Report of the International Consultative Group on Nuclear Energy

The Report which follows is published in the hope of assisting the wider debate about the international future of nuclear power which it has been one purpose of the International Consultative Group on Nuclear Energy (ICGNE) to encourage. There are technical, economic and political problems which still have to be addressed successfully if the wider civil use of nuclear energy is to be generally accepted. The object of this Report is to identify issues which remain to be resolved, especially internationally, and to define conditions crucial to resolving them

This Report represents a general consensus among those members of ICGNE whose names appear below. They come from a wide range of countries, developed and developing, and from a variety of backgrounds. Many, but not all, are professionally involved in the field of nuclear energy Some carry policy responsibilities; others do not. What they have in common is experience of and concern for energy in general and nuclear energy in particular.

During the two years of its activity, ICGNE has held seven plenary sessions and has already issued seven working papers by individual authors on specific topics.

All members of ICGNE have contributed to its work in their personal capacities, and the views expressed in this Report should not be understood as those of any organization with which individual participants are associated. Nor do they represent the opinions of the Group's co-sponsors, The Rockefeller Foundation and The Royal Institute of International Affairs, which are unofficial bodies that do not, as such, take positions on policy.

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ENERGY AND NUCLEAR POWER

Today, as users of energy, we all face unprecedented responsibilities and uncertainties. Over the next few decades, it is overwhelmingly probable that global petroleum production will level off and begin to fall, the price of fossil fuels will go on rising, and the balance between energy supply and demand will become even more precarious. One result is that the world's energy system will be increasingly vulnerable to error, accident or deliberate disruption. In that uncertain and delicately balanced future, the survival of our societies, as we know them, may depend on our separate and joint ability to limit energy consumption and expand energy production.

In the past, economic growth and development have always been accompanied by rising energy consumption. The ways in which they are connected to each other are not fully understood. Nor is the extent to which public policy can influence the connection between them. A great deal can certainly be done to use energy more efficiently. But more than that will be needed, if only because most conservation measures require large financial investments, are slow to produce results and, even then, can have only a limited effect. Meanwhile, population growth and the natural desire for higher living standards, especially in the less developed countries where more than three quarters of the world's people use less than a fifth of the world's energy, will continue to force up energy demand.

Despite higher prices and general economic recession, the world's annual consumption of primary energy has increased since 1972 by over 20 per cent: an amount equivalent to about two and a half times the current annual oil production of Saudi Arabia. But oil production alone can no longer be increased fast enough to meet that rising demand. Moreover, as recent events have shown, oil supplies can be affected by often unpredictable political circumstances. However much is done to use energy more efficiently, therefore,

we must expect the coming decades to be a period in which a growing proportion of demand will have to be satisfied by means other than petroleum – or not be satisfied at all As the balance between supply and demand becomes more delicate, we must also expect increasingly fierce international competition for the energy sources which are available.

The dangers of either unsatisfied demand for energy or an all-out competition for available energy supplies are self-evident. The impact on individual countries would, of course, vary, simply because countries differ in their access to energy sources, their dependence on them and their ability to pay for them In general, however, energy shortages, inevitably accompanied by sharply rising energy prices, would be bound to reduce industrial output, increase unemployment and depress living standards. The effects would be particularly severe in developing countries Far from securing the larger share of world resources which they seek, those countries would face the prospect of energy shortages and costs presenting yet another barrier to development programmes and perpetuating unemployment, poverty and hunger. But almost all the developed industrial countries would face real hardships as well.

Contemplating the possibility of unsatisfied energy demand, individual countries, fearing for their national welfare and security, would be tempted to use every asset to their separate advantage. Those with large reserves of essential raw materials and fuels, many of which are in the developing world, would be inclined to retain them or to raise their prices. Those possessing advanced technologies, including energy technologies, most of which are in the developed world, would tend to treat that asset in the same way. Those with larger financial resources would be driven to compete for the energy sources still available, pre-empting supplies and driving up prices In such a fiercely competitive atmosphere, the chances of establishing a reasonable relationship between developing countries with raw materials and developed countries with technology, each essential to the other's development, would be minimal Instead, feelings of insecurity would be accentuated and the risk of international conflict, including even military conflict, greatly increased.

The danger of fiercer international competition and conflict over energy supplies, provoked by the fear of unsatisfied demand, is obviously of universal concern. That only underlines the extent to which energy itself has become an inescapably international issue. The policies of individual states, even if intended to affect only the management of energy within their own borders, have an international impact. In facing a future of growing energy demand and increasing uncertainty about energy supplies and prices, all states must thus accept that global energy interdependence is a harsh reality

Although we must expect energy demand to increase and traditional energy sources to become harder to obtain at an acceptable price, we do not know exactly how much energy the world will need in 20, 30 or 40 years' time, nor how quickly additional supplies can be made available. Indeed, facts about the extent and cost of future energy supplies are increasingly difficult to establish. One necessary conclusion is that long-term energy policies have to be designed not merely to match a specified supply to a defined demand, since we can be sure of neither, but also to create a capacity for managing uncertainty. It is important, therefore, that a sufficient range of energy supply options should be developed in time for a rational choice to be made between them as the pattern of future demand develops.

The options we need to manage future uncertainty should include the best available techniques for producing, converting and using energy. The longer-term potential of nuclear fission energy, which is one of the supply sources already available to us, must be seen in that context.

Today, nuclear fission power equivalent to about 2 per cent of world primary energy supply provides only about 7 per cent of our electricity (although the proportion reaches over 25 per cent in some countries). Projections of future nuclear power growth vary However, programmes already in hand mean that its contribution will grow considerably during the 1980s A typical estimate would suggest that, by 1985, it will represent more than 5 per cent of primary energy and generate some 17 per cent of the world's electricity. By 2000, given the considerable scope for its further expansion, the role of nuclear power is likely to be larger still, and by 2020 it could be called upon to meet a fifth of all the world's primary energy needs. Already, therefore, it represents a significant part of the response to rising energy demand, while, for the uncertain long-term future, its expanded use constitutes one of the substantial energy supply options which can and should be placed at the world's disposal.

The option of expanding nuclear power supply will not be available for the long term unless its development is carefully sustained during the intervening period. In the last few years, the slower growth of electricity demand, a generally unfriendly economic climate and a variety of delays and difficulties in building, licensing and operating nuclear reactors have combined to inhibit nuclear power programmes. Economic constraints seem likely to bear heavily on nuclear investment in some countries, especially by private utilities, during the next few years as well. Timely development of nuclear options is particularly difficult in such a period Just for that reason, it is all the more important that governments and industries should take deliberate steps to maintain a rational balance of research and industrial capacity and an adequate supply of experienced scientists and trained technicians, so that the option of future nuclear power expansion is not closed off.

Expansion for its own sake, for the wrong reasons or at the wrong time is obviously to be avoided; planning for energy uncertainty requires the freedom not to pursue, as well as to pursue, any of the options available. Growth of energy demand, albeit at an uncertain rate, together with the danger of fiercer competition for energy supplies, is, however, to be expected. With that in mind, we believe that the continued development of nuclear power is needed as an important contribution to retaining a capacity for meeting the world's future energy needs

ESTABLISHING NUCLEAR OPTIONS

Current programmes will result in the wider commercial deployment of nuclear fission reactors similar to those already in service, fuelled with natural or low-enriched uranium but capable of extracting hardly 1 per cent of the energy potentially available in uranium itself. Decisions to install these so-called thermal reactors in particular countries reflect a number of different considerations: the relative cost of generating electricity by nuclear, as against other, means; the existence of an electricity grid able to absorb generating units of the relevant size; the technological capacity to support a nuclear programme; the availability of investment capital; the desire to reduce dependence on scarce or imported fuels. Especially in the developing world, those considerations limit the number of countries in which nuclear power is likely to be used before the end of this century.

In the longer term, the potential deployment of today's thermal reactors is more generally limited by the fact that economically recoverable uranium, like oil, is a finite commodity. Improved methods of uranium enrichment, fuel design and operation could somewhat extend the utility of current reactor types. Although its economic attractions are a matter of dispute, some contribution to uranium conservation might also be made by recycling plutonium and uranium separated from spent fuel into thermal reactors of present types. Because their intrinsic effeciency in using uranium is limited, however, these reactors cannot be expected to satisfy an indefinitely rising demand for nuclear power, into the 21st century. More efficient forms of uranium-fuelled thermal reactor are therefore worthy of development, as a valuable way of extending the viability of the present fuel cycle. But even that could not be more than an interim means of limiting uranium-consumption. For the long term, new and more advanced uranium-conserving technologies must be prepared.

If further development proved it feasible, a substantial saving of uranium might be achieved in the longer term by using thorium in thermal reactors. Ultimately, however, the way to escape from the constraint of uranium availability in the 21st century is seen to be to use fast breeder reactors: that is, reactors which 'breed' more fissile plutonium than they consume fissile uranium, and which thus, in effect, extract more of the energy potential from uranium itself.

Given uncertainties about the long-term energy future, it is impossible to predict the rate of commercial deployment of fast breeder reactors in different areas of the world. In any case, the total number likely to be deployed commercially during the early stages could not have any larger an effect on world uranium consumption over the next 30—40 years than might the use of more efficient thermal reactors. With the longer term in mind, however, we are convinced of the need to provide an option to deploy commercial fast breeder reactors. We are also convinced that the option will only be available if a major effort is made throughout the remainder of the present century to establish it, by further development and by successfully operating commercial-scale prototypes.

That effort must continue to involve substantial economic support and political commitment on the part of individual governments, with the main burden being carried in countries within the limited group, including France, Federal Republic of Germany, Japan, UK, USA and USSR, which is in the forefront of fast breeder reactor technology. However, given the scope and complexity of the work still needed, few countries could reasonably bear the financial burden of a completely independent fast breeder reactor programme, especially if it meant giving up development of other energy supply options. An even wider measure of international co-operation than already exists should also, therefore, be sought.

Because fast breeder reactors both produce and consume plutonium, their deployment entails reprocessing spent reactor fuel, to separate plutonium (and depleted uranium) for further use. There are other arguments for civil reprocessing as well, carrying different weights in different countries and circumstances: to concentrate nuclear waste into an environmentally acceptable form; to limit long-term access to plutonium; to deal with spent fuel which is particularly difficult to store, such as that from gas-graphite reactors; to separate plutonium for recycling into thermal reactors. It is, however, the potential commercial deployment of fast breeder reactors, and the need to have sufficient capacity in place to separate plutonium in time to meet their needs, which constitutes the most

generally persuasive reason for developing reprocessing as a routine stage in the nuclear fuel cycle.

In parallel with a programme to establish the fast breeder reactor option commercially, work must therefore continue on demonstrating the commercial feasibility of large-scale reprocessing of spent fuel from both thermal and breeder reactors. While allowance must also be made for the weight attached to other arguments, in particular national circumstances, the rate at which commercial reprocessing capacity is actually expanded should depend principally upon the rate at which it proves necessary to deploy fast breeder reactors. We believe, however, that a deliberate programme to develop and demonstrate commercial-scale reprocessing is needed now, as part of the preparation of nuclear options for the future.

NUCLEAR SAFETY AND THE PUBLIC INTEREST

Whatever technology may permit or economics demand, the future of nuclear power depends on earning and retaining a sufficient measure of public acceptance. Especially in most of the Western industrial countries, therefore, it depends on reducing public concern over the possibility of nuclear accidents, the problems of nuclear waste and the health effects of low-level radiation. Ultimately, it also depends on people being convinced that the wider use of nuclear power is compatible with the sort of society in which they want to live.

The question is not whether the civil use of nuclear energy entails risks. It does. Every stage in the fuel cycle, from uranium mining to waste disposal, carries risks to those who engage in it and to the community at large. So, however, do all other activities connected with the supply of energy: mining, transporting and burning coal, for example, or carrying liquid natural gas, or establishing large hydroelectric dams, or producing and fabricating solar installations. Risks of accident, injury, disease and death cannot be eliminated from any of those activities, any more than from flying, driving or eating.

While their relative significance varies from country to country, the real questions about nuclear safety are quite different. Are nuclear facilities designed and operated with due regard for the public interest? Do national institutions provide adequate information about nuclear and other risks and the means of containing them? Can nuclear risks and the risks of providing energy by other means be assessed accurately enough to compare them fairly with each other? How should nuclear risks be weighed against the alternative risks associated with the limits on future energy supply if nuclear power were not available? It is on answers to real questions such as these, rather than on any mere identification of risks in the abstract, that the future of nuclear power should depend.

Nuclear power is sometimes identified as a prominent example of the technical complexity and institutional centralization against which sentiment in at least some countries has become stronger. Some, taking an extreme view, have even accused nuclear power of leading towards necessarily authoritarian state control. There is no simple way of responding to such assertions. Nuclear power is a complex, costly and large-scale technology, which requires central control if stringent standards are to be maintained. It must be shown in practice, however, that the central controls needed to protect the public interest can be combined with responsiveness and accountability. The institutions responsible for nuclear power must therefore take unusual pains to demonstrate their

sensitivity to reasonable public fears or opinions, and to establish and maintain an unblemished reputation for open and honest public communication.

Some of the hazards associated with nuclear power are said or thought to be of a special kind. That is particularly true of radiation, statements about the possible long-term effects of which arouse widespread fear. Yet radiation hazards exist as a normal feature of daily life, in industry, in medical treatment or in the natural environment, and would so exit if nuclear fission had never been discovered. Partly for that reason, it has taken less time to assess them than it has to come to grips with the long-term health hazards of many other activities, such as the production of coal, tin, asbestos or toxic chemicals, the smoking of tobacco or the consumption of alcohol. The assessment shows clearly that the radiation hazards of nuclear power can, in principle, be held within publicly acceptable limits, especially when measured against the hazards associated with alternative energy sources

To say that nuclear risks can be held within acceptable limits is not to argue for complacency. What has to be demonstrated to the public is that the standards of public and occupational safety which are attainable in principle will also be enforced and maintained in practice. In general, nuclear power has a record of public and occupational safety which compares favourably with that of other industries, including other energy industries. In particular cases, the implementation and enforcement of safety criteria could nevertheless be improved. That, for example, is one lesson of the accident in March 1979 at the Three Mile Island nuclear power station, near Harrisburg, in the United States, where the fact that the accident happened and developed as it did is testimony to the need, in that particular case, to improve the national application of design and operating standards.

Another area needing continued attention is that of nuclear waste management. Much of the nuclear waste now in existence has come from military programmes. As the amount of electricity generated by nuclear means increases, however, a growing volume of spent nuclear fuel, containing plutonium, depleted uranium and highly radioactive fission products, will require careful handling and treatment.

While interim storage procedures for spent fuel are well established, techniques for disposing finally of highly active waste products separated in reprocessing, or of spent fuel itself if it is not to be reprocessed, are still being developed, tested or demonstrated. Because it will be some years before any large amount of nuclear power waste has to be disposed of permanently, that does not imply a need to delay other nuclear operations, such as reactor construction or licensing. It does imply that governments, supported by industry, should accelerate the testing and demonstration of effective and acceptable methods for disposing finally of reprocessed or unreprocessed nuclear waste, so that the public may have a reasonable assurance that safe provision will be available as the quantity of waste from nuclear power increases.

In addressing the real questions about nuclear safety, it is easy to lose a sense of proportion. Numerous public inquiries into nuclear programmes have explored the public and occupational hazards of nuclear power, to an extent unparalleled in the case of comparable industries. Their general conclusion has always been that nuclear risks can practicably be held to a level universally acceptable in other connections. Perhaps inevitably, that conclusion has received less public attention than the catalogue of the risks themselves. Yet there is no risk-free way of maintaining and increasing energy supplies. Standards used to

compare the alternative ways of doing so must therefore be even-handed, and judgement must not be distorted by applying one set of standards to nuclear power and a different set to other energy sources. Governments have a duty to ensure that their citizens are equally well informed about the risks associated with all forms of energy supply.

Governments also have an international responsibility in regard to nuclear safety. A major nuclear accident may cause damage beyond national borders, and is in any case likely to increase public concern in other countries. Conversely, work on nuclear safety or waste management in one country may be relevant to other countries as well. There is a clear need, therefore, for governments to intensify their co-operation in these areas, directly or through international agencies, to share information and experience freely, and to do all they can to assist countries with less developed nuclear power industries in achieving high standards of safety. Relevant information should be provided promptly to other countries in case of a nuclear accident, and other countries should be ready to respond, if practicable, to requests for assistance, bilaterally or under the auspices of the International Atomic Energy Agency (IAEA).

We believe that public concern over nuclear safety can only be dissipated by demonstrating convincingly that the risks inherent in producing nuclear power are very low and, in any case, no greater than the risks of alternatives, and that those responsible for nuclear power are firmly committed to, and capable of, protecting the public safety. Government and industry have a shared duty to provide that demonstration At the same time, the extent to which nuclear power is publicly accepted depends upon a wider range of political and social considerations than we have here presented Rational assessment of that wider range imposes responsibilities not only on industry and government but also on all groups which influence or contribute to public attitudes.

NUCLEAR TRADE AND NUCLEAR PROLIFERATION

The main impediment to international nuclear trade and collaboration is the fear of nuclear weapons proliferating. Many would regard the almost unimaginable destructive power of the nuclear weapons already deployed as an even graver risk to international security in general. It is fears of further proliferation, however, which have come more specifically to hamper the peaceful nuclear relations between states. Governments may disagree about the management of that problem. There is nevertheless widespread international understanding that a world in which more states control nuclear weapons, or where more nuclear weapons are deployed, would be an even more dangerous one for all.

Weapons proliferation is not an inevitable, nor even a probable, result of expanded civil nuclear energy use. Indeed, no nuclear weapons force has yet depended for its existence on civil nuclear power development. A country embarking on nuclear armament might well find that a self-sufficient civil nuclear power industry could shorten the time needed to produce material for weapons. But easier and cheaper routes to weapons acquisition are likely to lie through the establishment, in the first place, of separate facilities committed to military use. Moreover, having a substantial nuclear power industry which depends on international trade may deter a government from risking that portion of its national energy supply by embarking on a nuclear weapons programme in defiance of its trading partners.

The risk of weapons proliferation would continue to exist even if nuclear power did not. Particular stages of civil nuclear development, undertaken in particular circumstances, may nevertheless increase the fear that weapons proliferation will occur in future The stages in question are especially those involving enrichment or reprocessing facilities capable of producing the high-enriched uranium or separating the plutonium usable in weapons. To the extent that they are seen to be needed for civil purposes, establishing such facilities, provided they are under international safeguards, cannot reasonably be seen as a deliberate step towards acquiring weapons The fear that they will prove to be such a step may arise, however, if their exclusively civil purpose is not made immediately credible.

Countries operating or planning to operate power reactors requiring low-enriched uranium fuel must be expected to want assured access to enrichment services on equitable terms In the aggregate, the enrichment plants already in operation or scheduled to come into service have ample capacity to satisfy world requirements until close to the end of the century. Thus, the balance between total demand and total supply, although it may not be the only consideration, implies no urgent need for additional countries to undertake enrichment, especially in view of its technical difficulty and cost. That will only be relevant, however, if all countries in need of enriched uranium have solid grounds for believing that enrichment services will, in fact, be available to them internationally on acceptable terms.

Confidence on that score has been shaken in the past by unilateral changes in the terms on which enrichment services were provided by the United States. Some of that effect has been off-set by the subsequent emergence of additional suppliers, in Western Europe and the USSR, since a diversification of supply sources is itself one form of supply assurance. International confidence will only be fully rebuilt, however, if all suppliers of enrichment services provide credible evidence that all international contracts will be fulfilled on the terms originally agreed.

A thoroughly credible assurance of international supply would tend to weaken the argument for additional countries to establish civil enrichment plants Some might nevertheless consider exercising their sovereign right to do so, for reasons of technological development, supply security or economic advantage. However, because high-enriched uranium probably offers the shortest route to weapons production, they would have to take account of the fact that the international need for a convincing demonstration of their exclusively peaceful purpose would be all the greater if there were no longer an obvious energy security argument for independent enrichment.

Plutonium separated from spent fuel in a reprocessing plant offers another possible route to weapons manufacture One important difference between the cases of enrichment and reprocessing plants, however, is that reprocessing is not also immediately essential to operating most current power reactors, the spent fuel from which can instead be held in storage. Countries looking to the future may nevertheless want to be sure of having access, if needed, to the option of commercial reprocessing. Their desire to ensure such access by building their own reprocessing plants will be all the stronger if they see any reason to fear that adequate reprocessing services may not be available internationally, on acceptable terms, when they need them. Confidence in international supply is therefore as important potentially in the reprocessing case as it is immediately in the case of enrichment.

Because separated plutonium, like high-enriched uranium, is potentially usable in weapons, and thus 'sensitive', all countries involved in its civil production have reason to see that it

is separated, held and used in circumstances which minimize fears of its diversion to a military programme. International safeguards represent the first and most important step in that direction. But the burden on a safeguards system is bound to become heavier to the extent that the number of reprocessing plants in the world increases. So, for the countries concerned, is the burden of demonstrating that all such plants have an exclusively civil purpose. As in the case of uranium enrichment, therefore, minimizing the fear of possible proliferation argues for matching the number of facilities separating or handling plutonium under safeguards to the scale of nuclear power needs, including the need for all countries to have dependable access to the services and materials required for energy supply

Although the problems of horizontal and vertical proliferation exist independently, fears of proliferation are liable to grow as the expansion of nuclear power creates pressure for additional countries to undertake enrichment or reprocessing. Those fears can only be avoided or reduced by providing convincing evidence on two counts: that civil nuclear programmes involving 'sensitive' facilities or materials will remain exclusively peaceful, and that the international supply of nuclear materials, services and technology will be maintained on agreed and predictable terms. Averting the fear and risk that proliferation may stem from the expanded use of nuclear power depends not on technical contrivances or unilateral restrictions, which must be either insufficient or counter-productive, but on constructing that international bargain of confidence

Confidence in international nuclear supply cannot be based on rhetoric alone. It can only be established by the consistent performance of suppliers, complemented rather than countermanded by their national legislation and reinforced, as necessary, by formal guarantees, but demonstrated, above all, in practice.

As to confidence in the exclusively civil purpose of nuclear power programmes, the primary means of establishing that is, and should remain, the even-handed application of safeguards under the aegis of the IAEA. As nuclear power use expands, that safeguards system has to be further developed and more broadly applied. It can also usefully be reinforced by formal non-proliferation commitments and guarantees. The process must necessarily, however, be voluntary. Countries which have already accepted IAEA safeguards, or have subscribed to the Non-Proliferation Treaty or other relevant treaties, have done so freely, on the grounds that their national interests were thus served. States will equally make and maintain such commitments in future not as a result of international pressure but because they are convinced that their national security will most effectively be assured by doing so.

One way in which confidence in both international supply and peaceful purpose might be further reinforced is by developing arrangements to conduct 'sensitive' processes or hold 'sensitive' materials not only under safeguards but also under multinational auspices. The IAEA has taken a lead in studying possible multinational nuclear fuel cycle arrangements, implementation of which might reduce fears of both proliferation and unilateral restriction on international trade. Its efforts to explore their feasibility deserve general support. In particular, provided conditions for deposit and release were clearly defined and agreed, a commitment to place in international custody separated plutonium not needed for immediate civil use could help to alleviate fears aroused by the construction of additional reprocessing plants.

Multinational arrangements will never be easy to establish or administer, and will only have a useful role to play if countries with interest in both non-proliferation and nuclear power determine, through negotiation, that they will serve those two interests at once. They urgently deserve fuller international consideration, however, as one possible means of countering some of the fears associated with the expansion of nuclear power

Whatever is done to combat fears of proliferation must be done in a spirit of international co-operation, rather than confrontation Apart from the wider damage to international relations which confrontation may cause, it is likely to prove counter-productive, by serving only to encourage additional countries to develop self-sufficient national nuclear fuel cycle industries, despite their high cost. Co-operation, in turn, must be founded on reciprocal restraint. Any attempt to engage in political or economic extortion by exploiting particular strength – whether strength derives from ownership of resources, control of technology or a capacity to disturb international stability – is thus strongly antithetical to it. Provided there is reciprocal restraint, however, we are convinced that international co-operation can create more and stronger barriers to nuclear proliferation than international competition, confrontation or conflict, and that the immediate goal should therefore be to establish the 'bargain of confidence' which we have here described

CONDITIONS FOR THE FUTURE

To summarize the major conclusions of our work together, we believe that, if nuclear power is to be available to meet an increasing fraction of the world's future energy needs, at least five conditions will have to be satisfied

The first condition is that nuclear power, despite the difficulty of the short-term climate, will have to be systematically developed, without interruption or undue delay.

The possibility of unsatisfied energy demand and the danger of intense competition for energy supplies represent serious risks to security, development and welfare Nuclear power has an important part to play in containing those risks, by helping to meet the increasing demand for energy. Governments and industries must ensure that it is preserved and prepared as a substantial energy supply option, not only for the next decades but also for the long-term future.

The second condition is that nuclear power must earn and retain public acceptance.

The political and social issues bearing on acceptance extend beyond the nuclear energy field. Within that field, however, the issue of nuclear safety is particularly relevant. Government and industry again share a duty to demonstrate that the public and occupational hazards of nuclear power, in relation to the risks of alternatives, are acceptably small, that those responsible for nuclear power are committed to protecting the public safety, and that safety standards attainable in principle will also be maintained in practice. In that connection, testing and demonstration of effective and acceptable methods for disposing finally of nuclear waste must be accelerated, and international co-operation in both waste management and nuclear safety intensified.

The third condition is that technologies for using uranium more efficiently must be developed and tested as soon as possible, with both the coming decades and the 21st century in mind.

In the first instance, that means providing ways to make better use of uranium in existing and improved types of thermal reactors Although the proper timetable for their deployment cannot yet be determined, it also means demonstrating the commercial feasibility of fast breeder reactors as an option for the longer term, as well as the feasibility of the commercial-scale reprocessing necessary to that option. Future decisions about whether or when to deploy new uranium-conserving technologies commercially have to be taken in the light of particular and changing circumstances, but development of the options themselves cannot safely be delayed

The fourth condition is that the fear of nuclear weapons proliferation resulting from an expansion of nuclear power must be further reduced.

A convincing demonstration is needed that fuel cycle activities, including enrichment and reprocessing in particular, will be matched to nuclear power needs and have an exclusively peaceful purpose That cannot be achieved by technical contrivance or unilateral action based on strength. It can only be achieved by self-restraint and by voluntary application of the evolving system of IAEA safeguards, reinforced by formal non-proliferation commitments and possibly by new multinational arrangements.

The fifth condition, closely linked to the fourth, is that countries depending on nuclear technology, services or materials to ensure their energy supply must be convinced of continued international access to them, under safeguards, on acceptable terms.

Unless all are so convinced, their need for security of energy supply will drive more countries to seek a degree of nuclear self-sufficiency, at excessive cost, which may exacerbate fears of proliferation Assurance of international supply might again be reinforced by multinational arrangements, and can certainly be strengthened by credible guarantees. But the assurance itself can only come from practical experience of reliable performance in international nuclear trade and co-operation.

It is the international aspects of nuclear power which have particularly concerned us. The recent erosion of confidence in international nuclear relations must be repaired. There must, in fact, be re-created a sense of global responsibility, on the part of all states, strong enough to support practical arrangements for sharing both nuclear resources and technology internationally on mutually acceptable terms The only way of doing that is to construct a new 'bargain of confidence', in which credible guarantees of peaceful purpose will be balanced by firm assurances of access to nuclear services, materials and technology. Establishing that bargain depends on resolving existing disagreements by compromise. It is in that spirit that we have subscribed to this Report.

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