



An engraved bronze plaque on the wall of the West Stands at Stagg Field in Chicago, USA, marks the place where the nuclear age began. (Credit: Argonne National Laboratory.)

The dual challenge of a nuclear age

Over the past half century, international political and legal frameworks have been created for harnessing the atom

by Hans Blix

Two principal challenges have confronted the world ever since the first controlled chain reaction 50 years ago—the challenge not to use the atom for war and the challenge to exploit it safely for the benefit of mankind.

That the military applications of the new knowledge would be a dangerous and dominating future factor was realized from the outset. In his book *The Making of the Atomic Bomb*, Richard Rhodes quotes Leo Szilard as saying, “I shook hands with Fermi and said I thought this day would go down as a black day in the history of mankind”.

Whether we share that judgement or not — I do not—we must recognize that the early demonstration of the destructive capacity of nuclear weapons in active war and the decades of testing of ever more destructive, ever more sophisticated nuclear weapons show that we do not yet have a sure answer to the question how to limit the use of the nuclear chain reaction to peaceful purposes. We must also recognize that the evacuation of several hundred thousand people affected by the nuclear catastrophe at Chernobyl, and the fear that large segments of the public have of nuclear power, show that we do not yet have a fully satisfactory answer to the second question, how to effectively and safely use nuclear discoveries for energy generation.

Saying this is by no means to ignore that the world has come a very long way in meeting the challenges that arose in 1942. Broad approaches have been taken, and international political and legal frameworks and institutions have been created, to bring us to our goals.

Although it is too early to feel confident that the risk of nuclear war has been eliminated, there exist today good reasons for some optimism. At

long last, the nuclear weapons arsenals are shrinking and warheads are being pulled back from many areas. The nuclear-weapon-free areas of our world are growing. We can also note that the awareness is increasing that nuclear power—if properly handled and developed—is a viable means of meeting mankind’s needs for more energy and can be used with less risk to our climate, health, and environment than an expanded consumption of fossil fuels.

It has taken much scientific, technical, and political work, and many years, to bring us to this situation. The development could have been different and disastrous. Today we see mankind slowly moving away from the risk of nuclear conflagration. We know now just how close the world came to nuclear catastrophe in the Cuban missile crisis. And the employment of nuclear weapons might also have been contemplated in the Korean war. Nevertheless, the step over the brink of disaster has been avoided. The existence of nuclear weapons and their enormous power have acted as a deterrent from war between those who possessed them. Together with accelerating global economic integration and global environmental interdependence, these facts are leading us to search for the next phase in a still very primitive world order: a stronger legal framework for our living together and more developed common institutions to cope with our joint problems.

Toward a stronger legal framework

It was a tribute to the far-sightedness of a soldier turned statesman—President Dwight Eisenhower—that the first efforts were made in 1953 to come to terms with the duality of nuclear’s potential and to find ways of harnessing it for mankind’s benefit in peaceful applications while inhibiting simultaneously the spread of its military dimension. This was in his “Atoms for Peace” initiative to which the IAEA owed its birth 35 years ago and to which it still owes its dual mandate to promote the peaceful uses of

Dr Blix is Director General of the IAEA. This article is adapted from his address in November 1992 in Chicago, USA, at the International Meeting of the American Nuclear Society, European Nuclear Society, and United States Council for Energy Awareness to commemorate the 50th anniversary of the first controlled nuclear chain reaction on 2 December 1942.

nuclear energy and to help prevent the further spread of nuclear weapons.

The Treaty on the Non-Proliferation of Nuclear Weapons (NPT) of 1970 contained the same political thrust, enabling States to make binding and verified commitments to non-proliferation while promising to facilitate a transfer of peaceful nuclear applications to those making the commitment. Today, the Treaty, together with some regional accords like the Tlatelolco Treaty in Latin America, are rightly seen as essential and successful legal instruments to prevent the spread of nuclear weapons to further countries.

In the past year there have been important new commitments to these treaties: Argentina and Brazil in Latin America, South Africa and several other States in Africa. A new wave of accessions to the NPT may soon come from former States members of the Soviet Union. Some of them have, indeed, already joined the Treaty.

Apart from some States of the former Soviet Union, only a handful of States—Israel and Algeria in the Mediterranean region and India and Pakistan on the Indian sub-continent being the most significant — have refrained from making legally binding non-proliferation commitments and possess significant nuclear installations. It is not far-fetched to think that these countries, too, might legally commit themselves to a renunciation of nuclear weapons, provided *inter alia* that

peaceful relations can be securely established in their respective regions and that nuclear disarmament progresses among the five declared nuclear-weapon States.

Further agreements in the nuclear disarmament sphere can also be expected to create a positive framework for an unlimited extension of the NPT when that question comes up for decision in 1995. In the present international climate of global detente and surplus of highly enriched uranium and plutonium in the United States and in Russia, one might hope that these two States would take the initiative for a global agreement on a verified cut-off of production of fissionable material for weapons use.

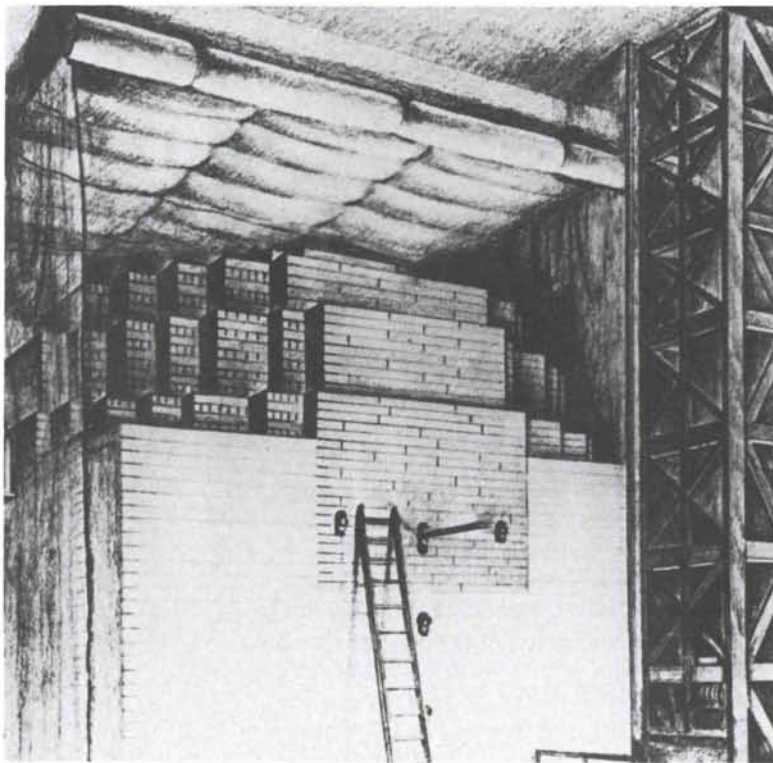
An agreement through which a date for the cessation of all nuclear testing was accepted by all nuclear-weapon States would also do much to solidify non-proliferation. Such an agreement — which has been on the agenda for the last 30 years — would signal that the world no longer tries out new and “better” nuclear weapons. Needless to say a continued and accelerated reduction in the stocks of nuclear weapons in all the States possessing them would be of importance in itself and a means of demonstrating the growing irrelevance of these weapons in the post Cold War world that is now taking shape.

I have painted the rosy side of the nuclear disarmament and non-proliferation picture. It may seem to some of you too optimistic. Yet, I would maintain that at no time since nuclear disarmament talks began has the political climate seemed more favourable than now for far-reaching agreements. It is time to act. The opportunities must not be lost!

I am obliged, however, also to register the threats which exist for an evolution toward an increasingly nuclear-weapon-free world. If for some reason tension were to recur between nuclear-weapon States, this would bring the disarmament process to a halt.

Two other risks are often pointed to. One is the risk that a trickling of plutonium, weapons-grade uranium, nuclear weapon technology or experts might occur from the former Soviet Union to potentially proliferating States. Media serve almost daily stories about such trafficking. While so far none of these has proved, upon analysis, to be serious from the viewpoint of proliferation, there is no ground for complacency. Effective measures need to be taken by all States to prevent the export of sensitive nuclear material or equipment which may risk contributing to the proliferation of nuclear weapons. It is true that the more detente and disarmament are consolidated globally and regionally, the less risk there will be of attempts by any State to acquire or develop nuclear weapons. However,

A sketch of CP-1, the first atomic pile reactor in Chicago.



as the case of Iraq shows, the risk is still to be taken very seriously and to be countered by measures in the fields of foreign and security policy, export controls, and verification.

The case of Iraq demonstrated that, in addition to many industrially advanced countries, a number of developing countries have attained such a technological level that, given sufficient security and political incentive, they could develop a nuclear weapons capacity. This reality underlines the urgency of removing the incentives through measures in the political security field, notably a peace settlement in the Middle East, of impeding efforts at importing material and techniques for weapons construction, and of strengthening verification.

A strengthened safeguards system

The safeguards system of the IAEA forms an important part of the regime which has been established to prevent the further spread of nuclear weapons and to create confidence that nuclear installations are used for only peaceful purposes. The world's first on-site inspection system has now been in operation for over 25 years. At a cost currently of some US \$60 million per year and through a staff of some 600 people, including some 200 inspectors, the world has been given assurance that fissionable material in declared nuclear installations is not diverted for weapons use. This remains a very important function, but the case of Iraq has raised the requirement that the system should also give warnings about any development of nuclear weapons or weapons-useable material through non-declared, clandestine activities and installations. This clearly more difficult task is now being tackled through a variety of measures, the most important of which relate to the acquisition of information, the right to perform inspections at non-declared sites, and the prospect of support by the Security Council of the United Nations.

The most fundamental requirement for successful inspection is information. Inspectors must know where to go and what to inspect. It is not possible for inspectors to visit and examine every building and basement in a foreign country and random visits will not help very much. Inspectors must have access to information leading them to sites and installations of possible interest.

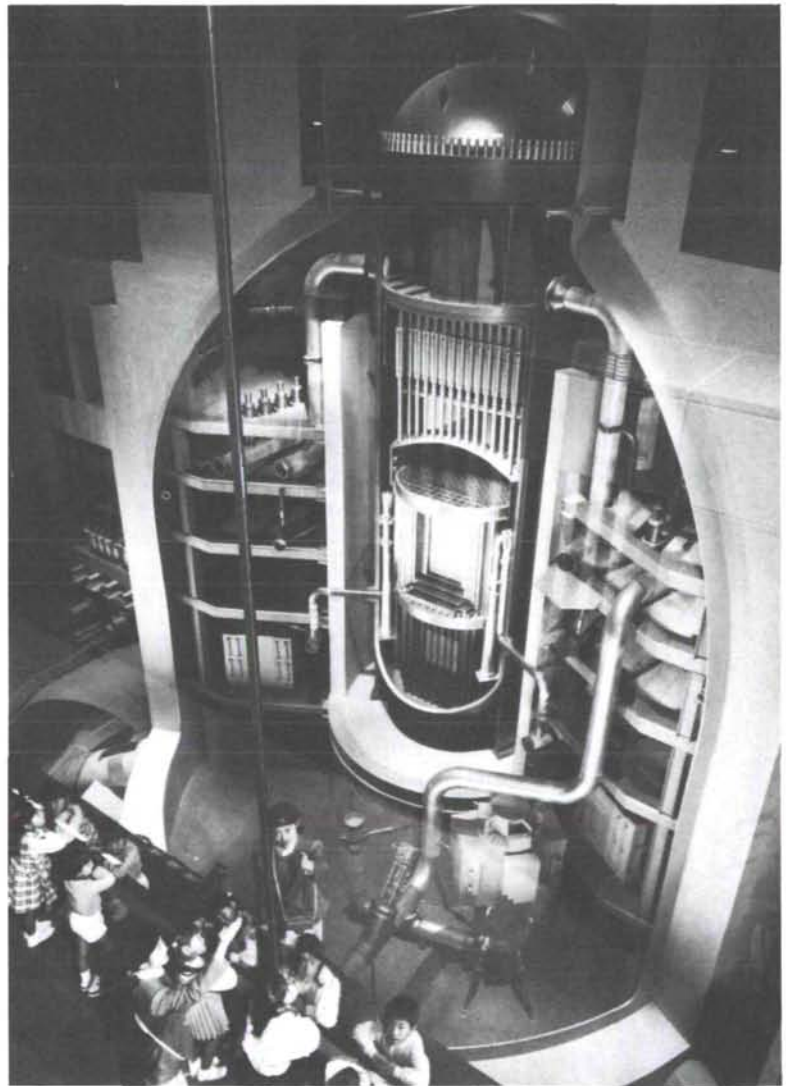
In the strengthened safeguards system now taking shape in the IAEA, the information provided by the inspected States will be supplemented by other data, e.g. from other States concerning the export and import of nuclear material and certain types of equipment. Had such data regarding Iraq been available to the

IAEA and been analysed before the Gulf War, it is quite possible that special explanations and visits would have been requested by the Agency.

All data that may be made available to the IAEA, including such that may originate in satellite surveillance or other sources, must of course be critically analysed and assessed. There is much erroneous information and disinformation in circulation. It is the Agency's professional duty not to base its actions and conclusions simply on trust; it is also its duty to avoid voicing unnecessary suspicions and false alarms.

A right of unimpeded access for inspectors to relevant sites and material is of crucial importance when information is available, suggesting the need for such inspection. In the case of Iraq exceptionally far-reaching rights of access were obtained through Security Council Resolution 687 and a subsequent agreement. It is not likely that governments generally would accept such comprehensive rights of access.

Life-size model of a modern nuclear reactor in Japan. (Credit: Chubu Electric Power Co.)



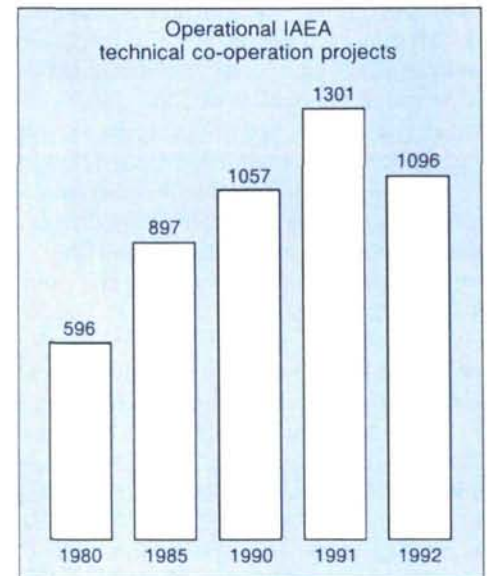
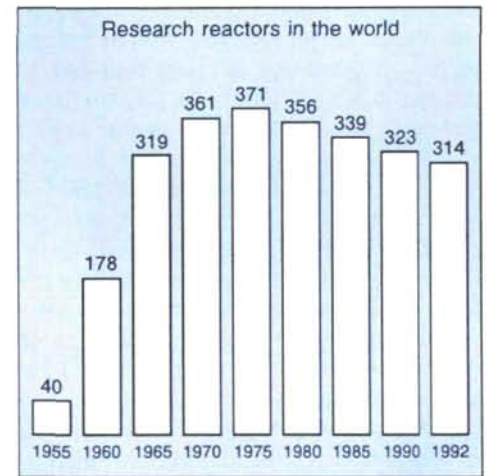
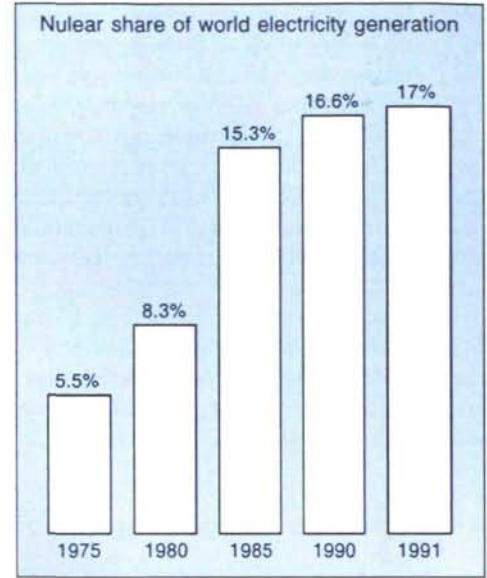
The recently drafted Convention prohibiting the production of chemical weapons probably shows how far governments generally are willing to go in accepting international inspections in today's world. A balance has to be struck. On the one hand, States wish to avoid revealing military, industrial, and commercial secrets and are concerned that industrial activities not be burdened with too frequent visits or cumbersome accounting duties. On the other hand, they have a mutual interest in creating the conditions necessary to make the inspection system credible. The Convention on chemical weapons shows that States today may be ready to go somewhat further in facilitating inspection than they were when the IAEA safeguards system was established 25 years ago. However, we still have some way to go before an international inspector is admitted to all States by simply presenting a UN *laissez-passer* and a letter showing that he is coming on official duty.

While it is important to continue strengthening and facilitating the right of access for international inspections, one must be aware that the inspectors are not an international police force that may be used, if need be, in some sort of commando raids. The inspectors go to territory and installations which are controlled by national authorities and which are made available by those authorities for inspection. The precise nature of that right of access, and effective international support for that right, therefore become crucial. An international inspectorate has no means of its own to force its way to a target of inspection.

In the case of inspections under the NPT, it has been confirmed by the IAEA Board of Governors that the Agency has the right to perform special inspections not only in declared sites and installations, but whenever there are reasons to believe that installations or material which should have been declared have not been so declared. It is most important that this right has been recognized and that States are fully aware of its existence.

It is equally important that after the case of Iraq and after the meeting of the Security Council in January 1992, all States are aware that the Council is likely to take what it called "appropriate measures", if any violation of a safeguards agreement is reported by the IAEA to the Council. I might add that a safeguards agreement would be violated not only by non-declaration of the production of enriched uranium or plutonium, but also by a denial of the right of access stipulated for inspectors.

In a world of few nuclear weapons there needs to be a high degree of confidence that no clandestine weapons production takes place. Several elements will be needed for such con-

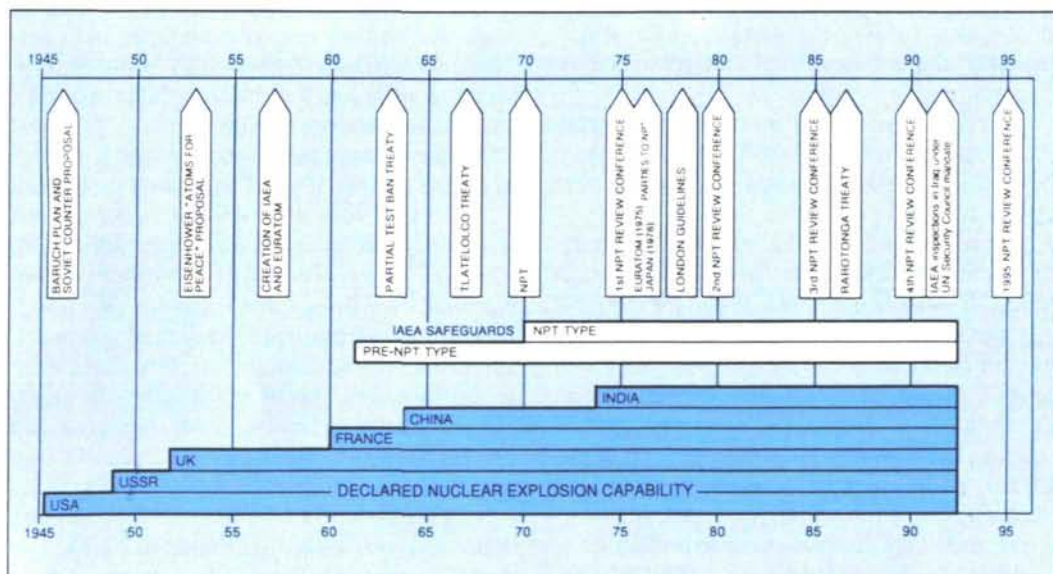
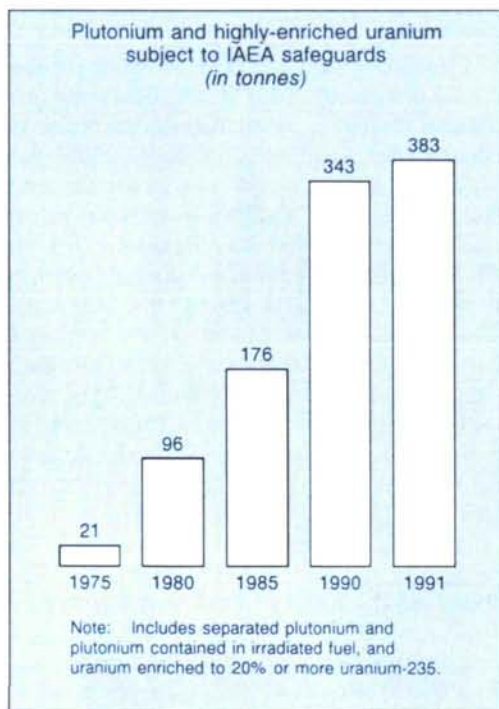
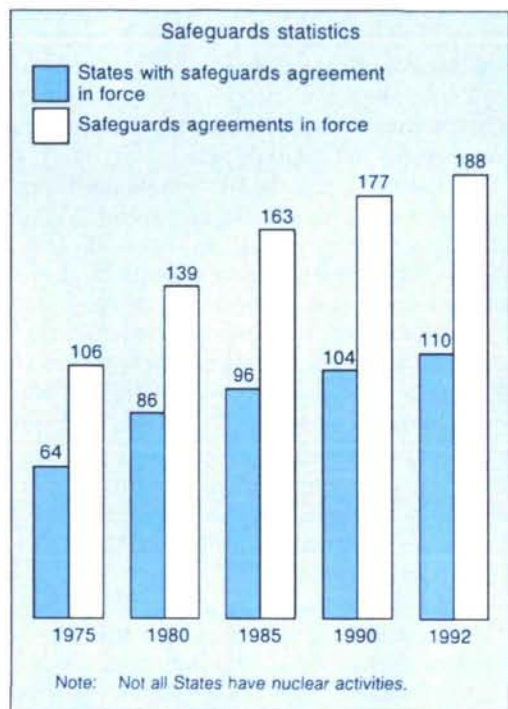


Nuclear science & technology transfer: Though growth has slowed, nuclear power's share of electricity generation has risen steadily since the 1960s. Today about 17% of the electricity produced around the world is provided by the 423 nuclear power plants operating in more than 20 countries. In nearly all countries, other nuclear technologies are being used in medical, agricultural, and industrial applications. Technical and support services for this transfer of technology often are provided through IAEA programmes. Nearly 1100 IAEA technical co-operation projects were operational in 1992, almost double the number a decade ago. More than 1000 IAEA research contracts also were awarded last year in sup-

port of nuclear-related studies and projects at scientific institutes and laboratories worldwide.

Nuclear non-proliferation: Extensive international legal and institutional frameworks have been created to prevent the further spread of nuclear weapons. One important element rests upon agreements that States sign with the IAEA for safeguarding nuclear materials and installations. A total of 188 agreements are now in force with 110 States, not all of which have nuclear activities. Most of these agreements have been negotiated in connection with the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), which 149 States have joined since it entered into force in 1970.

Nuclear numbers



confidence to exist and strengthened international verification is one of them. I have described how the present nuclear inspection system is being strengthened after the experience in Iraq. But even this reinforced system will have some limitations. Indeed, the case of Iraq is the best evidence of this. Even after 15 inspection missions (as of 7 November 1992), using rights that go much further than what States in general will accept, we still make the reservation that something could remain undetected and we stress the need for continuous and long-term monitoring. The scientific and technical knowledge to enrich uranium and design nuclear weapons remains intact in Iraq.

Confidence would be boosted in this case by a peace settlement in the Middle East removing essential incentives for all States in the region to make nuclear weapons. Confidence could also grow from active co-operation in the peaceful nuclear sphere, e.g. desalination of water by the use of nuclear power. But effective IAEA inspection is likely to remain an important element in any non-proliferation regime. It is also a resource that may be harnessed to give assurance that the growing quantities of enriched uranium and plutonium recovered from dismantled warheads and reprocessing are peacefully stored or used in nuclear reactors. It may also be used for the verification of a cut-off of production of fissionable material for weapons.

Ensuring the safety of nuclear energy

Regarding the other side of the nuclear challenge—that of safe and peaceful applications of nuclear science and technology in medicine, agriculture, industry, and energy generation—I should like to focus on the international legal and institutional framework that has been and is developing.

Much, indeed most, of the international transfer of peaceful nuclear techniques occurs in the large non-governmental nuclear sectors which have grown up all over the world. National rules provide most of the legal infrastructure for this transfer. However, the Atoms for Peace Policy, the Statute of the IAEA, and the NPT all envisage international governmental activities to promote co-operation for the safe utilization and transfer of peaceful nuclear techniques—not least to the developing countries.

I would like to focus in some detail on international activities to promote radiation protection and safety in the operation of nuclear power plants, and in the disposal of nuclear wastes.

After the Three Mile Island accident and even more so after the Chernobyl catastrophe,

the way of looking at these matters is changing. It is still recognized, of course, that the national authorities have full responsibility for nuclear safety and that nothing should be done in the international sphere to detract from that responsibility. It is also recognized, however, that some nuclear safety matters are of such direct international concern that they must be internationally regulated and that some others require certain minimum international standards, which cover essential points but leave detailed implementation to the national regulator. In the quest for what is termed an “international nuclear safety culture”, it is further recognized that services in the shape of international expert advice and peer review have roles to play.

Let me be more specific about the international normative infrastructure that has emerged—especially in the last decade.

Not surprisingly, the first international regulations worked out were those governing international transport of nuclear material. Here, there was no getting away from a common international concern that had to be satisfied. The next area to mention is that of liability for damage in the case of accidents, where two conventions were negotiated and, after Chernobyl, were linked through a joint protocol. This complex area, where national traditions and legal approaches vary greatly, will require further energetic work to ensure *inter alia* that transnational damage arising from any nuclear accident is subject to appropriate legal rules.

After the Chernobyl accident, two conventions were elaborated and adopted in record time, one concerning prompt notification of any nuclear accident which might have transnational consequences and one concerning emergency assistance in the case of accidents. Although we hope that neither will have frequent use, exercises are arranged periodically with governments to make sure that the procedures laid down in these conventions remain viable.

In the fields of nuclear power safety—siting, design, and operation—and waste processing and storage, many non-binding international guidelines and standards have been worked out over the years. The NUSS (Nuclear Safety Standards for design and operation of nuclear power plants) are comprehensive and systematic standards derived from the practical experience of the whole international community. They have been of great use as reference for some countries and as models for others. The Radioactive Waste Safety Standards (RADWASS) address safety requirements to be met in managing nuclear waste and have a function similar to NUSS.

It is only in the last few years that agreement has emerged that some rules are of such impor-

tance that they should be accepted not only as guiding but as binding by all States; that nuclear power plants and nuclear waste management and disposal everywhere in the world must respect certain standards. Where such standards are not met, there must be assistance and advice to ensure that the situation is rectified.

Last year negotiations began between governments under the auspices of the IAEA to formulate an international safety convention. Although there are many difficulties in achieving agreement, it is hoped that a draft convention will be ready by autumn 1993. In my view, the adoption of certain legally binding international norms concerning safety of nuclear power reactors and nuclear waste handling may help to convince a skeptical public that governments all over the world are agreed on the rules that must be respected. I should add that such norms must be subject to review and be updated as we acquire more knowledge and experience.

While the international community edges towards codifying safety norms binding on all, it has been grappling with the question of how to assist plants that have shortcomings which need to be addressed and which affect global perceptions about nuclear power.

International co-operation in practical measures to enhance radiation protection and nuclear safety worldwide has expanded rapidly in recent years through the services and peer reviews arranged by the IAEA and the World Association of Nuclear Operators (WANO), and through bilateral programmes. In the last 2 years considerable effort has been deployed to strengthen the safety of certain nuclear reactors in the former Soviet Union and in Central and Eastern Europe. The absence in some countries of adequate regulatory infrastructures is an additional cause for concern. There is a need for clearer direction and co-ordination of the many efforts underway. The IAEA for its part became involved at a relatively early stage, when it organized an inquiry into the safety problems of the oldest type of Soviet-designed reactor, the WWER-440/230. This systematic inquiry resulted in a diagnosis of some 100 safety issues related to plant design and operation. The report of the inquiry may be fundamental to priority setting by the countries concerned and to decisions on safety measures.

Another, more complicated effort concerns other types of power reactors in the former USSR and in Eastern and Central Europe. Judgements have to be made as to how much is possible and economic. As nuclear-generated electricity is a vital part of these countries' shaky economies, the question of phasing out is not an easy one.

The current efforts to upgrade the safety of reactors built to earlier standards put to the test



the determination of the international community to develop an international nuclear safety culture. This task calls for understanding, co-operation, and solidarity.

Laura and Enrico Fermi, the Italian scientist who headed the team that started and stopped the first self-sustaining nuclear chain reaction. (Credit: Argonne National Laboratory)

Toward the next generation

The first controlled nuclear chain reaction placed mankind before the dual challenge of achieving the peaceful exploitation of the atom and of avoiding the painful explosion of the atom. Fifty years later and 50 000 negotiations later in a post Cold War and post Gulf War world, we have reason to begin feeling that the threat of destruction from nuclear weapons is helping to bring us into an era in which the big wars are against poverty and against environmental destruction and are fought not with weapons but with science and technology—including nuclear science and technology.

While large segments of the public are not yet ready to accept an expansion of nuclear power and many governments are inclined to withhold active support for such expansion, the time should be used to complete the designs of the new generation of nuclear power plants, to establish all the elements of a nuclear safety culture accepted and respected by all States engaged in nuclear activities, and to bring about a universal commitment to non-proliferation by non-nuclear-weapon States and far-reaching agreements on nuclear disarmament by nuclear-weapon States.

If we successfully use the next few years to further these ambitions, I am convinced that the expansion of nuclear power—which may soon prove indispensable if energy demands are to be reconciled with environmental demands—will also prove acceptable to the public. □