

Training and development through the IAEA's global research network

An overview of the research contract programme and its impact

by Teresa Benson



"A man must stand erect, not be held erect by others." — Marcus Aurelius

Article III of the IAEA Statute authorizes the Agency "to encourage and assist research on, and development and practical application of, atomic energy for peaceful uses throughout the world". The Agency's research contract programme stimulates and co-ordinates the undertaking of research, in selected nuclear fields of interest, by scientists in IAEA Member States.

Programme policies

One special feature of the programme provides the opportunity for direct co-operation between the Agency and institutes in Member States. Research contract proposals originate in the Agency or at an institute, normally a non-profit making research organization. In either case, a formal proposal is submitted by the institute located in a Member State. This proposal may be made directly to the Agency without going through government channels.

When a proposal for research is made by an institution, the decision whether to award the research contract is made after careful consideration of all research aspects, such as the facilities and personnel available to the institution, previous research work related to the project and, in particular, the compatibility of the project with the Agency's functions and approved programmes. Proposals are screened by an Agency committee and forwarded for approval by the Director General.

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Photo above:

One of the IAEA's co-ordinated research programmes is directed at improving the productivity of livestock in the Mediterranean and North African countries.

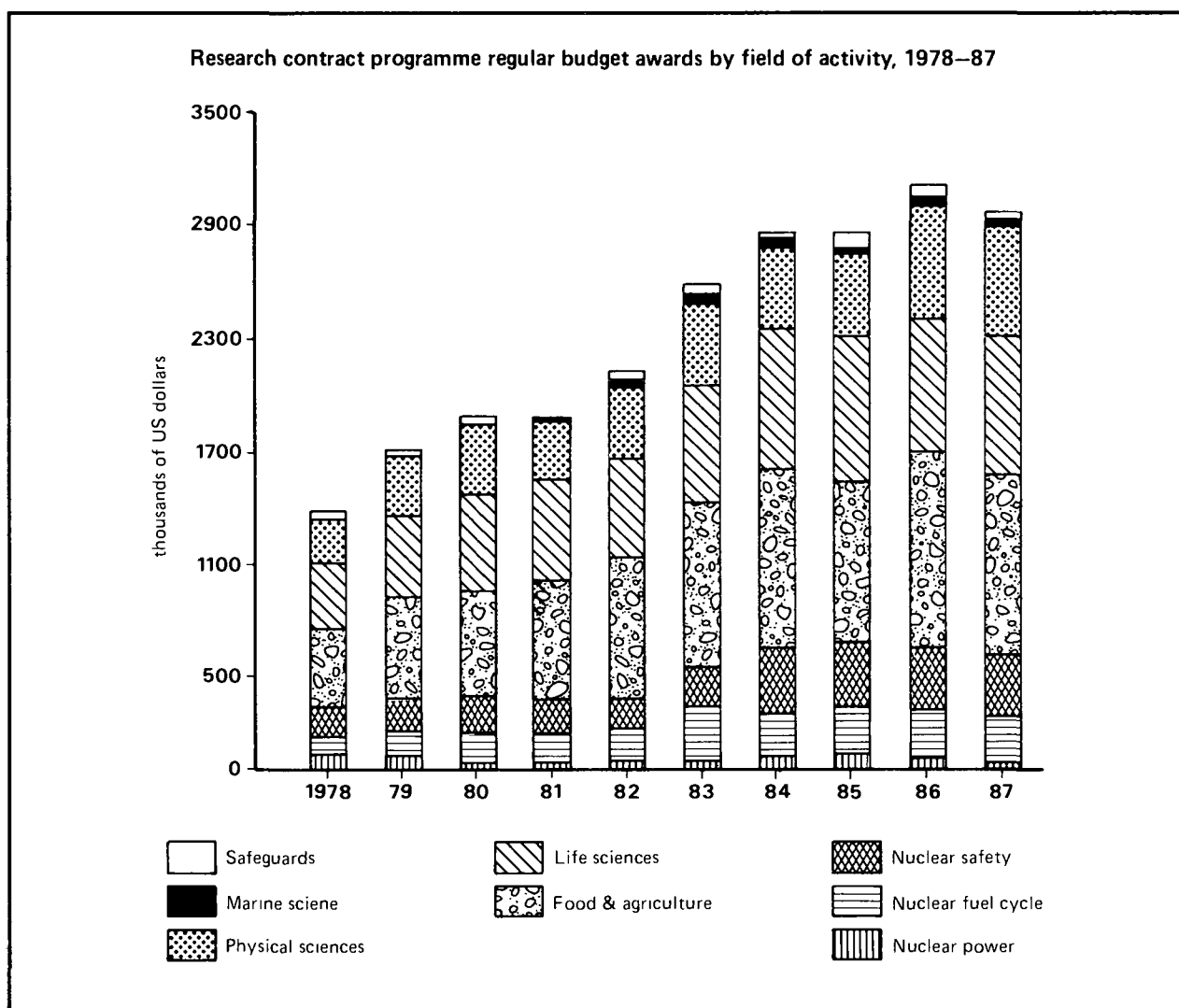
Scope and direction

A detailed list of subject areas covered by the programme is circulated each year to Member States. The list is drawn to reflect the detailed lines of activity contained in the Agency's overall programme for the following year as approved by its governing body.

Active since the inception of the Agency, the research contract programme has demonstrated flexibility in addressing the varying needs of Member States. It has stimulated development through research and the auxiliary training effects which have contributed to the objectives and priorities of the countries concerned.

Early in the programme, individual contracts were awarded to institutes in Member States to promote research in nuclear fields. In the mid-1960s, the idea of Agency co-ordinated research programmes was developed to take advantage of the opportunity the research contract programme presented for scientists to co-operate globally on common research endeavors. Co-ordinated research programmes (CRPs) have since furthered such co-operation and co-ordination between scientists undertaking related research projects at institutes in developing and developed countries.

The Agency designs CRPs with a well-defined research theme relating to its programme. Research teams from 10-12 institutes are selected for participation in each CRP. Institutes from developing and developed countries participate in the CRPs, which usually cover a 3-5 year period, with institutes in developed countries normally involved under research agreements. Under such agreements, the Chief Scientific Investigator agrees to provide one report per year covering work completed in support of the CRP and participates in all exchanges of information between CRP participants.



Regardless of the field of research, each CRP involves certain common aspects. Institutes in developed countries advise researchers in developing countries, who are encouraged to conduct work which will produce new research results, in addition to helping them gain experience in their own fields. Co-operation between institutes is strongly encouraged and supported by Research Co-ordination Meetings (RCMs), financed by the Agency for contractors and agreement holders and held at appropriate intervals for each CRP. At these meetings, the progress of the CRP is carefully reviewed and the future direction of work is established. At the final RCM, results are reviewed and evaluated by all participants and recommendations are made for future work in the field.

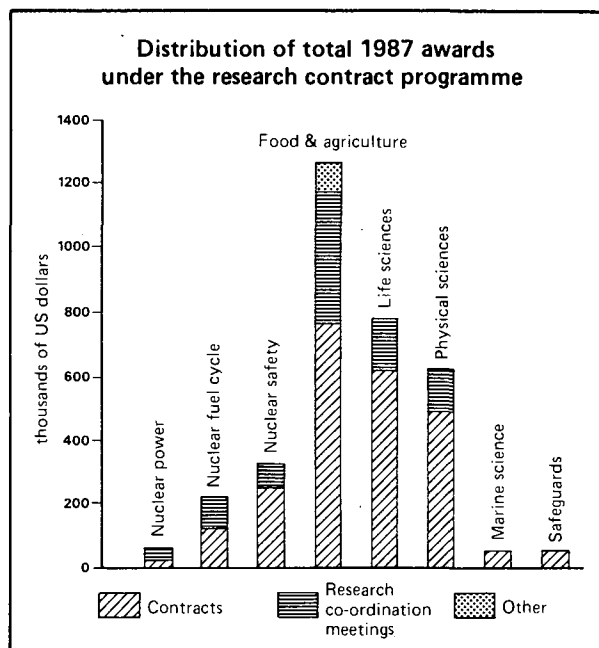
CRPs are developed in relation to well-defined research topics deemed desirable for participation by a group of institutes. These CRPs are an essential element of international research co-ordination and fulfil a unique training function by providing an opportunity for the direct exchange of information and experience among scientists from a large number of Member States.

CRPs, as well as individual contracts, have supported the promotion of research in fields ranging from nuclear applications in agriculture, medicine, and industry to nuclear power technology, nuclear safety, and the nuclear fuel cycle. (See accompanying graph.) While the scope of the projects within the latter areas may not appear to be closely related to the problems of most developing countries, these projects contribute substantially to ensuring the transfer of technology between developed and developing countries.

The number of awards and degree of funding demonstrate that the programme constitutes a significant activity within the general programme of the Agency. In the last 10 years, it has financed research activities in Member States totalling about US \$24 million. In 1987, US \$3 million was awarded to institutes in 71 Member States under contractual arrangements and to fund research co-ordination meetings. Additionally, US \$431 000 of extrabudgetary contributions was used to fund additional contracts and RCMs. (See accompanying graphs.) During 1987, more than 1400 research proposals were received and reviewed by the Agency,

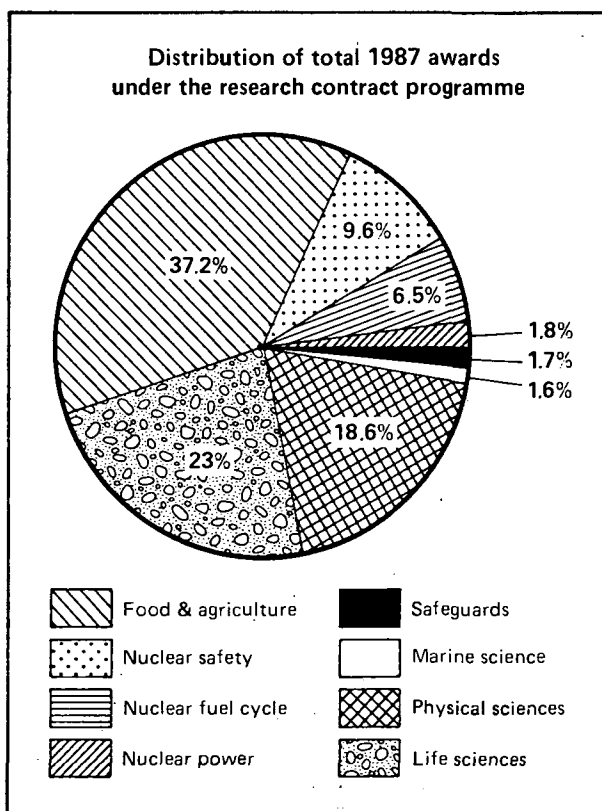
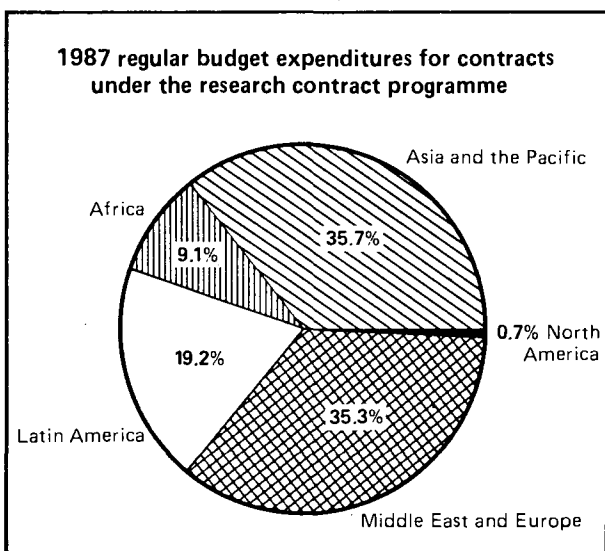
indicating the widespread interest of institutes. The Agency's regular budget for 1988 provides US \$3.6 million for the research contract programme.

The programme aims to provide further incentive and support to institutes in Member States which have received technical assistance. Thus, the objectives are being increasingly co-ordinated with the Agency's technical co-operation programme. The combined efforts of these Agency programmes can maximize benefits accruing to Member States. Technical co-operation and research contract projects are increasingly being linked, to better address and integrate the needs of all Member States within the limits of available financing for both activities. Complementary operations can serve as a vehicle to provide more comprehensive and continuous service to Member States.



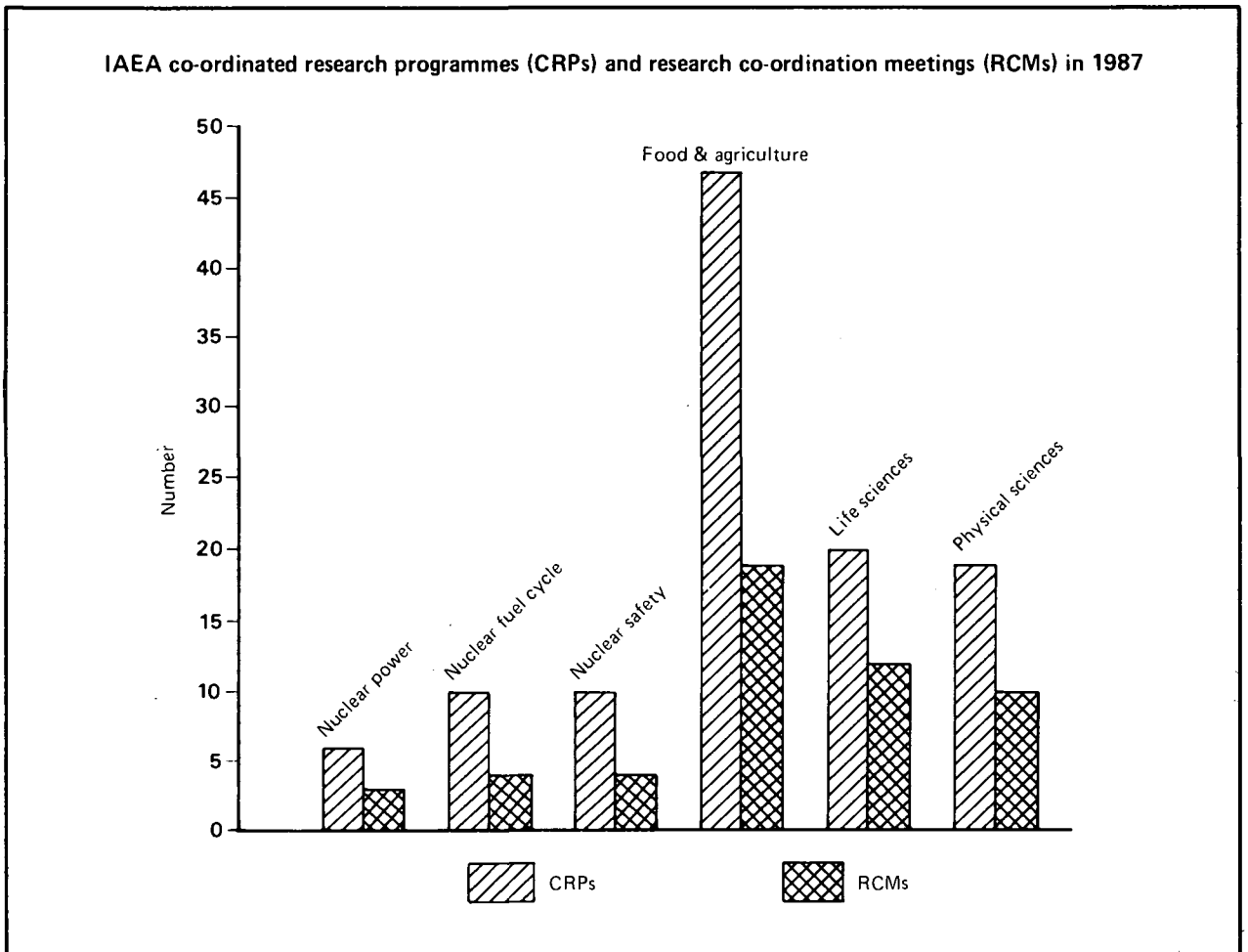
52 countries in 1978 and 71 countries in 1987, 87% of which were developing countries.

There are now more than 1300 active contractual arrangements under the research contract programme representing participation in 120 on-going CRPs, plus participation in individual projects. (See accompanying graph.) The results of projects carried out under this programme are available for review by Member States in Agency publications and scientific journals.



From 1978-87, the number and nominal value of Agency awards made under the research contract programme has risen significantly, a strong indication of the recognition by institutes of the inherent value of this programme. The number of contracts awarded rose from 230 in 1978 to 478 in 1987. The funds made available under these contracts more than doubled during this period. The impact of these increases is greater than amounts indicate, since funding, in effect, usually represents "seed money" which often invites additional funding for institutes in Member States. Thus, a relatively small Agency contribution (approximately US \$5000 per contract, per annum) attracts a far higher level of funding.

Co-ordination effort in research areas important to Member States has also greatly increased in the last 10 years. In 1978, institutes in Member States participated in 77 CRPs, while in 1987, the Agency sponsored 112 of these programmes. More than 80% of the contracts and agreements are earmarked for participation in Agency CRPs. Participating institutes came from



Training and education

Three recently concluded CRPs represent how the benefits of this programme are enhanced by the indirect results of training and education.

Animal health and productivity. This CRP concerned optimizing livestock productivity in the Mediterranean and North African countries with the aid of nuclear techniques. It stands as an example of the versatility of the programme in establishing a multi-disciplinary project, with emphasis on a specific region. The programme was financed solely by the Government of Italy; institutes in eight countries in the region and in four industrialized countries were involved.

The CRP was established to help find solutions to problems in rearing ruminant animals which have a major impact on animal productivity. Three principal inter-related impediments to producing meat, milk, and wool efficiently were examined. They included poor rates of reproduction, seasonal variation in breeds of animals, and their ability to adapt to environmental stresses such as low water supplies. The CRP sought to enhance reproductive efficiency, identify physiological parameters which would be linked to increased resistance to high ambient temperatures and water

shortage, and to overcome nutritional constraints on productivity.

The Agency sent experts to the region to identify institutes and scientists capable of conducting meaningful isotope-aided applied research within and across the disciplines of animal reproduction, nutrition, and environmental adaptation. To collect reliable data and ensure the proper integration of efforts, a large number of institutes was recommended for participation in the programme; participation was above average with 18 institutes from the region representing eight countries. The institutes were advised on specific techniques, experimental protocols, and preservation of results by six laboratories in four industrialized countries, as well as by Agency staff members.

Within the framework of this CRP, a major effort was made to characterize and improve the reproductive performance of indigenous livestock under the diverse environmental and management conditions prevailing in the countries concerned. Measurement of plasma and milk progesterone levels by radioimmunoassay (RIA) was employed in the studies monitoring ovarian status of various breeds and species of ruminants regarding fertility. In some studies, additional hormone RIAs were utilized in association with progesterone determinations

for examining nutritional and environmental influences on reproduction.

The successful development and efficient distribution of standardized blood and milk progesterone kits was an important achievement under this programme and has benefited other joint activities of the Food and Agriculture Organization (FAO) and IAEA in animal reproduction in developing countries. The major accomplishment of this programme was the degree to which it catalysed research into animal production in the region.

Training and other support provided to animal scientists in Mediterranean and North African countries under the programme have generated a substantial amount of new knowledge about the performance of many indigenous breeds and types of grazing livestock in the region and ways to overcome these prevailing constraints to increase productivity. A particularly interesting conclusion holds ecological implications, in that it may not be advantageous to improve the feed quality of animals grazing in desert areas since this increases the need for water and thereby restricts grazing to areas in the close vicinity of water sources.*

Monitoring malaria vectors. In contrast, a recently completed programme on the development of nuclear and related techniques for monitoring malaria vectors concentrated on a global problem on a broad geographical basis. Recognizing the importance of the recent increased prevalence of malaria, especially in tropical Africa, the programme was recommended in order to stimulate research into control methods targeted at the mosquito vector.

The Agency provided training equipment and financial support to establish the immunoradiometric assay (IRMA) at institutes in developing Member States. (The assays used monoclonal antibodies for detection and specific identification of human malaria sporozoites in mosquitoes.) The establishment of the assay was guided by four institutes from the USA and Italy with expertise in hybridoma and assay technology. Upon completion of the programme, institutes in seven developing countries — Colombia, Egypt, Kenya, Mali, Peru, Tanzania, and Thailand — had successfully established the assay and were using it routinely in epidemiological studies.

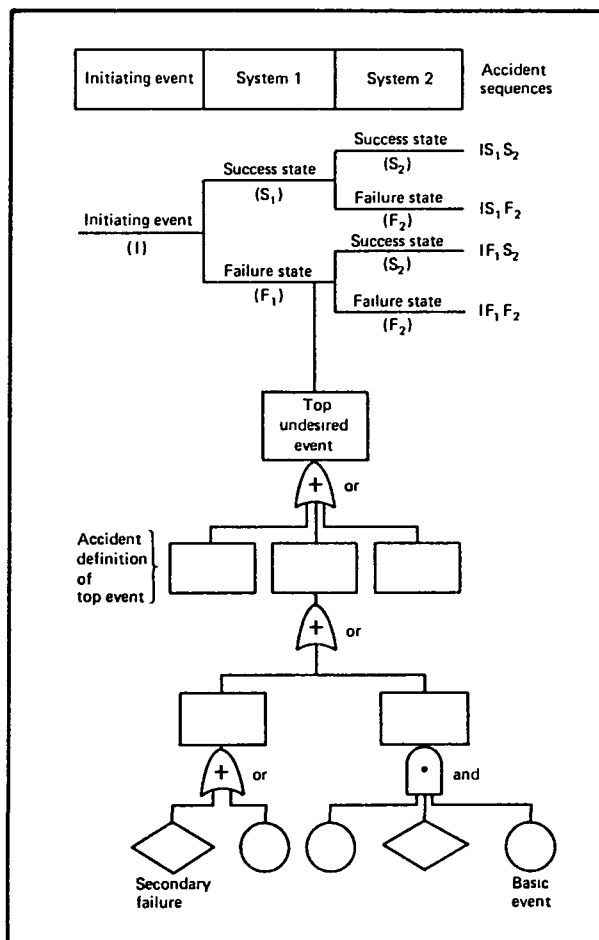
The final RCM recommended in late 1987 that the Agency should encourage the development of methodologies for detecting antibodies to synthetic malaria antigens in human populations. This could provide tools for the assessment of the malaria situation with reference to transmission rates and the evolution of the immune response, thus making a valuable contribution to the worldwide control of malaria. (The results of this CRP are to be published in an Agency technical document later in 1988.)

* The conclusions and recommendations of the CRP have been published by the IAEA in *Isotope Aided Studies on Livestock Productivity in Mediterranean and North African Countries*; STI/PUB/778 (1987).

Nuclear power and safety

In the areas of nuclear power technology, nuclear safety, and the nuclear fuel cycle, activities under the research contract programme have steadily increased in the past several years. In 1987, almost a fourth of the CRPs carried out under the programme were in these areas. A typical example is the nuclear safety CRP on the development of risk criteria for the nuclear fuel cycle, which has led to probabilistic safety assessment (PSA) programmes in more than 30 IAEA Member States. These PSA programmes are providing safety information needed for the development of nuclear power plant regulations, operating procedures, and design evaluation.

PSAs identify and quantify the probabilities and consequences of a range of accident sequences and the equipment and human failures which must take place for each accident to occur. The results of a PSA describe how, and over what time period, each accident could evolve; what damage to the nuclear facility, to the environment and to society could result; and the probability of each accident. PSA allows estimates to be made of the probabilities of such accidents based upon available experience with failure rates of components (pumps, valves, relays) and of personnel which assist in plant operation. Thus, PSA is particularly important to evaluate the safety of nuclear power plants since there



exists little or no experience on the frequencies and consequences of accidents with severe health, environmental, and/or economic consequences.

This information is critical in the prevention of accidents and it is particularly relevant for those working in nuclear installations to learn how to properly perform PSA and use the results for safety decisions.

PSA is performed by identifying a number of possible events which would initiate a spectrum of accident sequences. The calculation of the probability of each accident sequence requires knowledge of the probability of failure of each system belonging to an accident sequence. Accident sequences are described using event trees. (*See accompanying diagram.*)

The CRP on development of risk criteria for the nuclear fuel cycle was designed to identify and categorize the spectrum of different risk types in the nuclear fuel cycle; develop a consistent set of criteria for the expression of risks for the light-water reactor (LWR) fuel cycle; identify the elements necessary to include in a comprehensive risk analysis; identify the analytical methods, with their respective strengths and weaknesses; and select a final set of methods and identify the criteria used in the selection of these analytical methods.

Upon its conclusion in 1988, a technical document was published. This CRP led to two IAEA training courses and three interregional projects in PSA. The CRP concluded that there is a need to develop a standard framework for the conduct of PSA to allow the results of probabilistic studies performed by different analysts to be compared. Reference studies on the modelling of accident sequences also are needed to understand the source of uncertainties and differences in the results for the same problem solved by different analysts. Based on these conclusions, a new CRP on reference studies on probabilistic modelling of accident sequences was introduced at the end of 1987; the first RCM was held in May 1988. This new CRP strives to encourage a collective learning process that will integrate the latest knowledge of the technical community in PSA to ensure that all participating institutes obtain adequate practice in

applying PSA techniques and to foster the development of a standard framework in which PSA would be conducted.

Participation in the research contract programme

Institutes in Member States interested in participating in this programme are invited to apply directly to the IAEA. Contracts and agreements are normally awarded for an initial period of 1 year, renewable up to a total project period of 3 years. The contractor or agreement holder must submit a progress report at the end of each year and a comprehensive final report at the end of the final renewal.

Contract awards may be made in the form of financial assistance or, upon the contractor's request, the Agency can directly procure equipment required for the project.

Programme results

As evidenced by the examples mentioned, benefits of the research contract programme can be direct or indirect. Direct benefits include increased scientific knowledge in a specific field and case-by-case application of this knowledge.

Indirect benefits include the training effects — what participants in the programme learn via work carried out under the contract or at regularly held RCMs. The educational effect of CRPs is substantial as many institutes, guided by Agency scientific staff, learn how to conduct research without assistance.

Unanticipated spin-off benefits can also result from a CRP through information exchanges at RCMs that stimulate ideas for other research programmes or methods of research.

The research contract programme is an effective vehicle for stimulating research in Agency Member States. It is result-oriented. Thorough evaluation of ongoing and completed CRPs and contracts under the programme allows for optimal planning of future CRPs in line with the Agency's programme of work.

