was more and more clearly perceived by them, and requests for Agency assistance gradually increased. It became clear that there was a need for broadening the scope of the Agency's activities in this field. In the early 1970s, the frequency of nuclear power-oriented information-exchange meetings increased, with a resulting improvement in the perception in several countries of the need for qualified manpower.

Most Agency efforts in the early 1970s were concentrated in the areas of nuclear power planning and feasibility studies. Through a number of planning studies, a procedure was developed which directly involved a number of qualified professionals to perform the study under the guidance of Agency staff, and to acquire the IAEA-developed methodology for national use in planning. This approach to assist the developing Member States by training their nationals, rather than by performing the tasks and activities for them, became a standard feature of the Agency's programme for manpower development for nuclear power.

Training courses

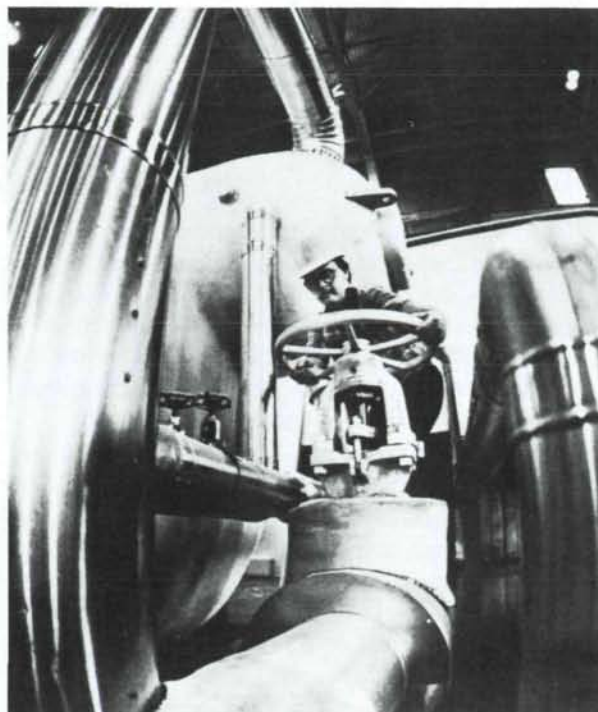
Nuclear power training courses, both general and specialized ones, constituted the first major Agency project within the framework of the manpower development programme. The first general course on nuclear power project planning and implementation was held in Karlsruhe in the Federal Republic of Germany in the autumn of 1975. This was followed by a series given at Argonne in the USA, Karlsruhe, and Saclay in France. Since 1978, eight to ten more specialized interregional courses are being held each year. New host institutes have joined in Spain, Argentina, Indonesia, Yugoslavia, Canada, and the United Kingdom. The courses have been a co-operative effort between each host institute and the Agency.

The basic objective has been a transfer of experience. The programme has been developed in a dynamic way, trying to respond to the different training needs of Member States. As a result, subject areas covered were increased, general courses were gradually replaced by more specialized ones, and a move to hold more national training courses developed.

Up to now, nearly 90 interregional nuclear power courses have been held, covering about 40 subject areas. More than 2200 participants from some 70 Member States have received nearly 4500 man-months of training. Also, about 20 national training courses have been held in seven developing Member States since 1980. It is to be noted that an overall evaluation of the nuclear power training programme is currently being performed within the Agency.

Technical guidebooks

Simultaneously with the launching of training courses, the preparation of a series of technical guide-



Manpower needs are diverse. Here a technician opens a drain isolation valve at Surry nuclear plant in Virginia, USA. (Credit: INPO)

books was initiated. The series now includes 17 guidebooks (eight published, six expected to be published in 1986, and three in preparation).

Within this series, the *Guidebook on manpower development for nuclear power* (published in 1980) has special relevance. It has found very wide acceptance and it has been translated into Korean and Russian for national use, for example. It also has provided a yardstick for assessment of manpower availability and a basis for formulating manpower development programmes in Member States. To provide further guidance on how to set up education in developing countries, a guidebook entitled *Engineering and science education for nuclear power* is now in publication and a similar guidebook on technician education and training is being prepared.

Qualification standards

Qualification standards have long been a difficult issue, in particular for plant operators. The Agency guidebook *Qualification of nuclear power plant operations personnel* presents conclusions of an international expert group and it should now probably be easier to get a broader agreement on what operator qualifications should be. Based on this guidebook, an interregional training course is to be held in Karlsruhe in the autumn of 1986, for which 23 developing Member States have presented candidates. In 1983, a national seminar was held in Egypt on operations personnel training. On nuclear power plant operations management, an international seminar was held in Vienna in 1984, and a

national training course in the Republic of Korea in 1986. The demand for Agency activities in this particular subject area shows an increasing trend.

Direct assistance

In general, the subject of manpower requirements, development needs, and qualification standards has gradually become one of the main subject areas covered in nuclear power conferences, symposia, and seminars. (On the specific subject of manpower requirements and development for nuclear power programmes, a symposium was held in Saclay, France, in 1979.)

Within the Agency's fellowship programme, a steady increase in nuclear power-oriented requests has become apparent. Requests for on-the-job training, in particular, are more frequent, and major efforts have been undertaken to make suitable opportunities available to developing Member States. Follow-up on-the-job training, after attendance at training courses, was one approach developed and applied.

With these general activities as a background, it has become possible to launch an integral assistance scheme that uses all elements of IAEA technical co-operation. The Agency will, if requested, assist a Member State to perform a manpower availability assessment and to draw up a manpower development programme to meet requirements when they arise. Such a programme will include, for example:

- Establishment of specialization courses at universities or nuclear institutes to precede the longer-term upgrading of the national education
- Use of fellowships and Agency international courses with on-the-job training fellowships after the course
- Establishment of national training courses (e.g., in safety analysis, quality assurance/control, project management, plant operations management)
- Setting up national training centres (e.g., a simulator centre for operator training).

Infrastructure support

Another aim is the establishment of a manpower development programme in step with development programmes for other infrastructures, notably the organizational and the industrial support structures. The IAEA has been asked to assist in such areas in several countries (Egypt, Republic of Korea, Philippines, and Yugoslavia). It also has worked through major projects of the United Nations Development Programme to establish nuclear power education and training in Argentina, Brazil, Chile, the Philippines and, more recently, the People's Republic of China.

The Agency's Division of Nuclear Power, which has the responsibility for substantive support to all nuclear power programme planning and implementation, has had nearly 100 activities over the past 10 years related to manpower development in Member States.

Statistics may not show the real impact achieved in Member States. Although a quantitative assessment of results so far is difficult if not impossible, a few qualitative indicators may nonetheless be mentioned:

- The availability of manpower, in particular at the management and professional levels with specialized knowledge and skills in nuclear power, has been substantially increased in developing Member States.
- Awareness of the need, importance, requirements, and problems of manpower development for nuclear power seems to have reached a stage, when further promotional efforts hardly appear necessary.
- In those Member States where the Agency has been asked to give advice, systematic manpower development programmes have generally been established and assistance has been provided for concrete projects in setting up education and training within the country.
- National training courses (e.g., in project management, plant operations management, quality assurance, and safety analysis) tend to diminish the need for inter-regional courses on these subjects, and it has been found that this type of training course can be especially well adjusted to the requirements of a particular country.
- The establishment of national training structures have also included technician training, which is difficult to arrange for internationally.

Programme support

Although the introduction of nuclear power into developing countries has been slower than was foreseen 10 to 15 years ago, there are between 10 and 20 countries actively considering the nuclear power option. Most of these countries are turning to the Agency to request assistance not only in planning but also in assessment of manpower and other infrastructures.

The IAEA's assistance has possibly its main significance just because it can and should be called upon at an early stage, before bilateral agreements and contractual arrangements can function. This also has naturally resulted in an emphasis in Agency programmes on senior and management level staff in Member States. It is rewarding that the Agency has had a strong and consistent support from the main supplier nations in the development of the manpower assistance programme.

Agency assistance in this field has undoubtedly been important over the past 10 to 15 years in several countries. This importance has been higher when assistance has been provided in an integral fashion, using all different means available to IAEA but also requiring a considerable effort from all concerned authorities in the recipient country.

Demands for Agency activities in this field have been steadily increasing up to now, though a certain shift in specific requirements for guidance and assistance has been noticeable. This again is a challenge that the Agency tries to meet by continually analysing and evaluating the evolution of requirements, and endeavouring to satisfy them in the best possible way.

Elements of Agency programme

Though manpower development is mainly a national effort, international information exchange, guidance, and assistance can be very useful. In particular for developing countries during the initial stages of their nuclear power programmes, international co-operation is indeed necessary.

One basic Agency objective is to promote the establishment of conditions that will permit the safe and reliable use of nuclear power; the availability of an adequate manpower infrastructure certainly constitutes one of the essential conditions to be fulfilled. IAEA's role in this field is to assist its Member States in every possible way, and in particular to provide guidance, advice, and help to developing Member States in the integral planning and

implementation of manpower development for their nuclear power programmes and projects. This is a challenge the Agency has endeavoured to meet in the past, and it continues to be one.

To meet it, the Agency has developed a comprehensive programme. Though most activities have at least an indirect effect on manpower development, some have been specifically directed and constitute the programme's basis.

As shown in the accompanying table, implementation forms are employed in a primary or secondary way respectively for each specific purpose. Some are better adapted for the achievement of a specific aim than others, while different forms complement each other for the achievement of best overall results.

IAEA manpower development activities

Objectives

Forms of implementation

	Information exchange meetings	Publications	Courses	Expert missions	Fellowships	Equipment	Major integral manpower development projects
Promotion of awareness of need, importance, requirements, problems	Primary	Primary	Secondary	Secondary	—	—	—
Guidance on assessment of requirements and for programme planning in general and in specific countries	Primary	Primary	Primary	Primary	Secondary	—	Primary
Provision of assistance in establishing national education and training	—	Secondary	Secondary	Primary	Secondary	Primary	Primary
Provision of individual training (directly or through host institutes)	—	—	Primary	—	Primary	—	Secondary

Paluel nuclear power station, France.

