UNITED
NATIONS

A

General Assembly

Distr.
GENERAL

A/38/337
7 October 1983

ORIGINAL: ENGLISH

Thirty-eighth session
Agenda item 28

ARMED ISRAELI AGGRESSION AGAINST THE IRAQI NUCLEAR INSTALLATIONS AND ITS GRAVE CONSEQUENCES FOR THE ESTABLISHED INTERNATIONAL SYSTEM CONCERNING THE PEACEFUL USES OF NUCLEAR ENERGY, THE NON-PROLIFERATION OF NUCLEAR WEAPONS AND INTERNATIONAL PEACE AND SECURITY

Study on the consequences of the Israeli armed attack against the Iraqi nuclear installations devoted to peaceful purposes

Report of the Secretary-General

1. In its resolution 37/18 of 16 November 1982, the General Assembly requested the Secretary-General to prepare, with the assistance of a group of experts, a comprehensive study on the consequences of the Israeli armed attack against the Iraqi nuclear installations devoted to peaceful purposes. Pursuant to that resolution, a group of experts was appointed by the Secretary-General to make a comprehensive study on the consequences of the Israeli armed attack against the Iraqi nuclear installations.

2. On 15 July 1983, the Group of Experts on the Consequences of the Israeli Armed Attack against the Iraqi Nuclear Installations submitted its study to the Secretary-General. The study is annexed to the present document.

ANNEX

Study of the Group of Experts on the Consequences of the Israeli Armed Attack against the Iraqi Nuclear Installations

CONTENTS

CONTENTS (continued)

APPENDICES

LIST OF FIGURES

FOREWORD BY THE SECRETARY-GENERAL

1. The attached study was prepared by a group of experts who were appointed by the Secretary-General to assist him in carrying out a comprehensive study on the consequences of the Israeli armed attack against the Iraqi nuclear installations devoted to peaceful purposes, as requested in paragraph 8 of General Assembly resolution 37/18 of 16 November 1982.

2. The Group of Experts on the Consequences of the Israeli Armed Attack against the Iraqi Nuclear Installations has submitted its study to the Secretary-General. In implementation of its mandate, the Group of Experts considered both the direct, site-related consequences and the implications of the precedent that was set by the Israeli attack.

3. The Secretary-General wishes to thank the Group of Experts for its comprehensive study. In this connection, it should be noted that the analysis contained therein is that of the experts and that, because of the complexity of the subject-matter, the Secretary-General is not in a position to pass judgement on all aspects of the work accomplished by the experts.

LETTER OF TRANSMITTAL

15 July 1983

Sir,

I have the honour to submit herewith the study by the Group of Experts on the Consequences of the Israeli Armed Attack against the Iraqi Nuclear Installations, which was appointed by you in pursuance of paragraph 8 of General Assembly resolution 37/18 of 16 November 1982.

The Experts appointed by you were the following:

Mr. Bo G. LINDELL
Adviser, Swedish National Institute of Radiation Protection
Stockholm, Sweden

Mr. Milan OSREDKAR
Professor, Jozef Stefan Institute and the Edvard Kardelj University
Ljubljana, Yugoslavia

Mr. Nikolai A. TITKOV
State Committee on Atomic Energy of the USSR
Moscow, Union of Soviet Socialist Republics

Mr. Kalyan G. VAIDYA
Consultant
New York
(former Ambassador and leader of the Indian delegation to the Conference on International Economic Co-operation, Paris 1976-1977)

Mr. Charles N. VAN DOREN
Consultant
Washington, D.C., United States of America
(former Assistant Director for Non-Proliferation, United States Arms Control and Disarmament Agency)

Mr. A. Bolaji AKINYEMI
Director-General
Nigerian Institute of International Affairs
Lagos, Nigeria
Professor of Political Science
University of Lagos
Lagos, Nigeria

His Excellency
Mr. Javier Pérez de Cuéllar
Secretary-General of the United Nations
New York

/...

The study was prepared between April 1983 and July 1983. The Group held two sessions, from 18 to 22 April 1983, at Vienna, and from 11 to 15 July 1983, in New York.

The members of the Group of Experts wish to express their appreciation for the valuable assistance they received from members of the Secretariat of the United Nations. They wish, in particular, to convey their thanks to Mr. Shigeo Iwai and Ms. Beng-Yong Chew, who served as Secretary to the Group, and Mr. Giovanni Silini, Secretary of the United Nations Scientific Committee on the Effects of Atomic Radiation.

They also wish to express their appreciation to the International Atomic Energy Agency and the Government of Iraq for providing the Group with valuable information and material.

I have been requested by the Group of Experts to submit to you on its behalf its study, which was unanimously approved.*

Accept, Sir, the assurances of my highest consideration.

(Signed) A. Bolaji AKINYEMI
Chairman of the Group of Experts on the
Consequences of the Israeli Armed Attack
against the Iraqi Nuclear Installations

---

* Subsequent to the approval of the study by the Group of Experts, on 15 July 1983, one member of the Group, Mr. Charles N. Van Doren, in a communication dated 18 July 1983 to the Secretary-General, informed the latter that, after carefully rereading the final text of the study, he felt compelled t change his position on the question of its approval to an abstention. Mr. Van Doren also requested that this fact be reflected in the Secretary-General's report to the General Assembly.

I. INTRODUCTION

1. On 7 June 1981, 14 Israeli airforce planes - 6 F-15 fighter escort planes and 8 F-16 bomber airplanes - bombed and caused severe destruction to the Iraqi nuclear installations devoted to peaceful purposes and located at the Tuwaitha Nuclear Research Centre near Baghdad.

2. The intensity of the reaction of the world community can be gauged from the debate by the Board of Governors of the International Atomic Energy Agency (IAEA); the General Conference of the IAEA, which debated the issue at its twenty-fifth and twenty-sixth regular sessions; the Security Council, which debated the issue from 12 to 19 June 1981; and the General Assembly, at its thirty-sixth session, which took up the issue from 11 to 13 November 1981.

3. The consideration by those bodies led to the adoption of a number of resolutions, which are discussed below.

4. So intense was the concern shown by the world community to the Israeli attack that Ambassador Muñoz Ledo of Mexico, who presided over the debate in the Security Council declared:

> "Few times in the life of the Council have more than 50 speakers come to consider an item. Few times have so many voices been raised to express the same things: alarm, indignation and condemnation." (S/PV.2288 of 19 June 1981, p. 42)

The intensity and extent of the reaction had to do with the fact that the consequences of the Israeli armed attack had a bearing on so many aspects of the preoccupations of the United Nations and other international agencies.

5. This study was prepared in accordance with the request of the General Assembly in paragraph 8 of its resolution 37/18 of 16 November 1982 and deals with the consequences of the Israeli armed attack against the Iraqi nuclear installations devoted to peaceful purposes.

6. In the light of its mandate for a comprehensive examination of the consequences of the attack, the Group studied not only the direct, site-related physical, technical, economic and health consequences of the attack, but also the more general political, legal, economic, technical and health consequences and implications of the precedent set by the attack - which the Group considers even more significant.

7. The Group has sought to avoid, as beyond its mandate and competence, an unnecessary duplication of the political judgements already made by the Security Council, the General Assembly, the Board of Governors and the General Conference of IAEA, and the many Governments participating in the deliberations of those bodies on this subject. Such judgements were reflected in Security Council resolution 487 (1981), which was unanimously adopted and in the resolution of the Board of Governors of IAEA, adopted on 12 June 1981 by a majority vote (see S/14532). The following General Assembly resolutions, adopted by majority votes, also expressed such judgements:

(a) Resolution 36/27 in which the Assembly issued a solemn warning to Israel to cease its threats and the commission of such armed attacks against nuclear installations; and reiterated its call to all States to cease forthwith any provision to Israel of arms and related material of all types which enabled it to commit acts of aggression against other States;

(b) Resolution 37/18, in which the Assembly strongly condemned Israel for the escalation of its acts of aggression in the region; demanded that Israel withdraw forthwith its officially declared threat to repeat its armed attack against nuclear facilities; and requested the Security Council to consider the necessary measures to deter Israel from repeating such an attack;

(c) Resolutions 36/87 and 37/75 on the establishment of a nuclear-weapon-free zone in the region of the Middle East;

(d) Resolution 37/19, in which the Assembly considered that Israel's threat to repeat its attack against nuclear facilities as well as any other armed attack against such facilities constituted, inter alia, a serious threat to the role of IAEA in the development and further promotion of nuclear energy for peaceful purposes;

(e) Resolution 37/99 C, in which the Assembly requested the Committee on Disarmament to continue its search for a solution to the question of prohibition of military attacks on nuclear facilities.

At the twenty-fifth session of the General Conference of IAEA, the Conference decided to suspend immediately the provision of any assistance to Israel under the Agency's technical assistance programme and called upon the Member States of the Agency to end all transfer of fissionable material and technology to Israel which could be used for nuclear arms (GC(XXV)/RES/381). At the twenty-sixth session of the Conference, the possibility of the suspension of Israel from the exercise of the privileges and rights of membership in the Agency was discussed; at the same session, the Conference did not recognize the credentials of the Israeli delegation (see GC(XXVI)/OR.246).

8. It should be noted that Israel persistently refuses to comply with the provisions of the General Assembly and Security Council resolutions referred to in paragraph 7.

9. The attack took place in the highly volatile Middle East which, since 1948, has been the subject of numerous United Nations resolutions, including, inter alia, General Assembly resolution 37/123 A on the situation in the Middle East.

10. Iraq is a party to the Treaty on the Non-Proliferation of Nuclear Weapons (General Assembly resolution 2373 (XXII), annex) and the limited test-ban Treaty (Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and under Water), 1/ and has placed all its nuclear activities under IAEA safeguards. Israel has not signed the non-proliferation Treaty nor accepted IAEA safeguards on certain of its most sensitive nuclear activities (see A/36/431, annex, "Report of the Group of Experts to Prepare a Study on Israeli Nuclear Armament") but is a party to the limited test-ban Treaty. Neither country has signed the 1977 Protocol I Additional to the Geneva Conventions of 12 August 1949 (see A/32/144, annex I, and appendix I to this report).

II. FACTUAL BACKGROUND; SAFEGUARDS AND THEIR IMPLEMENTATION

A. Factual background

11. In 1956 the Iraqi Nuclear Energy Commission established two centres for medical uses of radioisotopes. In the mid-1960s the Tuwaitha Nuclear Research Centre was established some 25 kilometres south-south-east of Baghdad. The centre site includes the older reactor building with laboratories, shops and storage facilities and the new reactor building with adjacent laboratories that were in the final stage of construction at the time of the attack.

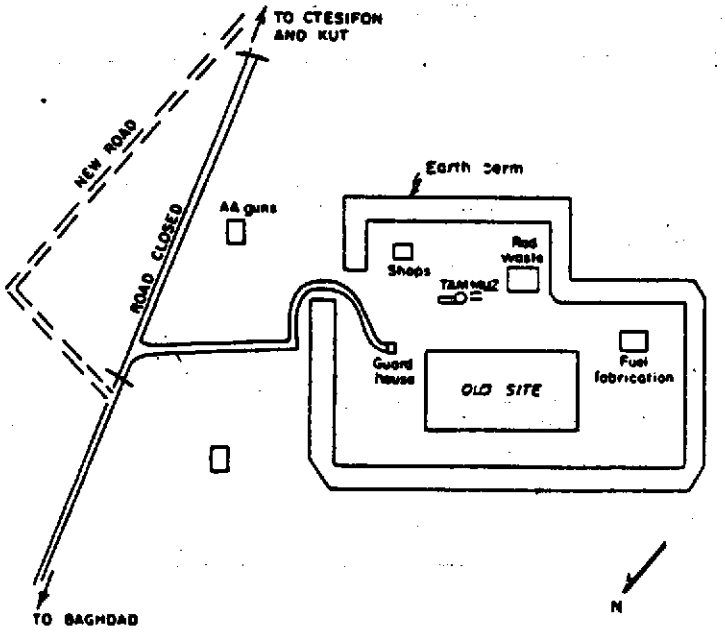

Figure I. Sketch of the Tuwaitha Nuclear Research Centre. 2/

12. The old reactor IRT-2000 is a pool-type, light-water-moderated research reactor supplied by the Soviet Union. It began operation in 1967. Its thermal power was originally 2 MW (megawatts) but was upgraded to 5 MW in 1979. It is using fuel elements of enriched uranium. The enrichment was originally 10 per cent and 36 per cent; later, when the power was upgraded, fuel with enrichment up to 80 per cent was used. The amount of 80 per cent enriched uranium was about 15 kg (kilograms).

13. In the area where the IRT-2000 is located, there is also a storage of natural and depleted uranium and a storage of yellowcake.

14. The new reactors were Tammuz-1, a 40 MW tank-pool-type research and material-testing reactor and Tammuz-2, a 500 kW (kilowatts) pool-type research reactor facility. The fuel for these reactors contains 93 per cent enriched uranium.

15. Both reactors were built by the French and were copies of the French reactors Osiris and Isis, except for the power of Osiris, which is 70 MW, while Tammuz-1 had a lower power of 40 MW. Also, the reactor building with adjacent laboratories and rooms was very similar to the Osiris building.

16. The Tammuz-2 (Isis) was a neutron mock-up of the Tammuz-1 core and both reactors were linked by a water channel allowing for safe transportation of irradiated fuel from one reactor to the other, or to the hot cells (located between the two reactors) for investigations on irradiated experimental pressurized-water-reactor fuel. The Tammuz-1 reactor core had 8 x 7 grid positions, all visible, for fuel elements, control elements, irradiation channels and reflector rods. Thirty-nine fuel elements containing around 12 kg of uranium were supplied for the Tammuz reactors. Of those, one fresh fuel element was located in a rack in the reactor hall, while 38 irradiated fuel elements were in the pool of the Tammuz-2 reactor.

17. Around the IRT-2000 reactor there are laboratories equipped for research in several fields, such as:

(a) Neutron physics;

(b) Solid state physics;

(c) Theoretical physics;

(d) Isotope production and labelled compounds;

(e) Radiochemistry;

(f) Radiology;

(g) Isotope applications in agriculture, biology, medicine, etc.

18. Some of the research equipment related to the reactor are: neutron capture gamma ray detection and measurement with GeLi and NaI counters; a double-axis computer-controlled neutron-diffraction spectrometer; a rabbit tube for short-lifetime isotope production and activation analysis. In laboratories, various nuclear applications were studied, such as use of tracer isotopes in soil physics to study the migration of radio-nuclides in soil, studies of water-use efficiency and moisture measurements.

19. Research was also done on some projects, jointly with research centres in other countries and with IAEA. Most of that research has been published in scientific reports.

20. For some experimental work, higher neutron flux and more experimental room and facilities inside and out of the reactor than those offered by the IRT-2000 are desired or required, since in reactors with lower neutron flux such experiments might become scientifically uncompetitive or even impossible. Also, in connection with the envisaged Iraqi acquisition of a nuclear power plant of a pressurized-water-reactor type, facilities for engineering experiments and training, which the IRT-2000 does not have, were required.

21. Therefore, the new reactor Tammuz-1 was to have significantly higher neutron flux and more research facilities. Besides experimental space and beam holes, it also was to have attached to the core, a heavy-water-moderated tank with a liquid hydrogen thimble for "cold neutrons" production. Along the cold neutrons beam, outside the reactor containment and on the core level that was below the earth's surface, a big hall was located for neutron experiments, equipped with a bridge crane for moving the experimental equipment. This facility, combined with the high neutron flux, offers improved conditions for research for example, with neutron diffraction or with polarized neutrons. On the opposite side of the core, space for engineering tests was provided, in particular, a test loop for testing small sections of fuel elements, such as are being used in pressurized-water reactors. The Tammuz-2 reactor, being a neutron mock-up of the Tammuz-1, offered a number of possibilities for the measurement and testing of many reactor physics data, under conditions as realistic as in the Tammuz-1 reactor in operation, without using that reactor, which is a complex and expensive facility, not to be used for low-power work.

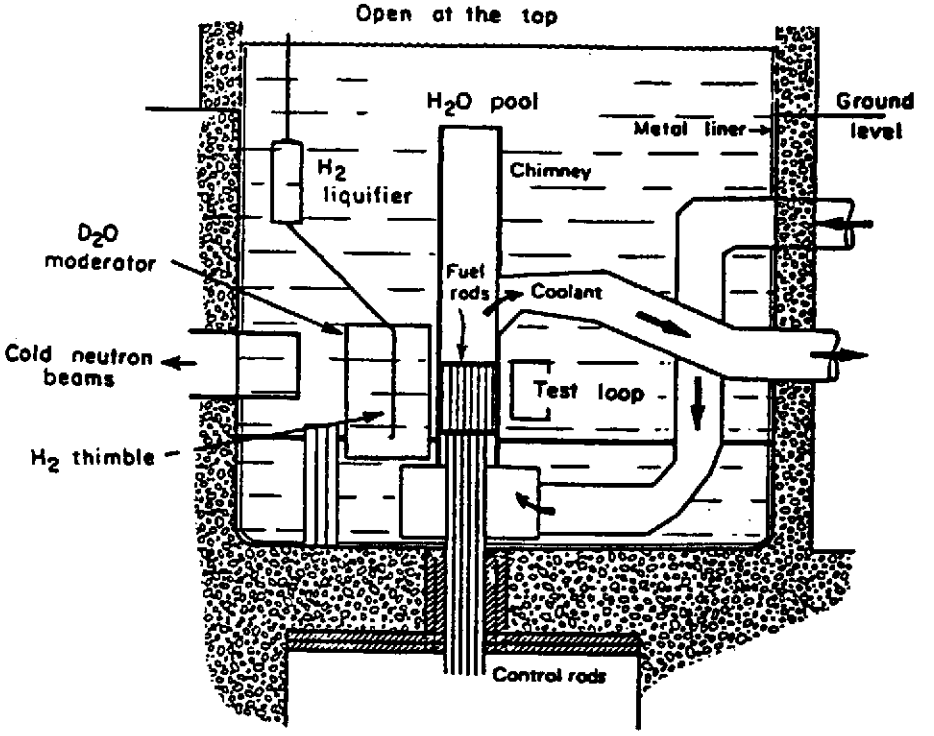

Figure II. Vertical section of the Tammuz-1 reactor. 3/

/...

22. In summary, the new Tammuz reactors offered significant additional possibilities for research and development. Particularly, they would have improved possibilities for material sciences related to fundamental research as well as for development of expertise related to nuclear power and particularly to the envisaged pressurized-water-reactor programme.

23. The Tuwaitha Nuclear Research Centre includes a pressurized water-reactor fuel fabrication laboratory intended for training, supplied by an Italian firm, with a capacity of the order of magnitude of several hundred kilograms yearly. It is equipped to produce UO_2 ceramics only, pressing and sintering it into pellets and placing them in zircalloy cladding, cutting and redissolving defective rods and similar tasks.

24. There is also a radioactive-waste laboratory equipped for treatment of wastes and encapsulation in concrete.

25. The Tuwaitha Nuclear Research Centre used to employ around 500 scientists, engineers and technicians before the attack. It is co-operating in university training and research, particularly in training nuclear engineers and in post-graduate research in several fields.

B. Safeguards and their implementation

26. Iraq has been a party to the non-proliferation Treaty since it came into force in 1970. In accordance with that Treaty, Iraq has accepted IAEA safeguards on all its nuclear activities.

27. The three research reactors and separate storage where natural and depleted uranium are stored have been placed under IAEA safeguards. Inspections by IAEA at the nuclear facilities in Iraq began in May 1973, after Iraq had concluded safeguards agreements with IAEA. On the basis of the inspections made, including the last inspection, in January 1981, made before the Israeli attack, the IAEA reported that all nuclear material was satisfactorily accounted for and that Iraq had fulfilled its obligations under IAEA safeguards pursuant to the non-proliferation Treaty to the satisfaction of IAEA. Following the attack, IAEA made an immediate inspection on 18 June 1981. It followed this with a further inspection, made from 15 to 17 November 1981; no non-compliance with the safeguards agreements concluded between Iraq and IAEA was revealed (see IAEA PR 81/32 of 19 November 1981).

28. The IAEA safeguards system and its basic principles and methods were developed on a wide international basis. IAEA has gained important experience in safeguards activities in non-nuclear-weapon States where, in 1982, it controlled 98 per cent of all nuclear facilities. In its resolution 36/25, of 11 November 1981, the General Assembly noted with satisfaction the steady improvement of the Agency's safeguards system. In its resolution (GC(XXV)/RES/381), the General Conference of IAEA reaffirmed its confidence in the effectiveness of the Agency safeguards system as a reliable means of verifying peaceful use of a nuclear facility. Israel, which, according to the report of the Secretary-General on Israeli nuclear armament (A/36/431), reached the threshold of becoming a nuclear-weapon State a decade ago,

and has neither adhered to the non-proliferation Treaty nor accepted IAEA safeguards on all its nuclear facilites, made many statements regarding the Treaty and the IAEA safeguards system in an attempt to justify its armed attack against the safeguarded Iraqi nuclear installations. The consideration of the Israeli statements is not a subject of this study. They were thoroughly analysed in a background paper entitled "Safeguards and the Iraqi nuclear centre" and prepared by IAEA in December 1981 (see appendix II) which the Group recommended be issued as a United Nations document.

III. PHYSICAL SITE-RELATED CONSEQUENCES

29. The Tammuz reactors building was hit by at least three bombs. One of them hit the side of the cold neutrons beam hall, located along the cold neutrons beam, and destroyed it, in spite of 0.6 m (metre) of concrete and 1.2 m of earth above it. The crane fell down. No major equipment was yet in the hall and a scientist who was working there was not killed.

30. One bomb hit the containment structure of the Tammuz-1 reactor from the south, opening a hole. Through this hole another bomb entered and exploded inside. It also destroyed the control room and killed one man there.

31. A large part of the containment and upper floor fell into the reactor tank, which was full of water. Afterwards, the whole building was flooded and its foundations cracked. The reactor tank and internals, fuel-supporting structure, hydrogen-liquified control rod systems, pumps, electrical and electronic equipment and installations and the instrumentation and control room have been practically all destroyed and will have to be rebuilt.

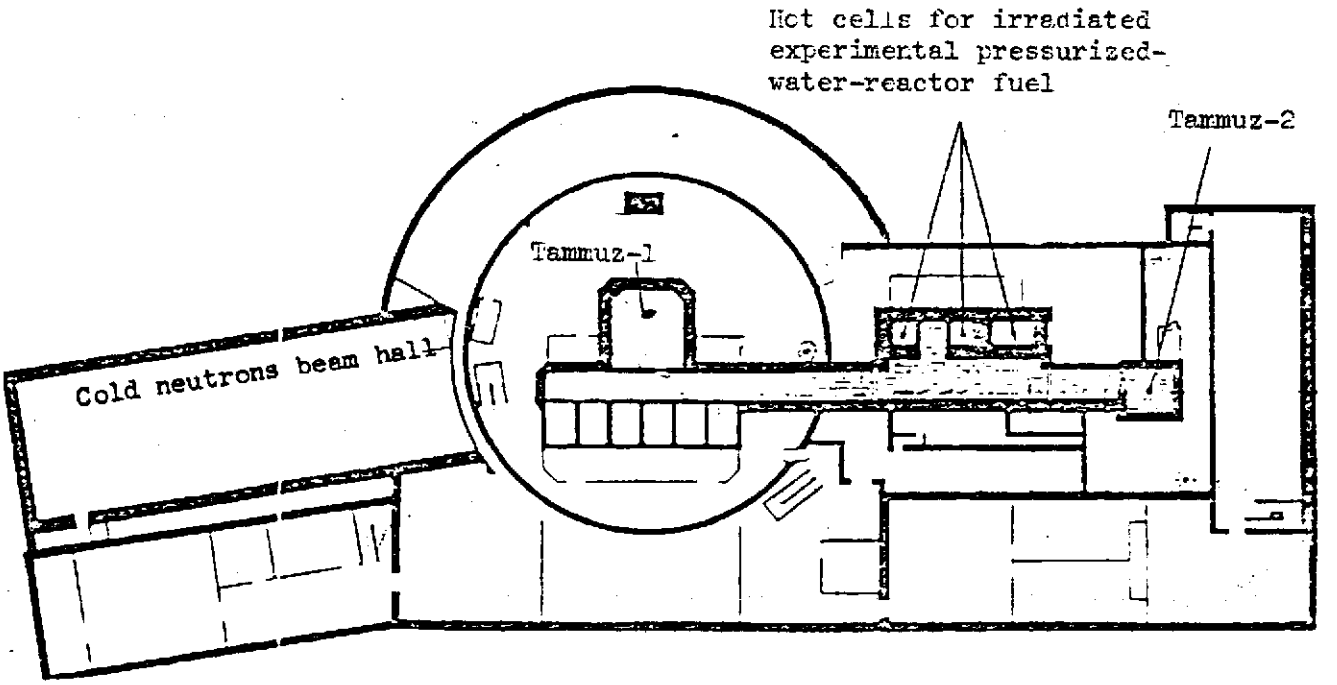

Figure 3. Main buildings: floor views
(Source: Iraqi Atomic Energy Commission).

32. The part of the building where the hot cells and Tammuz-2 reactor were located was not destroyed but was partially damaged. Neighbouring offices and laboratories, also containing some radioactive sources, were destroyed. However, the irradiated reactor fuel, which had been placed in the Tammuz-2 reactor, remained intact.

33. The material and financial damage done by bombing the reactor building and its facilities has not been estimated officially. From known information it amounts to a significant portion of the whole investment and is thus on the order of several hundred millions of dollars.

34. Before the building, the two reactors and other facilities in the building can be brought back to the stage they were in before 7 June 1981, at least five years will be required from the start of reconstruction, which has not yet begun.

IV. HEALTH CONSEQUENCES

35. The question of health consequences can be viewed in several ways. Of immediate interest is the local health consequences of the actual armed attack. However, since the Israeli Government has claimed that an attack after the Tammuz-1 reactor had been started up could have caused serious radiological consequences also at long distances, for example, at Baghdad, it is also relevant to review the estimates of these potential consequences. Finally, for the Group of Experts' assessment of the political consequences of the attack, the general question of the potential health consequences of armed attacks against nuclear reactors, including nuclear power stations, will need some attention. In the following sub-sections, each of these three aspects will be treated.

A. Health consequences of the actual armed attack

36. As described in the technical account of the attack, neither of the two Tammuz reactors contained any nuclear fuel at the time of the attack. Therefore, there was no material in the reactors that could have caused any serious health consequences if dispersed by the explosions, even though the irradiated fuel elements (see para. 16), if damaged, could have caused local contamination problems

37. Reactor fuel was stored at the site and had been irradiated after delivery. However, there is no reason to believe that this presented any significant hazard after the attack and, furthermore, subsequent IAEA inspection found all fuel elements present and intact.

38. Some radiation sources for technical uses were dispersed but later retrieved. As far as the Group of Experts could judge, therefore, there were no radiological health consequences of the attack.

39. No official Iraqi accounts of the casualties from the explosions have been available to the Group. According to Iraqi official information, there were three deaths from the attack: two directly related to the attack and one later, when a

bomb exploded during the cleaning work after the attack. One of the victims was a French technician.

B. Potential health consequences if the Tammuz reactors had been attacked while in operation

40. A large number of parameters would determine the radiation exposures, and therefore also the health consequences, if a nuclear reactor were subjected to an armed attack. Any assessment of the potential health consequences of an attack would be therefore necessarily qualified by a great number of assumptions. Two factors above all influence the result: the core cooling and the integrity of the reactor building and any inside containment. In the actual attack against the Tammuz reactors, the main reactor building was demolished, but there is no clear evidence that the core cooling would not have been sufficient to prevent a core melt, had the reactor been in operation at the time.

41. Since the number of possible sequences of events after an armed attack is unlimited, and since none can be totally excluded, assessments of potential consequences are usually based on pessimistic assumptions (for example, the assumption that all noble gases, a major part of the volatile fission products and some fraction of long-lived radio-nuclides of biological significance would escape from the fuel and also from the reactor building). In the official Israeli assessment of what the consequences could have been if the reactor had been in operation, the assumptions do not differ from what is usually assumed, but the thermal power of the reactor has been given as 70 MW instead of 40 MW, which is contrary to the IAEA opinion of the maximum power at which the reactor could have operated.

42. Although the thermal power of the Tammuz-1 reactor (40 MW) was much lower, by about a factor of 60, than that of a normal power reactor (2500 $\pm$ 1000 MW), the specific power was higher by about a factor of 30, owing to the 93 per cent fuel enrichment. The lower total thermal power would therefore not have excluded the possibility of a core melt and a substantial release of volatile fission products if the core cooling had failed. The armed attack would have to have demolished the building in order to permit the radioactive material to escape. The presence of water would have been crucial for the limitation of the release.

43. As a rough estimate, it can be assumed that the radiation doses from a demolished reactor would be proportional to the thermal power of the reactor (this assumption is not valid for long-lived fission products such as cesium-137, the amount of which would rather be proportional to the fuel burn-up). It is tempting to estimate the radiation doses in the environment by scaling down, in proportion to the thermal power, the many dose estimates that have been made for nuclear power reactors, assuming release fractions usually postulated for a core melt with a ruptured containment.

44. On that basis alone it would not seem likely that the radiation doses outside the research centre would have been large enough to cause any acute radiation injury. External doses would not have exceeded 0.1 Gy (Gray; absorbed radiation

dose of 1 joule per kilogram) over 24 hours, and thyroid doses from inhaled radio-iodines would have been less than 10 Gy even near the site. The only harmful effects would have been late, stochastic effects (cancer and hereditary harm).

45. There is one shortcoming of such estimates. In the assessments of consequences of accidents in nuclear power stations, the release height can be assumed to be between 10 and 100 m, with an additional plume lift due to thermal buoyancy. However, in an accident in a reactor of the Tammuz-1 type, this may not be the case, and the release height could be almost zero. This would greatly increase the dose estimates for short distances. A crude assessment can be based on the successive activity dilution in the plume. The result shows that it is not possible to exclude very high thyroid doses, lung doses and bone marrow doses. Lethal effects might have occurred within several kilometres, if the reactor had been attacked while in operation. In this respect, the conclusions in the Israeli report seem to be correct, although based on the incorrect assumption of 70 MW instead of 40 MW. Such severe consequences would have occurred in the case of stable weather conditions (inversion, "Pasquill class F"), which are not infrequent at night in the region.

46. The collective "effective" radiation dose, as calculated in the Israeli report (A/36/610-S/14732), would determine the expected number of individuals subject to late harm. A usual basis for estimates is to assume, on the average, one lethal case from late stochastic harm per each 50 man. Gy (collective absorbed radiation dose of 1 joule per kilogram) collective effective dose.

47. The collective dose would critically depend on the wind direction and the population distribution. In the case of the wind direction towards Baghdad and extreme release conditions (core melt, no water present, the building demolished), collective doses on the order of 10,000 to 100,000 man. Gy cannot be excluded (for comparison, it may be mentioned that the total collective dose from the Three Mile Island accident near Harrisburg, Pennsylvania, in 1979 was less than 100 man. Gy). This would have meant an expected number of 200 to 3,000 deaths from late effects, mainly cancer, after a latent period of perhaps 20 to 30 years and spread over some 20 to 30 years to follow. This, however, is a pessimistic estimate considering the extreme assumptions (the prevailing wind is from Baghdad towards the Tuwaitha Nuclear Research Centre). On the whole, however, recognizing this qualification, the estimate of consequences in the Israeli document, although unlikely, is not unrealistic.

C. Health consequences of armed attacks against nuclear power stations

48. It follows from what has already been said that any estimate of the health consequences of a reactor accident is based on a large number of assumptions that may or may not be valid in the actual situation. As has been described in a number of reports (for example, the United States' "WASH-1400" 4/ and the German "Risk Study" 5/), a wide spectrum of consequences is possible, with a probability distribution that can be assessed with more or less confidence. In the worst cases (the scenarios denoted "BWR-1", "BWR-2" and "PWR-1" in WASH-1400), the reactor containment is damaged so that radioactive material from the molten core can leak

to the environment. The likelihood of a containment rupture is believed to be very small, and there have been discussions about the realism in the assumption of steam explosions that could cause a rupture.

49. In an armed attack, the situation is different. If the purpose is only to destroy the electricity-generating capacity, this may be done in many ways, not necessarily with risk of radiological consequences. However, if the purpose is to cause a core melt and a release of radioactive material, the possibility of success is large if the assailant is knowledgeable and resourceful. Normal probability assessments would then no longer be meaningful.

50. The health consequences, however, would not be different from what has usually been assessed for the worst scenarios, except that, in a war situation, the possibilities of remedial action may be different (smaller or larger). In most nuclear power stations, also long-lived radio-nuclides, such as cesium-137, have accumulated in large activities. This will add potentially severe long-term consequences.

51. The number of persons harmed by radioactive substances would depend on the population distribution and the meteorological conditions. This would strongly influence the expected number of casualties from acute effects. Lethal radiation doses could occur at distances up to 30 to 40 km. In the case of precipitation, much of the collective dose would be delivered near the power station, perhaps within 100 km, depending on the population distribution. In dry weather, however, the major part of the collective dose would be delivered at greater distances, unless the population distribution were very uneven.

52. The collective dose (and, therefore, the expected number of late harmful effects) is less dependent on population distribution than on the number of acute injuries. Various assessments for the worst scenarios have indicated collective doses on the order of 100,000 to 1 million man. Gy. The expected number of late deaths from such collective doses would be on the order of 1,000 to 10,000 or more, but only after many years and distributed over many years.

53. One consequence that is often overlooked is the contamination of large land areas to the extent that it may be impossible or inadvisable to live there for many years. This is mainly due to the possible release of cesium-137, a radio-nuclide that has a half-life of 30 years. If the radiation dose from contaminated ground were so high that evacuation within a day was advisable, the remaining cesium-137 might make it difficult to live within the area for many years. Effective decontamination of large land areas is not very practicable. The land areas where the radiation dose over the first 24 hours might be expected to exceed 0.1 Gy (a common reference dose for evacuation) could be as large as 400 km^2 in the case of precipitation. The radiation dose over the first year in such areas, even assuming some shielding from buildings, could be as high as 1.5 Gy, which would be unacceptable under any circumstances. For reference it may be mentioned that the external dose from natural sources of radiation is less than 0.001 Gy per year and that the usual annual dose limit for people in most countries is 0.005 Gy in any one year. The internationally recommended annual dose limit for radiation workers is 0.05 Gy.

V. GENERAL CONSEQUENCES

54. This section concerns itself with the consequences that the Israeli armed attack had on the political aspects of the preoccupations of the United Nations and other international agencies.

55. The norms of behaviour that States are to conform to as articulated in the Charter of the United Nations, so far as this issue is concerned, can be summarized as follows: when conflicts arise between States all options should be explored for a peaceful settlement. Among the several options to be utilized for conflict-resolution, there should be a recourse to the Security Council and General Assembly. This was not done in the case under consideration because Israel acted unilaterally (see paras. 7 and 9 above).

56. Apart from the challenge posed to the raison d'être of international institutions (such as the United Nations and IAEA), the Israeli behaviour put in jeopardy the specific roles, objectives, and programmes of international institutions discussed below.

A. Consequences for disarmament

57. Even though one of the basic tenets of the realist school in international relations is the concept of deterrence (power deters aggression and hence ensues peace), an important argument for disarmament has rested on the hope that the collective security system of the United Nations could provide such an effective guarantee of security for small and non-nuclear medium-power nations that those nations need not invest their resources in joining the arms race. To the extent that it relied on conventional arms, the Israeli armed attack called into question the foundation of this argument. It could be argued reasonably that Israel would not have launched the attack unless it were sure that it would be successful. An expensive but effective anti-aircraft missile system would then have served as an effective deterrent. To that extent, States are likely to draw the conclusion that, to prevent Israeli-type behaviour, they should arm and not disarm. Therefore, the Israeli attack was dysfunctional to the disarmament aims of the United Nations and the world community.

58. The Israeli aggression has served to focus attention on the conflict between security and development. In the case of most developing countries, which suffer from a shortage of resources, the choice of allocating resources for either security or development is a difficult one. The Israeli attack would seem to have strengthened the position of those who argue that, to prevent the kind of foreign intervention that negates economic development, security concerns should get priority of resources.

B. Economic consequences

1. Importance of nuclear installations for Iraq's development

59. The description of the Tuwaitha Nuclear Research Centre indicates its possibilities to exploit the potential and benefits of activities in the field of

peaceful uses of nuclear energy for development of Iraqi scientific and technological abilities. Since the peaceful uses of nuclear energy encompass a very broad range of scientific and technological fields, they have a strong impact on scientific, technological and industrial development. Experience in many industrialized, as well as in less developed, countries has shown that nuclear research centres, owing to the extremely high requirements of nuclear research, also have a strong and beneficial influence on development in fields beyond and not immediately linked to nuclear energy research, such as electronics, computers, material science and high-quality conventional equipment. In many countries, nuclear research centres play a role of national centres of scientific and technical excellence. The Tuwaitha Nuclear Research Centre is to follow such examples in the world and offers good possibilities for developing domestic manpower and expertise, which can never be acquired otherwise. In this respect, existence of good facilities for research, such as in the Tuwaitha Nuclear Research Centre, is of extreme importance, since only favourable opportunities can attract good and talented people who otherwise would enter into other activities or even find employment abroad. In view of this, acquiring new, better and more powerful facilities is of particular importance. In this connection, international co-operation, bilateral agreements and joint research projects with France, Italy, IAEA and others should also be mentioned.

60. It should also not be forgotten that, at a time when the barriers to international transfer of advanced knowledge and know-how are not disappearing or may even be growing, such centres as the Tuwaitha Nuclear Research Centre, in developing human and material bases for a nation's inalienable rights, serve the purpose of contributing to national identity, pride and feeling of equality.

61. Data on Iraq's energy development plans are very scanty and difficult to obtain. Available indirect evidence, however, indicates that, in the country's total developmental perspective, high priority is being accorded to energy development. In keeping with Iraq's ambitious industrial development plans, a substantial expansion in energy output from fossil fuels is planned; such plans include some power-intensive projects, such as aluminium, steel and steel-rolling, and infrastructure development, including electrification of rural areas, powering the growing transport fleet, and lighting needs. Iraq's abundance of oil reserves hardly needs mentioning.

62. Conscious of the fact that both oil and gas, currently its principal sources of energy, are finite and exhaustible, Iraq has been concerned about developing alternative sources of energy. The nuclear research reactors at the Tuwaitha Nuclear Research Centre, including the Tammuz reactors that were under construction when attacked, were part of Iraq's endeavour to develop energy alternatives to oil and gas.

63. This indicates that the destruction of the nuclear reactors at the Tuwaitha Nuclear Research Centre by the Israeli attack will cause a serious set-back to Iraq's nuclear research programme and its search for alternative energy sources. The set-back caused by the destruction cannot be evaluated only in terms of the material and financial damage or the time needed for reconstruction in order to resume the planned research programmes. The adverse effects on the scientific and

technical community connected, directly or indirectly, with the work of the research centre may be felt for a long time. Indirectly, the tempo of Iraq's economic and social development is also bound to be retarded somewhat.

64. At the same time, the loss and delay in construction, and the consequent set-back, cannot be expected to decrease the determination of the people of Iraq to continue their development, and will certainly not relax the tensions in the area.

2. Relationship with declared international objectives

65. The Charter of Economic Rights and Duties of States (General Assembly resolution 3281 (XXIX) and the Declaration on the Establishment of the New International Economic Order (resolution 3201 (S-VI)) are important statements of international objectives against which the Group considered it important to measure the consequences of the Israeli attack.

(a) Violation of the Charter of Economic Rights and Duties of States

66. The Israeli attack constitutes without a doubt a flagrant violation of the spirit and an open infringement of the letter of the Charter of the Economic Rights and Duties of States.

67. A major objective of the Charter as spelt out in subparagraph (d) of its fifth preambular paragraph is the overcoming of main obstacles in the way of the economic development of the developing countries. This was violated. The Israeli aggression also violated the spirit of the Charter as expressed in subparagraph (c) of the same fifth preambular paragraph:

> "(c) The encouragement of co-operation, on the basis of mutual advantage and equitable benefits for all peace-loving States which are willing to carry out the provisions of the present Charter in the economic, trade, scientific and technical fields, regardless of political, economic or social systems, ..."

In attacking the nuclear installation set up by Iraq with French technical co-operation, Israel also violated the specific intent of the Charter of promoting international scientific and technical co-operation.

68. In addition, every one of the principles embodied in subparagraphs (a), (b), (c), (d), (e), (f), (g), (h) and (k) of chapter I of the Charter was transgressed. The principles of "sovereignty, territorial integrity and political independence of States" (subparagraph (a)), "sovereign equality of all States" (subparagraph (b)), "non-aggression" (subparagraph (c)), "non-intervention" (subparagraph (d)), "mutual and equitable benefit" (subparagraph (e)), "peaceful coexistence (subparagraph (f)), "equal rights and self-determination of peoples" (subparagraph (g)), "peaceful settlement of disputes" (subparagraph (h)) and "respect for human rights and fundamental freedoms" (subparagraph (k)) were all violated.

69. Above all, there was an open infringement of paragraph 1 of article 13 of the Charter, which sanctions the right of every State "to benefit from the advances and

developments in science and technology for the acceleration of its economic and social development," since the Tuwaitha Nuclear Research Centre was intended to advance Iraq's scientific and technological development with, inter alia, French collaboration. French technical assistance in this respect could be considered to be a response to the general appeal, contained in paragraph 2, of article 13, that all States "should promote international scientific and technological co-operation and the transfer of technology" and, in particular, to the call therein to all States to "facilitate the access of developing countries to the achievements of modern science and technology, the transfer of technology ... for the benefit of the developing countries in forms and in accordance with procedures which are suited to their economies and their needs".

70. Further, the attack on the nuclear reactors under construction also violated paragraph 3 of article 13, which calls upon developed countries to "co-operate with the developing countries in the establishment, strengthening and development of their scientific and technological infrastructures and their scientific research and technological activities ...".

71. According to article 16 of the Charter, "it is the right and duty of all States, individually and collectively, to eliminate ... all forms of foreign aggression, occupation and domination, and the economic and social consequences thereof, as a prerequisite for development". This would give Iraq the right and all States Members of the United Nations, including Iraq, collectively, the duty to eliminate the Israeli aggression and the economic and social consequences thereof. The same article goes on further to declare that "States which practise such coercive policies are economically responsible to the countries, territories and peoples affected for the restitution and full compensation for the exploitation and depletion of, and damages to, the natural and all other resources of those countries, territories and peoples. It is the duty of all States to extend assistance to them". In this case, Iraq has clearly suffered damage to its technical and scientific resources.

72. Finally, article 32 of the Charter was violated. That article expressly forbids any State to "use or encourage the use of economic, political or any other type of measures to coerce another State in order to obtain from it the subordination of the exercise of its sovereign rights", which the Israeli aggression attempted to do in Iraq.

(b) Violation of the new international economic order

73. The fundamental principles of the new international economic order were spelt out clearly in paragraph 4 of the Declaration on the Establishment of a New International Economic Order, adopted on May 1974 by the General Assembly at its sixth special session (resolution 3201 (S-VI)).

74. So far as the Israeli attack is concerned, it can be certainly said to have directly violated the following specific principles of the Declaration:

"(a) Sovereign equality of States ... territorial integrity and non-interference in the internal affairs of other States;"

and

"(p) Giving to the developing countries access to the achievements of modern science and technology, and promoting the transfer of technology and the creation of indigenous technology for the benefit of the developing countries in forms and in accordance with procedures which are suited to their economies;".

75. The violation of the principle embodied in subparagraph (p) is somewhat indirect, in the sense that Israel's action did not consist in a refusal to give Iraq access "to the achievements of modern science and technology, and promoting the transfer of technology and the creation of indigenous technology", but it indeed went further and sought to do damage to the scientific and technological infrastructure created in Iraq with French technical assistance.

76. There is at least one other principle that is more than violated, albeit indirectly. Thus, if the principle enunciated under subparagraph (f) of the Declaration establishes "the right of all States, territories and peoples under foreign occupation, alien and colonial domination or apartheid to restitution and full compensation for the exploitation and depletion of, and damages to, the natural resources and all other resources of those States, territories and peoples", could this not, by implication, be said to assert even more positively the right of independent States to "restitution and full compensation for ... damages to ... all other resources of those States"?

77. Section IV of the Programme of Action on the Establishment of a New International Economic Order (resolution 3202 (S-VI)) deals with the transfer of technology. Specifically, the section urges that all efforts should be made:

"(b) To give access on improved terms to modern technology and to adapt that technology, as appropriate, to specific economic, social and ecological conditions and varying stages of development in developing countries;

"(c) To expand significantly the assistance from developed to developing countries in research and development programmes and in the creation of suitable indigenous technology;"

and, most importantly,

"(e) To promote international co-operation in research and development in exploration and exploitation, conservation and the legitimate utilization of natural resources and all sources of energy."

78. Although, the Israeli attack could only be considered to be an indirect violation of the moral obligations imposed by the Programme of Action on the Establishment of a New International Economic Order on the members of the United Nations, in spirit it went further than a mere indirect violation. Thus, it did not just deny access to Iraq to modern technology - an act of denial that would

have been a violation of the spirit of the new international economic order - but went further and damaged the recommended type of access actually given by France.

3. Economic conclusion

79. It has not been possible to assess accurately the extent of damage caused by the Israeli attack. The Tammuz-1 nuclear reactor was totally destroyed. According to Iraqi sources the damage, while not officially estimated, would amount to "several hundred million dollars".

80. There is no doubt that the damage caused by the attack will result in a profound set-back to Iraqi nuclear research programmes. The reconstruction of the nuclear research facilities to the pre-attack level is estimated to take at least five years after the commencement of reconstruction.

81. In terms of the wider consequences for the Charter of Economic Rights and Duties of States and for the Programme of Action on the Establishment of a New International Economic Order, one must recognize that adherence to the principles of the Charter and implementation of the Programme of Action are, in the ultimate analysis, matters of moral obligations. It may be recalled that, even when the General Assembly adopted those important documents, some countries had expressed their reservations about them. In the more recent and more troubled environment of inflation-recession, protectionism and a generally uncongenial climate for international economic co-operation, actions such as the Israeli aggression in question can only result in a further weakening of a general sense of loyalty to the fundamental principles of the Charter and the new international economic order.

C. Consequences for positive behaviour by States

82. As speaker after speaker emphasized during the debates that ensued at the United Nations and at meetings of the Board of Governors and the General Conference of IAEA, Iraq is a party to the non-proliferation Treaty and its nuclear facilities were under the Agency's safeguards régime at the time of the attack. Joining an international organization or subscribing to a treaty often involves accepting a certain degree of limitation on the much cherished State sovereignty (obligations) in exchange for a certain amount of legal advantages (rights). The sum total of such obligations and rights provide some certainty and stability in a State's international relations. The element of expectation is crucial in this regard. In exchange for fulfilling one's obligations, one expects one's rights to be safeguarded. If those rights are safeguarded, a State is encouraged to continue fulfilling its State's obligations. Furthermore, the transformation of the world from warring independent States to a community of nations governed by international values, customs, norms and laws is evolutionary and not revolutionary. It is a process marked by accretion rather than leaps. In this process, the role played by encouraging positive behaviour by States is crucial. If States were ever to feel that, having fulfilled their parts of the bargain and having subscribed to legal documents and norms, the expected privileges - in this case, protection - would not be accorded, then they might well come to the conclusion that a legally ordered society is not a feasible option and hence nothing is to be gained from engaging in activities that result in evolving norms of behaviour for States.

D. Consequences for legitimacy of international régimes

83. Since the evolution of the nation-State system, nations have clung to the concept of sovereignty as tenaciously as they could. The evolution of international laws, norms and values to govern state behaviour and the evolution of international institutions to oversee compliance with these laws, norms and values have been a painstakingly slow process, with nations yielding as little as possible, testing the situation continually and remaining ever vigilant and suspicious of any encroachment on state rights.

84. Lacking the power of coercion, international institutions have to reassure States that the cost of non-compliance is greater than the cost of compliance. They have to ensure that those aspects of States' rights surrendered to their care are jealously guarded by them. They have to prove their utility and validity in the face of rational and at times irrational suspicion on the part of their creators and their wards - the nation-States.

85. The IAEA safeguards system represents a tentative and yet significant international effort at regulating the minefield of nuclear affairs, which has still not been fully charted. The non-proliferation Treaty and the safeguards system were designed to provide international assurance that peaceful uses of nuclear energy would not be diverted to military uses.

86. The attack on a facility that was under the safeguards of IAEA, that revealed no non-compliance with such safeguards, and that was located in a State party to the non-proliferation Treaty, was an Israeli challenge, showing disrespect for that Treaty, IAEA and the international safeguards system. Condoning such challenges could do grave damage to these international institutions and international co-operation. The condemnation by the international community of the Israeli attack and disrespect for IAEA safeguards has prevented the impairment of confidence in the non-proliferation treaty, and the safeguards systems of IAEA. While this does not justify complacency about the existing international safeguards system, which must continually be kept up to date and improved, special attention should be called to the response prepared by IAEA to the specific criticisms of the system raised in this case (see appendix II). 6/

E. Precedent-setting consequences

87. Situations of conflict are not limited to any one geographical area of the world. Those special characteristics of the Middle East situation that Israel claims are a justification for the armed attack on Iraq have been and can be replicated in other parts of the world.

88. Referring to the historical records of nuclear weapon acquisition, Ambassador Dorr of Ireland pointed out, during the Security Council debate, a number of instances "where the temptation for one country to strike pre-emptively at a hostile or rival country which was about to acquire such weapons must have been strong. In each such case the temptation was resisted" (see S/PV.2283, p. 8). The temptation was resisted because such behaviour was considered unacceptable and

too dangerous. The biggest fear now is that the Israeli attack has let the genie out of the bottle and has created a precendent that makes the threshold of unacceptability lower.

89. In none of the many situations of military conflict that have arisen in Africa, Asia and South America in recent years, before and after the Israeli aggression, has there been any attempt to destroy the nuclear facilities of one of the parties to the conflict by the other party. This must be attributed to the restraint imposed by international law, custom, norm, behaviour and expectation. One of the consequences of the Israeli armed attack could be to make the unexpected expected in terms of international state behaviour. The restraint on the behaviour of States, which had been created by a lack of precedence, has been weakened. The greatest danger is probably posed in the case of Africa because of the tendency for South Africa in its dealing with front-line African States to emulate Israeli military tactics and strategy towards the Arab States.

Nature of the legal precedent

90. To assess the legal consequences of this case, one must examine the nature of the precedent set by the attack and its purported legal justification. 7/ Two such justifications were suggested by the Government of Israel: (a) that the attack was a legitimate exercise of Israel's right of self-defence and (b) that a "state of war" still existed between Israel and Iraq and the attack was consistent with the laws of war. The Security Council and the General Assembly rejected these arguments, and the Assembly characterized the attack as an unlawful act of aggression (see resolution 36/27).

(a) Legal background

(i) On aggression

91. Article 2, paragraph 4 of the Charter of the United Nations contains the principle according to which

> "All Members shall refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any State, or in any other manner inconsistent with the Purposes of the United Nations."

In Article 39, the Security Council is given the responsibility for determining the existence of any threat to the peace, breach of the peace, or act of aggression and for making recommendations or decisions regarding the measures to be taken to maintain or restore international peace and security. As an aid to such determinations, the General Assembly, in its resolution 3314 (XXIX) of 14 December 1974, approved a definition of aggression that included the following pertinent provisions:

"Article 1

"Aggression is the use of armed force by a State against the sovereignty, territorial integrity or political independence of another State, or in any other manner inconsistent with the Charter of the United Nations, as set out in this Definition ..."

"Article 2

"The first use of armed force by a State in contravention of the Charter shall consitute prima facie evidence of an act of aggression although the Security Council may, in conformity with the Charter, conclude that a determination that an act of aggression has been committed would not be justified in the light of other relevant circumstances ..."

"Article 3

"Any of the following acts, regardless of a declaration of war, shall, subject to and in accordance with the provisions of article 2, qualify as an act of aggression:

"...

"(b) Bombardment by the armed forces of a State against the territory of another State or the use of any weapons by a State against the territory of another State ..."

"Article 5

"... Aggression gives rise to international responsibility ..."

"Article 6

"Nothing in this Definition shall be construed as in any way enlarging or diminishing the scope of the Charter, including its provisions concerning cases in which the use of force is lawful."

(ii) On self-defence

92. Article 51 of the Charter of the United Nations provides that "Nothing in the present Charter shall impair the inherent right of individual or collective self-defence if an armed attack occurs against a Member of the United Nations, until the Security Council has taken measures necessary to maintain international peace and security ..."

93. The first issue is the effect of Article 51 on pre-existing law. There is a split of opinion among international jurists as to whether it preserves the "inherent right of ... self-defence" as it existed under customary international law, 8/ or whether that right was narrowed by the phrase "if an armed attack occurs". 9/

94. Only under the first interpretation is it possible to claim a right of anticipatory self-defence. The classical limitations on the right require that there be an overwhelming necessity for immediate action, with no remaining choice of effective peaceful alternatives, and that the means used be proportional to the threat involved. 10/ While it has been argued that the advent of nuclear weapons has created risks of such immediate devastation as to warrant exceptions to such limitations, 11/ the contrary view has also been expressed. 12/

95. A further question is who determines whether the requirements for anticipatory self-defence have been met. The International Military Tribunal at Nuremberg, in rejecting the Nazis' claim that their own judgement as to the necessity of invading Norway and Denmark as a preventive action was conclusive, stated:

> "Whether action taken under the claim of self-defence was in fact aggressive or defensive must ultimately be subject to investigation and adjudication if international law is ever to be enforced." 13/

The role of the Security Council in this connection was referred to in paragraph 91 above.

(iii) On the relevance of a "state of war"

96. While there are differences of opinion among international jurists as to the impact of the Charter of the United Nations on the earlier sharp division of international law into the laws of war and the laws applicable under peace-time conditions, 14/ there is clearly a body of customary and conventional law designed to place limitations on how armed conflicts are conducted, regardless of whether or not initiation of such conflicts was legally justified.

97. In this connection, the Israelis asserted that Iraq was still technically in a "state of war" with Israel, and that its use of force was not in excess of that required to put out of action what it perceived to be a military target, in a manner that did minimum damage to non-combatants and did not pose a threat of radioactive exposure to neighbouring cities. 15/ While the international debate did not focus on this line of argument, one point is clear: the international community rejected Israel's assertion that the Tuwaitha facility was intended to serve military purposes.

(b) Legal consequences

98. It is against the background provided above that we must consider the consequences of the Tuwaitha incident for international law.

99. The Security Council unanimously condemned the attack in a resolution that did not use the term "aggression" (resolution 487 (1981)). The subsequent General Assembly resolution did characterize it as an act of aggression (resolution 36/27).

100. The preliminary judgement made by the Government of Israel that the requirements for justifying "anticipatory self-defence" were met in this case (see A/36/610-S/14732, annex) found no support in international deliberations. The

international community rejected Israel's assertion about Iraq's intentions, and no country agreed that any immediate military threat to Israel existed, or that Israel had exhausted diplomatic means of dealing with the situation.

101. Rejection of Israel's argument that its action was an act of self-defence avoided the damage to international law that would have been done by accepting that argument, which would have entailed not only a judgement that Article 51 of the Charter of the United Nations preserved the customary international law on anticipatory self-defence, but also:

(a) A significant weakening of the stringent limitations on the right of anticipatory self-defence, most notably with respect to the immediacy of the threat and the exhaustion of diplomatic alternatives;

(b) Acceptance of the argument that, in a nuclear age, the traditional restrictions on such a right should be relaxed;

(c) Acceptance of the claim that the ultimate judge of when an act of anticipatory self-defence is justified is the State purporting to exercise that right.

102. If the alternative argument based on the alleged continued existence of a "state of war" with Iraq were accepted, the precedent set would be somewhat narrower than that of accepting the claim of anticipatory self-defence, since it would apply only to countries that were at war with each other, as were Iran and Iraq at the time of the earlier attack on the Tuwaitha facility by Iranian war-planes. But it is difficult to see why the same argument could not be used by an Arab country in a state of war with Israel to justify an attack on Israeli facilities.

103. While that point was not the focus of much attention in the international debate on this case, the international community does not appear to be prepared to accept the adverse consequences for international law of the precedent that such a justification would establish.

G. Other general consequences

1. Attacks on nuclear facilities

104. Another consequence of the attack is to raise questions about the adequacy of the international legal means of inhibiting attacks against nuclear facilities that might result in major releases of radioactive material. The provisions on that subject in Protocol I Additional to the Geneva Conventions of 12 August 1949 (for pertinent provisions of this Protocol, see annex I), while now in force for 29 States, 16/ have not yet been signed by Israel, Iraq and a number of other States in the Middle East; they apply only during international armed conflicts, and not to peace-time conditions, and they apply only to "nuclear electrical generating stations", and not to nuclear research reactors (such as those at Tuwaitha), reprocessing plants or spent-fuel storage facilities. Such facilities

may in fact be more vulnerable to attack than nuclear electrical generating stations (which are ordinarily protected by heavy containment), and at least the last two types, if attacked, might release very substantial amounts of radioactivity.

105. These gaps in the pertinent international legal régime are currently under consideration in the Committee on Disarmament at Geneva, where obstacles to agreement have been encountered and have also given rise to other suggested remedies. 17/ The attack on the Tuwaitha Nuclear Research Centre has underscored the importance and urgency of seeking prompt international agreement on upgrading the pertinent international law.

2. Reparations

106. Yet another consequence of the attack is to raise questions as to the adequacy of international legal mechanisms for obtaining the payment of compensatory damages in cases of this type.

107. While Security Council resolution 487 (1981) stated that the Council considered that Iraq was "entitled to appropriate redress" for the destruction it had suffered, responsibility for which had been acknowledged by Irarael, and General Assembly resolution 36/27 of 13 December 1981 included a demand by the Assembly that Israel "pay prompt and adequate compensation for the material damage and loss of life" suffered as a result of the attack, Israel has made clear that it does not intend to pay any reparations to Iraq. It did, however, announce that it had made a payment ex gratia to the family of the French technician who was killed (see A/37/365-S/15320).

VI. POTENTIAL INTERNATIONAL RESPONSES

A. Israeli adherence to safeguards and/or the non-proliferation Treaty

108. Over a lengthy period there has been increasing concern among States Members of the United Nations with the reports that Israel has a nuclear explosive capability. This concern has been reflected in a number of General Assembly resolutions relating to Israeli nuclear armament, nuclear collaboration between Israel and South Africa, and the establishment of a nuclear-weapon-free zone in the region of the Middle East, and resolution 33/71 A of 14 December 1978, in which the Assembly requested the Security Council to call upon all States to end all transfer of nuclear equipment or fissionable material or technology to Israel. The Assembly on many occasions has noted with concern that Israel persistently refused to adhere to the non-proliferation Treaty or to place its nuclear facilities under IAEA safeguards (resolutions 35/157, 36/98 and 37/82).

109. Since the time of its establishment, Israel has been involved in various areas of nuclear research. During 1950s and 1960s, Israel maintained a close

collaboration in the nuclear field with France, the United States of America and other countries, which enabled it to train highly qualified manpower and provided it with nuclear facilities, equipment, materials and technology. According to the United Nations report already cited (A/36/431), Israel is involved practically in activities dealing with all elements of the nuclear fuel cycle. These activities are carried out at the Nuclear Research Centre at Nahal-Soreq, the Dimona Centre, the Weizmann Institute at Rehovoth and the Institute of Technology-Technion at Haifa.

110. It was noted in that report that "Israel, if it has not already crossed that threshold, has the capability to manufacture nuclear weapons within a very short time" (A/36/431, annex, para. 82). It was also pointed out in the report that there was an unsafeguarded natural uranium heavy-water-moderated reactor with a capacity of 25 MW capable of producing significant quantities of plutonium suitable for manufacturing nuclear explosive devices. In addition to the technical capability for manufacturing nuclear weapons, Israel possesses means of delivery of nuclear weapons to targets in the region.

111. Official statements by Israel concerning its plans and intentions relating to possession of nuclear weapons have been equivocal. Israel's refusal to adhere to the non-proliferation Treaty and to submit all its nuclear activities to IAEA safeguards, as well as the classified nature of activities at the nuclear centre at Dimona, which belongs to the Ministry of Defence and is a restricted zone, provides ground to believe that Israel, in the hope of achieving military superiority in the Middle East, considers the possession of nuclear weapons an important element of its external policies.

112. Acquisition by Israel of nuclear weapons would be a serious destabilizing factor, would lead to a further escalation of tensions in the Middle East, would immeasurably increase the nuclear threat to mankind and would deal a severe blow to the régime of non-proliferation of nuclear weapons.

113. Such developments could be prevented if Israel renounced its possession of, or intentions to acquire, nuclear weapons and placed all its nuclear activities under international safeguards through adherence to the non-proliferation Treaty and/or acceptance of the full scope of IAEA safeguards.

B. Establishment of a nuclear-weapon-free zone in the Middle East

114. The establishment of a nuclear-weapon-free zone in the Middle East would be a measure for strengthening the régime of non-proliferation of nuclear weapons, reducing the threat of a nuclear war and strengthening regional security and stability. It is necessary for such a zone to be free from nuclear weapons, and the relevant agreement should not contain any loopholes enabling violation of a nuclear-free status of the countries of the region. Such an agreement should include the provisions of the non-proliferation Treaty that deal with a binding obligation not to manufacture or acquire nuclear weapons or other explosive devices as well as not to obtain a direct or indirect control over them. This item was included for the first time in the agenda of the twenty-ninth session of the

General Assembly in 1974. In its resolution 3263 (XXIX) of 9 December 1974, the Assembly considered that it was indispensable that all parties concerned in the area proclaim solemnly and immediately their intention to refrain, on a reciprocal basis, from producing, testing, obtaining, acquiring or in any other way possessing nuclear weapons.

115. Resolutions on the establishment of a nuclear-weapon-free zone in the region of the Middle East, adopted at all subsequent sessions of the General Assembly with the same pattern of votes as at the twenty-ninth session, have undergone a certain development and refinement. Thus, in resolution 35/147 of 12 December 1980, the Assembly invited the countries concerned, pending the establishment of a nuclear-weapon-free zone in the Middle East and during the process of its establishment, to declare solemnly that they would refrain, on a reciprocal basis, from producing, acquiring or in any other way possessing nuclear weapons and nuclear explosive devices; called upon those countries to refrain from permitting the stationing of nuclear weapons on their territory by any third party; and further invited those countries to declare their support for establishing a nuclear-weapon-free zone in the region and to deposit those declarations with the Security Council for consideration.

116. In addition to a draft resolution proposed by Egypt at the thirty-fifth session of the General Assembly in 1980, and adopted by consensus (including Israel), Israel submitted a draft resolution (A/C.1/35/L.8) in which all States of the Middle East and non-nuclear-weapon States adjacent to the region that were not parties to any treaty on establishing a zone free from nuclear weapons were called upon "to convene at the earliest possibility a conference with a view to negotiating a multilateral treaty establishing a nuclear-weapon-free zone in the Middle East". This draft was opposed by a number of Arab States, in particular because it established an unacceptable preliminary condition for establishing the zone, that is, that the zone should be established on the basis of "regional agreements achieved resulting from the talks". This draft was later withdrawn by Israel.

117. In resolution 37/75 of 9 December 1982, the General Assembly urged all parties directly concerned to consider seriously taking the practical and urgent steps required for the implementation of the proposal to establish a nuclear-weapon-free zone in the region of the Middle East and, as a means of promoting that objective, invited the countries concerned to adhere to the non-proliferation Treaty; called upon all countries of the region that had not done so to agree to place all their nuclear activities under IAEA safeguards; and invited further those countries, pending the establishment of the zone not to develop, produce, test or otherwise acquire nuclear weapons or permit the stationing on their territories, or territories under their control, of nuclear weapons or nuclear explosive devices. It should be mentioned that, with the exception of Israel, the countries with significant nuclear activities (Egypt, Iran (Islamic Republic of), Iraq, Libyan Arab Jamahiriya and Turkey) are parties to the non-proliferation Treaty and all their nuclear activities are under IAEA safeguards.

C. Measures to be taken to prohibit armed attacks against peaceful nuclear facilities, promoting and ensuring the safe development of nuclear energy

118. The problem of ensuring the safe development of nuclear power is extremely timely and important now; it is of interest to both nuclear-weapon and non-nuclear-weapon States. The practical necessity of developing, without any delay, measures to ensure the safe development of nuclear power is closely connected with the rapid development of nuclear power research. With the depletion of non-renewable sources of organic fuels, nuclear power will play a greater role in meeting the demand of mankind for a new source of energy. The number of such non-military nuclear facilities as nuclear power plants, nuclear research reactors, nuclear-fuel fabrication and reprocessing plants and storage facilities for spent fuel is expanding in the world.

119. However, intentional destruction, by either conventional or nuclear weapons, of nuclear power plants and some other kinds of nuclear installations might cause the release into the environment of huge amounts of radioactive material and may result in radioactive contamination of large areas (see sect. IV, C, above).

120. An attack on nuclear facilities could have grave consequences not only for the State subjected to such an attack, but also for neighbouring States, since the radioactive material released by an attack might travel far beyond the borders of the State attacked.

121. In the event of the destruction of nuclear power plants and some other nuclear facilities with nuclear weapons there could be catastrophic radiological effects on a global scale as a result of the large amounts of radioactive material that would be dispersed from those facilities, in addition to the effects of the use of weapons themselves. This supports the conclusion that the world community should be extremely interested in the prohibition of attacks against peaceful nuclear facilities on the basis of international agreement.

122. This important problem was considered by the General Assembly at its thirty-seventh session. Provisions on the need for ensuring safety of nuclear power are contained in:

(a) Resolution 37/19 on the report of IAEA, in which the Assembly considered that any armed attack on nuclear facilities was a "serious threat" to the development and further promotion of nuclear energy for peaceful purposes;

(b) Resolution 37/99 C on the prohibition of the development, production, stockpiling and use of radiological weapons, in which the Assembly requested the Committee on Disarmament to continue its search for a solution to the question of prohibition of military attacks on nuclear facilities;

(c) Resolution 37/75 on the establishment of a nuclear-weapon-free zone in the region of the Middle East, in which the need for appropriate measures on the question of the prohibition of military attacks on nuclear facilities was emphasized.

VII. SUMMARY AND CONCLUSIONS

123. The Tuwaitha Nuclear Research Centre in which the Tammuz-1 reactor and adjacent facilities were under construction, represents a part of Iraq's efforts for scientific and technical development within the broader context of economic and social development. Its nuclear activities were under the safeguards of IAEA, which revealed no non-compliance with the safeguards agreement concluded between Iraq and IAEA and based on Iraqi adherence to the non-proliferation Treaty.

124. The Tammuz-1 reactor was attacked and destroyed on 7 June 1981 by Israel, which has not adhered to the non-proliferation Treaty nor placed all its nuclear facilities under the IAEA safeguards system. The attack was condemned by the Security Council, the General Assembly and IAEA. The Israeli policies and practices in the region have been condemned and deplored in numerous United Nations resolutions. Furthermore, a United Nations study has emphasized that "Israel, if it has not already crossed that threshold, has the capability to manufacture nuclear weapons within a very short time" (A/36/431, annex, para. 82).

125. The direct, site-related consequences of the attack included three deaths, virtually the total destruction of the Tammuz-1 reactor, and damage to other parts of the Tuwaitha Nuclear Research Centre. This resulted in direct losses of several hundreds of millions of dollars of investment, and set back the Iraqi nuclear research and training programme (with its economic and technical spin-off) by at least five years after the commencement of reconstruction.

126. No radiological health problems were caused, although some could have occurred if the bombs had struck the irradiated fuel stored at the site. There could have been an appreciable risk of radiological health consequences, had the attack occurred after the reactor had become operational.

127. The more general consequences of the attack - to which the Group attaches special importance - include its potentially serious damage to international norms and institutions. Thus, it involved Israel's direct disrespect for, and challenge to, the non-proliferation Treaty and the IAEA safeguards system; undermined international legal constraints on acts of aggression including those of the Charter of the United Nations; introduced new risks and uncertainties, posing a threat to further peaceful nuclear development and co-operation and the promotional activities of IAEA; and disserved the objectives set forth in the Charter of Economic Rights and Duties of States and in the Declaration on the Establishment of the Programme of Action for a New International Economic Order.

128. The Group felt that, if Israel became a party to the non-proliferation Treaty, accepted full-scope safeguards and complied with the General Assembly's demand that it should refrain from its threat to repeat its armed attacks against nuclear facilities, the situation would substantially improve. In reviewing possible constructive international responses to this incident, the Group expressed the hope that the incident would give new impetus to efforts to establish a nuclear-weapon-free zone, free of loopholes, in the region of the Middle East; to the establishment of additional legal instruments against attacks on peaceful nuclear facilities; and to the improvement of international mechanisms for otaining redress for damages.

Notes

1/ United Nations, Treaty Series, vol. 480, No. 6964, p. 43.

2/ Richard Wilson, "A visit to the bombed nuclear reactor at Tuwaitha, Iraq", Nature, vol. 302, 31 March 1982, p. 373.

3/ Ibid., p. 374.

4/ United States Atomic Energy Commission, Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants (1974).

5/ This was a report on risks associated with nuclear power reactors, issued by the Federal Ministry of Research and Technology of the Federal Republic of Germany on 15 August 1979.

6/ See also the September 1981 paper by Hans Gruemm, then Deputy Director-General of IAEA, Department of Safeguards, entitled "IAEA safeguards - status and prospects"; the article by Mr. Gruemm entitled "Safeguards and Tammuz: setting the record straight", International Atomic Energy Agency Bulletin, vol. 23, No. 4 (December 1981), pp. 10-14; the statements of the then Director-General, Sigvard Eklund, to the press (IAEA PR 81/9 of 9 June 1981), to the Board of Governors of IAEA (IAEA PR 81/10 of 12 June 1981 and PR 81/16 of 6 July 1981), to the Security Council (S/PV.2288 of 19 June 1981) and to the General Assembly (A/36/PV.51, 10 November 1981); and the following IAEA press releases: PR 81/11 of 12 June 1981, on the resolution adopted by the Board of Governors with respect to the attack, and PR 81/32 of 19 November 1981, on a post-attack inspection of the Iraqi research reactor.

7/ Differing treatments of these issues appear in: Riyadh Al-Qaysi (an Iraqi member of the International Law Commission), The Israeli Raid on the Iraqi Nuclear Installations and the International Legal Order: Aggression V. Self-Defence (Baghdad, Al-Hurriya Printing House, 1982); the appendix to document A/36/610-S/14732, containing a report by the Israeli Foreign Ministry; W. T. and S. V. Mallison, "The Israeli Aerial Attack of June 7 1981 upon the Iraqi Nuclear Reactor: Aggression or Self-Defence", Vanderbilt Journal of Transnational Law (Nashville, Tenn.), vol. 15, No. 3 (Summer 1982), pp. 417-448; and "Memorandum from American Law Division, Congressional Research Service, Entitled 'Aggression and Self-Defense under International Law'", Israeli Attack on Iraqi Nuclear Facilities: Hearings before the Subcommittees on International Security and Scientific Affairs on Europe and the Middle East and on International Economic Policy and Trade of the Committee on Foreign Affairs, House of Representatives, Ninety-seventh Congress, First Session, 17 and 25 June 1981 (Washington, U.S. Government Printing Office, 1981), appendix 6, pp. 111-127.

8/ See, for example, C. H. M. Waldcock, "The Regulation of the Use of Force by Individual States in International Law", Recueil des Cours (The Hague, Académie de Droit International de la Haye, 1952), vol. II, No. 81, pp. 455-514; D. W. Bowett, Self-Defence in International Law (Manchester, Manchester University Press, 1958), pp. 187 ff.; and James Leslie Brierly, The Law of Nations, 6th ed. (Oxford, Clarendon Press, 1963), pp. 416 ff.

9/ See P. C. Jessup, A Modern Law of Nations (New York, Macmillan Company, 1947), pp. 165-166; Hans Kelsen, The Law of the United Nations (London, London Institute of World Affairs, Stevens, 1950), pp. 791-792; and I. Brownlie, "The Use of Force in Self-Defence", British Year Book of International Law, 1961 (London, Oxford University Press, 1962), pp. 183-268.

10/ These limitations were formulated in connection with an incident in which the U.S.S. Caroline, which was being used to transport personnel and equipment to Canadian rebels, was destroyed in United States territory by British forces, with the loss of several American lives. The British claimed anticipatory self-defence and paid no reparations. See John Bassett Moore, History and Digest of International Arbitration to which the United States Has Been a Party, Vol. I, (Washington, Government Printing Office, 1898), p. 412.

11/ This question arose in connection with the earliest efforts to negotiate a treaty on the international control of atomic energy. The first report of the United Nations Atomic Energy Commission observed that "in consideration of the problem of violations of the terms of the treaty or convention, it should also be borne in mind that a violation might be of so grave a character as to give rise to the inherent right of self-defence recognized in Article 51" (AEC/18/Rev.1, p. 24). See also United Nations Repertory of Practice (1955) vol. II, p. 436.

12/ See Louis Henkin, "Force, Intervention and Neutrality in Contemporary International Law", Proceedings of the American Society of International Law at its 57th annual meeting, held at Washington, D.C., from 25 to 27 April 1963 (Washington, D.C., American Society of International Law, 1963), pp. 150-151.

13/ Trial of the Major War Criminals before the International Military Tribunal, Nuremberg, 14 November 1945 to 1 October 1946 (Nuremberg, 1947), p. 208.

14/ McNair and Watts, The Legal Effects of War (Cambridge University Press, 1966), pp. 2-6. There is also a question as to when belligerent rights terminate. Thus, for example, the Security Council rejected Egypt's claim to exercise the belligerent rights of visit, search and seizure of an Israeli vessel on the basis that it was still in a state of war with Israel, noting that active hostilities had ceased several years earlier (see Official Records of the Security Council, Ninth Year, Supplement, January, February and March 1954, p. 2). See also Nathan Feinberg, The Legality of a State of War after the Cessation of Hostilities under the Charter of the United Nations and the Covenant of the League of Nations (Jerusalem, The Magnes Press, The Hebrew University, 1961).

15/ The Israelis also indicated that the "state of war" with Iraq was a factor in their assessment of Iraqi intentions and of the necessity to exercise their right of anticipatory self-defence.

16/ Austria, Bahamas, Bangladesh, Botswana, Cyprus, Denmark, Ecuador, El Salvador, Finland, Gabon, Ghana, Jordan, Korea, Republic of, Lao People's Democratic Republic, Libyan Arab Jamahiriya, Mauritania, Mauritius, Mexico, Mozambique, Niger, Norway, Sweden, Switzerland, Tunisia, United Arab Emirates, United Republic of Tanzania, Viet Nam, Yugoslavia and Zaire. Protocol I has been signed but not yet ratified by 45 other States.

17/ Including suggestions for further amendment of the Geneva Conventions of 1949 and a proposal made by Soviet Foreign Minister Andrei Gromyko in his address to the General Assembly on 1 October 1982, that the General Assembly declare the destruction of peaceful nuclear facilities with conventional weapons equivalent to an attack with the use of nuclear weapons.

APPENDIX I

Pertinent provisions of Protocol I Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts

"Article 56 - Protection of works and installations containing dangerous forces

"1. Works or installations containing dangerous forces, namely dams, dykes and nuclear electrical generating stations, shall not be made the object of attack [emphasis added], even where these objects are military objectives, if such attack may cause the release of dangerous forces and consequent severe losses among the civilian population [emphasis added]. Other military objectives located at or in the vicinity of these works or installations shall not be made the object of attack if such attack may cause the release of dangerous forces from the works or installations and consequent severe losses among the civilian population.

"2. The special protection against attack provided by paragraph 1 shall cease:

"...

"(b) For a nuclear electrical generating station only if it provides electric power in regular, significant and direct support of military operations and if such attack is the only feasible way to terminate such support;

"...

"3. In all cases, the civilian population and individual civilians shall remain entitled to all the protection accorded them by international law, including the protection of the precautionary measures provided for in Article 57 [which relate to planning and decisions upon attacks]. If the protection ceases and any of the works, installations or military objectives mentioned in paragraph 1 is attacked, all practical precautions shall be taken to avoid the release of the dangerous forces.

"4. It is prohibited to make any of the works, installations or military objectives mentioned in paragraph 1 the object of reprisals [emphasis added].

"..." (see A/32/144, annex I)

APPENDIX II

Safeguards and the Iraqi nuclear centre

(Background briefing paper issued by the International Atomic Energy Agency in December 1981)

In recent public discussions of the Israeli attack on the Iraqi nuclear centre on 7 June 1981 many statements have been made about the ability of the International Atomic Energy Agency (IAEA) to detect in such a centre the clandestine diversion of nuclear material to produce plutonium for nuclear weapons and about the use that could be made of nuclear facilities and material at the centre.

The following comments are intended to place the matter in its correct perspective.

General comment

In the first place it is essential to understand the obligations of Iraq as a country that has ratified the Treaty on the Non-Proliferation of Nuclear Weapons and has concluded the required safeguards agreement with IAEA as well as the obligations of IAEA under that agreement.

In broad terms, Iraq is required to place under IAEA safeguards all nuclear material in every nuclear activity that it conducts. In the case of nuclear material of a composition and purity not suitable for fuel fabrication without further processing (for example, yellow cake), Iraq is required to inform IAEA about all imports and exports. All other nuclear material (natural and enriched uranium, plutonium) is subject to the full range of IAEA safeguards. All production of such material and every movement of such material (except very small quantities) must be recorded and reported to IAEA. Well before such material is introduced into a new facility, IAEA must be given the information about the design of the facility that it needs to carry out effective safeguards.

Iraq concluded its NPT (non-proliferation Treaty) safeguards agreement in 1972 and has carried out its obligations under the agreement. Imports of yellow cake have been notified to IAEA and the yellow cake has in fact been made available for inspection although this is not required by the agreement. Imports of other nuclear materials including the fuel for the small Soviet-supplied reactor that Iraq has been operating since 1973, for the low-power Tammuz II reactor and for the 40 MW(th) Tammuz I research reactor have similarly been notified and inspected by IAEA. Design information on these facilities has been submitted to IAEA in accordance with the requirements of the agreement. Iraq is also establishing a number of small research facilities at the centre (a "hot" laboratory, other facilities for nuclear fuel manufacture and for isotope production, etc.). Before Iraq introduces nuclear material into these facilities, it will have to provide IAEA with design information about them and IAEA safeguards will follow the nuclear material into them.

For its part, IAEA is obliged under the agreement to ensure that safeguards are applied on all nuclear material in Iraq. This obligation would apply even if Iraq were to fail to notify IAEA of certain material. While IAEA inspectors cannot, of course, travel around a country that has accepted full-scope safeguards in search of any material that it may have failed to notify, the inspectors would be obliged to report to IAEA any such material that they might find in the course of an inspection. IAEA would require that the material be promptly placed under safeguards and would draw the attention of the authorities concerned to the infraction of their reporting obligations.

IAEA has been carrying out its obligations under the agreement. It has been regularly inspecting the small Soviet-supplied research reactor since 1973. It inspected the nuclear fuel for Tammuz II and Tammuz I in June 1980 when the fuel arrived from France (approximately 12 1/2 kg of highly enriched uranium). The fuel was again inspected in January 1981 and a further inspection was due shortly after the time of the Israeli attack. Because of the damage to the reactor and the presence of unexploded bombs, the inspectors were not able to verify the presence of the Tammuz fuel. However, after receiving notification that the bombs had been removed, a further inspection was carried out in mid-November 1981 and all the fuel was accounted for.

IAEA examined the design information for Tammuz I and Tammuz II when it was received in June 1980 and was in the process of drawing up a "facility attachment" (that is, the detailed document setting forth all arrangements for safeguarding the reactor) when the Israeli attack took place.

IAEA safeguards are designed to detect in a timely manner the diversion of a significant quantity of nuclear material. It is not the task of IAEA to speculate on the plans or intentions of the States in which safeguards are applied. IAEA safeguards are concerned with measurable and observable actions. It is for Governments to assess intentions.

However, as a safeguarding authority, it is the obligation of IAEA not to exclude the possibility that any country in which safeguards are applied might seek to divert nuclear material. If such a possibility were excluded, there would be no reason for safeguards. Accordingly, IAEA prepares hypothetical diversion "strategies" for all types of nuclear plants in order to develop safeguards approaches to counter the diversion strategy in question. Originally the "diversion strategy" for the Tammuz reactors assumed that they would be using significant quantities of highly enriched uranium (25 kg is considered sufficient for the production of a single nuclear explosive). When Iraq acquired yellow cake and natural uranium from various sources, IAEA was similarly obliged, as a safeguarding authority, to study a second diversion strategy for the unlikely but not impossible case that the reactor would be used for the clandestine production of plutonium. This study began early in 1980.

The Tammuz I Reactor

The Tammuz I (Osirak) reactor is a 40 MW(th) research reactor modelled closely on the Osiris reactor in France.

It is a reactor of the pool type (see figure I). In other words, its fuel assemblies are inserted into holes in a grid at the bottom of a tank that is filled with ordinary water about 10 m deep. Above the grid is a rectangular "chimney" in and out of which clear water circulates (the water moderates and cools the reactor and serves as a radiation shield protecting the persons operating the reactor or carrying out experiments in it). The chimney and the tank are open at the top and all fuel assemblies are visible from above. The grid within the chimney as well as a grid surrounding it have holes into which capsules or containers can be inserted for irradiation, for instance, in order to test the behaviour of various materials under radiation or to produce radioisotopes for medical or research purposes. Essentially, the Tammuz reactor is an enlarged version of a standard type of research reactor used at many nuclear centres throughout the world.

The following are more detailed comments on a number of statements made in the course of public discussions.

1. Statement

It has been stated that of all available research reactors, the Osiris type reactor is one of the most suitable for the production of weapons-grade plutonium.

Comment

On the contrary, the Osiris type reactor produces practically no plutonium during normal operation because of the very high U-235 content (93 per cent) of its fuel. The most suitable reactors for producing plutonium are natural uranium reactors that use completely unenriched fuel. A natural urnanium reactor directly produces the plutonium in its own fuel. Natural uranium research reactors (moderated by heavy water) are in operation in several countries. Two of them are unsafeguarded: one in Israel, one in India. The Indian natural uranium research reactor is reported to be the one used for producing the plutonium for the nuclear explosion that India conducted in 1974.

It is true that a highly enriched uranium reactor of the Osiris type can be used to produce larger amounts of plutonium by changing substantially the mode of operation of the reactor, by introducing into the reactor large quantities of natural uranium (not part of the reactor's fuel) and by irradiating this natural uranium. Such a procedure is technically feasible but it represents a much more complex and elaborate operation than simply using a natural uranium reactor's own fuel to produce plutonium. Diversion strategies that assume such changes in the mode of operation of the reactor are examined in point 4. It should be noted that the use of a reactor in this manner would result in the consumption of more fissile (that is, potentially explosive) nuclear material in the form of highly enriched uranium than the fissile material produced (in the form of plutonium).

2. Statement

It has been stated that the IAEA safeguards system is especially suited for reactors that produce electric power (rather than for research reactors) and that IAEA inspections concentrate on the nuclear materials accounting system for the reactor and its fuel cycle.

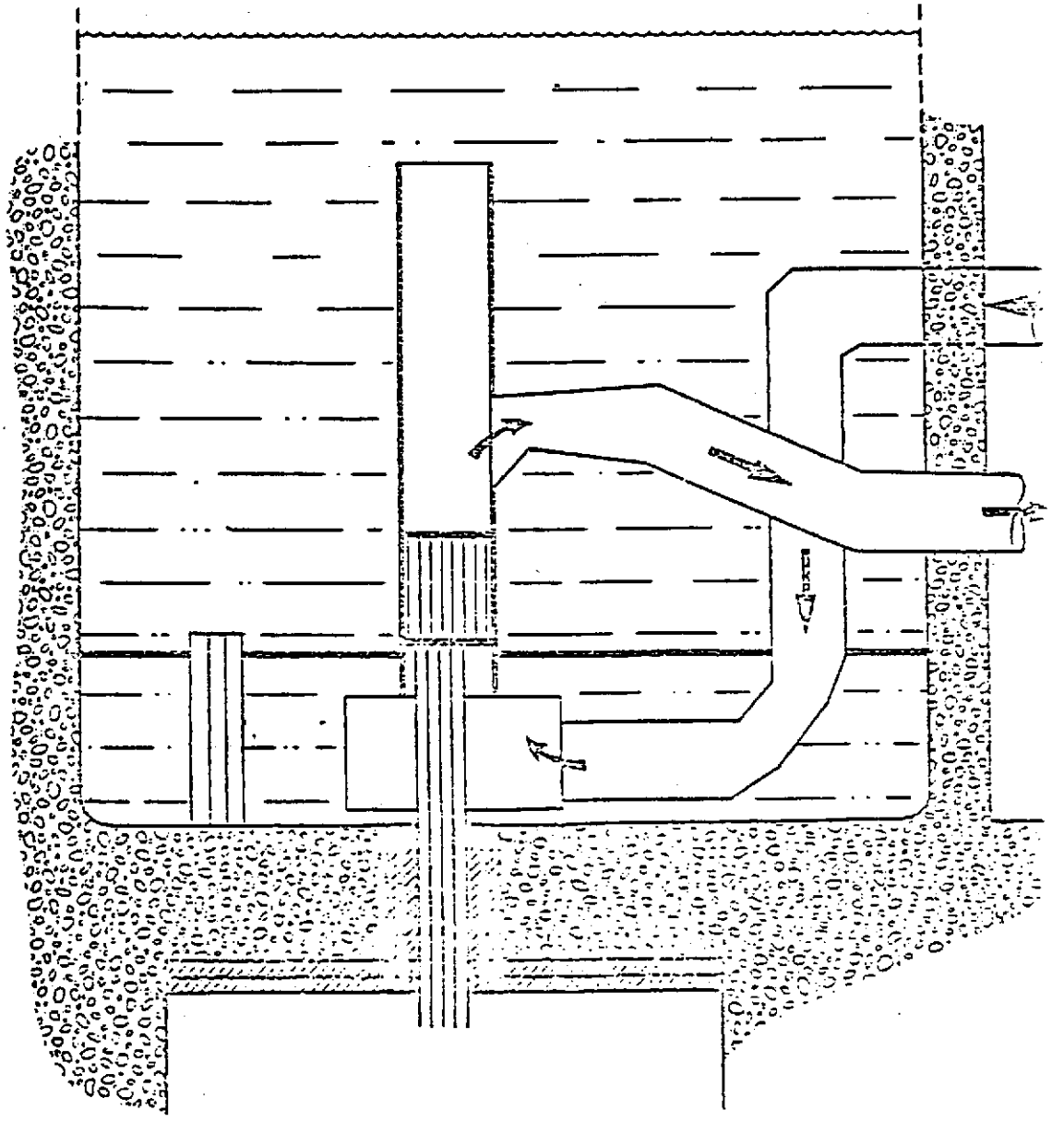

Figure I. Vertical section of the Osiris reactor

Comment

In fact, IAEA applies safeguards, inter alia, at 175 research reactors of which about 100 are swimming-pool- and tank-type reactors like Tammuz I. A few of those reactors operate at similar power level to that planned for Tammuz I. IAEA has been applying its safeguards at research reactors since the early 1960s and extensive experience has shown that reactors of this simple, swimming-pool- or tank-type design present no special problem for safeguards.

3. Statement

It has also been stated that it would be very difficult for IAEA safeguards to prevent the operator from diverting fresh or slightly irradiated highly enriched uranium fuel from an Osiris-type reactor to make nuclear weapons.

Comment

It is not difficult to detect diversion of highly enriched nuclear fuel from this type of research reactor whether the fuel be fresh or irradiated:

(a) The fuel assemblies are fairly large (about 1 m long and 8 cm across), are relatively few in number (30 to 40) and are clearly visible from above through the coolant water. Any possibility that an inspector might miscount, and therefore not detect, the removal of fuel assemblies can thus be dismissed;

(b) If a fuel assembly were taken out and replaced by an inert dummy, the absence of the characteristic Cherenkov glow emitted by an irradiated fuel assembly would give the dummy away;

(c) In addition, IAEA uses non-destructive techniques to verify the enrichment of fuel. Thus, the replacement of some of the original highly enriched fuel assemblies by dummies containing natural uranium would also be detected;

(d) Diversion of a quantity of highly enriched uranium sufficient to make a nuclear explosive would in fact require removal of all, or at least a large proportion of, the highly enriched fuel assemblies. Besides being easily detectable, this would make it impossible for the reactor to operate. This, too, would not escape notice.

4. Statement

It has been said that it would have been relatively simple to produce weapons-grade plutonium within the "chimney" of the Tammuz I reactor in a manner unobservable to IAEA inspectors. In support of this contention it has been said that this procedure would not have involved the highly enriched fuel used in the reactor. There would therefore have been no observable anomalies in the materials accounting for this fuel.

This use of the reactor "chimney" to produce plutonium would be possible without any modification of the external hardware of the reactor. It has been

contended that the process would simply involve moving natural uranium target assemblies (clandestinely inserted into the reactor) within the core of the reactor. There would be no way of detecting this except by continuous human inspection. Even surveillance equipment would not be effective. Since IAEA inspection is not continuous and IAEA normally gives advance notice before sending an inspector, Iraq could have loaded the reactor with natural uranium after each inspection and unloaded it before the next. In this way, Iraq could have produced plutonium without fear of being detected by IAEA inspectors.

Comment

The strategy described in this series of statements is the main basis for claiming that IAEA safeguards would not have detected the misuse of the Tammuz I reactor to produce plutonium in sufficient quantities for a nuclear weapons programme. It calls for several detailed comments:

(a) In the first place, the most effective way of using a highly enriched uranium reactor of this type to produce plutonium is to erect a blanket of natural uranium assemblies outside the "chimney" in addition to inserting such assemblies in the reactor core. This would entail conspicuous permanent structural modifications that would be detected visually by the IAEA inspector (see figure II). Furthermore, this "blanket" would require additional cooling of the reactor, also a conspicuous modification. This strategy is therefore not plausible;

(b) A diversion strategy using the "chimney" without external structural modification, would also involve easily detectable activities. Before describing these activities, it should be pointed out that this "chimney" strategy would not produce one significant quantity of (8 kg) of plutonium 1/ during one year. In fact, the amount of plutonium that could be produced each year would be of the order of up to two kilograms. This assumes a reasonably attainable annual operating time for the reactor and that it would be operated at its full rated power of 40 MW(th). It also takes into account the space that would in practice be available (for natural uranium assemblies) in the "chimney". Despite these inherent limitations, the "chimney" diversion strategy was also considered in preparing the safeguards approach for the Tammuz I reactor;

(c) The number of highly enriched assemblies that should be present in the core can easily be determined from the records of the fuel supplied to Iraq and the fresh as well as the spent fuel in storage at the reactor. As has already been noted, visual inspection is sufficient to determine the total number of assemblies actually present in the "chimney". Several devices are available for checking whether "fertile" natural uranium assemblies have been substituted for any of the supplied highly enriched fuel or added to it. These devices include fission chambers, Cherenkov glow-devices, underwater periscope and underwater closed-circuit television that permits very detailed observation;

(d) Furthermore, the concealment procedure is by no means as simple as has been contended. It means that, after each inspection, most or all of the about 35 highly enriched assemblies would have to be clandestinely rearranged in the reactor grid. In addition, about 20 natural uranium fuel assemblies would have to be clandestinely inserted into the grid. Each of these assemblies is about one metre long and 8 cm across and weighs up to 20 kg;

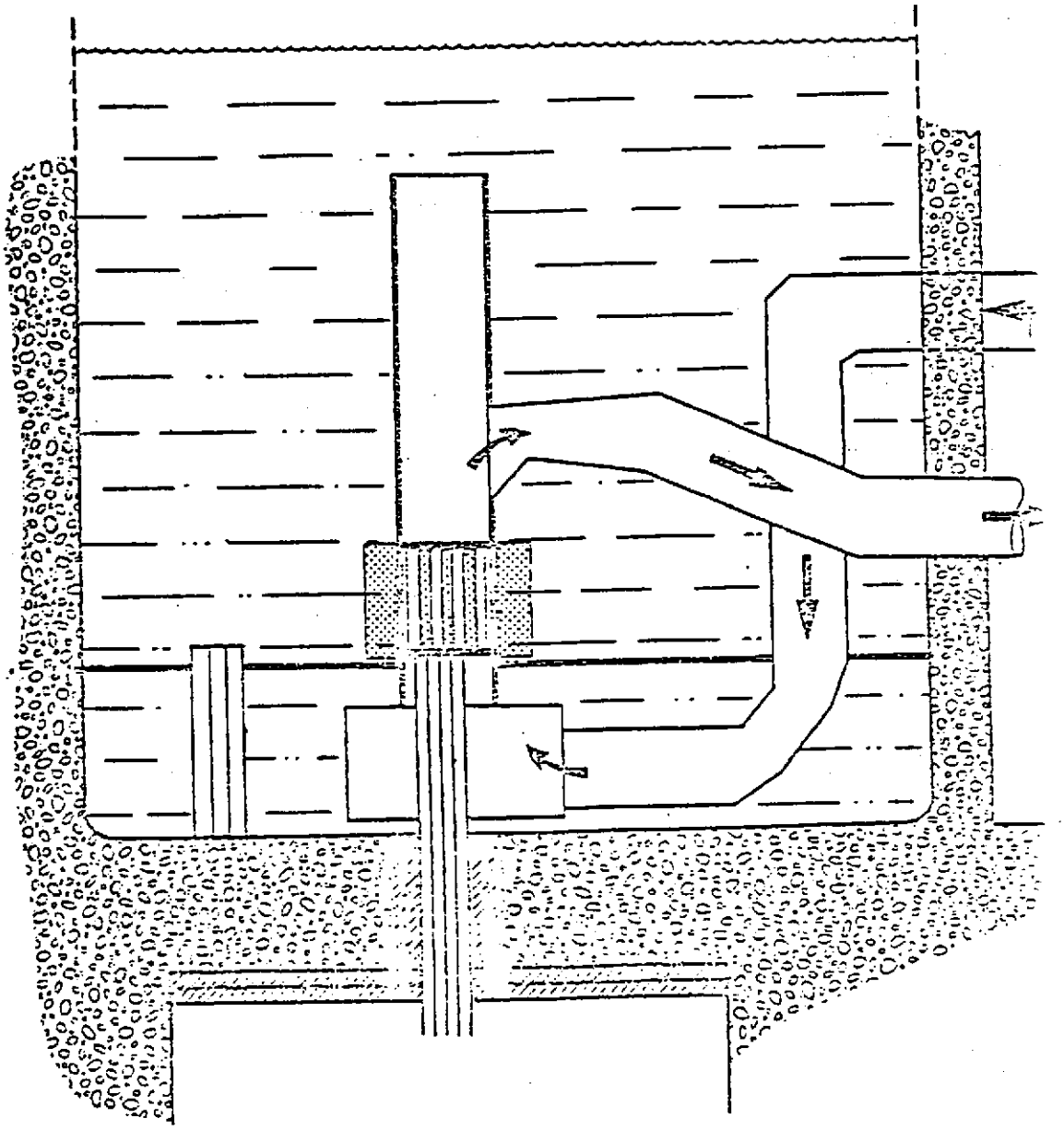

Figure II. Vertical section of the Osiris reactor

(e) Before the next inspection, all the "fertile" natural uranium assemblies would have to be clandestinely lifted about five metres to remove them from the "chimney". Since they are intensely radioactive they would have to be transferred in heavy shielded flasks out of the reactor and hidden elsewhere. Furthermore, to avoid arousing suspicion, all the original highly enriched uranium fuel assemblies would have to be restored to a normal configuration. With a minimum inspection frequency of approximately once a month, 2/ this elaborate clandestine procedure would have to be repeated 12 times a year and several hundred assembly transfers would have to be carried out. This would severely reduce the time available for plutonium production and the annual output would be below the two kilograms or so producible. Moreover, the fertile natural uranium rods would look very different from the irradiation capsules that would normally be used for experiments and isotope production. The abnormal activity before and after inspection would be easily detected by the automatic optical surveillance of the reactor (see point 5);

(f) Moreover, once the natural uranium assemblies had built up sufficient plutonium, they would have to be removed as above in heavy containers from the reactor pool or moved about 20 m in a water channel and brought into the hot cells;

(g) In order to produce sufficient plutonium for a single nuclear explosive device, about 500 natural uranium assemblies would have to be clandestinely produced and inserted into the reactor and subsequently removed from the bottom of the transparent pool, thus requiring about 1,000 movements. In addition, because plutonium production in a Tammuz-I-type research reactor would rapidly consume the highly enriched fuel, the original fuel assemblies would have to be replaced frequently. About 100 such replacements would be necessary, thereby entailing a further 200 movements;

(h) All in all, the production of the required amount of plutonium would involve more than 1,000 movements of rather large objects in addition to the elaborate procedures involved in rearranging the reactor core configuration and removing and reinserting all the natural uranium assemblies before and after each inspection. To complete the "cover-up" it would also be necessary to falsify the operating records of the reactor;

(i) In short, the clandestine production of plutonium in the "chimney" would involve exceptionally intense and sustained activity at the reactor that would clearly distinguish it from normal research activities and which would easily be detected by inspectors and would be recorded on film by IAEA surveillance cameras;

(j) Finally, the use of the "chimney" in this fashion would entail a large consumption of highly enriched fuel, far greater than that consumed by a reactor of this kind for normal research activities. The highly enriched fuel load would in fact have to be completely replaced three or four times a year. This anomalous consumption of fuel would be obvious when inspectors examined the accounting and operating records of the reactor; it would be equally obvious to the supplier of the fuel (which moreover notifies the secretariat of IAEA of its shipments). In

other words, the use of the "chimney" for the production of plutonium would require the co-operation of the country supplying the highly enriched uranium.

5. Statement

It has been stated that no television and photographic surveillance instruments - to monitor events between the visits of inspectors - are foreseen in present safeguards approaches for large research reactors like Tammuz I. As a result there are no means available to detect diversion between inspections.

It has been contended that the normal mode of operation of large research reactors like Tammuz I may include frequent insertion in to the core and removal therefrom of irradiation capsules and experimental systems. This makes it difficult to interpret unambiguously the results of surveillance (that is, pictures taken by surveillance cameras).

It has been further stated that, in the case of Tammuz I, there are no standard experimental systems, element containers, etc., and containment/ surveillance measures would have been ineffective. Even if camers had detected unreasonably frequent movements, IAEA inspectors could not have intervened.

Comment

The draft facility attachment for Tammuz I provides for containmnt and surveillance measures to survey the fresh fuel storage, the spent fuel storage area and the reactor hall. These include automatic, tamper-indicating camera systems, taking pictures every few minutes throughout the year. These measures are essentially the same as those applied at a similar large research reactor in another State.

The numerous "fertile" assemblies containing natural uranium that Iraq would have had to introduce clandestinely into the reactor in order to breed plutonium would have been quite different in appearance from those of the targets normally used for experimental purposes. As has already been stated, IAEA surveillance instruments would record any unusual activities and movements of natural or irradiated uranium in and out of the "chimney" would have been detected.

IAEA inspectors are entitled to ask for explanations of any unusual movements. They are also entitled to check the contents of the entire core of the reactor during its shut-down periods and to carry out special inspections if circumstances so require.

6. Statement

It has been stated that the subsidiary arrangements (that is, facility attachments) relating to Tammuz I and Tammuz II were not in force by 31 December 1980, although the fuel for the reactors had been supplied six months earlier. This, it has been contended, is in direct contradiction of article 42 of the safeguards agreement. Because of this, all inspections carried out after the fuel arrived had to be "ad hoc" inspections. It has been further contended that

the absence of subsidiary arrangements and facility attachments for Tammuz I and II and other facilities and locations containing nuclear material could also be considered as an irregularity if not a violation by Iraq of its obligations.

Comment

The fact that no facility attachment was in force for Tammuz I and II at the end of 1980 was not in contradiction with either article 42 or any other article of the safeguards agreement with Iraq and does not constitute any violation of that agreement.

Article 42 of the safeguards agreement requires only that design information shall be provided as soon as possible before nuclear materials are introduced into a nuclear facility. Iraq had in fact provided such design information well before the nuclear material could have been inserted in Tammuz I.

The provision of the agreement relating to the conclusion of subsidiary arrangements is article 40. This, however, dealt with the situation when the agreement entered into force and provided that Iraq and IAEA should make every effort to bring the subsidiary arrangements (including the facility attachments for all their then existing facilities) into force within 90 days of the entry into force of the original agreement. In the case of Iraq the subsidiary arrangements entered into force in July 1973.

To ensure that effective safeguards can be applied pending the entry into force of facility attachments, all NPT safeguards agreements authorize IAEA to carry out "ad hoc" inspections during such transition periods. Unlike the "routine" inspections that follow the entry into force of the facility attachments, these "ad hoc" inspections are neither limited in number nor in access. Apart from this, there is nothing unusual about "ad hoc" inspections; on the contrary, they are common practice when, as is often the case, considerable time is needed for drawing up a facility attachment. Finally, the absence of facility attachments for other facilities and locations at the centre is also quite normal since no nuclear material has been introduced into these facilities and locations. As already pointed out, (see "General comment" above), Iraq must submit design information for these other facilities/locations before nuclear material is introduced into them.

7. Statement

It has been stated that various IAEA papers have given the power of Tammuz I as 50 MW(th) and 40 MW(th), respectively, while in fact the power output of the Tammuz I is 70 MW(th). This confusion is said to reflect the failure of Iraq to provide IAEA with adequate design information.

Comment

The IAEA annual report for 1980 correctly states that the output of Tammuz I is 40 MW(th). This is the figure indicated in the design information. The Osiris reactor in France on which Tammuz I was modelled can indeed be operated up to 70 MW(th) but this is not possible in the case of Tammuz I. Because of constraints

arising from local climatic conditions, its power level cannot be raised above 40 MW(th) without substantial modifications.

8. Statement

It has been stated that the existing IAEA safeguards methods do not apply to nuclear research in facilities and that, because of this, there are substantial possibilities of diversion and concealment at Tammuz-I-type reactors. For instance, the operator need give no information to an IAEA inspector about an experiment that the operator undertakes in the reactor. The operator's obligation is only to submit accounts of changes in the inventory of fuel that Iraq has "declared" to IAEA. In a large research reactor such as Tammuz I this would, for instance, permit the operator to insert various targets into the reactor, including undeclared uranium for which the operator is not accountable to IAEA or its inspectors.

Comment

The operator is accountable to IAEA and the inspector for any nuclear material - natural or enriched uranium or plutonium - that he introduces into or produces in the reactor. In fact, Iraq, as already pointed out, must report all nuclear material in Iraq (and not only in the reactor) to IAEA. The operating records of the reactor must, inter alia, indicate the location of all nuclear material as well as the amount of power the reactor produces while it is in operation. For these reasons, as well as those already given in the "General comment" above, the insertion of natural uranium assemblies into the reactor would have to be reported and any clandestine insertion would be detected.

9. Statement

It has been stated that NPT does not permit IAEA to carry out special inspections on the basis of accusations by other countries.

Comment

No safeguards system in force today provides for such inspections. Apparently this is a reference to the Additional Protocol I of the Treaty for the Prohibition of Nuclear Weapons in Latin America (Treaty of Tlatelolco), 3/ which foresees that under certain circumstances special inspections may be carried out at the cost of an accuser country when it alleges that any activity contrary to the Treaty (such as the clandestine import of nuclear weapons or the operation of clandestine facilities) is taking place. However, the provisions of the Treaty have not been articulated into any inspection procedures by the organization responsible for monitoring the application of the Treaty (Organization for the Prohibition of Nuclear Armaments in Latin America) and no inspections are carried out.

On the other hand, when unusual events occur, IAEA is fully entitled to require special reports and to carry out special inspections.

10. Statement

It has been stated that IAEA convened an "extraordinary meeting" of nine senior specialists to consider the "dangers presented" by the Iraqi nuclear programme and that the specialists concluded that "plutonium diversion paths were technically practicable" because the existing safeguards approach to reactors of the Tammuz-I-type was inadequate. The IAEA specialists are stated to have said that the requisite "strengthening" of safeguards would involve a fundamental change in the scope of IAEA responsibilities, including searching for clandestine installations instead of merely verifying the accuracy of governmental statements. It was further stated that the latter idea was dismissed as being quite unacceptable to Governments.

Comment

No "extraordinary meeting" was convened. As indicated in the "General comment" above, when Iraq obtained supplies of natural uranium, IAEA began studying the possibility of a plutonium diversion strategy (which is indeed "technically practicable", otherwise there would have been no need to study it). The directive to begin the study was given in April 1980, the study was completed in September 1980 and it was taken into account in preparing the draft facility attachment for the Tammuz I reactor. In November 1980, the IAEA specialists were also asked to explore a safeguards approach in which IAEA would endeavour to detect diversion of as little as one kilogram of plutonium a year. (The standard current goal is eight kilograms a year, that is, the amount needed to make an explosive). This approach was found to be impracticable and the IAEA specialists recommended retention of the eight-kilogram goal as a design guideline but left no doubt that this goal could be attained at the Tammuz reactors. IAEA specialists submitted technical proposals for doing so.

The question of the rights of IAEA in regard to unreported nuclear material is dealt with in the "General comment" above.

Despite its inaccuracies, the statement referred to above illustrates clearly that IAEA takes considerable pains to study alternative diversion paths and detection strategies and that these are discussed internally in a free and critical manner.

11. Statement

It has been stated that several very sensitive nuclear facilities at the Iraqi centre are not subject to IAEA safeguards under the safeguards agreement. These are stated to include a uranium manufacturing facility, a small "hot" laboratory capable of handling small quantities of plutonium, a training installation on the operation of separation plants and various other facilities about which, it was stated, Iraq has not provided design information to IAEA. The conclusion drawn was that, so long as Iraq maintains that it is not processing plutonium or fabricating nuclear fuel in these facilities, they would remain outside safeguards.

Comment

Thre are no nuclear facilities in Iraq that are "not subject to safeguards under the safeguards agreement". As indicated in the "General comment" above, Iraq is required to place all nuclear material in Iraq under safeguards and it appears to have done so. Iraq is also required to provide design information when it plans to introduce nuclear materials into new facilities. Upon such introduction they automatically come under safeguards. Iraq has provided such design information on all facilities that now contain nuclear material and there is no reason to assume that it would fail to carry out its obligations in respect of the facilities mentioned in the statement (facilities of which IAEA is fully aware and about which it has received general information from the supplier country). Moreover, before these facilities could be used for the clandestine separation of plutonium, it would first be necessary to produce and divert material in the reactor itself as described in point 4. Any such diversion would have been detected.

12. Statement

It has been stated that Iraq is entitled to accept or reject IAEA designated inspectors and has exercised that right and that only inspectors of Soviet and Hungarian nationalities have been reported to have visited Iraq.

Comment

No country would be prepared to relinquish its right under international law to decline the designation of a particular inspector. In fact, however, IAEA has proposed and Iraq has accepted the designation of inspectors from France, Hungary, Switzerland and the Soviet Union, and an inspector of French nationality took part in the inspection carried out from 15 to 17 November 1981.

13. Statement

It has been stated that Iraq is entitled to determine the time of a proposed inspection and that in practice, inspectors arrive in Iraq only after prior notice is given. If IAEA attempted to exercise its right to carry out an inspection without advance notification (as article 84 of the agreement provides), Iraq would have been able to employ various tactics to delay the actual inspection and thus to cloak any clandestine activities.

It has been further stated that such "delaying tactics" can prevent inspections for lengthy periods and that IAEA is forced to accept them without protest. To substantiate this, it has been stated that Iraq took advantage of "such a loophole" in November 1980 when it notified IAEA that, in view of the fact that it was at war with Iran, it was unable to accept inspectors. IAEA "admitted that it was concerned" but was unable to act upon its concern. Iraq could have repeated such tactics at a later date when even larger quantities of weapons-grade material might have been in its possession.

Comment

Iraq is not entitled to determine the time of a proposed inspection. The decision on the timing of inspections rests entirely with IAEA. Normally, IAEA arranges timing with the plant operator so as to ensure that IAEA inspectors are present during crucial operations (for instance, the annual discharge and reloading of the fuel of a ligh-water reactor, or at times when the operator is taking a physical inventory of all nuclear material; such inventories are usually not taken more than twice a year depending upon the type of facility). Moreover, technical preparations are often necessary in advance to ensure that an inspector does not waste time, for example, preparations for the taking of samples or calibration of instruments. However, IAEA has the right to carry out routine inspections without advance notice.

On no occasion during its inspections in the 49 non-nuclear-weapon countries party to NPT that are operating nuclear facilities has IAEA encountered "delaying tactics"; if they were encountered, they would have to be reported immediately to the Board of Governors of IAEA under article 18 of the standard NPT safeguards agreement. The circumstances of the incident referred to differ substantially from the description given. In November 1980, after the war between Iran and Iraq broke out, IAEA telexed the Iraqi authorities to enquire about the status of the nuclear material at the nuclear centre and about inspection access. In reply, the Iraqi authorities confirmed that all nuclear material was intact and accounted for and that they would advise IAEA as soon as inspections could safely be resumed. IAEA responded that it was for it to determine whether the risks involved in carrying out an inspection were acceptable. The Iraqi authorities agreed and arrangements were made for a further inspection, which took place in January 1981 and which confirmed that all nuclear material under safeguards in Iraq was indeed accounted for and that all the nuclear fuel for Tammuz I was in storage awaiting the date when the reactor could be started up.

Notes

1/ Taking into account losses, this is the minimum amount of plutonium considered to be sufficient for a single nuclear explosive device.

2/ If large amounts of fresh fuel should be present at the plant, inspection frequency would be raised up to 26 times a year.

3/ United Nations, Treaty Series, vol. 634, No. 9068, p. 326.
