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THE ROAD AHEAD

PERSPECTIVES

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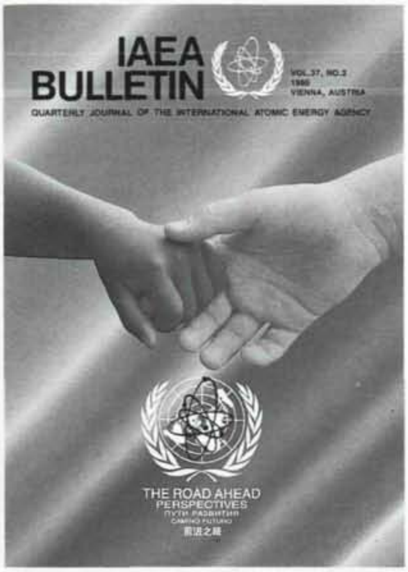

Front Cover: The United Nations officially commemorates its 50th anniversary in October, with the international community taking stock of both its accomplishments and shortcomings as the world's instrument for international peace and sustainable development. The road ahead is full of challenge and opportunity. For the IAEA — which works closely with the UN and its family of organizations in the nuclear sphere — the future is unfolding along a compelling new course. Problems and needs have emerged which demand greater vigilance and cooperation among States — particularly concerning issues of nuclear non-proliferation, arms control, and safety. As they build toward the next 50 years, the IAEA and its UN partners will need renewed support to effectively help countries take steps on the road ahead for achieving a better, safer world.
(Cover design: Hannelore Wilczek, IAEA; Stefan Brodek, Vienna; Photo: Zefa, Vienna; Bryan F. Peterson)

Facing Page: Emerging from the dust and death of scorched fields, a flower unfolds to the promise of life.
(Credit: Stefan Brodek, Vienna)

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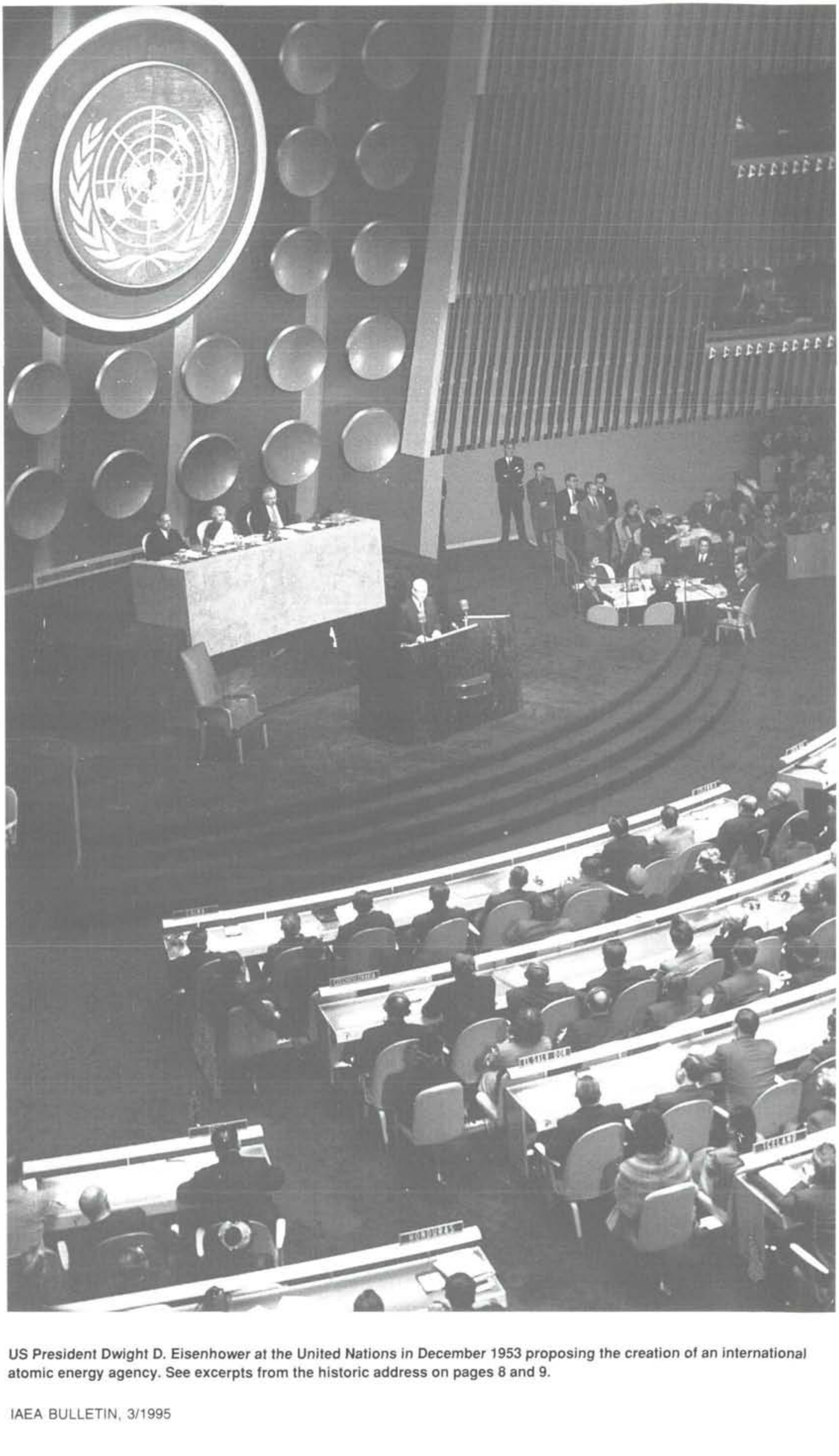

US President Dwight D. Eisenhower at the United Nations in December 1953 proposing the creation of an international atomic energy agency. **See excerpts from the historic address on pages 8 and 9.**

The IAEA, United Nations, and the new global nuclear agenda

Cooperative links in key areas have been strengthened in response to emerging challenges and opportunities

by Hans Blix

Radical changes in the global nuclear landscape after the Cold War have set the world on a compelling new course. Smaller nuclear arsenals, stronger bonds against the bomb's further spread, and renewed commitments for the atom's safe and peaceful use are all parts of the changing scene. The transformation is redefining the global nuclear agenda for the United Nations and the IAEA on the road to the next millennium.

Today's challenges and opportunities are rooted in the concerted international drive over the past half century to harness the atom and brighten prospects for a nuclear-weapons-free world. Despite positive steps and welcome shifts of attitude, there is a difficult distance to go. But key elements for sustaining progress are in place and the missing pieces are not hard to see.

The picture can be easily overshadowed by the many critical assessments and competing headlines of the day, especially in a year marking both the atomic bomb's horrific power and the anxious birth of the United Nations 50 years ago.

The UN and its system of organizations have come in for some particularly tough criticism. Whatever specific points at issue, the views are bound by common threads: the aspiration for a better and safer world, and the growing desire for greater confidence that one is being built. The UN was born as the world's instrument for international peace and security to meet humanity's highest hopes and greatest expectations, and in some ways it has been asked to carry out nearly impossible missions. As the "Atoms for Peace" organization within the UN system, the IAEA, too, is held to serve our highest standards and ideals. *(See box, page 9.)*

While some of the criticism and calls for reform are justified, many accusations are misplaced. Often discounted is the fact that no organization operates in a vacuum. Achievements, and shortcomings, are closely bound with fluid external events and internal realities of what members are willing to do, pay for, and politically support. At the global level, the members are sovereign States who do not always see eye-to-eye every step of the way. Efforts to bridge differences, build consensus, and coordinate actions can be a complex, lengthy process. While talking about problems is not enough, it is the first step to finding and implementing workable solutions for them.

Fortunately, the international climate now is more conducive to constructive action than during most of the UN's first half century. The polarized ideological debates of the cold war no longer threaten to deadlock the UN. The warmer climate has opened important new avenues of global cooperation, and is bringing new problems that must be solved to the tables of the UN and its family of organizations.

"The problems that confront the United Nations are also a challenge for the Member States that make up the United Nations and the peoples of the world whom the organization serves," UN Secretary-General Boutros-Ghali has recently written. "In these changed circumstances, there is a pressing need for governments and public opinion to decide what they want the United Nations to be, what they want it to do, and what they are willing to contribute to make it work."

In the past, a good deal of criticism has been directed at the lack of cohesion and coordination in the UN system. In my view, the criticism is not applicable to the IAEA and its relations with the UN in the nuclear sphere. Channels have long been in place for effective cooperative action in fields of nuclear non-proliferation and arms control, and the safe development of peaceful nuclear technologies.

Three events over the past decade — the Chernobyl nuclear plant accident in 1986, the discovery of Iraq's clandestine nuclear-weapons

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programme in 1991, and the breakup of the Soviet Union into independent States in the 1990s — have particularly left their marks. The IAEA's agenda has adapted accordingly, to respond to new sets of problems and needs. Some programmes have been reoriented, others significantly strengthened. The overriding aim is to support States in building a stronger, more effective international framework for safe nuclear development. Allow me to more fully address some important aspects within the context of global developments and the Agency's roles within the UN system.

Securing a nuclear-weapons-free world

Most visibly in the 1990s, the IAEA and UN have demonstrated close, prompt, and effective interaction in areas of disarmament and nuclear non-proliferation. The widely publicized nuclear inspections in Iraq — which the IAEA performs under the mandate given by the UN Security Council and with the cooperation of the UN Special Commission set up after the Gulf War — are a case in point. Through dozens of IAEA-led missions under the Council's mandate, inspectors discovered and mapped Iraq's clandestine nuclear weapons programme, effectively moved to destroy or neutralize it, and activated a long-term monitoring and verification plan to prevent its revival.

The case tested the global community's resolve and the responsiveness of its mechanisms for sustained, coordinated and firm action. The IAEA's founders presciently vested the Agency with a right of direct access to the Security Council, where international authority for enforcement action is placed. The Council's determination to prevent proliferation was underscored in January 1992. In declaring that "the proliferation of all weapons of mass destruction constitutes a threat to international peace and security", the Council emphasized the integral role of effective IAEA safeguards in efforts to stop the spread of nuclear weapons, and stated its readiness to take appropriate measures in the case of any safeguards violations notified by the IAEA.

In Iraq, the Council granted the IAEA inspectorate incomparably wider powers and access to more information than States normally do under its safeguards system. Lessons from the case have prompted States to accept verification measures, and to consider others, that greatly strengthen the Agency's confidential database and verification capabilities, especially with respect to detecting *undeclared* nuclear activities. The Agency's inspections to verify the nuclear material subject to safeguards in the Democratic People's Republic of Korea (DPRK) already have demonstrated that these measures are working, albeit difficulties remain in securing the DPRK's full compliance with its safeguards agreement.

Overall, the Security Council has looked to the IAEA as the nuclear inspection arm of the UN system, and the IAEA has looked to the Council as the body politically responsible for ensuring compliance with nuclear non-proliferation undertakings. Building upon this established relationship is now of paramount importance as more arms-control agreements requiring verification are adopted or near completion, and the non-proliferation regime nears universality.

Forward movements. In May 1995, meeting at UN headquarters in New York, the 178 States party to the landmark Treaty on the Non-Proliferation of Nuclear Weapons (NPT) took important steps forward. *(See related article beginning on page 30.)* They indefinitely extended the NPT and confirmed that the NPT involved a commitment to nuclear disarmament by the nuclear-weapon States. They targeted 1996 for conclusion of a Comprehensive Test Ban Treaty (CTBT), which is being negotiated under auspices of the UN Conference on Disarmament in Geneva. States also called for an early conclusion of an agreement to cut off production of fissile materials for weapons purposes; they endorsed the creation of more nuclear-weapon-free zones; they expressed support for ongoing efforts aimed at more effective nuclear verification and IAEA safeguards; and they called for the provision of necessary resources for the Agency to meet its responsibilities under the NPT.

As the outcome of the NPT Conference made clear, there is near universal renunciation of the bomb. The overwhelming majority of States no longer see the acquisition of nuclear weapons as being in the best interests of their national security. Rather, these interests today are tied to social, environmental, and economic conditions where expensive nuclear *weapons* are useless tools but affordable *peaceful* nuclear techniques are valuable resources.

At the same time, more States are showing a readiness to make their nuclear programmes more transparent and open to IAEA inspection and verification. They are doing so in recognition of the need to provide credible assurance to their neighbours and the world that nuclear material and installations are used exclusively for peaceful purposes. Rather than limiting national sovereignty, nuclear transparency and verification are seen as means through which a State can enhance confidence in its non-nuclear weapon status and respect for its sovereignty.

Extremely positive moves have been made. South Africa rolled back its nuclear-weapons programme, joined the NPT, and fully cooperated with subsequent IAEA verification measures. Both Argentina and Brazil have opened their nuclear sectors for inspection to each other and the IAEA, and nuclear-weapon-free zones pinned to IAEA verification are poised to come into being in Africa and into full force in Latin America and the Caribbean. Such a zone in the Middle East also is no longer just a utopian dream, in light of progress painstakingly achieved through the region's peace process.

Challenges. Not all States having significant nuclear activities have adhered to the NPT or accepted full-scope IAEA safeguards. That is one important missing piece of the non-proliferation regime. While these States do not say they house nuclear weapons or harbour ambitions to make them, they have so far not been willing to accept comprehensive international verification of their nuclear programmes. The hope for the future hinges on the resolution of underlying regional security problems and further progress in the nuclear disarmament field. A combination of measures will be needed, including those further reducing the nuclear arsenals of nuclear-weapon States, and fostering detente, security arrangements, and assurance that neighbours do not develop nuclear weapons. In the Middle East, for example, the IAEA is assisting States on future verification models and approaches within the framework of their desire to create a regional zone free of nuclear and other weapons of mass destruction.

Another challenge facing the global community is the anxiety over new risks following the breakup of the Soviet Union. In particular, the illicit trafficking of nuclear materials has raised concerns, both from the standpoint of radiation safety and nuclear security. Most of the cases reported and investigated so far, predominately in Europe, have involved material of an amount or nature not useful for weapons, and none has ultimately posed a serious proliferation or radiation risk. The illegal actions have set off an alarm, however, prompting strong countermeasures against such unauthorized and uncontrolled movement of nuclear material. States cooperatively are strengthening their internal and border surveillance systems, and the IAEA is executing an action plan to assist them in dealing with some aspects of the problem. The work includes the establishment of a databank on reported trafficking cases and advising States on effective systems of nuclear material accountancy and control. In July 1995, the President of the UN Security Council issued a statement underlining the Council's support for IAEA activities in this area.

The dissolution of the Soviet Union also gave rise to three new independent States with nuclear weapons on their territories, Ukraine, Belarus, and Kazakhstan. All three have joined the NPT as non-nuclear weapon States, and accepted comprehensive IAEA safeguards. The actions reconfirm their commitments to remove all nuclear weapons from their territories, though these steps are envisaged over the longer term.

A number of other challenges emanate from emerging needs for effective verification in areas of nuclear disarmament and arms control.

New verification roles. The CTBT, cut-off agreement, and nuclear disarmament accords already reached or in sight will all require effective verification systems.

The nuclear test ban treaty will involve various types of verification measures and approaches, some of which States have noted could effectively be carried out by the IAEA. The treaty's obligations, for instance, will considerably overlap relevant provisions of the NPT, under which the IAEA already implements verification measures in non-nuclear weapon States. Some States envisage the IAEA being entrusted with further verification tasks under the CTBT.

The cut-off agreement foresees a non-discriminatory ban on the production of fissionable material for nuclear weapons purposes. Here, too, the IAEA's relevant experience is being recognized. Under the NPT, the Agency applies safeguards to the types of installations that would be subject to verification under a cut-off agreement.

Under disarmament agreements, large amounts of nuclear material will arise from the dismantling of nuclear warheads. While the nuclear-weapon States will verify actual dismantlement of weapons, that is not necessarily the case for verification of the recovered plutonium and highly enriched uranium. Since late last year, the IAEA has been safeguarding some stored quantities of weapons-usable nuclear material in the United States, and it could provide similar verification in Russia or other nuclear-weapon States as decisions are taken.

Stockpiles of plutonium and enriched uranium are projected to grow considerably in years ahead, both as a result of weapons dismantlement and commercial nuclear operations. The Agency already is working with States on methods and approaches that are needed for effectively safeguarding these materials — whether they are kept in storage, disposed of as waste, or recycled as fuel in nuclear plants for electricity generation.

Expanding legal framework. In all these areas of non-proliferation and arms control, the established legal nuclear framework will expand as new agreements are reached. We know from experience, however, that agreements cannot be built on trust alone. They invariably call for confidence-building measures, notably effective verification. The more that armed forces and armaments are reduced, the more States will need to be confident that commitments are being observed, respected, and credibly verified.

The IAEA's efforts to strengthen its verification system aim at providing more credible assurances about the correctness and completeness of declared nuclear inventories under NPT safeguards agreements, and thus about the absence of undeclared nuclear activities. Measures already in place and planned call for greater cooperation from States. That governments are supporting them signals the growing importance they place upon raising the world's level of nuclear security, and reinforcing confidence in its global guardians.

Nuclear safety & sustainable development

As in the safeguards field, new challenges and opportunities are influencing directions to ensure safe nuclear development. Many activities greatly contribute to realizing global objectives for sustainable development under Agenda 21 adopted at the 1992 UN Conference on Environment and Development.

High on the agenda are issues of nuclear and radiation safety. Since the devastating Chernobyl accident in 1986, States have adopted three safety-related international conventions under IAEA auspices and are now working on others. The adopted agreements, which all set legally binding rules, cover the early notification of nuclear accidents; the provision of assistance in the case of nuclear emergencies; and fundamental requirements and mechanisms for ensuring the safety of nuclear power plants. Under preparation is a convention covering the safe management of radioactive waste, and a revision of the Vienna Convention on liability for nuclear damage. Additionally, parties to the London Convention, under auspices of the UN's International Maritime Organization, have adopted an international ban on the dumping of radioactive waste at sea, assigning the IAEA new responsibilities.

These global steps do not transfer jurisdiction from national authorities who remain chiefly responsible for nuclear and radiation safety. They do, however, underline the growing awareness among States that safety levels must be high everywhere, and that basic rules should be respected by all.

In many instances, the work draws upon and augments the IAEA's extensive base of safety standards and services. Over the past years, for example, fundamental standards for nuclear power plants, and for radiation protection in fields of medicine, agriculture, and industry, have been revised. International organizations ranging from the World Health Organization (WHO) to the Food and Agriculture Organization (FAO) and International Labour Office (ILO) have been involved in these efforts. In 1996, the IAEA will be updating its recommendations covering the safe transport of radioactive materials, which regulators apply worldwide for shipments on land, by sea, and by air.

The effects of radiation releases on human health and the environment also are drawing close attention. Building upon its sponsorship of the International Chernobyl Project in the early 1990s, the IAEA is organizing with WHO and the European Commission a major international symposium in April 1996, a decade after the accident. The scientific meeting will factually assess Chernobyl's radiological consequences, in light of continuing speculation over its health and environmental effects.

Some special needs have arisen in countries of Central and Eastern Europe. They include upgrading levels of safety at nuclear plants of Chernobyl design, as well as other types of power reactors; improving regulation and control of radiation sources and their safe use; and coordinating actions to strengthen global cooperation with Russia in areas of radioactive waste management and environmental restoration.

Nuclear power and energy needs. Greater attention to issues of global safety should not mask the overall nuclear record, which is excellent. The world's 432 nuclear power plants, for example, generate about 17% of the world's total electricity, and far higher shares in many countries. Their normal operation has little environmental impact. As the environmentally conscious Club of Rome has noted and many States have realized in practice, nuclear power is a greener option than those emitting carbon dioxide and other gases as waste products threatening the atmosphere.

As sustainable development brings better living conditions to a growing world population, greater use of energy, especially electricity, will be demanded. Where will it come from? Extensive analyses of energy options are needed to factually frame answers. The IAEA and several other international organizations are assisting in comparative assessments of the benefits and problems of different electrical power options, including nuclear energy.

Nuclear techniques and development. Most States do not have nuclear power plants, but they do apply nuclear techniques in many other ways. Being emphasized today are applications targeted at improving the production and preservation of food, health care services, industrial production processes, and fresh water supplies, a problem of growing magnitude.

Working with a range of UN partners, the IAEA is carrying out projects to improve crop yields and pest controls in Bangladesh, China, and Mali, for example, and to strengthen health screening programmes of newborn infants in Tunisia and Uruguay. At the same time, desalination of seawater is drawing attention from countries in North Africa and the Middle East confronted with serious water needs. Agency specialists are examining the technology's potential. Studies include analysis of possible coupling schemes with nuclear reactors to meet both desalination's energy requirements and the electricity needs of local factories, households, and businesses.

Throughout these and other IAEA-supported projects, countries are building up their capacity and skills for safely applying nuclear techniques to achieve key development goals. To maximize project benefits, stretch its limited resources, and bring the needed scientific expertise to bear on specific problems, the Agency is now reinforcing its ties with national and regional development agencies and banks, as well as with other global organizations.

Building for the future

As we critically reflect upon the changing world in this commemorative year, loud headlines should not obscure the quiet achievements of global cooperation. The record reflects substantial progress, giving us much to build upon.

In a climate favouring nuclear cooperation rather than confrontation, renewed efforts to uplift human standards of living have a greater chance of fruition. Disarmament is integral to the pace of progress. So, too, are advances in other fields — notably telecommunications, biotechnology, and branches of science and medicine that will expand our access to knowledge and understanding of earth and human life systems.

We have learned first hand that the world's security cannot be defined by the military dimension alone. At the personal level, human security fundamentally embodies safety from threats of hunger and disease.

The military side of the equation has tended to dominate thoughts — and national budgets. That is starting to change, as countries cut back military spending, overall at a 3% annual rate since 1987. The UN has estimated that the reduction — the so-called peace dividend — has amounted to an estimated US $935 billion worldwide between 1987-94. Unfortunately so far, not much of that peace dividend has been rechanneled for social and environmental development — or for what might be called "sustainable disarmament".

Coming decisions will greatly influence capabilities to meet the needs of global human security, in all its growing dimensions. In the next century — as we heard so dramatically at the United Nations Conference on Population and Development in Cairo — there will be millions more citizens of the world. The headlines tell us the population bomb is ticking, that it took 10,000 generations for the world to reach two billion people but only 46 years — about the UN's lifetime — for the population to triple.

The future is clear in its problems. Yet as UN Secretary-General Boutros-Ghali has noted, it is in many ways more uncertain and complicated as to solutions. Hard work, greater cooperation, and resources are demanded. This is especially true in the nuclear sphere, where the global foundation — tested and strengthened over the past decade — must now be even more firmly supported to meet the challenges and opportunities before us. ❐

IAEA-supported projects are helping countries use nuclear techniques for their social and economic development.

Forty-two years ago this December, US President Dwight D. Eisenhower made an historic address to the 8th Session of the United Nations General Assembly. On 8 December 1953, President Eisenhower proposed the creation of an international atomic energy agency. That proposal led to the IAEA. Excerpts follow:

I feel impelled to speak today in a language that in a sense is new, one which I, who have spent so much of my life in the military profession, would have preferred never to use. That new language is the language of atomic warfare.

The atomic age has moved forward at such a pace that every citizen of the world should have some comprehension, at least in comparative terms, of the extent of this development, of the utmost significance to every one of us. Clearly, if the peoples of the world are to conduct an intelligent search for peace, they must be armed with the significant facts of today's existence.

My recital of atomic danger and power is necessarily stated in United States terms, for these are the only incontrovertible facts that I know. I need hardly point out to this Assembly, however, that this subject is global, not merely national in character.

On 16 July 1945, the United States set off the world's biggest atomic explosion. Since that date in 1945, the United States of America has conducted forty-two test explosions. Atomic bombs are more than twenty-five times as powerful as the weapons with which the atomic age dawned, while hydrogen weapons are in the ranges of millions of tons of TNT equivalent.

Today, the United States stockpile of atomic weapons, which, of course, increases daily, exceeds by many times the total equivalent of the total of all bombs and all shells that came from every plane and every gun in every theatre of war in all the years of the Second World War. A single air group whether afloat or land based, can now deliver to any reachable target a destructive cargo exceeding in power all the bombs that fell on Britain in all the Second World War.

In size and variety, the development of atomic weapons has been no less remarkable. The development has been such that atomic weapons have virtually achieved conventional status within our armed services. In the United States, the Army, the Navy, the Air Force and the Marine Corps are all capable of putting this weapon to military use.

But the dread secret and the fearful engines of atomic might are not ours alone.

In the first place, the secret is possessed by our friends and allies, the United Kingdom and Canada, whose scientific genius made a tremendous contribution to our original discoveries and the designs of atomic bombs.

The secret is also known by the Soviet Union. The Soviet Union has informed us that, over recent years, it has devoted extensive resources to atomic weapons. During this period the Soviet Union has exploded a series of atomic devices, including at least one involving thermo-nuclear reactions.

If at one time the United States possessed what might have been called a monopoly of atomic power, that monopoly ceased to exist several years ago. Therefore, although our earlier start has permitted us to accumulate what is today a great quantitative advantage, the atomic realities of today comprehend two facts of even greater significance. First, the knowledge now possessed by several nations will eventually be shared by others, possibly all others. Second, even a vast superiority in numbers of weapons, and a consequent capability of devastating retaliation, is no preventive, of itself, against the fearful material damage and toll of human lives that would be inflicted by surprise aggression...

I know that in a world divided, such as ours today, salvation cannot be attained by one dramatic act. I know that many steps will have to be taken over many months before the world can look at itself one day and truly realize that a new climate of mutually peaceful confidence is abroad in the world. But I know, above all else, that we must start to take these steps — now...

There is at least one new avenue of peace which has not been well explored — an avenue now laid out by the General Assembly of the United Nations. In its resolution of 28 November 1953 (resolution 715 (VIII)) this General Assembly suggested: "that the Disarmament Commission study the desirability of establishing a sub-committee consisting of representatives of the Powers principally involved, which should seek in private an acceptable solution and report...on such a solution to the General Assembly and to the Security Council not later than 1 September 1954.

The United States, heeding the suggestion of the General Assembly of the United Nations, is instantly prepared to meet privately with such other countries as may be "principally involved", to seek "an acceptable solution" to the atomic armaments race which overshadows not only the peace, but the very life, of the world. We shall carry into these private or diplomatic talks a new conception.

The United States would seek more than the mere reduction or elimination of atomic materials for military purposes. It is not enough to take this weapon out of the hands of the soldiers. It must be put into the hands of those who will know how to strip its military casing and adapt it to the arts of peace. The United States knows that if the fearful trend of atomic military build-up can be reversed, this greatest of destructive forces can be developed into a great boon, for the benefit of all mankind. The United States knows that peaceful power from atomic energy is no dream of the future. The capability, already proved, is here today. Who can doubt that, if the entire body of the world's scientists and engineers had adequate amounts of fissionable material with which to test and develop their ideas, this capability would rapidly be transformed into universal, efficient and economic usage?

To hasten the day when fear of the atom will begin to disappear from the minds the people and the governments of the East and West, there are certain steps that can be taken now.

I therefore make the following proposal.

The governments principally involved, to the extent permitted by elementary prudence, should begin now and continue to make joint contributions from their stockpiles of normal uranium and fissionable materials to an international atomic energy agency. We would expect that such an agency would be set up under the aegis of the United Nations. The ratios of contributions, the procedures and other details would properly be within the scope of the "private conversations" I referred to earlier.

The United States is prepared to undertake these explorations in good faith. Any partner of the United States acting in the same good faith will find the United States a not unreasonable or ungenerous associate.

Undoubtedly, initial and early contributions to this plan would be small in quantity. However, the proposal has the great virtue that it can be undertaken without the irritations and mutual suspicions incident to any attempt to set up a completely acceptable system of world-wide inspection and control.

The atomic energy agency could be made responsible for the impounding, storage and protection of the contributed fissionable and other materials. The ingenuity of our scientists will provide special safe conditions under which such a bank of fissionable material can be made essentially immune to surprise seizure.

The more important responsibility of this atomic energy agency would be to devise methods whereby this fissionable material would be allocated to serve the peaceful pursuits of mankind. Experts would be mobilized to apply atomic energy to the needs of agriculture, medicine and other peaceful activities. A special purpose would be to provide abundant electrical energy in the power-starved areas of the world.

Thus the contributing Powers would be dedicating some of their strength to serve the needs rather than the fears of mankind.

The United States would be more than willing — it would be proud to take up with others "principally involved" the development of plans whereby such peaceful use of atomic energy would be expedited. Of those "principally involved" the Soviet Union must, of course, be one.

I would be prepared to submit to the Congress of the United States, and with every expectation of approval, any such plan that would, first, encourage world-wide investigation into the most effective peacetime uses of fissionable material, and with the certainty that the investigators had all the material needed for the conducting of all experiments that were appropriate; second, begin to diminish the potential destructive power of the world's atomic stockpiles; third, allow all peoples of all nations to see that, in this enlightened age, the great Powers of the earth, both of the East and of the West, are interested in human aspirations first rather than in building up the armaments of war; fourth, open up a new channel for peaceful discussion and initiative, at least a new approach to the many difficult problems that must be solved in both private and public conversations if the world is to shake off the inertia imposed by fear and is to make positive progress towards peace.

Against the dark background of the atomic bomb, the United States does not wish merely to present strength, but also the desire and the hope for peace.

The coming months will be fraught with fateful decisions. In this Assembly, in the capitals and military headquarters of the world, in the hearts of men everywhere, be they governed or governors, may they be the decisions which will lead this world out of fear and into peace. To the making of these fateful decisions, the United States pledges before you, and therefore before the world, its determination to help solve the fearful atomic dilemma — to devote its entire heart and mind to finding the way by which the miraculous inventiveness of man shall not be dedicated to his death, but consecrated to his life.

The IAEA and United Nations

Within the UN system, the IAEA is an autonomous organization in its own right. Often thought of as the "Atoms for Peace" organization, the Agency traces its origins to the vision of US President Dwight Eisenhower. In December 1953, Eisenhower proposed to the UN General Assembly in New York the creation of an international atomic energy agency to harness the atom for the benefit of humanity. In 1954, the General Assembly set the proposal in motion, and a group was formed to define the new agency's mandate.

The IAEA Statute was approved on 26 October 1956 at an international conference held at UN headquarters in New York, and the Agency came into existence in Vienna, Austria, on 29 July 1957. In November 1957, the General Assembly approved an agreement on the IAEA's relationship with the UN. The IAEA reports annually to the General Assembly and, whenever necessary, to the Security Council, which has primary responsibility for maintaining international peace and security, and the Economic and Social Council, which coordinates developmental work of the UN and its specialized agencies.

Today, the Agency has 122 Member States who are directly involved in most aspects of nuclear energy's global development. The global role of the IAEA is basically twofold: One, to help interested countries put peaceful nuclear technologies to work for beneficial applications in fields such as electricity production, health care, agricultural development, and industry. And two, to monitor civil nuclear activities, at the request of a State, to verify that safeguarded nuclear materials are not diverted to military purposes. This dual role has many dimensions. The IAEA's technical cooperation programme comprises nearly 1400 projects in about 90 developing countries, at a value of about US $50 million. Additionally, some 150 IAEA-supported research programmes are in some phase of operation around the world. Nearly 3000 experts are sent each year to developing countries to run training courses, for example, and more than 1000 scientific fellows and visiting scientists receive hands-on experience each year, at national or regional institutes, or at one of the IAEA's three research centres and laboratories.

Activities related to safeguards and verification are fundamentally based on the Agency's Statute and safeguards agreements concluded with States. At the end of 1994, there were 843 nuclear facilities under safeguards, including facilities and other locations containing nuclear material. Safeguards agreements have been concluded with 118 States, including 102 States party to the Treaty on the Non-Proliferation of Nuclear Weapons, under which the IAEA is the designated inspectorate.

The IAEA and the UN family: Networks of nuclear co-operation

A range of formal agreements and arrangements support the global foundation for peaceful nuclear development in many fields

by Sheel Kant Sharma

While its Charter makes no specific mention of the nuclear age, the United Nations moved quickly after its formation in 1945 to lay the basis of global co-operation in the nuclear field. At its first session in January 1946, the General Assembly adopted a resolution that, *inter alia,* established the UN Atomic Energy Commission, which was formed to make specific proposals related to the international control and peaceful development of nuclear energy. Before it was dissolved in January 1952, the Commission issued a number of reports to the Security Council. New impetus came in December 1953, when US President Eisenhower addressed the General Assembly and dramatically proposed the creation of an international atomic energy agency.

In 1954, the General Assembly adopted the resolution [810A (IX)] that set in motion the process to establish the IAEA. During that same session, the Assembly also favourably considered a draft resolution to convene in 1955 what would later become the first of four International Conferences on the Peaceful Uses of Atomic Energy, and it established the UN Secretary-General's Advisory Committee on the Peaceful Uses of Atomic Energy. Three years later, in 1957, this Committee formally negotiated on the UN's behalf the relationship agreement with the IAEA Preparatory Commission, both of which had been envisaged in the Agency's Statute.

Since that time, the UN and the IAEA have built an extensive network of global nuclear co-operation in fields related to international security, economic and social development, and the environment. This article presents an overview of agreements that have been put in place with the UN and its specialized agencies. It also reviews formalized cooperative arrangements that the IAEA has with other national, regional, and global organizations whose work is of interest to Agency activities.

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Relationship agreement with the UN

The IAEA's relationship agreement with the UN was, in fact, the result of many years of deliberation. The work was guided by the experience gained over a decade by specialized agencies that had concluded agreements with the UN. The lengthy deliberations on the IAEA agreement reflected the special position that the IAEA has under the UN's aegis, namely to be responsible for "international activities concerned with the peaceful uses of atomic energy". The agreement was fashioned to accommodate the unique nature of the IAEA's planned activities and the terms of its Statute. It thus brought the IAEA into a category different from the specialized agencies within the UN system. The agreement recognized the Agency as an autonomous international organization (under its Statute) in "working relations" with the UN.

Some basic principles underpin the relationship, as stated in the agreement's first Article: "The Agency undertakes to conduct its activities in accordance with the Purposes and Principles of the United Nations Charter to promote peace and international co-operation, and in conformity with policies of the United Nations furthering the establishment of safeguarded world-wide disarmament and in conformity with any international agreements entered into pursuant to such policies".

Other important features are that the IAEA is:

- required to submit its annual report to the UN General Assembly;
- called upon to submit reports, when appropriate, to the Security Council and notify the Council whenever, in connection with the activities of the Agency, questions within the

In Africa and other regions, the IAEA works closely with the FAO to help countries improve food production.
(Credit: Emma Robson/UNDP)

competence of the Council arise. The IAEA is also called upon to cooperate with the Security Council by furnishing to it, at its request such information and assistance as may be required in the exercise of the Council's responsibility for maintenance or restoration of international peace and security. The agreement further provides that the Agency shall report to the Security Council and the General Assembly any case of non-compliance with safeguards undertakings, within the meaning of relevant provisions in the IAEA Statute.

- called upon to undertake consideration of any resolution related to the Agency, adopted by the General Assembly or by a Council of the UN. Effective co-operation and co-ordination are also stipulated between the IAEA and other UN-established bodies concerning the provision of technical assistance in the field of atomic energy. Other provisions address co-operation with the UN's Administrative Committee on Co-ordination (ACC), as well as with UN specialized agencies.

Agreements with inter-governmental organizations and specialized agencies

The IAEA Statute envisaged co-operation with specialized agencies within the UN family. The specific terms for collaboration were subsequently fleshed out in individual formal agreements. These *co-operation agreements* reflect the particular interface between the wide range of nuclear applications and the specialized fields of these agencies. They further provide for inter-agency consultations and co-operation in various forms. *(See figure.)*

Apart from this formal framework, informal working contacts have been set up over the years based on shared interests and knowledge that can be brought to bear on specific issues. Participation by the Agency in the meetings of the ACC and its subsidiary organs also has broadened bilateral or trilateral consultations.

In some cases, *standing arrangements* have been put into place. First and foremost among these is the one between the IAEA and Food and Agriculture Organization (FAO), which operate the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture. Located at IAEA headquarters in Vienna, the Joint Division marked 30 years of service in 1994 under an arrangement whereby all of its programmes and activities are approved by the governing bodies of the two autonomous organizations. Notable achievements have been recorded. A prime example is the work related to mutation breeding, through which nearly 2000 new beneficial varieties of crops have been developed using radiation-based technology.

Another valuable form of co-operation is through *standing inter-agency forums.* An example here is the International Consultative Group on Food Irradiation (ICGFI), the coordinating group for global work in this field. It has been in operation since 1984 with participation by the IAEA, FAO, and World Health Organization (WHO).

Other cases of such arrangements are evident from the work of IAEA research laboratories and centres. The IAEA and United Nations Educational, Cultural and Scientific Organization (UNESCO), for instance, jointly operate the International Centre for Theoretical Physics in Trieste, Italy. The IAEA's Marine Environment Laboratory in Monaco (IAEA-MEL) — unique in the UN system — has long-standing arrangements in place with the United Nations Environment Programme (UNEP) and with UNESCO's Intergovernmental Oceanographic Commission (IOC). Links have especially been strengthened since the 1992 UN Conference on Environment and Development (UNCED) on matters related to the measurement and control of global marine pollution, and protection of ocean and coastal waters. In the context of the Earthwatch initiative, UNEP also has designated the IAEA's Seibersdorf Laboratories as as an inter-agency collaborating centre, specifically to serve as the laboratory for reference environmental materials and methods.

Less institutional but effective co-operation is maintained with WHO. By mutual agreement, areas of interest have been defined to avoid duplication; this is the case, for instance, in the field of hormone radioimmunoassay. WHO takes part in IAEA radiation protection services and the two organizations operate an international network of Secondary Standard Dosimetry Laboratories and a dose intercomparison programme for cobalt-60, widely used in medical treatment.

The IAEA additionally undertakes joint projects with other members of the UN family, pooling expertise and resources whenever appropriate. In areas of nuclear and radiation safety, a practice has evolved whereby manuals, standards, regulations, and recommendations are issued under the joint sponsorship of IAEA, FAO, WHO, and the International Labour Office (ILO). In the 1990s, the International Chernobyl Project involved co-operation with FAO, ILO, WHO, the World Meteorological Organization (WMO), and the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), as well as the Commission of the European Communities. Similarly, WHO's International Programme on the Health Effects of the Chernobyl Accident (IPHECA) is coordinated with the IAEA, FAO, ILO, the Pan-American Health Organization (PAHO), and the Nuclear Energy Agency of the Organization for Economic co-operation and Development (OECD/NEA).

The IAEA and non-governmental organizations (NGOs)

In keeping with the IAEA's Statute — which authorizes it to establish appropriate relations with "any organization the work of which is related to that of the Agency" — 19 non-governmental organizations (NGOs) have formal consultative status with the Agency. Seven others have been invited by the IAEA Board of Governors as observers to the Agency's General Conference or to undertake specific tasks.

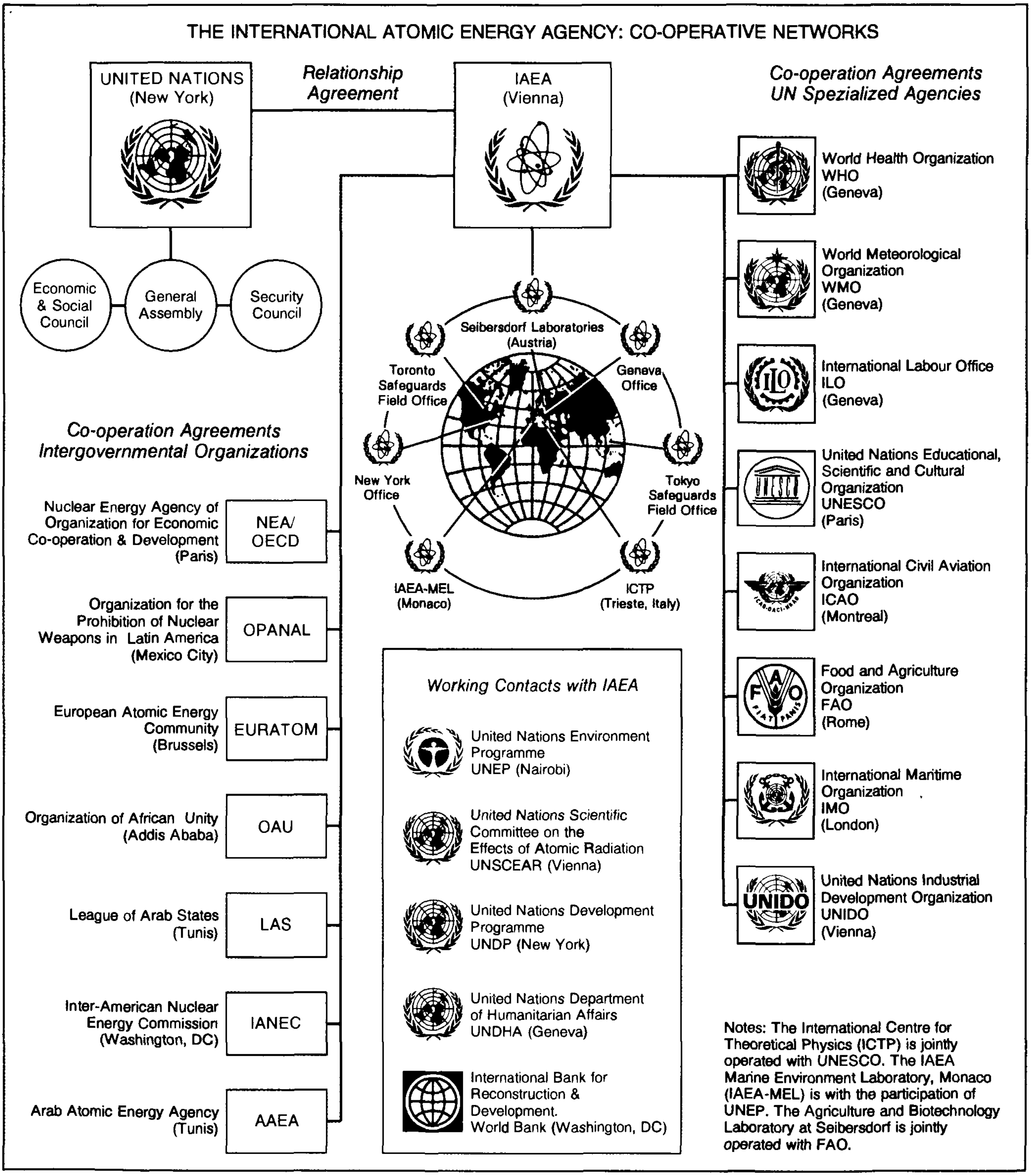
Those with consultative status are the European Atomic Forum; European Confederation of Agriculture; International Air Transport Association; International Cargo Handling Co-ordination Association; International Chamber of Commerce; International Commission on Radiological Protection; International Commission on Radiation Units and Measurements; International Confederation of Free Trade Unions; International Co-operative Alliance; International Council of Scientific Unions; International Federation of Documentation; International Federation of Industrial Producers of Electricity for Own Consumption; International Organization for Standardization; International Union for Inland Navigation; International Union of Producers and Distributors of Electrical Energy; Japan Atomic Industrial Forum, Inc.; World Confederation of Labour; World Energy Council; and World Federation of United Nations Associations.

In addition, certain NGOs with no formal consultative status but having concern with developing uses of nuclear energy for peaceful purposes are invited to send observers to the regular session of the Agency's General Conference. These include: the American Nuclear Society; Canadian Nuclear Society; European Nuclear Society; European Physical Society; International Institute for Applied Systems Analysis; International Nuclear Societies Council; International Radiation Protection Association; Nuclear Energy Institute; the Uranium Institute, and the World Association of Nuclear Operators (WANO). The Director General may request NGOs having special competence in a particular field to undertake specific studies or investigations, or to prepare papers for the Agency.

NGOs with consultative status are allowed certain privileges and facilities in connection with meetings of the General Conference and the Board. These include the right to receive the provisional agendas of the Conference; the right to send observers to all public meetings of the General Conference and of the Board; the right to submit written statements to any organ of the Agency, subject to censorship by the Director General; the right to submit oral statements to Committees of the General Conference or before public meetings of the Board, subject to various restrictions; the right to be invited by the Director General to other meetings convened by the Agency; the right to consult with members of the Secretariat; the right to have access to any document services established for the press and to the Agency's library.

Arrangements have also been made with NGOs active in the field of electric power and energy economics for the exchange of statistics and documents and for attendance at each other's meetings. Thus, representatives of the International Union of Producers and Distributors of Electrical Energy and of the World Energy Council have participated in the Agency activities and are in close collaboration with the IAEA on matters of mutual interest, In many cases, the joint organization of scientific meetings has become a common practice. A case in point is the upcoming international conference on Chernobyl's radiological consequences in April 1996. It is being co-sponsored by the European Commission, the IAEA, and WHO, in co-operation with the UN Department of Humanitarian Affairs (UNDHA), UNESCO, UNEP, UNSCEAR, FAO, and OECD/NEA.

On energy-related matters, the IAEA has joined forces with a number of organizations within and outside the UN family. One particular focus is on the comparative assessment of energy sources for electricity production. In 1991 at a



THE INTERNATIONAL ATOMIC ENERGY AGENCY: CO-OPERATIVE NETWORKS symposium organized by the IAEA and nine partners, senior experts examined the environmental and health effects of different energy systems for electricity generation and the prospects of increasing efficiency in energy use. The conclusions were submitted to the Preparatory Committee of the Rio Conference (UNCED). Subsequently, the Agency initiated a joint inter-agency project on databases and methodologies for comparative assessment of different energy sources for electricity generation, called DECADES. Databases cover technical and economic parameters as well as emission levels and problems at different steps of the electricity generation chain. The work includes a review of the various approaches to comparative assessment that may be used in the planning and decision-making processes. Project results will be considered in October 1995, at a major international symposium on electricity, health, and the environment. It is being co-sponsored by the IAEA, WMO, World Bank, OECD/NEA, EC, International Institute of Applied Systems Analysis (IIASA), United Nations Industrial Development Organization (UNIDO), and the Organization of Petroleum Exporting Countries (OPEC).

Another cooperative venture, involving the IAEA and United Nations Development Programme (UNDP), was launched in 1993 to assist Newly Independent States (NIS) of the former Soviet Union to improve their infrastructures for radiation protection and nuclear safety.

Technical co-operation links

Technical co-operation activities of the IAEA have grown considerably over the last two decades, significantly expanding their scope. In general, the cooperative network can be described broadly under three relationship levels:

Participation in the coordinating machinery of the UN system for operational activities. The IAEA participates in the work of the ACC, which is at the apex of UN system-wide co-ordination. The link extends to various subsidiary bodies within the ACC framework that deal with specific matters; for example, statistical activities; information management; groundwater resources; oceans and coastal areas; and women's concerns.

The Agency also takes part in other inter-agency mechanisms, including the IACSD (Inter-Agency Committee on Sustainable Development), CCPOQ (Consultative Committee on Programme and Operational Questions), and the CCAQ (Consultative Committee on Administrative Questions). The IACSD co-ordinates follow-up work to the UNCED on activities related to the environment and sustainable development. The CCPOQ holds discussions on technical co-operation in order to arrive at a common understanding of the problems involved and to establish, wherever possible, a common approach in dealing with them. One of the main issues currently under review is the implementation of General Assembly Resolution 47/199 regarding UN operational activities for development. Other issues include African development, field level co-ordination mechanisms, and support costs.

The IAEA additionally supports work of the UN's Joint Inspection Unit (JIU) by regularly contributing to its draft reports and evaluations.

Other mechanisms for coordinating inter-agency activities have been created in response to specific issues and needs involving the IAEA's support. They include the Intergovernmental Panel on Climate Change (IPCC) and the Joint Group of Experts on the Scientific Aspects of Marine Environment Protection (GESAMP), which is under the co-sponsorship of the International Maritime Organization (IMO), FAO, WMO, WHO, IAEA, UN, UNESCO, and UNEP.

Relations at the headquarters level. The IAEA maintains close links with UNDP headquarters on Agency projects, its activities related to its regional programmes, and other related matters.

For projects related to mineral exploration, there is an understanding on delineation of tasks with the UN Department of Development Support and Management Services. General mining exploration activities are carried out by the UN Department, but exploration for uranium-bearing minerals is the IAEA's responsibility. The IAEA has carried out mineral exploration projects involving uranium resources financed by UNDP. Under a UNDP-initiated energy project, the Agency also has co-operated closely with the World Bank through provision of technical advice on the development of energy policies and strategies.

In other areas of technical co-operation, common interests were identified with UNIDO in a 1987 agreement. UNIDO is currently working with the Agency to ascertain the viability of mass-rearing insects on an industrial scale using radiation technology in support of pest control projects in Africa. UNEP is working with the IAEA on environmental monitoring of non-radioactive pollutants in areas where IAEA activities complement activities under its Global Environmental Monitoring System (GEMS).

Co-operation at the national level with UN agencies, in particular UNDP. Since it has no technical officers permanently in the field, the IAEA draws upon the UN resident co-ordinator system, working closely with UNDP field offices. Delivery of IAEA technical assistance is channeled through the local UNDP office. UNDP-financed projects often serve as focal points around which IAEA technical assistance can be designed and thereby more deeply anchored in the development priorities of recipient countries. Co-ordination with UNDP also ensures better awareness, through resident planning authorities, of nuclear applications and their potential contributions in fields such as plant breeding, hydrology, medicine, industry, and pest control.

Relationships with non-UN organizations

To put the global nuclear network into true perspective, it is useful to look at the IAEA's relationships with organizations outside the UN system. Their activities in many cases are directly related to the IAEA's work in specific areas.

Nineteen non-governmental organizations have *consultative status* with the Agency, which enables close working contacts. *(See box).* Formal *co-operation agreements* have been concluded with seven inter-governmental organizations: the OECD/NEA, the Inter-American Nuclear Energy Commission of the Organization of American States (IANEC); the Organization of African Unity (OAU); the European Atomic Energy Community (EURATOM); the League of Arab States (LAS); the Organization for the Prohibition of Nuclear Weapons in Latin America (OPANAL); and the Arab Atomic Energy Agency (AAEA).

By virtue of these agreements, these organizations are entitled to be represented at the sessions of the General Conference. An additional seven inter-governmental organizations are normally invited to send observers to the General Conference every year by virtue of their concern with developing uses of nuclear energy for peaceful purposes or with research in the nuclear services. These are the: Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC); International Bureau of Weights and Measures (IBWM); International Energy Agency of the Organization for Economic Co-operation and Development (OECD/IEA); Joint Institute for Nuclear Research (JINR); Latin American Energy Organization (OLADE); Middle Eastern Regional Radioisotope Centre for the Arab Countries (MERRCAC); and OPEC.

The IAEA's co-operation with the NEA is particularly close in several key areas. It includes joint preparation of specialized publications, such as *Uranium Resources Production and Demand*, and the joint operation of the Incident Reporting System for nuclear power plants. High-level meetings are held annually to review and discuss co-operation in these and other areas, including training programmes, scientific conferences, and research in fields related to health and safety, waste disposal, transport of radioactive materials, and nuclear law.

Strengthening the foundation

The IAEA's relationships with the UN and other organizations have been established carefully and steadily over the years. The agreements with the UN and some of its specialized agencies have been founded on the provisions of the Agency's Statute as well as the UN Charter. Major changes could not be envisaged without corresponding amendments to these instruments.

Overall, the relationships have served to augment the global foundation for nuclear co-operation in important ways. It has been relatively easy to tailor or expand the cooperative network to meet the demands of important new priorities of the UN and IAEA. Such has been the case regarding the range of Agency activities contributing to Agenda 21 and sustainable development. Even closer and broader co-operation is required as this agenda moves ahead.

In the IAEA's experience, co-operation and co-ordination among many organizations generally has been most effective on administrative and financial matters where the problems are rather clearly spelled out and the solutions, accordingly, easier to find. More difficult, because of the complexities and different technologies involved, is co-ordination on matters relating to technical programmes. Owing to differing mandates and administrative procedures, practical problems and delays can frequently arise.

For greater effectiveness, relationships between organizations, as those between individuals, must be kept alive and active. Rigid adherence to the letter of the law, or to precedent and formal procedure, may not achieve the needed results. Overall experience has shown that it is generally possible to reach flexible, workable arrangements to overcome difficulties, prevent unnecessary duplication, and ensure coordinated international action.

As more emphasis is placed on global co-operation involving organizations within and outside the UN family, more unified approaches will be demanded. The co-operative network established in the nuclear field over the past half century offers a solid basis for more concerted and effective action. ❐

International law and nuclear energy: Overview of the legal framework

The global legal order for the atom's safe and peaceful uses is grounded on a mix of binding norms and advisory regulations

by
Mohamed ElBaradei, Edwin Nwogugu and John Rames

Peaceful applications of nuclear energy — and all the promise they entail for humanity — are paradoxically often perceived in juxtaposition with the prospects of nuclear weapons' proliferation and nuclear war. The mixed perception is understandable: the materials, knowledge, and expertise required to produce nuclear weapons are often indistinguishable from those needed to generate nuclear power and conduct nuclear research.

As a result, the focus of the international community has always been to ensure that nuclear energy is used peacefully and safely. The approach is defined by a complex network of national and international measures. For while it was accepted that the primary responsibility for the regulation of the use of nuclear energy rests with national authorities, it has been equally recognized that other countries may be affected as well. Consequently, the regulation of nuclear energy, like so many other human activities which could have potential transboundary impacts, necessitates the endowment of the international community with residual responsibility, or in certain instances co-responsibility, to ensure among other things uniformity of standards, co-ordination, pooling of resources and services, as well as compliance.*

In this respect, the IAEA, among other international and regional organizations, has served as a focal point. Article II of the IAEA Statute provides that "the Agency shall seek to accelerate and enlarge the contribution of atomic energy to peace, health, and prosperity throughout the world" and to ensure so far as it is able, "that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose".

Over the past three decades, international co-operation in the field of nuclear energy has yielded a mix of legally binding rules and advisory standards and regulations. This article presents an overview of this global legal framework for nuclear energy's safe and peaceful development. It specifically addresses areas of nuclear safety, radiation protection, radioactive waste management, the transport of radioactive materials, emergency assistance and planning, civil liability for nuclear damage, physical protection of nuclear material, armed attacks against nuclear installations, and IAEA safeguards and verification.

The safe use of nuclear energy

Article III.A.6 of the IAEA Statute empowers the Agency to establish or adopt standards of safety for the protection of health and the minimization of danger to life and property. That provision also requires that those standards must be applied to the IAEA's own operations and to operations making use of materials, services, equipment, facilities, and information made available by the Agency or at its request or under its control or supervision. States which receive technical assistance or reactor project assistance must sign an agreement with the IAEA in which they undertake to apply to the assisted operations the Agency's safety standards and measures that are specified in the agreement. The Statute also authorizes the Agency to apply its safety standards, at the request of States, to any of their operations or activities.

In fulfilling its statutory function of developing safety standards, the IAEA takes account of

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* See generally, "The Role of the IAEA in the Development of International Law", by Dr. Hans Blix, *Nordic Journal of International Law,* 58 (1989).

the work of relevant international scientific and technical bodies, such as the International Commission on Radiological Protection (ICRP), the United Nations Committee on the Effects of Atomic Radiation (UNSCEAR), the World Health Organization (WHO), and the International Labour Office (ILO).

Concern to ensure the safe use of nuclear energy — which includes activities making use of the by-products of nuclear energy and the use of radioactive substances in medical, industrial, and agricultural activities — is caused by the capacity of ionizing radiation to cause damage to living beings and the environment. The safety objectives strive to protect living beings, society, and the environment against the adverse effects of ionizing radiation.

International action in this field began with the establishment of the ICRP, which has issued recommendations on radiation protection since its inception in 1928. In 1955, the United Nations General Assembly established UNSCEAR to evaluate doses, effects, and risk from ionizing radiation on a worldwide scale. The work of these two bodies provides the basis for the standards elaborated by other international and regional organizations, such as the IAEA, ILO, WHO, Euratom, and the NEA. In developing standards, these organizations have built close working relationships.

The need to establish appropriate standards designed to ensure the safe use of nuclear energy is reflected in the constituent instruments of such organizations. The binding nature of the safety standards developed pursuant to such international instruments varies. Thus, while the safety standards developed by Euratom are mandatory, the activities relating to safety regulation of the Nuclear Energy Agency of the Organization for Economic Cooperation and Development (OECD/NEA) and the Arab Atomic Energy Agency (AAEA) are recommendatory. The IAEA's safety standards are mandatory with regard to nuclear activities undertaken with IAEA assistance, but where such assistance is not provided the standards are recommendatory.

Radiation protection. The scientific basis for radiation protection standards is found in recommendations made, and periodically reviewed, by the ICRP which take account of the UNSCEAR studies.

The work underlies the *International Basic Safety Standards (BSS) for Protection Against Ionizing Radiation and for the Safety of Radiation Sources* by which the IAEA, ILO, WHO, and NEA have provided a worldwide basis for harmonized and up-to-date standards. The BSS recently were reviewed and revised by those four organizations together with the Food and Agriculture Organization (FAO) of the United Nations, and the Pan-American Health Organization (PAHO). The IAEA Board of Governors approved the revised standards in September 1994.

The BSS are complemented by other standards dealing with particular aspects of radiation protection: occupational protection; protection of the public and the environment; and intervention in case of a nuclear accident or radiological emergency.

Safety of nuclear power plants

The IAEA has developed Nuclear Safety Standards (NUSS) for nuclear power plants which were prepared by experts from its Member States. They cover the following five areas: governmental organization of regulation of nuclear power plants; safety in nuclear power plant siting; safety in the design of nuclear power plants; safety in nuclear power plant operation; and quality assurance for safety of nuclear power plants. It was considered that formalized safety criteria, covering these areas, in the form of codes of practice and guides, would considerably assist in ensuring that the basic requirements on which the safety of nuclear power plants rest are understood and met. These basic requirements are: an adequate supply of trained personnel at a plant and to staff a regulatory agency; the ability to conduct a careful and detailed safety evaluation of a nuclear power plant project from its inception and at all stages throughout its life; and, the ability to conduct an appropriate quality assurance programme including control and inspection.

Codes of Practice relating to each of the five areas were initially issued in 1978, and have been subsequently revised. The Codes are supplemented by more than 60 Safety Guides which detail their implementation.

Although the international community at large is not yet willing to transform these recommendations into binding standards, they are widely used in the elaboration of national regulations. However, the application of NUSS is mandatory where assistance is provided by or through the IAEA.

Nuclear safety convention. In September 1994, the International Convention on Nuclear Safety was opened for signature at the IAEA General Conference. Since then, six of the 58 signatory States have become parties to the Convention.

The Convention commits participating States to ensure the safety of land-based civil nuclear power plants including such storage, handling, and treatment facilities for radioactive materials as are on the same site. States are obliged to take within the framework of their national laws, the legislative, regulating and administrative measures, and other steps necessary for implementing their obligations under the Convention. Main features include the establishment of a reporting system on the implementation by Contracting States of the obligations of the Convention.

Notification of a nuclear accident and emergency assistance. Following the Three Mile Island (TMI) nuclear accident in 1979 in the United States, the need to create a framework for reporting and mutual assistance in nuclear accidents was brought home to the international community. Under the auspices of the IAEA, two documents were developed after TMI that set guidelines for States.

In the aftermath of the Chernobyl accident in 1986, two conventions — the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency — were elaborated and adopted within the framework of the IAEA. The Conventions came into force on 27 October 1986 and 26 February 1987, respectively. Seventy-four States have become parties to the early notification convention and 70 States have become parties to the assistance convention.

A number of bilateral and regional arrangements also exist in these areas. In 1963, the Nordic Emergency Assistance Agreement in Connection with Radiation Accidents was concluded between the IAEA and the governments of Denmark, Finland, Norway, and Sweden. Also the Council of European Communities adopted on 11 December 1984 a Decision on Community Arrangements for the Early Exchange of Information in the Event of a Radiological Emergency.

Radioactive waste management

In view of the potential hazard to man and the environment posed by radioactive waste, its management and disposal have become an important issue in considering the nuclear power option and in the use of nuclear materials. The IAEA has developed safety objectives for the management of radioactive waste. Several IAEA documents further have established criteria to govern the management and disposal of radioactive waste. The IAEA also established the Radioactive Waste Safety Standards (RADWASS) programme in 1991 to prepare a harmonized approach to the safe management of radioactive waste at the international level. RADWASS will constitute a hierarchy of documents headed by a Safety Fundamentals document.

In 1990, the IAEA General Conference adopted a Code of Practice on International Transboundary Movement of Radioactive Waste. The Code's purpose is to provide preventive measures against any uncontrolled international movement and disposal of such waste.

States and international organizations have also been engaged in the regulation of radioactive waste. Two examples may be given. The Antarctic Treaty (Article V) prohibits the disposal of radioactive waste in the Antarctic region. Similarly, Article IV of the London Convention 1972 regulates the sea dumping of radioactive waste. In February 1994, amendments to the London Convention took effect that prohibit the dumping of all types of radioactive waste at sea. Further, Article 5 of the Convention on the Prevention of Marine Pollution from Land-Based Sources obliges Member States to adopt measures to eliminate pollution of the marine area by radioactive substances from land-based sources.

Regional regulation of sea dumping of radioactive waste has also been undertaken in various parts of the world. In 1977 a Decision of the OECD Council replaced the *ad hoc* and voluntary arrangements previously in existence with a Multilateral Consultation and Surveillance Mechanism for Sea Dumping of Radioactive Waste. The decision commits participating countries to apply the guidelines and procedures adopted within the NEA and to subject their sea dumping operations to the system of prior consultation and international surveillance organized by the NEA. Other examples of regional arrangements are the Convention on the Pollution of the Mediterranean Sea, 1976 and its two Protocols of 1976 and 1980; the Convention on the Protection of the Marine Environment of the Baltic Area, 1974; and the South Pacific Convention for the Protection of the Natural Resources and Environment of the South Pacific Region, 1986.

The concern of developing countries that radioactive waste is not imported into their territories was largely responsible for the inclusion in Article 39 of the Fourth Convention (1989) between African, Caribbean, and Pacific States and the European Economic Community of an undertaking by the Community to prohibit the export of such waste from the territory of its Member States. On the other hand, the African, Caribbean and Pacific States undertook to prohibit the import of radioactive waste from the Community or from any other country. In conformity with this provision, Article 4 of the Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement of Hazardous Wastes within Africa — which was adopted by the Organization of African States in January 1991 — prohibits the import of all hazardous wastes including radioactive substances into Africa from non-contracting parties.

Steps toward convention on radioactive waste management. In 1993, the IAEA General Conference requested the Directed General "to initiate preparations for a convention on the safety of waste management as soon as the ongoing process of developing waste management safety fundamentals has resulted in broad international agreement". At its March 1995 session, the IAEA Board approved the safety fundamentals document entitled "The Principles of Radioactive Waste Management". The document will facilitate the work of an open-ended group of technical and legal experts charged with carrying out the necessary substantive preparations for a convention on the safety of radioactive waste management. Toward this end, the group has held meetings in February and in July 1995.

Transport of radioactive material

The IAEA has taken the lead in developing appropriate regulations for the safe transport of radioactive material. It first published *Regulations for the Safe Transport of Radioactive Materials* (Safety Series No. 6) in 1961 for application to all means of national and international transport. The Regulations since then have been widely accepted and adopted by competent international bodies as binding requirements for the transport of radioactive materials.

The transport of radioactive materials has also been dealt with through conventions. A well known example is the International Convention for the Safety of Life at Sea (SOLAS), 1974. It regulates, *inter alia*, the transport of dangerous goods including radioactive materials. Article 23 of the United Nations Convention on the Law of the Sea, 1982, regulates the exercise by foreign nuclear-powered ships or ships carrying nuclear substances of the right of innocent passage through the territorial sea of States.

Safety standards for nuclear merchant ships. Action to reconsider the safety standards for nuclear merchant ships, established by the International Maritime Organization (IMO) in 1981 has been instituted. In September 1990, the IAEA General Conference requested the Director General "to consult, ...with the International Maritime Organization the plans of the international maritime community regarding civilian nuclear-powered ships, the need to review the Code of Safety for Nuclear Merchant Ships in the light of existing nuclear safety technology, and whether the Code at present applies to all existing and projected civilian nuclear-powered ships, and if not, the implications of extending the Code to all such ships".

In 1993, a Joint Working Group of the IAEA, IMO, and United Nations Environment Programme (UNEP) elaborated a draft "Code for the Safe Carriage of Irradiated Nuclear Fuel, Plutonium and High Level Radioactive Wastes in Flasks on board Ships". The Code has received the approval of the IMO Assembly and of the IAEA's policy-making organs.

Civil liability for nuclear damage

The mitigation of the consequences of a nuclear accident through prompt and adequate compensation is an important component of the regime for the safe utilization of nuclear energy. Today several international conventions regulate liability for nuclear damage.

The first is the 1963 Vienna Convention on Civil Liability for Nuclear Damage, concluded under the auspices of the IAEA. This Convention is worldwide in scope but only 14 States have become parties. The second is the 1960 Paris Convention on Third Party Liability in the Field of Nuclear Energy concluded within the framework of the OECD. This Convention, which is regional in character and has 14 Western European States Party to it, was supplemented in 1963 by the Brussels Supplementary Convention. Both the Paris Convention and the Brussels Supplementary Convention have been amended by Protocols in 1964 and 1982.

The basic features of the Vienna and Paris Conventions are identical. Both are based on the exclusive and strict liability of the operator of a nuclear installation, on limitation of liability in amount and in time, and on the jurisdiction of the courts of the installation State. Both Conventions provide for a minimum amount of compensation and for financial coverage through insurance or other financial security and, in the case of the Brussels Supplementary Convention, through a system of state funding.

Two other Conventions deal with the question of liability in the context of marine carriage. The 1962 Convention on the Liability of Operators of Nuclear Ships, which is not yet in force, and the 1971 Convention Relating to Civil Liability in the Field of Maritime Carriage of Nuclear Materials. Both Conventions are based on the principle of strict liability of the operator.

Regarding nuclear-related incidents in outer space, liability for nuclear damage is covered by the 1972 Convention on International Liability for Damage Caused by Space Objects. It would govern, *inter alia*, situations where a space object is either propelled with nuclear power or carries nuclear objects. In 1992 the UN General Assembly adopted a resolution on the principles relevant to the use of nuclear power sources in outer space.

For nuclear power plants, the Chernobyl accident made it clear that the existing liability regime is not adequate to ensure equitable and rapid compensation, particularly in the event of large-scale damage. This is because of the regime's limited territorial application, its narrow definition of damage, and the low level of guaranteed compensation under it.

The existing regime is being strengthened. In 1988, a Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention was concluded. Its basic aim is to extend the scope of application of both Conventions. It also resolves potential conflicts of law which could result from the simultaneous application of the two Conventions to the same nuclear accident, notably in the case of international transport.

In 1990, the IAEA Board of Governors decided to set up a Standing Committee on Liability for Nuclear Damage. It was requested to consider international liability for nuclear damage, including international civil liability, international State liability, and the relationship between international civil and State liability.

The work of the Standing Committee has shown broad areas of agreement on proposals for the revision of the Vienna Convention. Attention has shifted mainly to the feasibility of elaborating a supplementary funding convention. A number of proposals have been considered in this respect but no general agreement has been reached. The Committee has recommended to the IAEA Board that a diplomatic conference be convened in 1996 to be devoted to the revision of the Vienna Convention and supplementary funding. The Board is expected to act on the recommendation at its meetings in September 1995.

Physical protection of nuclear material

Two international instruments provide the basis for the physical protection of nuclear material: a set of recommendations and a Convention, both developed under IAEA auspices.

The set of recommendations was first developed in 1972 and has been revised on three occasions since then: 1975, 1977, and 1989. The major purposes of the most recent revision were to give equal treatment to the concerns relating to unauthorized removal of nuclear material and sabotage of nuclear facilities; to reflect the existence of the Convention on the Physical Protection of Nuclear Material; and to strengthen the recommendations on several points of standard practice.

The recommendations reflect a broad consensus among IAEA Member States on the requirements for effective physical protection. They apply to nuclear material in domestic use, transport and storage; to nuclear material in international transport; and to nuclear facilities in a State. Although these recommendations are not binding, their application is required by the IAEA in agreements with States that receive assistance from it. An equivalent requirement has been included by a number of States in bilateral nuclear co-operation agreements.

The Convention on the Physical Protection of Nuclear Material was adopted on 26 October 1979 and entered into force on 8 February 1987. Its scope of application is narrower than the recommendations, in that the Convention applies primarily to nuclear material while in international nuclear transport (which necessarily includes storage incidental to such transport).

A Review Conference of Parties to the Convention was held in Vienna in September 1992. Among other things, the Conference affirmed that the Convention provides a sound basis for physical protection of nuclear material during international transport and is acceptable in its current form. The Conference also called upon the IAEA to organize a meeting to examine the IAEA physical protection recommendations in IAEA document INFCIRC/225/Rev. 2, and to consider the incorporation of further guidance on such issues as irradiated fuel, nuclear material contained in waste, and other matters. As a result of a Technical Committee meeting in June 1993, revised recommendations were issued in September 1993 (as INFCIRC/225/ Rev.3) that reflect the Committees's views in these respects.

Armed attacks against nuclear installations

Protocols I and II Additional to the Geneva Conventions of 1949* relate to the protection of victims of international armed conflicts and of non-international armed conflicts, respectively. Article 56 of Protocol I and Article 15 of Protocol II relate to the protection of, among other things, nuclear electrical generating stations

The protection accorded by the Protocols applies only to a limited category of nuclear installations. The phrase "nuclear electrical generating stations" obviously includes nuclear power reactors. However, it would not include nuclear research reactors, enrichment facilities, fuel fab-

* The four 1949 Geneva Conventions to which the Protocols are additional relate, respectively, to: the amelioration of the wounded and sick in armed forces in the field; the amelioration of the conditions of wounded, sick and shipwrecked members of armed forces at sea; the treatment of prisoners of war; and, the protection of civilian persons in times of war.

rication facilities, reprocessing facilities, and spent fuel storage facilities. All such facilities, particularly the last two, could cause substantial radioactive releases if attacked.

Although the need to prohibit armed attacks on all nuclear facilities and the urgency of concluding an international agreement relating thereto, seems to be generally recognized, the establishment of more comprehensive international rules in this area is still in the process of development. Thus, for example, the IAEA General Conference in 1987 adopted a resolution regarding Protection of Nuclear Installations against Armed Attacks. In the preamble of that resolution, the General Conference recorded that it was "aware of the fact that an armed attack on a nuclear installation could result in radioactive releases with grave consequences within and beyond the boundaries of the State which has been attacked" and was "convinced of the need to prohibit armed attacks on nuclear installations from which such releases could occur and of the urgency of concluding an international agreement in this regard".

The peaceful uses of nuclear energy

The impetus to ensure the peaceful use of nuclear energy that finds expression in the IAEA Statute and the European Atomic Energy Community (Euratom) Treaty has been supplemented by various non-proliferation conventions.

The ultimate objective of the international community is the achievement of general and complete disarmament. In the context of nuclear disarmament, avoidance of vertical proliferation (i.e. increases in existing nuclear arsenals) is fostered by the adoption of arms reduction agreements between nuclear-weapon States. The prohibition of nuclear weapons is also being sought through the adoption of requirements applicable to all States, regardless of whether they possess nuclear weapons and through the adoption of requirements designed to ensure that those States that do not have nuclear weapons do not acquire them (prevention of horizontal proliferation).

Examples of requirements applicable to all States are the Antarctic Treaty; the Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water; the Treaty on Principles to Govern the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies; and the Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Seabed and the Ocean Floor and in the Subsoil thereof. They are designed to limit the geographical locations where nuclear weapons can be tested, deployed, and/or used.

The Treaty on the Non-Proliferation of Nuclear Weapons (NPT), the Treaty for the Prohibition of Nuclear Weapons in Latin America (the Treaty of Tlatelolco), and the South Pacific Nuclear Free Zone Treaty (the Treaty of Rarotonga) illustrate the requirements applicable to non-nuclear weapon States. They are designed primarily to prevent horizontal proliferation. These three treaties couple the prohibition on the acquisition of nuclear weapons with a requirement that the parties thereto accept IAEA safeguards on all existing and future nuclear activities.

During the early 1970s, two non-treaty initiatives were undertaken by a number of States to support the non-proliferation regime. The first group of States, known as the "Zangger Committee", are all parties to the NPT. The Committee's aim was to establish a uniform approach to the implementation of the obligation contained in Article III.2 of the NPT, by defining the source and special fissionable material and the equipment or material especially designed or prepared for the processing, use or production of special fissionable material, the provision of which requires the application of IAEA safeguards. (The results of this initiative are reproduced in IAEA document INFCIRC/209/Rev. 1 and Adds. 1 and 2.)

The second group of States, which include participants in the Zangger Committee initiative, is known as the London Suppliers' Group and includes States that are and are not parties to the NPT. This Group of States has produced a set of guidelines (reproduced in IAEA document INFCIRC/254) for the export of nuclear material, equipment, or technology. Consequently, the guidelines set forth additional conditions applicable to the export of nuclear material, equipment and technology that, for example: link the duration of safeguards to the continued existence of safeguardable material and equipment regardless of the duration of the safeguards agreement; require the application of physical protection measures; require the exercise of restraint in the transfer of sensitive facilities, technology, and weapons-usable materials; and impose limitations on the retransfer of certain exported items. The guidelines are also intended to remove assurances relating to safeguards and non-proliferation from the field of commercial competition.

IAEA safeguards system

Article III.A.5 of the IAEA Statute authorizes the Agency "to establish and administer safeguards designed to ensure that special fissionable and other materials, services, equipment, facilities and information made available by the Agency or at its request or under its supervision or control are not used in such a way as to further any military purpose; and to apply safeguards, at the request of the Parties, to any bilateral or multilateral arrangement, or at the request of a State, to any of the State's activities in the field of atomic energy."

The Agency's safeguards system was thus conceived as a legally binding scheme of verification for all IAEA-related nuclear transactions which would apply when a State received assistance from or through the IAEA under an Agency project. Nuclear activities in which the IAEA was *not* involved would be subject to safeguards only on a voluntary and selective basis.

During the 1970s, the IAEA's safeguards system underwent a major transformation in character and scope. The change was the result of the development of what is referred to as the "non-proliferation regime"; that is the set of legal norms and voluntary undertakings which were developed both within and outside of the framework of the IAEA to deal with the peaceful uses of nuclear energy and nuclear weapons proliferation.

By virtue of the 1967 Treaty of Tlatelolco in Latin America, each party undertakes to use exclusively for peaceful purposes the nuclear material and facilities which are under its jurisdiction and to prohibit and prevent in its territory the testing, use, manufacture, production, acquisition, receipt, storage, installation, deployment and possession of any nuclear weapons. Each party also assumes the obligation to negotiate multilateral or bilateral agreements with the IAEA for the application of safeguards to its nuclear activities.

Of wider significance is the 1968 NPT, which is of a universal character. It provides that each non-nuclear-weapon State party to the Treaty assumes a basic obligation not to manufacture, acquire, receive or control nuclear weapons or other nuclear explosive devices. In addition, such a State agrees to accept the safeguards set forth in an agreement to be negotiated and concluded with the IAEA in accordance with the latter Statute and its safeguards system. The exclusive purpose of this agreement is the verification of the fulfilment by the State of its treaty obligation to prevent the diversion of nuclear energy uses to nuclear weapons or other nuclear explosive devices.

Additionally, the parties to the Rarotonga Treaty in Southeast Asia and the Pacific and the Brazilian-Argentine Agreement on the Exclusively Peaceful Utilization of Nuclear Energy have also made a non-proliferation commitment. Thus, for States parties to these agreements, acceptance of IAEA safeguards that are comprehensive in scope has become obligatory in character.

Safeguards objectives. Safeguards are *technical* means of verifying compliance with *legal* obligations relevant to the peaceful uses of nuclear energy. Their objectives are political, that is, to *assure* the international community of the peaceful nature of safeguarded nuclear activity and to *deter* the diversion or misuse of safeguarded materials or facilities through the risk of early detection.

The system has a number of basic features which should be understood. The first is that the application of safeguards is primarily but not exclusively based on information provided by the State as to the existence of nuclear material or equipment that should be subject to safeguards. The Agency, however, has a right to undertake special inspections to ensure that all nuclear material that is subject to safeguards are in fact safeguarded and for that purpose to obtain and have access to additional information and locations to guard against possible undeclared activities.

The second is that safeguards cannot by themselves prevent a violation by a State of its obligations not to divert nuclear material from peaceful purposes. The system is designed as an early warning mechanism to initiate the necessary procedures for remedial action in case of violation. Under the IAEA Statute, non-compliance with safeguards obligations is to be reported to the United Nations Security Council for appropriate action.

The third is that safeguards cannot assess the future intentions of States. The system can be analogized to a radar device which can only report on the existing situation.

The actual application of safeguards requires a contractual agreement between the IAEA and the State in which the system will operate, whether the application of the system is the result of a voluntary undertaking by the State, or is in fulfilment of a legal obligation under a bilateral or multilateral agreement.

Safeguards agreements set out the parties' basic rights and obligations, relevant to the application of safeguards. Detailed implementation procedures are found in a technical set of "subsidiary arrangements", which are tailored to the specific requirements of safeguarded facilities. Subsidiary arrangements are implementing instruments that do not require approval of the IAEA Board of Governors. They are concluded between the IAEA Secretariat and the State Party simultaneously with or subsequent to the conclusion of the safeguards agreement. Subsidiary arrangements are considered confidential. They are accessible only to the IAEA Secretariat and the State Party. They are not available to other Member States, except that specific information relating to safeguards implementation may be given to the Board of Governors to the extent necessary for the IAEA to fulfil its responsibilities in implementing the agreement.

Categories of safeguards agreements. Four categories of safeguards agreements have been entered into by the IAEA.

The ***first category*** is with non-nuclear-weapon States that have made a non-proliferation commitment, e.g. States Party to the NPT, the Treaty of Tlatelolco, the Treaty of Rarotonga, or the Brazilian-Argentine Agreement on the Exclusively Peaceful Utilization Of Nuclear Energy. These safeguards agreements cover all the nuclear activities of the State. In Argentina and Brazil, IAEA safeguards are carried out under a Quadripartite Agreement, which is *sui generis* in nature, between the two countries, the IAEA, and the Brazilian-Argentine Agency for the Accounting and Control of Nuclear Material (ABACC). The other aforementioned agreements are standard in nature and are based on guidelines (INFCIRC/153) adopted for that purpose by the IAEA Board of Governors. The guidelines serve as the basis for the structure and content of these agreements.

Application of safeguards under these agreements is linked to the safeguarded material. Safeguards are terminated by the IAEA under these agreements upon determination that the material is no longer usable for any nuclear activity relevant from the point of view of safeguards, or has become practically irrecoverable. Safeguards are terminated upon transfer of the safeguarded nuclear material out of the State to another jurisdiction.

Under the Treaty of Rarotonga and the Quadripartite Agreement, Parties are not to provide any State with nuclear material or equipment that require the application of safeguards, unless subject to the IAEA's safeguards. NPT Parties are under a similar obligation, but only with regard to supplies to non-nuclear-weapon States. Provision of nuclear material and equipment to nuclear-weapon States does not require the application of IAEA safeguards under the NPT. Under the Treaty of Tlatelolco, Parties are under no obligation to require the application of IAEA safeguards on supplies of nuclear material and equipment to other States.

The application of safeguards depends equally upon the duration of the safeguards agreement. All the above agreements have provisions stating they shall remain in force as long as the State is Party to the respective Treaty.

The ***second category*** of agreements is with non-nuclear-weapon States that have not made a binding non-proliferation commitment. These agreements are normally entered into upon the conclusion of a Project Agreement between the IAEA and a Member State; upon unilateral submission by a State; or upon the conclusion of a supply agreement between two or more States that requires the application of IAEA safeguards. Agreements in this category cover only specified facilities and materials. Assurances by the IAEA are necessarily limited to the safeguarded facilities or materials and do not extend to cover the totality of the State's nuclear activities.

The rights and obligations of the IAEA and the State under this category of agreements are also based on guidelines adopted by the Board of Governors (INFCIRC/66/Rev.2 and its earlier versions). These guidelines were the first to be developed for the purpose of concluding safeguards agreements. Unlike those developed later for NPT safeguards agreements, they deal only with principles and procedures of applying safeguards.

The basic undertaking of the State under these agreements, however, is not to use any material, equipment, facilities or other items under safeguards in such a way as to further any military purpose. This undertaking, which is based on the language of the Statute, is understood by the IAEA to prohibit the manufacture or possession of any nuclear explosive device, and not to permit the withdrawal of any nuclear material subject to safeguards. In most of these agreements, the duration of safeguards and of the agreement itself is linked to the safeguarded material and facilities. Safeguards continue to apply as long as the material or facilities can be used for any nuclear activity which warrant their application. Safeguards generally follow the nuclear material upon its transfer out of the State.

The ***third category*** of agreements is with nuclear-weapon States. All five nuclear weapon States identified in the NPT — China, France, the Soviet Union (now its successor, Russia), the United Kingdom, and the United States — have accepted the application of safeguards on some or all of their peaceful nuclear activities. These agreements are not designed to verify non-proliferation, but are meant to broaden the IAEA's safeguards experience, to affirm that nuclear-weapon States are not rewarded by being exempt from safeguards on their peaceful activities and, most importantly, to establish a precedent for on-site verification in the nuclear-weapon States. Under these agreements, facilities or nuclear material in facilities notified to the IAEA by the State concerned are offered for the application of safeguards. The agreements provide for the possibility of withdrawal of such facilities or material from the application of safeguards. All of these agreements are of unlimited duration but provide for the right of termination upon six month's notice if the purpose for which the agreement was intended can no longer be served.

The *fourth category* is with non-nuclear-weapon States which have not made a previous non-proliferation commitment but which are ready to make that commitment as a part of the safeguards agreement. No guidelines have been developed for this category. One agreement of this type was concluded with Albania before it became Party to the NPT. The basic undertaking under this agreement is not to use any nuclear material or facility within the territory of Albania, or under its jurisdiction or control for the manufacture of any nuclear explosive device or to further any military purpose. Safeguards under the agreement continue to apply as long as such material or facilities can be used for any nuclear activity that can warrant their application. Albania is obliged not to transfer nuclear material, facilities or relevant technological information to another State before the IAEA has confirmed that it has made appropriate arrangements to apply safeguards. The agreement has an initial duration of 25 years. Termination of the agreement, however, does not affect the continuing application of safeguards on material and facilities subject to safeguards at the date of termination.

Technical features and measures. The IAEA's safeguards system under any of the four categories of agreements has three basic features: material accounting, containment and surveillance, and on-site inspection.

Material accounting establishes the quantities of nuclear material present within defined areas and the changes in those quantities that take place within defined periods of time. Containment and surveillance measures are designed to take advantage of physical barriers such as walls, containers, tanks or pipes, to restrict or control the movement of or access to nuclear materials. Such measures help to reduce the probability that undetected movements of nuclear material or equipment take place. Surveillance is used to detect undeclared movements of nuclear materials, tampering with containment, fabrication of false information or interference with safeguards devices. The aim of on-site inspection is verification of the IAEA's information. The intensity and frequency of inspections are usually specified in the safeguards agreement and vary with the type of facility inspected.

Reporting to the UN Security Council. Article XII of the IAEA Statute requires, among other things, that the Board of Governors report to the UN Security Council and General Assembly as well as to all IAEA Member States any non-compliance with an IAEA safeguards agreement which it finds to have occurred. In two instances, Iraq and the Democratic People's Republic of Korea, the Board of Governors has adopted resolutions recording its finding of non-compliance.

The case of Iraq occurred in the aftermath of the Gulf war and included the revelation that Iraq had constructed a large undeclared nuclear programme, including undeclared enrichment facilities. From this case, it became apparent that the IAEA safeguards system — though effective with regard to declared activities — is incomplete insofar as its ability to detect undeclared activities. Since that time, the focus of the IAEA has been to adopt measures designed to strengthen the safeguards system and in particular to develop an ability for the system to detect and have access to undeclared activities. Important measures already have been taken.

Following recommendations made by the IAEA's Standing Advisory Group on Safeguards Implementation, in April 1993, the Agency instituted a safeguards development programme (Programme 93+2) to consider the feasibility of further measures to strengthen and improve the cost-effectiveness of safeguards. At its March 1995 session, the IAEA Board endorsed the general direction of the Programme and requested specific proposals, which were submitted to the Board in June 1995. In June, the Board took note of the Agency's plan to implement at an early date the measures identified by the Secretariat as being within the scope of existing legal authority of comprehensive safeguards based on INFCIRC/153 (corrected), with the understanding that elaboration of the implementation arrangements for, and clarification of concerns about, them would require consultations between the Secretariat and individual Member States. The Secretariat intends to submit specific proposals relating to those measures that require complementary authority for their implementation to the IAEA Board in December 1995.

IAEA verification under the UN Charter

The IAEA's nuclear inspections in Iraq were undertaken in accordance with resolutions of the UN Security Council. Following the cessation of hostilities in the Gulf War, the Security Council — acting under Chapter VII of the United Nations Charter — adopted Resolution 687 on 3 April 1991. Paragraph 12 of that Resolution required Iraq to unconditionally agree not to acquire or develop nuclear weapons or nuclear-weapons-usable material or any subsystems or components or any research, development, support or manufacturing facilities related thereto; to provide a declaration of the locations, amounts, and types of all items referred to above; to place all of its nuclear-weapons-usable materials under the exclusive control, for custody and removal, of the IAEA, acting with the assistance and co-operation of a Special Commission to be established pursuant to the Resolution; to accept on-site inspection and the destruction, removal and rendering harmless of all the above-mentioned items; and to accept a plan, to be prepared by the IAEA Director General, for the future ongoing monitoring and verification of its compliance with these undertakings.

Operative paragraph 13 of the Resolution requested the IAEA Director General, with the assistance and co-operation of the Special Commission, to carry out immediate on-site inspection of Iraq's nuclear capabilities based on Iraq's declarations and any additional locations designated by the Special Commission; to develop and carry out a plan for the destruction, removal, or rendering harmless of all items referred to in operative paragraph 12; and to develop a plan for the future ongoing monitoring and verification of Iraq's compliance with operative paragraph 12, including an inventory of all nuclear material in Iraq subject to the IAEA's verification and inspection to confirm that IAEA safeguards cover all nuclear activities in Iraq.

These provisions of Resolution 687 were supplemented by Security Council Resolution 707, adopted on 15 August 1991, which imposed further restrictions on permissible nuclear activities in Iraq.

In carrying out its inspections in Iraq, the IAEA had more extensive verification rights than it has under safeguards agreements. This has been outlined in an Exchange of Letters between the United Nations and Iraq on the rights and privileges necessary for the IAEA and the Special Commission to perform their activities under Resolution 687. The various plans required by Resolution 687 were approved by Security Council Resolutions 699 and 715. It should be noted that the plan for on-going monitoring also contains extensive rights and privileges for the IAEA in comparison with safeguards agreements.

Other verification initiatives

The international community is currently considering three arms control/non-proliferation initiatives with potential impact on the IAEA's verification activities. First, a Committee of the UN Conference on Disarmament (CD) is in the process of developing a Comprehensive Nuclear Test-Ban Treaty (CTBT). Although the work of the CD Committee is still in progress, it seems likely that the CTBT being developed by it will include seismological monitoring, on-site inspections to ascertain the nature of events that have not been satisfactorily explained, on-site monitoring of large non-nuclear explosions, and an International Data Centre to process the information obtained from seismological monitoring (and from other monitoring — e.g., of radionuclides in the atmosphere — that may be agreed to be included in the CTBT). It is possible that the CTBT will assign a number of the verification activities under the Treaty to the IAEA.

Secondly, consideration is being given to the development of a treaty that would ban the future production of plutonium and highly enriched uranium for use in nuclear weapons (the so-called "Cut-Off Treaty"). Last year, the General Assembly of the United Nations adopted resolution A/Res/48/75 L, which, among other things:

"Recommend[ed] the negotiation in the most appropriate international forum of a non-discriminatory, multilateral and internationally and effectively verifiable treaty banning the production of fissile material for nuclear weapons or other nuclear explosive devices;

"Request[ed] the International Atomic Energy Agency to provide assistance for examination of verification arrangements for such a treaty as required; and

"Call[ed] upon all States to demonstrate their commitment to the objectives of a non-discriminatory, multilateral and internationally and effectively verifiable treaty banning the production of fissile material for nuclear weapons or other nuclear explosive devices".

The third initiative relates to the possibility that the plutonium and highly enriched uranium that was formerly contained in nuclear weapons but is no longer required for that purpose will be submitted to IAEA safeguards by some or all of the nuclear-weapon States.

A changing progressive picture

The international legal order for nuclear energy is characterized by a mix of legally binding rules and agreements and advisory standards and regulations. This mix is constantly changing. What were recently non-binding standards are today binding commitments. The conventions in the area of physical protection and for the notification of a nuclear accident and emergency assistance are but some examples.

The fact that many regulations are still non-binding should not be a matter for concern. Many States have accepted such standards as a basis for their national legislation. By doing so, they have, in effect, voluntarily undertaken to comply with international norms that they formally view as recommendations because of their belief that it is in their best interest to do so.

Long at the centre of the process, the IAEA will remain actively engaged in the progressive international development of nuclear law. ❐

Radiation protection services: From the laboratory to the field

From monitoring exposures to supporting cooperative projects, the IAEA's activities are being tailored to meet new demands

by
Robert Ouvrard
and Fernando
Lopez-Lizana

Developments commanding global attention over the past decade have elevated interest in issues of nuclear and radiation safety. In various ways, States today are placing greater emphasis on cooperative projects and services designed to establish or strengthen national capabilities for effective radiological protection.

At the international level, the Agency has long provided extensive safety-related services. In the field of radiation safety, the work has involved the formulation of standards and advisory missions, for example. In 1979, the IAEA set up a Radiation Safety Services Section (RSSS) to technically support activities in radiation protection. The work involves the operation of radiation protection laboratories, the provision of analytical and support services, and operation of an emergency response system. *(See box.)* In recent years, for example, these services have supported the Agency's post-Chernobyl radiological assessments, as well as its nuclear inspections in Iraq. This article takes a closer look at activities, specifically those related to radiation monitoring, field projects, and emergency planning and response.

Radiation monitoring services

The IAEA provides radiation monitoring services for its own staff whose work can involve exposure to radiation, and for personnel participating in Agency-supported projects, predominately in developing countries. The monitoring system covers external exposure as well as internal contamination, and it extends to laboratory and field services.

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External exposure monitoring. About 400 IAEA staff members are routinely monitored for external exposure, 300 from the Department of Safeguards and 100 from the IAEA's laboratories. Another 400 individuals typically are monitored in connection with particular assignments. These include about 150 technical cooperation experts, 150 specialists taking part in safety missions, and 100 scientific fellows and trainees.

The RSSS also provides dosimetry services to some Member States under technical cooperation projects or through a joint programme run with the World Health Organization (WHO). In total, about 2800 persons are monitored yearly. *(See table.)*

To strengthen its services, the RSSS recently acquired two new thermoluminescent dosimeter readers for the determination of external radiation doses. It is also working with the Hungarian Atomic Energy Research Institute on the calibration and development of a new specific algorithm for neutron dosimeters. Another area of development is computerized record-keeping, where a new system has been instituted. A data management system was created, for example, to efficiently monitor individual annual exposures and ensure that they comply with existing radiation protection requirements. The programme further enables analysis of trends in radiation exposures.

Radiation workers whose extremities may be exposed to high doses are provided with specific dosimeters. Such workers include, for example, those who handle solutions that emit high energy beta radiation (e.g. phosphorus-32), or medical staff involved in specific X-ray techniques. The dosimeters consist of lithium fluoride crystals mounted on finger rings which are assembled and processed at the Vienna International Centre (VIC) laboratory. Whereas the need for such dosimeters is relatively limited among IAEA staff, the demand from developing countries has increased during

IAEA Radiation Safety Services

The IAEA's Radiation Safety Services Section (RSSS) was created in 1979 to support its activities in radiation protection. Main tasks include:

- operating radiation protection laboratories to meet measurement requirements of the IAEA and its Member States;
- maintaining instrumentation capabilities for radiation protection purposes, and for supporting technical cooperation projects in areas of radiation safety;
- providing training and advisory services in radiation protection;
- operating an emergency response system to assist Member States in discharging their obligations under two post-Chernobyl conventions related to early notification of a nuclear accident and provision of emergency assistance.

To fulfill these responsibilities, the RSSS is structured into three units having interrelated support roles:

- **The Vienna International Centre (VIC) Health Physics Laboratory Unit.** Responsibilities cover personal dose records, external dosimetry; monitoring equipment loans; training in radiation protection; external support services; field missions; and technical cooperation projects.
- **The Seibersdorf Health Physics Group Unit.** Responsibilities cover laboratory surveys; internal dosimetry (whole body counting and bioassay); calibration of monitoring equipment; laboratory training in radiation protection; field missions; and on-call duties.
- **The Emergency Response Unit.** Responsibilities cover supporting IAEA obligations under relevant international conventions; operating the Agency's emergency response system; and supporting technical cooperation projects.

Countries receiving radiation dosimetry services in 1994

IAEA technical co-operation projects	IAEA/WHO joint dosimetry programme
Cameroon	Afghanistan
Cuba	Bangladesh
Niger	Djibouti
Panama	Egypt
Sierra Leone	Maldives Islands
Sri Lanka	Nepal
United Arab Emirates	Nigeria
	Pakistan
	Yemen

IAEA radiation safety services support training and related activities at the Agency's Seibersdorf Laboratories.

recent years. Up to 1600 dosimeters have been dispatched annually.

Internal contamination monitoring. The RSSS operates the whole-body counter, which is installed at the IAEA's Laboratories in Seibersdorf, Austria. Measurements are done using the stretcher geometry assisted by four sodium-iodine (NaI) detectors for gamma emitters and two Phoswich detectors for low energy photon emitters (which is the case for plutonium). To maintain the whole-body counter at the highest technical level, two new Phoswich detectors were purchased. Also acquired was a thyroid uptake monitoring system for surveys of radioactive iodine incorporation in the event of a nuclear accident.

This whole-body counter proved invaluable during the period shortly after the Chernobyl accident. From May to December 1986, a study was conducted on individuals working at the IAEA Seibersdorf Laboratories to assess the immediate impact of the accident in this area. This study confirmed, as observed in other countries, that the actual individual intake was below the expected value (sometimes by a factor of three) obtained from practical environmental measurements and using theoretical models. During the same period, collaboration was initiated with the Austrian Research Centre for the measurement of various groups of the local population. In November 1986, seven months after the Chernobyl accident, a study was undertaken on the daily caesium-137 urine excretion from IAEA staff. The observed mean daily value was 12.2 becquerel per day (Bq/d), corresponding to 0.67% of the whole body content, in good agreement with the values reported in international surveys (range of 0.3% to 1.3 %). The result was also in good agreement with the calculated daily intake (from food) derived from body measurements done on the same subjects. In April 1990, at the request of the Byelorussian authorities, measurements were performed on four of their nationals.

Quality assurance. Quality control of measurements is periodically conducted through intercomparison exercises with external institutions. These have been done, for example, with institutes in Germany, namely the University of Saarland in 1985; the University of Frankfurt in 1989; and the nuclear research centre in Karlsruhe in 1992.

Support in field projects and missions

Two highly publicized cases have illustrated how the IAEA's radiation safety services are applied in the field: the International Chernobyl Project, and the nuclear inspections in Iraq under terms of UN Security Council resolutions.

Chernobyl project. During 1990-91, the RSSS was involved in the monitoring of individuals in nine selected villages affected by the Chernobyl accident. From May to December 1990, about 12,000 individual dosimeters were distributed in cooperation with Russian experts. At the same time, the instrument's purpose and the project's aims were explained to the people.

During the same period, the RSSS organized a campaign of internal contamination monitoring among the population. With a mobile whole-body counter provided by France, four teams worked in shifts and often under rather poor environmental conditions to conduct about 10,000 individual measurements. Results were used in subsequent studies.

Iraq. In May 1991, the RSSS was requested to take responsibility for radiation protection during IAEA missions in Iraq. The work involved providing equipment, advice, and assistance to team members, as well as ensuring that individual exposures were kept to a minimum. Major tasks during these missions dealt with the safe handling of nuclear fuel materials, and fresh or spent fuel elements. Agency radiation experts played a particularly valuable role in the operation to remove spent fuel from Iraq.* Individual radiation exposures among the 170 people involved in the mission were kept reasonably low, far below the level which could have been expected for such a difficult operation. This testifies to the cooperative preparatory work and the high level of expertise available during the operation.

Laboratories and related facilities

The IAEA operates a number of laboratories where radioactive materials are or may be handled. They are principally located in Seibersdorf and Monaco, with smaller facilities at approved locations in the Vienna International Centre.

A radio-chemical laboratory for the measurement of alpha emitters in urine has been operational since 1993 and located at Seibersdorf. About 350 samples are analyzed yearly for alpha contamination. In addition, a gamma spectrometry facility is used for analyzing more than 500 urine samples a year for gamma contamination.

The RSSS has set up a comprehensive monitoring programme to ensure compliance with good radiation protection practices and maintenance of proper working conditions. This programme concentrates on activities at the IAEA's Safeguards Analytical Laboratory (SAL) where plutonium and transuranium radioisotopes are handled. About 12,000 smears and 700 air monitoring filters are checked yearly for contamination.

The RSSS is also in charge of a scanner unit which measures the plutonium content of radioactive wastes generated by the Seibersdorf Laboratories and stored in drums. A special computer program has been developed that provides necessary data and results, together with graphs showing the physical distribution of activity and density in measured waste drums. This makes it possible to localize, if needed, higher activity "clusters" inside any drum. From 1981 to 1994, more than 250 drums were measured in this installation.

Radiation monitoring equipment

To fulfill its monitoring and assistance tasks, the RSSS makes use of various types of equip-

*See "Nuclear inspections in Iraq: Removing final stocks of irradiated fuel", *IAEA Bulletin* Vol. 36, No. 3 (1994).

ment. They include 50 contamination monitors, 45 dose rate meters, seven hand monitors, six count rate meters, three multichannel analyzers, and 100 electronic personal dosimeters. All equipment is checked and calibrated yearly, with the assistance of the Dosimetry Unit at Seibersdorf. A loan service has been established to respond to staff demand.

In addition, the RSSS provides users, as needed, with practical handbooks for specific equipment; tests new equipment loaned by suppliers, in view of their potential use either for internal purposes or in the framework of technical cooperation projects; develops special indigenous instrumentation, for its own use; and provides advice on radiation protection equipment. A database has been prepared for this purpose, and now contains more than 600 entries.

Training activities. IAEA training activities in radiation protection frequently draw upon the expertise of RSSS staff for lectures, practical exercises, and monitoring demonstrations, for example. This has been the case, for example, for introductory courses on IAEA safeguards, and for radiation protection courses under Agency technical cooperation projects.

In addition, new staff and visiting scientific fellows at the Seibersdorf Laboratories receive training tailored to the requirements of their tasks.

Emergency Response Unit

After the Chernobyl accident in 1986, States approved two international conventions which placed responsibilities on the IAEA for the establishment of an Emergency Response Unit. The unit, which is operated by the RSSS, additionally supports the efforts of IAEA Member States to meet their obligations under these conventions, which address the early notification of a nuclear accident and the provision of assistance in the case of a radiological emergency.

At the IAEA's headquarters, a dedicated facility contains communication and computer equipment, as well as the documentation and databases that would be needed to deal with an emergency.

Two exercises have been conducted, in April 1990 and in January 1992, involving Agency staff and those from Member States, other UN organizations, and diplomatic missions to the IAEA. Results were used to improve the emergency response system, in terms of its resources and facilities, operational procedures, and communication capabilities.

Other activities have included:

- assisting authorities in 1987 in connection with the accident in Goiania, Brazil, that involved a large caesium-137 teletherapy source. The IAEA provided both equipment and expert advisory services.
- coordinating the receipt, assessment, and dispatch of data in 1992 in connection with the widely reported incident at a nuclear plant near St. Petersburg, Russia;
- assisting Vietnamese authorities in March 1993 in dealing with the overexposure of an individual conducting research with a 15 MeV electron beam. The Agency arranged, through the ERU, for the patient to receive specialized treatment at an institution in France.
- transmitting notification that the IAEA received from Russian authorities in 1993 of the accident at the Tomsk facility. A team of IAEA experts was sent to the site to assess the situation.
- helping Estonian authorities in late 1994 to arrange for an international team of experts in connection with an incident involving a stolen caesium-137 source. The incident had resulted in one death and several overexposures among the general population.

Responding to new needs

Over the past 15 years, the IAEA's activities in areas of radiation protection have expanded considerably in the face of growing demands for expert assistance and services. Initially foreseen to deal only with the Agency's internal requirements, the RSSS increasingly is called upon to support cooperative projects and missions.

A number of developments today point toward new demands ahead. The implementation of the new *International Basic Safety Standards for Protection Against Ionizing Radiation and the Safety of Radiation Sources* is foreseen to demand the monitoring of a wider group of individuals and the study of new dosimetry concepts. Overall in areas of radiation protection, greater emphasis further is being placed on quality assurance and control. Also increasingly evident is a growing need for practical training and related services, especially in developing countries, where national radiation protection infrastructures are being established.

In these areas, among others, the IAEA's established radiation protection services provide a solid basis for responding to emerging requirements for technical expertise and support. ❐

Measure for measure: The NPT and the road ahead

Yielding overall positive results, the 1995 NPT Conference extended the Treaty indefinitely and underscored the IAEA's roles

by Berhanykun Andemicael, Merle Opelz, and Jan Priest

Even before the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) took effect in 1970, the IAEA was an integral component of the world's efforts against the spread of nuclear weapons. The NPT significantly expanded the world's nuclear verification system and the Agency's central role, to the extent that today nearly all of the IAEA's safeguards agreements are concluded in connection with the Treaty. On that basis alone, the outcome of the NPT Review and Extension Conference in May 1995 was of major importance to the Agency and the international community it serves.

On 11 May 1995, the Conference decided to extend the Treaty indefinitely, with greater accountability in future review conferences about its implementation. It further adopted a set of Principles and Objectives for Nuclear Non-Proliferation and Disarmament, and a resolution on the Middle East. *(See box.)* The Conference, however, was not able to adopt a Final Declaration.

Overall, as IAEA Director General Hans Blix has pointed out, the NPT Conference sent some welcome overriding messages. It reconfirmed that the ultimate objective of the Treaty is a nuclear-weapon free world, and supported the "Atoms for Peace" approach for the use and transfer of peaceful nuclear technology consistent with NPT provisions. For the IAEA, this points to the continued importance of its existing, and in some cases expanding, roles in areas of verification and safeguards, nuclear safety, waste disposal, transfer of nuclear technology, and technical assistance.

This article takes a closer look at the deliberations and decisions of the 1995 NPT Review and Extension Conference. In so doing, it focuses on the achievements as they relate to the evolving role and responsibilities of the IAEA, and outlines those issues of relevance to the Agency on which consensus could not be reached.

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NPT extension: Options and decision

The indefinite extension of the NPT, which originally was given a 25-year lifespan, was by no means a foregone conclusion. In fact, very few delegates or observers at the opening of the Conference would have been ready to bet on that outcome. On the other hand, there were also few who did not wish to see the Treaty given a long lease of life, even its greatest critics.

Various options were announced or proposed in addition to indefinite extension. In the months before the Conference opened, Venezuela announced an option that would extend the Treaty for another 25-year period on the same terms and conditions it was originally concluded. There was uncertainty, however, whether the Treaty's provisions could be interpreted to provide for the necessary subsequent extension conferences. By the third week of the Conference, the Venezuelan approach was replaced by two formally proposed options to go alongside the one for indefinite extension. The first option, introduced by Indonesia, called for extending the Treaty for rolling fixed periods of 25 years, with review conferences convened every 5 years. The second option, introduced by Mexico, proposed indefinite extension tied to a number of commitments, the attainment of which would be reviewed every 5 years.

Well into the Conference, Canada took the initiative to circulate a draft decision for indefinite extension through which States could indicate the position they would take should the question come to a vote. In the end it was through this initiative that the Conference was able to decide that a majority existed for indefinite ex-

INSIDE
TECHNICAL COOPERATION

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Ready for partnership

When Lyndon Baines Johnson spoke of the need to "open the doors of opportunity" for people, he was quick to add that they must also be equipped "to walk through those doors". From its inception in 1957, some years before LBJ became president of the USA, the International Atomic Energy Agency took on the twin task of making nuclear technologies available to member countries and of enabling recipients to use them safely. For decades the focus of its **technical assistance** activities was dominated by building capacity to utilize nuclear technologies in scientific and research applications.

As other UN agencies were busy designing and delivering development projects, IAEA technical assistance built basic infrastructure—national institutions, research units, expertise and skills at all levels, interaction with other countries—so that each country would have the capacity to absorb and apply nuclear techniques to resolve local problems. The option, you could say, was thrust upon the Agency. Unlike other development sectors, it was clear that few countries had even a semblance of the required capacity. But beyond that, the IAEA reasoned, there was not a strong justification for transferring technologies that recipients would be forever dependent on foreign experts to use.

"Anybody who is involved in economic development anywhere in the world ... knows how critical human and institutional capacity is to the development effort and the chances of success," Edward V. K. Jaycox, World Bank Vice President for the Africa Region, said in a 1993

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Marine research: deploying a sediment trap

UN family ties

A three-week cruise on the Caspian Sea this summer may sound enjoyable but would misconstrue what is happening on the Azerbaijan research vessel Alif Gadgiev rented by the IAEA. This is all work and no play. As the ship moves slowly from the shallow northern to the deeper middle and then the very deep basin in the south, the passengers are using sophisticated equipment to gather water samples at various depths and doing a number of measurements and experiments.

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More dried fish not DDT ...

Dried fish is an important source of protein

Bangladesh scientists recently made a frightening find. Dried fish sold across the country contained DDT. Some samples analyzed at the Agency-established Pesticide Residue Laboratory of the Bangladesh Atomic Energy Commission (BAEC) had 100 times what was the permissible level before DDT use was internationally banned, including in Bangladesh, some 20 years ago. By then, DDT—the oldest synthetic organic pesticide and the most widely used worldwide—had got into virtually everything alive, from the eggs of soaring eagles to fish several kilometers down in the oceans. It was reported that by the early 1970s the milk of most mothers in the United States had so much DDT that, under US commercial regulations, it could be prevented from crossing from one state to another.

The DDT in the dried fish, Bangladesh's main source of animal protein, did not get there by chance from a residual. It was put there, by traders, to kill insect larvae that normally infest the sun dried fish and reduce them to bones in a few weeks. Dipping in (or spraying) DDT could extend the shelflife of the commodity to several months. Where they get the pesticide from has not been established. Despite its long name, *dichlorodiphenyl trichloroethane*, DDT is based on a simple compound found in natural gas and can be produced in a backyard laboratory. The damage it can do to human health is considerable. But what to do, beyond policing and cracking down on the use of the already banned substance?

Happily Bangladesh does have the means to preserve dried fish for many months, without using DDT: a demonstration and partly commercial multi-purpose (food and medical supplies) irradiation facility. The 80 000 curie Russian-built plant, paid for from TC funds, began operating in March 1993. Sited in Chittagong, in the heart of the fishing region, it could treat all the dried fish the country produces. Irradiation after packaging would keep the food undamaged by larvae and cleansed of pathogens as well. The government's emerging strategy to ensure that DDT is not used includes both compelling the traders to use the facility—and enabling them to do so. In fact it embraces other foods which are treated with other toxic substances after harvest.

Bangladesh is a least developed country (LDC) as defined by the UN, but in nuclear terms it is more advanced than many in the developing category. The key reason is governmental commitment to invest in the atom. Apart from the irradiation facility, it operates a research reactor, a linear accelerator and a neutron generator. The build-up of capacity to absorb nuclear technical help began when an atomic energy centre was set up in Dhaka in 1965, when the country was still East Pakistan.

BAEC, formed in 1973, two years after separation from Pakistan, has set up many facilities (including an institute of nuclear medicine and 11 nuclear medicine centres, a radiation testing laboratory, and an atomic energy research facility) and guided an extensive research and development programme. It can now train scientists, engineers and technicians in nuclear physics, chemistry, electronics, medicine, radiation biology, isotope applications in agriculture and industry and other fields—for its own activities as well for others in the public and private sectors. IAEA **technical co-operation** assists in-country group training and funds fellowships abroad for top specialists

BAEC's institute of food and radiation biology began research on human tissue grafting in 1985, with IAEA **technical co-operation** help. Over the years items from its tissue bank—of bones, cartilage, embryonic tissue, ligaments, skin—sterilized by radiation, have been successfully used on more than 400 patients in Bangladesh hospitals. Tissue banking has developed over the past 40 years and today there are more than 100 banks worldwide. One of them is in this LDC.

...bigger harvests with less fertilizer

A major new drive by the Vienna-based Joint Division of the Food and Agriculture Organization (FAO) and the IAEA is to increase crop yields while using less chemical fertilizer which is both expensive and harmful to the environment. In Bangladesh the ultimate target crop is rice. But it has started on legumes, the principal protein source of the poor. Legumes have the natural ability to absorb nitrogen not only from the soil (and from fertilizers put there) but from the air. In fact this "fixing" of atmospheric nitrogen (N^2) is done by a bacterium called rhizobium in the soil. All legume plants seem to recognize rhizobia as alien, and form nodules around the bacteria at their roots. But the bacteria are benign and those in nodules go on fixing N^2 in forms usable by the plant.

The more nodules the better the plant thrives and the more protein it provides for humans and animals. The number of nodules is proportionate to the density of rhizobia in the soil. Since 1988 IAEA **technical co-operation** has aided the Bangladesh Institute of Nuclear Agriculture (BINA) in a project to improve its rhyzobiology capacity and take on the research and development to maximize this gift of nature. BINA has identified elite genotypes of grain legumes which, in combination with appropriate strains of rhizobia, can fix greater amounts of nitrogen than the traditionally used local cultivars, and shown that yields of chickpea, groundnut and lentil can be increased significantly.

Using a unique nitrogen-15 (N^{15}) technique developed by the FAO/IAEA Joint Division, the BINA studies have also shown that application of a **biofertilizer** of peat and the best strains of local rhizobia for lentils, chickpea and groundnut can add 70-100 kilograms per hectare of atmospheric nitrogen to the soil through biological fixation. This is about what 150-200 kg/ha of urea would provide. Urea costs US$20-25 per hectare, the biofertilizer $3-4. And the biofertilizer has none of the environmentally harmful effects of commercial nitrogen fertilizer. Lentils, chickpea and groundnut are grown on 357,000 hectares in Bangladesh (roughly half the area covered by all pulses). The amount of biofertilizer (rhizobia plus peat) needed, if chemicals are replaced in the total area, is estimated to be 750 tonnes a year.

Bangladeshi farmer and family at the edge of his lentil field.

Until the introduction of Model Projects (see "A Model Vehicle", page 3), such experimental findings might have remained in the institute, waiting for someone to come along and use them. In this case a model project called *biofertilizers for increased legume production* was launched this year. With seed money and some technical help from TC in the first three years, it is expected to generate its own funds through a contract mechanism with the private sector to sustain its future activities.

The idea is for BINA, the Ministry of Agriculture and private companies to collaborate and steadily build-up both the farmers' capacity to use the biofertilizers (different mixes for different legume crops) as well as the country's capacity to produce them. Both will require successive and widespread field trials to evaluate what is best for where. On the production side, BINA already has a pilot-scale factory with three small (100 litre) fermenters needed for rhizobia production, each able to produce 5-8 tonnes a year of bacteria-plus-carrier which would be sufficient for the early trials. Decisions on large scale production of biofertilizer and a large scale programme for sustainable legume production will not be taken until all the findings of the first two years (1995 and 1996) are in. But the government is committed to introduce a biofertilizer industry in Bangladesh. It is hoped to attract private investors in setting up a commercial scale plant with technical and scientific support from BINA.

IAEA technical co-operation will provide expert services to support the production of high quality biofertilizer, as well as some equipment and supplies, mainly inoculum fermenters and N^{15} labelled fertilizer for field testing. Its total contribution over three years, including fellowships and scientific visits, is budgeted at $151,650. For Bangladesh, which will invest much more in various ways, increasing legume production by about 25% through the use of biofertilizer could lead to savings of about $25 million on imported legumes and about $6 million on chemical fertilizers. The returns in terms of a new industry, employment opportunities, and environment friendly sustainable legume cultivation, are more difficult to quantify.

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speech. Providers of development assistance, he said, "tend to use expatriate resident technical assistance to solve all kinds of problems. Not only do these problems not get solved, but I would contend that this is a systematic destructive force which is undermining the development of capacity ..."

Fewer than one quarter of the Agency's members have a nuclear energy programme and most of those are developed countries. But among the rest there is a clear interest to apply nuclear technologies for economic development.

The applications are now quite numerous, reaching ordinary people almost everywhere and everyday. These technologies range from treating cancer in humans to diagnosing diseases in animals, from improving crop productivity to producing disease-resistant plants, from controlling pests and eradicating pathogen carriers to measuring water resources, soil fertility and fertilizer regimes, from industrial applications such as measuring the thickness of paper and the integrity of oil or gas pipelines to those that affect us as individuals such as the quality of the food on our plates. These and many other nuclear technology applications can produce significant social and economic benefit for developing countries.

Under the Agency's traditional approach, each country, once it had developed its capacity, would be in a position to identify the problems that nuclear technology could best resolve; handling the research and preparing projects for implementation. A government could ask for international assistance when it had established what it wanted to accomplish.

In contrast, as Mr. Jaycox of the World Bank observed, much technical assistance "is imposed, it is not welcome and there is no demand for it really." For example, the World Bank Group lends US $4 billion a year in sub-Saharan Africa. In 1993 it had US $14 billion outstanding. The commitments were there, but no drawdown. Why? "It's an issue of capacity," Jaycox said.

Of the 88 countries which now benefit from IAEA **technical assistance**, the most advanced in nuclear science are those, unsurprisingly, whose governments have committed themselves to the task. Ghana (see Ghana, page 6) is one of the best examples in Sub-Saharan Africa, the region least advanced in application of nuclear techniques. Similarly, Bangladesh, a least developed country (LDC), is much more advanced in the nuclear field than some developing countries (see Bangladesh, pages 2,3).

IAEA support for nuclear based development activities to these two countries has amounted to some US $18million over the years. These are paltry sums compared with total development assistance, but Ghana and Bangladesh are now able to apply nuclear means to achieve nationally important ends, and have already done so, due in part to the Agency's concentration on capacity.

Now, after three decades of intensive focus on building infrastructure—typically through felloships abroad, training within the country, research contracts, expert assistance, and provision of laboratory equipment and facilities—Agency **technical assistance** is ready for a new partnership in **technical co-operation**.

For the TC Department, the reasoning is straightforward:

"Adequate infrastructure including trained people in the field has been successfully established in many countries. The next step is adequate national capacity to take nuclear techniques into the development arena. With strong government commitment and the support of other partners nuclear technology can reach the end users and effect significant social and economic impact. We can no longer just transfer technology and hope somebody uses it. Its application must be part of a programme to address major problems and achieve lasting results."

A model vehicle

Having taken the step to enter the wider arena of development, utilizing its expertise and the capacities of its counterpart national nuclear bodies in a new partnership in development, the **Technical Co-operation (TC) Department** realized it needed a new vehicle. The road was clear. While many other development agencies continued to complain of lack of national capacity, many of the TC Department's national counterparts already had the skills and infrastructure to apply nuclear techniques, especially in the priority areas of human health and agriculture.

The vehicle for applying nuclear technologies in social-economic development is what the TC Department calls its **Model Project**. In the past two years 23 Model Projects have been launched. The inauguration on 1 June this year of China's first industrial scale irradiation plant to be used for disinfestation of foodstuffs, mainly rice, reflects the success of one. Like all Model Projects, it has immediate practical benefit to the national economy. It is sustainable with national expertise and the technology has comparative advantage over conventional approaches.

The Chinese Government's strategy is to expand food irradiation applications once this pioneer project has demonstrated that the technology is economical and effective. Growing demand for quality foods has led to increasing restrictions on conventional methods of disinfestation (insecticides and chemical fumigation) which are harmful to human and environmental health. Irradiation offers a safe and effective means of achieving greater crop utility and value. For the IAEA the Model Project is the next stage in the evolution of its technical co-operation programme, from the transfer of technology to a partnership in national development. The MP concept, still being fine tuned, takes the results of nuclear science all the way to end users such as farmers, health services, industries.

For example, research by Mali scientists has produced mutations of native rice and sorghum that give higher yields than those now cultivated and are of a quality that is more attractive to consumers and more valuable to farmers. The TC Department provided expertise, equipment and training to accomplish this breakthrough. If the new seeds prove vigorous and can be widely distributed, farmers would earn more and the country's imports would be reduced. How to demonstrate the viability of the mutant seeds for the farmer? This is the thrust of a Model Project started this year, in which the government, particularly the Agriculture Ministry, is the primary motivator. The key prerequisites of all Model Projects are that they receive strong national commitment, respond to national development plans and be of practical value to specified end users.

Model projects are based on national capacities and designed to address national priority needs. The TC Department proposes application of nuclear techniques only where they are clearly advantageous or at least cost-effective compared to other means to ends that achieve results. The government must fully commit to the Model Projects objectives: construct building and facilities, provide national project personnel and even contribute in cash. China put in a massive US$1,015,500 of a total cost of $1,331,300 for the irradiation plant. The share in cash may vary, but all governments must provide substantial contributions. Additionally, Model Projects are designed to be completed in a few years, therefore governments must be prepared to sustain the activity after support from the Agency is discontinued, and also be able to do so with minimal international funds and expertise.

While the IAEA can develop basic national infrastructure and initiate projects that demonstrate the effectiveness of a particular nuclear technique to achieve national objectives, its resources are not sufficient to reach all end-users and situations in which the technologies are demonstrably useful. Many funding agencies have the opposite problem: finding good and clearly implementable projects which the government has the capacity to absorb. The Model Project concept provides a framework and opportunity for donors and development agencies to become partners in IAEA TC activities. Recent experience and discussions with top funding agencies have indicated that significant amounts of bilateral and multilateral assistance, already made available but unutilized by some IAEA Member Countries, could be redirected into IAEA **technical co-operation** projects that could be absorbed with significant socio-economic impact. The IAEA's Technical Co-operation Department has developed the tools to bring the benefit of nuclear technology to the doorstep of developmental objectives in food security, environmental quality, health, industry and poverty alleviation. The only thing missing is the opportunity to develop the full potential of this important contribution to human development.

Home improvement

As it prepared for the transition from basic technology transfer to developmental partnership, the IAEA's Technical Co-operation Department also looked *inward*. Peer review was an important com- ponent for improving efficiency and enhancing the relevance of Agency TC activities.

The Model Projects initiative has established a new standard for the Agency's technical co-operation activities based on national priorities and providing end-users with new and powerful technical solutions. They have also served to orientate Agency staff to seeing nuclear technology not as an end in itself, but as a means to achieve improvements in the human condition.

The Department's new strategy to spread the Model Project concept throughout the TC programme and involve additional Agency technical officers, national nuclear counterparts, and officials of recipient countries includes two initiatives—country programming and thematic planning. These initiatives will identify where nuclear technologies can be most effective and concentrate assistance on "fewer but better" projects in order to create significant national impacts through strengthened commitment to priority activities, better co-ordination with other UN organizations **at country level** and interacting more effectively with donors and funding agencies.

Co-ordination between TC and other IAEA Departments (such as Research & Isotopes or Nuclear Safety) is also being enhanced, especially with those Divisions and Sections having a role in implementing TC projects. Each project has a project officer from the Technical Co-operation Department and a technical officer who could be from any one of the technical divisions of another Department. Regular meetings between technical and programme staff have speeded up the project implementation process significantly as witnessed by the rate of financial implementation for Technical Co-operation Fund (TCF) resources of almost 72%.

The Department was concerned about the large number of projects not implemented on schedule and the annual carry-over of unutilized resources. There was an unacceptable gap between project approval and implementation caused by delays in getting the prerequisites for the first six months of projects—expert job descriptions, specifications for equipment procurement, workplans, fellowship applications and the like. Improved technical liaison has cut those delays. In 1994, project prerequisites were sought and received for a substantial number of proposed projects between 3-6 months earlier than in previous years, yielding an important "head start" in project implementation of the 1995-96 Programme.

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On board are experts from the Agency and the Intergovernmental Oceanographic Commission (IOC) of UNESCO, and participants from the five countries that surround the sea (Azerbaijan, Iran, Kazakhstan, Russia and Turkmenistan) who are doing the sample taking and receiving hands-on training to do precise oceanographic measurements and acquire the skills necessary for follow-up activities. Such sampling, especially at great depths, needs special equipment and skills. Training in management and collaboration among the disciplines involved—chemistry, oceanography, isotope technology and marine biology—is also included in the on-board course.

Loading sterilized flies for aerial release.

The mystery of the Caspian's dramatic sea level rise since the late 1970s remains to be solved. It has risen an estimated 2.5 metres in the past 15 years and is still rising at about 15 centimeters per year. The devastating consequences to the people of this basin include flooding of harbours and coastal facilities, changing groundwater flow of adjacent aquifers, cholera outbreaks caused by stagnating sewage which cannot flow towards the sea, pollutant build up from refining oil and salt water intrusion into adjacent groundwater and agricultural soils. The increase in pollutants is affecting fisheries and caviar production due to declining sturgeon numbers. The cruise, which is also expected to provide valuable new data on the Caspian Sea, is a small but important input in a massive programme being knitted together by members of the UN family.

An international meeting called by the UN Environment Programme (UNEP) in Geneva early this year concluded that a multidisciplinary, multisectoral and intergovernmental approach is needed to cope with a situation that is getting worse. The comprehensive programme which is being finalized will be coordinated by UNEP and involve many other UN agencies which have visited the riparian states in order to establish government commitment and active participation.

The World Meteorological Organization (WMO) is preparing to re-establish and upgrade the hydro-meteorolocal monitoring stations in the region, especially in the Caspian's catchment area, that have fallen into disuse or neglect since the break up of the former USSR. UNESCO (the UN Educational, Scientific and Cultural Organization) and the World Health Organization (WHO) are also deeply involved because of the threat to national heritage and human health.

The IAEA has a key role in establishing the *cause* of the sea level rise, without which preventive, mitigative or curative actions cannot be planned. The "cruise" project, an Agency initiative in which the IOC is taking part, will provide initial baseline data from isotopic analyses of the samples it gathers. The **Technical Co-operation Department of IAEA** has a second-phase project designed to produce detailed data on this phenomenon and contribute significantly to the remediation activities planned by UNEP.

Joining forces with other agencies is crucial to the effectiveness of **technical co-operation** in efforts to apply nuclear science in the social and economic growth of Member States of the Agency. Because the technologies are applicable in so many areas, the Agency can seldom take the lead. Instead it sees itself as a valuable "partner in development" in support of many areas of activity by UN specialised agencies. Collaboration, with governments and development agencies, has become an important component of Agency TC. Its Model Project concept provides a mechanism for realizing the socio-economic benefits of nuclear technology.

The IAEA and FAO (the Rome-based Food and Agriculture Organization of the UN) established a Joint Division in Vienna more than 30 years ago. The recent FAO initiative (with UNDP financial support) on global food security, has led to even greater co-operation with FAO in Rome. The TC Department, however, wants to go beyond just transferring nuclear techniques in agriculture; it seeks to carry their application through to end users, using FAO connections with national agriculture extension services. Collaboration with WHO is expanding as well. One noteworthy programme is directed against cancer. Cancer is increasing worldwide and the greatest increase is in the developing world. By 2010 approximately two-thirds of new cases will be in developing countries.

Given their different mandates, WHO and IAEA have played different but significant roles in the fight against cancer. WHO has concentrated on diagnosis and treatment while transfer of technology and equipment for radiological methods such as teletherapy and brachytherapy has been left exclusively to the IAEA.

Early diagnosis is vital for successful treatment. For example cervical cancer is decreasing in the developed world because of early diagnosis. Many cases that come to cancer treatment centres in developing countries are too far advanced to permit treatment. A new WHO/IAEA collaboration is planned to develop national diagnostics and radiotherapy systems for health maintenance programmes in several developing countries.

Ghana sees big benefits from "mini" research reactor

In March this year Ghana started-up its first research reactor, 32 years after a grand design to install a much larger one from the then Soviet Union was aborted. The new Chinese-built reactor is truly 'mini', with a capacity of only 30 kilowatts. Commonly research reactors have megawatt-plus capacity. But Ghana has made enormous strides in nuclear science in recent years and has the capacity to make maximum use of it. An important activity for the national economy would be neutron activation analysis (NAA) techniques, using neutrons produced by this research reactor to assay rocks, sands, soils, and help identify mineral resources such as bauxite and manganese which are very important to the Ghanaian economy.

NAA techniques will also be applied to assess the quality of the environment, water, and food supplies, both imported and locally produced. NAA can determine minuscule particles of elemental and other impurities in a sample very rapidly and accurately, far beyond the capability of conventional chemical methods. Using the research reactor Ghanaian scientists are now able to perform these analyses. The procedure includes spectral analysis to find out what elements are present and in what concentration in the whole sample. But this requires computer software. Shortly after the reactor was started up, Ghanaian technicians adapted a software that the agency had developed for spectral analysis. Since then a dedicated software package specially designed by the Chinese for NAA in this reactor type has been installed.

The other key activity for the reactor is radioisotope production. Many radioactive isotopes are routinely used in agriculture, health care, hydrology and other fields. They are commonly produced in nuclear research reactors with a minimum flux density of neutrons. Although it is small the reactor in Ghana has the flux density to produce certain specific radioisotopes, though not on a commercial scale. Most importantly the mini reactor will be used for research and training, increasing Ghana's skilled manpower and upgrading expertise.

Collaboration with others organizations of the UN family has not been easy, but many new projects have been launched recently or are being developed. One such initiative with the UN Industrial Development Organization (UNIDO) seeks to set up a pilot facility to produce sterile male tsetse flies in Africa. Tsetse flies infest 36 countries and a total area of 10 million square kilometres in Africa.

Throughout this area the disease transmitted by the tsetse fly has a devastating effect on huge numbers of livestock. The sterile insect technique (SIT), which involves releasing sterilized males to challenge the fertile wild ones as mates, has the potential to eradicate the pest in significant portions of Africa where tsetse infestation is seriously affecting human and animal health, and economic productivity. IAEA has the ability to transfer technology to breed and sterilise the flies on a massive scale to combat this devastating pest, while UNIDO is assessing the capacity to industrialize this process as a *national* activity which is essential for sustainability. UNDP has the field network to organize the activity on a regional and sub-regional level.

Several projects have sought to control tsetse fly populations, but not as yet eradicate them over truly large areas. Eradication will bring highly desirable consequences to African social and economic development and also for the environment which would be spared of chemical control effects. Much remains to be done in conjunction with planning, organization, infrastructure development relating to fly rearing, release, monitoring and maintenance. However, the success of FAO and other international partners such as the European Union in controlling tsetse fly species creates a favorable situation for full eradication, especially with the strong commitment of governments, national counterparts and extension services.

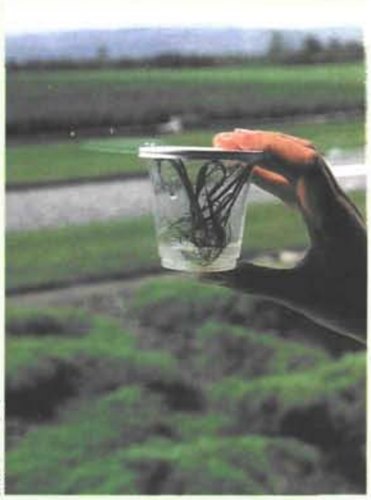
Search for sleeping genes

The crops that feed us today evolved over millions of years. Their early ancestors often had to contend with extremely hostile conditions such as salinity, drought, frost, heat, and water-logging. Only those that had the right genetic make-up survived. Later, as climate conditions became more comfortable, there was less need for those hardy genes. But plant scientists believe they are not dead, just dormant, and that if crop plants are suitably challenged the appropriate genes would be aroused from slumber.

The need to awaken these "inducible" genes is becoming urgent. The burgeoning human population has to be fed. Demand for living space adds to the need for more crops to be grown on less land, in nutrient-depleted soils, in areas prone to increased flooding or drought, heat and cold. Already some 40 per cent of cropland worldwide suffers from salinity, another 20% from acidity.

In mid-1994, the Agency launched a coordinated research programme (CRP) to search for inducible genes in crops that either do not produce viable seeds or are propagated by seed but the progeny are very different from the parent. The aim is to identify the genes that enable each crop to tolerate one or other inhibiting condition—drought tolerance in potatoes is an example—isolate these genes, clone or transfer them to that variety, or accentuate their effect, so that the crop better meets the challenge. Another part of the programme is to induce mutations by irradiation and thereby produce new and possibly more productive varieties of crops.

IAEA Coordinated Research Programmes, designed to promote international research in a thematic way, network agricultural research institutes of a number of countries with focus on a single subject to be researched in a way prescribed in detail. Typically they bring together institutes of developing countries and one organization that has done extensive research on the theme, normally from a developed country.



From lab to land: tissue culture is a key to improving vegetatively propagated plants. (credit: Beant Ahloowalia)

The CRP on ***in-vitro* techniques for mutation induction and selection of desired genotypes** involves national agricultural research institutes of nine countries—Bangladesh, China, Colombia, Egypt, Ghana, India, Pakistan, Peru and Syria—with Ilga Winicov of the University of Nevada, Reno, USA, as agreement holder.

Crops being studied are cassava (Kenya), garlic (China, Syria), pineapple (Ghana), potato (Colombia, Egypt, India, Pakistan), sugarcane (Bangladesh, Pakistan) and sweet potato (Peru). The countries are seeking to find out how these plants can withstand specific stress in a particular environment. Peru, for instance, wants a sweet potato that can cope with high temperature and drought. Bangladesh wants a sugarcane that can grow in water-logged conditions, and one that does not flower because flowering stops growth and sugar recovery suffers.

Ilga Winicov has done pioneering work on alfalfa. By stressing alfalfa with high doses of sodium in the growing medium she has been able to select cell lines and regenerate plants (even seeds) that are much more tolerant than the parental variety; and can withstand 1% sodium chloride in the water. What's more, they exclude the salt rather than survive salt uptake. In much earlier experiments with sugarcane, in Hawaii and Cuba, scientists found plants that tolerated salt but took it up, so when crystallising sugar the salt was also crystallised. Winicov has also used molecular techniques to identify the messenger RNA in alfalfa, opening new avenues for that technique to be used.

The CRP is applying a combination of tissue culture and radiation mutation techniques, to induce desired genes or produce new ones. In the first, the planting medium is manipulated by adding salt or chemicals that produce the undesired effect in the plant, such as cell dessication which is what happens in drought, to simulate the stress conditions in a field. In the second, mutations can be induced in millions of plant cells or entire plants by a single radiation dose. Both provide the huge cell populations needed, to select the desired traits. In some cases, even selection can be done at the test tube culture stage. And once the required genetic changes have been identified the selected plants can be multiplied in tissue culture very quickly in the lab, for release to farmers—the ultimate target. Some CRP participants already have plants in field trials which were produced in the lab.

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tension. Only Egypt and Syria mentioned the suspension of the Conference if no decision could be taken, with it to reconvene at a later date until which time the Treaty would remain in force.

Of the five nuclear-weapon States, four — France, Russia, the United States, and the United Kingdom — advocated indefinite extension from the start, strongly supported by Canada, Australia, and most European States. China joined the support later. While some developing countries supported indefinite extension from the beginning, most did not. The opposition started to fade about midway into the NPT Conference, following the outcome of the Bandung meeting of Foreign Ministers of States in the Non-Aligned Movement (NAM). The meeting did not unite around demands for the option of a 25-year rolling extension.

By the third week of the Conference, more than 100 States had signed up for indefinite extension and the question was no longer whether or not the Treaty would be extended indefinitely, but by how great a majority and under what conditions.

While it was clear that there would be a majority for indefinite extension if it came to a vote, the President of the Conference, Sri Lankan Ambassador Jayantha Dhanapala, was firm in seeking to achieve consensus. Using its unique position as an ex-nuclear-weapon State and as a non-aligned developing country, South Africa proposed linking an "enhanced" review process and the acceptance of "principles" covering non-proliferation, universality, safeguards, peaceful uses, nuclear disarmament and nuclear-weapon-free zones with the decision to extend the Treaty indefinitely. South Africa stressed that the principles were not "conditions", but a "yardstick". These principles were discussed in a small group of Friends of the President parallel to the review of the Treaty which was being carried out in three main committees. In the end, it was this package, augmented by a resolution on the Middle East, that won the day.

Main Committee I: Disarmament and security issues

The aim of the NPT Conference to adopt a Final Declaration on the review of the Treaty's implementation could not be achieved because of deep divisions within Main Committee I over the issues of non-proliferation and nuclear disarmament.

Polarized debate. Main Committee I was unable to resolve the fundamental difference of perception on issues between the nuclear-weapon States and the majority of non-nuclear-weapon States. The disagreements cut across North-South lines. Notably, criticism of the nuclear-weapon States on issues of disarmament brought together members of the NAM and some members of the Western European and Other States Group.

Non-proliferation commitments. At issue was the responsibility for past acquisitions by non-nuclear weapon States of sensitive nuclear technology and the manner in which future transfers could be prevented. The first disagreement occurred when Mexico raised two questions: whether Articles I and II were violated by the deployment of American and British nuclear weapons in the territories of other NATO members, with control transferable in times of war; and whether nuclear components and technology received by the UK under the US/UK Mutual Defense Agreement constituted nuclear transfer in breach of Article 1.

Many NAM members agreed with Mexico that such transfers were not consistent with NPT obligations, while the argument was vigorously refuted by the US, the UK, and a number of NATO members. A second issue concerned a point made by Iran and several Arab States that certain nuclear-weapon States should bear responsibility for the acquisition of sensitive nuclear technology and materials by non-NPT parties, particularly Israel. No responsibility was acknowledged by any nuclear-weapon State for any such transfers. A third issue concerned the breach by Iraq of its non-proliferation obligations under Article II and the non-compliance by the Democratic People's Republic of Korea (DPRK) with its safeguards obligations under Article III, with possible implications for Article II. There was not much disagreement on these issues as such, except by Iraq and the DPRK themselves who would not join a consensus if their cases were explicitly mentioned. The prevailing view among the NAM members was that a balanced assessment of non-compliance should cover both Articles I and II.

These issues by themselves were not intractable but they could not be resolved in the context of the deeper division over Article VI.

Disarmament. The main disagreement regarding Article VI concerned the following issues: whether the arms race has indeed ceased; how to speed up the process of nuclear disarmament by all nuclear-weapon States and achieve total elimination of nuclear weapons; how to strengthen existing security assurances to non-nuclear-weapon States; and whether a plan of action with specific time-frames was feasible for future nuclear disarmament. There was less problem with the specific issues of negotiations for a Comprehensive Test Ban Treaty (CTBT)

The NPT, the 1995 Conference, and the IAEA

The Review and Extension Conference of the Parties to the Treaty on the Non-Proliferation on Nuclear Weapons (NPT) was convened in New York from 17 April to 12 May 1995. Its significance was underscored by the participation of 175 of the Treaty's 178 States Parties and by the decision to extend the Treaty indefinitely. The dual purpose of the Conference was to review the operation of the Treaty and to decide upon its extension. Ambassador Jayantha Dhanapala, of Sri Lanka, was President of the Conference.

The Conference preparatory process, which had started in May 1993, was done in four sessions of the Preparatory Committee. Eleven background documents were accepted for transmission to the Conference, including three prepared by the IAEA. However, relatively little time was devoted to substantive discussions and no major issue were resolved before the Conference. The focus had been on preparation of the draft rules of procedure for the Conference, the most controversial rule of which was left for the Conference itself to resolve. This concerned the voting procedure on the extension decision, a question closely associated with the substantive issue of options for extension, both of which were eventually resolved in the last week of the Conference. The review of the Treaty's implementation was undertaken by three Main Committees with the following mandates:

- ***Main Committee I: Disarmament and Security Issues***
  Review and implementation of Articles I and II (non-proliferation commitments), Article VI (nuclear and general disarmament commitments); and Article VII (nuclear-weapon-free zones as related to disarmament and security issues) and the related preambular paragraphs.
- ***Main Committee II: Non-Proliferation. Safeguards, and Nuclear-Weapon-Free Zones***
  Review of implementation of Article III (verification and IAEA safeguards); Articles I and II (non-proliferation commitments in relation to verification and peaceful uses of nuclear energy); and Article VII (nuclear-weapon-free zones). Role of the Treaty in promoting non-proliferation, nuclear disarmament, and peace and security. Measures to promote the Treaty's wider acceptance.
- ***Main Committee III: Peaceful Uses of Nuclear Energy***
  Review of implementation of Article III (as regards application of safeguards in such a way as to avoid hampering the economic or technological development of Parties); Article IV (on promotion of peaceful uses of nuclear energy); and Article V (on peaceful applications of nuclear explosions) and related preambular paragraphs.

IAEA Roles and Responsibilities. Under the NPT, the IAEA has been entrusted with the specific role as the international safeguards inspectorate and is generally recognized as the multilateral channel for the transfer of technology for peaceful uses of nuclear energy. Responsibilities emanate from Articles III and IV, respectively. In practical terms, the Agency has roles in connection with a number of other Articles. In practice, the IAEA has been entrusted with verification pursuant to Articles VII (in the Treaty-based nuclear weapon free zones already established or in prospect) and to Article VI (in the context of safeguarding nuclear material deemed excess to US defense requirements.) Possible new roles include those emerging from completion of negotiations for a Comprehensive Test-Ban Treaty (CTBT); and the conclusion of an agreement banning the production of fissionable material for nuclear weapons or other nuclear explosives.

In his statement to the Conference on 17 April 1995, IAEA Director General Hans Blix described the important role which has been given to the IAEA in the implementation and fulfilment of the NPT, the Agency's potential role in new areas of nuclear arms control, and its extensive technical cooperation and assistance activities. Background Documents prepared by the IAEA provided detailed information to the Conference. IAEA staff further provided assistance to the Committees, in clarifying issues as well as in providing service as part of the Conference Secretariat.

NPT Origins and Objectives. Signed in 1968 and in force since 1970, the NPT has been hailed as one of the great success stories of multilateral arms control. Its main objectives are to halt the further spread of nuclear weapons, to provide security for non-nuclear weapon States which have given up the nuclear option, to create a climate where co-operation in the peaceful uses of nuclear energy can be fostered, and to encourage good faith arms control negotiations leading to the eventual elimination of nuclear weapons. While opinions differ among States as to how successful the NPT has been in achieving these goals, most are of the view that the world is a safer place with the Treaty than it would be without it.

Considering what is at stake, the NPT is a rather simple document consisting of only 10 Articles, the longest of which is six paragraphs. The details of the verification of Treaty obligations are left for negotiation in the framework of the IAEA. These safeguards agreements and subsidiary arrangements go into much greater detail and constitute the Treaty's verification system.

The Treaty provides for periodic review conferences at 5-year intervals. The first one was thus held in 1975, followed by those convened in 1980, 1985 and 1990 in accordance with NPT provisions and resolutions by the United Nations General Assembly. The 1995 Conference was specifically provided for in Article X of the Treaty: "Twenty-five years after the entry into force of the Treaty, a conference shall be convened to decide whether the Treaty shall continue in force indefinitely, or shall be extended for an additional fixed period or periods. This decision shall be taken by a majority of the Parties to the Treaty.".

The Final Package of Decisions

The positive outcome of the NPT Conference was a package of three decisions:

- **Extension of the Treaty.** The Conference decided that, as a majority exists among States Party to the Treaty for its indefinite extension, in accordance with its Article X.2, the Treaty shall continue in force indefinitely.

- **Principles and Objectives for Nuclear Non-Proliferation and Disarmament.** In 20 operative paragraphs, the Conference adopted principles and objectives in all relevant areas. ***Universality:*** Urgent priority was given to universal adherence to the NPT. ***Non-Proliferation:*** The NPT's vital role in preventing nuclear proliferation and reducing the danger of nuclear war was stressed, as well as the need to make every effort to implement the non-proliferation provisions in all their aspects. ***Nuclear disarmament:*** The commitments by nuclear-weapon-States to pursue nuclear disarmament negotiations in good faith were reaffirmed and those States were urged to fulfil their undertakings with determination. Specifically, the implementation of the following programme of action was stressed: completion of negotiations on a Comprehensive Nuclear Test Ban Treaty no later than 1996, with utmost restraint on testing pending its entry into force; immediate commencement and early conclusion of negotiations for a cut-off agreement on the production of fissile material for nuclear weapons; determined, systematic, and progressive efforts by nuclear-weapon States to reduce nuclear weapons globally, with the ultimate goal of their elimination. ***Nuclear-weapon-free-zones (NWFZs):*** The development of NWFZs and zones free of all weapons of mass destruction, especially in regions of tension such as the Middle East, was encouraged as a matter of priority. ***Security assurances:*** Going beyond Security Council resolution 984 (1995) and the recent declarations by nuclear-weapon States on negative and positive assurances, consideration should be given to further steps that could take the form of "an internationally binding instrument." ***Safeguards:*** Recognizing that the IAEA is the competent authority responsible to verify and assure compliance with the safeguards agreements under Article III of the NPT, the Conference stated that nothing should be done to undermine IAEA's authority; States parties that had not yet concluded safeguards agreements should do so without delay; decisions of the IAEA's Board of Governors for further strengthening the effectiveness of IAEA safeguards should be supported; acceptance of safeguards and legally binding non-proliferation commitments should constitute a precondition for new supply arrangements for transferring nuclear material or equipment or items specially designed for the processing, use, or production of special fissionable material; nuclear material transferred by nuclear-weapon States from military to civilian use should, as soon as practicable, be placed under IAEA's voluntary offer safeguards. ***Peaceful uses of nuclear energy:*** Stressing the inalienable right of all parties to develop research, production, and use of nuclear energy for peaceful purposes without discrimination and in accordance with NPT provisions, the Conference urged full implementation of undertakings to facilitate transfer of peaceful nuclear technology; preferential treatment for non-nuclear-weapon States Parties in all peaceful nuclear activities; transparency and dialogue in nuclear-related export controls; maintenance of highest practical levels of nuclear safety, including in waste management, physical protection and transport of nuclear materials; and strict avoidance of attacks or threats of attack on peaceful nuclear facilities. ***Resources for IAEA:*** The Conference urged that every effort should be made to ensure that the IAEA is equipped with adequate financial and human resources to meet effectively its responsibilities and that the Agency should intensify its efforts to find ways and means for funding technical assistance through predictable and assured resources.

- **Strengthening the Review Process.** In addition to the Review Conferences at 5-year intervals, it was decided that, beginning in 1997, the Preparatory Committee should hold a meeting in each of the three years prior to the Review Conference to consider the Principles and Objectives and ways to promote the full implementation of the Treaty.

- **Resolution on the Middle East.** The resolution reaffirms the importance of the early realization of universal adherence to the NPT and calls upon all States of the Middle East that have not yet done so to accede to the Treaty as soon as possible and to accept IAEA full-scope safeguards. It also endorses the aim and objectives of the Middle East peace process and calls upon States in the region to take practical steps in appropriate forums towards the establishment of a Middle East Zone free of weapons of mass destruction and their delivery systems. The resolution, which was adopted without a vote, was sponsored by the NPT depositary States: Russia, the United Kingdom, and the United States. A first version was originally proposed by 14 members of the League of Arab States expressing concern about Israel's unsafeguarded nuclear facilities and calling for a Middle East free of nuclear and all other weapons of mass destruction and their delivery systems. As other States resisted singling out Israel, a compromise was reached whereby the language agreed in the report of Main Committee III was referred to. That language had expressed concern about unsafeguarded sensitive nuclear facilities in India, Israel, and Pakistan.

and a cut-off agreement on fissionable material. On those issues, the adopted Principles and Objectives reflect the eventual agreements.

The Principles and Objectives acknowledge that nuclear disarmament is substantially facilitated by the easing of international tension and by the strengthening of trust between States. They include specific measures that would certainly require effective verification.

On disarmament issues, the five nuclear-weapon States reaffirmed the position that they had taken in recent declarations. In April 1995, France, Russia, the UK, and the US had issued a joint statement which welcomed the fact that the arms race had ceased, underlined the importance of the security assurances that were approved by the Security Council, and reaffirmed their commitment, as stated in Article VI, "to pursue negotiations in good faith on effective measures relating to nuclear disarmament, which remains [their] ultimate goal." The fifth nuclear-weapon State, China, had issued a separate declaration, reiterating its position on non-first use of nuclear weapons and its support for legally binding security assurances for non-nuclear-weapon States. It also called for the complete prohibition and total destruction of nuclear weapons. But it did not address many of the specific issues raised by the non-nuclear-weapon States.

Countries of the Non-Aligned Movement contended that the arms race could not be assumed to have ended, as long as new warheads were being made, fissionable material was being produced for weapons, and nuclear tests were allowed. While the recent nuclear reductions by Russia and the United States were welcomed, the NAM countries called for further commitments to deeper cuts by them and by China, France, and the UK at this stage. They further regarded the reference to nuclear disarmament as an "ultimate goal" and its placement in the context of "general and complete disarmament" as language presenting disarmament as a virtually unreachable goal. They also argued that the Conference should agree on a programme of action for concrete steps towards the total elimination of nuclear weapons in the foreseeable future.

Committee report. The polarized debate led to deadlock and a massive heavily bracketed report reflecting all the differences. The report could therefore not provide a basis for the segment of the draft Final Declaration addressing non-proliferation and disarmament issues. In the last week of the Conference, parallel with the effort of the Conference President, the Chairman of the Drafting Committee, Tadeusz Strulak of Poland, drafted a new paper reflecting a middle course on the divisive issues. But no consensus could be reached on the last day of the Conference, even with the active support of the Conference President and the backdrop of the adoption of the final package of decisions.

In a broad sense, however, it can be concluded that the absence of agreement was partly filled by the relevant elements of the decision on Principles and Objectives. Of particular significance were the paragraphs on CTBT, the cut-off agreement, and security assurances, all of which went beyond the points of the April joint statement of the four nuclear-weapon States.

Main Committee II: Non-Proliferation, safeguards, and nuclear-weapon-free zones

Largely because fundamental differences in Main Committee I precluded agreement on a Final Declaration, the report of Main Committee II was issued as a document of the Conference. It will, one assumes, be a point of reference for future work under the enhanced review mechanism. The main point, however, from the IAEA perspective is that some of the key elements (and indeed the language) of the Main Committee II report are incorporated in the adopted Principles and Objectives. *(See box, page 33.)*

To facilitate its work, the Committee had before it 15 Background Documents, including three prepared by the IAEA relevant to Article III, Article IV, and Article V, and 18 separate working papers submitted by individual or groups of delegations on topics relevant to the Committee's deliberations.

Safeguards. What, from the IAEA perspective, could reasonably have been expected from the Conference, and what was achieved?

At previous NPT Review Conferences, Parties had expressed or reaffirmed the conviction that Agency safeguards play a key role in preventing proliferation. They *inter alia* had reaffirmed their determination to strengthen barriers against nuclear weapons proliferation and had urged the IAEA to take full advantage of its rights under safeguards agreements. Previous Conferences had also welcomed the significant contributions made by NPT Parties in facilitating safeguards application and had recognized the crucial importance of continuing political, technical, and financial support for IAEA safeguards.

The detailed IAEA Background Document submitted to the Conference on safeguards highlighted the measures which had been taken in response to such decisions and conclusions. It did so against the background of new and ever-increasing demands upon the Agency's safeguards system; the financial constraints and critically important developments relevant to safeguards since 1990, notably the discovery of Iraq's clandestine nuclear programme; the end of the Cold War and all its implications; and the needs emerging as a result of advances in areas of nuclear disarmament.

It was significant that the 1995 Conference reaffirmed support for IAEA verification and ongoing efforts to strengthen safeguards, which the IAEA applies on behalf of the international community, and that it decided, in the broad interests of the non-proliferation regime, on the long-term future of the Treaty. This is because the duration of safeguards agreements between the IAEA and NPT Parties are linked to the Treaty itself.

The safeguards-related elements of the adopted Principles and Objectives can be expected to have significant implications for the further evolution of the verification system, both in terms of its scope of application and effectiveness. Although the safeguards system has proved effective with regard to *declared* nuclear activities, the case of Iraq made clear that the system was not effectively equipped to detect any *undeclared* activities, primarily because of a shortage of information about any such activities. This realization was fundamental to the first and subsequent steps that the IAEA Board of Governors has approved and which are aimed at correcting such shortcomings. Strengthening measures in place had already proved effective, for example in connection with IAEA verification activities related to assessing the completeness and correctness of the DPRK's declaration of its nuclear material subject to safeguards.

In the broad interests of the non-proliferation regime, it was very important for the Agency that the NPT Conference supported and endorsed what it was seeking to achieve in strengthening safeguards. The IAEA gave a presentation at the Conference on "Programme 93+2", its overall safeguards development programme, that was well received. During the General Debate and throughout the Committee's discussions, many positive statements were made about the IAEA's efforts, and the continuing need to support them, notwithstanding some divergences of views on some of the programme's specific ideas and proposals.

In terms of the practical support which might be expected to assist safeguards implementation, the 1995 Conference *inter alia* acknowledged that under comprehensive safeguards agreements, NPT Parties and the IAEA have an obligation to co-operate fully to ensure effective safeguards in all circumstances. In this respect it is to be hoped that — over and above the characteristic calls upon Parties at NPT Conferences to ensure adequate technical and financial support for safeguards — States will also agree to implement other measures of practical value for the efficient discharge of the IAEA's functions. These include such measures as agreeing to simplify designation procedures for Agency inspectors and agreeing to waive visa requirements or to grant multiple-entry visas to Agency inspectors. This is particularly important, given that short notice or no notice inspections are among key elements of safeguards strengthening proposals under "Programme 93+2". Clearly, such inspections cannot be carried out if restrictive visa requirements prevail.

Nuclear-Weapon-Free-Zones (NWFZs). Article VII of the NPT reflects the significance of regional non-proliferation arrangements as valuable complements to global ones. NWFZs established by virtue of the Tlatelolco and Rarotonga Treaties provide for verification arrangements closely linked with safeguards implementation pursuant to the NPT. Additionally, a draft Treaty on an African NWFZ also assigns to the IAEA the responsibility for verifying compliance. In the Middle East, although the creation of an NWFZ is likely to come about only in the context of an overall peace settlement, there is agreement in principle among Middle East States as to the potential value of such a zone in their region.

The importance attributed to NWFZs by NPT Parties was reflected in three specific paragraphs of the Principles and Objectives. In discussions on this issue, there was a broad agreement about the value of and growing interest in NWFZs. There were differences of view, however, as to the appropriate language for referring to NWFZs in specific areas. Some differences were accommodated through a spirit of compromise. Thus, ultimately, bracketed language was retained in the relevant paragraphs of the Main Committee II report only with regard to a future NWFZ in the Middle East (because of very predictable differences of perception centering on Israel's accession to the Treaty and the significance of the Middle East peace process) and on an NWFZ in Central Europe (supported by Belarus but contested by others, essentially on the grounds of what constituted "Central Europe").

That said, it is significant that the Conference was firm in its conviction, expressed formally through the Principles and Objectives, that the development of NWFZs, especially in regions of tension, should be encouraged as a matter of priority, taking into account the specific characteristics of each region. Of relevance as well is the resolution on the Middle East which was adopted on 11 May 1995. It calls upon all States in the Middle East to take practical steps towards the establishment of an effectively verifiable Middle East zone free of nuclear and all other weapons of mass destruction and their delivery systems.

Other related issues. Other issues relevant to safeguards were addressed in Main Committee II. Thus, paragraphs in the Committee's report address, *inter alia*, a need for greater transparency on the management of plutonium and highly enriched uranium for civil purposes; the paramount importance of effective physical protection of nuclear material, especially such material useable for military purposes; the need for strengthened international co-operation and physical protection in preventing illicit trafficking in nuclear material, (including in this respect the work already being conducted under IAEA auspices); and the non-proliferation benefits of converting civilian research reactors from high enriched uranium to low enriched uranium fuel.

Main Committee III: Peaceful uses of nuclear energy

The "peaceful uses" Committee benefitted from a constructive and non-confrontational atmosphere from the outset. The only matter which eluded consensus was a text that expressed regret concerning restrictions on free and unimpeded access to peaceful nuclear technology which was sent to the Drafting Committee. The delegation of Iran insisted on the retention of the text within brackets, but intimated that it might be withdrawn in the light of final versions of other bracketed text being looked at by the Drafting Committee. Since the Drafting Committee was unable to put together a consensus text, this short paragraph remained in brackets.

At the Conference, as it did with respect to its safeguards work, the IAEA gave a presentation on its technical cooperation and related activities. The deliberations of Main Committee III were supportive of IAEA efforts. Technical cooperation and nuclear safety activities were specifically mentioned in the adopted Principles and Objectives as areas where efforts should be made to ensure that the IAEA has the financial and human resources necessary to meet its responsibilities. The Committee reviewed with approval the new directions of IAEA's technical cooperation programme. It also discussed issues that have been attracting international attention in the "sustainable development" debate: nuclear safety and in particular the 1994 Nuclear Safety Convention; the transport of nuclear materials by sea; radioactive waste management, in particular endorsing preparatory work towards an international convention on the safety of radioactive waste management; liability for nuclear damage; and conversion of nuclear materials to peaceful uses.

While consensus was reached on all the above issues, some were more difficult to resolve than others:

Fuel cycle choices. A few States which have made policy decisions not to develop nuclear power for the production of electricity were wary of strong endorsements of the technology. Some others resented what they considered interference with their national decision-making authority in the peaceful nuclear field. Still others pointed out that the NPT does not oblige a State to actively support the fuel cycle choices of another State Party. To cover these concerns, the Conference confirmed "that each country's choices and decisions in [this] field .. should be respected without jeopardizing its policies or international cooperation agreements and arrangements ... and its fuel-cycle policies"

Nuclear safety. The importance of ensuring a high level of nuclear safety through rigorous national measures, international instruments, and international cooperation was recognized by all. The nuclear safety services provided by IAEA were fully endorsed and the 1994 Convention on Nuclear Safety was welcomed. States were urged to utilize its principles pending its entry into force. Steps to define the peer review process for the Convention were supported. Some States wished to welcome a voluntary extension of the Convention, or at least its safety objectives, to other civil nuclear activities. Consensus was reached on a recommendation to consider the possibility of further conventions that might strengthen safety in nuclear activities other than civil nuclear power plants.

Safety of marine transport of nuclear material. The group of small island developing States, supported by Australia, New Zealand, and several non-governmental organizations (NGOs), expressed particular concern about the safety of marine transport of nuclear material. A rather lengthy text was eventually worked out recognizing the International Maritime Organization (IMO) Code for the Safe Carriage of Irradiated Nuclear Fuel, Plutonium and High-level Nuclear Wastes in Flasks on Board Ships, and stressing the importance of ongoing work within IAEA to complement the Code. The same group also introduced language noting that effective liability mechanisms are essential to provide compensation for nuclear-related damage that may occur during sea transport.

Nuclear waste. The Conference recognized the need to prohibit dumping of radioactive waste and noted the 1994 amendment of the London Convention, 1972, by which sea dumping of all types of radioactive waste is prohibited. The Conference noted the particular importance of ensuring that possible effects on human health and the environment beyond national borders are taken into account in the management of all kinds of radioactive waste, civilian as well as military.

Conversion of nuclear materials to peaceful uses. The Conference recognized the problems of safety and contamination related to the discontinuation of nuclear operations formerly associated with nuclear-weapon programmes. It called for international assistance for remedial measures, safe resettlement of displaced populations, and restoration of economic productivity to affected areas, where appropriate. Further, the Conference acknowledged the existence of a special responsibility towards those people of former United Nations Trust Territories who have been adversely affected as a result of nuclear weapons tests.

Liability. Recognizing the need for completion of ongoing work in the field of nuclear liability within the IAEA and the Nuclear Energy Agency of the Organization for Economic Cooperation and Development, the Conference took note of the proposal to hold a diplomatic conference in the first quarter of 1996. The conference is to be convened to revise the Vienna Convention on Civil Liability for Nuclear Damage and provide an effective supplementary funding regime.

Technical cooperation. Differences among States on technical cooperation were mainly of emphasis rather than of substance. All commended the work of IAEA and agreed that the IAEA technical cooperation programme, in particular its new directions, should be fully supported. There was general concern about declining pledges and payments to the Technical Cooperation Fund. The developing countries stressed the need for more adequate and predictable funds and called for a "new financing method" to that end; they also wanted a more active role by IAEA in assisting developing countries in the development of nuclear power. Several supported the creation of the standing advisory group on technical assistance and cooperation and this was reflected in the final text. In view of the fact that many NPT Parties are not IAEA Member States, the Agency was encouraged to give special attention to the needs of least-developed countries and to look into ways it could extend technical assistance to non-members.

As regards bilateral cooperation, the Conference regretted that some non-parties had been able to benefit from cooperation with NPT Parties that may have contributed to non-peaceful programmes and welcomed subsequent steps to rectify the situation. As in the past, preferential treatment to Parties to the Treaty was urged.

Access to peaceful nuclear technology. Several supplier States pointed out that the main obstacles to transfers related to nuclear power were the lack of interest (because of availability of other energy sources), infrastructure or financing, rather than restrictions on technology transfer. There was general agreement that non-proliferation measures should not be a pretext for restricted access as long as the recipient was Party to the NPT and accepted comprehensive IAEA safeguards. A number of countries, led by Iran and Malaysia, called for transparency and non-discrimination in export controls and an NPT forum for discussing nuclear technology transfers that was open to recipients as well as suppliers. The text finally agreed in Main Committee III called for all States to observe the legitimate rights of all NPT Parties to have full access to nuclear technology for peaceful purposes. Transfers made in conformity with Articles I, II, and III of the Treaty were to be encouraged and "undue constraints" eliminated.

This issue would have been more divisive had it not been for the emerging consensus on an "enhanced" review process, which provides an opportunity for assessing progress in implementing the adopted Principles and Objectives.

The non-issues. Compared to heated debate in past Review Conferences, two issues were resolved with fewer words and more solidarity than might have been expected: prohibition of armed attacks against peaceful nuclear facilities, and Article V of the Treaty which deals with peaceful nuclear explosions. Armed attacks were dealt with succinctly as jeopardizing nuclear safety and raising concerns of international law on the use of force.

Regarding peaceful nuclear explosions, the Conference recorded that their potential benefits have neither materialized nor been demonstrated and on the contrary, serious concerns have been expressed about their environmental consequences. This was an important message which the quasi-totality of NPT Parties wished to pass on to the Conference on Disarmament (CD) in the context of ongoing negotiations on a Comprehensive Test Ban Treaty. China alone resisted the reference to the CD, saying that it went beyond the review of the Treaty, but accepted the rest of the text. Eventually the message passed, albeit somewhat diluted with possible "future developments" which should also be taken into account.

Universality of NPT membership. In the last area of its work, the Review of Article IX on universal membership of the NPT, Main Committee III agreed to a text that eventually was a key to the adoption of the final package, as it addressed the issue of non-parties in a way that was found acceptable by all. This issue was of particular concern to Middle East Parties.

The Australian delegation provided the original draft which became the basis for consensus on the following paragraph: "The Conference particularly urges those non-parties to the Treaty which operate unsafeguarded sensitive nuclear facilities — India, Israel and Pakistan — to take such action [accede to NPT], and affirms the important contribution this would make to regional and global security."

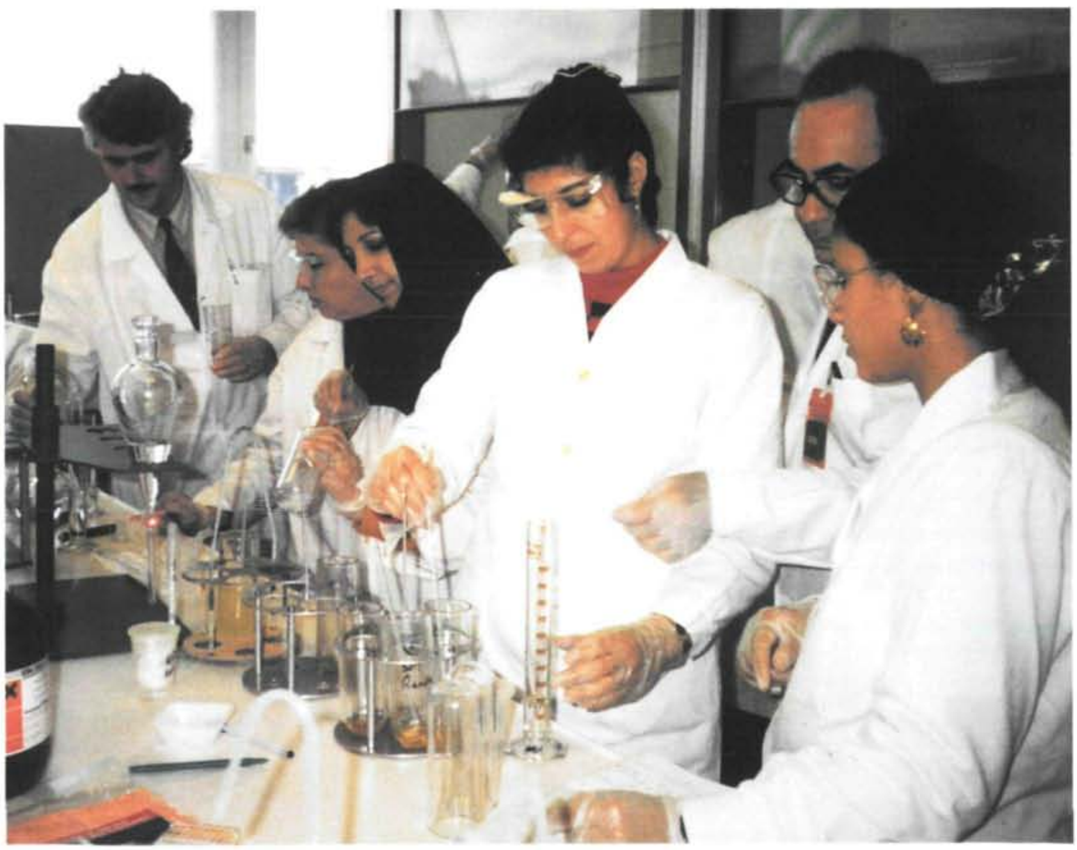
If the measure of a Treaty's success is in its membership, the NPT regime is much stronger today than at its last Review in 1990. In 1990 there were 139 Parties, 84 of which participated in the Review Conference. France and China had not yet joined. By early 1995 there were 178 Parties, 175 of which participated in the NPT Conference. The accession of States such as South Africa and Argentina, as well as the former Soviet Republics, and the positive role played by them in their "first" Review Conference, created an atmosphere that was quite different from previous Conferences. The NPT Club had gone global. Just days after the Conference ended, Chile announced its accession to the Treaty.

The road ahead

Despite lack of agreement at the NPT Conference on a Final Declaration, the overall consensus is reflected in the package of decisions that was adopted. It significantly incorporates strong support for IAEA roles, programmes, and plans. The Conference notably commended Agency efforts in areas of safeguards and the transfer of technology for peaceful applications of nuclear energy, particularly with respect to technical cooperation and nuclear safety, and it called for renewed efforts to ensure that the IAEA is equipped with adequate financial and human resources to meet effectively its responsibilities.

At a time when the international community is facing new demands and challenges in areas of nuclear verification and social and economic development, there is greater need than ever for strengthening the institutions engaged in these efforts. In many respects, a window of opportunity exists for reinforcing the IAEA's roles and capabilities within the evolving global framework, something which was grasped clearly if judged from deliberations at the 1995 NPT Conference. However, as IAEA Director General Hans Blix has made clear, what will be achieved depends essentially on whether States are now prepared to match words with actions by granting the Agency the necessary political, technical, and financial support.

Which way the international community moves on the road ahead remains to be seen. ❒



Peaceful nuclear technologies are being applied worldwide.

INIS at 25: Pioneer of the nuclear information highway

Marking its silver anniversary of service, the IAEA's International Nuclear Information System is carving out some new directions

by Joyce Amenta and Alexander Sorokin

From the beginning, the collection and dissemination of information has been an important part of the IAEA's mandate. Indeed, the Agency is required by its Statute ".... to encourage the exchange among its members of information relating to the nature and peaceful uses of atomic energy and ... serve as an intermediary among its members for this purpose".

The birth of such a globally oriented nuclear information system, however, was some years in the making.

The first documented proposal on an international nuclear information system was made in 1966 by Dr. L.L. Isaev of the Soviet Union and Dr. R.K. Wakerling of the United States. Two years later, in 1968, a detailed systems study was carried out by a team consisting of experts from these two countries, plus the United Kingdom, Federal Republic of Germany, European Atomic Energy Community (Euratom), and the IAEA. The team's report, which was the culmination of an intensive 2-year period of work of many consultants, formed the basis of a proposal submitted to the IAEA Board of Governors. At its meeting on 26 February 1969, the IAEA Board decided to ".... approve the setting up of INIS on an operational basis as early as possible in 1970, and authorize the Director General to request the participation of Member States therein ....". Upon the proposal of the Governor from India, Mr. Trivedi, the Board also decided that "In developing INIS, the Agency would as far as possible take note of the needs of developing countries".

Within that framework, the world's first truly international computerized system was born with its mission "to produce and disseminate both a database containing records of the world's nuclear literature and full text of non-conventional literature on microfiche". INIS operations officially began in March 1970.

An information cooperative

INIS is a co-operative system between the Agency and its Member States including some international organizations. A distinguishing feature is the decentralized operational philosophy. Each Member State participating in INIS scans the scientific literature published within its national boundaries, identifies items that fall within the subject scope of the system, prepares standardized descriptions of these, and sends the descriptions, in many cases together with a copy of the original piece of literature, to the Agency. At IAEA headquarters, the incoming information is checked and merged into a single file so as to create a comprehensive bibliographic database. A copy of the full text of non-conventional literature (e.g., research reports and conference papers) is microfiched and stored in a central collection. Copies of the database and microfiche are delivered to the Member States for their use in providing information services to end-users.

Each Member State is represented in INIS by a Liaison Officer officially appointed by the appropriate national authority. Jointly with the IAEA Secretariat, the Liaison Officers are responsible for the day-to-day management and smooth running of the system. Each year they come together at a three- to four-day consultative meeting convened by the IAEA to review the progress achieved by INIS during the previous 12 months and make recommendations for its future development.

Far-reaching benefits. The decentralized approach to input preparation and output dissemination yields valuable benefits. It results in comprehensive coverage of nuclear literature, ef-

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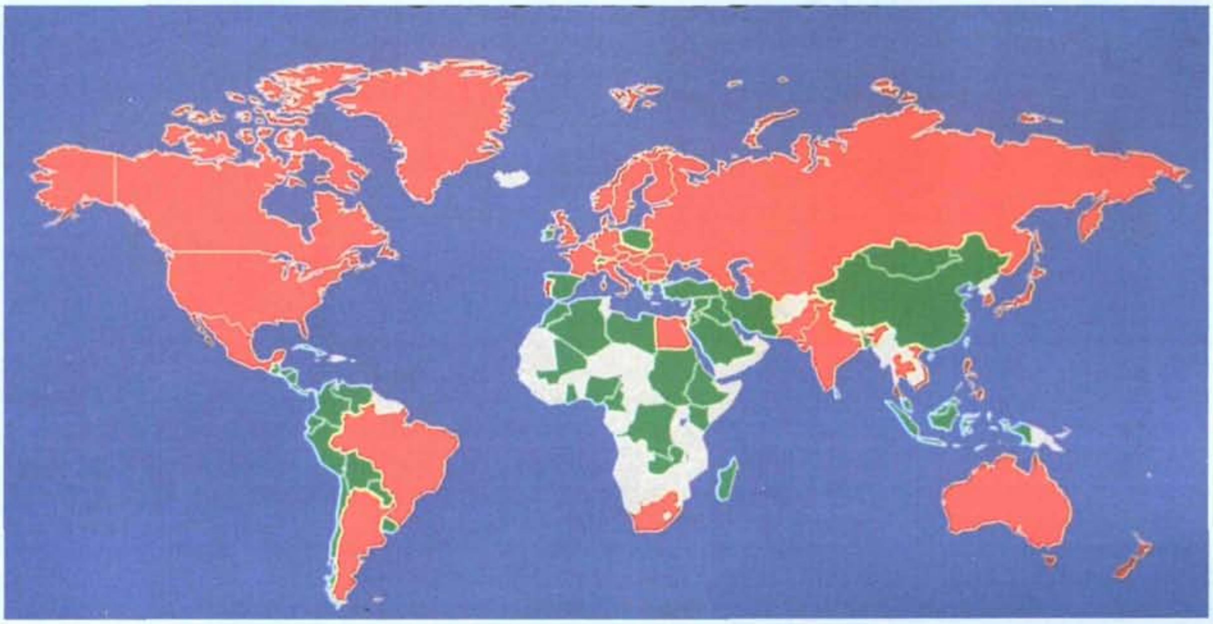
INIS Participating Member States



States joining 1969-70

States joining after 1970

fective handling of information in different languages, and highly satisfactory services for users of the information in each participating country.

Spectacular growth has taken place in participation by Agency Member States. In 1970, at the commencement of the system, 38 countries indicated their willingness to participate. By the beginning of 1995, the number of countries had grown to 90. *(See map.)*

INIS on line in Germany. *(Credit: Fachinformationszentrum Karlsruhe)*

In April 1970, the initial output product of the new International Nuclear Information System was distributed. In the first 2 or 3 years the amount of information collected and redistributed was relatively small. Gradually, however, the system's organization took shape on an international basis and by 1973 the number of items processed per year amounted to 56,700, about twice as many as the combined total of processed items from the previous 3 years. From 1974 on, INIS had achieved a steady operation, processing annually 60,000 to 70,000 documents. By 1976, INIS was considered the world's comprehensive abstracting and indexing service in the field of atomic energy. The total amount of information that has been collected in the 25 years that INIS has been operating now consists of over 1.8 million items, with an annual increase of 80-85,000 documents.

The usefulness of the system to end users — in particular decision makers, scientists and engineers — lies in access to information related to in all the areas of interest and activities of the IAEA covered by the subject scope of the INIS database. The subjects include nuclear power, nuclear safety, radiation protection, safeguards, nuclear applications, and related topics.

Choice of products

INIS provides useful products to Member States at different stages of development. The policy of "benefits for all" is met by producing a carefully balanced range of products and services. INIS information is available in different forms and the user may select the most appropriate forms for his facilities and users. INIS output products and services currently consist of:

- *INIS Atomindex*, a printed journal with full bibliographic references and abstracts for all literature reported to the system. There are 24 issues per year.
- Magnetic tape, the machine-readable equivalent of *Atomindex*. It is distributed upon request either 12 or 24 times a year.
- CD-ROM. The set consists of five archival disks covering 1976 through 1994 and one current disk which is updated four times per year.
- Document delivery services. Full text of non-conventional literature reported to the system, distributed on microfiche 24 times a year.
- On-line services. The INIS database is available on-line from the Agency's computer in Vienna as well as from hosts in Member States to users anywhere who have the appropriate technical capability.

High levels of demand. The most powerful criteria that can be used in the assessment of any information service is customer satisfaction. The usage of information products and services is one of these indicators.

Four hundred sets of printed *INIS Atomindex* are distributed annually to national libraries, research institutes, and universities in more than 100 countries. About 95,000 copies of microfiche containing full text of non-conventional literature are distributed annually to information centres, libraries, and individuals in 54 countries. Twenty-one countries receive *Atomindex* on magnetic tape which is used by information centres to disseminate INIS information internally. About 70,000 searches of the INIS database were performed in 1994 by those who have a network connection. Additionally, 173 sets of the INIS database on CD-ROM are currently distributed annually to collective and individual users in 85 countries. (A large number of searches are made on CD-ROM disks.) These statistics would seem to confirm the high usage of INIS output products.

Transferring expertise and systems

One major advantage of a decentralized system is that it tends to stimulate the improvement of the national information infrastructure as well as promote the transfer of modern information technology.

In order to assist Member States in building up their information processing capabilities, INIS has established a regular training programme of seminars usually held every second year, a fellowship training scheme, and advisory services to national centres.

Over the years, INIS expertise has provided and facilitated information technology transfer; the development of information skills, and the adoption and use of standards for maximizing information exchange. Information technology transfer is achieved, for example, by both INIS training and IAEA technical co-operation projects. These activities assure the establishment or upgrading of INIS National Information Centres, and provide necessary information technologies. They also facilitate formal and on-the-job information skills development. To date, INIS has conducted 48 training events with 1500 trainees.

Through an early regional technical cooperation project, the INIS network was strengthened. The project resulted in information centres being established or improved in 14 countries in Latin America, in the training of more than 50 staff, and the introduction of new information technologies. As a result, these countries can now function collectively and the exchange of information has strengthened ties within the region. Currently, there are three active regional technical co-operation projects in Asia and the Pacific, Europe, and West Asia. In addition to regional projects, INIS has been involved with 16 national technical cooperation projects, four of which are currently still active (Belarus, Lebanon, Mongolia, and Sri Lanka).

The benefits of such projects are the improved transfer of scientific and technical nuclear information to the recipient countries, strengthened capabilities of national information centres, and expansion of the INIS network as an "information co-operative". Each participating Member State, in providing information to INIS, gets a "return on its investment" and has access to a larger nuclear information database to which all Members contribute.

The basic organizational principles of INIS are still valid after 25 years. INIS has been used as a model for other United Nations information systems, notably for agricultural sciences and technology (AGRIS) established by FAO. From its inception, AGRIS adopted the basic principles, standards, and procedures from INIS, even to the extent of utilizing the same computer software.

INIS technical standards and rules for processing literature have also been adopted by two other international information systems. They

International Nuclear Information System: New directions and partnerships

INIS set itself the goal 25 years ago to employ the most up-to-date information technologies in providing nuclear information services to Member States. The range of output products enabled members to provide information services to their users according to their capabilities.

Over the years, INIS has adapted both its methodologies for information processing and the services that its products can provide. The current "information revolution", however, calls for a re-evaluation of methodologies for effectively providing nuclear information to users. This applies both to "what" information is provided and "how" it is provided. For example, what is currently referred to as the "information highway" provides worldwide telecommunication networks linking computers everywhere and enables searches of databases to be made from any location no matter where the databases themselves are stored. Once relevant references have been identified, the full text of the document can then be transmitted to the user.

Strategic planning. In the light of these developments, the IAEA and its INIS participating States have launched a plan for strategic development of the system to be enacted during the period 1995-2000 and beyond. Strategic developments that take advantage of the information revolution may change some of the basic tenets upon which the system was based.

The exchange of information has in the past been based on the development of a large bibliographic database containing references to the world's literature on the peaceful applications of nuclear science and technology provided by the national INIS centres. In addition, the full text of non-conventional literature (NCL) has been available on microform from the IAEA in Vienna. The new approach would continue the development of a bibliographic database of references supplied by the national INIS centres, but it would include additional bibliographic references through arrangements with other database producers. Further sources of information would be accessed directly through networks to hosts located anywhere in the world. Developments in optical storage technologies open new possibilities for distribution of NCL. The full text of NCL can be scanned onto optical disk and distributed widely at low cost.

To proceed with the implementation of strategic developments as outlined above, the participating INIS Member States and the IAEA have adopted an Action Plan. It foresees the establishment of partnerships with publishers of primary and secondary information. The publishers of primary information can provide bibliographic records of their publications in electronic form for direct incorporation into the INIS database and possibly provide access to the full text of their publications in electronic form. The publishers of secondary information — essentially the producers of bibliographic databases — could provide bibliographic records from their databases to the INIS database eliminating duplication in the processing of the literature by the IAEA or one of its Member States. These partnerships would necessarily need to be "two-way streets". While the publishers of primary information may see their benefit in the announcement of their publications in the INIS database, the publishers of secondary information would see a quid pro quo in being able to draw references from INIS to be included in their databases. Further action would be the establishment of partnerships with database hosts. Three-party agreements between INIS, individual database producers, and database hosts would enable users to gain access to information available in other databases offered by the hosts and to do so through INIS.

The printed version of the INIS database has been available as an abstracting journal, *INIS Atomindex*, as a parallel product to the electronic database. It has been enjoying a decreasing popularity. A forthcoming action will be to discontinue the printed product and to make the database more widely available on CD-ROM at a substantially reduced price. A system is being developed to enable digitalization and optical storage of full text documents onto CD-ROM from hard copies sent to Vienna by the INIS centres. The system will also accept digitized documents from remote locations so that Member States having the technical capability can scan documents at their own sites and transfer these electronically to Vienna. There will be no need for those centres to ship hard copies to Vienna. Actions on implementation of this optical storage system will, however, include the continued availability of NCL in microform for a certain period of time for services to those Member States not yet capable of fully utilizing documents in electronic form.

Users in the nuclear community also require information of a factual or numerical nature, information that is found in catalogues and directories, press releases, calendars of meetings or information on persons having specific expertise, etc. Such information exists at the IAEA and in Member States. As part of the Action Plan, INIS will provide access to this type of non-bibliographic information available either in Vienna or at locations in the Member States.

Impact on INIS centres. Implementation of the Action Plan will affect operations at the national INIS centres. As a result of partnerships established with publishers and database producers for the provision of records to INIS, national centres may not need to process certain portions of their national nuclear literature, thus reducing their costs for input preparation. To ensure that all the relevant literature is covered for the database, further co-ordination will need to be established. On the other hand, INIS centres and their users will benefit from access to nuclear-related information available from other sources. With regard to document delivery, the availability of NCL in electronic form will speed its distribution, utility, and timeliness.

The strategic developments for INIS inherent in the Action Plan for the years 1995-2000 and beyond accentuate timely changes to current operations and will serve the users of nuclear information well into the 21st century.— ***Mr. Claudio Todeschini, INIS Section, Division of Scientific and Technical Information.***

are the Energy Technology Data Exchange system established in 1987 by countries of the Organization for Economic Cooperation and Development; and a document delivery system set up 15 years ago by the European Association for Grey Literature Exploitation which covers grey literature produced in European countries.

Indeed, through its adoption and development of international information processing standards, INIS has contributed significantly towards improved compatibility and interconnection between information systems.

Systems such as INIS, which capitalize on information technology transfer, information skills development, and the use of standards for information management and exchange have literally "paved the way" for the global information highway envisioned today.

Future developments

The agenda for the further development of INIS reflects the changes that have occurred in the information industry and in the nuclear community. The information technology environment has changed, technology for electronic data exchange has been developing at a very rapid pace, the economics of information services at the national centres have changed, and the needs for nuclear information are also different from those that existed 25 years ago when INIS was established.

The main technological developments lie in telecommunication networks, digitization of information, and miniaturization of electronic equipment.

Networking, epitomized by the emergence of the Internet, has established the information highways along which flow data, information, and computing power so that access to these commodities spans time and space.

The digitization of all types of information (text, images, sound and video) provides new opportunities for information delivery. A growing portion of the total information productivity will consist of information in electronic form, especially full-text databases and images.

Miniaturization of equipment allows the information user to be more mobile and places large amounts of information at the user's fingertips.

There is considerable confidence in the technological feasibility of new products and services but whether they are economically feasible should be studied. The production and costs have to be acceptable and should be compared with the costs of existing media and the added value of the new technologies.

A careful evaluation of the environment, background needs and training of intended information users is crucial. Information which is distributed by electronic means is not yet equally accessible to all countries. The outcome of these considerations should make it possible to provide information which meets the needs of users more adequately.

New missions. Besides the issues related to changing user needs and rapidly developing technology, there are some issues related to international co-operation and economics of information activity. The major one is "database building versus access to existing sources". For a considerable number of countries, the INIS database is the single and only source of readily accessible electronic information. In others, mainly the industrialized countries, nuclear and nuclear related information can be obtained from other databases. This issue was addressed by the Advisory Committee for INIS at its meeting in December 1994. The discussion resulted in a proposed new Mission Statement for INIS and recommendations on the development for the next 5-year period.

The new mission for INIS stresses not only the continued building of the database, but the need for INIS to provide access to mission-related information not encompassed by its own database but available elsewhere. The technology to provide such access already exists. The institutional arrangements need to be established.

As its founders envisaged a quarter century ago, the development of the International Nuclear Information System must go hand-in-hand with evolving technology and the changing information needs of the IAEA's Member States. ❐

The INIS databank contains about 1.8 million items of information. *(Credit: CERN)*

The IAEA on line: Closer links for the global nuclear community

***iaeo@iaea1.iaea.or.at** and **http://www.iaea.or.at/worldatom** are two signs of the IAEA's expanding electronic information services*

by
Jerry Barton and Lothar Wedekind

A phenomenon without precedent, the worldwide computer network called Internet has gone from a little-known academic and research network to become the talk of cyberspace. Turn to any issue of any popular weekly journal. You will find an article about international computer communications and computers you can reach via the Internet. Vinton G. Cerf, president of the Internet Society, believes that a fertile mixture of high-risk ideas, stable research funding, visionary leadership, extraordinary grass-roots cooperation, and vigorous entrepreneurship has led to an emerging global information infrastructure unlike anything seen before.

Expectations run high, and opportunities are exciting. Yet as organizations are learning, reading about the Internet is easier than using it in a concerted, reliable, and professional way.

The IAEA started developing its Internet capabilities in 1993. (IAEA's Internet address: iaeo@iaea1.iaea.or.at) Further development is designed to improve capabilities for meeting internal information needs, and to expand access to the Agency's extensive range of databanks and information systems within its Member States.

Internet's origins. All electronic communications between computers rely on precisely defined structures of signals, called protocols , that define the contents of the message, where it came from, and where it is going. In the early 1970s, a protocol was developed at Stanford University in the United States that allows multiple networks to be interconnected in a flexible and dynamic way. This protocol, called TCP/IP, together with the USA's research network, was the basis for the Internet. A decision in the early 1980s supported the creation of regional networks that would aggregate traffic and feed it to the backbone networks. Thus the ability to support global connections through local networks was born.

Over the past 12 years, the number of host computers on the Internet has increased from 200 to 2.5 million, an annual growth rate of 120%. Nearly 8 million people can use complete Internet services, and more than 27 million people can use it to exchange electronic mail.

Internet services range from relatively simple to highly sophisticated. The Agency uses a commercial electronic mail package for its in-house electronic mail. With the addition of a gateway computer linking this mail network to the Internet, IAEA staff can send and receive mail from any worldwide location via the Internet. They do not need to learn much more than how to code the receiver's electronic mail address. The Internet serves as the interchange medium so that messages originating in different systems can be understood. The next stage of Internet services is the direct connection to a remote computer. This connection can take two forms: either the ability to locate and copy files from the remote computer to your computer, or the ability to log on to the remote computer as a local terminal.

The Agency added these services in early 1994. Called FTP and TELNET respectively, they require special skills and software on each user's desktop computer. About 400 people in the Agency have these services. The IAEA also established an FTP computer for public access in early 1994, so that people worldwide could download publicly available Agency files. In some cases, organizations are allowed to deposit data onto the Agency's FTP computer for retrieval by IAEA staff. The highest levels of Internet services are the so-called "special servers" , namely Gopher and the World Wide Web, or WWW. These services, developed by the University of Minnesota in the United States and the European Centre for Particle Research (CERN) in Geneva respectively, add descriptive information to the files that are available, making

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their access easier for the user. Gopher is a text-based interface that does not require sophisticated computers. The WWW is a full multi-media graphical interface that includes the ability to jump between documents automatically by clicking on highlighted words, i.e. hypertext links. The WWW requires more communications bandwidth and more powerful desktop computers, but it is already the most heavily used Internet service. It is simple to use and the documents you find are displayed immediately on your screen and can be either copied or printed directly.

The IAEA and Information Technology: Tools for Efficiency

Information technology (IT) — the use of computers and networks to electronically collect, manipulate, and disseminate data in organized ways — is a common thread of IAEA programmes. About 10% of the IAEA's budget is earmarked for IT activities. Some activities deliver databases directly to Member States, while many others are directed towards increasing organizational efficiency. The Agency's IT capabilities have progressed significantly over the years.

1970s and 1980s: Process Automation. Most early uses of IT were to automate manual support processes, such as payroll, bookkeeping, and project tracking. These activities were characterized by well-defined procedures and reporting needs. The IAEA's Central Computer Services (CCS) operated two mainframe computers through a central group of computer professionals. One computer was used exclusively by the Department of Safeguards to ensure the confidentiality of inspection and verification data. By the mid-1980s, there were more than 100 computer systems on the two mainframe computers.

1980s: Text Processing and Personal Computers. By the 1980s, Agency staff needed more flexibility in the way data, text, and graphics were processed and used, and in responding promptly to inquiries. The Agency approved the use of personal computers (PCs) in 1984 to provide this flexibility and speed. Today about 2000 PCs are in use throughout the Agency. Purchases and applications are governed by standards and procedures to ensure cost effectiveness and compatibility with the Agency's computer network.

1990s: Move to Decentralize. By 1989, it had become obvious that mainframe computers, with central development and support, could not provide sufficient flexibility and local decision-making power. The needs of programme managers were changing too rapidly for traditional computer systems. The IAEA decided in 1989 to decentralize IT operations, giving responsibility for computing to each department, whose divisions now have IT Coordinators and, frequently, their own programming staff. The CCS was given the responsibility of overall support, providing a technical infrastructure for common networking, training, problem resolution, and guidance for technical development.

In 1991, the IAEA Board authorized US $5.5 million in a special allocation to help move IT activities towards the decentralized goal. An Agency-wide plan for networking was developed and implemented between 1991 and 1994. The central computer network today provides a highway along which each department can develop its services tailored to programmatic needs.

1990s: Support and Services. Working with IT Coordinators, the CCS today provides support for a broad portfolio of desktop productivity products. The support includes providing about 1000 hours of software training monthly to Agency staff; answering technical questions through a central help line; and evaluating technologies, new applications, and systems. Electronic mail and Internet services further are provided to the entire Agency. More than 250,000 messages are exchanged monthly via the in-house electronic mail service and about 30,000 messages are received from outside the IAEA via the Agency's connection to the Internet.

1995 and Beyond: Information Management. As computer systems move to local networks, the need for maintaining a coherent Agency-wide understanding and treatment of the data increases. Data must be shared where appropriate to avoid needless duplication and promote efficient operations. The Agency consequently is looking more closely at the need for managing information through technology, rather than just managing the technology.

Greater transfer of information will require an improved technical infrastructure. The network and database computers consequently will be upgraded in 1996. Applications also must be revised frequently to meet new programmatic requirements, requiring evaluation and selection of appropriate tools and expertise. Moreover, staff must be properly trained to apply new technologies for greater productivity at the workplace.

The IAEA has been recognized as one of the leading organizations in the UN family in terms of its use of technology to implement its programmes. Its strategy for the turn of the century bridges the established in-house IT partnerships with the development of well-established policies for information management. The efforts are fundamental elements for strengthening the IAEA's capabilities to efficiently apply information technologies for programme effectiveness and organizational productivity.—***Barbara Paul, Division of Scientific and Technical Information.***

The IAEA added WWW services to its spectrum of Internet services in early 1995, and most of the users of FTP, TELNET, and Gopher have now migrated to WWW. In June 1995, the Agency announced the worldwide availability of its WWW computer, and the *IAEA's WorldAtom* was opened to the public. *(See box.)*

The Web inside the IAEA. Agency staff need access to a wide range of information to do their jobs effectively. Much of this information is not available directly in-house, but comes from other sources. The Internet provides an efficient way of obtaining it. Almost all nuclear research institutes worldwide are connected to the Internet. Large institutes, such as the Los Alamos Laboratories in the United States, have significant collections of documents on-line that are searchable via WWW. The documents can be copied to a desktop in Vienna in a short time.

The Agency also needs a medium for making administrative information more readily available to all staff. The in-house use of the Internet provides this medium, reaching all parts of the IAEA despite the use of different network configurations. Material such as the administrative manual, Secretariat notes, and desk-to-desk circulars can be made available via WWW to the desktops. The technology was put into place in the second quarter of 1995, and now the procedures for its use are being established.

The UN and the Internet. Since 1990, United Nations organizations and specialized agencies have been working on ways to allow Member States more access to databases and documents electronically in a consistent, coordinated manner. The Information Systems Coordinating Committee (ISCC), which reports to the Advisory Committee on Coordination, is responsible for this task. Recently its Task Force on Information Access and Dissemination established a number of principles. Among them are the UN's reliance on the Internet as the primary (although not sole) means of computer communication with Member States; the need for all UN organizations to develop information access policies and procedures; and the use of the International Computing Centre in Geneva to provide a starting point for UN-wide information searches via the WWW.

The IAEA has started a pilot project to allow Member State missions in Vienna access to numerous Agency databases via connection to its network. It also is making documents electronically available to Member States in connection with the IAEA's General Conference in September 1995.

Internet issues. The IAEA's Central Computer Services are continuing to work on four issues that affect the public's use of the Internet. These concern questions of security, searching, document dissemination, and capacity.

The security issue is one of providing access to public information without putting the in-house network at risk. The solution now being used is based on establishing a special "firewall" computer between the publicly accessible computer and the protected in-house network. Agency staff can access the remote Internet computers through the firewall, but users of remote computers cannot gain access.

Searching for information is still a complex issue. Various commercial and university-created products exist. The Agency is using one such system to allow searching of bibliographic databases, and is investigating which products can provide good searching of all WWW information.

Document dissemination is a time-consuming task that needs to be automated as far as possible. Most IAEA documents are available in word processing form. Putting these documents onto the WWW computer requires translating these documents into the WWW's text processing language, the Hypertext General Mark-up Language, or HTML. Tools for this conversion are still being developed worldwide. Text that refers to other documents needs to be marked and the names of the links must be coded.

Finally, the issue of capacity means that the IAEA needs to watch the growth of the Internet worldwide and the demand for networking capacity closely. At usage rates that double annually, available networking bandwidth can be exhausted quickly, requiring additional investment to maintain quality. Today, the IAEA pays a flat annual fee for Internet access to a commercial company that links it to the Internet. Such fee systems may not be sufficient in the future, and many organizations, such as the Internet Society, are already discussing different charging modalities.

Expanding on-line services. Over the past four decades, the IAEA has developed a range of on-line databases for public and technical users. They include the Power Reactor Information System; the International Nuclear Information System; the International Information System for the Agricultural Sciences and Technology, jointly with the Food and Agriculture Organization (FAO); the Nuclear Data Information System; and the Atomic and Molecular Data Information System.

However Internet's future unfolds, the IAEA's acquired experience will prove invaluable in keeping up with rapid developments in the computer and telecommunications fields. As importantly, the work will guide ongoing efforts to reinforce the IAEA's capabilities for providing information more productively and efficiently. The next stages of development will help define the IAEA's role on the emerging global nuclear information highway. ❐

Home Pages on the Web: A Look at the *IAEA's World Atom*

World Wide Web sounds like a conspiracy from the pages of Ian Fleming. That it's a relatively harmless communications tool from the talented minds of the CERN scientific research centre in Geneva should not be too surprising. Born of frustration in electronically accessing and retrieving scientific data, reports, graphs, charts, models, and figures, the Web stands as one of science's latest successful transfers of technology. The welcome wizard and its system of "home pages" enable customized multi-media communications over the world's interlinked computer networks called the Internet.

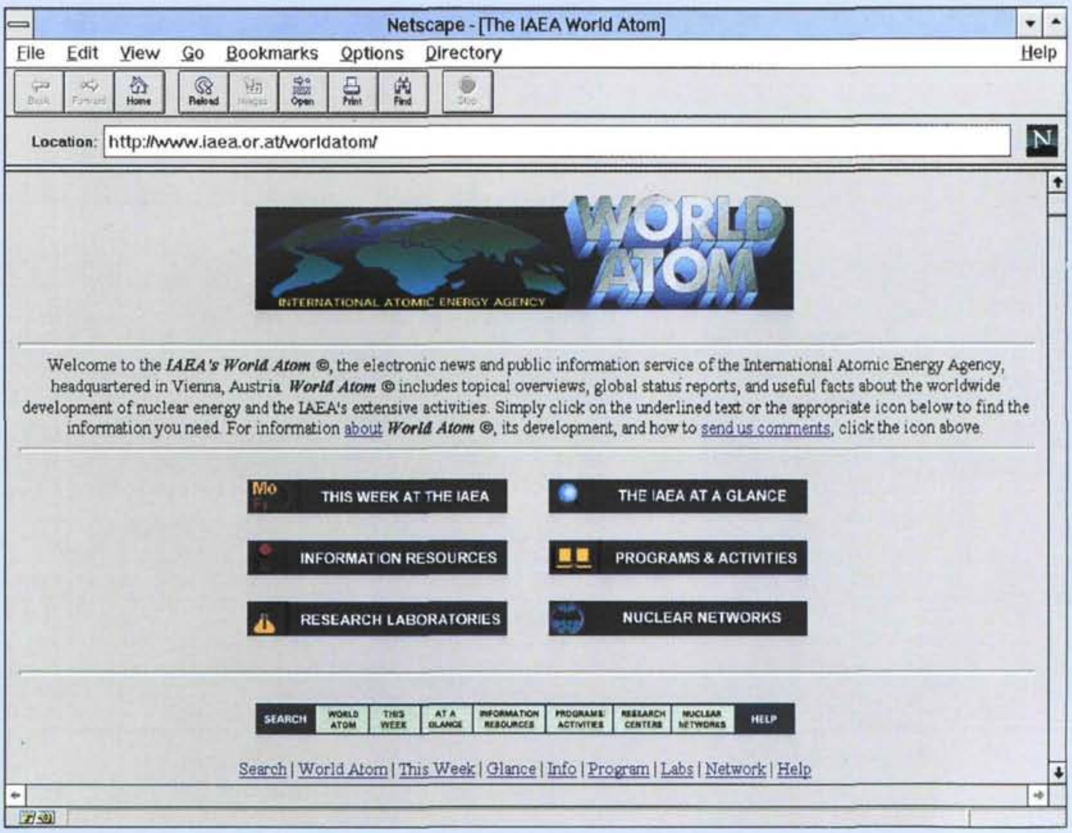
The IAEA opened a set of home pages to public access in June 1995. The *IAEA's World Atom* today delivers information about the Agency and global nuclear development drawn from more than 1000 underlying, interconnected, and formatted documents and files. The system includes background information as well as more detailed reports about the status of nuclear power, nuclear safeguards and verification, global nuclear conventions, nuclear and radiation safety, and nuclear applications, for example. *World Atom* — a joint project of the IAEA's computer and public information services — also links users to selected other nuclear-related networks on the Web based in the IAEA's Member States and at organizations within the UN system.

Primarily intended for general audiences, *World Atom* is being designed for easy use. It is built around the concept of a magazine bound by seemingly endless numbers of electronic pages, which readers can flip through with the click of the mouse. Decisions about where the pages are, how they are linked and designed, and what information they contain are part of the day-to-day production process. For the most part, links are topically oriented, in efforts to integrate *World Atom's* hundreds of underlying pages.

Still in its early stages, the system today is a skeleton of what it will become as the *World Atom* team prepares empty pages for production and brings future links on line. Envisaged is an integrated family of home pages customized to the particular information requirements of the Agency and its scientific, governmental, and public audiences.

GC/39 on line. One sign of the times appears in *World Atom* this September, in connection with the 39th Regular Session of the IAEA General Conference. For the first time, the Agency is placing key information from and about the Conference on line. Pages will feature the annotated agenda and related public reference documents; full texts of selected addresses, including the statement of the IAEA Director General; summaries of delegate statements; and press releases and background notes for the media. Information will be updated throughout the week-long Conference, as part of a wider IAEA computer exhibit to demonstrate its Internet-based services and capabilities.

Like other information about the Agency, the set of GC/39 pages can be found on the *IAEA's World Atom* at its Web address: **http://www.iaea.or.at/worldatom.** Selected pages, including the full set of GC resolutions and decisions, will stay on line for easy reference well after the Conference closes.—***Lothar Wedekind, Division of Public Information.***



IAEA General Conference in Vienna

Opening in Vienna 18 September 1995, the 39th regular session of the IAEA General Conference was set to address a range of topics on the Agency's policies, programmes, and budget.

The provisional agenda includes items related to strengthening technical cooperation activities; measures to strengthen international cooperation in nuclear safety, radiological protection, and radioactive waste management; strengthening the effectiveness and improving the efficiency of the safeguards system; measures against illicit trafficking in nuclear materials and other radioactive sources; implementation of the safeguards agreement with the Democratic People's Republic of Korea; implementation of United Nations Security Council resolutions relating to nuclear inspections in Iraq; an African nuclear-weapon-free zone; application of IAEA safeguards in the Middle East; and the IAEA's programme and budget for 1996.

Board meetings. At its meetings in June 1995, the IAEA Board of Governors took decisions on matters related to some of these topics. They included the Board's approval of the IAEA's regular budget for 1996, which calls for expenditures of US $219 million, at an exchange rate of 12.70 Austrian schillings to the dollar. Other matters related to items before the General Conference were considered by the Board at its pre-Conference meetings beginning 11 September 1995.

Scientific programme. In conjunction with the General Conference, a special scientific programme is scheduled for 19 and 20 September. Three subjects are being examined: environmental restoration (19 September); applications of accelerators in research, industrial, and other fields (20 September, morning session); new safeguards technologies, specifically with respect to environmental monitoring and equipment that operates in unattended modes (20 September, afternoon session).

Safety meeting. Also organized, for 20 and 21 September, is the traditional meeting of senior safety officials. Topics address selected nuclear plant safety issues; regulation of radioactive waste management; and the use of quantitative probabilistic criteria in safety regulations.

Technical cooperation. Technical cooperation meetings at the Conference are scheduled for 19, 20, and 21 September. They include group meetings on regional cooperation activities in Africa, Asia and the Pacific, and Latin America, as well as consultations with representatives of IAEA Member States.

Internet corner. The Conference also features the "Internet Corner", a demonstration of selected IAEA on-line information services, notably those available through Internet and World Wide Web. *(See related articles on the Agency's new on-line services in this edition of the Bulletin.)*

Recent IAEA seminars, conferences, and symposia

Recent scientific seminars, conferences, and symposia convened by the IAEA included those related to:

Implementation of new Basic Safety Standards. From 14-18 August 1995, radiation protection and safety specialists and regulators participated in the International Seminar on Advancement in the Implementation of the New Basic Safety Standards — Experience in Applying the 1990 Recommendations of the International Commission on Radiological Protection (ICRP). The seminar featured technical sessions focusing on the practical application of the new *International Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources*, which the IAEA issued in 1994 under its Safety Series as an interim edition. The Standards set out the basic requirements to be fulfilled in all activities involving radiation exposure. Their development was jointly sponsored by the IAEA, Food and Agriculture Organization (FAO) of the United Nations, International Labour Office (ILO), Nuclear Energy Agency (NEA) of the Organization for Economic Cooperation and Development (OECD), World Health Organization (WHO), and the Pan-American Health Organization (PAHO).

Discussions focused on the broad range of practices and sources that give rise to or could give rise to exposure to radiation. The issue-oriented technical sessions addressed protection of workers; protection of patients; protection of the public; potential exposure situations; emergency and chronic exposure situations; administrative requirements; exemptions; interventions; and national infrastructures for implementation.

Operational Safety of Nuclear Power Plants. The best international practices were highlighted at the IAEA's International Conference on Advances in the Operational Safety of Nuclear Power Plants, convened 4-8 September 1995.

Presentations from nuclear plant operators and safety officials addressed recent advances and new methods for enhancing the safe operation of nuclear plants, which worldwide supply about 17% of total electricity. In particular, case studies reviewed recent achievements in national nuclear programmes, as well as through international cooperative projects and services, and a panel discussion addressed ways to monitor plant performance and operational safety, and how to communicate the findings to the public. Invited papers focused on three major topics: the regulatory role in operational safety advances; the utility perspective and experience in areas of operational safety; and public understanding of nuclear plant operational safety issues.

Radioactive waste management. At a seminar in Vienna 28-31 August 1995, specialists reviewed technical and regulatory requirements for the safe management of radioactive waste and major topics influencing global cooperation in the field. Sessions included reviews of the Agency's Radioactive Waste Management Safety Standards (RADWASS) programme; the preparation of an international convention covering radioactive waste management; application of radiation protection requirements; national experiences in the field; safety of repositories; and regulatory and licensing requirements. Seminar discussions provided a broad coverage of key issues and further demonstrated the range of international consensus concerning requirements for safe and effective radioactive waste management programmes.

The outcome is expected to prove useful in the ongoing preparations of the international convention for radioactive waste management being developed under IAEA auspices.

Tomography in nuclear medicine. From 21-25 August in Vienna, medical imaging specialists and health practitioners from more than 60 countries attended an International Symposium on Tomography in Nuclear Medicine jointly organized by the IAEA and World Health Organization (WHO). The meeting provided insights into major strides that have been made over the past decade in medical and nuclear imaging, and examined the prospects for the future in light of recent advances in the field. Applications in medical diagnosis of single photon emission tomography (SPECT) and photon emission tomography (PET) were particularly addressed.

Security Council statement on illicit trafficking in nuclear materials

The United Nations Security Council in July 1995 extended its "full support to the IAEA and other international bodies for the work they are undertaking against the problem of illicit trafficking in nuclear materials".

The statement was made in a letter of 19 July 1995 from the President of the Security Council, Mr. Gerardo Martínez Blanco, to UN Secretary-General Boutros-Ghali. The letter further noted the initiative by Russian President Yeltsin to host a nuclear safety summit in Moscow early next year and expressed the hope that the trafficking issue would be addressed there.

In a letter to the President of the Security Council on 11 July 1995, UN Secretary-General Boutros-Ghali focused attention on the problem of illicit trafficking and the need for concerted action by States and relevant intergovernmental agencies. The Secretary-General stated that he was in contact with IAEA Director General Hans Blix on the issue, which he said was receiving high priority at the Agency.

"The Agency's concern is matched by many Governments," Mr. Boutros-Ghali wrote, "as was demonstrated when, at its recent meeting in Halifax, the Group of Seven accepted the offer of President Yeltsin to host a summit in the spring to discuss nuclear safety, including the issue of illicit trafficking. There is also a clear public perception that this is a serious matter, as evidenced by the number of references in the media and by the activity of non-governmental organizations."

As part of its work in this area, the IAEA has strengthened its assistance to States in areas related to the establishment of a reliable database of reported incidents and to the accounting and control of nuclear material. The Agency's actions are in response to a resolution on illicit trafficking in nuclear materials adopted by the IAEA General Conference in September 1994. A report on the subject from IAEA Director General Blix is being to submitted to the General Conference this September.

Argentina: Seminar for journalists

Journalists from Argentina and other countries are participating in a seminar being sponsored for the sixth time by the Argentine Atomic Energy Commission. Being convened 9-13 October in Buenos Aires, the meeting will focus on the peaceful uses of atomic energy, specifically topics related to health, the environment, nuclear power plant operations, waste management, and other aspects of the nuclear fuel cycle. To supplement discussions, Argentine authorities are including tours to nearby nuclear facilities, including a radioactive waste site and the Atucha nuclear plant. More information may be obtained from Ms. Elida Bustos, Head of the Public Opinion Division, CNEA, Av. del Libertador 8250 (1429), Buenos Aires, Argentina. Facsimile: (54-1) 704-1173.

Austria, Morocco, and Kenya: FAO/IAEA training activities

Rabat, Nairobi, and the IAEA's Laboratories at Seibersdorf, Austria, are sites of upcoming training courses in the field of animal health and productivity.

From 9 October to 3 November 1995 in Rabat, African scientists specifically will learn about the use of immunoassay and molecular methods for the diagnosis and control of diseases affecting livestock. Jointly sponsored by the Joint Division of the IAEA and Food and Agriculture Organization (FAO), the regional training course is designed to further the transfer of technology in the field, including the use of enzyme linked immunosorbent assay (ELISA) and new techniques such as the polymerase chain reaction and DNA probes. The IAEA and FAO have developed internationally accepted, validated, and standardized ELISA kits for diagnosing diseases, monitoring disease control programmes, and for studying the epidemiology of diseases. Throughout Africa and the developing world, animal diseases continue to sharply reduce livestock production, thereby hampering economic development.

The training course in Rabat is among those regularly run by the Joint Division in various areas related to food and agricultural production. Other activities in 1995 include a workshop in Nairobi, Kenya, in November and December, on the diagnosis of tick-borne diseases using immunoassay methods, and an interregional training course at the IAEA's Seibersdorf Laboratories from September to November on improving the productivity of ruminant livestock through "on-farm" assessment of nutrition. More information may be obtained from the Joint FAO/IAEA Division at the Agency's headquarters in Vienna.

Ukraine: Uranium resources

The IAEA is exploring possible approaches for strengthening global cooperation with Ukraine in areas related to the development and production of uranium resources.

Earlier this year, in May 1995, the IAEA held a technical committee meeting near Kiev on recent changes and events in uranium deposit development, exploration, resources, production, and the world supply/demand relationship. The meeting — the first of its kind in the Commonwealth of Independent States — was organized in cooperation with the Nuclear Energy Agency (NEA) of the Organization for Economic Cooperation and Development (OECD) and held at the Bila Dubrava Facilities of the Ukrainian State Geological Enterprise, "Kirovgeology". More than 60 specialists from Ukraine and 19 other countries participated. Information from technical papers on uranium geology, resources, production, and related environmental and economic topics will be used to update the IAEA and NEA's joint publication, called the Red Book, which covers uranium supply and demand.

The meeting provided an unparalleled opportunity for exchanging information between Ukrainian specialists and international experts on uranium-related issues. More than 20 Ukrainian specialists took part in the meeting. Additionally, Ukrainian authorities arranged field trips following the meeting to facilities involved in uranium mining and production. Ukraine's uranium production industry currently produces about 40% to 50% of the country's uranium requirements. Its estimated 1994 uranium production was about 1000 tonnes uranium, placing it among the world's 12 largest producers. Programmes are being put into place to develop the industry within the framework of a market economy.

India: Radiation technologies

A comprehensive technical overview of industrially applied radiation tools has been issued by India's National Association for Applications of Radioisotopes and Radiation in Industry (NAARRI) in Bombay. *Isotopes and Radiation Technology in Industry* — the proceedings of the 1994 International Conference on Applications of Radioisotopes and Radiation in Industrial Development — features detailed reports on radiation processing, tracer technology, nucleonic control systems, non-destructive testing, and nuclear analytical techniques. It further presents overviews of global cooperation in the field through national, regional, and international projects. The 1994 Conference was held 7-9 February and organized by NAARRI in collaboration with the IAEA, India's Department of Atomic Energy, the Indian Nuclear Society, and the Indo-French Technical Association.

Edited by S.M. Rao and K.M. Kulkarni of the Bhaba Atomic Research Centre (BARC) Isotope Division, the proceedings illustrate the important role that radiation technologies can play in furthering the industrial development of countries.

"With the liberalization of economies in countries like India and China, there is a certain urgency to upgrade the quality of the industrial processes and products," writes Mr. D.D. Sood, Director of BARC's Radiochemistry and Isotope Group, in the book's foreword. "Isotopes and radiation technology have much to contribute in this direction... Over and above, modern industry is eagerly looking forward to environment-friendly and less energy-intensive technologies. Isotopes and radiation have much to offer not only in providing eco-benign technologies...but also in the treatment of domestic and industrial waste."

More information about the book may be obtained from the Secretary, NAARRI, Isotope Division, Bhabha Atomic Research Centre, Bombay 400085, India. Facsimile: (91-22) 556-0750.

Brazil: Radiation protection

Brazil will be hosting an international meeting on radiation protection in industry early next year. The meeting — scheduled for 17-20 March 1996 — is being organized by Brazil's non-destructive testing association, ABENDE, with support from the Brazilian Committee on Nuclear Energy and the IAEA within the framework of an Agency-supported regional technical cooperation project. About 300 experts from Brazil and other countries are expected to participate. Technical presentations will address topics including radioisotope applications in industry; personnel training and qualification; inspection and quality control systems; regulatory and legislative aspects; optimization of radiation protection techniques and applications; uses of ionizing radiation in industry; and environmental issues related to radiation applications.

More information about the meeting may be obtained from ABENDE, Rua Luis Goes 2341, 04043-400, Sao Paulo, Brazil. Facsimile: (0055-011) 581-1164, or from Mr. J.A. Conte, Av. Vitorio Bortolan, 1450, Pque, N.S. das Dores, IV Etapa, Limeira, Brazil. Facsimile: (0055 194) 41-5837.

Luxembourg: Radiation atlas

The Commission of the European Communities (CEC) has issued a *Radiation Atlas* mapping levels of radiation from natural sources. The atlas includes maps from 17 countries in Europe — the United Kingdom, Ireland, Portugal, Spain, France, Luxembourg, Belgium, Netherlands, Switzerland, Italy, Germany, Austria, Greece, Denmark, Norway, Sweden, and Finland.

The maps, which are introduced by overviews in the language of each country surveyed, present data for cosmic rays, gamma rays outdoors and indoors, and radon indoors, the principal cause of human exposure. The quantities used for cosmic rays and gamma rays enable comparisons of the individual components of exposure to natural radiation from country to country. Conversion coefficients are provided to facilitate overall comparisons. The atlas, which was prepared by B.M.R. Green, J.S. Hughes, and P.R. Lomas of the National Radiological Protection Board in the United Kingdom, also includes useful listings of references and a glossary of key terms.

The CEC's atlas has prompted interest in the preparation of a global atlas, as jointly proposed by R.N. Alves of the Instituto Militar de Engenharia in Brazil and M. Oberhofer of the CEC's Ispra Joint Research Centre in Italy. Such an atlas is needed to help people place radiation issues in perspective, they point out, by documenting the levels of natural background radiation throughout the world. More information about the CEC atlas may be obtained from the CEC, 2, rue Mercier, L-2985 Luxembourg, and about the proposed world atlas from Dr. M. Oberdorfer, Radiation Protection Unit, Ispra Joint Research Centre, I-21020 Ispra (Va) Italy. Facsimile: (39) 332-789001.

PLUTONIUM ISSUES. A study commissioned by the American Nuclear Society has concluded that plutonium disposed of as spent fuel in geologic repositories cannot be assumed to be irretrievable or protected from being used to build nuclear weapons in the future. The best solution, the panel said, is to burn plutonium in power reactors, and continue research and development of advanced reactors, including the fast-breeder reactor. The ANS panel included Dr. Glenn Seaborg, Nobel Laureate and discoverer of plutonium; Richard Kennedy, former US Ambassador-at-Large for Nuclear Proliferation; Bertrand Goldschmidt, former Director of International Relations for the French Atomic Energy Commission; Sir John Hill, former Chairman of the United Kingdom Atomic Energy Authority; Ryukicki Imai, former Ambassador of Japan to the United Nations Disarmament Committee; Nikolai Ponomarev-Stepnoi, Vice President, Kurchatov Institute in Russia; Stanley R. Hatcher, former President and Chief Executive Officer of Atomic Energy of Canada Ltd; and Rudolph Rometsch, former Deputy Director General for Safeguards at the IAEA. More information may be obtained from the Nuclear Energy Institute, 1776 Eye Street, Suite 400, Washington, DC 20006-3708.

SCIENTIFIC DEVELOPMENT. Issues related to scientific development in selected countries are featured in a recent edition of the *TWAS Newsletter*, from the Third World Academy of Sciences in Trieste, Italy. The newsletter includes reports about developments in Tanzania, Venezuela, Congo, Colombia, Senegal, Peru, and Jamaica. Also featured is a report on TWAS activities in 1994. TWAS was formed to support scientific excellence and research in the developing world. More information may be obtained from TWAS, c/o the International Centre for Theoretical Physics, P.O. Box 586, 34100 Trieste, Italy. Facsimile: (39-40) 224-559. E-mail: TWAS@ictp.trieste.it.

CHEMICAL WEAPONS. Information about the prohibition of chemical weapons is now being offered over computer lines. Access is through the World Wide Web at the address http://www.opcw.nl, or by using any Internet search tool. The Chemical Weapons Convention has been signed by 159 States, of which just over 30 have ratified it. More information may be obtained from the Provisional Secretariat, Organization for the Prohibition of Chemical Weapons, Laan van Meerdervoort 51, 2517 AE The Hague, The Netherlands. Facsimile: (31) 70-360-0944.

The *IAEA Yearbook:* 1995 Edition

Comprehensive reports on the global development of nuclear energy and the IAEA's range of activities, programmes, and services are featured in the 1995 edition of the ***IAEA Yearbook.***

The latest edition reviews the status and trends of the world's nuclear power programmes, the nuclear fuel cycle, and radioactive waste management. Also presented is an international overview of programmes, projects, and services in major areas of nuclear safety and radiological protection; nuclear safeguards safeguards for 1994; and reports on the Agency's activities related to the transfer of nuclear technologies and related applications. Among the ***Yearbook's*** special reports is one on the outcome of the Review and Extension Conference of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) in the context of the IAEA's roles under the NPT, and a summary of the Agency's safeguards implementation in 1994.

The ***Yearbook's*** specialized sections, some of which are available separately, provide information and data on the nuclear fuel cycle, from uranium resources to the management of radioactive waste; the safety and operation of nuclear power plants and related topical issues; a review of the steps already taken and the measures being implemented to improve the cost effectiveness of safeguards and to assure the completeness of information on nuclear activities in States which have undertaken not to acquire nuclear weapons, as well as new verification roles that the IAEA may be called upon to play in support of international nuclear arms control agreements; and examples of nuclear techniques and research in fields including food and agriculture, medicine, industry, earth sciences, and hydrology.

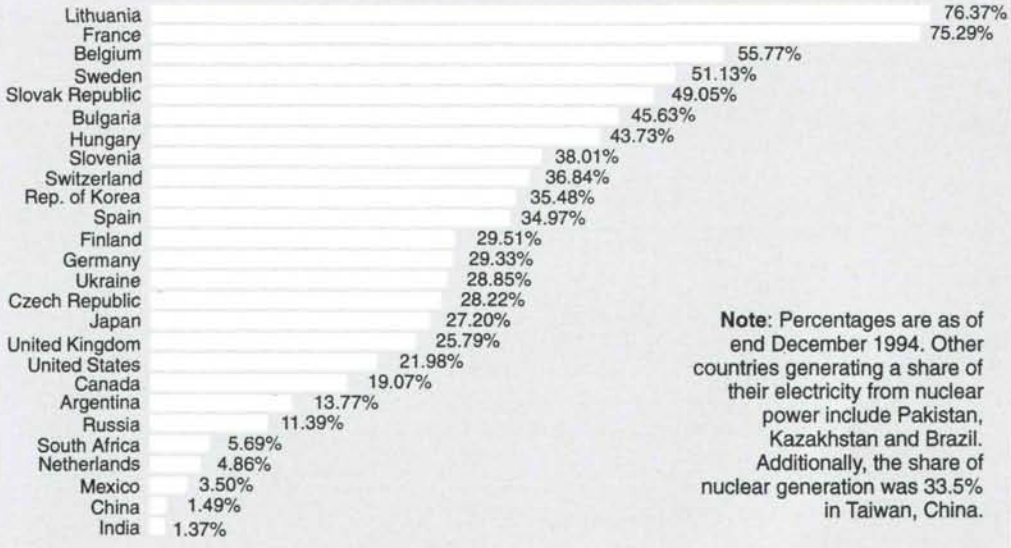
The ***IAEA Yearbook*** is available for purchase from the IAEA or its sales outlets in Member States. See the *Keep Abreast* section in the *IAEA Bulletin* for ordering information.

Nuclear power status around the world

	In operation		Under construction	
	No. of units	Total net MWe	No. of units	Total net MWe
Argentina	2	935	1	692
Belgium	7	5 527		
Brazil	1	626	1	1245
Bulgaria	6	3 538		
Canada	22	15 755		
China	3	2 100		
Czech Republic	4	1 648	2	1 824
Finland	4	2 310		
France	56	58 493	4	5 810
Germany	21	22 657		
Hungary	4	1 729		
India	9	1 493	5	1 010
Iran			2	2 392
Japan	49	38 875	5	4 799
Kazakhstan	1	70		
Korea, Rep. of	10	8 170	6	4 820
Lithuania	2	2 370		
Mexico	2	1 308		
Netherlands	2	504		
Pakistan	1	125	1	300
Romania			5	3 250
Russian Federation	29	19 843	4	3 375
South Africa	2	1 842		
Slovak Republic	4	1 632	4	1 552
Slovenia	1	632		
Spain	9	7 105		
Sweden	12	10 002		
Switzerland	5	2 985		
United Kingdom	34	11 720	1	1 188
Ukraine	15	12 679	6	5 700
USA	109	98 784	1	1 165
World total*	432	340 347	48	38 876

* The total includesTaiwan, China where six reactors totalling 4890 MWe are in operation.

Nuclear share of electricity generation in selected countries



Note: Percentages are as of end December 1994. Other countries generating a share of their electricity from nuclear power include Pakistan, Kazakhstan and Brazil. Additionally, the share of nuclear generation was 33.5% in Taiwan, China.

KEEP ABREAST

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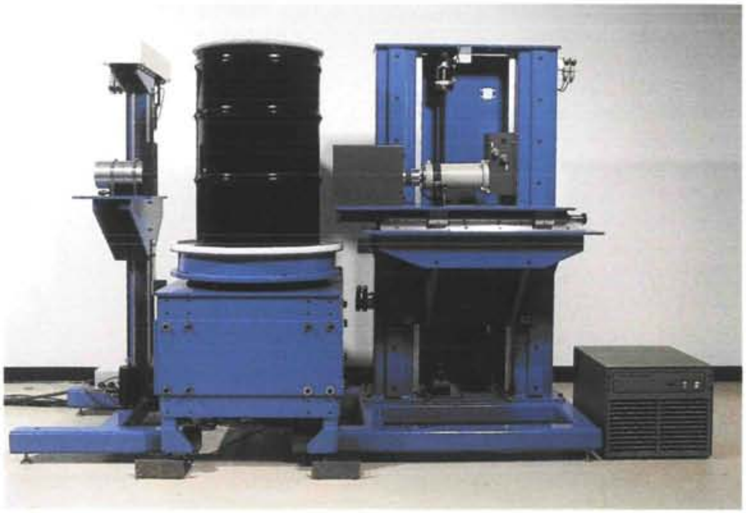

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POSTS ANNOUNCED BY THE IAEA

CHEMIST (95-053), Department of Research & Isotopes. This P-4 post requires a Ph.D. or equivalent in applied chemistry or radiochemistry and at least 10 years of proven R&D experience in radiochemistry related to production of radioisotopes and preparation and quality control of radiopharmaceuticals and other labelled compounds which are used in *in vivo* nuclear medicine and *in vitro* assays.
Closing date: 15 December 1995.

NUCLEAR ANALYST SPECIALIST (95-052), Department of Research & Isotopes. This P-3 post requires an advanced university degree or equivalent in a scientific discipline relevant to the duties of the post and a comprehensive knowledge of nuclear analytical techniques and their applications in health-related environmental research and monitoring.
Closing date: 15 December 1995.

STATISTICIAN (95-051), Department of Safeguards. This P-4 post requires a post-graduate degree in statistics or operations research, and at least 10 years of experience in error propagation, sequential testing and reasoning with uncertainty. Also required is substantial training or experience in physical or chemical sciences.
Closing date: 15 December 1995.

ANALYST PROGRAMMER (95-050), Department of Nuclear Energy & Safety. This P-2 post requires a university degree in computer science or related field and at least 2 years of practical experience with computerized bibliographic information systems. Also required is good knowledge of modern programming tools ("C/C++", SQL, Visual Basic) and environment (UNIX, Sybase, Windows).
Closing date: 15 December 1995.

SENIOR NUCLEAR POWER PLANNER/ENERGY ECONOMIST (95-049), Department of Nuclear Energy & Safety. This P-5 post requires an advanced university degree in energy economics, energy and environment analysis or closely-relevant applied science field, or equivalent level of knowledge and skill acquired through experience and at least 15 years of experience in national, regional or international organizations, in the fields of electric power planning studies and energy and electricity supply/demand analysis. Also required is extensive experience in evaluating, assessing and preparing reports on the comparative technical, economic, health and environmental data for different energy sources.
Closing date: 27 November 1995.

RCA CO-ORDINATOR (95-048), Department of Technical Co-operation. This P-5 post requires an advanced university degree in sciences or engineering with experience in the application of isotope and radiation, administration and management. Also required are at least 15 years of managerial and administrative experience at a national and/or international level in programming, formulation and implementation of scientific/technical projects, and experience in project management.
Closing date: 27 November 1995.

RADIATION PROTECTION LABORATORY SPECIALIST (95-047), Department of Nuclear Energy & Safety. This P-4 post requires an advanced university degree, or equivalent in physics, with specialization in radiation protection and dosimetry and at least 10 years of experience in operational radiation protection, oriented to university scale laboratory activities. Also required is practical laboratory experience in internal contamination monitoring, good knowledge of radiation protection instrumentation, and practical experience in quality assurance programmes.
Closing date: 27 November 1995.

PERSONNEL POLICY ANALYST (95-046), Department of Administration. This P-2 post requires a university degree in personnel administration, business management, public administration, law or other fields of equal relevance, with significant course work in statistics or quantitative analysis plus a minimum of 2 years of experience in a national or international institution. Also required is the ability to utilize computer based tools in researching and evaluating data.
Closing date: 6 November 1995.

RADIATION SAFETY SPECIALIST (95-045), Department of Nuclear Energy & Safety. This P-5 post requires a Ph.D. or equivalent in the field of radiation protection and 15 years of experience in radiation protection, mainly applied to industrial radiation sources.
Closing date: 27 October 1995.

SECTION HEAD (95-044), Department of Research and Isotopes. This P-5 post requires a Ph.D. or equivalent in veterinary medicine or animal science and 15 years of research and project management experience, including studies using isotope, radiation and biotechnological techniques in either animal health, reproduction or nutrition.
Closing date: 27 October 1995.

HEAD, ANIMAL PRODUCTION UNIT (95-043), Department of Research and Isotopes. This P-4 post requires a Ph.D. or equivalent degree in veterinary medicine, animal science or a biological science and a minimum of 10 years of experience in the development and use of immunoassays for the diagnosis of animal diseases, measurement of reproductive and metabolic hormones and veterinary drug residues. *Closing date: 27 October 1995.*

SECTION HEAD (95-041), Department of Safeguards. This P-5 post requires an advanced university degree or equivalent in nuclear technology or related field, and at least 15 years of relevant experience in nuclear industry, nuclear related research or international/government service. Also required is sound knowledge of the use of computers in large information systems with experience in program management and operation of complex automated information systems. *Closing date: 27 October 1995.*

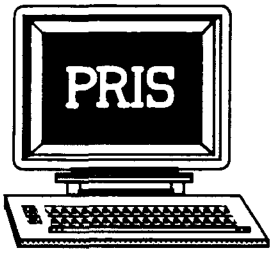
READER'S NOTE:

The ***IAEA Bulletin*** publishes short summaries of vacancy notices as a service to readers interested in the types of professional positions required by the IAEA. They are ***not*** the official notices and remain subject to change. On a frequent basis, the IAEA sends vacancy notices to governmental bodies and organizations in the Agency's Member States (typically the foreign ministry and atomic energy authority), as well as to United Nations offices and information centres. Prospective applicants are advised to maintain contact with them. Applications are invited from suitable qualified women as well as men. More specific information about employment opportunities at the IAEA may be obtained by writing the Division of Personnel, Box 100, A-1400 Vienna, Austria.

ON-LINE COMPUTER SERVICES. IAEA vacancy notices for professional positions, as well as application forms, now are available through a global computerized network that can be accessed directly. Access is through the Internet. The vacancy notices are located in a public directory accessible via the normal Internet file transfer services. To use the service, connect to the IAEA's Internet address NESIRS01.IAEA.OR.AT (161.5.64.10), and then log on using the identification *anonymous* and your user identification. The vacancy notices are in the directory called *pub/vacancy_posts*. A *README* file contains general information, and an *INDEX* file contains a short description of each vacancy notice. Other information, in the form of files that may be copied, includes an application form and conditions of employment. Please note that applications for posts cannot be forwarded through the computerized network, since they must be received in writing by the IAEA Division of Personnel.

ON LINE DATABASES

OF THE INTERNATIONAL ATOMIC ENERGY AGENCY



Database name

Power Reactor Information System (PRIS)

Type of database

Factual

Producer

International Atomic Energy Agency in co-operation with 29 IAEA Member States

IAEA contact

IAEA, Nuclear Power Engineering Section, P.O. Box 100
A-1400 Vienna, Austria
Telephone (43) (1) 2060
Telex (1)-12645
Facsimile +43 1 20607
Electronic mail via BITNET/INTERNET to ID:
NES@IAEA1.IAEA.OR.AT

Scope

Worldwide information on power reactors in operation, under construction, planned or shutdown, and data on operating experience with nuclear power plants in IAEA Member States.

Coverage

Reactor status, name, location, type, supplier, turbine generator supplier, plant owner and operator, thermal power, gross and net electrical power, date of construction start, date of first criticality, date of first synchronization to grid, date of commercial operation, date of shutdown, and data on reactor core characteristics and plant systems; energy produced; planned and unplanned energy losses; energy availability and unavailability factors; operating factor, and load factor.

Database name

International Information System for the Agricultural Sciences and Technology (AGRIS)

Type of database

Bibliographic

Producer

Food and Agriculture Organization of the United Nations (FAO) in co-operation with 172 national, regional, and international AGRIS centres

IAEA contact

AGRIS Processing Unit
c/o IAEA, P.O. Box 100
A-1400 Vienna, Austria
Telephone (43) (1) 2060
Telex (1)-12645
Facsimile +43 1 20607
Electronic mail via BITNET/INTERNET to ID:
FAS@IAEA1.IAEA.OR.AT

Number of records on line from January 1993 to date

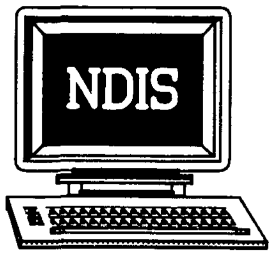
more than 130 000

Scope

Worldwide information on agricultural sciences and technology, including forestry, fisheries, and nutrition.

Coverage

Agriculture in general; geography and history; education, extension, and information; administration and legislation; agricultural economics; development and rural sociology; plant and animal science and production; plant protection; post-harvest technology; fisheries and aquaculture; agricultural machinery and engineering; natural resources; processing of agricultural products; human nutrition; pollution; methodology.



Database name

Nuclear Data Information System (NDIS)

Type of database

Numerical and bibliographic

Producer

International Atomic Energy Agency in co-operation with the United States National Nuclear Data Centre at the Brookhaven National Laboratory, the Nuclear Data Bank of the Nuclear Energy Agency, Organisation for Economic Co-operation and Development in Paris, France, and a network of 22 other nuclear data centres worldwide

IAEA contact

IAEA Nuclear Data Section, P.O. Box 100
A-1400 Vienna, Austria
Telephone (43) (1) 2060
Telex (1)-12645
Facsimile +43 1 20607
Electronic mail via BITNET/INTERNET to ID:
RNDS@IAEA1.IAEA.OR.AT

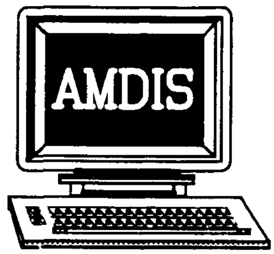
Scope

Numerical nuclear physics data files describing the interaction of radiation with matter, and related bibliographic data.

Data types

Evaluated neutron reaction data in ENDF format; experimental nuclear reaction data in EXFOR format, for reactions induced by neutrons, charged particles, or photons; nuclear half-lives and radioactive decay data in the systems NUDAT and ENSDF; related bibliographic information from the IAEA databases CINDA and NSR; various other types of data.

Note: Off-line data retrievals from NDIS also may be obtained from the producer on magnetic tape



Database name

Atomic and Molecular Data Information System (AMDIS)

Type of database

Numerical and bibliographic

Producer

International Atomic Energy Agency in co-operation with the International Atomic and Molecular Data Centre network, a group of 16 national data centres from several countries.

IAEA contact

IAEA Atomic and Molecular Data Unit, Nuclear Data Section
Electronic mail via BITNET to: RNDS@IAEA1;
via INTERNET to ID:
PSM@RIPCRS01.IAEA.OR.AT

Scope

Data on atomic, molecular, plasma-surface interaction, and material properties of interest to fusion research and technology

Coverage

Includes ALADDIN formatted data on atomic structure and spectra (energy levels, wave lengths, and transition probabilities); electron and heavy particle collisions with atoms, ions, and molecules (cross sections and/or rate coefficients, including, in most cases, analytic fit to the data); sputtering of surfaces by impact of main plasma constituents and self sputtering; particle reflection from surfaces; thermophysical and thermomechanical properties of beryllium and pyrolytic graphites.

Note: Off-line data and bibliographic retrievals, as well as ALADDIN software and manual, also may be ob-tained from the producer on diskettes, magnetic tape, or hard copy.

For access to these databases, please contact the producers.
Information from these databases also may be purchased from the producer in printed form.
INIS and AGRIS additionally are available on CD-ROM.

Database name
International Nuclear Information System (INIS)

Type of database
Bibliographic

Producer
International Atomic Energy Agency in co-operation with 91 IAEA Member States and 17 other international member organizations

IAEA contact
IAEA, INIS Section, P.O. Box 100, A-1400 Vienna, Austria
Telephone (43) (1) 2060 22842
Facsimile +43 1 20607 22842
Electronic mail via BITNET/INTERNET to ID: ATIEH@IAEA1.IAEA.OR.AT

Number of records on line from January 1976 to date
more than 1.6 million

Scope
Worldwide information on the peaceful uses of nuclear science and technology; economic and environmental aspects of other energy sources.

Coverage
The central areas of coverage are nuclear reactors, reactor safety, nuclear fusion, applications of radiation or isotopes in medicine, agriculture, industry, and pest control, as well as related fields such as nuclear chemistry, nuclear physics, and materials science. Special emphasis is placed on the environmental, economic, and health effects of nuclear energy, as well as, from 1992, the economic and environmental aspects of non-nuclear energy sources. Legal and social aspects associated with nuclear energy also are covered.

IAEA UPCOMING CO-ORDINATED RESEARCH PROGRAMMES

Quality assurance in radiotherapy in Latin America
To formulate a practical quality assurance programme for clinical radiotherapy departments in Latin America which may also be adapted by similar institutions in the developing countries.

Use of radiotherapy in advanced cancer
To encourage development and introduction of appropriate radiotherapy techniques and other modalities in the management of advanced cancers which account for over 75% of the work load in radiotherapy departments in the developing countries.

Potential of thorium-based fuel cycles to constrain plutonium and to reduce long-term waste toxicities
To investigate the potential of thorium-based fuel cycles to constrain plutonium and to reduce long-term waste toxicities for current, advanced and innovative nuclear power reactors including hybrid systems.

Applied research on air pollution using nuclear-related analytical techniques in Asia and the Pacific Region (RCA)
To use nuclear-related analytical techniques for air pollution studies in the Asia and Pacific region through the assessment of toxic heavy metal pollution and other trace elements in air particulate matter.

Regional personal dosimetry intercomparison (ARCAL)
To provide participating personal dosimetry service organizations an assessment of their ability to measure relevant external dosimetry quantities with sufficient accuracy for radiation protection purposes.

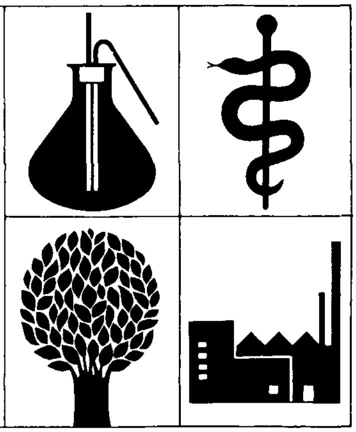
Site characterization techniques used in environmental restoration activities
To encourage the development and improvement of site characterization technology, reduce the duplication of efforts by various parties, and provide useful results and tools for Member States planning activities in areas of environmental restoration.

Application of heavy charged particles in cancer radiotherapy
To promote the application of heavy charged particles in radiotherapy (protons and heavy ions) by evaluating their potential benefit as well as by identifying the mechanisms through which this benefit can be achieved.

Irradiation treatment of water, waste-water and sludges
To develop technology for decontamination of water, waste-water and sewage sludge based on the utilization of ionizing radiation as such, or in combination with other agents.

Isotope-aided studies of atmospheric carbon dioxide and other greenhouse gases — Phase 2
To improve the present understanding of the behaviour and the role of major greenhouse gases in the global ecosystem through observations of temporal and spatial variability of their isotopic composition in selected locations, combined with relevant modelling work.

These are selected listings, subject to change. More complete information about IAEA meetings can be obtained from the IAEA Conference Service Section at the Agency's headquarters in Vienna, or by referring to the IAEA quarterly publication ***Meetings on Atomic Energy*** (See the *Keep Abreast* section for ordering information.) More detailed information about the IAEA's co-ordinated research programmes may be obtained from the Research Contracts Administration Section at IAEA headquarters. The programmes are designed to facilitate global co-operation on scientific and technical subjects in various fields, ranging from radiation applications in medicine, agriculture, and industry to nuclear power technology and safety.



IAEA SYMPOSIA & SEMINARS

NOVEMBER 1995

Regional (Asia & the Pacific) Seminar on Education and Training in Radiation Protection and Nuclear Safety
Melbourne, Australia
(27 November - 1 December)

Regional Seminar for Asia and the Pacific on Radiotherapy Dosimetry: Radiation Dose in Radiotherapy from Prescription to Delivery
Bangkok, Thailand
(28 November - 1 December)

Second FAO/IAEA Seminar for Africa on Animal Trypanosomiasis: Vector and Disease Control Using Nuclear Techniques
Zanzibar, Tanzania
(27 November - 1 December)

FEBRUARY 1996

FAO/IAEA/IIR/ITC/WHO Interregional Seminar on Food Irradiation to Control Food Losses and Food-Borne Diseases in Africa and Near East Regions
Rabat, Morocco
(26 February - 1 March)

MARCH 1996

International Seminar on Enhanced Utilization of Research and Test Reactors
Bombay, India
(11 - 15 March)

APRIL 1996

International Conference One Decade after Chernobyl: Summing Up the Consequences
Vienna, Austria
(8 - 12 April)

JUNE 1996

Seminar on Nuclear Techniques Related to the Diagnosis and Management of Cancer
Vienna, Austria
(3 - 7 June)

Symposium on Experience in the Planning and Operation of Low Level Waste Disposal Facilities
Vienna, Austria
(17 - 21 June)

JULY 1996

FAO/IAEA Symposium on the Use of Nuclear and Related Techniques for Studying Environmental Behavior of Crop Protection Chemicals
Vienna, Austria
(1 - 5 July)

95-02859

IAEA BULLETIN

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Tel: (43-1) 2060-21270
Facsimile: (43-1) 20607
E-mail: iaeo@iaea1.iaea.or.at

IAEA MEMBER STATES

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Germany
Greece
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Holy See
Hungary
Iceland
India
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Netherlands
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Russian Federation
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Spain
Sri Lanka
Sweden
Switzerland
Thailand
Tunisia
Turkey
Ukraine
United Kingdom of Great Britain and Northern Ireland
United States of America
Venezuela
Viet Nam
Yugoslavia

1958
Belgium
Cambodia
Ecuador
Finland
Iran, Islamic Republic of
Luxembourg
Mexico
Philippines
Sudan

1959
Iraq

1960
Chile
Colombia
Ghana
Senegal

1961
Lebanon
Mali
Zaire

1962
Liberia
Saudi Arabia

1963
Algeria
Bolivia
Côte d'Ivoire
Libyan Arab Jamahiriya
Syrian Arab Republic
Uruguay

1964
Cameroon
Gabon
Kuwait
Nigeria

1965
Costa Rica
Cyprus
Jamaica
Kenya
Madagascar

1966
Jordan
Panama

1967
Sierra Leone
Singapore
Uganda

1968
Liechtenstein

1969
Malaysia
Niger
Zambia

1970
Ireland

1972
Bangladesh

1973
Mongolia

1974
Mauritius

1976
Qatar
United Arab Emirates
United Republic of Tanzania

1977
Nicaragua

1983
Namibia

1984
China

1986
Zimbabwe

1991
Latvia
Lithuania

1992
Croatia
Estonia
Slovenia

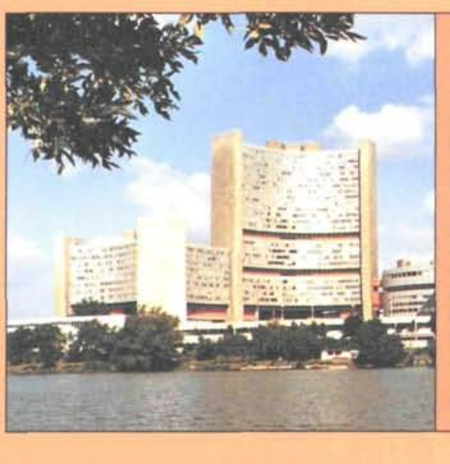
1993
Armenia
Czech Republic
Slovakia

1994
Former Yugoslav Republic of Macedonia
Kazakhstan
Marshall Islands
Uzbekistan
Yemen

Eighteen ratifications were required to bring the IAEA's Statute into force. By 29 July 1957, the States in bold face had ratified the Statute.

Year denotes year of membership. Names of the States are not necessarily their historical designations.

For States in italic, membership has been approved by the IAEA General Conference and will take effect once the required legal instruments have been deposited.



The International Atomic Energy Agency, which came into being on 29 July 1957, is an independent intergovernmental organization within the United Nations System. Headquartered in Vienna, Austria, the Agency has more than 100 Member States who together work to carry out the main objectives of IAEA's Statute: To accelerate and enlarge the contribution of atomic energy to peace, health, and prosperity throughout the world and to ensure so far as it is able that assistance provided by it, or at its request or under its supervision or control, is not used in such a way as to further any military purpose.

IAEA headquarters, at the Vienna International Centre.

Until now, one of the biggest problems with reading personal exposure doses has been the size of the monitoring equipment. Which is precisely why we're introducing the Electronic Pocket Dosimeter (EPD) "MY DOSE mini™" PDM-Series.

These high-performance dosimeters combine an easy-to-read digital display with a wide measuring range suiting a wide range of needs.

But the big news is how very small and lightweight they've become. Able to fit into any pocket and weighing just 50~90 grams, the Aloka EPDs can go anywhere you go. Which may prove to be quite a sizable improvement, indeed.

Model	Energy	Range	Application
PDM-101	60 keV ~	0.01 ~ 99.99 μSv	High sensitivity, photon
PDM-102	40 keV ~	1 ~ 9,999 μSv	General use, photon
PDM-173	40 keV ~	0.01 ~ 99.99 mSv	General use, photon
PDM-107	20 keV ~	1 ~ 9,999 μSv	Low energy, photon
PDM-303	thermal ~ fast	0.01 ~ 99.99 mSv	Neutron
ADM-102	40 keV ~	0.001 ~ 99.99 mSv	With vibration & sound alarm, photon

SCIENCE AND HUMANITY

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