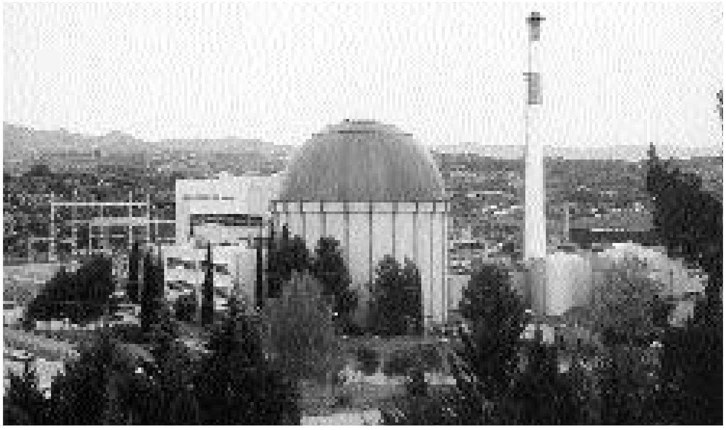
NUCLEAR GREEN

PERSPECTIVES ON SCIENCE, DIPLOMACY, & ATOMS FOR PEACE

BY JOHN B. RITCH III

Heading into the next millennium, issues surrounding the world's sustainable development present a formidable challenge for energy producers. More tests lie in the 21st century political arena and marketplace. What role will nuclear energy play to help meet electricity needs and curb the threat of climate change? This September in Vienna, the IAEA General Conference features a Scientific Forum where leading authorities will examine nuclear power's role in the international context of sustainable development.

In this essay, US Ambassador John B. Ritch III offers a straightforward perspective on nuclear energy's global development, set in the context of the world's diplomatic achievements, energy and environmental goals, and issues influencing public understanding of atoms for peace.



My thesis is simple: in the next century mankind must harness the nuclear genie if our energy needs are to be met and our security preserved. We have made great progress towards this end in nuclear diplomacy and nuclear technology, but politics lags far behind.

Indeed, on the eve of the 21st century, we face an acute green paradox. In the industrial democracies, those most concerned about the potentially cataclysmic effect of pouring billions of tonnes of greenhouse gases into the atmosphere are essentially the same as those most opposed to nuclear energy. In other words, the people who see the global warming problem most vividly are often those most strongly opposed to the most realistic approach to the problem.

Similarly, in the developing world, anti-nuclear sentiment appears to be strongest among the forces pressing hardest for democratic reform. Throughout the world (with the notable exception of France) "progressive" politics tends to be "anti-nuclear" politics.

There are understandable historical reasons for this alliance, but it survives in disregard of two profoundly important nuclear success stories.

The first is the progress made in establishing an effective regime of non-proliferation of nuclear weapons and in starting to destroy the terrifying nuclear arsenals built up during the cold war. The second is the progress made in making nuclear energy a safe, clean and efficient means of meeting the globe's expanding energy needs – needs which cannot be met by any other non-carbon-based technology, despite the appeal of wind, solar power and other "renewables."

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Photo: Spain's Jose Cabrera nuclear plant. Worldwide nuclear power supplies about 16% of total electricity. Credit: UNESA (Unidad Electrica SA)

The word "nuclear" covers three distinct groups of technologies. The first are those required to yield a nuclear explosion. Second are those used to heat water in a reactor, and thereby power an electricity-producing turbine. These technologies have in common the use of uranium and plutonium – fissile material – and the splitting of the atom to release energy.

The third group – sometimes called "nuclear applications"– includes technologies which depend on the positive effects of radiation. Although little known to the public, these technologies are dazzling in their diversity and are having a dramatic impact on every aspect of human life.

Nuclear techniques are being used to adapt food plants to local conditions and thus enlarge harvests; to find water; to improve irrigation flows; to combat devastating pest populations such as the medfly, screw-worm and tsetse fly; to control water pollution in the seas; to raise quality in many industrial processes; to fabricate new materials; to preserve food; to protect art works; and to treat human disease. Some of these techniques are especially relevant to the less developed countries; others are now pervasive in the industrialized democracies.

We have never been in a better position to use nuclear energy safely, and we have never been in greater need of doing so. And yet public understanding of nuclear power remains shrouded in myths and fears quite disproportionate to the facts. My aim is to challenge those myths and offer some facts that bear on future global policy.

THE QUESTION OF ENERGY

Today of the world's six billion people, two billion have no access to electricity. In the next 25 years, the world's population is expected to grow by two billion. We must assume that these four billion people – and billions more who today consume very little energy – will exert enormous pressure for higher standards of living and increased global energy consumption. This is a demand we should try to meet, not only to alleviate human misery but also because an increased standard of living is a necessary condition for stabilizing the global population.

A reasonable prediction is that worldwide energy consumption will increase 50% by the year 2020, and could double by mid-century. No larger question faces humanity than whether and how this energy demand will be met. Already, at present levels of consumption, we are releasing greenhouse gases – primarily carbon dioxide – at a rate which will cause the total atmospheric accumulation, some time in the 21st century, to almost double from pre-industrial levels.

Climate Change. The greenhouse effect itself is beyond dispute. Indeed, without that capture of heat the surface of the earth would be covered in ice. What remains unknown is what will occur as the greenhouse effect intensifies. But a large majority of scientists predict global warming of several degrees, with catastrophic climatic repercussions.

We cannot wait to see. The multi-decade lead times involved – the result of the long use of energy infrastructure once built, and the long duration of greenhouse gases once emitted – require a global energy strategy embodying the principle of "no regrets." Any other policy risks disaster.

The Kyoto Protocol – with its targets for emission reduction and "flexibility" mechanisms for meeting those targets – represents an admirable, if limited, start to our efforts to curtail greenhouse gas emissions. The less developed countries, with their low *per capita* emission levels, have so far resisted emission targets on the grounds that the problem emanates from the industrial countries. Their projected energy consumption makes their participation essential. But if a global regime is to be established, an act of political leadership will be required within the industrial democracies.

Here we move from the promising to the surreal. The reductions required in the industrialized world – not just to meet the Kyoto targets of slightly reduced emissions, but to achieve the deeper reductions which would stabilize the atmospheric concentration of greenhouse gases – seem to exceed, by far, the potential contribution of the means being considered.

Great attention is quite properly focused on energy conservation; this can yield real gains at the margin. But the hopes being attached to renewables – solar and wind power, geothermal energy, biomass and hydroelectric – are quite fantastic in the light of realistic assessments of the role they can play. The potential of the most effective renewable – hydroelectric – has already been heavily exploited and now provides 6% of global energy. But the remaining renewables, which now yield under 1%, offer only limited promise. The World Energy Council predicts that, even with heavy research support and subsidies, these renewables can provide no more than 3% to 6% of energy supply by 2020. Meanwhile nuclear power, which supplies 6% of global energy (about 16% of global electricity), and remains the one available technology able to meet rising base-load energy needs with negligible greenhouse emissions, is subject to a widespread political taboo.

Even the UN development programme, in its "Energy After Rio" report, dismissed nuclear power as an energy option, citing "public concerns." But political leaders abdicate responsibility if they simply yield to "public concerns" about nuclear power, in attempting to draw up a balanced appraisal of real risks and options.

Answering deeply rooted public concerns about nuclear energy means challenging three widespread myths: that nuclear energy fosters nuclear weapons proliferation; that nuclear energy use risks another Chernobyl; and that nuclear waste represents an environmental time bomb.

THE QUESTION OF THE BOMB

The first myth – that nuclear reactors are likely to breed weapons – has little foundation in experience. Each of the five nuclear-weapon States built the bomb before moving to civilian power production; technically, power reactors were not a necessary intermediate step.

Furthermore, people seldom recognize our success in controlling nuclear weapons proliferation. The core of all nuclear arms control is the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) which, after three decades of diplomacy, is now nearly universal and rigorously enforced.

This achievement must be seen against US President Kennedy's plausible prediction that our century would see dozens of nations armed with nuclear weapons. Instead, we have capped the number at eight: the five nuclear-weapon States on the UN Security Council, who are obliged to engage in good faith disarmament; and the three States – India, Pakistan and Israel – which for their own national security reasons have declined to accept NPT obligations.

Apart from these eight countries, every other country in the world is now legally committed – an obligation rigorously overseen by the IAEA – to abstain from nuclear-weapon development.

This achievement was not inevitable. Before joining the NPT, governments as diverse as Argentina, Brazil, Sweden, Switzerland, Taiwan, China, and South Korea are thought to have engaged in serious nuclear-weapon research. South Africa joined the NPT and forswore nuclear arms after building several working bombs. Ukraine, Belarus, and Kazakhstan inherited nuclear weapons from the Soviet Union but made admirable decisions to forgo weapon-State status.

The NPT's status as a bulwark of international security depends on reliable verification to ensure compliance. Given the sweeping scope of the NPT and the new strength of IAEA safeguards, any aspiring proliferator bent on breaching the regime would face a strong probability of detection – and the sure knowledge that a violation would turn it into an international pariah facing collective action by the UN Security Council with a likely military response.

The world is indebted to Saddam Hussein for promoting a radical upgrade in IAEA safeguards. In the decades before the Gulf war, the world community had operated on the assumption that any illicit weapon would come from fissile material secretly produced under the guise of a commercial or research reactor.

This is why the IAEA was invested only with the power to apply safeguards at the world's known nuclear facilities. Saddam's creation of a clandestine nuclear programme, even while the IAEA was safeguarding Iraq's "declared" nuclear facilities, taught us that the IAEA needed a broader range of powers.

Between 1993 and 1997, IAEA Member States and the Agency Secretariat worked on these new powers. In 1997, the results – which represent a remarkable ceding of national sovereignty in the interests of collective security – were incorporated in a Safeguards-Strengthening Protocol which all NPT members are expected to sign before the NPT Review Conference in the year 2000. Under the protocol, each non-nuclear-weapon State will be obliged to provide the IAEA with unprecedented access not only to all nuclear-related information, but to all sites which might reasonably be suspect. Failure to sign – or denial of access under the protocol – would be the equivalent of a confession of weapons intent.

This expansion of IAEA authority has been reinforced by two other developments. The first is an unprecedented willingness on the part of Member States to share usable intelligence – both data and high-powered imagery – with the IAEA's inspectorate. The second is the advent of increasingly sophisticated sensing technologies, which can detect and identify nuclear activity from minute samples taken many miles away.

When North Korea, in order to gain access to nuclear trade, joined the NPT and submitted itself to IAEA inspection, it was the sophistication of IAEA sample analysis, combined with satellite imagery provided to the IAEA, which provided conclusive proof of discrepancies in North Korea's account of its nuclear history. The Member States of the IAEA confronted North Korea, precipitating the crisis which was resolved through US-led negotiations. Under the 1994 Agreed Framework, and pursuant to UN mandate, IAEA inspectors have remained in North Korea to monitor the nuclear freeze to which the North Koreans agreed. In other words, the system worked. (The later discovery and inspection of a possible nuclear construction project in North Korea underlines the power of advanced intelligence techniques to back up the IAEA.)

The NPT violations committed by Iraq and North Korea, and even the nuclear tests in India and Pakistan, are exceptions to a larger rule: the world is turning decisively away from nuclear weapons, and erecting strong barriers against recidivism. Gradual military denuclearization by the five official nuclear States is also progressing. The second Strategic Arms Reduction Treaty, START-2, when fully implemented, will cut the US and Russian strategic arsenals from their cold war highs by 70%. The safe handling of nuclear material from the Soviet arsenal remains a matter of urgent international concern, but such concern should not obstruct rational decisions about future global energy supply.

What of the three "unofficial" nuclear weapons powers? Israel – surrounded by larger and hostile States – has stated that its NPT membership must be preceded by substantial steps in Arab-Israeli peace, probably including a regional nuclear weapons inspection arrangement in which Israel itself would participate. Most Arab States, even while resenting Israel's unique nuclear status in the region, recognize their collective interest in a non-nuclear Arab world. Israel is already a signatory of the Comprehensive Nuclear Test Ban Treaty (CTBT).

Both India and Pakistan, having made their nuclear "statements," are also likely to join the CTBT and to enter into talks on the cut-off of fissile material production for weapons. The CTBT, with its rigorous International Monitoring System nearly complete, is on course to establish a world without nuclear testing, either furtive or open.

Even more fundamentally, the fear of nuclear proliferation is simply misplaced in the global warming debate. Most current carbon consumption is in countries which already have nuclear weapons or which can be relied on as good-faith parties to the NPT. And the largest growth markets in energy consumption are China and India, both of which already have weapons capabilities. In short, almost everywhere the reduction in carbon emissions could yield important benefits for climate protection, proliferation is not even an issue.

THE QUESTION OF SAFETY

The second myth, which exercises a powerful hold on the public mind, is that a nuclear power plant itself constitutes a kind of bomb – likely, in case of accident, to explode or to release massively fatal doses of radiation. This myth is embodied in collective memory by the accidents at Three Mile Island and Chernobyl. The power of those two images far exceeds what is warranted by the facts.

At Three Mile Island in 1979, the simple truth is that public health was not endangered. Despite a series of mistakes which seriously damaged the reactor, the only outside effect was an inconsequential release of radiation – negligible when compared to natural radiation in the atmosphere. The citizens of the Three Mile Island area would have received more radiation by taking a flight from New York to Miami or standing for a few minutes amid the granite of Grand Central Station. The protective barriers in the reactor's design worked.

By contrast, the accident at Chernobyl in 1986 was a tragedy with serious human and environmental consequences. Chernobyl was a classic product of the Soviet era. A gargantuan reactor lacked the safety technology, the procedures and the protective barriers considered normal elsewhere in the world. The fire led to a massive release of radiation through the open roof of the reactor. More than two dozen firemen died from direct radiation exposure.

A conference sponsored by the World Health Organization (WHO) on the disaster's tenth anniversary in 1996 issued a report based on intensive study of the 1.1 million people most directly exposed to the fallout. The main finding was a sharp increase in thyroid cancer among children; 800 cases of the disease had been observed, from which three children had died, with several thousand more cases projected. The report also predicted 3500 radiation-induced cancer deaths, mainly late in life.

These statistics do not minimize the gravity of what happened at Chernobyl, but they place that singular event in perspective. The nuclear age has now produced more than 8000 reactor-years of combined operational time – and one serious accident.

Meanwhile, the production and consumption of fossil fuel yields a constant flow of accidents and disease, in addition to greenhouse gases. In the years since Chernobyl, many thousands have died in the production of coal, oil and gas; and millions each year are afflicted with pollution-induced disease resulting from the use of carbon fuels to produce energy which could be produced by nuclear power. According to the WHO, three million people die each year due to air pollution from a global energy system dominated by fossil fuels.

The question is: what has been done to prevent another Chernobyl? While Chernobyl severely damaged the standing of nuclear power, it inspired important advances in the global industry. Just as Saddam Hussein helped to strengthen safeguards against proliferators, Chernobyl accelerated the arrival of a stronger nuclear safety culture. National regulatory agencies, a new World Association of Nuclear Operators and the IAEA work together to promulgate state-of-the-art knowledge. Two years ago, a Convention on Nuclear Safety introduced a system of peer review to detect any deviation from the high safety standards which are now the norm.

For the total of some 430 power reactors (half in Europe) operating in 31 countries, and producing 16% of the world's electricity, only one large safety problem remains: in three countries of the former Soviet empire some 15 plants of the Chernobyl type are still in use. Although now equipped with safety upgrades and better trained personnel, these reactors fall short of current standards and must be phased out as soon as alternative energy supplies can be funded and installed.

Elimination of Chernobyl-style reactors will be an important step in ensuring that the industry will only have reactors of the most modern design. Building on a large base of operating experience, today's reactors are engineered on the principle of "defense in depth," ensuring against a release into the environment even in the case of a severe internal accident. Moreover, designers believe that the newest plants would experience such an environmentally harmless event no more than once in every 100,000 reactor-years of operation. Advanced plants now under development will have even less risk of internal damage.

THE QUESTION OF WASTES

The fact that modern reactors are immensely safe shifts attention to the question of nuclear waste. The myth is that, regardless of reactor safety, the resulting waste is an insoluble problem – a permanent and accumulating environmental hazard. The reality is that, of all energy forms capable of meeting the world's expanding needs, nuclear power yields the least and most easily managed waste.

The challenge of climate protection arises precisely because it is fossil fuel consumption, not nuclear power, which presents an insoluble waste problem. The problem has two aspects: the huge volume of waste products, primarily gases and particulates; and the method of disposal, which is dispersion into the atmosphere. Neither seems subject to amelioration through technology.

In contrast, nuclear waste is small in volume and subject to sound management. Most nuclear waste consists of relatively short-lived, low and intermediate level waste – annually, some 800 tonnes from an average reactor. Such waste can be handled safely through standard techniques of controlled burial or storage in near-surface facilities. Half of such waste comes from industrial and medical activities rather than from power production.

High-level waste consists of spent fuel or the liquid waste which remains after spent fuel is reprocessed to recover uranium or plutonium for further use.

The annual global volume of spent fuel from all reactors is 12,000 tonnes. This amount – tiny in comparison to the billions of tonnes of greenhouse gases and many thousands of tonnes of toxic pollutants being discharged annually – can be stored above or below ground. Moreover, the volume decreases considerably if the fuel is reprocessed. The 30 tonnes of spent fuel coming from the average reactor yield a volume of liquid waste of only 10 cubic metres per year.

Even with twice today's number of reactors, the annual global volume of liquid waste, if spent fuel were reprocessed, would be only 9000 cubic metres – the space occupied by a two-metre high structure built on a soccer field. Liquid waste from reprocessing can be vitrified into a glass which is chemically stable and subject to a variety of remarkably safe storage techniques. Indeed, the use of those techniques in long-term storage is now more a political than a technical question.

So far, as a result of political obstacles, nations employ various methods of interim storage because no long-term disposal site has been licensed in any country. A number of countries, however, are developing repository concepts. Under consideration are deep underground geological formations such as solid salt domes and granite tunnels which are impervious to water and thus to the leaching of materials. If such sites were used, this protection would be compounded by a series of other barriers: the vitrified state of the waste, high-endurance storage canisters, and absorbent clay.

According to the IAEA, even if these barriers were not used, "the long path through the host rock to the surface would probably ensure sufficient dilution so as to pose little risk to human health or the environment." Moreover, storage sites can be designed so that all material remains under strict supervision -— and subject to retrieval in the event that technological advance offers new opportunities for retreatment.

Clearly, the management of nuclear waste must meet high standards not only of public safety but also of public acceptance. A first step requires a broader understanding of the waste issue not as a disqualifying liability of the nuclear industry but as a matter of momentous social decision. The choice is between the reckless dispersal of horrendous volumes of fossil fuel emissions and the careful containment of comparatively limited quantities of spent nuclear fuel.

To give a stark example: if Europe today were to eliminate nuclear-generated electricity and revert to traditional fossil fuel power, the extra greenhouse gases created would be the equivalent of doubling the number of cars on the road.

HISTORY'S LESSONS

For more than 50 years, the words Hiroshima and Nagasaki have served as an unambiguous message of the horror of nuclear war and spurred the world to constructive action.

The effect of the word Chernobyl has been more ambiguous. That catastrophe – a singular example of industrial malpractice – could scarcely have been more severe if men had conspired to create the worst debacle in nuclear history. Yet even as scientists and diplomats acted to ensure that such a disaster would never occur again, the word became a rallying cry for resistance to future reliance on nuclear power. This was a lesson wrongly learned.

Today, mankind faces needs, and perils, demanding that we exploit the constructive power of nuclear energy and fulfill US President Eisenhower's vision of "Atoms for Peace." Science and diplomacy have paved the way. Politics, and policy, must now follow. ❑