Public Acceptance of Nuclear Power - Some Ethical Issues

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Since the last major International Atomic Energy Agency Conference on "Peaceful Uses of Atomic Energy", nations have been obliged to adjust to significant new factors that have come to dominate the world energy market. At previous meetings, the industrialized nations were assuming a long-term future dependence on the use of nuclear energy for electric power generation. The developing nations were closely monitoring the circumstances governing investment in nuclear power but were for the most part acknowledging that for them the point of entry was some way off. The IAEA itself was acting to provide access to the nuclear option for those nations that were exploring the scale of their future commitment to nuclear energy. There was a certain fluidity in the situation as each nation examined its own position in the general programme of nuclear power development. Public opinion had, for the most part, acknowledged from a distance the availability of nuclear power. But it failed to perceive the implied future scale of dependence on nuclear energy and was apathetic to its social and ethical implications.

Since 1973 there has been a historic shift in this process of gradual appraisal. The rapidly increasing costs and the escalating scale of demand for all forms of primary energy, set against a familiar back-cloth of diminished fossil fuel resources, suddenly brought forward in a dramatic way the threshold of a more substantial world-wide dependence on nuclear energy.

It is not, therefore, surprising that a vibrant debate began to gather momentum outside the nuclear industry with the immediate purpose of raising the level of public awareness of the social, political and technical risks that are inevitably associated with the large-scale and accelerating adoption of nuclear power generation. The nuclear industry has given a mixed response to this debate, to accusations of irresponsibility and to demands for more specific attention to the recognized hazards of the fuel cycle. The World Council of Churches favours the widest possible discussion of these issues. It is most encouraging that the IAEA has been able to admit to this forum contributions that are not committed to the unqualified acceptance of nuclear energy production. It is to be hoped that future discussions will be even broader.

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The Public Appraisal of Nuclear Energy

For those scientists and engineers who have dedicated their lives to the development of this technology most of the problems posed in the public debate have been part of their concern for a long time. However some of these now take on a fresh importance in the light of public exposure and the growing recognition that particular questions — such as those concerned with the long-lived radioactive wastes — introduced a new time dimension into the concern for environmental protection. Some specific problems have been too long submerged. In any case, a policy of ignoring or treating lightly the volume of public questions and criticism will not work. The nuclear industry cannot afford merely to point to a very creditable safety record in justification of its present action and future plans. There is a collective responsibility on all participants in this conference to address the critical issues in a much more substantive way. While there have been occasional misrepresentations of facts there is now an established body of informed public opinion holding that we cannot proceed to the adoption of a plutonium-based fuel economy without a more fundamental and completely open examination of the risks involved.

In this situation non-governmental bodies such as the World Council of Churches have a responsibility to examine carefully the issues so far identified and to place these in a social and ethical context[1]. The W.C.C. involvement in the nuclear debate is only one part of its more general concern for the risks associated with rapid technological change, from the manipulation of genetic material to the prevention of industrial pollution. The W.C.C. wishes to present its general position on nuclear energy as follows:

A. The availability of nuclear energy is a controversial feature of today's world in that it affords the opportunity to provide a large fraction of the world's energy needs, counter-balanced by the exceptional nature of the risks involved, and other problems related to the employment of large-scale, capital-intensive high technology.

B. The maturity of the nuclear energy system is not yet such as to justify its world-wide application; the consequences of large-scale expansion of nuclear energy production are still relatively poorly understood and require further assessment.

C. The rights of access to nuclear technology should be preserved to the extent that the nuclear 'haves' may not deny the nuclear 'have nots' by any form of exclusive consultation.

D. There should be sufficient discussion of the factors governing access to nuclear technology to bring all nations to a new awareness of its risks and uncertainties as well as its opportunities; and the collective responsibility for monitoring and administering safeguards should reside with the IAEA rather than with individual governments.

E. Public confidence in the use of nuclear energy, seriously shaken in recent years, can be revived only by the widest possible public discussion of the technical options and of the value judgements underlying present patterns of energy consumption.

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[1] For example: Report of the 1974 World Conference on Science and Technology for Human Development, *Anticipation* no.19 (1974) 9, where the W.C.C. first considered the "nuclear power option"; *Facing up to Nuclear Power,* ed. by John Francis and Paul Abrecht (Edinburgh and Philadelphia, 1976), including the report of the 1975 Ecumenical Hearing on Nuclear Energy in Sigtuna, Sweden; and "Energy for a Just and Sustainable Society", *Anticipation* no.23 (1976).

What emerges from these statements is a requirement that decisions governing the future utilization of nuclear energy must now be taken in this larger setting, and that the pattern of nuclear energy supply must be rethought in terms of total world energy needs and the wide disparities in supply that exist at present. In this connection there is need for a new emphasis on the ethical component, in order to perceive the provision of energy resources for all people as an essential part of the struggle for a more just and sustainable society.

Within each country already possessing a basic capability in nuclear technology, certain assumptions have already been made governing the scale, availability and general disposition of their future nuclear development. Such assumptions are now open to challenge. The days of great expectation arising from the birth of nuclear technology have now been foreclosed by the days of decision under uncertainty that presently characterize nuclear power developments in many countries. Surely few are politically naive enough to suggest that nuclear technology could be abandoned; but a new sense of realism is undoubtedly abroad and challenges to a high level of nuclear dependence must be answered. If public confidence in the future deployment of the technology is further eroded, then re-establishing such confidence will prove undoubtedly to be even harder. A clear definition of future risks and uncertainties would therefore seem essential.

The Risks of Nuclear Technology

The W.C.C., in co-operation with a group of nuclear scientists, has studied this matter, and wishes to make clear its own understanding.

The risks are those of inadvertently incurring various social costs, which fall generally into three broad categories: (1) of unintended accidents and hazards associated directly with operation of the technology; (2) of an unquestioning and undesirable dependence upon the technology and the degree of social and economic centralization it incurs; (3) of the misuse of fissionable material for weapons.

Debates like this, far from being new, have appeared with varying seriousness and intensity through all of history[2]. Technological security is a relative matter involving other technologies, other persons, other places, other times. Recalling the lessons of history we recognize that absolute security is a dangerous myth.

It is our understanding that the principal perceived technological risks are these:

(a) of improper storage of high-level radioactive nuclear wastes;
(b) of catastrophic accidents, principally to nuclear reactors;
(c) of the effect of a multiplicity of low-level releases of radioactivity during normal operation, from various parts of the nuclear cycle;
(d) of possible accidents in fuel reprocessing plants.

[2] Agricola in publishing his classic treatise *De re metallica* in 1556 starts his work not with technology but rather with the fundamental questions both of safety and desirability of mining — an issue hotly debated at the time.

Nuclear Waste Disposal

The nuclear waste problem is probably the greatest single cause of public anxiety. It is our understanding that the situation is as follows:

(a) Except for plutonium, the radioactive waste generated per unit of energy produced is about the same for present-day reactors now in service, and for breeder reactors. Thus the nature of the radioactive waste problem is similar for all nuclear reactors.

(b) Regarding plutonium, present-day reactors produce about one-half as much plutonium in their normal course of operation as would a breeder reactor operating on a uranium-plutonium cycle. Some of this plutonium fissions in the reactor during its operation, and the remainder appears in the used fuel. Thus the plutonium question already exists: the main difference is that, with breeder reactors, the plutonium must be recovered from the spent fuel and recycled as new fuel. With present-day reactors the fuel need not necessarily be reprocessed, as long as the reserves of high-grade uranium ore last; but that is only a few decades at most.

(c) Regardless of decisions about civilian nuclear power, a legacy of nuclear wastes exists from weapons programmes in several countries, and its total equals the wastes expected to be produced by all civilian nuclear power plants operating until about AD 2000. Thus, at least for some countries, the waste problem is present, real and unavoidable.

It seems to be generally agreed that the critical storage time for the decay products of the civilian reactor programme will depend on the details of chemical separation, but will require safe management for a minimum of about 1000 years. Beyond that time, the toxicity of the remaining actinides starts to become comparable to that of the uranium ore originally mined.

The need thus arises to do two tasks well: (a) to separate the wastes carefully, recover ^{239}Pu (or ^{233}U); and turn the remainder into an insoluble glassy matrix, without spreading contamination through the plant or surrounding environment; (b) to sequester the residual glassified wastes in appropriate geologic structures.

The public is assured that these activities are technologically feasible. The question is: Will the work actually be carried out on the appropriate scale? Past performance has been inadequate, partly to be blamed on the haste of great powers to build nuclear weapons capability. We are assured that the mistakes of the past will not be repeated. It is our judgement that this can be best assured by a policy of open review. However, as long as technologically satisfactory solutions to the high-level waste disposal problem have not been demonstrated, the idea of rapidly expanding nuclear power production is bound to strike much of the public as highly questionable, given the irreversible character of the risk.

Catastrophic Accidents

Many people are concerned about the possibility of catastrophic accidents. Studies in the USA [1] of present-day light-water reactors quote the probability of large accidents caused by design, engineering or operating failures (not including hostile acts) as about one chance in a billion per reactor-year of operation, with a loss of several thousand lives. These figures are disputed, but no better ones are yet forthcoming; and there is the further observation that no core melt-down accidents have been reported in about 500 reactor-years of large power plant operation world-wide. Such an event would be the necessary but insufficient precursor to an accident that significantly involves the public.

Maintaining an accident record as favourable as even the present demonstrable performance requires great dedication to high standards; a few precedents exist, such as for airplane manufacturing, where the record is generally good, but occasionally clouded by conscious problem-avoidance. Predictions of accident patterns show that smaller ones involving little or no public hazard will occur much more frequently than the catastrophic large-loss ones. Thus scrupulous investigation and publicizing of the whole spectrum of small-scale accidents should contribute to avoiding the large ones.

Public concern over major accidents on fast breeder reactors is being widely propagated and the basis for public reassurance is still largely hypothetical. The public naturally believes that since the stored energy in a fast reactor core is greater than in a thermal reactor, then the release of this energy under accident conditions will be proportionately greater. Some of the principal researchers have agreed that they do not have enough knowledge to justify a major commitment to fast reactor technology [2].

Accidents in Reprocessing Plants

The likelihood and possible severity of accidents in fuel reprocessing plants are hard to judge at present. Experience in plants processing weapons-type material are largely irrelevant, because they handle uranium or plutonium in its highly reactive pure metallic form, whereas nearly all commercial reactors, planned or in service use oxide fuel. In a civilian nuclear reprocessing plant, the bare metal never appears anywhere in the stream, but only as the relatively (or very) inert nitrate, oxide, etc. Critical amounts of uranium or plutonium salt solutions have accidentally accumulated in processing streams. While the accident hazard here appears small, the probability needs better estimation.

Low-Level Radiation

The routine low-level emissions of nuclear power cause little harm, especially if compared to the environmental and health damage caused by the fossil fuels that it replaces. In fact, the largest hazard would probably arise from uranium mining and milling if the reactors were of the light-water type — about 70 deaths per year for 400 000 MWe of nuclear power. For a breeder, the mining and milling requirements would be 70 times smaller. These numbers stand in striking comparison to recent estimates of death attributable to burning coal in the Eastern United States: for 400 000 MW of coal-electric, the death would be 8000—40 000 per year with no sulfur abatement, and perhaps 1000—4000 per year with full enforcement of the present air quality standards. The statistics on morbidity from this cause are poor, but the effect is undoubtedly large.

Public concern about the risks of nuclear technology has led in many countries to a demand for a moratorium, especially on the reprocessing of spent fuel and on the commercial development of the breeder reactor. Some church groups have adopted this approach. A report by the World Council of Churches' study group has pointed to the possible misuse of the moratorium as a tactic to avoid making a decision or to delay a decision without regard to the consequences [3]. However if a moratorium provides an opportunity for an informed public discussion and the communication of continuing research on technical problems this could be a useful action.

In view of current uncertainties over the maintenance of energy supplies, particularly to large urban communities, the W.C.C. appreciates the necessity of retaining nuclear power as one of several possible options for the future in many countries. This should in no way diminish the search for alternative, long-term, safer forms of energy. The credibility of the nuclear option can be achieved only through the resolution of the major questions inherent in its use. In view of the impending large and irreversible world-wide commitment, these questions must be tackled without further delay.

Nuclear Weapons

The possibility of diverting fissionable material for nefarious purposes is important, and has figured significantly in the debate over the advantages and disadvantages of nuclear power.

Our difficulty in discussing the matter stems from the simple fact that the hazard from weapons made from the diversion of materials from the civilian power programme is negligible compared with the hazard from the vast store of nuclear armaments in the military programme. Yet the two hazards are so inextricably linked that they cannot be discussed in proper perspective separately.

At this point we emphasize the finding of the 1975 W.C.C. Hearing on Nuclear Energy concerning Nuclear Energy and Nuclear Weapons:

"It is difficult on political and moral grounds to deny countries without nuclear technology the right to obtain it because of a fear that they might use it for the development of nuclear weapons. The proposition that the appropriation of nuclear technology would forever be a limited right, to be doled out by the present nuclear countries according to rules determined by their interest is unacceptable. This would be an intolerable situation for many developing countries seeking to benefit from the peaceful application of nuclear energy and throw offf technological domination by the already industrialized countries"[3].

The 1975 Hearing noted further that the continuing production and possession of nuclear weapons by the major industrial countries was the principal obstacle to nuclear disarmament; and pointed to the serious limitations of the Non-Proliferation Treaty in preventing nuclear arms' proliferation, because "it is based on discrimination in favour of countries already possessing nuclear weapons"[4]. Since these statements were made our opinion about the particular vulnerability of the Non-Proliferation Treaty has been reinforced.

Much has been written about the need for the highest possible degree of physical security to prevent the misuse of nuclear materials. Hence, guarding critical nuclear facilities against terrorists would, it is claimed, lead to a virtual police state. Careful calculations based on present experience tend to deny such claims. It is possible to design the system so that such a high degree of physical security is necessary at only a few strategic points — entailing no threat to basic liberties.

Access versus Security

Nevertheless two dangers exist: of the misuse of nuclear technology for clandestine weapon-making and the protection by the presently nuclear-armed nations of their proprietary rights.

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[3] *Facing up to Nuclear Power* (op.cit.), 193.
[4] *op.cit.* 193.

The first of these dangers leads to the nuclear safeguards of the IAEA and other international arrangements, which attempt: (a) to ensure that nuclear materials are used for peaceful purposes only; (b) to deter by early detection the diversion of such materials to illegal purposes; (c) to build up safeguards systems that are as effective as possible within practical national and international limitations. None of these systems is fool-proof. The IAEA's ability to deter diversion can be impeded if a participating government changes its attitude and either withdraws from its treaty obligations or produces critical material in clandestine operations. Furthermore, no safeguards system can be completely satisfactory until the entire nuclear activity in the receiving country is placed under IAEA safeguards. This is not the case in many countries, even though more than 100 nations have subscribed to such safeguards under the Non-Proliferation Treaty.

The countries presently well advanced in nuclear technology are using the Non-Proliferation Treaty to protect their own proprietary interests. This can have two deleterious consequences. First, an additional separation between rich and poor countries can develop. Second, frustration among either non-signers or constrained signers of the Non-Proliferation Treaty can lead to the establishment of new ventures and centres entirely outside the "established" groups. These dangers appear obvious to the public, hence public confidence erodes.

An international decision on the allocation of reprocessing facilities is now urgent and overdue. The present pattern of reprocessing is at an impasse because of the unsolved problems of long-term waste storage. At the same time there is undoubtedly an immediate demand for reprocessing facilities to match reactor programmes even in the major producing countries. Such an important decision cannot be limited to those nations already in consultation over the control of these technologies.

Nuclear Energy and a New International Economic Order

Nuclear energy provides the only presently available alternative to fossil fuels and hydropower for the supply of bulk electric energy, and many countries want its benefits. However its larger social implications have yet to be adequately identified and explored. Some people are concerned that this complex technology might reinforce the trend towards the centralization and urbanization of society which they would like to reverse. Others fear that it will tend to widen the economic and technological gap between the rich and poor countries. They are also concerned lest the present commerce in nuclear technology undermine the struggle against racial and social injustice. Clearly there is a need to determine how the use of nuclear energy relates to the struggle for a new and more just international economic order.

Thus far most of the debate about nuclear power refers to industrialized countries. The same assumptions do not apply to the developing countries, and there is need to establish how best to accommodate nuclear power programmes within the framework of their development.

A number of factors have precluded the widespread use of nuclear energy for electricity production in developing countries. Many of the power systems there are of modest proportions and cannot absorb the large nuclear generating units of the order of 600 MW and above.

However in the longer run, some of these countries will be on a sufficiently strong industrial and economic footing to support nuclear power installations and be large enough to need the power. There is consequently a growing interest in nuclear energy technology in many developing countries. It may be some time — perhaps 25 to 30 years — before their distribution systems could accommodate the large nuclear units; but they must start preparing now for the future [4]. This means training of skilled manpower for the maintenance, operation and supervision of nuclear plant installations. Some are seriously considering the feasibility of setting up sub-regional or regional training centres.

The high initial costs of a large nuclear power unit would, it is argued, be met through joint financing along the same lines suggested for the development of large-capacity hydro-electric plants [5].

The same developing countries have shown great interest in the technical, environmental and social problems associated with the adoption of nuclear technology on a large scale. The candid and honest airing of these problems, the risks involved, the safety limits, resource limits, and waste products and spent fuel management, should go far towards providing a realistic picture for those countries seriously contemplating nuclear energy.

Ethical and Religious Perspectives

Every phase in this analysis has involved an interaction between two kinds of thinking: *one,* highly technical, depending on the knowledge of contemporary scientific experts. The *other* concerns human purposes, values and commitments. These have been the subject of centuries of inquiry by prophets and poets, tragedians and comedians, heroes and saints in all societies. This quest is not the domain of any elite; every human being has a voice and a stake in it.

Although technology exists to serve human needs, it can destroy people and human values, whether by deliberate intent of oppressors or by unintended consequences. Hence the values that guide technological processes require constant public scrutiny and discussion. The question must also be raised whether technological processes are actually serving the ends intended or whether they are proceeding by a momentum of their own that overrides human values.

Il would be convenient, if it were possible, to separate neatly goals and values from techniques and means, to assume that societies decide their goals, then enlist scientific technologies to realize them. But in fact technology influences goals. Sometimes it suggests or makes possible new goals not previously envisioned. At other times the technical means used to achieve some goals destroy possibilities of achieving other equally important ones. Any sharp separation of technology from human values greatly oversimplifies the dialectics of the relation between technology and society.

That is why our present contribution to the discussions about the expansion of nuclear power, though based on religious and ethical commitments, has necessarily entered into many technical issues. For the same reason the scientific literature on nuclear energy frequently shows a high sensitivity to the ethical issues connected with the awesome power it makes available.

Thus decisions about large technical issues like nuclear energy are too important to remain confined within the nuclear scientific and engineering communities. Yet without the full collaboration of these expert groups there can be no resolution of the questions. The problem is to devise new ways by which technological developments can be examined by many different groups. Fortunately there are emerging in many countries some encouraging new examples of creative dialogue between technical experts, governments, and the public as part of a responsible decision-making process.

Scientists themselves are asking about the meaning of their achievements for human life and destiny. Metaphysical and spiritual issues hang like a shadow over all the purely practical discussions of nuclear energy.

At the same time religious thinkers are aware that their traditions offer no ready-made answers to the right use of nuclear technology. If they welcome the increasing awareness that science and technology are not the sole ways to truth and wisdom, they know their own limitations, too. A critical attitude toward technological reason must not lead to social confusion, to delight in the irrational, to the veneration of simplistic and utopian solutions to human problems. Moreover no one religious perspective can be accepted today as the spiritual basis of a new world-wide concern for humanity and the right use of science and technology. So the churches and religious leaders are not in a position of moral superiority but share the uncertainty which afflicts our contemporary culture. This however does not diminish but rather heightens the need for a clear sense of moral purpose at the centre of the decision-making process.

In urging continuing conversations on the technical and the ethical-religious aspects of nuclear energy, the W.C.C. Hearing on Nuclear Energy (1975) refused to "put forward categorical recommendations ... in either entirely rejecting, or in whole-heartedly recommending large-scale use of nuclear energy". In submitting this paper we re-emphasize the need for further information, further inquiry, further conversation.

Three Convictions

Nevertheless we do not hesitate to express three convictions:

1. Pandora's box cannot be closed. We cannot live as though nuclear energy had not been discovered. It is one of the ingredients of our technological age. Campaigns against its development and use in some particular situation must reckon with this fact. We shall find no quick solution to our dilemma, either by abandoning nuclear energy entirely or by devising fool-proof means to control it. The technological system has brought us great benefits but it has also led us into new dangers. Nuclear energy epitomizes this dilemma.

2. There is need for a continuous conversation among people of diverse faiths and ideologies about the relation of ever-increasing production and consumption of energy, and other economic goods, to the good life and good society. Nuclear energy must not be looked upon as end in itself, but must serve social justice and quality of life. There is a temptation to seize upon growth in production as a device to evade the demands of social justice. Too often the rich and powerful have sought to answer the rightful demands of the poor not by justice but by promises, sometimes false, of economic and technological progress that would presumably benefit everyone and cost no one anything. While affirming the need of many societies for increased energy, we deny that such energy is either a panacea for contemporary social ills or a substitute for justice. The churches feel a responsibility to take a stand for a new style of life which would emphasize values other than consumption.

3. The wise use of high technologies, like nuclear fission, depends paradoxically on a new understanding of human limits. The modern spirit has emphasized the energetic

technological drive to overcome obstacles, to solve problems and enhance human powers. The record includes glorious achievements. But increasingly voices, often from within the scientific community, are calling people to a new recognition that they are not God, that their power has its limits, that not all problems yield to technological solutions, that humanity must learn to live with nature as well as to harness its resources. A wise humanity will therefore unite aspiration with modesty. Indeed the dilemmas now faced by nuclear scientists may make them especially aware of the validity of the spiritual insight that, in the future as in the past, we must "work out our salvation in fear and trembling".

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