

**Chapter V**

**CONCLUSIONS**

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The problems of economic development of the Third World and the relevance of modern technologies in this development increasingly overlap with the issues of international control of science and technology. Nuclear energy represents most clearly the complex intertwining of the above issues. The dawn of nuclear age coincided with the process of decolonisation. Several newly independent nations had hoped that nuclear energy would significantly contribute to their socio-economic development. The Indian elite, the more advanced among the new ruling elites, coherently articulated these hopes. Nuclear energy was seen as heralding a new epoch in the history of mankind. It was believed that the developing nations which had missed the industrial revolution could not afford to miss the nuclear revolution. A highly optimistic scenario for the future of nuclear power in the Third World was envisaged. Nuclear energy development in the last three decades has largely belied these great expectations. By 1981, out of about the 250 nuclear power reactors operating around the globe, only 7 are located in the developing nations. This indicates the acutely asymmetric character of international nuclear energy development.

It must be noted that even in the developed countries, nuclear power generation has not matched the expectations of the 1960s and early 1970s. The growth of nuclear energy in the developed countries was affected by the recession resulting

from the energy crisis and the mounting public opposition to nuclear power. The basic problem in the developing countries related to the grafting of a frontier technology like nuclear technology onto industrially backward societies. Moreover, the optimistic projections for nuclear growth in the Third World were based on a number of erroneous assumptions, and an under-estimation of the conventional energy resources. The inability of the developing countries to build nuclear programmes in the last three decades has led to hasty conclusions that nuclear energy is irrelevant to the needs of developing countries. Despite the earlier unrealistic scenarios for nuclear energy development in the Third World, and the setbacks for nuclear power development, the basic case of nuclear energy for the Third World remains valid. The relevance and urgency for nuclear energy growth has been reinforced by the rising prices of oil and the as yet incipient character of solar energy. However, a more realistic attitude towards nuclear energy with a tempered view of its share in the future energy-mix is warranted by the past experience of nuclear power growth.

The analysis of the constraints on the nuclear technological growth in the Third World explicates the importance of a planned approach to nurturing of nuclear technology in the Third World. In this context the relevance of frontier technologies to the economic development of the Third World assumes specific importance. It is likely that in the 1980s, besides nuclear power, a number of frontier technologies such as space, micro-electronics, telecommunications and biotechnology would gain importance in the production process,

with a far-reaching impact. If the Third World is to benefit from these revolutionary technical changes, their decision-makers would have to comprehend the complexity of developing frontier technologies.

In the advanced countries, nuclear and other high technologies were developed on a sound base of conventional industry. In the Third World, the development of these technologies will have to necessarily overlap with the very process of industrialisation and modernisation. The absence of an effective institutional framework for the development of modern technologies hampers nuclear energy growth. Since there is no spontaneous growth of technology in the underdeveloped countries, the governments in these countries have the unenviable task of building scientific institutions from a scratch. In the implementation of this task, however, the state is undermined by the continuation of outmoded, rigid and colonial administrative structures. The inadequate R & D infrastructure and insufficient scientific and technical manpower form another set of inhibiting factors. The backward industrial infrastructure is unable to keep pace with the stringent demands of a nuclear industry. Coordination between the government, R & D establishments and the domestic industry is indispensable for the growth of nuclear energy programmes. Besides the secular economic crisis in the Third World which affects economic development, the specific characteristics of nuclear industry such as heavy front-end investments and long lead-times pose acute fiscal constraints on nuclear energy growth. Apart

from these domestic structural factors acting against nuclear energy, the very nature of international nuclear technology market severely circumscribes the technology choice available for developing countries. For example, the small and medium power reactors (SMPRs) which are suited to the needs of developing countries, are no longer available on the international market. Thus the task of developing nuclear energy in the Third World is Herculean. Yet the Indian experience would suggest that with an integrated plan for nuclear technology development, a number of the obstacles could be successfully overcome. Such a strategy would lead not only towards absorbing nuclear technology but would also generate new skills in such frontier areas as space and electronics and in various conventional areas like precision fabrication, metallurgy, etc.

The analysis of the growth of the nuclear fuel cycle in Argentina, Brazil, India, Mexico, Pakistan and South Korea raises the question whether there is a preferred strategy for nuclear energy development in the Third World. The wide variations in the socio-economic and political conditions of the six countries would advise caution in comparing the nuclear strategies. In a broad sense, however, it could be asserted that in terms of self-reliance and sophistication of technological development, the Indian nuclear strategy was the most successful. Dating back to the pre-independence period, the Indian nuclear programme emphasised nationalism and self-reliance from the beginning. At an early stage, India evolved appropriate institutional structures for the growth of nuclear technology,

developed R & D infrastructure and manpower. Even before it embarked on the nuclear power programme, it generated capabilities in the various aspects of the nuclear fuel cycle. It also seized the opportunities of the liberal international nuclear trading climate of the late 1950s and early 1960s, to acquire nuclear skills. The Indian effort was to ensure the maximisation of the use of domestic resources and minimisation of the dependence on overseas technology. This scheme was dovetailed into the broader Indian strategy of planned and self-reliant domestic development and an independent foreign policy. By the turn of 1980s, India was self-reliant in all aspects of nuclear fuel cycle, except in uranium enrichment and heavy water production. While there have been significant setbacks in the 1970s, the achievements of the Indian programme stand out. The most impressive achievement is the ability to design and construct an entire nuclear power reactor indigenously. India is the only Third World country which can do so.

Like India, Argentina emphasised on self-reliance in its nuclear strategy. But the Argentine concept of self-reliance was not as comprehensive as the Indian concept and was therefore less successful in assimilating and replicating nuclear technology. Argentina has acquired autarky in uranium production and is moving towards that goal in fuel fabrication and heavy water production. In reactor engineering and construction, Argentina had to take resort to forming a joint company with West Germany. Through this Argentina hopes to acquire domestic capability in power reactor construction over the next two decades.

Brazil's nuclear strategy was unique in its attempt to purchase the entire nuclear fuel cycle technology in one single swoop from West Germany. This grandiose strategy was attacked in North America as opening the flood gates of nuclear proliferation. However, the Brazilian nuclear strategy had a number of serious weaknesses. It could not mobilise broad consensual support from the Brazilian scientific community. Though spectacular, the Brazilian attempt was not matched by the domestic capabilities in R & D and manpower. The safeguards conditions on technology were too stringent. Compounding this, the approach of joint German-Brazilian companies for every aspect of the nuclear fuel cycle, yielded tremendous control to German nuclear industrial companies over the Brazilian nuclear energy programme. The German-Brazil nuclear deal was criticised in the West as giving nuclear autarky for Brazil. In real terms, however, the deal ensures neither autonomous technological decision-making nor growth of local nuclear skills in Brazil.

South Korea, despite having the largest nuclear power programme in the Third World, has not put emphasis on self-reliance. Its nuclear strategy aimed at a dependent, but large nuclear power programme. Even the limited efforts at "localisation" of nuclear skills were sought to be done through subsidiary companies of large Western multinationals. This perhaps is in conformity with the larger political reality that South Korea (unlike India, Argentina and Brazil) is not in search of an independent role in world politics. Probably, South Korea is content to remain as a junior

partner in the Western strategic, political and economic systems.

In Mexico, the nuclear planners could not articulate a coherent strategy of nuclear power development. Two power reactors were ordered hastily, without any preparation in terms of R & D, and manpower. There was undue foreign influence in domestic nuclear decision-making. There was not even an elementary comprehension of the complexities of nuclear reactor construction in Mexico.

Nuclear developments in Pakistan took a peculiar turn since the early 1970s. Since then the small nuclear power programme has ran aground. KANUPP, the only power reactor has been operating intermittently since the late 1970s, and that too at a very low capacity. Since the first reactor ordered in mid-1960s, a firm order for a second reactor is yet to be placed. This inability to run a viable nuclear programme flies in the face of Pakistan's emphasis on acquiring an enrichment plant. The enrichment plant is being acquired not through an open and legal transaction, but by clandestine means. Pakistan, in a series of undercover operations throughout North America and Western Europe, is purchasing in a piecemeal fashion, the equipment for an enrichment plant. This obsessive emphasis on enrichment appears incompatible with the strategy for a civil nuclear energy programme.

The nuclear power programmes in the Third World are still heavily dependent on the developed countries. In spite of its sophisticated and successful nuclear strategy, even

India continues to be dependent on external sources in a few crucial areas. For other countries, the nuclear dependence is of a greater degree. Nuclear autarky has proved to be quite elusive for the developing countries. Nuclear technology, like many other advanced technologies, remains the preserve of a few advanced countries. The developing nations, in demanding modern technologies for economic development, have been unable to acquire these without political conditions which are not conducive to the growth self-reliant technological development. The nuclear export policies of the developed countries influence the shape and structure of the nuclear fuel cycle in the Third World. The exaggerated fears of nuclear weapon proliferation provided the stimulus for a drastic transformation of the nuclear export policies from the mid-1970s. The actual nuclear export policies, were the result of the complex interaction of domestic and international factors, and politico-strategic and economic factors. The size and character of the domestic and international reactor and uranium markets gave a strong export-orientation to the nuclear industries in the exporting countries. While politico-strategic fears of nuclear proliferation inhibited nuclear exports, politico-strategic pressures for energy security, energy independence and use of high technology exports to further foreign policy goals encouraged nuclear exports.

Canada and the United States gave overriding importance to non-proliferation concerns in their nuclear export policies, to the extent of tolerating damage to domestic nuclear industry. They sought to revamp drastically the nature of world nuclear

technological development and impose a tough nuclear non-proliferation policy. However, in attempting to unilaterally revise the existing norms of international nuclear relations, in trying to reverse the accepted strategies of nuclear development, in forcing unacceptable restrictions on transfer of nuclear technology to the Third World, and in demanding the acceptance of the NPT or fullscope safeguards as preconditions to nuclear exports, the United States was crippled by the absence of the nuclear pre-eminence it had enjoyed in 1950s and 1960s.

In the implementation of this policy, the United States had to compromise at various levels. It had to give continual concessions to Western Europe and Japan, who were not convinced with the new policy. While restricting nuclear transfers to Argentina, Brazil and India, the US turned a blind eye to nuclear proliferation potentials in crucial allies such as Israel and South Africa. In Pakistan, where a tough nuclear policy was sought to be implemented, it was reversed in the name of Soviet threat from Afghanistan and the utility of Pakistan as a "frontline state" against the Soviets. There was widespread resentment in the Third World to the North American nuclear policies. They were seen as unreliable nuclear partners, and a number of developing countries such as Argentina, Brazil and South Korea turned away from North America and looked towards Western Europe as a source of nuclear technology.

The West European countries were neither willing to jeopardise their domestic nuclear growth, nor were ready to

forgo the benefits of nuclear exports. Being vulnerable to disruption of energy supplies, they were determined to develop nuclear energy domestically. Being dependent on the Third World for supply of raw materials and also on the Third World markets for exports of industrial goods, France and West Germany sought to use nuclear exports to developing nations as bridges over which import of raw materials and export of industrial goods could be assured. Therefore, France and West Germany projected themselves as friends of the Third World in the field of nuclear relations. This claim, however, does not stand scrutiny. While willing to trade with the developing countries in nuclear technology, France and West Germany ensured the strictest possible international safeguards, and managed to acquire considerable control over the host countries' nuclear power programmes. Germany, in particular, through the elegant articulation of an ersatz philosophy of nuclear technology transfer, and through the subtle system of joint companies, gained stranglehold over the nuclear programmes of Argentina and Brazil.

The Soviet Union had a very cautious nuclear export policy. The Soviet Union demanded, at the London Club, fullscope safeguards or accession to NPT as preconditions to nuclear exports. But unlike the US and Canada, it did not insist on these conditions in its exports to Third World countries. It only followed the consensual rules adopted at the London Club. In this way, the Soviet Union avoided being the butt of vituperation of the Third World on nuclear issues.

On the whole, the evolution of the nuclear export policies of the developed countries hampered the growth of independent and self-reliant nuclear programmes in the Third World. While North America followed a policy of outright technological denial, Western Europe sold nuclear technology, but effectively robbed the autonomy of nuclear decision-making in the Third World. The changes in the nuclear export policies since the mid-1970s suggest that technological development in the Third World could be abruptly halted by the whimsical changes in perception of the developed countries. They also would imply that the relevance of modern technologies for the Third World and the norms of their development would not only be determined by the developed countries, but also that the norms can be unilaterally revised at any time by the advanced countries. In the case of nuclear technology, to suit their perceptions, the developed countries changed the very meaning of the phrase nuclear proliferation from the spread of nuclear weapons to the diffusion of nuclear explosive capability and finally to mean any spread of civil nuclear technology. It is also ironic that the developed countries in the West, even as they seek to abrogate or renege upon binding international commitments to some developing countries and restrict open and above-the-board nuclear transactions, have allowed clandestine nuclear sales to their allies such as South Africa, Israel and Pakistan.

Overarching the individual nuclear export policies of the supplier countries, there is an international regime on nuclear non-proliferation. By virtue of their preponderant

influence in the formation of international regimes, the Western countries with the active collaboration of the Soviet Union, erected the regime on nuclear non-proliferation, which acts against nuclear energy development in the Third World. The NPT, the centrepiece of this regime, was criticised at its incipience by India and others as being a discriminatory treaty. The criticism of these countries has been vindicated and reinforced by the implementation of the NPT over the last decade. The nuclear weapon powers violated every major provision of the Treaty. The limited responsibilities undertaken by them and the limited concessions they offered to developing nations were not implemented. The failure of the two review conferences of the NPT to move towards redressing some of the imbalances has eroded the strength of the Treaty. Although it preceded the NPT, the International Atomic Energy Agency (IAEA) was reduced to becoming the "Nuclear Policeman" for the NPT. The IAEA has put on the backburner its original objective of promoting nuclear energy and began to emphasise on safeguards. The undue emphasis on safeguards when an overwhelming majority of the developing nations are yet to taste the fruits of nuclear energy, makes a mockery of IAEA's statutory objectives. Besides enacting the developmental role of the IAEA, the nuclear supplier countries formed the secretive nuclear cartel the London Club - to restrict the transfer of nuclear technology. It was an attempt by the nuclear suppliers to resolve the differences among themselves, and to ensure that their competition for nuclear sales would not induce spread of nuclear technology. The London Club was

an attempt to transcend the NPT, and a clear violation of Article IV of the Treaty. Under the dispensation of the London Club, even those countries which signed the NPT were not above suspicion and would be denied certain technologies. The most recent component of the nuclear non-proliferation regime is the growing corpus of proposals for "internationalisation" of the nuclear fuel cycle. These proposals amount to limiting certain components of the nuclear fuel cycle, such as reprocessing, enrichment, and fuel fabrication to a few developed countries.

The attempts by the developed countries to impose an unjust international regime on modern technologies is the most blatant in the case of nuclear energy, but not unique. Similar efforts are underway in the regulation of deep seabed mining, space, information and communication technologies. However, throughout the 1970s, as part of the growing collective affirmation and the quest for a new international economic order, the developing countries have been battling for just international regulation of technologies. In this battle, there has been a growing belief in the strategy of collective self-reliance through "Economic Cooperation among Developing Countries" (ECDC) and "Technological Cooperation among Developing Countries" (TCDC). In the nuclear field, as a response to the international nuclear regime, there is a trend towards nuclear cooperation among the developing countries. Since the mid-1970s, the non-aligned movement has been strident in its criticism of the nuclear regime. The movement was also groping towards institutional measures towards

collective political action and technological cooperation in the nuclear arena.

An increasing number of bilateral nuclear cooperation agreements are being concluded among the developing countries. Most of these agreements relate only to elementary research and training. However, at the turn of 1980s, these agreements matured towards exchange of nuclear hardware and raw materials. The Argentina-Peru (1979), Brazil-Iraq (1979) and Argentina-Brazil (1980) nuclear cooperation agreements are indicative of this emerging trend. These agreements reflect the potential role the advanced nuclear countries in the Third World -- India and Argentina -- could play in the growth of nuclear technology in the underdeveloped world. Insofar as regional nuclear cooperation is concerned, Latin America seems to offer the best possibility. There are of course, a number of political and institutional hurdles for an increased regional and international nuclear cooperation among the developing nations. But the emergence of such a process would be of immense benefit to a number of less advanced developing nations in building nuclear technology for economic development. This, perhaps, is the only means by which the Third World could alter the dynamics of a discriminatory nuclear non-proliferation regime.