Reinforcing the Global Nuclear Order for Peace and Prosperity

The Role of the IAEA to 2020 and Beyond

Report prepared by an independent Commission at the request of the Director General of the International Atomic Energy Agency

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This Commission is fully independent. Members serve in their personal capacity and not under instructions from any government or organization. The report reflects strictly personal views of the members of the Commission and is in no way an expression of their views in their official capacity nor the views of any government or organization with which they are affiliated. The members of the Commission endorse the report as a whole but do not each subscribe to every statement and recommendation in the text. In particular, Dr. Wolfgang Schüssel would have preferred a more skeptical perspective on the prospects of nuclear energy. Dr. Rajagopala Chidambaram, Senator Lamberto Dini and Ms. Anne Lauvergeon, on the other hand, believe that the report does not always give a balanced representation of nuclear energy issues. They feel that the safety and security risks have been exaggerated and consider that these issues are being adequately addressed and improvements continually made, with the constructive support of the IAEA, resulting in increased safety and security of nuclear energy. In their opinion, the expansion of nuclear energy can be pursued in a safe and secure manner, provided the required institutional and safety framework is put in place in the countries that are newcomers to nuclear energy. While fully appreciating the importance of global nuclear disarmament, they do not accept that there should be a direct correlation between disarmament and deployment of the peaceful uses of nuclear energy. At any rate, they estimate that the issue of disarmament is beyond the Statute of the IAEA and should not be within the scope of this report, for it is being addressed by the Conference on Disarmament in Geneva.

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The Commission wishes to thank Graham Allison (Harvard University) and Ambassador T.P. Sreenivasan who served with excellence as Executive Directors of the project; Matthew Bunn (Belfer Center, Harvard University) who played a key role in the research and drafting of the report; and Haynie Wheeler (Yale Center for the Study of Globalization) for her assistance to the project. The Commission also acknowledges with appreciation William Martin who served as the Project Coordinator appointed by the IAEA.

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Executive Summary

The international community has both auspicious opportunities and significant challenges to tackle as the world moves into its seventh nuclear decade. Expanded use of nuclear technologies offers immense potential to meet important development needs. In fact, to satisfy energy demands and to mitigate the threat of climate change – two of the 21st century's greatest challenges – there are major opportunities for expansion of nuclear energy in those countries that choose to have it. But those opportunities also pose complex and broad-ranging safety and security questions that must be addressed effectively.

The International Atomic Energy Agency (IAEA), in its continuing quest to maximize the contributions of nuclear technologies to human well-being, while minimizing the risks, deserves the unstinting support of the international community. The Agency is unique in the mission assigned to it by member states, the authorities that are granted in its Statute and in safeguards agreements to inspect nuclear activities around the world, its global expertise in nuclear science and technology, its well-earned reputation for objectivity and technical competence, and its role at the center of so many aspects of the world's nuclear future. The Agency's roles in nuclear safeguards, safety, and security complement each other: measures to strengthen any of these "three S's" can have important benefits for the others, and all of the three S's are essential to the future growth of nuclear applications. A strengthened IAEA with adequate authority, resources and personnel is absolutely essential to reinforce the global nuclear order for peace and prosperity.

Nonproliferation, disarmament, and peaceful use – the three pillars of the Treaty on the Nonproliferation of Nuclear Weapons (NPT) – are integrally linked, and achievements in each area are likely to require progress in the others. In particular, gaining agreement on the steps needed to strengthen the global nonproliferation regime will require meaningful progress toward nuclear disarmament and toward making the benefits of nuclear energy potentially available to all. Hence, a bold agenda is required that seeks to address all of these challenges simultaneously.

In this report we call for a reinvigorated global nuclear order that will reduce risks while allowing rapidly growing contributions to human well-being from nuclear technologies. If successful, this new order could lead, ultimately and effectively, to an era of Atoms for Peace and Prosperity as envisioned at the Agency's conception in 1953. A reinforced global nuclear order will emerge as a product of increased collective action and partnership, expanded transparency, increasingly effective standards for safety and security worldwide, new nonproliferation measures, and progressive steps to reduce and ultimately eliminate nuclear weapons.

Four strong partnerships are needed to forge a reinvigorated nuclear order: first, between nuclear weapons states and non-nuclear weapon states; second, among nuclear technology and fuel-cycle suppliers, states that want nuclear energy, and the IAEA; third, among the states, the private sector, and international agencies; and fourth, among developed countries, developing countries, international development institutions and the IAEA.

The spiraling cost of fossil fuels and the impending threat of climate change, against which nuclear power is recognized as an important mitigating option, may make a renaissance of nuclear energy likely in the near future. International cooperation should be strengthened immediately to ensure that any possible expansion of nuclear energy will be safe and secure and will not contribute to nuclear weapons proliferation. The IAEA will have the responsibility to help newcomer states put in place the necessary infrastructure needed to develop nuclear energy safely, securely and peacefully. It should work with member states to coordinate research to design reactors that are economical, safe and proliferation-resistant. It must expand its efforts to help states establish safe and sustainable approaches to managing nuclear waste, and to build public and international support for implementing them. The Agency will also be required to develop international nuclear safety standards and to promote the harmonization of certification processes for new reactor models. Shared regional nuclear plants, mechanisms for the assured supply of nuclear fuel, including international banks of enriched uranium, multinational management of the entire

fuel cycle, estimation of global resources of uranium and research and development of thorium fuel cycles are among the endeavors that will result in additional responsibilities for the IAEA.

The IAEA's technical assistance in developing countries for nuclear applications in health, agriculture, industry, environment, hydrology and biological and physical research is important both for its direct contribution to human well-being and because it helps to build broad support for the Agency itself and its larger energy, safety, security, and non-proliferation missions. In many applications outside the nuclear energy sector, the nuclear component may be only a small part of the whole effort, but crucial to success, and the IAEA is the only agency with the necessary expertise. Also, the nuclear community's extensive knowledge in areas such as thermal engineering, materials, and computational fluid dynamics can be networked through the IAEA to contribute significantly to other technologies. The Agency's technical cooperation program needs to be expanded and diversified to ensure it keeps pace with the growth in the Agency's other activities. This will entail a higher outlay and assured and predictable funding for nuclear applications and technical cooperation. Demand for technical assistance will always exceed the resources allocated for it, but developing countries' expectations for such support from the IAEA need to be better satisfied in the future.

Safeguards are a core mission of the IAEA and will continue to be a central part of its work. In fact, the IAEA's safeguards responsibilities have been expanding rapidly. From 1984 to 2007 the amount of nuclear material under safeguards increased more than tenfold. Member states are calling on the Agency to implement the Additional Protocol as well as to pursue a country-level, information-driven approach to safeguards that requires the Agency to examine a broad range of additional and more sophisticated types of information. The IAEA's existing authorities should be interpreted to give the Agency the responsibility to inspect for indicators of nuclear weaponization activities. As has become clear from recent events, sometimes transparency going well beyond the measures called for in the Additional Protocol is needed to provide confidence that a state's nuclear program is entirely peaceful. The IAEA should work closely with member states developing new fuel cycle processes, so that effective safeguards, nonproliferation, and physical protection measures can be designed into such new systems from the outset. Clearly, further increases for safeguards work will be needed if nuclear energy grows and other circumstances change in the future. Yet, since the early 1980s, the Agency was subject to zero real growth in funding, except for a modest increase approved in 2003. Given these increased responsibilities, a substantial increase in IAEA resources for safeguards is urgently required. IAEA member states should provide the funds needed to ensure that the effectiveness of safeguards is not compromised by lack of resources.

Though nuclear security is fundamentally the responsibility of individual states, the IAEA has an important role to play in addressing the threat of nuclear terrorism. It is the only global body with relevant competence and expertise relied on by a wide range of countries. States should negotiate binding agreements that set effective global nuclear security standards. They should agree to give the IAEA an important role in developing those binding standards and assisting in and confirming their implementation. The IAEA should develop model legislation that will help states fulfill their UNSC 1540 obligations to enact effective national laws prohibiting acts related to nuclear terrorism and nuclear smuggling. The IAEA should expand its efforts to ensure effective security for the most dangerous radiological sources worldwide and increase the priority it gives to preventing nuclear smuggling. And it should continue its efforts to help states prepare to cope with the consequences of a radiological dispersal.

Although nuclear safety has improved enormously in recent decades, the risk of an accident at any given reactor must continue to be reduced. The IAEA's role in persistently improving the global safety regime is critical and must be strengthened. The Agency should lead an international effort to establish a global nuclear safety network, and ensure that critical safety knowledge, experience, and lessons learned are broadly exchanged. Over time, with the IAEA's involvement, states should enter into binding agreements to adhere to effective global safety standards and to be subject to international nuclear safety peer reviews. Member states and the IAEA should strengthen their critically important efforts to ensure that countries embarking on nuclear power programs develop sound safety infrastructures, including effective and independent regulatory bodies. The Agency should expand its

efforts to assist states in assessing and strengthening the nuclear safety culture.

Article VI of the NPT legally obligates the nuclear weapons state parties to negotiate in good faith toward nuclear disarmament, and at the 2000 NPT Review Conference, they agreed that the treaty represented an "unequivocal undertaking" to "accomplish the total elimination of their nuclear arsenals." This commitment is an integral part of the NPT bargain. The need for the NPT to become universal cannot be stressed enough. States must recommit to the vision of a world free of nuclear weapons. They must take firmer steps to reinvigorate the grand bargain that was struck 40 years ago. The renewed grand bargain will need to combine steps that can be taken immediately with a vision for the longer term, to draw in states that are not parties to the NPT. The IAEA is not the lead agency or forum for nuclear disarmament, but progress towards disarmament, or the lack of it, deeply affects the IAEA's nonproliferation mission. And the IAEA's rich experience in verification must be utilized as disarmament proceeds.

The stronger global nuclear order we propose would feature greatly expanded international cooperation and transparency, with new partnerships for nuclear energy, development, disarmament, non-proliferation, safety, and security. It would:

- Help enable a safe and secure expansion of nuclear energy in those countries that seek it, helping to power a growing global economy while mitigating the threat of climate change;

- Make it possible for nuclear technologies to expand their role in saving lives, growing crops, and providing jobs in the developing world;

- Reduce the dangers of nuclear accidents and nuclear terrorism; and

- Provide a path toward dramatically reduced dangers to humanity from nuclear weapons and nuclear proliferation.

While building the reinvigorated global nuclear order we propose will require actions by many parties going well beyond the IAEA, a strengthened IAEA with additional resources, able to attract and retain the best personnel, will be essential. The global investment in the crucial mission of the IAEA with immense consequences for world security has been remarkably small. The safeguards budget of the IAEA, which is meant to safeguard hundreds of tons of nuclear material in hundreds of facilities in scores of countries, is not more than the budget of the police department of the city in which it is located. Investments in nuclear security, nuclear safety, nuclear energy, nuclear applications and technical cooperation are even smaller. Modernization of the Agency's scientific and information infrastructures is long overdue.

A thorough reform of the funding of the Agency has become all the more urgent with the additional tasks that this report envisages for the Agency in 2020 and beyond to effectively seize the opportunity of Atoms for Peace and Prosperity. Without additional and reliable funding, the IAEA will not be able to:

- Carry out independent analysis of safeguards samples, essential to provide credible verification of the non-proliferation of nuclear weapons. Urgent funding is needed to shore up the failing infrastructure and instrumentation, and ensure the safety and security, of the Safeguards Analytical Laboratory.

- Play its essential role in combating nuclear terrorism and in ensuring the safety of nuclear power plants and other nuclear facilities. The staffing of these vital programs currently has to rely to a very large extent on unpredictable voluntary funding.

- Provide an adequate response, in terms of prompt international coordination and assistance, to a nuclear accident or terrorist act involving nuclear or radioactive material.

- Ensure that the many new countries considering introducing nuclear power programs do so in a carefully planned, and safe and secure, manner.

- Respond to pressing global crises in food security, health and the availability of drinking water through the use of nuclear techniques, for example by helping to ensure transboundary control of insect pests harmful to fruit and vegetables, developing sustainable crop varieties tolerant to harsh conditions, helping address the growing cancer epidemic, especially in the developing world, and underpinning desperately

needed improvements in water resources management.

- Meet, in a timely manner, urgent requests relating to verification of non-proliferation. Currently, voluntary funding has to be sought for unforeseen high priority needs.

The increase in funding must be accompanied by a renewed and transparent effort by the IAEA Secretariat to further improve its already impressive record of efficiency. It must not rest on its laurels but seek every opportunity to further develop a management culture that emphasizes accountability, a readiness to accept change, and effective coordination with other organizations. The IAEA's personnel policies also require reform.

The Commission unanimously believes that to enable the IAEA to properly accomplish its duties, it should be allocated considerably larger resources by its members. We recommend that the Board of Governors provide an immediate one-time increase in the IAEA's budget by €80 million for *inter alia* refurbishing the Safeguards Analytical Laboratory and for adequate funding of the Agency's Incident and Emergency Response Center.[1] The Board should also agree to consistent annual increases in the regular budget to underpin the expansion of the Agency's security and safety work, other activities in support of newcomer states embarking on nuclear programs, and an expansion of work in nuclear applications and technology transfer. The exact amount of additional regular budget should be determined after a detailed review of the budgetary situation and additional workloads of the Agency, but the Commission estimates that increases of about €50 million annually in real terms might be necessary during several years.

In the longer time frame, the regular budget will need to continue increasing in order to meet the growing demands for IAEA services. A substantially bigger regular budget – by 2020 perhaps twice as large as the present one – would allow the needed expansion of work on nuclear reactors and the fuel cycle, security and safety, and support for meeting basic human needs through nuclear applications and technical cooperation. It would also meet an additional funding requirement in the verification area to ensure an independent and credible system, and address other existing unfunded liabilities.

The Commission endorses the idea that the IAEA is an "extraordinary bargain," considering that it carries out its responsibilities of immense value to humanity at a very low cost. By 2020 and beyond, these responsibilities will increase dramatically as mankind and the Agency face new opportunities and challenges. In the new partnerships that the Commission envisages for nuclear energy, development, disarmament, non-proliferation, safety, and security, the IAEA's strengthened role would require additional authority, resources, personnel and technology. The cost of providing these would be insignificant compared either to the benefits to be gained or to the risks and costs of failure to act. Now is the time to choose.

[1] We have taken as credible the figure that was provided in the Director General's Report (footnote 22, page 24, "20/20 Vision for the Future").

1. Introduction: Opportunities and Challenges

The international community has auspicious opportunities and significant challenges to tackle as the world moves into its seventh nuclear decade. Expanded use of nuclear technologies offers immense potential to meet important development needs. In fact, to satisfy energy demands and to mitigate the threat of climate change – two of the 21st century's greatest challenges – there are major opportunities for expansion of nuclear energy in those countries that choose to have it. Other nuclear technologies are playing an important role in economic and social development and can play a larger role in the future, by helping to prevent and treat deadly diseases, control insect pests, manage safe water supplies, and develop more drought- and disease-resistant crops. But nuclear technologies also pose complex and broad-ranging safety and security challenges that must be addressed effectively.

The Commission's Charge

With a record of fifty years of distinguished service to humanity, recognized in the award of the Nobel Peace Prize in 2005, the International Atomic Energy Agency (IAEA) is actively exploring how the world and the Agency must adapt to seize the opportunities and cope with the challenges. In late 2007, IAEA Director General Mohamed ElBaradei established this Commission to advise on how the nuclear future might evolve to 2020 and beyond, what the world is likely to demand of the IAEA, and what steps need to be taken to allow the IAEA to fill those needs.

In its largest sense, the question before us is: what actions must the international community take to maximize the contributions to human well-being from nuclear technologies, while minimizing their risks? The answers we offer focus first and foremost on steps the IAEA can take. But we also emphasize that additional significant steps will need to be taken by other multilateral institutions, national governments, industry, and other key stakeholders in the global nuclear system.

Our Commission was greatly assisted in its work by an excellent background report, "20/20 Vision for the Future," prepared by the Director General of the IAEA. The Director General's report is a comprehensive, professional, and accessible document. As that report and many other inputs to the Commission make clear, the IAEA plays critical roles in nuclear energy, nuclear applications, nuclear nonproliferation and safeguards, nuclear safety, and nuclear security.

The IAEA is unique in the mission assigned to it by member states, the authorities granted in the IAEA Statute and in safeguards agreements to inspect nuclear activities around the world, its global expertise in nuclear science and technology, its well-earned reputation for objectivity and technical competence, and its role at the center of so many aspects of the world's nuclear future. The Agency's roles in nuclear safeguards, safety, and security complement each other: measures to strengthen any of these "three S's" can have important benefits for the others, and all of the three S's are essential to the future growth of nuclear applications.

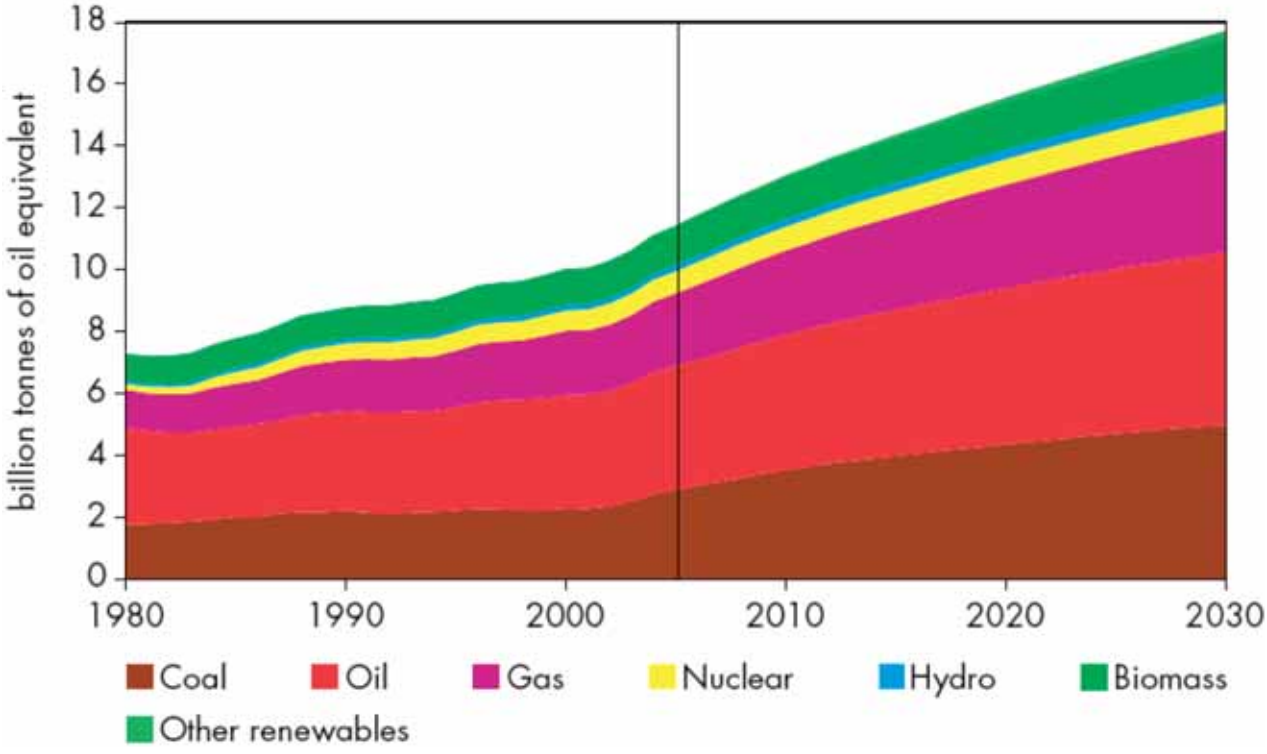
Facts and Trends that Frame the Opportunities and Challenges

Ten key facts and trends frame the nuclear opportunities and challenges the world now faces.

1. **Energy demand is surging worldwide.** To sustain rapid global economic growth will require doubling the supply of energy, and tripling the supply of electricity, by 2050. (Figure 1.1 shows projected energy demand and fuel use to 2030.) Meeting these demands will stretch all current sources of energy supply and require major improvements in efficiency. At the same time, mitigating climate change will require shifts in the fuel mix.

2. **Billions of poor people need energy and other life-saving and job-creating technologies.** Four out of every ten people on earth today live on less than $2 a day. The suffering and loss of human potential caused by this poverty is the greatest tragedy of our time. Combating global poverty requires economic growth, and economic growth requires adequate and reliable supplies of energy; indeed, the Human Development Index correlates very strongly with per capita energy consumption. Applications of nuclear techniques in areas such as agriculture and the management of water resources also

Figure 1.1: **World Primary Energy Demand**



Source: International Energy Agency, *World Energy Outlook 2007,* reference scenario.

hold promise for improving the living standards of the poor.

3. **Energy prices are increasing.** Current oil prices of more than $100 a barrel are fueling frictions and development setbacks around the world. In coming decades, growing competition for supplies of oil and natural gas will exacerbate geopolitical tensions and heighten the risk of conflicts. Conceivably, a broader reliance on nuclear energy, whose prices are much less dependent on its fuel costs, could help ameliorate those tensions and risks.

4. **Drastic steps are needed to reduce greenhouse gas emissions.** In a world still dependent on burning coal, oil, and natural gas for 80 percent of its energy supply, surging energy use causes surging emissions of greenhouse gases, disrupting the climate with potentially catastrophic results. A major transformation of global energy use and supply, involving substantial growth in low-carbon energy production, will be required to stabilize atmospheric concentrations of greenhouse gases and thus mitigate climate change.

5. **Substantial growth in "clean" energy production will be required to mitigate climate change.** Though opinions differ about its future growth rate, nuclear energy is a readily expandable source of low-carbon baseload electricity, and in the future might also help to meet other energy needs, such as for hydrogen production and water desalination. Today, 439 nuclear power plants with a capacity of 369 gigawatts-electric (GWe) in 30 countries provide some 15 percent of the world's electricity, meeting approximately 6 percent of global primary energy demand. Producing this amount of electricity with oil would require some 650 million metric tons of oil per year. For nuclear plants to provide a significant fraction of the low-carbon energy likely to be needed in the 21st century would require a three-fold increase or more in nuclear capacity by 2050. With such a global tripling, nuclear plants would provide 15 to 25 percent of the world's electricity supply.

6. **Nuclear energy's recent growth has been slow but has started to speed up.** Since the aftermath of the Three Mile Island and Chernobyl accidents, the global growth of nuclear energy

has been slow, and in recent years only about 4 GWe of nuclear power generation capacity has been connected to the grid each year worldwide. Yet today, two large third-generation reactors are under construction in Western Europe (Finland and France) and more are planned in the UK and Eastern Europe; a significant number of US utilities have engaged in construction and operating license processes to build new nuclear power plants; Russia is investing billions of dollars to rapidly expand its nuclear energy capacity; Japan and South Korea have expansion programs underway, while China and India have both started substantial expansions of their nuclear energy infrastructure, suggesting that by 2050, nuclear power might grow as much as tenfold in Asia; South Africa is selecting a supplier for two reactors, and possibly twelve more; Brazil is contemplating a new expansion of its nuclear energy capacity; and dozens of countries are now considering building their first nuclear power plants.

7. **Nuclear safety has improved significantly but the risk of accidents persists.** A wide range of safety indicators make clear that nuclear safety in many countries has improved significantly since the Three Mile Island and Chernobyl accidents. The third-generation nuclear reactors now being built are designed to reduce further the risk of nuclear accidents and any potential adverse impact on health and the environment. But the Davis-Besse incident in the United States in 2002 – where less than a centimeter of steel remained in the steel pressure vessel to prevent a major loss of coolant, in a sequence of events that had never been included in probabilistic risk assessments – is a reminder that maintaining nuclear safety is an ongoing process that requires the utmost care, not only at the design stage but also during operation. Some of the oldest-design reactors still in use in several countries pose particular concerns, and in newcomer states that are just establishing their regulatory infrastructures, teams of qualified personnel, and nuclear safety cultures, the safety of reactors will require special attention. A serious accident anywhere would impair any prospect for large-scale global growth of nuclear energy.

8. **Nuclear terrorism poses a real threat to all.** Government studies in several countries have made clear that a sophisticated and well-financed terrorist group that acquired enough highly enriched uranium (HEU) or separated plutonium might be able to construct a crude nuclear bomb that could incinerate the heart of any of the world's major cities.[2] If such an attack occurred, no matter where, its economic and security consequences would affect every country. Security for nuclear weapons, installations, and materials has improved substantially in many countries over the past decade. But seizures of small quantities of stolen HEU or plutonium – most recently in Georgia in 2006 – make clear that at some locations these materials are still vulnerable to theft. Most of the material seized over the years has never been reported missing, suggesting that at some sites material control and accounting measures are also inadequate. No specific and binding global standards for nuclear security yet exist. Appropriate steps are also required to further protect major nuclear facilities from sabotage and to improve controls over dangerous radiological sources. A terrorist nuclear bomb or a major radioactive release from terrorist sabotage of a nuclear facility could cancel any chance for large-scale growth in nuclear energy use.

9. **The nuclear nonproliferation regime must be strengthened.** Recent years have seen some significant successes in stemming the spread of nuclear weapons, with Libya's decision to give up its secret nuclear weapons program; Belarus, Kazakhstan, and Ukraine sending all the nuclear weapons on their soil back to Russia and joining the Treaty on the Nonproliferation of Nuclear Weapons (NPT) as non-nuclear-weapons states; the breakup of the global black-market nuclear technology network that was led by Pakistan's A.Q. Khan; the adoption of the Additional Protocol[3] designed to strengthen safeguards agreements; and more effective information-driven approaches to safeguards. Significantly, in 1990 South Africa terminated its nuclear weapons program and in 1991 it signed the NPT and welcomed the IAEA to conduct

[2] Matthew Bunn, *Securing the Bomb 2007*, Cambridge, MA and Washington, D.C.: Project on Managing the Atom, Harvard University, and Nuclear Threat Initiative, September 26, 2007.

[3] The text of the Additional Protocol is online at <http://www.iaea.org/Publications/Documents/Infcircs/1997/infcirc540.pdf>

an unprecedented verification of its nuclear rollback. Indeed, there are now more states that have started nuclear weapons programs and verifiably given them up than there are states with nuclear weapons. Historically, nonproliferation efforts succeed more often than they fail. At the same time, however, the stresses in the system have grown. If Iran and North Korea both become established nuclear weapons states, other states would come under increased pressure to follow suit and the global nonproliferation regime would be severely weakened. If nuclear weapons continue to be seen as offering security and prestige, and states that maintain them continue to send the message that nuclear weapons are essential to security, more states may seek such weapons. If, as nuclear energy grows and spreads, the dual-use technologies that make it possible to produce nuclear weapons material also spread, more and more states may be in a position to leave the global regime and produce nuclear weapons on short notice. In short, as the UN High-level Panel on Threats, Challenges, and Change warned, "we are approaching the point at which the erosion of the non-proliferation regime could become irreversible and result in a cascade of proliferation."[4]

10. **Progress on disarmament is slow.** Four decades after the NPT was signed, some 25,000 nuclear weapons still exist – thousands of them on quick-launch alert. The nuclear weapons states point to ongoing reductions in their nuclear stockpiles as evidence that they are fulfilling their NPT Article VI obligations to negotiate in good faith toward nuclear disarmament. By contrast, many of the non-nuclear-weapons states see the progress as too slow, and believe that the nuclear weapons states are not serious about carrying out their obligations. Some states with nuclear weapons are pursuing the production of weapons-grade material and indeed seem to be increasing their reliance on nuclear weapons, laying plans for maintaining nuclear arsenals indefinitely. At the 2000 NPT Review Conference, the nuclear weapons states committed to an "unequivocal undertaking" to "accomplish the total elimination of their nuclear arsenals," and to taking 13 "practical steps" to fulfill the NPT's disarmament obligation. But few of these steps have yet been implemented, and the 2005 Review Conference collapsed in part because a major nuclear power refused even to discuss them. This situation causes festering resentment over "double standards," and what are seen as efforts to perpetuate the inequities of the nonproliferation regime. The mounting resentment makes it much more difficult to agree on steps that are urgently needed to strengthen the global effort to stem the spread of nuclear weapons – even though such steps would serve the interests of all. While the IAEA is not the lead forum or agency for disarmament, this resentment could seriously impede the IAEA's ability to accomplish its other missions.

[4] *A More Secure World: Our Shared Responsibility, Report of the Secretary-General's High-level Panel on Threats, Challenges and Change (2004).* <http://www.un.org/secureworld/>

2. A Reinforced Global Nuclear Order

If the world fails to seize the opportunities and to meet the current challenges – in particular by failing to give the IAEA the authorities and resources it requires to carry out its missions – there is a serious risk that the world will move on to a downward path fraught with significant dangers. In such a world, large-scale growth of nuclear energy would be unlikely, meeting the challenge of climate change would be more difficult, and human needs that require energy would be harder to satisfy.

Major steps are required to seize a potentially huge opportunity: for a safe and secure nuclear order in which atoms, for those countries that so wish, provide low-carbon energy that helps to sustain global economic growth while helping to avoid severe climate disruptions. Non-proliferation, disarmament, and peaceful use – the three pillars of the Nonproliferation Treaty – are integrally linked, and achievements in each area are likely to require progress in the others. In particular, gaining agreement on the steps needed to strengthen the global nonproliferation regime will require meaningful progress toward nuclear disarmament and toward making the benefits of nuclear technology available to all. Hence, a bold agenda is required that seeks to address all of these challenges simultaneously.

In this report we call for action on this bold agenda, to reinvigorate the global nuclear order so as to reduce risks while allowing rapidly growing contributions to human well-being from nuclear technologies. In the Commission's judgment, the cost and risks of taking such action now – including the costs of building a stronger and more effective IAEA – are tiny in comparison to the costs and risks of failing to act.

If it can be created, this strengthened nuclear order could ultimately produce an era of Atoms for Peace and Prosperity, as was the hope when the IAEA was conceived in 1953. This is a task that goes well beyond the IAEA's mandate and capabilities, but reinforcing the IAEA will be crucial. A stronger nuclear order will emerge as a product of increased collective action and partnership, expanded transparency, increasingly effective standards for safety and security worldwide, new nonproliferation measures, and progressive steps to reduce and ultimately eliminate nuclear weapons. National governments, private industry, industry associations and other non-government organizations, academic organizations and research laboratories, the public, and the press will all have to work along with the United Nations, the IAEA, and other international institutions to create the stronger structure we envisage. Indeed, nuclear technologies are only one element of the broader security and development agenda. Achieving effective, sustainable, and equitable security and development will require a broad range of steps going far beyond the scope of this report, including a reinvigorated United Nations and Security Council, as well as a strengthening of the multilateral institutions for development.

Four strong partnerships are needed:

1. **A partnership between nuclear weapons states and non-nuclear weapons states** that takes major steps to strengthen the global nonproliferation regime and major steps toward nuclear disarmament. Action on both of these fronts serves the security interests of all states, and action on both will be required to achieve agreement on either.

2. **A partnership among nuclear technology and fuel-cycle suppliers, states that want nuclear energy, and the IAEA,** to provide assured supply of nuclear fuel products and services, and of services for used fuel and waste management, under international supervision and control.

3. **A partnership among states, the private sector, and international agencies**, in which all parties share both the responsibilities and costs of assuring that the use of nuclear energy remains safe and secure, and does not contribute to nuclear proliferation.

4. **A partnership among developed countries, developing countries, international development institutions, and the IAEA**, to ensure that the world community maximizes the contribution of nuclear technologies to development and human well-being and minimizes the risks to human health and the environment.

The following sections of our report provide specific recommendations for achieving the goals of these four partnerships, particularly (though not exclusively) focusing on the role the IAEA should play. These goals can be expressed by three "yes's" and three "no's":

- A safe and secure expansion of nuclear energy for countries that seek it
- Enlarging the contribution of nuclear applications to human well-being
- Substantive and rapid progress in nuclear disarmament
- No nuclear proliferation
- No nuclear terrorism
- No nuclear accidents.

These propositions lead us to say a final "yes:" to a stronger IAEA, with the authority, information, technology, high-quality personnel, and resources it needs to help build the reinforced nuclear order that is required.

3. A Safe and Secure Expansion of Nuclear Energy for Countries that Seek It

Planning for the growth of nuclear energy is accelerating, as was noted in Section 1 above. China, India, Russia and South Africa in particular are planning large programs to build new nuclear power plants. In the United States, utilities are planning new nuclear reactors for the first time in many years. New nuclear projects are planned in as many as half the European Union member states. Japan and South Korea are pursuing expansion programs. Many developing countries have announced plans to build nuclear power plants.

The expected growth in nuclear energy will inevitably place new demands on the IAEA, requiring expanded resources. The Agency must continue its work on developing safety standards particularly for the benefit of newcomers in the use of power plants for electricity generation. If states without nuclear weapons do not establish new fuel-cycle facilities, the additional demands for safeguards may be modest, but there will nonetheless be substantial growth in the need for the IAEA to help establish national frameworks and infrastructure for the safe and secure use of nuclear energy. To meet these needs, the Agency will require additional resources for its departments concerned with nuclear energy and technical cooperation.

The economics of complex and sensitive nuclear fuel-cycle facilities (for uranium enrichment or spent fuel reprocessing) do not warrant a multiplication of these facilities. They rather call for establishing large-scale multinational facilities in a limited number of locations that are optimized to respond to worldwide needs. Countries that choose to develop nuclear energy without investing in such facilities must be assured that at all times they will be able to obtain the necessary supplies to operate their reactors over the long term.

The continued effective operation of the world's fuel-cycle market provides the first and basic level of supply security on reliable and competitive terms. The suppliers' responsibility is to serve the competitive world market, and to offer long-term supply contracts with attractive and reliable terms. The security of supply achieved by such long-term contracts would be enhanced if supplier states were to grant guaranteed generic export licenses, underpinned by a legally binding commitment not to revoke such licenses provided the recipient country continues to meet its non-proliferation obligations, as determined by the IAEA.

The leading fuel-cycle supplier states and the Agency are currently working to establish additional mechanisms for assured fuel supply, including two more layers of guarantees: a collective guarantee by suppliers (industry and states) in case of a contract disruption for political reasons other than nonproliferation; and an IAEA-controlled inventory of enriched uranium that could be used as a last resort, with associated arrangements to provide assurances regarding fuel fabrication.

Such mechanisms would help countries have access to nuclear power while reducing the need to construct proliferation-sensitive facilities themselves. Countries should not be asked, however, to give up their legal right to develop such facilities.

Other initiatives are in progress to promote international cooperation for the safe and secure expansion of nuclear energy. Russia has launched a number of proposals, stretching back to President Putin's speech at the United Nations Millennium Summit of September 2000, which called for a new, safe, and secure approach to nuclear energy. More recently, Russia proposed the development of a global network of international fuel-cycle centers that could provide assured fuel-cycle services to nuclear reactors throughout the world without spreading sensitive technologies. Russia has established the International Enrichment Center at Angarsk, offering interested nations the opportunity to participate in the Center's management and profits without accessing the technology, much as the EURODIF consortium has done in France since the mid-1970s. Urenco represents a somewhat different multilateral approach in which the participants share the technology, but following a recent agreement the technology is now confined to a single entity under the control of the Cardiff Treaty among France, Germany, the Netherlands, and the United Kingdom.

The IAEA's International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) brings

many states together to consider approaches to safer, cheaper, more secure, and more proliferation-resistant nuclear systems, with effective management of nuclear waste. The United States and a group of other leading nuclear technology states have established the Generation IV International Forum to develop the next generation of nuclear reactors and fuel cycles. In 2006, the United States proposed a Global Nuclear Energy Partnership (GNEP), and a group of states has now agreed to a GNEP statement of principles focusing on cooperating in the safe, secure, and proliferation-resistant development of nuclear energy. The leading fuel-cycle suppliers and the IAEA are working to establish multinational mechanisms for assured fuel supply.

Germany has proposed the establishment of an international enrichment facility under fully international control; Austria has proposed placing all transactions regarding nuclear fuel under the auspices of a Nuclear Fuel Bank; the United Kingdom has put forward the Enrichment Bond initiative to provide robust back-up guarantees against politically motivated interruptions of enrichment supply; Japan has proposed to take care of all front-end activities of the fuel cycle and to entrust the IAEA with the task of further improving the transparency of the market. As is pointed out in Section 6 of this report, the multilateralization of the nuclear fuel cycle would also make a decisive contribution to nonproliferation efforts.

At their 2006 energy summit, the G-8 countries strongly supported international cooperation to develop and expand nuclear energy. Such developments and expansion require efficient management of natural resources and of radioactive wastes – which may include extensive recycling to better use the energy contained in uranium and to reduce the volume and radio-toxicity of the ultimate waste – and appropriate conditioning and engineered technologies for waste disposal.

Developing solutions to the nuclear waste problem that are sustainable and acceptable to the public is essential. The IAEA has an important role to play in fostering international cooperation, reviewing national approaches, building international consensus, and communicating to the public a balanced assessment of the solutions and risks involved. States are pursuing different approaches to the nuclear fuel cycle. Whatever approach they take, they must adopt and maintain the highest standards of safety, security, and proliferation-resistance. Through programs like INPRO, the IAEA can play a key role in establishing international approaches and criteria that help ensure that such standards are maintained.

National governments, private companies, and consortia among them will lead in developing and deploying new nuclear energy systems. But the IAEA must play a central part in setting the standards and establishing the frameworks that could allow nuclear energy to grow safely, securely, and with minimum proliferation risk.

Continued and expanded contributions from the IAEA in the following areas will be indispensable:

- Setting safety, security, and nonproliferation standards, helping states to meet them, and reviewing states' performance in implementing them.

- Assisting "newcomer" states in energy planning and decisions on whether to pursue nuclear energy, and, at these states' request, providing technical support for establishing appropriate infrastructure, regulations, cadres of trained personnel, and safety culture.

- Promoting international exchange of ideas, experience, and critical data.

- Promoting the development of technological solutions that enhance the sustainability, economics, safety, and proliferation-resistance of nuclear energy systems and reduce their generation of long-lived waste.

- Encouraging the development of – and possibly managing – new forms of international and regional cooperation on nuclear energy, including new mechanisms for assured fuel supply, internationally controlled fuel-cycle facilities, international consortia to provide comprehensive services for nuclear energy, international sharing of nuclear reactors, and, in the future, international facilities for storing spent fuel, retiring nuclear waste, and storing fissile material.

Recommendations

- International cooperation should be strengthened immediately to ensure that an expansion of nuclear energy will be safe and secure and will not contribute to weapons proliferation.

- The IAEA should encourage "newcomer" states that have not yet done so to sign and ratify all international conventions related to nuclear energy, so they can benefit from the harmonized dispositions that those conventions provide in developing the institutional framework and infrastructures they need for introducing nuclear energy.

- The IAEA – using its document *Milestones in the Development of a National Infrastructure for Nuclear Power*[5] as a framework, and working with supplier states and donor states – should help "newcomer" states to consider their options; to put in place the necessary infrastructure to develop nuclear energy safely, securely, and peacefully; and to launch their nuclear energy programs. In particular, the Agency can help these states in: (a) energy planning; (b) nuclear law and regulations, including the establishment of effective and independent nuclear regulatory authorities; (c) preparation for waste management and environmental protection; (d) site selection; (e) safety and security standards and culture; (f) personnel training; (g) quality assurance; (h) understanding available financing options; (i) best practices; (j) operating technology; (k) nuclear knowledge management; and (l) management efficiency. This assistance can be optimized by coordination with efforts that are underway under cooperation agreements between supplier and recipient states.

- The IAEA should continue to work with member states and industry to coordinate and influence research and development on nuclear energy and to promote international cooperation on advanced nuclear science and technology. It should encourage states to design the highest levels of safety, security, and proliferation-resistance (including safeguardability) into new nuclear systems from the outset. Programs such as INPRO are important in this regard, and should be continued. The IAEA should continue to support R&D in member states on a wide range of next-generation nuclear energy options, including fast reactors, high-temperature reactors, small factory-built sealed-core reactors, and accelerator-driven systems, among others. Further, R&D should be promoted to advance the technologies for closing the nuclear fuel cycle and for the use of thorium to solve many of the challenges of enhanced nuclear deployment. Such R&D should include nuclear systems for electricity generation, but also for hydrogen production and water desalination; it should also include innovative approaches to the fuel cycle that may improve economics, safety, proliferation-resistance, or waste management. The IAEA should also continue to support international R&D on nuclear fusion, which may be an important energy option for the longer term.

- The IAEA should enhance its cooperation with scientific organizations such as the International Council for Science (ICSU), the InterAcademy Council (IAC), and the InterAcademy Panel on International Issues (IAP), with a view to encouraging nuclear scientists to work on research of relevance to the IAEA. The Agency would also benefit from the development of a network of scientists interested in the cutting-edge issues of energy.

- The IAEA should expand its efforts to help states establish safe and sustainable approaches to managing spent fuel and nuclear waste, including recycling and waste minimization, and to build public and international support for implementing these approaches.

- International initiatives and cooperation should be encouraged to assure nuclear fuel supply to countries without increasing the risks of spreading sensitive technologies. To this end, the nuclear industry should maintain the existing trend towards assured long-term supply contracts that provide assurances of fuel-cycle supply through market mechanisms; fuel-cycle suppliers should enter into collective arrangements to step in and provide services in the event of an interruption in supply. Supplier states should develop and adopt a

[5] *Milestones in the Development of a National Infrastructure for Nuclear Power.* Vienna: IAEA, 2007.

generic export license system guaranteeing that supply will not be interrupted except in the case of a breach by the recipient country of its nonproliferation obligations, as determined by the IAEA. The IAEA should encourage these arrangements for assured supply, and play a leading role in backing them up. This could be done, as a last resort in the near term, by means of international banks of enriched uranium and associated arrangements to provide assurances regarding fuel fabrication as a last resort backup to a layered network of fuel assurance mechanisms. This would boost countries' confidence that they can rely on nuclear fuel supplies without building their own fuel-cycle facilities. The IAEA Board of Governors should give high priority to the establishment of a multi-layer fuel-cycle supply assurance mechanism.

- The IAEA should also encourage the establishment of internationally owned and controlled fuel-cycle centers, and promote a steady trend toward increasing the multilateral or international ownership and control of enrichment and reprocessing worldwide. These steps would significantly contribute to international nonproliferation efforts and allow more countries to take part in owning and profiting from such facilities without spreading sensitive dual-use technologies.

- To run a nuclear facility efficiently and prevent it from spreading technologies that could contribute to nuclear weapons programs will always require a single manager. But, to quote IAEA Director General Mohamed ElBaradei, the ultimate goal "should be to bring the entire fuel cycle, including waste disposal, under multinational control, so that no one country has the exclusive capability to produce the material for nuclear weapons."[6]

- The IAEA should encourage the establishment of mechanisms for fuel leasing or spent fuel take-back, and for multinational or international spent-fuel storage, processing, or disposal sites, so as to optimize the geographical or geological location of such sites and the costs associated with developing them. (The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management recognizes that each state that generates nuclear waste bears the responsibility for managing it safely, but also recognizes that in some cases this responsibility can be discharged through international cooperation.) Assured arrangements for fuel leasing or spent fuel take-back would provide a powerful incentive for countries to rely on the world market for fuel-cycle supply, rather than establishing at great cost their own sensitive dual-use facilities. Reactor-leasing arrangements, focused on factory-built reactors that already contain lifetime cores of fuel, should also be explored.

- Member states, industry, and the IAEA should work together to establish multinational partnerships to provide standardized, factory-built, medium and small reactors with extremely high levels of safety and security to any countries that wish to acquire them. The reactors should be provided with comprehensive fuel services. Consideration should be given to implementation models that might make the benefits of nuclear energy available even to states that lack the expert personnel and infrastructure needed to build or operate reactors on their own. Nuclear supplier states and international financial institutions should consider providing financing for such efforts. Such financing should include paying for the necessary IAEA services throughout the life cycle of these projects. Potentially, such comprehensive services could be made so attractive that few states would want to follow any other approach, thus yielding a wide array of advantages for safety, security, and nonproliferation.

- The IAEA should work with states to encourage the establishment of shared regional nuclear plants. These can help countries whose electricity demand or power grid is too small to justify their own large baseload plants to access nuclear energy, if they so wish.

- In cases where neighboring states disagree over the safety, security, and impact of nuclear facilities, the IAEA should be prepared to take a role in mediating and providing objective assessments if the concerned states ask it to do so.

[6] Mohamed ElBaradei, "Reviving Nuclear Disarmament," conference on "Achieving the Vision of a World Free of Nuclear Weapons," Oslo, 26 February 2008.

- The IAEA should help states around the world with knowledge management in high-technology nuclear-related areas.

- To further the considerable work being done to develop international nuclear safety standards and common practices, the IAEA should promote the harmonization of certification processes for new reactor models. This would allow beneficial sharing of safety approaches and help to optimize the subsequent work of safety authorities in different countries that are deploying the same reactor designs.

- The IAEA should work with member states to prepare better estimates of the global resources of uranium likely to be available at different prices as technology and exploration advance, including more rigorous assessments of the potential for recovering uranium from unconventional sources (including low-grade terrestrial deposits, phosphates, and, eventually, seawater). In parallel, the IAEA should work with member states to explore world thorium resources and to coordinate research and development on thorium fuel cycles.

- The IAEA should prioritize those areas where it can make the most difference, especially where the activities of member states and the private sector leave significant gaps.

4. Enlarging the Contribution of Nuclear Applications to Human Well-being

Nuclear technologies and techniques can offer vital benefits for improving human well-being throughout the world: fighting disease, helping to grow food, addressing food security and safety, managing safe water and other natural resources, and more. In the near term, these will be the areas where nuclear technologies can make their biggest contributions to helping the world's poor.

As part of its statutory mandate "to accelerate and enlarge the contribution of atomic energy to peace, health, and prosperity throughout the world," the IAEA has a key role to play in helping developing countries make use of nuclear technologies. Yet in recent years, the Agency's target budgets for technical cooperation have fallen short even of zero real growth, and a substantial number of approved projects have gone unfunded.

The IAEA's work in helping developing countries with nuclear applications is important not only for its direct contribution to human well-being but also because it helps to build broad support for the Agency itself and its larger energy, safety, security, and nonproliferation missions. For the majority of member states, which have no nuclear power reactors, technical cooperation in applications of nuclear techniques in agriculture, human health, industry, environment, hydrology, or biological and physical research is a primary benefit of membership in the IAEA. These programs are crucial to making the Agency relevant to the entire human family. Developing countries have seen the advantage of couching their demands for technical assistance within the larger context of the Agency's immediate need to deal with proliferation, security, and safety issues, and the Agency has responded with a careful mix of priorities and programs.

Nuclear technologies are only one part of the broader development agenda, and the IAEA is not the lead international agency for development, health, food, or agriculture. The IAEA therefore must work in partnership with developed countries, developing countries, and international development institutions to ensure that the world community maximizes the contribution of nuclear technologies to development and human well-being – allowing each of the actors to fill the roles for which it is best suited.

Knowledge from the nuclear community is often helpful in pursuing non-nuclear technologies, and the IAEA is the only UN agency with the necessary nuclear knowledge. Within the energy sector, the nuclear community around the world, which the IAEA is uniquely positioned to network, can contribute significantly to other technologies. In renewable energy technologies, for example, the nuclear community's extensive knowledge is a valuable resource in areas such as thermal engineering, materials, and computational fluid dynamics. Outside the energy sector, in many applications the nuclear component may be only a small part of the whole effort but it may be crucial to success.

In human health care, nuclear techniques have unique characteristics that make them an essential complement to traditional technologies. Indeed, as populations age and suffer increasing chronic diseases, from cardiac problems to cancer, techniques such as nuclear medicine and radiation therapy will become even more important in providing earlier, more accurate diagnoses and safer, more effective treatments. Nuclear technologies will remain central even while non-nuclear technologies also improve. Already, the largest number of IAEA's technical cooperation projects are related to human health issues. Because no other international organization has the mandate of supporting nuclear applications in human health, wider recognition of the role the IAEA plays will significantly raise the demands for the Agency's assistance.

Nuclear techniques have also contributed significantly to improving global food security and safety. The IAEA, through its partnership with the Food and Agriculture Organization of the United Nations, has played an indispensable role not only in developing nuclear technology but also in building capacity and transferring technology to member states for key agricultural projects. The goals of these projects include improving the efficiency and sustainability of land and water management; breeding new crops with special qualities and adapted to marginal environments; improving

animal production and health; controlling insects that are major pests of plants and livestock; and increasing food safety while facilitating international trade.

Global food supplies and agricultural resources will increasingly come under pressure from climate change and an expanded demand for food, feed, and biofuels from a growing world population. Nuclear techniques can be used to provide accurate information on the efficiency of land and water management practices, which can be used to adapt to climate change and enhance food and biofuel production. To preserve agricultural resources and the environment, isotopic techniques will increasingly be important to develop efficient management strategies for water – including groundwater – and soils. The IAEA's activities to induce mutations for improving crop productivity will become more important to develop crop varieties that can grow under the harsher conditions brought about by climate change and on marginal lands not yet exploited for agriculture. Since most of the IAEA's member states do not have the mature capacity to use these nuclear techniques, the involvement of the Agency in building capacity and transferring techniques for more efficient land and water management – which are considered to be in the "public good" domain – will remain crucial for sustainable agriculture and the socio-economic stability of these member states.

Nuclear techniques can also help increase agricultural productivity by reducing the major losses that are caused by plant and animal pests and diseases. Techniques for diagnosing transboundary animal diseases, focusing on nuclear and nuclear-related molecular technologies, will be increasingly important for early and rapid detection in both the laboratory and the field. Area-wide application of the Sterile Insect Technique (SIT) to protect crops and livestock from pests is a unique technology in which the Agency has global leadership and an excellent track record. Expanding international agricultural trade will increasingly require the integration of pre- and post-harvest pest-control measures such as SIT and food irradiation, so that member states can meet regulations for international agricultural export markets.

The optimal role for the IAEA in helping with nuclear applications will change over time. With economic growth and the broad adoption of nuclear technologies in many countries, requests from member states for IAEA work in these areas will increase. But in many mature technologies, developed countries and private firms may be able to provide the necessary technology and expertise. The IAEA's activities should focus on helping with safety and security standards, regulations, and training to ensure that these technologies will be used safely and securely. The IAEA can also develop products and processes for states and development agencies. Regional programs – such as the use of isotope hydrology in the Sahel region to trace and measure groundwater and the use of the SIT to eliminate pests in North Africa – are likely to grow in importance.

The IAEA could significantly enlarge its contribution to human well-being if it can combine a reorientation in its technical assistance – towards helping establish the frameworks for efficient, safe, and secure use of nuclear technologies – with a substantial increase in the technical cooperation budget.

Recommendations

- If the Agency is to fully discharge its mandate to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world, the funding of the IAEA's Technical Cooperation Program should be made more predictable and assured; the Technical Cooperation Fund should be increased substantially.

- Following the examples of the Program of Action for Cancer Therapy and the SIT, wherever possible the IAEA should seek to partner with other organizations that can provide additional funding beyond the Technical Cooperation Fund to help developing countries make beneficial use of nuclear techniques.

- Recipient states should pay some portion of the costs of technical cooperation, on a sliding scale based on ability to pay.

- The IAEA should work in partnership with other development agencies and with member states to direct its development cooperation to areas where nuclear technologies and its own particular capabilities can make a significant contribution to human well-being, such as

disease prevention and control, food safety and security, hydrology, and sustainable management of natural resources and ecosystems. The foremost consideration in planning and administering its technical assistance program should be to ensure a cost-efficient, direct, and measurable impact on the recipient country's priority social and economic needs. The Agency, the country concerned, and international development agencies should be partners in development, and measurable benefits should go to end users such as health professionals and farmers.

- Developed and developing member states and the IAEA should work together to develop nuclear applications that suit the needs of developing countries, by utilizing mechanisms such as coordinated research programs, the IAEA laboratories, and national laboratories and research and development institutions.

- Helping states improve nuclear safety and security, including through careful nuclear waste management, should be a fundamental part of the IAEA's assistance efforts. The implementation of safety and security measures in Agency-sponsored efforts should be subject to rigorous international peer reviews.

- Wherever technologies that could have any application to a nuclear weapons program are involved, the Agency should conduct a thorough proliferation-risk assessment before agreeing to any particular project. Where such risks are involved, the Agency should provide assistance only when appropriate arrangements for managing the risk have been put in place, and the benefits outweigh the remaining risks.

- Use of the SIT for area-wide pest control should be expanded to new species of plant and animal pests, including those causing human diseases.

- The Agency should work with other international organizations to harmonize practices and set the highest health and environmental standards in the field of nuclear applications in food and agriculture.

- The Agency should make greater use of laboratories in member states except where independence and confidentiality concerns would prevent this.

- The IAEA should gradually move from buying and providing equipment to helping states identify the most effective technologies to acquire, and helping with safety and security standards, regulations, and training to ensure that these technologies will be used safely and securely.

- The Agency should help governments and private organizations develop the capability and infrastructure to manage nuclear and radiological applications on their own. It should undertake projects designed to improve the scientific infrastructures of developing countries and help to train and educate their scientists and technicians, and its laboratories should also be used as facilities for training scientists from the developing world. The Agency should have benchmarks for each country to determine the stage at which the country will no longer need IAEA assistance in a particular sector.

- The Agency should share information with other agencies, policy makers, and civil society concerning the benefits and risks of nuclear energy and nuclear applications.

5. Substantive and Rapid Progress in Nuclear Disarmament

The IAEA is not the lead agency or forum for nuclear disarmament; nuclear disarmament negotiations take place between nuclear weapons states, at the United Nations, and at the Conference on Disarmament. But progress toward disarmament, or the lack of it, will deeply affect the success of the IAEA's nonproliferation mission.

Article VI of the Treaty on the Nonproliferation of Nuclear Weapons (NPT) legally obligates the nuclear weapons state parties to negotiate in good faith toward nuclear disarmament, and at the 2000 NPT Review Conference, they agreed that the treaty represented an "unequivocal undertaking" to "accomplish the total elimination of their nuclear arsenals." This commitment is an integral part of the NPT bargain. The need for the NPT to become universal cannot be stressed enough. States must recommit to the vision of a world free of nuclear weapons and take firmer steps in that direction.

True, the nuclear weapons states have significantly reduced their nuclear arsenals since the end of the Cold War. Under bilateral treaties and unilateral initiatives, the United States and Russia have each dismantled thousands of nuclear weapons. France and the United Kingdom have also reduced their much smaller nuclear arsenals, and the United Kingdom has launched an initiative to explore international approaches to verifying disarmament. All of the NPT nuclear weapons states have ceased producing plutonium and highly enriched uranium for weapons, and the United States, Russia, and the United Kingdom have declared portions of their stockpiles of plutonium and HEU to be excess to their military needs and have begun reducing these excess stocks. Indeed, in the US-Russian HEU Purchase Agreement alone,[7] enough HEU for some 13,000 nuclear weapons has already been blended to low-enriched uranium (LEU); in recent years, almost 10 percent of the electricity in the United States has been fueled with material from dismantled Russian nuclear weapons.

But the nuclear weapons states still possess some 25,000 nuclear weapons. The danger of large-scale nuclear war has greatly decreased since the end of the Cold War but it has not disappeared, and these weapons continue to pose an existential threat to civilization. Thousands of them remain on quick-launch alert, placing the human future in the hands of decisions that must be made within minutes and risking nuclear catastrophe from false warnings or fatal miscalculations. Some of the nuclear weapons states have been designing new nuclear weapons and laying plans that will explicitly allow them to maintain their nuclear arsenals indefinitely. The reductions that have occurred have either not been verified at all, or have been verified only between the United States and Russia, offering just limited transparency to the broader international community to confirm that these important steps are being accomplished.

The long-sought and long-promised Comprehensive Test Ban Treaty continues to languish without entering into force, because some nuclear weapons states have failed to ratify it. The Conference on Disarmament has made no progress for a decade, and negotiations for a fissile cutoff agreement have still not begun. Although at the 2000 NPT Review Conference the nuclear weapons states committed to 13 practical steps toward nuclear disarmament, few of those steps have been taken, and at the 2005 Review Conference – which ended in total failure – the official US position was that these steps were no longer relevant. The 2005 United Nations World Summit declaration made no reference at all to disarmament or nonproliferation.[8]

Given these circumstances, the non-nuclear-weapons states believe that the nuclear weapons states are failing to fulfill their Article VI obligations. When many states without nuclear weapons are asked about implementing the Additional Protocol, or phasing out their use of highly enriched uranium, or entering into new multilateral fuel-cycle arrangements, they ask: "what about disarmament?" As urgent as stronger steps may be to stem the

[7] This refers to an agreement by which HEU from dismantled Russian nuclear weapons is blended to proliferation resistant low-enriched uranium and sold to the US as fuel for commercial nuclear power plants.

[8] Resolution adopted by the General Assembly, October 24, 2005. <http://unpan1.un.org/intradoc/groups/public/documents/UN/UNPAN021752.pdf>

spread of nuclear weapons, and as much as they serve the security of all, it is extraordinarily difficult to convince non-nuclear weapons states to commit to strengthening the nonproliferation side of the NPT bargain when they believe that the nuclear weapons states have reneged on the disarmament side of the bargain. When the world's most powerful states give every sign that they consider nuclear weapons essential to their security, they strengthen the hand of nuclear weapons advocates elsewhere.

A world free of nuclear weapons will not be achieved quickly, and will require action by many actors in the international system, going far beyond the mandate and capabilities of the IAEA. New approaches to verifying compliance with treaty obligations, to providing security for states in the absence of nuclear weapons, and to punishing states that violate the regime will certainly be required, and new methods to control the sensitive elements of the nuclear fuel cycle will likely be needed as well. As four senior US statesmen have written, "In some respects, the goal of a world free of nuclear weapons is like the top of a very tall mountain. From the vantage point of our troubled world today, we can't even see the top of the mountain, and it is tempting and easy to say we can't get there from here. But the risks from continuing to go down the mountain or standing pat are too real to ignore. We must chart a course to higher ground where the mountaintop becomes more visible."[9]

States both with and without nuclear weapons must join in a new partnership to strengthen the global nonproliferation regime and take major steps toward nuclear disarmament. Action on both of these fronts serves the security interests of all states. What is needed is an ambitious reinvigoration of the grand bargain that was struck 40 years ago in the NPT. The renewed grand bargain will need to combine steps that can be taken immediately with a vision for the longer term, and to draw in states that are not parties to the NPT. As the four senior US statesmen have argued, "Without the bold vision, the actions will not be perceived as fair or urgent. Without the actions, the vision will not be perceived as realistic or possible."

[9] George P. Shultz, William J. Perry, Henry A. Kissinger, and Sam Nunn, "Toward a Nuclear-Free World," *Wall Street Journal,* 15 January 2008.

What the IAEA's future role in disarmament might be remains to be determined. International nuclear verification will certainly be essential as disarmament proceeds, and the IAEA's existing capabilities and experience make it well suited to play a central role in that endeavor. The IAEA was created as a result of US President Dwight Eisenhower's famous "Atoms for Peace" address, in which he envisaged that the United States and the Soviet Union would remove large quantities of nuclear material from their weapons stockpiles and provide them to the Agency to be used for peaceful purposes, linking nuclear arms reductions and peaceful use. The IAEA's Statute requires the Agency to conduct its activities "in conformity with policies of the United Nations furthering the establishment of safeguarded worldwide disarmament and in conformity with any international agreements entered into pursuant to such policies."

The IAEA has decades of experience in verifying nuclear material, and it would be logical, as disarmament proceeds, for states to give the Agency a central role in monitoring the huge stockpiles of fissile material that would be freed from nuclear weapons programs. Indeed, under the US-Russia-IAEA Trilateral Initiative, technologies, procedures, and model legal agreements have already been developed that would make it possible for the IAEA to monitor fissile material released from weapons programs without compromising sensitive information – even if the material remains in classified form – and to ensure that the material's removal from weapons programs is legally irrevocable. For other elements of disarmament, such as reductions in delivery systems or the dismantling of nuclear warheads themselves, other verification approaches and institutions may be needed.

Recommendations

- The nuclear weapons states must honor their commitments under Article VI of the NPT. They should recommit to the goal of a world free of nuclear weapons, and to implementing the steps agreed at the 2000 NPT Review Conference.

- As one early step in the transition towards a world free of nuclear weapons, the governments with nuclear weapons should clearly state that nuclear weapons have no purpose except to deter attacks with nuclear weapons, and should

commit never to use or threaten to use nuclear weapons against states that do not have such weapons. These states should take successive actions to make nuclear weapons increasingly irrelevant to operational military planning and to international affairs.

- Other early steps should include: deep reductions in existing arsenals; removal of all nuclear weapons from quick-launch alert; transparent security and accounting for, and reductions in, tactical nuclear weapons; verifiable dismantling of excess nuclear weapons; secure and verified storage and disposition of all plutonium and HEU not required for remaining military purposes; ratification of the Comprehensive Test Ban Treaty; and a verifiable global treaty ending the production of nuclear materials for nuclear weapons.

- Verification of nuclear arms reductions should be international, to give all states, not just the United States and Russia, confidence that reductions are being carried out as agreed. In particular, the United States and Russia should use the procedures developed in the Trilateral Initiative to place excess nuclear materials under IAEA monitoring, and they should provide the IAEA with enough additional resources to pay for monitoring without reducing its other important activities. The IAEA appears to be the most appropriate organization for verifying an end to the production of fissile materials outside of safeguards.

- States that are not now parties to the NPT should join in a new partnership for disarmament and nonproliferation, capping, reducing, and ultimately eliminating their nuclear arsenals as other states do the same. They should ratify the Comprehensive Test Ban treaty and support the negotiation of a fissile cutoff agreement.

6. No Nuclear Proliferation

Some notable recent victories have been achieved in the effort to stem the spread of nuclear weapons – often with the IAEA playing an important role.

But the nonproliferation regime is under stress. To strengthen the global nonproliferation regime and prevent a cascade of proliferation, the following steps are imperative:

- Strengthened safeguards
- New approaches to managing the nuclear fuel cycle
- More effective export controls and measures to stop black-market networks
- Stronger enforcement (which pertains to the UN Security Council)
- New measures to reduce demand for nuclear weapons.

Strengthened Safeguards

Safeguards are a core mission for the IAEA and must continue to be a central part of its work. The IAEA's greatest asset in this area is the authority, granted by the Statute, the NPT, and by safeguards agreements, for its inspectors to carry out inspections.

The safeguards system has changed drastically in recent years, with the Additional Protocol giving the Agency much broader access to information and sites and the Agency focusing on a more information-driven, country-level approach, designed to increase confidence that no nuclear material has been diverted from declared sites and that there is no evidence of clandestine nuclear activities elsewhere.

The IAEA's authorities, technologies, personnel, and resources should be reviewed with a view to further increasing the effectiveness of IAEA safeguards. Dozens of parties to the NPT still lack even a comprehensive safeguards agreement, and several states with important nuclear activities have not yet accepted the Additional Protocol. The growth and spread of nuclear power generation – and particularly the establishment of new facilities for uranium enrichment, spent-fuel reprocessing, or processing of direct-use nuclear material – will require additional resources for safeguards. Moreover, as has become clear from recent events, sometimes transparency going beyond the measures called for in the Additional Protocol is needed to provide confidence that a state's nuclear program is entirely peaceful. Ultimately, states should agree to incorporate those measures in an "Additional Protocol Plus." The latter would confirm the IAEA's right and obligation to access sites and information related to nuclear material production technologies (such as centrifuge manufacturing facilities) and to nuclear weaponization activities, as well as the Agency's right to private interviews with individuals who may know about such activities.

Recommendations

To strengthen the Agency's ability to provide the necessary confidence, states should agree to give the IAEA access to additional information, sites, and people, along with the money, qualified personnel, and technology that it needs to carry out its mission. The IAEA should take additional steps to strengthen its safeguards culture, and adopt new approaches to recruiting, training, and retaining highly qualified personnel. Each of these issues is treated below.

Access to all necessary information, locations, and people

- All states should ratify the Additional Protocol, which should become the universal standard for nuclear verification. Supplier states should make the Additional Protocol a condition for granting export licenses of nuclear materials, services, and technologies.
- All states should adopt the principle and practice of transparency in their civil nuclear activities, providing the IAEA with access to any information, locations, and individuals in their countries that may help it carry out its mission. States that engage in sensitive nuclear activities, in particular, should offer full transparency concerning all aspects of their civilian nuclear activities, to build international confidence.
- All member states should provide the IAEA with the information it needs to do its job

– including data on exports and imports of nuclear and related technologies, export denials, inquiries, and suspicious procurement attempts; information that states may have available from other sources; relevant police information, as appropriate; and more.

- The IAEA's existing authorities should be interpreted to give the Agency the responsibility to inspect for indicators of nuclear weaponization activities. The Agency should establish a small team of qualified specialists for that purpose.

Safeguards technologies

- Member states and the nuclear industry should increase their investment in developing new technologies to make safeguards more effective and efficient, and should establish mechanisms by which the Agency can commission development work to provide the technology advances that it needs.

- In particular, the IAEA should work closely with member states and industry participants that are developing new fuel-cycle processes, such as those proposed in INPRO, Generation IV, and the Global Nuclear Energy Partnership, so that effective safeguards, nonproliferation, and physical protection measures can be designed into such new systems from the outset.

- Additional resources should be provided for the IAEA's Safeguards Analytical Laboratory, to bring the lab to modern standards and allow it to do its job effectively. The IAEA should revise its personnel procedures to make it possible to attract highly qualified personnel for the laboratory.

A strengthened safeguards culture

- A strong safeguards culture is critical to the success of IAEA safeguards. The IAEA should perform regular in-depth assessments of its safeguards culture – just as it recommends that nuclear facilities regularly assess their safety culture – and take steps to correct any weaknesses identified.

Recruiting, training, and retaining qualified safeguards personnel

- The IAEA should launch a substantial campaign to recruit, train, and retain the highly qualified personnel needed to carry out its safeguards responsibilities.

- Member states should launch initiatives to attract and educate the next generation of specialists in safeguards-related technologies and give them incentives to pursue careers with the IAEA.

New approaches to managing the nuclear fuel cycle

The key technical challenge in a nuclear weapons program is to produce the needed nuclear material: highly enriched uranium or separated weapons-usable plutonium. It is important to restrain the spread of the technologies needed to make these materials but without taking away any state's sovereign rights to make its own fuel-cycle decisions.

The Commission's recommendations on fuel-cycle supply assurances, multilateral fuel-cycle approaches, fuel leasing and take-back arrangements, and other measures in this area, which can make an important contribution in the field of nonproliferation, were discussed in Section 3.

More effective export controls and measures to stop black-market networks

The experience of a global black-market nuclear network operating in some 20 countries for decades before it was shut down makes clear that additional steps are needed to control sensitive nuclear and dual-use technologies and prevent illicit technology networks from operating. One important new tool is UN Security Council Resolution 1540, which legally obligates all UN member states to provide "appropriate effective export controls, border controls, and transshipment controls." The IAEA has already begun to assist states to improve their export and import control systems.

Recommendations

- Early steps should include: all states putting in place effective export, border, and transshipment controls as required by UNSC 1540; expanded

IAEA assistance in this regard, including development of model legislation; expanded international police, intelligence, and export-control cooperation, focused on stopping and preventing black-market nuclear networks; and an expansion of the IAEA unit focused on black-market technology networks, along with an expansion of its mission to include helping states to shut down these networks and find and fix leaks in their control systems. Governments and private firms with sensitive technologies should strengthen their partnerships to help these firms build strong internal compliance programs and give them incentives to provide key information on suspicious inquiries and procurements. Current international efforts to interdict money laundering and terrorist financing should be expanded to include interdiction of financing for illicit nuclear transactions.

- States should participate, within the limits of their capabilities, in voluntary initiatives such as the Global Partnership against the Spread of Weapons and Materials of Mass Destruction, and the Proliferation Security Initiative.

New measures to reduce demand for nuclear weapons

Controls on supply can only slow, not stop, the spread of nuclear weapons. Ultimately, the key is to reduce states' demand for nuclear weapons. This approach has been far more successful than is often realized. The vast majority of the world's states have concluded that their security is better served without nuclear weapons. Nevertheless, recent international events may have strengthened demand for nuclear weapons in some states, and action is needed to reduce this demand.

Recommendations

- The UN Security Council should go beyond its Resolution 1540 by: passing a new resolution making clear that the proliferation of nuclear weapons is a threat to international peace and security; legally prohibiting any state that withdraws from the Nonproliferation Treaty from using for military purposes any nuclear facility, materials, or technologies that it received for peaceful purposes while a party to the NPT; and legally imposing safeguards obligations, going well beyond the Additional Protocol, on any state that substantially violates its safeguards obligations.

- Steps are needed to devalue nuclear weapons – that is, to reduce their strategic, reputational, and diplomatic value. Nuclear weapons states must renew their commitment to nuclear disarmament and take steps in that direction in the near term.

- The major powers should reaffirm their obligations under the UN Charter not to use or threaten to use force against states that have not attacked them and do not pose an imminent threat.

- All states should work to resolve major global or regional conflicts that drive demand for nuclear weapons.

- States should ratify and bring into force the nuclear weapons-free zones that have been negotiated, and negotiate to create additional such zones.

- All states should work together to begin building new structures of international security that can give increased confidence to states around the world that threats to their security will be effectively addressed.

7. No Nuclear Terrorism

Since the 9/11 attacks in the United States, a great deal has been done to reduce the danger of nuclear or radiological terrorism. Individual states and cooperative programs have dramatically improved the security of nuclear stockpiles and facilities in the former Soviet Union and elsewhere around the world. Controls over radiological sources are improving in many countries. New international instruments have been put in place, including the Code of Conduct on the Safety and Security of Radioactive Sources, the amended Convention on Physical Protection of Nuclear Materials and Nuclear Facilities, the International Convention for the Suppression of Acts of Nuclear Terrorism, and more. Voluntary initiatives such as the Global Threat Reduction Initiative (focused on removing highly enriched uranium from sites around the world and improving security for research reactors and radiological sources) and the Global Initiative to Combat Nuclear Terrorism are engaging scores of countries around the world in efforts to reduce the danger of nuclear terrorism.

UN Security Council Resolution 1540 requires all states to establish "appropriate effective" laws prohibiting acts related to nuclear, chemical, or biological terrorism; to take "appropriate effective" measures to account for and secure toxic biological and chemical agents and fissile materials and provide "appropriate effective" physical protection for them; and to put in place "appropriate effective" border control and law enforcement efforts to interdict illicit trafficking in such items. A Security Council committee reviews states' reports on their implementation of this resolution, and the IAEA has been providing advice and limited assistance in several areas covered by the resolution. But much more remains to be done.

Across the globe, the danger of nuclear and radiological terrorism remains very real. Some terrorist groups are actively seeking nuclear weapons and the materials and expertise needed to make them, and the seizures of stolen or lost material that continue to occur show that some of these materials remain vulnerable to theft.[10] Moreover, attacks on nuclear facilities have occurred in the past, and terrorists have repeatedly considered attempting a major sabotage of a nuclear power reactor, or spreading radioactive material with a so-called "dirty bomb." Proper account should be taken of the fact that terrorist groups, including potential users of nuclear arms or materials, tend to flourish in countries where the state has been weakened by conflict.

Though nuclear security is fundamentally the responsibility of individual states, the IAEA has an important role to play in addressing these threats. It is the only global body with relevant competence and expertise relied on by a wide range of states. IAEA recommendations and standards, IAEA-led international reviews, and IAEA assistance to member states form useful parts of the evolving global nuclear security framework. The Agency has greatly expanded its nuclear security work under a series of nuclear security action plans. The IAEA actively helps member states to enhance nuclear security through capacity-building activities such as training, regulation development, exercises, reviews, and more. It is also helping to coordinate national, donor-state, and international nuclear security programs, to close gaps and reduce overlaps.

Here it is important to emphasize that nuclear material held under safeguards is not secured against theft. Despite their name, IAEA safeguards are not designed to ensure either safety or guarding. The purpose of safeguards is to *detect* any diversion of nuclear materials to military purposes by the safeguarded state; IAEA inspectors can detect a theft as readily as a diversion, but they cannot prevent material from being stolen. No program exists in which safeguards inspectors systematically report any security weaknesses they may observe, because the Agency's safeguards agreements with member states require – in return for the authorization for inspectors to go to facilities to implement safeguards – that the Agency use the information only for safeguards purposes and keep it confidential.

Recommendations

- Member states should agree to give the IAEA an important role in helping them to define and put in place national security standards that are consistent with the International Convention on Physical Protection of Nuclear Materials

[10] Bunn, op. cit.

and Facilities. Over time, with the Agency's technical support, states should negotiate binding agreements that set effective global nuclear security standards and give the IAEA a precise mandate to confirm that these standards are being implemented.

- Within the constraints of necessary secrecy, measures should be developed to give all states confidence that other states are implementing the agreed standards. Ultimately, international reviews of both safety and security should become a regular part of business at nuclear facilities with HEU or separated weapons-usable plutonium, and at nuclear facilities whose sabotage could have widespread consequences, as well as at entities that transport HEU or separated weapons-usable plutonium.

- Every nuclear weapon and every cache of HEU or separated weapons-usable plutonium worldwide must be protected by security measures that can reliably defeat the threats that terrorists and criminals have shown they can pose. Nuclear facilities or parts thereof whose sabotage could have widespread consequences should receive similar protection.

- The nuclear industry should continue to emphasize a philosophy of sustained improvement in nuclear security, as it has in nuclear safety. The global nuclear community should lead an international effort to promote best practices in nuclear security, for example through a new organization such as the World Institute for Nuclear Security (WINS) proposed by the Nuclear Threat Initiative with broad international support.

- All states should implement the requirements of UNSC 1540. The IAEA should work with member states and with the Security Council's 1540 Committee to define what elements must be in place in order for nuclear physical protection, material accounting, and border control systems to be considered "appropriate effective" as required by UNSC 1540. It should work to establish mechanisms to review whether states have these essential elements in place and should help, where necessary, to put them into place. It should develop model legislation to help states fulfill their UNSC 1540 obligations to enact national laws that effectively prohibit acts related to nuclear terrorism and nuclear smuggling; such legislation should include severe criminal penalties.

- The IAEA should continue to develop the broad range of recommendations and standards related to nuclear security that are needed to build an appropriate global nuclear security framework, and should continue to develop and implement integrated nuclear security support plans for member states. These plans should be designed to build the capacity and commitment of states to sustain effective nuclear security measures with their own resources over the long haul. The IAEA should also continue to promote the broadest possible exchange and implementation of best practices in nuclear security.

- All states with nuclear weapons, HEU, or separated weapons-usable plutonium on their soil should seek to consolidate these stocks at the smallest practicable number of secure sites. Research reactors using HEU as fuel or targets for medical isotope production[11] should be converted to use low-enriched uranium or should be shut down. The IAEA, working with public and private donors, should assist states in these consolidation efforts, including converting HEU-fueled research reactors, returning HEU to the country of origin or to other secure locations, and providing assistance and incentives to encourage underutilized research reactors to shut down and allow any HEU they may have to be removed.[12] Addressing the issues posed by underutilized research reactors is also important for nuclear safety.

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[11] Some research reactors use HEU as their fuel. Others use LEU fuel, but insert HEU as "targets:" that is, the HEU is bombarded with neutrons in the reactor, producing various fission products, including Molybdenum-99, the most important medical isotope. Enough 90 percent enriched HEU to make two or three terrorist bombs is shipped from place to place each year for medical isotope production. The "waste" from this process remains essentially weapons-grade uranium, and is hardly radioactive at all, making this, too, a theft concern. Since medical isotopes can easily be made with LEU, this use of HEU ought to be phased out.

[12] In 2002, for example, cooperation among the governments of Yugoslavia, Russia, and the United States, the IAEA, and the private Nuclear Threat Initiative (NTI) made it possible to airlift 48 kilograms of 80 percent enriched HEU from a potentially vulnerable research reactor near Belgrade, eliminating a potential nuclear terrorist threat. A promise of assistance with the management of spent fuel and radioactive waste at this site, initially financed by NTI, proved to be an essential incentive for Yugoslav participation in this effort, and the IAEA continues to play a leading role in implementing this assistance and coordinating additional donations to address these issues at the site.

- All states should agree to phase out the civil use of HEU wherever practicable; to end further production of HEU for any purpose; and to reduce accumulated stockpiles of separated weapons-usable plutonium and HEU, both military and civilian, as rapidly as practicable.

- All states should strengthen international cooperation to detect and disrupt terrorist nuclear plots, establish police and intelligence units trained and equipped to deal with nuclear smuggling and nuclear terrorism, and put in place effective systems to detect attempts at nuclear smuggling.

- The IAEA should expand its efforts to ensure effective security for the most dangerous radiological sources worldwide, to recover and secure "orphan" sources (those no longer controlled by their original owner), to help states substitute less dangerous technologies where appropriate, and to reduce the danger of a possible "dirty bomb" attack. It should also increase the priority it gives to preventing nuclear smuggling – devoting more resources, highly qualified personnel, and leadership attention to this issue. Sufficient resources should be provided, for example, to conduct in-depth investigations and analyses of the most important nuclear smuggling cases.

- The new version of the IAEA's recommendations for physical protection of nuclear material, now being discussed, should include a minimum level of threat against which all nuclear material that could be used to make a nuclear bomb should be protected. Such a minimum threat to be defended against should also be considered one of the essential elements of an "appropriate effective" physical protection system as required by UNSC 1540. The new recommendations should also specify more detailed steps for preventing sabotage.

- It is imperative and urgent that the IAEA establish a regular process by which safeguards inspectors would report to the IAEA Office of Nuclear Security any nuclear security weaknesses they observe, with appropriate confidentiality. Preventing use of nuclear material by terrorists should be seen as part of preventing use for "any military purpose," which is the statutory purpose of safeguards. In this way, the sharing of information by inspectors will be possible under existing safeguards agreements. Safeguards inspectors should be trained to help them play this role.

- The IAEA should work with member states to construct expanded international databases on nuclear material characteristics for nuclear forensics (the effort to examine the characteristics of seized or exploded nuclear materials to help understand where they may have come from). Such a database should draw on the Agency's extensive safeguards data on nuclear materials in many states, with appropriate confidentiality, if the Agency determines that this is possible under the terms of existing safeguards agreements or can get the permission of relevant states.

- The IAEA should expand its nuclear security training and capacity-building efforts. Achieving the goals outlined above as the use of nuclear energy and nuclear applications expands around the world will require training large numbers of experts in several different fields of nuclear security.

- Because nuclear security measures will never be perfect, the IAEA should continue its efforts to help states prepare to cope with the consequences of a radiological dispersal. The IAEA should expand the capabilities of its Incident and Emergency Response Center, and will need additional funding for this purpose. Most of the needed response capabilities will be equally applicable to either an accident or a terrorist attack. Effective plans for public communication in such a crisis are particularly critical, to reduce the likelihood of panic.

- All states should sign, ratify, and implement the amended Convention on the Physical Protection of Nuclear Materials and Nuclear Facilities and the International Convention on the Suppression of Acts of Nuclear Terrorism, and should implement the Code of Conduct on the Safety and Security of Radioactive Sources.

- States should participate, within their capabilities, in voluntary initiatives such as the Global Initiative to Combat Nuclear Terrorism and the Global Threat Reduction Initiative, as well as in other international cooperative programs to improve nuclear security measures.

8. No Nuclear Accidents

As Chernobyl showed, a nuclear accident anywhere is a nuclear accident everywhere.[13] A major accidental release of radioactivity could cause widespread suffering and economic disruption, and undermine prospects for large-scale growth in peaceful nuclear applications. Member states and the IAEA must do everything they can to ensure that such an accident never occurs again.

Fortunately, nuclear safety has improved dramatically in recent decades, as shown by a wide range of national and international safety indicators. Nuclear operators bear the fundamental responsibility for safety, and they, along with national nuclear regulators, have played the leading role in achieving these global safety improvements. But many other actors have also contributed: the IAEA; nuclear industry designers and builders; associations such as the World Association of Nuclear Operators (WANO); other international agencies, such as the Nuclear Energy Agency of the Organization for Economic Cooperation and Development; other non-government organizations; and the press and the public.

The IAEA plays a wide range of important roles in supporting nuclear safety around the world. It:

- Develops and publishes crucially important safety standards, recommendations, and guides.
- Serves as the depositary for nuclear safety conventions, and helps to develop new instruments as necessary.
- Organizes international reviews of the safety of particular facilities at the request of member states; these reviews have led to major improvements in safety at many facilities.[14]
- Helps coordinate assistance to member states in improving safety measures.
- Helps coordinate exchanges of best practices, experience, and lessons learned.
- Collects and analyzes a wide range of international data important for safety.
- Organizes studies and discussions of key safety issues.

Looking ahead, if the number of nuclear power plants around the world is to grow substantially without increasing the total risk of a nuclear accident, the risk of an accident at any given reactor must continue to be reduced. As additional countries build nuclear power plants, it is essential that they establish strong safety measures, including competent, effective, and independent national regulators.

The world is still a long way from a regime of mandatory, effective global safety standards and comprehensive reviews of performance in meeting them. The IAEA roles in maintaining and continuously improving the global safety regime that emerged after Chernobyl are particularly critical, and must continue to be strengthened and expanded to ensure nuclear safety and protection from radiotoxicity. For example, IAEA's comprehensive reviews of performance in meeting safety standards should be expanded so as to cover all the world's operating reactors and nuclear installations, including research reactors and fuel-cycle facilities.

[13] Mohamed ElBaradei, "Major Impacts of the Chernobyl Accident", Opening Address at the International Conference, *Chernobyl – Looking Back to Go Forwards: Towards a United Nations Consensus on the Effects of the Accident and the Future*, Vienna, September 6, 2005.

[14] At present, the IAEA is not in a position to comprehensively assess the safety of reactors around the world or identify and address the highest-risk facilities, because all its safety reviews are undertaken purely at countries' discretion. In-depth reviews have been conducted for only a fraction of the world's operating reactors. The IAEA plays only a modest role in the peer review process conducted among the contracting parties of the nuclear safety conventions, and the parties to these conventions are not required to report on the results of the IAEA safety reviews in the national reports they must submit. The coverage of the nuclear safety conventions is still limited, and does not include research reactors or nuclear fuel-cycle installations.

The IAEA's role in the peer review process conducted among the contracting parties of the nuclear safety conventions should be increased, and the parties to these conventions should be required to report on the results of the IAEA safety reviews in the national reports they must submit.

Knowledge and experience that contribute to nuclear safety and protection from radio-toxicity are accumulating rapidly, and the process of capturing, analyzing, and widely sharing experiences requires more vigorous international cooperation and leadership. The IAEA has been promoting and assisting the development of regional safety networks, but more remains to be done.

Several initiatives have been launched to harmonize licensing procedures for new reactor designs. They include the European Utility Requirements (EUR) at the European level and the Multinational Design Evaluation Program (MDEP) at the OECD level. These initiatives should be encouraged and expanded, with the full support of the IAEA, as a way to share experience and best practices on safety design and regulation.

Safety is an enabling factor for sustainable use of nuclear technology, and must be embedded in the culture and actions of all individuals and organizations involved in nuclear activities. It is, however, essential to maintain an adequate separation between the promotional and safety aspects of nuclear programs. This will demonstrate the independence of safety decisions and increase public confidence.

Despite all prevention measures, accidents can still occur. Hence it is vital that countries be prepared to respond to such unlikely events. Within the framework of the safety conventions, the IAEA has the important role of coordinating international notification and assistance actions. It has established an Incident and Emergency Response Center, as noted in Section 7 above, but it does not yet have the resources to fully carry out this role.

Recommendations

- The IAEA should lead an international effort to establish a global nuclear safety network and ensure that critical knowledge, experience, and lessons learned about safety are exchanged as broadly as they need to be. This capacity-building effort should include, among other elements, training on the IAEA safety standards and on key safety issues and trends, along with efforts to promote strong safety cultures in all the firms and organizations relevant to nuclear safety.

- National regulatory agencies should continue to strengthen and harmonize their safety standards, with the ultimate objective of achieving a standardized and highly effective system of nuclear safety worldwide. In parallel, and in close consultation with national regulators, the IAEA should continue to consolidate and promote global nuclear safety standards.

- Granting that decisions on nuclear safety ultimately rest with national regulators, over time states should enter into binding agreements to adhere to effective safety standards and to be subject to international peer reviews of nuclear safety. Should peer reviews indicate that a facility poses a high risk of accident that cannot be readily remedied, a recommendation should be made to the pertinent national regulator to shut down that facility.

- Every state making use of nuclear energy should establish the highest nuclear safety regulations, and ensure that its regulatory body has the resources, expertise, independence, and culture required to enforce these rules. The IAEA should expand its efforts to assist states in this regard.

- The IAEA should expand its highly successful program of international safety reviews and encourage peer reviews of national regulators. These safety reviews should also be an integral feature of the national reports of the parties to the nuclear safety conventions.

- All players in the nuclear industry should continue to emphasize constant improvement in nuclear safety at the design, construction, and operation stages. The industry should permanently strengthen its efforts to exchange best practices, lessons learned, and peer reviews, through organizations such as the World Association of Nuclear Operators.

- All states, and in particular those that have or seek a nuclear energy program, should become

parties to and abide by the international conventions on nuclear safety and civil liabilities.

- Member states and the IAEA should strengthen and coordinate their critically important efforts to ensure that countries embarking on nuclear power programs develop sound safety infrastructures, including effective and independent regulatory bodies. Companies exporting nuclear reactors should continue their policy of insisting on sound infrastructure and effective regulation in any state seeking a nuclear power plant. The IAEA should coordinate with pertinent public and private institutions to help each country meet its own safety rules and IAEA safety standards. This coordination should also take into account the interests of the neighbors of the countries embarking on nuclear power programs.

- The IAEA should develop new services for countries with, or seeking, nuclear energy programs in order to support them, their regulators, and their nuclear licensees in building a strong safety culture and acquiring the competences to honor it.

- The IAEA should work with key regional stakeholders to ensure that states adhere to nuclear safety standards and implement them effectively.

- While all major nuclear facilities should be subject to periodic international safety reviews, the IAEA should place its highest priority on identifying and helping to fix the few facilities worldwide that pose the highest risks of a nuclear accident, based on the IAEA safety standards.

- Every state making use of nuclear energy should regularly review the safety culture at all its major nuclear facilities, and require immediate action where the safety culture appears to be weakening. The IAEA should expand its efforts to assist states in assessing and strengthening their nuclear safety culture.

- Member states and the IAEA should support the trend toward standardized reactor designs and the harmonization of certification processes for new models of reactors, which allow sharing of experience and lessons learned that can lead to significantly improved safety.

- The third generation of reactors has been designed to achieve substantially improved levels of safety. Fourth-generation reactors, now being developed, should be designed to achieve still higher safety levels, taking advantage of advances in technology, including employing passive and inherent safety measures to the extent practicable. The IAEA should work more with states developing such next-generation systems toward this end, including through the INPRO program.

- Member states should strengthen their preparedness to cope with nuclear emergencies, and should provide the IAEA's Incident and Emergency Response Center with the resources it needs to play its role as the global hub for emergency preparedness and response to nuclear accidents.

- The IAEA should work with member states to ensure that promotional and safety activities are adequately separated in nuclear programs worldwide and in its own programs.

- Member states and the IAEA should work together to ensure that nuclear safety efforts draw appropriately not only on nuclear experts but also on scientists and engineers from other disciplines.

9. Toward a Stronger Global Nuclear Order and a Stronger IAEA

The record of the IAEA during its first half century speaks for itself. The Agency has pursued with dedication and efficacy its mandate to promote safe, secure, and peaceful use of nuclear technologies through international cooperation, while providing safeguards needed to ensure that facilities for nuclear energy do not contribute to military purposes. The Agency has come to play critical roles in nuclear safety, nuclear security, nuclear energy development, and nuclear applications worldwide. And its objective technical assessments have played a central role in matters of international security.

Over the years, the IAEA has assumed new responsibilities as new opportunities and challenges presented themselves, including the entry into force of the Nonproliferation Treaty (NPT), the development of new technologies, clandestine programs to acquire nuclear weapons in certain states, and the emergence of terrorism. Funding for additional activities has come from diverse sources, some of them voluntary, unpredictable, and with strings attached. The Agency has, however, managed to maintain a certain balance among its statutory activities, and has carried out its diverse responsibilities efficiently and effectively. Uniquely in the UN system, the IAEA's core strength lies in its science and technology abilities.

Looking ahead, the Commission recommends a bold agenda to maximize the contributions to human well-being from nuclear technologies while minimizing the risks, making possible a new era of Atoms for Peace and Prosperity. As outlined earlier in this report, this is a task that goes well beyond the IAEA's mandate and capabilities. The stronger global nuclear order we propose would feature greatly expanded international cooperation and transparency, with new partnerships for nuclear energy, development, disarmament, non-proliferation, safety, and security. It would:

- Help enable a safe and secure expansion of nuclear energy in those countries that seek it, helping to power a growing global economy while mitigating the threat of climate change.
- Make it possible for nuclear technologies to expand their role in saving lives, growing crops, and providing jobs in the developing world.
- Reduce the dangers of nuclear accidents and nuclear terrorism.
- Provide a path toward dramatically reduced dangers to humanity from nuclear weapons and nuclear proliferation.

Modest improvements in existing approaches are unlikely to be sufficient to seize these opportunities or meet these challenges. A bold approach is required, that seeks to address intertwined issues in parallel.

In the stronger nuclear order that we propose, a strengthened IAEA that has adequate resources and can attract and retain the best personnel will be essential. The Agency will face escalating demands in several quarters.

The likely growth and spread of nuclear energy, in response to growing concerns over prices and availability of fossil fuels and the threat of climate change, will increase the demands on the IAEA to:

- Help "newcomer" states establish the necessary infrastructure to develop nuclear energy safely, securely, and peacefully.
- Help strengthen global frameworks for ensuring that nuclear energy growth is safe, secure, and proliferation-resistant.
- Support nonproliferation-oriented mechanisms for assured supply of nuclear fuel, including international banks of enriched uranium and establishment of additional multilateral fuel-cycle centers.
- Help member states with training and nuclear knowledge management.
- Expand its contribution to the development of safe and sustainable methods of managing spent fuel and nuclear waste.

- Help member states coordinate R&D on next-generation nuclear energy systems, which may offer improvements in cost, safety, security, resource management, waste management, and proliferation resistance.

- Assess global resources of uranium and thorium.

Another source of increased demands on the Agency will be the expanding role of nuclear technologies in promoting development and human well-being. The IAEA's technical assistance to developing countries with nuclear applications in health, agriculture, industry, environment, hydrology, and biological and physical research helps to build broad support for the Agency and its larger energy, safety, security, and non-proliferation missions. The IAEA's Technical Cooperation Program needs to be expanded and diversified to ensure it keeps pace with the growth in the Agency's other activities. This will entail a higher outlay and assured funding for nuclear applications and technical cooperation. Demand for technical assistance will always exceed the resources allocated for it, but developing countries' expectations for such support from the IAEA need to be better satisfied in future.

The Commission has dwelt at length on the interrelationship between nonproliferation and disarmament, and urges the international community to take a number of measures to honor its obligations for nuclear disarmament. Substantial steps are needed to strengthen the global effort to stem the spread of nuclear weapons and to move toward disarmament. Stronger measures to prevent proliferation and new steps toward disarmament serve the security interests of all, and neither is likely to be achieved without the other. While the IAEA is not the lead forum or agency for disarmament, perceptions of progress or lack of progress in disarmament directly affect many of the Agency's other critical missions, and with its decades of experience in monitoring nuclear materials the IAEA may have an important verification role to play as disarmament proceeds, requiring substantial additional resources.

Safeguards are a core mission of the IAEA and must continue to be a central part of its work. In fact, the IAEA's safeguards responsibilities have been expanding dramatically. From 1984 to 2007 the amount of nuclear material under safeguards increased from 1,090 to 11,874 "significant quantities" (1089%).[15] Member states have already called on the Agency to implement the Additional Protocol (which inevitably requires additional resources for a period in the transition to integrated safeguards) as well as to pursue a country-level, information-driven approach to safeguards that requires the Agency to examine a broad range of additional types of information, from open sources to satellite photographs, and to track black-market nuclear networks. Further increases for safeguards work will be needed if nuclear energy grows and other circumstances change in the future. Yet, since the mid 1980s, the Agency was, for the most part, subject to zero real growth in funding, the only significant departure being a modest increase approved in 2003. Given these increased responsibilities, a substantial increase in IAEA resources for safeguards is clearly required. IAEA member states should provide the funds needed to ensure that the effectiveness of safeguards is not compromised by lack of resources.

Nuclear and radiological terrorism are serious dangers. Terrorists are actively seeking nuclear weapons and material to inflict catastrophic destruction on their targets. Thefts and losses of nuclear and radiological material point to a continuing need for strengthened security measures. Nuclear security is fundamentally the responsibility of individual states, but the IAEA has a critical role to play by supporting its members in setting security standards and by organizing international peer reviews to confirm full compliance with these standards. Over time, member states should enter into binding agreements that set effective global nuclear security standards, and the IAEA should be given a role in helping to develop these standards and confirming their implementation. The Agency will need additional, and more predictable, resources to fully implement its existing nuclear security responsibilities and to take on an expanded role in this area.

Although nuclear safety has improved substantially in recent decades, thanks to the work of nuclear operators and regulators, the IAEA, nuclear vendors, builders, national governments, associations, the press and the public, the highest standards of nuclear safety will be required as nuclear energy grows.

[15] The IAEA defines "significant quantities" as 8 kilograms of plutonium and 25 kilograms of contained uranium 235 for highly enriched uranium.

The IAEA's role in maintaining, implementing, and continuously improving the global nuclear safety regime is critical and must be strengthened. In particular, in states that are building their first nuclear power plants the IAEA should play a major role in helping to ensure the highest levels of safety and security, including through training and the establishment of effective and independent regulatory bodies. Member states should enter into binding agreements setting effective standards for nuclear safety, as for nuclear security, and regular international nuclear safety peer reviews should become the norm. All of this will require a substantial increase in the Agency's resources focused on nuclear safety.

Effective plans for public communication in a crisis resulting from a nuclear accident are vital to build public confidence and reduce the likelihood of panic. A modest addition to its annual budget would drastically increase the IAEA's ability to meet member state demands for reviews of, and assistance with, emergency preparedness; upgrade its emergency communications capabilities; and strengthen its capability to respond rapidly to a major emergency. The IAEA will also have an important role in coordinating the international response to a nuclear or radiological incident, and further resources are required to expand the capabilities of its Incident and Emergency Response Center.

Seen against the immense consequences for world security, global investment in the crucial mission of the IAEA has been remarkably small. For example, the safeguards budget of the IAEA – which is meant to ensure the security of hundreds of tons of nuclear material in hundreds of facilities in scores of countries – is no larger than the budget of the police department of the city in which the Agency is located. IAEA budgets for nuclear security, nuclear safety, nuclear energy, nuclear applications, and technical cooperation are even smaller. Modernization of the Agency's scientific and information infrastructures is long overdue. The Safeguards Analytical Laboratory alone requires sizeable investments to make it fully functional. In addition to a large deficit for infrastructure and technology investments, the Agency has a significant unfunded liability for health and other benefits for its former employees.

The long-standing policy of "zero real growth" – even while the IAEA's responsibilities have been dramatically increasing – has long ago cut into the Agency's ability to carry out its most critical missions. The increase approved in 2003 helped, but not enough. As early as 2002, a management review conducted by Mannet of Switzerland[16] concluded that, despite its efficient management of resources, the Agency was showing signs of systems stress and could not sustain its achievements or respond to increasing demands without concomitant increases in resources.

Member states have helped to address the IAEA budget problem by providing extra-budgetary contributions for particular purposes, such as inspection equipment and measures for preventing nuclear terrorism. In recent decades, these contributions have been critical to the Agency's ability to respond to new challenges. For example, more than 90 percent of the IAEA's funding for preventing terrorism currently comes from voluntary contributions. Most such contributions are highly unpredictable, making it very difficult to make long-term plans and hire permanent staff. Moreover, voluntary contributions are often tied to particular projects of interest to the donor, leaving other urgent priorities unfunded.

The IAEA also faces an incipient crisis in staffing. Much needs to be done to ensure that the IAEA is able to attract and retain the top-quality professionals it needs to carry out its multiple missions. Because of its participation in the UN Common System, the Agency has a retirement age of 62 years for most staff and only 60 years for a quarter of the staff. Half of its top management and its senior inspectors are expected to hit this limit and retire in the next five years. Several factors make it difficult for the IAEA to recruit and retain the experts it needs, particularly in highly technical specialties that are in demand in the private sector. These include the IAEA's policy of offering only three-year initial contracts (which may be extended to five or seven years, and only in limited cases for longer periods), and the Agency's salary structure. The IAEA's personnel policies make it difficult to hire needed talent quickly, and often result in a replacement arriving months after a key expert has left, resulting in major losses of institutional memory and expertise.

[16] "At What Cost, Success", Mannet of Switzerland, 14 October 2002.

A thorough reform of the Agency's funding has become all the more urgent with the additional tasks that this report envisages for the Agency in 2020 and beyond, to seize the opportunity of Atoms for Peace and Prosperity. Without additional and reliable funding, the IAEA will not be able to:

- Carry out independent analysis of safeguards samples, essential to provide credible verification of the non-proliferation of nuclear weapons. Urgent funding is needed to shore up the failing infrastructure and instrumentation, and ensure the safety and security, of the Safeguards Analytical Laboratory.

- Play its essential role in combating nuclear terrorism and in ensuring the safety of nuclear power plants and other nuclear facilities. The staffing of these vital programs currently has to rely to a very large extent on unpredictable voluntary funding.

- Provide an adequate response, in terms of prompt international coordination and assistance, to a nuclear accident or terrorist act involving nuclear or radioactive material.

- Ensure that the many new countries considering introducing nuclear power programs do so in a carefully planned, and safe and secure, manner.

- Respond to pressing global crises in food security, health and the availability of drinking water through the use of nuclear techniques, for example by helping to ensure transboundary control of insect pests harmful to fruit and vegetables, developing sustainable crop varieties tolerant to harsh conditions, helping address the growing cancer epidemic, especially in the developing world, and underpinning desperately needed improvements in water resources management.

- Meet, in a timely manner, urgent requests relating to verification of non-proliferation. Currently, voluntary funding has to be sought for unforeseen high priority needs.

The needed increase in funding must be accompanied by a renewed and transparent effort by the IAEA Secretariat to improve on the Agency's already impressive record of efficiency. It must seek every opportunity to develop a management culture that emphasizes accountability, readiness to accept change, and effective coordination with other organizations. The IAEA's personnel policies also need reform, to allow the Agency to compete successfully with the private sector to employ the experts it needs.

Recommendations for a stronger IAEA

The Commission's recommendations on actions to reinforce the global nuclear order, including actions to be taken by the IAEA, are offered in the preceding sections of this report. Recommendations for strengthening the Agency are offered below.

- The unique scientific and technological capabilities that the IAEA brings to all its activities should be sustained and enhanced.

- The Board of Governors should agree to provide an immediate one-time increase in the IAEA's budget by €80 million for *inter alia* refurbishing the Safeguards Analytical Laboratory and for adequate funding of the Agency's Incident and Emergency Response Center.[17] The Board should also agree to consistent annual increases in the regular budget to underpin the expansion of the Agency's security and safety work, other activities in support of newcomer states embarking on nuclear programs, and an expansion of work in nuclear applications and technology transfer. The exact amount of additional regular budget should be determined after a detailed review of the budgetary situation and additional workloads of the Agency, but the Commission estimates that increases of about €50 million annually in real terms might be necessary during several years.

- In the longer time frame, the regular budget will need to continue increasing in order to meet the growing demands for IAEA services. A substantially bigger regular budget – by 2020 perhaps twice as large as the present one – would allow the needed expansion of work on nuclear reactors and the fuel cycle, security and safety, and support for meeting basic human needs through nuclear applications and technical cooperation. It would also meet an additional

[17] We have taken as credible the figure that was provided in the Director General's Report (footnote 22, page 24, "20/20 Vision for the Future").

funding requirement in the verification area to ensure an independent and credible system, and address other existing unfunded liabilities.

- To better inform planning and budget debates, the Agency should establish a comprehensive approach to assessing its future resource requirements, and should estimate the negative impacts and consequent risks of particular levels of budget constraint or gauge what could be done with particular levels of budget increases.

- The statutory functions of the Agency – including in nuclear energy, nuclear applications, development, safety, security, and safeguards – should be fully funded from assessed contributions. Voluntary contributions can help cover unforeseen expenditures in any of these areas, but should no longer be relied on for day-to-day financing of core missions.

- The Technical Cooperation Fund should continue to be based on negotiated targets, but it should be adequate to cover the new areas of activity covered in this report, predictable on a multi-year basis, and assured. Recipient states should pay some portion of the costs of technical cooperation, on a sliding scale based on their ability to pay. The Agency should consider a variety of approaches to such payments, and may wish to reassess the National Participation Cost system that was adopted in 2004, which in some cases may divert funds that states might otherwise have spent to support vital technical cooperation projects in their countries.

- A Contingency Fund should be established from assessed contributions to alleviate problems arising from delay in payments and to enable the Agency to respond to emergencies such as nuclear accidents, terrorist attacks, or urgent verification requests.

- The Agency and its member states should examine a variety of options for innovative financing arrangements that could supplement or even replace the current system of budget assessments. For example, efforts should be made to develop mechanisms under which states would pay the Agency a portion of the monetized value of the reduction in risk resulting from the Agency's activities. The Agency should also consider other user fees or participation fees for its services, keeping in mind both the needs of developing countries and the need to maintain incentives for states to accept safety and security reviews.

- Qualified public and private organizations should be invited to expand their support for the Agency. Such donations should be used only for purposes and activities authorized by the Board of Governors.

- Regional institutions in the field of safety and safeguards should be encouraged to expand their cooperation with the Agency to achieve better synergies and allocations of resources.

- The Agency should adopt a flexible and transparent personnel system focused on attracting, training, and retaining the highly qualified personnel that it needs. The member states should give the Director General flexibility to offer attractive terms to specially qualified and indispensable personnel, including the possibility of higher salaries, career employment, and other benefits. Exemption should be sought from the regulations of the UN Common System to meet the special needs of the Agency.

- Member states should work with the IAEA to establish programs to attract and train appropriate experts to work at the IAEA, and to give their nationals incentives to pursue placements at the IAEA (ranging from salary bonuses to career advancement opportunities on their return home).

- The Agency should continue to pursue opportunities to increase efficiency by using modern methods of management and communications. In particular, it should make needed investments in information technology that can bring significant payoffs in efficiency and economy in the long term.

Conclusion

The UN High-level Panel on Threats, Challenges, and Change characterized the IAEA as an "extraordinary bargain," considering the very low cost at which the Agency carries out responsibilities of immense value to humanity. By 2020 and beyond, these responsibilities will increase

dramatically as mankind and the Agency face new opportunities and challenges in the nuclear arena. In the new partnerships that the Commission envisages for nuclear energy, development, disarmament, nonproliferation, safety, and security, the IAEA's strengthened role would require additional authority, resources, personnel, and technology. The cost of providing these would be insignificant compared either to the benefits to be gained or to the risks and costs of failure to act. Now is the time to choose.

Abbreviations and Acronyms

EUR	European Utility Requirements
FAO	Food and Agriculture Organization of the United Nations
GNEP	Global Nuclear Energy Partnership
HEU	highly enriched uranium
IAC	InterAcademy Council
IAEA	International Atomic Energy Agency
IAP	InterAcademy Panel on International Issues
ICSU	International Council for Science
INPRO	Innovative Nuclear Reactors and Fuel Cycles
LEU	low enriched uranium
MDEP	Multinational Design Evaluation Program
NPT	Treaty on the Nonproliferation of Nuclear Weapons
NTI	Nuclear Threat Initiative
OECD	Organization for Economic Cooperation and Development
R&D	research and development
SIT	Sterile Insect Technique
TCF	IAEA Technical Cooperation Fund
UNSC	United Nations Security Council
WANO	World Association of Nuclear Operators
WINS	World Institute for Nuclear Security