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International Legal Safeguards Against The Misuse Of Nuclear Materials

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Contents

1. The Position Of Safeguards In International Law.: An Overview.

The expression "international legal safeguards against the misuse of nuclear materials" embraces two separate areas of international law. On the one hand, there is the narrow definition of nuclear safeguards, ie. a system of international checks designed to discourage the diversion of nuclear materials to unauthorised uses, and to detect any such diversion. On the other, there is the issue of liability for damage arising from any misuse. This second aspect normally is divorced from any study of safeguards per se because it relates to legal provisions "after the event". Consequently, it has not been given any attention in this paper although it is worth mentioning that a weighty structure of nuclear indemnity legislation exists at the international level and that this could act as a deterrent to the misuse of nuclear materials in certain circumstances.

The purpose of safeguards has been defined by the International Atomic Energy Agency (IAEA) as "the timely detection of diversion of significant quantities of nuclear material from peaceful nuclear activities to the manufacture of nuclear weapons or of other nuclear explosive devices or for purposes unknown, and deterrence of such diversion by the risk of early detection". * The fundamental safeguard measure recognised by the Agency is material accountancy, "with containment and surveillance as important

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* INFCIRC/153(28)

complementary measures". "Containment" means the use of physical controls - walls, locks, seals, etc - designed to prevent illegal diversion, while "surveillance" involves guards, inspection and access to all facilities and systems where nuclear materials are handled.

The extension of the safeguards concept to cover adequate physical control, as well as surveillance, has involved the acceptance of a new level of international constraints (the nearest parallel could be the use of peace-keeping forces in potential war zones). While simple verification through inspection and reporting has been an established principle in international treaties, little precedent has existed fof states to actually be told how they should go about ensuring that their obligations are complied with. To illustrate this point, the ICAO Convention, for example, sets out specific conditions to be fulfilled by aircraft operating in member states *. However, states are not required to accept these standards internally under threat of being denied air links with member nations; the onus to implement adequate controls is presented as a common ideal of contracting parties (and any state is free to allow aircraft to operate over its territory under any separate or less stringent conditions it may lay down). In contrast, the evolving system of international nuclear safeguards increasingly abrogates the sovereignty of contracting states over the way nuclear materials are handled internally.

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* ICAO Convention, 1944, chapter II.12; chapter V.

As an example, a state wishing to obtain, say, 10Kg of nuclear fuel from a supplier would be likely to find: a) that this meant accepting international scrutiny of its entire peaceful nuclear programme, possibly indefinitly; b) that no alternative supplier would offer more favourable conditions; and c) that supplies would be withheld or withdrawn if it engaged in certain areas of peaceful research.

The strict regimes of material accountancy administered by the IAEA, both under its original safeguards system and that established by the Treaty on the Non-proliferation of Nuclear Weapons (NPT), also overstep the conventional limits of international interference in domestic affairs. States accepting nuclear materials for peaceful purposes on such terms are not free to use or redistribute these as they see fit, they must keep an inventory of the whereabouts and use to which these are put for as long as they remain within their territory. They do not, in effect, ever "own" such materials completely. Furthermore, the systems of supply restrictions established by the 'London Group' (the major nuclear supplier nations) and the '209 Group' (those states which have announced formally that they will prohibit the export of nuclear goods to nations which do not accept Agency safeguards) probably have no counterpart in the non-nuclear trade field (and would, in fact, be viewed as collusive or restrictive practices in normal trade law).

Going beyond the surrender of sovereignty involved in

international safeguards, there also is a tendency for specific controls or moderating arrangements instituted by individual states or groups of states to be internationalised simply because of the relationship with nuclear issues. This occurs through the process of norm-building on which international nuclear law is based. Thus, recent decisions by countries such as the United States to halt the commercialisation of more risky nuclear energy programmes, along with a move by particularly concerned nations to discuss ways in which nuclear energy can be disseminated without increasing the likelihood of nuclear weapons proliferation (through participation in the 'International Nuclear Fuel Cycle Evaluation' - INFCE - programme) contribute to the establishment of a concensus in this area. The stronger the concensus reached, the more binding will be any international legislation covering the subjects involved. The facility, and relative haste, with which new norms are identified and transcribed into international legislation is a unique feature of nuclear safeguards, reflecting both the urgency of the problem and the power of the resources being brought into play to prevent nuclear proliferation.

Yet another area where the safeguards concept is breaking new ground in international law involves efforts, particularly by the United States, to freeze international commerce in facilities for the production of nuclear power by what are considered to be more "dangerous" methods in terms of proliferation risks (eg. the nuclear fuel and energy cycles based on plutonium, an element which can be used for

the manufacture of nuclear weapons without further refining: see Annex 1). Attempts to create international concensus on this issue, and also - through unilateral and multilateral action - to prevent states from engaging in the peaceful development of nuclear energy in such areas, call for a further surrender of sovereignty by acceding nations. Going even beyond this, such attempts also mean that those nations which are pioneering research into the "dangerous" fuel/energy cycles are entitled, by concentrating their efforts on making such systems safer (presumably through massive inputs of money and technology) to reinforce their existing commercial monopolies while expecting the eventual recipient nations to bear many of the additional costs.

This last point is central to the unique position of nuclear safeguards in international law. Because the objective of safeguards is to deny the vast bulk of nations access to weapons which an elite already possess, and also to deny them the use of the option or threat to one day "go nuclear" unless their foreign policy objectives are satisfied, they are based on acceptance of inequality. This is in sharp contrast to the basic premise of international law that all nations must be treated as equals. Efforts by the nuclear elite to compensate for the unequal burden which other nations must assume in accepting safeguards have emphasised compensatory "sacrifices" to get over this initial inequality. Such sacrifices involve bearing a disproportionate share of the cost of research into safeguards

and safe energy processes; attempting to agree among themselves to reduce their own nuclear arsenals; and giving guarantees of stable supplies of nuclear materials to nations which are denied the right to manufacture their own.

The success of the international safeguards system may depend in part on the effectiveness of the compensatory sacrifices mentioned above. However, it can be argued: a) that any costs incurred in devising fail-safe mechanisms ultimately will be passed on to the consumer; b) that there are few realistic signs of any mutual phase-down of nuclear weaponry ; and c) that no guarantees can overcome the eventual prospect of a run-down in available supplies of "safe" nuclear fuels. Also, there has been some evidence that the supplier nations have breached the trust placed in them by the safeguards system by refusing to supply more sensitive items to acceding states. The dicriminatory aspects of international safeguards are dealt with in subsequent sections, as is the concept of reaching an "equilibrium of sacrifice" between the nuclear 'haves' and 'have-nots' through treaties and conventions.

Aside from the issues outlined above, the question of the overall effectiveness of the safeguards system must be considered. States agree to comply with safeguards in the belief that these will contribute to a lowered risk of nuclear proliferation. If it is evident that those countries most likely to want nuclear weapons are able to

obtain the necessary materials, expertise and will despite the costly sacrifices of the vast majority of states then the legal foundation of the safeguards system must be invalidated. Previous attempts to legislate internationally against behavior which offends supposed common norms (eg. the oil boycott against Rhodesia, which the United Kingdom now appears to have been circumventing) have tended to prove inadequate. The international regime of safeguards against nuclear proliferation can only be said to have substance if it can be seen to be working.

One final point which must be borne in mind in considering the place of safeguards in international law is the importance of the propaganda component both in helping new 'norms' to crystallise and in persuading nations to accept the progressive surrender of sovereign rights because they believe the system already is proving itself. An analysis of the foreign policy stances of the key nations supporting safeguards is outside the scope of this paper. However, it is worth observing that the purpose and effectiveness of nuclear controls has been stressed in recent official statements by members of the "Suppliers' Group" of nations (the London Group), particularly the USA. In contrast, those nations the safeguards system is attempting to restrain tend to be unanimous in their scepticism towards nuclear legal controls. The relative ease with which India was able to make the transition from being a nuclear 'have-not' to a 'have' (ie. without any overwhelming weight of sanctions being imposed) indicates that the safeguards

system applying up to 1974, at least, did not live up to its reputation.

India's example also may indicate that the supposed equality at least of non-nuclear nations under safeguards regimes is a myth: the relative susceptibility of different states to political pressure from the Great Powers may be far more effective than the safeguards system in deciding a) whether or not they will abuse their rights of access to nuclear materials, and b) whether or not they will be punished for any such abuse. It is possible that the supposed international norms on which safeguards are based are only a legal veneer covering a conglomerate of threats and bribes which is constructed and maintained by the powerful nations.

2. The Foundations Of International Safeguards.

While initial research into nuclear energy was cloaked in secrecy, this was for reasons of national security rather than to protect the common interests of the international community. Similarly, the November 1945 Tripartite Declaration (the 'Three Nations Declaration', by the USA, UK and Canada), stating that information concerning the industrial application of nuclear energy would not be released to other nations until "effective, reciprocal and enforceable safeguards" acceptable to all had been drawn up and implemented, must be regarded as an attempt by the three allies to retain a monopoly on the bomb rather than as a seminal point in the development of safeguards (although it did contain the first use of the term "safeguards" in the nuclear context).

The initial General Assembly resolution in 1945, which established the United Nations Atomic Energy Commission (UNAEC), incorporated part of the Tripartite Declaration in calling, inter alia, "for effective safeguards by way of inspection and other means..." against the spread of nuclear weapons.

A subsequent attempt by the Tripartite powers to conceal their inflexible stance behind the 'Barach Plan'(put to the United Nations in 1946 by the USA) also rested on a ban on nuclear activities by states rather than on the evolution of a system of controls which would enable the benefits of atomic power to be shared by other nations. Under this plan,

the USA would surrender control of all nuclear activities to an 'International Atomic Energy Authority' which would be responsible for all nuclear research, and which would have powers to impose sanctions against any nation attempting unilateral research. The 'catch-22' clause in the Barach Plan was a stipulation that the USA would retain sole control over its nuclear programme until effective "veto-free" sanctions were operative (the Soviet Union refused to accept any curbs on its own nuclear research without "prior destruction of the US weapons stockpile", and the plan consequently failed).

Lengthy debate in the UNAEC and the UN itself on the Barach Plan and various counter-proposals was overtaken by events as other nations developed and exploded their own atomic bombs, and as the prospects for international control of all nuclear activities vanished. By 1953 factors such as the death of Stalin, the success of the U K in producing its own nuclear weapon despite being frozen out of the post-War US nuclear programme and, especially, a mistaken belief that nuclear power would become economically viable in Europe before the USA, had combined to encourage the Eisenhower administration to yield to the inevitable. The concept of total control was abandoned and, instead, the US began to think in terms of using its nuclear preeminence as a bribe to channel other countries' research into peaceful areas.

The "Atoms for Peace" proposal which Eisenhower presented

to the General Assembly in December 1953 involved the establishment of an international atomic energy agency which would be allocated stocks of nuclear material, and which would oversee the internationalising of research into peaceful uses of nuclear energy. The concept of safeguards, while not mentioned in the proposal, was implicit in the structure of the agency envisaged. In support of this initiative, the US relaxed its export prohibition on nuclear materials (through the Atomic Energy Act 1954), declassified a number of processes and began to accept loose bilateral guarantees of "peaceful use" as the criterion for dissemination of uranium.

With the Atoms for Peace move, the US in effect offered to assist with the accel erated development of nuclear programmes in other nations, in return for the international recognition of the conditions under which such programmes would proceed. Acceptance of the proposal, and the establishment of the IAEA in 1957, marked the first successful efforts to persuade nations that the potential benefits from nuclear energy were sufficient (and the risks grave enough) to warrant the intrusion of safeguards into their sovereignty. It should not be overlooked that the Tripartite Proposal nations had separately developed profitable and increasingly prestigious nuclear export industries by 1957, meaning that a number of projects had escaped the IAEA safeguards net even then, and that the commercial desirability of a common safeguards regime had become apparent, regardless of any higher justification.

3. The International Atomic Energy Agency And Safeguards.

A. The Statute

The safeguards provisions of the IAEA Statute resulted from lengthy debate and involved a strong element of compromise. Consequently, they tend to be fairly general. Article II requires the Agency to "ensure, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose". Article III.A.5 empowers the IAEA "to establish and administer safeguards designed to ensure that special fissionable and other materials, services, facilities and information made available by the Agency, or at its request or under its supervision or control are not used in such a way as to further any military purpose", and to apply safeguards:

a) In connection with its own assistance Programmes (so-called 'Agency projects');
b) At the request of the parties to any bilateral or multilateral arrangement; and
c) At the request of any state with regard to its own territory.

Article XI.F.4 stipulates that any state engaging in an Agency project must make a legal undertaking not to use the assistance so provided to further any military purpose, and to accept the safeguards which the Agency lays down.

The final parts of the Statute dealing with safeguards are Article XII (which specifies the Agency's powers to require inventories to be kept, to review security procedures at facilities, and to take similar measures to prevent the diversion of materials under its control for military purposes), and Article XIV (which includes the cost of safeguards under the Agency's administrative expenses, where this is not provided for under separate agreements)* The Statute makes it clear that the automaticity of the Barach Plan (ie. safeguards applying automatically to all national research when it moved into the nuclear area) had been abandoned at this stage, and that the IAEA would only be able to intervene when specifically requested to do so by the states involved.

The only sanctions provided for in the Statute are the withdrawal of IAEA sponsorship, and requests for the return of material which has been supplied to offending states. Any further action is left entirely to the United Nations, with the Agency's Board of Governors being required to report non-compliance to both the Security Council and the General Assembly.

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* B. Sanders & Ha Vinh Phuong 'International Safeguards', in NLB No 18 (Dec 1976) cover the Agency's Statute in more depth.

B. The Initial Safeguards Regimes

The general responsibility of the IAEA to provide safeguards when these are required by separate bilateral or multilateral arrangements (Article III.A.5) made it highly desirable for a standard list of procedures to be drawn up which theoretically could be applied, with minor modifications, in all cases. The first attempt at this, 'The Agency Safeguards System (1961)' - INFCIRC/26 - was a tentative effort aimed solely at small research reactors (there was some doubt among supplier nations at that stage whether controls administered by an international agency would be as effective as those specified under the bilateral co-operation agreements then being entered into. The impetus to produce INFCIRC/26 came particularly from a 1958 application by Japan for IAEA assistance in obtaining nuclear fuel for a research reactor. The Japanese agreed in principle to accept any Agency safeguards which might be considered necessary).

In 1965 INFCIRC/26 was extended to cover all nuclear reactors (INFCIRC/66), and it was revised in 1966 and again in 1968 to cover a full range of nuclear facilities and materials, including reprocessing and fuel fabrication plants. Since 1968 the basic IAEA safeguards document has been INFCIRC/66/Rev.2, and all agreements made under the Agency's aegis between 1968 and the introduction of the NPT safeguards regime in 1970 (and beyond then for non-NPT

signatories) have been in terms of this document. A few early agreements made under the less specific arrangements of INFCIRC/26 have lingered on but the tendency has been for these to be phased out in favour of the provisions agreed on by the Agency in 1968.

In addition to INFCIRC/66/Rev.2, supplementary provision for inspections is made in a separate document entitled 'The Agency's Inspectorate' (document GC-V-INF/39), given effect in 1961.

The actual application of Agency safeguards began in 1961 but involved only Agency projects, covering materials made available by or through the Agency. However, from 1962 onwards the USA - with the agreement of the other nation involved in each case - began to transfer to the IAEA the safeguards responsibilities provided for in its own bilateral nuclear co-operation arrangements. In 1963 the USSR, acknowledging with regret that the dissemination of nuclear materials was a fact of life, strongly supported the concept of a uniform code of IAEA safeguards for all recipient countries.

The above moves by the two Super Powers marked the beginning of a whole series of 'safeguards transfer agreements', or trilateral agreements between the individual states involved and the Agency as provided for in Article III.A.5 of the Statute. Similarly, a number of nations have since unilaterally submitted their nuclear activities to Agency control.

4. IAEA Safeguards And The Treaty On The Non-Proliferation Of Nuclear Weapons.

A. The New Safeguards Regime

As the Agency's safeguards arrangements were evolving, the United Nations made parallel efforts to place direct curbs on the actual construction of nuclear weapons by states which had not already done so. Beginning with a 1958 resolution (presented by Ireland), the text of the NPT was drawn up by the Assembly's Disarmament Committee and adopted by an overwhelming vote (95 for, 5 against and 21 abstentions) in 1968 (entering into force, after the necessary ratifications, in March 1970). Essentially, states party to the NPT undertake not to develop (if they have not already done so) or assist in the development of nuclear weapons or nuclear explosives. Moreover, 'non-weapons' signatories agree to put all their nuclear facilities under safeguards to ensure that the risk of proliferation is minimised (this undertaking covers facilities developed domestically, as well as imports).

Under the NPT, states with nuclear weapons - 'nuclear powers' - agree not to transfer these to non-nuclear states, and the Treaty provides for a neutral inspectorate tasked with identifying and exposing any attempt to contravene this undertaking. The right of all signatories to engage in peaceful nuclear activities is underlined in the NPT

but every non-weapons party is obliged to accept IAEA safeguards on all such activities under its control. The Treaty also contains an undertaking by all its parties not to supply sensitive equipment or nuclear materials for peaceful purposes to any non-weapons state, regardless of whether or not it is a party to the Treaty, unless these are made subject to the same safeguards.

Specifically, the key clauses of the NPT dealing with safeguards appear in Article III.1 (where non-weapon parties agree to accept IAEA safeguards); and Article III.2 (extending IAEA safeguards to trade in nuclear materials etc).

The NPT does not have its own defined system of safeguards but relies on the IAEA to provide this. It thus reinforces the authority of the Agency. However, the greater emphasis given to signatories' rights to minimise the intrusive aspects of inspection and detection in the Treaty (concessions made by the pro-NPT powers in order to maximise its political acceptability) necessitated an immediate review of the basic Agency safeguards system. This took the form of 'INFCIRC/153' entitled "The Structure and Content of Agreements Between the Agency and States Required in Connection With the NPT". INFCIRC/153 has been the basis of all safeguards agreements so far concluded in connection with the NPT.

The most important distinctions between the Agency's original safeguards system (INFCIRC/66/Rev.2) and that resulting from the NPT (INFCIRC/153) are set out in the

following table.

Subject	Agency Safeguards	NPT Safeguards
Coverage.	Apply only as a result of the specific Agency projects, trilateral agreements and unilateral agreements.	Apply automatically to all peaceful nuclear activities of signatories.
Activities specifically banned.	None of the items covered by agreements are to be put to any military purpose.	Nuclear energy may not be used by non-weapons signatories to produce explosives. However, it may be used for other military purposes.
Responsibilities of signatories.	The Agency itself inspects facilities subject to agreement periodically.	States must establish their own systems of accounting and control, and the IAEA is empowered to verify their findings.
Scope of inspections.	Inspections concentrate on specific facilities defined by each agreement.	Inspections cover all areas of the national peaceful nuclear programme.

All NPT safeguards are negotiated within the terms of INFCIRC/153, and this gives them a uniformity which the old INFCIRC/66/Rev.2 arrangements lacked. Because of its greater demands, and its need for flexibility to meet varying circumstances, the earlier document does not contain the "structure and content" of agreements, whereas this is specified in INFCIRC/153.

The pre-NPT system gives various objectives and proceedures for the application of safeguards but these must be further elaborated in the appropriate specific agreements. There is considerable flexibility over the extent to which the IAEA's provisions are incorporated in a particular agreement, and the safeguards aspects of such agreements need only be "essentially consistent" with those of INFCIRC/66/Rev.2. A number of very basic points are left to the various specific agreements. These include notifications of materials transfers, the types of inventories and records which the Agency is to be required to keep, and the types of security measures to be applied.

In order to secure as much standardisation as possible, the Agency evolved its own model "Subsidiary Arrangements" covering the above points, and endeavoured to encourage states to couch specific agreements made under INFCIRC/66/Rev.2 in terms of these. However, because of the highly technical nature of such subsidiary arrangements, there was an inevitable tendency for the less technically advanced nations to accept the IAEA's guidelines almost without modification but for the more advanced to tailor them to suit themselves.

B. The Concept Of Pursuit

One area where IAEA safeguards agreements outside the NPT have shown considerable variation has involved the process of "pursuit" (ie. of keeping track of used fuel and equipment and, especially, of the fissionable end-products

from some nuclear reactors). Pursuit involves both tracing subsequent exports of sensitive materials created in a facility which is subject to safeguards, and monitoring the use to which such materials (and further generations of materials which may, in turn, be derived from these) are put. Such monitoring may be required indefinitely.

The concept of pursuit is entrenched in the IAEA Statute, and expanded in INFCIRC/66/Rev.2 (paragraph 16) which states that it is desirable that agreements should provide for the continuation of safeguards for fissionable products. While many agreements do embrace the concept, or else make allowance for further negotiations on pursuit when they expire, others contain specific time limits and overlook the question of continued safeguards on sensitive materials which may have been produced in the course of a safeguarded operation's lifetime.* The IAEA in 1974 attempted to close the pursuit loophole by formally announcing that it considered indefinite follow-up of all nuclear products should "normally" be an essential feature of future safeguards agreements. Since then, this guideline seems to have been accepted but, given the added surveillance complexity which pursuit creates, it is premature to judge the effectiveness of such provisions. The rapid expansion of nuclear processes could soon make pursuit an impossible burden.

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* As examples, the trilateral agreement between India, Canada and the Agency (INFCIRC/211) for supply of materials for the Rajasthan power station applied for an initial period of only five years but specific provision was made for subsequent generations of nuclear material produced to be safeguarded indefinitely. In contrast, the unilateral undertaking by Argentina to the Agency for the Atucha power station (INFCIRC/168) contains no provision for such follow-up surveillance.

5. The Implications Of The NPT.

A. The Position Of The Nuclear Powers

From the earliest stages in its evolution, the NPT has been associated with the nuclear 'haves' of the world - and, particularly, with the United States and the USSR - and has been presented as a penalty which the 'have-nots' must pay in order to enjoy harmonious relations with the Great Powers.

Initially, in August 1957, the Western powers (the USA, UK, Canada and France) submitted a "package" of measures to the sub-committee of the UN Disarmament Commission offering various concessions and calling for a parallel commitment by each UN member "not to transfer out of its control any nuclear weapons, or to accept transfer to it of such weapons" except for self defence. At the time the USSR opposed this move, calling for a complete ban on the transfer of nuclear weapons and on the stationing of nuclear weapons in foreign countries (referring to the US nuclear presence in Europe). Consequently, the "package" offer was defeated.

In 1961 the General Assembly unanimously approved an Irish resolution calling on all states to reach formal agreement to refrain from the transfer or acquisition of nuclear weapons. The success of this resolution, after the 1957 failure, can be attributed in part to the USSR's belated recognition that its nuclear cooperation programme with China - which ended abruptly in 1960 - had been creating

a potentially hostile weapons state on its border (the first Chinese nuclear explosion occured in 1964).

On 21 January 1964 the United States put an arms control proposal to the UN's Eighteen Nation Disarmament Committee. This included a non-dissemination and non-acquisition clause, based on the 1961 resolution, together with safeguards on the transfer of nuclear materials for peaceful purposes. An important feature was a call for the major nuclear powers to accept that their peaceful nuclear activities increasingly undergo "the same inspection they recommend for other states".

Despite implied Soviet support for the concept of non-proliferation, little more progress was made for some time. The US had been having talks with its NATO allies on the possible creation of a multilateral nuclear force (MLF), and the USSR viewed this as a direct attempt at nuclear dissemination which precluded any form of non-proliferation agreement. The debate between the two Super Powers led to the tabling of separate draft non-proliferation treaties by each in 1965, the main features being a US move to have IAEA or equivalent safeguards applied to all non-nuclear weapons signatories, and a Soviet proposal (without safeguards provisions) which was aimed particularly at prohibiting the MLF.

By 1966, despite continuing disagreement over the MLF issue, it was clear that both sides supported further

movement towards an agreement on non-proliferation. Very significantly, the non-nuclear nations also were becoming heavily involved in the debate at this stage (as was demonstrated by a series of General Assembly resolutions urging priority attention for non-proliferation. The 1964 African Summit Conference, and the subsequent Cairo Conference of Non-Aligned States, also produced strong calls for progress with nuclear weapons limitation).

The US and USSR conferred throughout 1966, finally reaching agreement on a draft treaty (in the process, the US abandoned the MLF idea, and the Soviet side appears to have been equally conciliatory). This was presented, as joint drafts, to the Eighteen Nation Disarmament Committee in August 1967 and, after a number of revisions based largely on concerns expressed by non-weapons states, was approved by the General Assembly in June 1968.

Objections by the non-nuclear states included
a) the commercial disadvantage arising from safeguards being placed on their development programmes when nuclear weapon states were being spared this burden (there is no NPT obligation for nuclear-weapon states to accept safeguards on their peaceful nuclear activities *). This

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* Under the old INFCIRC/66/Rev.2 system the obligation of safeguards may arise if nuclear material is returned to a nuclear-weapon state in an "improved" - ie. weapons grade condition.

objection was partly overcome when the USA and the UK agreed to accept safeguards also; b) integration of the EEC's peaceful nuclear programme, EURATOM, into the system; and c) the possible discriminatory effect of safeguards. This last concern led to Articles IV and V of the NPT, guaranteeing signatories free access to nuclear equipment, materials and technology.

B. The "Balanced Obligations" Undertaking

A key element in the final phase of the NPT negotiations was acceptance by the nuclear powers that they had an obligation to reduce their nuclear arsenals and to work towards progressive disarmament. The Preamble to the Treaty stresses intentions by parties "to achieve at the earliest possible date the cessation of the nuclear arms race and to undertake effective measures in the direction of nuclear disarmament"; "..to seek to achieve the discontinuance of all test explosions of nuclear weapons"; and "...to facilitate...the liquidation of all their existing stockpiles, and the elimination from national arsenals of nuclear weapons and the means of their delivery pursuant to a treaty on general and complete disarmament under strict and effective international control". These sentiments are reiterated specifically in Article VI.

To many non-nuclear nations, the NPT was "a compact between nuclear-weapons powers and non-nuclear weapons states in which the latter accepted restraints on their

sovereignty in return for measures towards nuclear disarmament by nuclear-weapons states" *. The very limited progress made towards this objective since 1970 (the SALT talks) may be viewed as a serious attempt by the USA and USSR to meet their side of the bargain. Conversely, it may be seen as a minimal effort designed to create the illusion of movement towards what is, in fact, an unattainable goal in the present political situation.

C. The Incentives Aspect, And Sanctions

The United States and the Soviet Union, in preparing their joint 1967 drafts, appear to have been conscious that these would need to guarantee access to nuclear materials on a non-discriminatory basis if they were to obtain general endorsement. However, debate within the Disarmament Committee after the drafts were presented still highlighted the need for additional guarantees to this effect. Both the final drafting (within the Disarmament Committee) and the formulation of INFCIRC/153 accordingly were aimed at creating a safeguards regime that offered "better" (ie. less discriminatory) access rights than those established under the existing safeguards arrangements normally applied by the supplier nations. To this effect, the specific

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* Pakistan's Permanent Representative to the Security Council, in Columbia Journal of Transnational Law, vol. 16, 1977, p. 464

aspects of the old INFCIRC/66/Rev.2 system were replaced (for NPT purposes) by a much more general set of commitments.

The supplier states had been able to dictate terms to recipient countries over the areas where IAEA safeguards would be applied, the level of access for inspection, etc under the old system. In practise, although the desirability of uniformity was stressed, this meant that safeguards could be applied far more intrusively to the "weak" nations which were not in a position to threaten to find alternative sources (such as domestic manufacture), or to nations which the supplier did not fully trust. Under the NPT regime, signatories were to be rewarded by being able to conclude "easier" and more acceptable INFCIRC/153 agreements, whereas non-signatories would be forced to accept supplies only under INFCIRC/66/Rev.2 conditions.

Provisions for the application of sanctions against offending states as a result of the NPT are somewhat more positive than those provided for by the IAEA Statute. Agreements made by the Agency with individual states or groups of states under the conditions of the NPT are subject to a rule (INFCIRC/153, paras. 18 &19) that the IAEA Board of Governors may decide, on the basis of a report from the Director General, to call on a party to take "essential and urgent" action to enable the Agency to verify that there has been no diversion (this rule can be administered, for example, in cases of obstruction or denial of access). This means

that the Agency can react before there has been an obvious breach of an agreement, and can call for sanctions on the basis of a lack of information instead of being required to prove guilt. Simple failure to verify that no diversion has occured is considered sufficient to justify sanctions. However, the actual punitive powers available under the NPT still amount to only a public condemnation (via the UN), a freeze on supplies of nuclear materials, and a right to demand the return of any such materials subject to the specific agreement involved.

India's nuclear test in May 1974 brought home the weakness of existing sanctions. India is not a nuclear-weapon state in the sense of the NPT (Article IX.3 defines such nations as those which had manufactured and exploded a nuclear weapon or other nuclear device prior to 1967), and the plutonium used to create the explosion was derived from a Canadian-supplied reactor. Reprocessing of the spent fuel was carried out in facilities constructed without outside assistance *. As a non-NPT signatory, India was not obliged to apply IAEA safeguards affecting any part of its extensive domestic nuclear industry, and the diversion of small quantities of plutonium - ostensibly for peaceful purposes (India still maintains that its 1974 explosion was a test of a non-military explosive device) - clearly did not prove impossible.

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* The reprocessing plant in Trombay. See W. Van Cleave, 'Nuclear Technology & Weapons', in 'Nuclear Proliferation Phase II' ed. R.M. Lawrence/J. Larus, 1974, p. 30.

The fact that no effective sanctions were applied to India after the event (Canada ceased its nuclear cooperation programme with India as a result of the explosion but this has not prevented further substatial progress by the domestic nuclear industry, including construction of a 470-MW nuclear power plant in Madras) demonstrates that the IAEA regime has limits to its enforcement functions. Efforts by concerned nations since May 1974 have centred about persuading India not to move any further towards developing a tactical bomb, arguably the the most reasonable approach under the circumstances*. Actions which might have alienated the Indians or generated sympathy for their position among Third World countries were generally avoided. Thus, in July 1976, the US Nuclear Regulatory Commission approved a licence to ship 82 Kg of low-enriched uranium to India under a safeguarded agreement.

D. The "Security Assurances" Aspect

In the course of the negotiations leading up to the NPT, non-nuclear weapons states sought assurances that renunciation of such armaments would not increase their military vulnerability. Many, such as Israel, argued that their peculiar security problems meant that they would be required to make far bigger sacrifices than would be required of others if they signed the Treaty. This particular debate led, on

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J.S. Nye 'Non-Proliferation: A Long-Term Strategy', in 'Foreign Affairs', April 1978, p.612 makes this point with regard to US strategy towards India.

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7 March 1968, to an independent submission to the Eighteen Nation Disarmament Committee by the USA, UK and USSR aimed at providing "security assurances" to non-nuclear nations acceding to the proposed NPT.

The assurances proposal called for a Security Council resolution which, noting the security concerns of states wishing to subscribe to the NPT, would recognise that nuclear aggression or the threat of nuclear aggression created a situation requiring "immediate action" by the Council (and, especially, by its permanent members). This would be supported by separate declarations by the three powers.

The NPT itself was submitted to the General Assembly in the context of the "security assurances" offer, and further progress on the assurances issue was implicit in the Treaty negotiations from that point. The three powers stated their intentions to invite the Security Council immediately to; a) recognise that "nuclear aggression or the threat of it" would necessitate action under the UN Charter, particularly by the nuclear-weapon members; b) welcome their intention to support assistance to any non-nuclear party to the NPT exposed to nuclear aggression; and c) reaffirm the "inherent" right of individual and collective self defence under Article 51 of the Charter. The resultant Security Council declaration to this effect gave considerable weight to the argument in favour of the NPT. Only France failed to support the declaration, abstaining on the grounds that complete nuclear disarmament was the only adequate security guarantee.

6. The Mechanics Of Present IAEA Safeguards

Recapitulating briefly at this point, three separate IAEA safeguards regimes are in operation at present:

- those established under the original loose rules of INFCIRC/26, on the basis of the Agency's Statute (mainly applying to research reactors);

- those made subsequently under INFCIRC/66/Rev.2 to govern specific agreements between states and the Agency;

- those established for the purpose of administering the controls accepted by the signatories to the NPT (ie, the IAEA's INFCIRC/153).

Agreements based on the first of these systems are now anachronisms and very few remain in force. Those based on the second are still being made or extended (e.g. covering the transfer of nuclear materials between states not party to the NPT). However, the great bulk of the Agency's safeguards effort since 1970 has been directed towards the administration of the third system, and the overwhelming tendency is for other agreements (e.g. between non-signatories or, perhaps, dealing with nuclear materials supplied for 'non-explosive' military purposes) to be couched in terms of INFCIRC/153. For the purposes of this paper, this therefore will be regarded as the 'current' safeguards regime.

A. Book-Keeping Controls

As already mentioned, materials accountancy is considered to be of "fundamental importance" to safeguards, while physical packaging and security, and surveillance, are important "complementary measures". In practice, continuous stocktaking (every two months for the most dangerous materials - i.e. free plutonium and highly enriched uranium-235, and every six months for low-enriched U-235 or material contained in a nuclear reactor) is the basic check against illegal diversion. So-called "limits of error of unaccounted material" (LEMUF) are set for each stage in nuclear

handling procedures and are periodically made more stringent as techniques improve.

Because of the fine limits of tolerance involved, the book-keeping process is causing minor but highly annoying strains for a number of states. The emphasis in the NPT system is on the timely detection of any materials diverted, rather than on verification that materials supplied by or through the Agency or for projects under its supervision have not been put to military uses (the objective of the old systems). States accepting NPT controls, which they are required to administer themselves, have found that advances in weapons technology are now making it progressively more difficult for them to meet their responsibilities. For example, the redefinition of the LEMUF for plutonium to a level below half of one percent of the total throughput (of a fuel element fabrication plant) may mean a considerable unplanned cost in new equipment and the retraining of staff. By accepting IAEA safeguards, and then making, perhaps, irreversible outlays on nuclear facilities, states can find themselves locked into a system which subsequently will mean far greater inroads into their independence than were originally envisaged.

The blanket of secrecy over nuclear weapons research contributes to the above "grey area". States signing the NPT could find that domestic resources or facilities acquire a strategic significence overnight as new weapons are developed or as well-concealed research by one or more weapons-states becomes public. The Treaty therefore has one of the most undesirable features of any form of international commitment; the list of obligations it entails is relatively open-ended.

An area of special concern to smaller states obtaining nuclear materials on NPT terms is the inequality implicit in the book-keeping arrangements. The greater the throughput of any nuclear establishment or complex of establishments, the greater the opportunity to divert the quantities necessary to construct a nuclear device. Thus, a nuclear fuel reprocessing plant could handle 15 000 Kg of plutonium annually and, given a LEMUF for

such an operation of 1 percent, this would mean that up to 150 Kg (sufficient to make from 10 to 20 bombs - see annex 1) could fail to be accounted for without causing any widespread alarm. Furthermore, the more advanced states - which tend to possess larger and more advanced nuclear establishments - are probably more able to acheive the level of process control which would be required to divert materials illegally without going beyond the LEMUF. The implication of this situation is that the smaller, developing, nations are required to accept what are, in effect, tighter controls than those imposed on their larger fellow signatories.

B. Inspection Controls

Non-weapons states adhering to the NPT agree to accept inspection of all peaceful nuclear facilities by the IAEA, at the latter's discretion. If it suspects a possible illegality the Agency can concentrate inspectors at any facility in the suspect nation's peaceful nuclear programme. If administered flexibly, this provision could help to compensate for the extra burden placed on smaller nations by book-keeping as, presumably, frequency of inspection should be directly proportionate to the potential which exists for illegal diversion. However, INFCIRC/153 specifies (in "man-years") the total allowable inspection time at any facility, meaning that only limited scope for "flexibility" exists.

In practice, the IAEA's main interest (in terms of INFCIRC/153) is on the flow of nuclear materials rather than in the operations of specific establishments within contracting states. "Material Balance Areas" (MBA) are defined by the Agency's inspectors, and their efforts concentrate on measuring the flow of nuclear items into, and out of, these. INFCIRC/153 describes in detail the purposes and scope of inspections, and sets limits on what inspectors need to have access to. From this point of view, it is a less "open-ended" document than INFCIRC/66/Rev.2, and this may partly atone for the tendency for materials accounting procedures to become increasingly rigorous. In addition, the number of IAEA inspectors is small (113 as at June 1978. the trend

has been to keep the number of inspectors approximately in step with the number of facilities subject to inspection), and this factor places a physical limit on the degree to which the Agency can intrude.

7. The Nuclear Supplier States And NPT Obligations

Particularly since the 1960s, the Soviet Union has found common ground with the old Tripartite Group in ensuring that outsiders were discouraged from playing off East/West rivalries in order to obtain nuclear weapons. The common interests of the main nuclear powers in maintaining the existing nuclear balance gives enormous weight to international attempts to establish effective safeguards: non-proliferation is probably the only major strategic issue where they agree and where they have an overwhelming interest in obtaining results.

While the established nuclear-weapons states have demonstrated considerable solidarity, the somewhat larger 'club' of nuclear supplier nations has not proved to be completely monolithic on the safeguards issue. The USA and the USSR, paradoxically, have tended to find themselves aligned against other suppliers at various times. A Paris/Bonn grouping, attracting tentative support from some of the other nuclear nouveaux riches (and even occasionally from the UK) has taken the view that the Washington/Moscow alliance shows strong elements of commercial collusion.

The Paris/Bonn argument is based largely on economics, although the restrictive practices employed by the US in the past are also cited frequently. Both countries claim the right to use "discernment"in their sales policies, and claim that they have a firm directive in the NPT (Article IV) to supply to all, and thus to avoid the mistake the US had made in the 1950s and 60s of denying peaceful nuclear facilities to nations which would "develop the technology themselves" if necessary.

While the Washington/Moscow stance appears the more reasonable at first glance, the European reaction is readily understood when America's past record is considered. The US has supplied nuclear reactors to a number of non-NPT signatories (Israel, Spain, possibly Pakistan) and to several other 'doubtful' cases (e.g. Egypt). Of the twenty-nine US nuclear cooperation agreements, thirteen were with non-NPT nations as at March 1975. The Europeans argued that, because the US, the USSR and Canada had dispersed plutonium-producing reactors fairly indiscriminately,

they had no right to deny other nations equal sales opportunities.

These competitive aspects posed a major threat to the ideals of the NPT until recently, and it remains doubtful whether they have been overcome. From 1974 through to early 1976 the NPT appeared to be directly threatened by a number of deals between non-signatory suppliers and some of the more volatile "near-nuclear" nations. Among the more notable of these was a move by France to sell a fuel re-processing plant to Pakistan in August 1976, despite the fact that neither Pakistan nor any other non-communist country outside the United States and Europe had a demonstrable need for such a facility (in fact, Pakistan's failure to sign the NPT, and the rivalry with India, leave little doubt about the motivation for the purchase, which would have provided the potential to manufacture nuclear weapons). Another particularly sensitive deal involved the sale by West Germany of a complete nuclear energy cycle, from enrich mant through to re-processing, to Brazil (a non-NPT signatory with a long-standing rivalry with Argentina - a country with a well-developed nuclear industry).*

Initial attempts by the status quo nuclear powers and their supporters to prevent sales of this type were singularly unsuccessful. As an extreme example, a call by the Colombo Non-aligned Conference for an oil boycott of France, for supplying South Africa - a typically "sensitive" near-nuclear state - with nuclear reactors producing weapons grade plutonium had no impact whatsoever. The fact that sales such as the Franco-Pakistan one showed every sign of going ahead despite both parties eventually bowing to

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* For further comment on the Brazilian and Pakistan purchases see Columbia Journal of Transnational Law, 1977, Vol. 16, pp. 451/452 and 459/465.

international pressures* to apply full INFCIRC/66/Rev.2 safeguards tended to discredit the value of IAEA controls. For strategic and economic reasons it seemed clear that Pakistan, for example, wanted a reprocessing plant to give it the potential to join the nuclear club. If the Pakistani government felt it had retained this potential even with safeguards, then these could only be regarded rather cynically.

In 1975 the nuclear "conservatives" - the USA, USSR, UK and Canada - made a concerted effort to overcome the burgeoning problems being caused by competition among suppliers. This move was associated with other problems affecting the NPT and is dealt with in a later section.

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* Attempts by the US to block the sale to Pakistan included hints that aid would be cut off, and successful pressures on South Korea (which had been involved under a subsidiary arrangement) to withdraw. Eventually, these were partially successful in that, on 9 August 1976, Dr Kissinger was able to announce that he had negotiated a safeguards agreement with Pakistan to cover the French equipment (he implied that this agreement had been associated with a sale of US bombers to that country).

8. The Non-Nuclear Recipient States

A. General Attitudes

Acheivement of the NPT itself is not necessarily viewed with the same optimism in many non-nuclear states as it is in the dominant nuclear powers and their allies. Thus, India's 1974 explosion of a"peaceful" nuclear device was generally applauded by the developing world (Pakistan was the only developing country to condemn it), and the NPT is probably still seen by many as a device to deny developing nations weapons which the major developed powers either possess or have ready access to. Also, the "iron law of nuclear proliferation" - if one country confronting an adversary develops nuclear weapons, that adversary will do the same - still has considerable currency. Nations in confrontation situations could reasonably argue that their right to self-defence, defined in the UN Charter, over-rides any commitments under subsidiary agreements such as the NPT, and that the General Assembly's 'Security Assurances' cannot be taken seriously when the vagaries of world politics are considered.

Many developing nations have continuing reasons to resent (and resist) what they see as efforts by the supplier nations - especially the Washington/Ottawa/Moscow group - to limit the spread of nuclear technology to industrialised countries. US sales of plutonium and weapons grade uranium to advanced nations (including Israel and South Africa) are likely to have proved particularly offensive, when similar sales to the developing world were consistently refused, at least until the NPT.

Against this background, acheivements of the 'Treaty of the Prohibition of Nuclear Weapons in Latin America' can be seen to have been a major development which warrants brief mention in this paper as the only successful initiative, other than the NPT (and comparatively minor acheivements - from a safeguards point of view - such as the agreements barring nuclear weapons in Antarctica and in outer space) to limit nuclear proliferation by international agreement.

B. The Treaty for the Prohibition of Nuclear Weapons in Latin America: Safeguards Aspects

This, popularly known as the 'Tlatelolco Treaty', declares a nuclear weapon-free zone in "Latin America". It arose out of South American countries' unease after the 1962 Cuban missile crisis and, after being signed in 1967, has now been ratified by all Latin American nations except Cuba (Brazil considers that its own ratification does not have any legal effect until Cuba also ratifies). The Treaty was endorsed by the General Assembly without dissenting vote that year.

The basic safeguards provision occurs in Article 13, which places all peaceful nuclear activities in the zone under the IAEA INFCIRC/66/Rev.2 regime. An accompanying protocol calls on the four outside nations (the USA, UK, Netherlands and France) with territories inside the zone to accept these restrictions also, and all but France have agreed to this.

Within Latin America, Argentina and now Brazil are considered "near-nuclear" states, both being well on the way towards acquiring the facilities and/or materials to manufacture nuclear weapons. Neither has ratified the NPT but both, along with all other nuclear recipients in Latin America, have accepted IAEA safeguards as a precondition of all nuclear imports since 1968. The international unease associated with Brazil's purchase of a reprocessing plant has already been dealt with. However, there have been no reports of any violations of the Tlatelolco Treaty by any signatory and it must be assumed to be working effectively, given the fairly limited nuclear aspirations of most South American nations up to now.

9. The NPT's Failings And The Emergence Of The 'London Group'

During the early 1970s, a combination of cheap oil, relaxation after the acheivement of the NPT, and a general conviction by dominant supplier countries (notably the United States) that safeguards were working reasonably well and that the steady advancement of commercialised nuclear energy should not be interrupted, contributed to a sense of international complacency about the safeguards issue. From 1974 onwards, several factors have again raised the priority of nuclear safeguards.

Firstly, the economic impact of the 1974 oil shock - coupled with the political effects of India's nuclear explosion that year - created strong pressures on the one hand to increase world-wide reliance on nuclear power and, on the other, to further restrict the availability of weapons-grade materials.

Secondly, the warning that oil reserves were finite, been paralleled by similar fears about future enriched uranium supplies. As well as Brazil and Pakistan, a number of other countries showed strong interest in obtaining fuel reprocessing plants or other facilities which would give them access to weapons grade fuel. Several states sought to break the supplier nations' stranglehold on various links in the energy chain (see annex 1). European nations and Japan (as well as South Africa) were working on their own enrichment facilities, spurred on by American refusal to release details of its enrichment process and, most significantly, the commercial application of new generations of "liquid metal fast breeder reactors" (which would be fuelled by plutonium) and "high temperature gas-cooled reactors" (using weapons grade uranium) was approaching. Very briefly, traditional nuclear power reactors of the type supplied by the USA and European nations consume low-enriched uranium which cannot be used to produce bombs. As an end product they turn out plutonium, which can, as India demonstrated, be used for bombs. However, in the relative absence of reprocessing facilities, and with the aid of IAEA accounting methods, it is possible to remain fairly confident that this plutonium will not end up in

illegal weapons. The widespread use of uranium enriched to a level where it could be used to make bombs, or of plutonium fuel which does not require reprocessing before being used in weapons creates a vastly greater risk of weapons proliferation (these technical aspects are dealt with fully in the annex).

From its inception, the IAEA had been associated with the 'Atoms for Peace' ideal of helping to make nuclear materials and information freely available for peaceful purposes. Because it was established to oversee the orderly transfer of goods which previously had been denied to all but a few states, its safeguards function initially was seen as auxiliary to this role. In accordance with its status as a United Nations organ recipient countries still tend to regard the Agency as a forward-looking champion of impartial nuclear development. This attitude is likely to be reflected within the IAEA, as its staff consists typically of permanent officials who have had a lengthy technical association with the development of nuclear power in their own countries.

A 1975 conference to review the NPT (provision for such a review after five years to consider the operation of the Treaty "with a view to ensuring that the purposes of the Preamble and the provisions of the Treaty are being realised" exists in Article VIII.3 of the NPT) tended to bring this position to the surface. The need to continue to update safeguards to meet new technical challenges was the dominant theme of the conference, with virtual consensus being reached on the value of improved methods and techniques, the need for effective export controls, and the desirability of IAEA safeguards being made applicable with the greatest possible uniformity. Very little attention was given to the new threats being presented by the developments outlined above (impending reliance on weapons grade fuels, etc).

Perhaps because they were conscious of the Agency's bias, the supplier nations deliberately by-passed the IAEA (and the UN) when they initiated a series of "secret" meetings, beginning in London in 1975. Official comment when these meetings eventually came to light was that they were directed towards

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the drafting of strict new rules to govern future technology exports*. It soon became apparent that nations involved - the 'London Group' - were, in effect, rejecting the assumption that the NPT had created a safeguards regime which was sufficiently effective to remove any reasonable risk of weapons proliferation.

The London Group has formulated its own list of conditions under which various established IAEA procedures are to be applied, under Agency scrutiny, to the trade and application of nuclear materials and technology. This is aimed at plugging a number of the gaps in the NPT system**. In January 1978 the supplier countries submitted uniform "Guidelines" to the IAEA setting forth their safeguards conditions. This move confirmed that the London Group's activities will be supportive of the IAEA safeguards system, and are not a move away from it. However, it also means that the agreed "balanced obligations" system accepted by NPT signatories has been superceded in some areas. Also, the intrusive aspects of IAEA safeguards have been increased.

Members of the group (i.e. the USA, USSR, UK, Canada, France, W. Germany, E. Germany, Belgium, Czechoslovakia, Italy, Japan, Netherlands, Poland and Sweden) have agreed to submit all nuclear material and equipment they might export to established IAEA safeguards, and to ensure that any facility based on knowledge they might export (even in non-NPT countries) will be subject to such safeguards also. Recipient states are to be required to protect their nuclear facilities and material in the light of existing IAEA recommendations for physical protection (these are reproduced in the IAEA's INFCIRC/225 of February 1976), and a nuclear materials "blacklist" has been created involving items

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* Mr James Callaghan, British Parlt Debates, 31 March 1976, p.516

** The United States, as a prime mover of the NPT negotiations, had been forced to accept what its chief negotiator considered "less than satisfactory" IAEA safeguards and book-keeping systems in 1970 in order to obtain widest possible ratification of the Treaty. West Germany and Japan for example had both been insistent that the far more rigorous systems proposed by the Americans would be unacceptable.

that can only be supplied under exceptional guarantees. Most importantly, Group members have given their support to a new system of enforcement: it is implied that states failing to adhere to the safeguards rules (e.g. by withdrawing from the NPT when they have what they want) will face a collective boycott from all nuclear suppliers*.

As well as pointing to the inadequacies of the NPT, the London Group's initiatives demonstrate that it is easier for the advanced nations, with their supply monopoly, to dictate terms to the rest of the world than it is for these to be set by international law, despite the near-consensus that non-proliferation is a worth-while and highly important aim.

The IAEA, as an international agency, has proved well-suited to drawing up technical lists of safeguards and administering these but has had little influence on the extension of such safeguards to new or sensitive areas. Initiatives from its parent body - the UN - have been valuable in confirming international mores and in providing (with the NPT) a framework of commitments which, once established, can be progressively extended to cover all nations and eventualities. However, as India's example demonstrated, the lack of effective and certain sanctions can mean that these commitments are not effective without additional support from the supplier nations. In the absence of such support, it is possible that they create a deceptive sense of security among the vast majority of "law-abiding" states, obscuring the reality that the few exceptions they allow (countries - like Israel, South Africa, India, Pakistan - which refuse to sign the NPT for example) include those areas where abuses are most likely to occur.

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* See NLB No 18, Dec 1975, p.63 for a partial account of the London group's stance. A related unilateral move has been the US 'Symington Amendment, which threatens to cut off all economic and political aid to any nation violating safeguards agreements.

10. The Post-London Group Era

The secrecy surrounding the processes of the London Group prevents firm developments from being identified. However, it is significant that the number of states which have ratified the NPT suddenly proliferated in 1976/77 (from 75 in December 1974 to 103 as at February 1978 - the number had remained constant for several years). The US/USSR grouping appears to have been able to persuade all major nuclear suppliers to conform with its tightened safeguard demands, and a total US freeze on the commercialisation of fuel reprocessing seems to have encouraged a slow-down in developments in this area internationally. Latest developments within the London Group are reported to be directed towards the establishment of IAEA controlled multi-lateral centres for reprocessing, and towards the establishment of leasing or buy-back arrangements to cover all fuel supplies to non-nuclear states.

The United States, as spokesman for the conservative nuclear suppliers, is now stressing that mere possession of plutonium is an evil to be avoided:

> "...the basic orientation of the international safeguards system, therefore, is a diversion from the ultimate problem, which I would define as ... a world with vast national ... stores of plutonium." *

It would seem that, if these trends continue, the IAEA will be increasingly involved in ensuring that plutonium is removed from national control.

As well as restraints on the availability of equipment for fuel reprocessing, the USA - in particular - has delayed commercial application of its fast breeder programme until fail-safe controls

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* P.Leventhal, in Columbia Journal of Transnational Law, 1976 Vol. 16, p.453.

can be worked out. Both of these moves serve to deny would-be recipients access to nuclear equipment, and therefore appear to violate Article IV of the NPT. The United States argues that "...so long as it is temporary ... restraint is consistent with the fact that under the Treaty, we also undertake to avoid steps that would lead to the spread of nuclear weapons"* (i.e. Article I) Other recent American initiatives have included a declaration that all states receiving US material or equipment must place their nuclear facilities under safeguards. In April 1978 the Carter administration froze all nuclear fuel exports to the EEC indefinitely, on the grounds that the Community's continuing programme to reprocess spent fuel was incompatible with US policies.

One frequent criticism of these 'denial" strategies is that they encourage eventual proliferation by forcing thwarted importers to develop their own nuclear manufacturing facilities. This is essentially what happened in Europe during the 1950s and 1960s. Another, related, criticism is that the political price is very high compared with the limited results that can be expected. Nevertheless, some notable developments have occured since the new era of greatly increased caution and concern was ushered in by the nuclear conservatives. In Decenber 1976 France announced that it would cease exporting reprocessing plants, and Germany made a similar undertaking in June 1977.

Ultimately, countries denied access to reprocessing and other facilities are likely to design their own, and the current phase in the development of safeguards can therefore be viewed as a race to evolve systems which will make such sensitive areas of the fuel cycle as safe as those which are not subject to denial strategies.

In October 1977 a US-sponsored study, the 'International Nuclear Fuel Cycle Evaluation' (INFCE) was initiated. This

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* J.S.Nye 'Nonproliferation: A Long-Term Strategy' in Foreign Affairs April 1978, pp 610/611

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is working towards a new system of nuclear cooperation involving international fuel stockpiles and spent fuel repositories, international enrichment facilities, and international reprocessing facilities.

It is not clear what, if any, relationship the INFCE will have with the IAEA. However, its objectives appear complementary to those of the Agency, and imply a continuing and expanding role for safeguards. Essentially it is an attempt by the nuclear powers to build a consensus with the non-nuclear ones and to minimise the trend towards confrontation caused by the current policies of restricting supply.

Conclusion

The development of the present safeguards system essentially reflects an overwhelming desire by those world powers which possess nuclear weapons, supported by their allies, to deny these to other nations. As a corollary to having this objective enshrined in international law they have been prepared to offer various concessions. However, where it has become evident that these concessions could eventually contribute to nuclear proliferation, they have been hastily withdrawn.

Among the nuclear recipients is a significant body of states which do not necessarily have the same perception of nuclear proliferation as that of the nuclear 'haves'. A primary purpose of the various safeguards regimes is to ensure that these nations are not able to deviate from the attitudes and codes of behaviour dictated by the dominant group. While the desirability of curbing the spread of nuclear weapons appears superficially to be an established international more the very stringency of the present nuclear safeguards is tacit recognition that those states whose strategic situation could benefit from a nuclear arsenal are very likely to attempt to acquire one.

Annex 1.

Nuclear Power Generation Technology.

1. Nuclear Fission

Uranium, the basic fuel of the present generation of nuclear power reactors, occurs as a mixture of two main 'isotopes' or elemental forms with identical chemical but significantly different physical properties. One of these isotopes (U-235) makes up only 0.77% of natural uranium (which is primarily U-238) but it is this rare form which is consumed in nuclear reactors. Extraction of the U-235 is by far the most difficult and expensive stage in the production of nuclear fuel elements and, at present, only the U.S.A., USSR and China have been able to do this commercially. This means that, while uranium ore is found in a large number of countries, only the three dominant military powers are able to produce U-235.

In practise, although atom bombs require uranium which has had its U-235 content "enriched" up to 90% or more ("weapons grade" uranium), most nuclear power stations are designed to operate at an enrichment level of only about 3% U-235 (enrichment even to this level requires virtually the same facilities as those required to produce weapons grade uranium). However, when U-235 mixed with large quantities of ordinary uranium undergoes fission in a nuclear power reactor it converts much of this into plutonium, a separate element which is itself very suitable for the production of nuclear weapons. Separation of plutonium from the other end-products of uranium fission is considerably more simple than uranium enrichment, and the number of countries possessing the facilities to do this is increasing fairly rapidly.

2. Nuclear Reactors

There are two main types of nuclear power reactor in commercial operation at present: the so-called "light water reactors" (LWRs), which are produced in the U.S.A. and Europe; and "heavy water reactors" (HWRs) which are marketed by Canada. The essential difference between the two types is fuels: LWRs require uranium which has been enriched to about 3% U-235, whereas HWRs are able to use natural uranium. A third type of reactor, the " high temperature gas - cooled reactor" (HTGR), which is undergoing extensive development in the U.S. and Europe, consumes weapons grade (90% enriched) uranium and is likely to become considerably more common within the next decade.

The relative efficiency of the various types of reactor is of considerable significance to any country endeavouring to obtain nuclear power generating facilities, and is directly related to the degree of enrichment of the fuel. HWRs, using natural uranium, are able to extract only about 1% of the energy theoretically available. LWRs have a higher net efficiency (about 32%), while HTGRs are able to achieve a net efficiency of 40%. An important consideration bearing on efficiency is the size of the reactor, as controls in the U.S. and some other countries limit most reactors to a maximum fission rate of 3800 Mw. This means that the largest LWR available will only be able to supply purhaps 1200 Mw (about 32% of 3800) whereas a HTGR of the same size would would be able to produce 1500 Mw$ of electricity.

Each type of reactor produces a different range of end products, and not all of these are suitable for the manufacture of nuclear weapons. As mentioned above, LWRs (which use "safe" low - enriched uranium) produce large quantities of plutonium, the principal ingredient in most nuclear weapons. HWRs, using equally safe natural uranium, also produce plutonium. On the other hand, HTGRs (using

weapons grade uranium) consume their fuel completely and do not produce any fissionable end products.

3. Nuclear Fuel Cycles

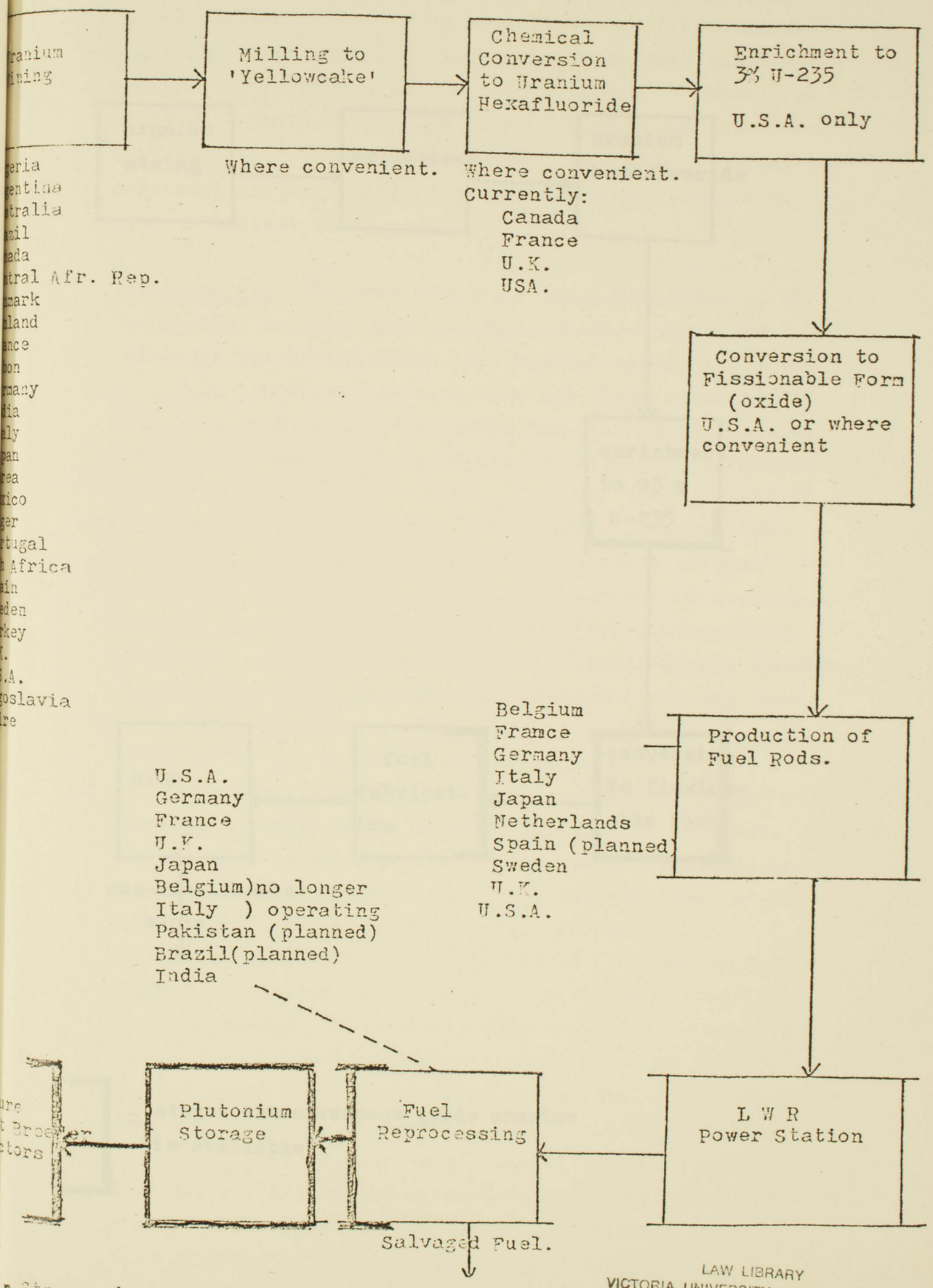
While the three dominant military powers have a monopoly only over uranium enrichment, there are several other stages in the production of nuclear reactor fuel where [illegible] smaller countries have been denied access to essential technology. Also, there are certain areas in the nuclear fuel production/utilisation cycle where weapons grade materials become available, and where the supplier nations (and the international community) have an interest in imposing stringent controls.

Uranium ore is normally concentrated to "yellowcake" (crude uranium oxide) in the country where it is mined. This is a very simple process. The next stage in the production of pure uranium is also simple, and involves the digestion of the yellowcake to obtain uranium hexafluoride. Enrichment of gaseous uranium hexafluoride id the third, and most difficult, step. Other stages involving advanced technology are the production of fuel rods and the reprocessing of spent fuel to separate unused U-235 from the plutonium end product.* All stages may be shown diagramatically as follows:

Footnote: * A further stage in the cycle, "liquid metal fast breeder reactors" (LMFBRs) is now being developed. These will consume plutonium produced by LWRs, and large quantities of plutonium now in storage will be disposed of in this way. The first experimental LMFBR came on stream in the USSR in 1972 but France and the U.K. are now the world leaders in this field, with commercial plants planned for the early 1980's (both countries are actively soliciting orders). Japan and F.R. Germany are also believed to be ahead of the U.S.A. in this field but all three countries are working on demonstration plants.

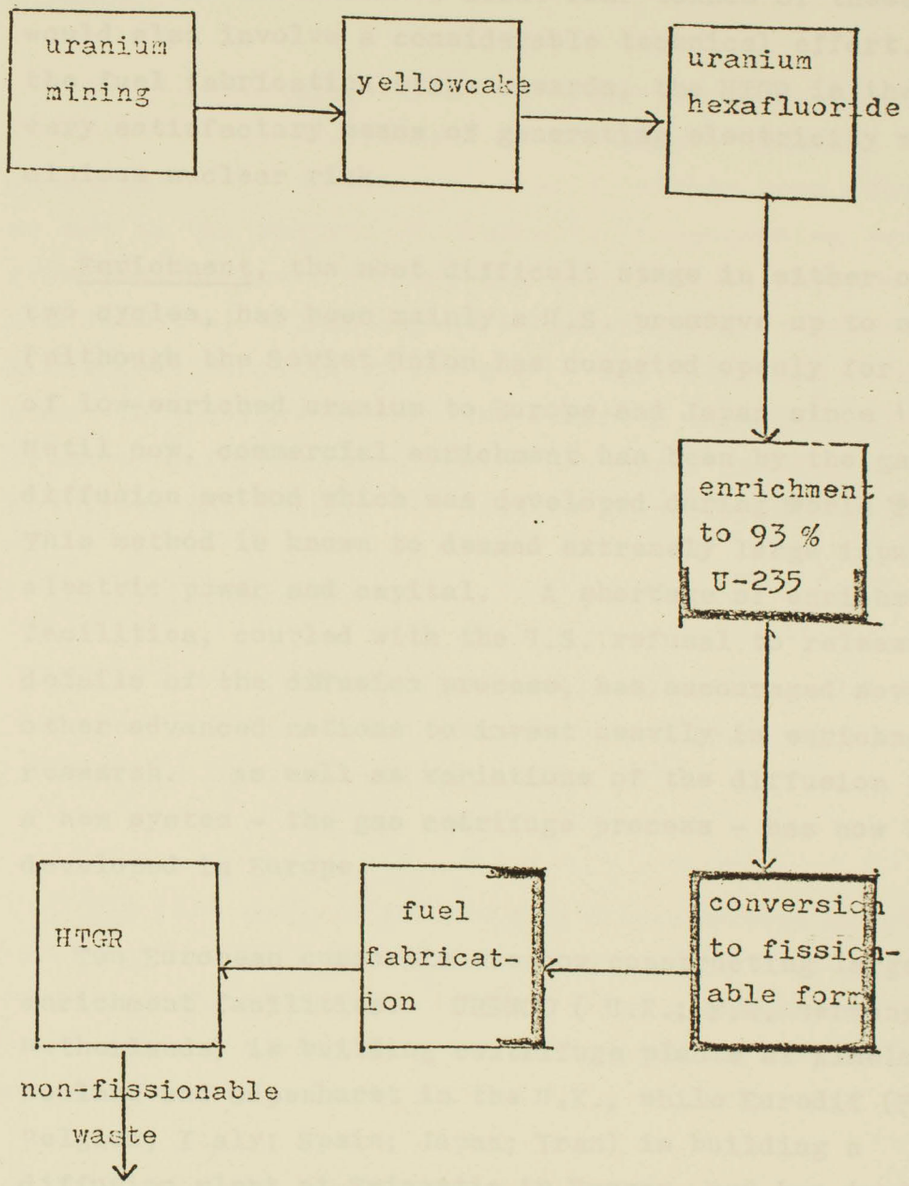
Light Water Reactor Fuel Cycle

(non-communist countries)



* Stages where weapons-grade material is available.

The development of HTGRs has been held back by U.S. reluctance to divert or export weapons grade uranium but several European firms have produced working reactors, and an American firm - the General Atomic Co.- manufactures these for the domestic market. The HTGR fuel cycle is as follows:



[ ] = stages where weapons grade uranium is available.

Although HTGRs use highly enriched U-235, in practise this is diluted with a number of inert products (graphite, silicon carbide, thorium) at the fuel fabrication stage. To recover about 15Kg of weapons grade U-235 (enough for a nuclear bomb) from HTGR fuel rods reportedly would involve the diversion of about four tonnes of these, and would also involve a considerable technical effort. From the fuel fabrication stage onwards, the HTGR is therefore a very satisfactory means of generating electricity with minimum nuclear risk.

Enrichment, the most difficult stage in either of the two cycles, has been mainly a U.S. preserve up to now (although the Soviet Union has competed openly for sales of low-enriched uranium to Europe and Japan since 1972). Until now, commercial enrichment has been by the gaseous diffusion method which was developed during World War II. This method is known to demand extremely large inputs of electric power and capital. A shortage of enrichment facilities, coupled with the U.S. refusal to release details of the diffusion process, has encouraged several other advanced nations to invest heavily in enrichment research. As well as variations of the diffusion process, a new system - the gas centrifuge process - has now been developed in Europe.

Two European consortia are now constructing large enrichment facilities. URENCO (U.K.; F.R. Germany; Netherlands) is building centrifuge plants at Almelo in Holland and Capenhurst in the U.K., while Eurodif (France; Belgium; Italy; Spain; Japan; Iran) is building a diffusion plant at Tricastin in France, and has tentative plans for a second installation. Both groups hope to be in production by the early 1980's. South Africa is constructing a small enrichment plant based on what is claimed to be local technology, and several other countries (Brazil, Japan, Iran, Australia) have all shown interest in having their own enrichment facilities, depending upon their abilities to attract foreign technology and (in the case of Brazil and Australia) capital.

Fuel element fabrication does not demand advanced technology or massive capital investment but does require a skilled work force and very strict quality control. At least nine non-communist countries have been able to manufacture fuel elements, and Spain is now establishing a plant.

Fuel reprocessing units are manufactured by the U.S., France, F.R. Germany, the U.K. and Japan. Several other countries (Pakistan, Brazil) either have obtained, or are in the process of obtaining, reprocessing equipment from the supplier nations, and recent press reports indicate that Taiwan may have either built or purchased a clandestine plant of its own. Any efficient reprocessing plant is believed to have the capacity to handle the fuel from up to forty nuclear power stations, meaning that few countries can justify the expense in purely economic terms.

4. Nuclear Explosions

There are three main fissionable materials which are known to be suitable for the production of nuclear weapons: two isotopes of uranium, and plutonium.

U-235 (the naturally-occurring minor isotope which must be concentrated in the enrichment process). For practial purposes, the minimum enrichment level necessary to produce U-235 for a nuclear explosion would probably be around fifty percent (when about 50 Kg would be required).

U-233. This isotope can only be obtained in special nuclear reactors. It always contains quantities of a third isotope which is highly radioactive, and is extremely dangerous and difficult to work with. For these reasons, and because of its scarcity, it is not considered in this paper.

Plutonium is produced in the vast majority of commercial power reactors. It is not dangerous to work with (i.e. it isn't dangerously radioactive but is very poisonous). The critical mass of plutonium needed to produce a nuclear

explosion is believed to be about 8 Kg, or half that of pure U-235.

While much of the information on nuclear weapon manufacture remains classified, a large number of texts claim that this is a relatively simple procedure which is well within the capabilities of most nations (e.g. "Under conceivable circumstances, a few persons, possibly even one person working alone, who possessed about ten kilograms of plutonium oxide and a substatial amount of chemical high explosive could, within several weeks, design and build a crude fission bomb" - Willrich & Taylor, pp. 20/21).

Essentially, a nuclear explosion appears to result when any one of the three fissionable materials mentioned above reaches "critical mass", i.e. a size where the number of neutrons (radioactive decay particles) passing through a given volume of plutonium or uranium is sufficient to set off a chain reaction. A number of refinements exist to reduce the quantities of uranium or plutonium required. These include compression inside an ordinary chemical explosion, and encasing the nuclear material in a "reflector" of some sort. Such techniques are believed to allow nuclear weapons containing as little as 4 Kg of plutonium to be manufactured, and it is probable that research has (or will) reduced the quantities required even further.

The average LWR produces about 200 Kg of plutonium annually, and it is estimated that between 15 000 and 20 000 Kg of plutonium will be in storage in the U.S. alone by 1977. The quantity of fissionable material which would need to be diverted from a nuclear reactor by a government intending to produce a nuclear weapon is therefore comparitively small.

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