107TH CONGRESS
2d Session

SENATE

TREATY DOC.
107–7

THE PROTOCOL TO THE AGREEMENT OF THE INTERNATIONAL ATOMIC ENERGY AGENCY REGARDING SAFEGUARDS IN THE UNITED STATES

MESSAGE

FROM

THE PRESIDENT OF THE UNITED STATES

TRANSMITTING

THE PROTOCOL ADDITIONAL TO THE AGREEMENT BETWEEN THE UNITED STATES OF AMERICA AND THE INTERNATIONAL ATOMIC ENERGY AGENCY FOR THE APPLICATION OF SAFEGUARDS IN THE UNITED STATES OF AMERICA, WITH ANNEXES, SIGNED AT VIENNA JUNE 12, 1998

MAY 10, 2002.—Protocol was read the first time, and together with the accompanying papers, referred to the Committee on Foreign Relations and ordered to be printed for the use of the Senate

U.S. GOVERNMENT PRINTING OFFICE
99–118 WASHINGTON : 2002

LETTER OF TRANSMITTAL

THE WHITE HOUSE, *May 9, 2002.*

To the Senate of the United States:

I submit herewith, for Senate advice and consent to ratification, the Protocol Additional to the Agreement Between the United States of America and the International Atomic Energy Agency for the Application of Safeguards in the United States of America, with annexes, signed at Vienna June 12, 1998 (the "Additional Protocol"). Adhering to the Additional Protocol will bolster U.S. efforts to strengthen nuclear safeguards and promote the nonproliferation of nuclear weapons, which is a cornerstone of U.S. foreign and national security policy.

At the end of the Persian Gulf War, the world learned the extent of Iraq's clandestine pursuit of an advanced program to develop nuclear weapons. In order to increase the capability of the International Atomic Energy Agency (the "Agency") to detect such programs, the international community negotiated a Model Additional Protocol (the "Model Protocol") to strengthen the Agency's nuclear safeguards system. The Model Protocol is to be used to amend the existing bilateral safeguards agreements of states with the Agency.

The Model Protocol is a milestone in U.S. efforts to strengthen the safeguards system of the Agency and thereby to reduce the threat posed by clandestine efforts to develop a nuclear weapon capability. By accepting the Model Protocol, states assume new obligations that will provide far greater transparency for their nuclear activities. Specifically, the Model Protocol strengthens safeguards by requiring states to provide broader declarations to the Agency about their nuclear programs and nuclear-related activities and by expanding the access rights of the Agency.

The United States signed the Additional Protocol at Vienna on June 12, 1998. The Additional Protocol is a bilateral treaty that would supplement and amend the Agency verification arrangements under the existing Agreement Between the United States of America and the International Atomic Energy Agency for the Application of Safeguards in the United States of America of November 18, 1977 (the "Voluntary Offer"), which entered into force on December 9, 1980. The Additional Protocol will enter into force when the United States notifies the Agency that the U.S. statutory and constitutional requirements for entry into force have been met.

The Treaty on the Non-Proliferation of Nuclear Weapons (the "NPT") requires non-nuclear-weapon states parties to accept Agency safeguards on their nuclear activities. The United States, as a nuclear-weapon state party to the NPT, is not obligated to accept Agency safeguards on its nuclear activities. Nonetheless, it has been the announced policy of the United States since 1967 to per-

mit the application of Agency safeguards to its nuclear facilities—excluding only those of direct national security significance. The Additional Protocol similarly allows the United States to exclude its application in instances where the United States decides that its application would result in access by the Agency to activities with direct national security significance to the United States or access to locations or information associated with such activities. I am, therefore, confident that the Additional Protocol, given our right to invoke the national security exclusion and to manage access in accordance with established principles for implementing these provisions, can be implemented in a fashion that is fully consistent with U.S. national security.

By submitting itself to the same safeguards on all of its civil nuclear activities that non-nuclear-weapon states parties to the NPT are subject to, the United States intends to demonstrate that adherence to the Model Protocol does not place other countries at a commercial disadvantage. The U.S. signature of the Additional Protocol was an important factor in the decisions of many non-nuclear-weapon states to accept the Model Protocol and provided significant impetus toward their early acceptance. I am satisfied that the provisions of the Additional Protocol, given our right to manage access in accordance with Article 7 and established implementation principles, will allow the United States to prevent the dissemination of proliferation-sensitive information and protect proprietary or commercially sensitive information.

I also transmit, for the information of the Senate, the report of the Department of State concerning the Additional Protocol, including an article-by-article analysis, a subsidiary arrangement, and a letter the United States has sent to the Agency concerning the Additional Protocol. Additionally, the recommended legislation necessary to implement the Additional Protocol will be submitted separately to the Congress.

I believe that the Additional Protocol is in the best interests of the United States. Our acceptance of this agreement will sustain our longstanding record of voluntary acceptance of nuclear safeguards and greatly strengthen our ability to promote universal adoption of the Model Protocol, a central goal of my nuclear nonproliferation policy. Widespread acceptance of the Protocol will contribute significantly to our nonproliferation objectives as well as strengthen U.S., allied, and international security. I, therefore, urge the Senate to give early and favorable consideration to the Additional Protocol, and to give advice and consent to its ratification.

GEORGE W. BUSH.

LETTER OF SUBMITTAL

THE SECRETARY OF STATE,
Washington, April 30, 2002.

THE PRESIDENT: I have the honor to submit to you the Protocol Additional to the Agreement Between the United States of America and the International Atomic Energy Agency for the Application of Safeguards in the United States of America, with annexes (the "Additional Protocol"). I recommend that the Additional Protocol be transmitted to the Senate for advice and consent to ratification. Also enclosed, for the information of the Senate, are a letter the United States has sent to the International Atomic Energy Agency (the "Agency") concerning the Additional Protocol; a Subsidiary Arrangement to the Additional Protocol, which specifies particular, but not all, measures that the United States intends to use to protect information of direct national security significance to the United States and to manage access under the Additional Protocol; and an article-by-article analysis of the Additional Protocol, including its annexes. The recommended legislation necessary to implement the Additional Protocol will be submitted separately to the Congress.

The Additional Protocol was approved by the Board of Governors of the Agency on June 11, 1998, signed by the United States and the Agency on June 12, 1998, and will enter into force when the United States notifies the Agency that the U.S. statutory and constitutional requirements for entry into force have been met. The Administration intends to put in place the necessary regulatory and implementation framework before entry into force.

This Additional Protocol is a bilateral treaty that supplements and amends the Agency verification arrangements set forth in the existing Agreement Between the United States of America and the International Atomic Energy Agency for the Application of Safeguards in the United States of America of November 18, 1977 (the "Voluntary Offer"), which entered into force on December 9, 1980. Specifically, this Additional Protocol expands the types of nuclear and nuclear-related locations and activities the United States will declare and, by permitting access to these locations and activities in certain circumstances, expands the Agency's access rights. As is the case with the Voluntary Offer, the Additional Protocol permits the United States to exclude its application in instances where its application would result in access by the Agency to activities with direct national security significance to the United States or to locations or information associated with such activities (the "National Security Exclusion"). Consistent with the President's authority, the decision by a Federal Agency to use the National Security Exclusion will be guided by principles developed for its application. The

United States intends to provide information and access to the Agency in accordance with the terms of the Additional Protocol in order to assist it in developing the procedures, tools, and techniques that will strengthen the capability of the Agency to detect undeclared nuclear activities in non-nuclear-weapon states. The Additional Protocol contains no arms control or disarmament undertakings.

The Treaty on the Non-Proliferation of Nuclear Weapons (the "NPT") requires non-nuclear-weapon states parties to accept Agency safeguards on all nuclear material in all of their peaceful nuclear activities. The United States, as a nuclear-weapon state party to the NPT, is under no legal obligation to accept such safeguards. However, beginning with President Johnson's 1967 pledge, it has been the announced policy of the United States to permit the application of Agency safeguards to all of its nuclear facilities, except only those excluded for national security reasons. By submitting itself to the same safeguards on all of its civil nuclear facilities that non-nuclear-weapon states parties are subject to, the United States intended to demonstrate that adherence to the NPT did not place other countries at a commercial disadvantage, either because of increased costs associated with safeguards or because of the risk of the compromise of proprietary information. This offer was critical to gaining the acceptance of the NPT by countries such as Germany and Japan.

At the end of the Persian Gulf War, the world learned about the extent of Iraq's clandestine pursuit of an advanced program to develop nuclear weapons. The international community recognized that the Agency's international inspection system needed to be strengthened in order to increase its capability to detect secret nuclear programs. After 4 years of work by the Secretariat of the Agency, an Agency committee agreed on a Model Additional Protocol (the "Model Protocol") for strengthening nuclear safeguards. The Model Protocol was approved by the Agency's Board of Governors in 1997. The Model Protocol was designed to be used to amend existing safeguards agreements to strengthen such safeguards by requiring non-nuclear-weapon states to provide, inter alia, broader declarations to the Agency about their nuclear programs and nuclear-related activities, and by expanding the access rights of the Agency. The new safeguards measures become effective in each state when it brings its protocol into force.

During the negotiations of the Model Protocol, many non-nuclear-weapon states parties to the NPT urged the United States, as the strongest proponent, to accept on a voluntary basis the provisions of the Model Protocol. Following the example of the Voluntary Offer, the United States stated during the negotiations that it would accept the provisions of the Model Protocol, subject to a National Security Exclusion. The United States took a leading role in the negotiation of the Model Protocol, and the success in achieving a strong Model Protocol was critically dependent on voluntary acceptance of Model Protocol measures by the United States. The U.S. signature of the Additional Protocol was a significant factor in the early decision by many non-nuclear-weapon states to accept the Protocol. By the end of March of this year, 61 states had signed additional protocols with the Agency based on the Model Protocol.

The Model Protocol requires states to report a range of information to the Agency about their nuclear and nuclear-related activities and about the planned developments in their nuclear fuel cycles. This includes expanded information about their holdings of uranium and thorium ores and ore concentrates and of other plutonium and uranium materials not currently subject to Agency safeguards, general information about their manufacturing of equipment for enriching uranium or producing plutonium, general information about their nuclear fuel cycle-related research and development activities not involving nuclear material, and their import and export of nuclear material and equipment.

Such broad-based information makes it substantially more difficult for a state planning a nuclear-weapon program to conceal the early stages of that program and provides the Agency with a critical reference base for comparison with information otherwise available to it, including information from other states. The Model Protocol also provides the Agency with certain rights of access to declared locations as well as to other locations to investigate the possibility of undeclared activities. This increased risk of early detection is intended to deter non-nuclear-weapon states that might, in the future, be tempted to undertake a clandestine nuclear weapon program. With increased transparency of non-nuclear-weapon states' nuclear programs, the Agency should be able to provide greater assurance of both the absence of diversion of declared nuclear material and the absence of undeclared nuclear material and activities in non-nuclear-weapon states.

Minimizing the burden of safeguards on inspected locations is a long-standing concern of the Agency and its member states and is reflected in a number of provisions of existing safeguards agreements, including the Voluntary Offer, and in the Model Protocol. Existing Agency safeguards agreements specify that safeguards shall be implemented in a manner designed to avoid hampering economic and technological development and to avoid undue interference in peaceful nuclear activities, that the Agency shall take every precaution to protect commercial and industrial secrets and other confidential information coming to its knowledge, and that the Agency shall require only the minimum amount of information and data consistent with carrying out its responsibilities. These provisions of existing safeguards agreements remain in force and are expanded by the Model Protocol.

The overall design of the Model Protocol was shaped by the interest of states in establishing an appropriate balance between improving the effectiveness of the safeguards system and the need to avoid undue interference with legitimate nuclear or nuclear-related activities. The declaration requirements of the Model Protocol are of a general character. The Agency is precluded from mechanistically or systematically verifying the declarations. The Model Protocol defines the activities the Agency may carry out at locations of different types; provides for managed access to protect various classes of sensitive information; and provides for the negotiation of subsidiary arrangements as needed to further define how Protocol measures shall be applied, including at particular locations. The Model Protocol requires the Agency to maintain a stringent regime

to ensure effective protection against disclosure of confidential information.

The Department of State, the former Arms Control and Disarmament Agency, the Department of Defense, the Department of Energy, and the Nuclear Regulatory Commission, with the advice and support of the Central Intelligence Agency, were primarily responsible for the negotiation of the Additional Protocol. The responsibility for preparing for its entry into force has been undertaken by an interagency group led by the National Security Council staff and comprised of representatives of the Department of State, the Department of Defense, the Department of Justice, the Department of Commerce, the Department of Energy, the Nuclear Regulatory Commission, and the Central Intelligence Agency. Based on the deliberations of this interagency group, the Department of State, the Department of Defense, the Department of Justice, the Department of Commerce, the Department of Energy, and the Nuclear Regulatory Commission, with the advice and support of the Central Intelligence Agency, support the transmittal of the Additional Protocol to the Senate for advice and consent to ratification.

Acceptance of the Additional Protocol will sustain the longstanding U.S. record of voluntary acceptance of nuclear safeguards and greatly strengthen the U.S. ability to promote universal adoption of the Model Protocol, a central goal of U.S. nuclear nonproliferation policy. Widespread acceptance of the Model Protocol will contribute significantly to U.S. nonproliferation objectives, as well as strengthen U.S. and international security. I therefore recommend that you submit the Additional Protocol to the Senate for its advice and consent to ratification at the earliest possible date.

Respectfully submitted,

COLIN L. POWELL.

UNITED STATES MISSION TO
INTERNATIONAL ORGANIZATIONS IN VIENNA

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April 30, 2002

Mr. Mohamed ElBaradei
Director General
International Atomic Energy Agency
Vienna International Center

Dear Mr. ElBaradei:

I wish to inform the International Atomic Energy Agency of the decision to recommend that President Bush seek the advice and consent of the U.S. Senate to ratification of the Protocol Additional to the Agreement between the United States of America and the International Atomic Energy Agency for the Application of Safeguards in the United States of America (the "Additional Protocol"), signed on June 12, 1998.

The recommendation to the President to seek Senate advice and consent to ratification of the Additional Protocol is based on how the United States views implementation of key provisions of the Additional Protocol. The United States intends to provide information and access to the IAEA in accordance with the terms of the Additional Protocol in order to assist it in developing the procedures, tools, and techniques that will strengthen the capability of the IAEA to detect undeclared nuclear activities in "non-nuclear-weapon states" (NNWS).

A. Use of the National Security Exclusion and Managed Access

The Additional Protocol includes all of the measures of the Model Protocol adopted by the Board of Governors. It also contains several provisions unique to the status of the United States as a "nuclear weapon state" (NWS). In particular, the Additional Protocol contains a "national security exclusion" (NSE) that allows the United States to exclude the application of the Additional Protocol where the United States decides that its application would result in "access by the Agency to activities with direct national security significance to the United States or to locations or information associated with such activities." (Article 1.b) The Additional Protocol also contains a provision not contained in the Model Protocol for NNWS that permits the United States to manage access "in connection with activities with direct national security significance to the United States or in connection with locations or information associated with such activities."
(Article 1.c)

The United States will make full and repeated use of these provisions in order to protect information, locations, and activities of direct national security significance to the United States.

Decisions regarding the use of these provisions are a unilateral prerogative of the United States -- not subject to interpretation by, or justification to, any other party.

The United States, unlike NNWS, has and will continue to have, undeclared nuclear material and activities outside the scope of the Additional Protocol and the November 18, 1977, Agreement between the United States of America and the International Atomic Energy Agency for the Application of Safeguards in the United States of America and their applicable inspection provisions, consistent with its status as a NWS. Certain activities that occur at locations that are part of the United States civil nuclear program may also be excluded from the declaration and access provisions of the Additional Protocol in accordance with the terms of the NSE.

The U.S.-IAEA Subsidiary Arrangement to the Additional Protocol signed at Vienna on June 12, 1998, will enter into force when the Additional Protocol enters into force.

B. Role of the Additional Protocol in Strengthening IAEA Capabilities

The United States intends that its implementation of the Additional Protocol will, as expressed in the Preamble, "further enhance nuclear non-proliferation by strengthening the effectiveness and improving the efficiency of the Agency's safeguards system." Since the United States will have undeclared nuclear activities, Agency activities directed toward the detection of undeclared nuclear activities in the United States are not viewed as necessary to enhance nonproliferation. In accordance with the NSE, the United States will supply information pursuant to Article 2 of the Additional Protocol only on those unclassified activities to which it has determined that it will be able to provide the IAEA with sufficient access, including with managed access, to enable it to verify the accuracy of the declared information.

The United States expects the IAEA to seek access in the United States for the purpose of increasing the effectiveness or efficiency of IAEA safeguards at facilities in NNWS, or enhancing the capability of the IAEA to detect undeclared nuclear material and activities in NNWS.

As a NWS, the United States foresees no circumstances in which the IAEA would need to request access in the United States pursuant to Article 4.d of the Additional Protocol on the basis of a question or inconsistency without first providing the United States with the opportunity to clarify and facilitate the resolution of the question or inconsistency.

When the IAEA has access to a location, site or facility in the United States, the United States will conduct "managed access" under Article 1.c of the Additional Protocol according to U.S. national security requirements, or under Article 7 of the Additional Protocol, according to requirements to protect, inter alia, proprietary or commercially sensitive information, as applicable.

C. Questions Under Article 2

A "question relating to the correctness and completeness of the information provided pursuant to Article 2," (Article 4.a.(ii)) or an "inconsistency relating to that information" (Article 4.a.(ii)) will be judged by the IAEA strictly within the context of

whether the information provided with respect to civil nuclear activities is complete, correct, and internally consistent.

D. Wide-Area and Site-Specific Sampling

Should the use of wide area environmental sampling be approved by the IAEA Board of Governors in accordance with Article 9. the United States does not foresee circumstances in which the IAEA would need to propose to conduct wide area environmental sampling in the United States.

In accordance with the NSE, the United States will not allow location specific environmental sampling with respect to locations, information, and activities of direct national security significance to the United States. In this regard, the United States intends to use the NSE with regard to location specific environmental sampling at any current or former nuclear weapon production complex site.

It is on the basis of these U.S. views that the United States is prepared to move toward bringing the Additional Protocol into force. The United States looks forward to working with the IAEA in improving its capability to detect undeclared nuclear material and activities in NNWS.

Sincerely yours,

Kenneth C. Brill
Ambassador

SUBSIDIARY ARRANGEMENT

TO THE

PROTOCOL ADDITIONAL TO THE AGREEMENT BETWEEN THE UNITED STATES OF AMERICA AND THE INTERNATIONAL ATOMIC ENERGY AGENCY FOR THE APPLICATION OF SAFEGUARDS IN THE UNITED STATES OF AMERICA

This Subsidiary Arrangement is done pursuant to Article 13 of the Protocol Additiona to the Agreement Between the United States of America and the International Atomic Energy Agency for the Application of Safeguards in the United States of America, signed at Vienna on 17/6/98 (hereinafter "the Additional Protocol"). This Subsidiary Arrangement shall enter into force upon entry into force of the Additional Protocol.

For the purposes of the Additional Protocol with the United States as a nuclear-weapon State, the measures for managed access under the Additional Protocol may include, inter alia: (a) removal of sensitive papers from office spaces; (b) shrouding of sensitive displays, stores, and equipment; (c) shrouding of sensitive pieces of equipment, such as computers or electronic systems; (d) logging off computer systems and turning off data indicating devices; (e) restriction of safeguards instrumentation or environmental sampling to the purpose of the access; and (f) in exceptional cases, giving only individual inspectors access to certain parts of the inspection location.

Done at Vienna on the 17. day of June 1998, in duplicate, in the English language.

FOR THE UNITED STATES OF AMERICA:

FOR THE INTERNATIONAL ATOMIC ENERGY AGENCY:

Article-by-Article Analysis of the Additional Protocol

The Protocol Additional to the Agreement between the United States of America and the International Atomic Energy Agency for the Application of Safeguards in the United States of America (the "Additional Protocol") consists of the main text of the Protocol along with two annexes, which are an integral part of the Additional Protocol. It is based on the Model Additional Protocol, with certain additions, most notably the provision that allows the United States to exclude application of the Additional Protocol in cases where the United States decides it would result in access by the International Atomic Energy Agency (the "Agency") to activities with direct national security significance to the United States or to locations or information associated with such activities. This provision is referred to herein as the "National Security Exclusion." Executive Branch agencies will exercise their responsibilities to implement the Additional Protocol subject in all respects to the President's authority as chief executive and consistent with his foreign affairs power.

Title and Preamble

The Title of the Additional Protocol is the "Protocol Additional to the Agreement between the United States of America and the International Atomic Energy Agency for the Application of Safeguards in the United States of America." The Additional Protocol is a bilateral treaty that will supplement and amend the Agency verification arrangements set forth in the existing Agreement between the United States of America and the International Atomic Energy Agency for the Application of Safeguards in the United States of America (the "Voluntary

Offer"), which was signed at Vienna on November 18, 1977, and entered into force on December 9, 1980.

The Preamble to the Additional Protocol serves as an introduction and sets forth the intention of the United States and the Agency in broad terms. The first paragraph of the Preamble notes that the United States and the Agency are already parties to the Voluntary Offer. The following paragraphs of the preamble set forth the Parties' considerations upon entering into the Additional Protocol. These paragraphs first recognize the desire of the international community to further enhance nuclear non-proliferation by strengthening the Agency's safeguards system. They also reiterate certain provisions in the Voluntary Offer, *inter alia*, that the Agency must, in the implementation of safeguards, take into account the need to avoid hampering the economic and technological development of the United States or international cooperation in the field of peaceful nuclear activities; respect health, safety, physical protection and other security provisions in force and the rights of individuals; and take every precaution to protect commercial, technological, and industrial secrets as well as other confidential information. Furthermore, they note that, consistent with the objective to strengthen the effectiveness and improve the efficiency of safeguards, the frequency and intensity of activities described in the Additional Protocol will be kept to a minimum.

Article 1 -- Relationship Between the Additional Protocol and the Voluntary Offer, U.S. National Security Exclusion, and Managed Access

Article 1.a establishes the relationship between the Voluntary Offer and the Additional Protocol. It provides that the provisions of the Voluntary Offer will apply to the Additional Protocol to the extent relevant to and compatible with the provisions of the Additional Protocol. Where there is a

conflict between the two agreements, the provisions of the Additional Protocol are to apply. The principal differences between the Voluntary Offer and the Additional Protocol include the broader declaration requirements called for and the expanded access permitted in the Additional Protocol. There are also improved procedures for designating Agency inspectors, issuing their visas, and protecting safeguards information by the Agency. These procedures are discussed below in the sections describing Articles 11, 12, and 15. In such areas, the Additional Protocol provisions will govern. As a practical matter, the United States has been implementing procedures similar to those in the Additional Protocol for designating inspectors and issuing their visas on a voluntary basis for several years.

Under Article 1.b of the Additional Protocol, the United States has the right to exclude the application of the Additional Protocol where the United States decides that its application would result in access by the Agency to activities with direct national security significance to the United States or to locations or information associated with such activities. The United States has the sole discretion to determine whether an activity implicates information of direct national security significance and therefore whether and how to invoke the National Security Exclusion. The United States will have undeclared nuclear material and activities outside the scope of the Additional Protocol and the Voluntary Offer, including certain activities at locations that are part of the U.S. civil nuclear program, consistent with its status as a nuclear-weapon state. The Agency knows and accepts that this will be the case.

In addition, under Article 1.c, the United States has the right to use managed access in connection with activities with direct national security significance to the United States or in connection with locations or information associated with such activities. This right is not available to non-nuclear-weapon

states. Consistent with the President's authority, use of the National Security Exclusion will be guided by principles developed for its application.

Information of direct national security significance will be protected in all aspects of implementation of the Additional Protocol through invoking the National Security Exclusion or through the implementation of managed access. The National Security Exclusion is applicable to each of the following provisions and will exempt the United States from the requirements noted when it is invoked.

The United States will make full use of the managed access and National Security Exclusion provisions of Article 1 in order to protect activities of direct national security significance to the United States or locations or information associated with such activities. Additionally, decisions concerning the use of the National Security Exclusion and managed access to protect national security information will be made in accordance with established implementing procedures solely by the affected cognizant Department or Agency.

Article 2 -- Provision of Information

Article 2 sets forth information that the United States is to provide to the Agency. The United States must provide the following declarations specified in Article 2.a: information regarding nuclear fuel cycle-related research and development activities not involving nuclear material that are funded, specifically authorized or controlled by, or carried out on behalf of, the United States (Article 2.a(i)); if agreed by the United States, additional information needed to improve the effectiveness or efficiency of safeguards on nuclear material at nuclear facilities and locations outside facilities (Article 2.a(ii)); a general description of each building on a site (i.e.,

the area delimited by the United States in the relevant design information for a facility) (Articles 2.a(iii) and 18.b); a description of the scale of operations of each location engaged in the manufacturing activities specified in Annex I (Article 2.a(iv)); information regarding uranium mines and concentration plants and thorium concentration plants (Article 2.a(v)); information regarding locations with certain quantities of specified nuclear materials as well as information regarding exports and imports of certain quantities of these materials (Article 2.a(vi)); information regarding nuclear material declared by the United States but exempted from safeguards by arrangement with the Agency (Article 2.a.(vii)); information regarding the location or further processing of intermediate or high-level waste containing plutonium, high enriched uranium or uranium-233 on which safeguards have been terminated pursuant to Article 11 of the Voluntary Offer (Article 2.a(viii)); information regarding the equipment and non-nuclear material specified in Annex II with regard to exports and imports of such items (Article 2.a(ix)); and information regarding general plans for the succeeding 10-year period relevant to the development of the nuclear fuel cycle when approved by the appropriate authorities in the United States (Article 2.a(x)).

Article 2.b requires the United States to make every reasonable effort to provide: information regarding specified nuclear fuel cycle-related research and development activities not involving nuclear material that are not funded, specifically authorized or controlled by, or carried out on behalf of, the United States (Article 2.b(i)); and a general description of activities and the identity of the person or entity carrying out activities at locations identified by the Agency outside a site (i.e., the area delimited by the United States in the relevant design information for a facility) that the Agency considers

might be functionally related to the activities of that site (Articles 2.b(ii) and 18.b).

Article 2.c requires the United States, if requested by the Agency, to provide amplifications or clarifications of any information provided under Article 2, in so far as relevant for the purpose of safeguards. The United States has informed the Agency that it expects that a "question relating to the correctness and completeness of the information provided pursuant to Article 2," (Article 4.a.(ii)) or an "inconsistency relating to that information" (Article 4.a.(ii)) will be judged by the Agency strictly within the context of whether the information provided with respect to civil nuclear activities is complete, correct, and internally consistent. In accordance with the National Security Exclusion, the United States will supply information pursuant to Article 2 of the Additional Protocol only on those unclassified activities to which it has determined that it will be able to provide the Agency with sufficient access, including with managed access, to enable it to verify the accuracy of the declared information.

Article 3 -- Timelines for the Provision of Information

Article 3 sets forth the timelines for submission of the U.S. declarations. The United States must provide to the Agency the information identified in Article 2.a(i), (iii), (iv), (v), (vi)(a), (vii) and (x) and Article 2.b(i) within 180 days of the entry into force of the Additional Protocol. Other information is to be submitted on a quarterly or annual basis, within a specified period from a particular event, or as negotiated on a case-by-case basis.

Articles 4-6 -- Complementary Access

Article 4 establishes the rights and obligations of the Agency with regard to the implementation of complementary access. Specifically, Article 4.a provides that the Agency shall not mechanistically or systematically seek to verify the information in the Article 2 declarations and then sets forth the purposes for which the Agency can exercise complementary access. Article 4.a(i) specifies that the Agency shall have access to the locations referred to in Article 5.a(i) or (ii) on a selective basis in order to assure the absence of undeclared nuclear material and activities. Under Article 4.a(ii), the Agency shall have access to the locations specified in Articles 5.b or 5.c for the purpose of resolving a question relating to the correctness and completeness of the information provided or resolving an inconsistency relating to that information. Article 4.a(iii) allows the Agency to have access to any of the decommissioned locations referred to in Article 5.a(iii) to the extent necessary to confirm the U.S. declaration. The United States has informed the Agency that it expects the Agency to seek such access in the United States for the purpose of increasing the effectiveness or efficiency of IAEA safeguards at facilities in non-nuclear-weapon states or enhancing the capability of the Agency to detect undeclared nuclear material and activities in a non-nuclear-weapon state. Further, the United States has informed the Agency that, as a nuclear-weapon state, the United States foresees no circumstances in which the Agency would need to request access in the United States pursuant to Article 4.d of the Additional Protocol without first providing the United States with the opportunity to clarify and facilitate the resolution of the question or inconsistency.

Under Article 4.b, the Agency is generally required to give advance notice of access of at least 24 hours. However, for

access to any place on a site (defined in Article 18.b as the area delimited by the United States in the relevant design information for a facility) that is sought in conjunction with design information verification visits or ad hoc or routine inspections on that site, the period of advance notice shall, if the Agency so requests, be at least two hours, but in exceptional circumstances may be less than two hours. Under Article 4.c, the advance notice shall be in writing and specify the reasons for access and the activities to be carried out. Article 4.d states that, in the case of a question or inconsistency, the Agency shall provide the United States with an opportunity to clarify and facilitate the resolution of the question or inconsistency. The Additional Protocol states that such an opportunity is to be provided before a request for access, unless the Agency considers that delay in access would prejudice the purpose for which the access is sought. The Agency is not to draw any conclusions about the question or inconsistency until the United States has been provided with such an opportunity. As noted above the United States has informed the Agency that as a nuclear-weapon state, the United States foresees no circumstances in which the Agency would need to request access pursuant to Article 4.d of the Additional Protocol without first providing the United States with the opportunity to clarify and facilitate the resolution of the question or inconsistency. Pursuant to Article 4.e, unless otherwise agreed to by the United States, access shall only take place during regular working hours. Article 4.f specifically authorizes U.S. representatives to accompany Agency inspectors during their access, provided that the inspectors are not thereby delayed or otherwise impeded in the exercise of their functions. However, the managed access provisions of Article 1 and Article 7 or the National Security Exclusion could be invoked and, if invoked, could preclude or otherwise affect IAEA access or activities.

Article 5 sets forth the locations to which the Agency may have access. Specifically, Article 5.a defines the locations for which the United States must provide access subject to the managed access provision of Article 1 and the National Security Exclusion or the managed access provisions of Article 7. These are: any place on a site (i.e., the area delimited by the United States in the relevant design information for a facility) (Article 5.a(i)); any location identified by the United States in its declarations under Article 2.a(v)-(viii) (Article 5.a(ii); and any decommissioned facility or decommissioned location outside facilities where nuclear material was customarily used (Article 5.a(iii)).

Articles 5.b and 5.c list other locations for which the United States shall provide access or, if it is unable to do so, "shall make every reasonable effort" to satisfy Agency requirements, without delay, through other means. The locations in Article 5.b are the locations (other than those referred to in Article 5.a(i)) described in the declarations made under the following provisions: Article 2.a(i) (locations of nuclear fuel cycle-related research and development funded, authorized or controlled by, or carried out on behalf of the United States); Article 2.a(iv) (locations engaged in activities listed in Annex I); Article 2.a(ix)(b) (locations of intended use in the United States of imported Annex II equipment and non-nuclear material) and Article 2.b (specified nuclear fuel cycle-related research and development that is not funded, authorized or controlled by, or carried out on behalf of, the United States and locations outside a site). Article 5.c provides for access to any location specified by the Agency, other than locations referred to in Article 5.a or 5.b, to carry out location-specific environmental sampling.

Under the National Security Exclusion, the United States has the right to exclude from the Article 2 declarations locations

that it determines would result in Agency access to activities with direct national security significance or to locations or information associated with such activities. Access under Articles 5.a(i), 5.a(ii) and 5.a(iii) and 5.b is limited to those locations identified by the United States in its declarations under Article 2. The Agency could seek access to other locations (Article 5.c), but the United States will invoke the National Security Exclusion and deny access if it determines that such access would result in access by the Agency to activities with direct national security significance or to locations or information associated with such activities.

Article 6 sets forth the range of activities that may be employed by Agency inspectors during complementary access. Under Article 6, the type of activities that can be conducted by the inspectors depends on the particular location under inspection. The United States intends to exercise its right under the National Security Exclusion and managed access provisions of Article 1 to preclude the use of particular measures if their use would result in access by the Agency to activities with direct national security significance to the United States or to locations or information associated with such activities. For example, the United States will use the National Security Exclusion to preclude the Agency from collecting location specific environmental samples from current or former nuclear weapon production complex sites. In addition, the complementary access activities referred to in Articles 5 and 6 are subject to the managed access provisions contained in Article 7.

Article 7 -- Managed Access

Article 7 provides that, upon request by the United States, the Agency and the United States shall make arrangements for managed access under the Additional Protocol in order to prevent

the dissemination of proliferation sensitive information, to meet safety or physical protection requirements, or to protect proprietary or commercially sensitive information. Under Article 7.b, the United States may, when providing the information referred to in Article 2, inform the Agency of the places at a site or location at which managed access may be applicable, although it is not obligated to do so. Article 7.c allows the United States to use managed access pending entry into force of any necessary Subsidiary Arrangements. Specific managed access measures needed to protect the types of information set forth in Article 7 will be determined on a case-by-case basis and will depend on, among other factors, the details of the particular location, and the inspection activities that are requested by the Agency. As noted previously, the United States intends to deny access or the application of specific measures on the basis of the National Security Exclusion. Where the United States decides to permit access, Article 1.c also allows the United States to use managed access to protect activities, information, or locations of direct national security significance. This gives the United States the discretion to use managed access, rather than exclusion, to protect activities, information, or locations of direct national security significance. Such circumstances may arise, for example, where unclassified, civil nuclear activities are being conducted at installations where national security activities are also being conducted and it has been determined that managed access procedures can be implemented to allow Agency access to the unclassified activities while fully protecting classified information.

When the Additional Protocol was concluded, a Subsidiary Arrangement was agreed to between the United States and the Agency specifying, for the purposes of the Additional Protocol with the United States, as a nuclear-weapon state, measures that could be taken to manage access. These may include, *inter alia*:

(a) removal of sensitive papers from office spaces; (b) shrouding of sensitive displays, stores, and equipment; (c) shrouding of sensitive pieces of equipment, such as computers or electronic systems; (d) logging off of computer systems and turning off data indicating devices; (e) restriction of safeguards instrumentation or environmental sampling to the purpose of the access; and (f) in exceptional cases, giving only individual inspectors access to certain parts of the inspection location. This Subsidiary Arrangement is to enter into force when the Additional Protocol enters into force.

Article 8 -- Additional Access at U.S. Request

Article 8 allows the United States to offer the Agency access to locations in addition to those referred to in Articles 5 and 9 and to request that the Agency conduct verification activities at a particular location. The Agency shall, without delay, make every reasonable effort to act upon such a request.

Article 9 -- Environmental Sampling

Under Article 9, the United States shall provide the Agency with access to locations specified by the Agency to carry out wide-area environmental sampling, provided that if the United States is unable to provide such access, it shall make every reasonable effort to satisfy Agency requirements at alternative locations. Article 9 further provides that the Agency shall not seek such access until the use of wide-area environmental sampling and the procedural arrangements therefor have been approved by the Agency's Board of Governors (the "Board") and following consultations between the Agency and the United States. Such arrangements have not been brought before or approved by the Board. The United States has informed the Agency that even if

such arrangements were approved, the United States does not foresee circumstances in which the Agency would need to propose to conduct wide area environmental sampling.

Article 10 -- Requirements for IAEA Reports to the United States

Article 10 requires the Agency to inform the United States, within specified time limits, of activities carried out under the Additional Protocol, the results of activities in respect of any questions or inconsistencies the Agency had brought to the attention of the United States, and the conclusions it has drawn from its activities under the Additional Protocol.

Article 11 -- Designation of Agency Inspectors

Article 11 provides improved procedures for the designation of Agency inspectors. Under Article 11, the Director General shall notify the United States of the Board's approval of any Agency official as a safeguards inspector. Unless the United States advises the Director General of its rejection of such an official as an inspector within three months of receipt of notification of the Board's approval, the inspector will be considered designated to the United States. Under the terms of the Voluntary Offer, the United States also retains the right subsequently to withdraw acceptance of inspectors as needed.

Article 12 -- Visas

To enable inspectors to carry out their duties in the United States, Article 12 requires the United States to issue appropriate multiple-entry/exit and/or transit visas to designated Agency inspectors. These visas must be valid for at least one year, must be issued within one month of a request, and

must be renewed, as required, to cover the duration of the inspector's designation to the United States.

Article 13 -- Subsidiary Arrangements

Article 13 provides for the conclusion of Subsidiary Arrangements that specify how Additional Protocol measures are to be applied. Requests for such arrangements can be made at any time by either the United States or the Agency. Subsidiary Arrangements are likely to regard matters such as managed access and Agency communications. The United States and the Agency shall agree on such arrangements within 90 days of the entry into force of the Additional Protocol or, where the indication of the need for such Subsidiary Arrangements is made after the entry into force of the Additional Protocol, within 90 days of date of such indication. As discussed in Article 7, the United States and the Agency have agreed to a Subsidiary Arrangement governing certain measures regarding managed access. This Arrangement is to enter into force upon entry into force of the Additional Protocol.

Article 14 -- Agency Communication Systems

Under Article 14, the United States is required to permit and protect unimpeded communications by the Agency for official purposes between Agency inspectors in the United States and Agency Headquarters and/or Regional Offices. The Agency has the right, in consultation with the United States, to make use of internationally established systems of direct communications, including satellite systems and other forms of telecommunication. Agency communications shall take due account of the need to protect proprietary or commercially sensitive information or

design information that the United States regards as being of particular sensitivity.

Article 15 -- Agency Protection of Confidential Information

Article 15 requires the Agency to maintain a stringent regime to ensure effective protection against disclosure of commercial, technological and industrial secrets and other confidential information coming to its knowledge. The Board has approved a strengthened regime and is required under the Additional Protocol to review it periodically. This regime includes provisions relating to general principles and associated measures for the handling of confidential information, conditions of staff employment relating to the protection of confidential information, and procedures in cases of breaches or alleged breaches of confidentiality.

Article 16 -- Integration and Amendment of the Annexes

Article 16.a provides that the Annexes to the Additional Protocol are an integral part thereof. These Annexes provide technical definitions of key nuclear activities and equipment and material declarable under Article 2 of the Additional Protocol. Article 16.b provides that the Annexes may be amended by the Board upon the advice of a working group of experts established by the Board and open to all members of the Agency. Any such amendment will take effect four months after its adoption by the Board.

Article 17 -- Entry into Force

This provision establishes the date of entry into force of the Additional Protocol. Specifically, the Additional Protocol

will come into force only when the Agency receives written notification from the United States that its statutory and constitutional requirements for entry into force have been met.

Article 18 -- Definitions

Article 18 sets forth the definitions of the following terms used in the Additional Protocol: nuclear fuel cycle-related research and development activities, site, decommissioned facility and decommissioned location outside facilities, closed-down facility and closed-down location outside facilities, high enriched uranium, location-specific environmental sampling, wide-area environmental sampling, nuclear material, facility, and location outside facilities.

Annexes

Annex I contains a list of nuclear-related activities, such as centrifuge manufacturing, required to be reported under Article 2.a(iv). Annex II contains the list of specified equipment and non-nuclear material for the reporting of exports and imports, as required by Article 2.a(ix). Annex II reproduces the list of specified equipment and non-nuclear material that was approved by the Board in 1992 for voluntary reporting of exports to the Agency.

PROTOCOL ADDITIONAL TO THE AGREEMENT BETWEEN THE UNITED STATES OF AMERICA AND THE INTERNATIONAL ATOMIC ENERGY AGENCY FOR THE APPLICATION OF SAFEGUARDS IN THE UNITED STATES OF AMERICA

WHEREAS the United States of America (hereinafter referred to as "the United States") and the International Atomic Energy Agency (hereinafter referred to as the "Agency") are parties to an Agreement for the Application of Safeguards in the United States of America done at Vienna on November 18, 1977 (hereinafter referred to as the "Safeguards Agreement"), which entered into force on December 9, 1980;

AWARE OF the desire of the international community to further enhance nuclear non-proliferation by strengthening the effectiveness and improving the efficiency of the Agency's safeguards system;

RECALLING that the Agency must take into account in the implementation of safeguards the need to: avoid hampering the economic and technological development of the United States or international co-operation in the field of peaceful nuclear activities; respect health, safety, physical protection and other security provisions in force and the rights of individuals; and take every precaution to protect commercial, technological and industrial secrets as well as other confidential information coming to its knowledge;

WHEREAS the frequency and intensity of activities described in this Protocol shall be kept to the minimum consistent with the objective of strengthening the effectiveness and improving the efficiency of Agency safeguards;

NOW THEREFORE the United States and the Agency have agreed as follows:

RELATIONSHIP BETWEEN THE PROTOCOL AND THE SAFEGUARDS AGREEMENT

Article 1

a. The provisions of the Safeguards Agreement shall apply to this Protocol to the extent that they are relevant to and compatible with the provisions of this Protocol. In case of conflict between the provisions of the Safeguards Agreement and those of this Protocol, the provisions of this Protocol shall apply.

b. The United States shall apply, and permit the Agency to apply, this Protocol, excluding only instances where its application would result in access by the Agency to activities with direct national security significance to the United States or to locations or information associated with such activities.

c. Without prejudice to paragraph b. above, the United States shall have the right to use managed access in connection with activities with direct national security significance to the United States or in connection with locations or information associated with such activities.

PROVISION OF INFORMATION

Article 2

a. The United States shall provide the Agency with a declaration containing:

(i) A general description of and information specifying the location of nuclear fuel cycle-related research and development activities not involving nuclear material carried out anywhere that are funded, specifically authorized or controlled by, or carried out on behalf of, the United States.

(ii) Information identified by the Agency on the basis of expected gains in effectiveness or efficiency, and agreed to by the United States, on operational activities of safeguards relevance at facilities and locations outside facilities where nuclear material is customarily used.

(iii) A general description of each building on each site, including its use and, if not apparent from that description, its contents. The description shall include a map of the site.

(iv) A description of the scale of operations for each location engaged in the activities specified in Annex I to this Protocol.

(v) Information specifying the location, operational status and the estimated annual production capacity of uranium mines and concentration plants and thorium concentration plants, and the current annual production of such mines and concentration plants for the United States as a whole. The United States shall

provide, upon request by the Agency, the current annual production of an individual mine or concentration plant. The provision of this information does not require detailed nuclear material accountancy.

(vi) Information regarding source material which has not reached the composition and purity suitable for fuel fabrication or for being isotopically enriched, as follows:

(a) The quantities, the chemical composition, the use or intended use of such material, whether in nuclear or non-nuclear use, for each location in the United States at which the material is present in quantities exceeding ten metric tons of uranium and/or twenty metric tons of thorium, and for other locations with quantities of more than one metric ton, the aggregate for the United States as a whole if the aggregate exceeds ten metric tons of uranium or twenty metric tons of thorium. The provision of this information does not require detailed nuclear material accountancy;

(b) The quantities, the chemical composition and the destination of each export out of the United States, of such material for specifically non-nuclear purposes in quantities exceeding:

(1) Ten metric tons of uranium, or for successive exports of uranium from the United States to the same State, each of less than ten metric tons, but exceeding a total of ten metric tons for the year;

(2) Twenty metric tons of thorium, or for successive exports of thorium from the United States to the same State, each of less than twenty metric tons, but exceeding a total of twenty metric tons for the year;

(c) The quantities, chemical composition, current location and use or intended use of each import into the United States of such material for specifically non-nuclear purposes in quantities exceeding:

(1) Ten metric tons of uranium, or for successive imports of uranium into the United States each of less than ten metric tons, but exceeding a total of ten metric tons for the year;

(2) Twenty metric tons of thorium, or for successive imports of thorium into the United States each of less than twenty metric tons, but exceeding a total of twenty metric tons for the year;

it being understood that there is no requirement to provide information on such material intended for a non-nuclear use once it is in its non-nuclear end-use form.

(vii) (a) Information regarding the quantities, uses and locations of nuclear material exempted from safeguards pursuant to Article 37 of the Safeguards Agreement;

(b) Information regarding the quantities (which may be in the form of estimates) and uses at each location, of nuclear material exempted from safeguards pursuant to Article 36(b) of the Safeguards Agreement but not yet in a non-nuclear end-use form, in quantities exceeding those set out in Article 37 of the Safeguards Agreement. The provision of this information does not require detailed nuclear material accountancy.

(viii) Information regarding the location or further processing of intermediate or high-level waste containing plutonium, high enriched uranium or uranium-233 on which safeguards have been terminated pursuant to Article 11 of the Safeguards Agreement. For the purpose of this paragraph, "further processing" does not include repackaging of the waste or its further conditioning not involving the separation of elements, for storage or disposal.

(ix) The following information regarding specified equipment and non-nuclear material listed in Annex II:

(a) For each export out of the United States of such equipment and material: the identity, quantity, location of intended use in the receiving State and date or, as appropriate, expected date, of export;

(b) Upon specific request by the Agency, confirmation by the United States, as importing State, of information provided to the Agency by another State concerning the identity, quantity and location of intended use in the United States, and date of import, or, as appropriate, expected date of the import, of such equipment and material into the United States.

(x) General plans for the succeeding ten-year period relevant to the development of the nuclear fuel cycle (including planned nuclear fuel cycle-related research and development activities) when approved by the appropriate authorities in the United States.

b. The United States shall make every reasonable effort to provide the Agency with the following information:

(i) A general description of and information specifying the location of nuclear fuel cycle-related research and development activities not involving nuclear material which are specifically related to enrichment, reprocessing of nuclear fuel or the processing of intermediate or high-level waste containing plutonium, high enriched uranium or uranium-233 that are carried out anywhere in the United States but which are not funded, specifically authorized or controlled by, or carried out on behalf of, the United States. For the purpose of this paragraph, "processing" of intermediate or high-level waste does not include repackaging

of the waste or its conditioning not involving the separation of elements, for storage or disposal.

(ii) A general description of activities and the identity of the person or entity carrying out such activities, at locations identified by the Agency outside a site which the Agency considers might be functionally related to the activities of that site. The provision of this information is subject to a specific request by the Agency. It shall be provided in consultation with the Agency and in a timely fashion.

c. Upon request by the Agency, the United States shall provide amplifications or clarifications of any information it has provided under this Article, in so far as relevant for the purpose of safeguards.

Article 3

a. The United States shall provide to the Agency the information identified in Article 2.a.(i), (iii), (iv), (v), (vi)(a), (vii) and (x) and Article 2.b.(i) within 180 days of the entry into force of this Protocol.

b. The United States shall provide to the Agency, by 15 May of each year, updates of the information referred to in paragraph a. above for the period covering the previous calendar year. If there has been no change to the information previously provided, the United States shall so indicate.

c. The United States shall provide to the Agency, by 15 May of each year, the information identified in Article 2.a.(vi)(b) and (c) for the period covering the previous calendar year.

d. The United States shall provide to the Agency on a quarterly basis the information identified in Article 2.a.(ix)(a). This information shall be provided within sixty days of the end of each quarter.

e. The United States shall provide to the Agency the information identified in Article 2.a.(viii) 180 days before further processing is carried out and, by 15 May of each year, information on changes in location for the period covering the previous calendar year.

f. The United States and the Agency shall agree on the timing and frequency of the provision of the information identified in Article 2.a.(ii).

g. The United States shall provide to the Agency the information in Article 2.a.(ix)(b) within sixty days of the Agency's request.

COMPLEMENTARY ACCESS

Article 4

The following shall apply in connection with the implementation of complementary access under Article 5 of this Protocol:

a. The Agency shall not mechanistically or systematically seek to verify the information referred to in Article 2; however, the Agency shall have access to:

(i) Any location referred to in Article 5.a.(i) or (ii) on a selective basis in order to assure the absence of undeclared nuclear material and activities;

(ii) Any location referred to in Article 5.b. or c. to resolve a question relating to the correctness and completeness of the information provided pursuant to Article 2 or to resolve an inconsistency relating to that information;

(iii) Any location referred to in Article 5.a.(iii) to the extent necessary for the Agency to confirm, for safeguards purposes, the United States' declaration of the decommissioned status of a facility or location outside facilities where nuclear material was customarily used.

b. (i) Except as provided in paragraph (ii) below, the Agency shall give the United States advance notice of access of at least 24 hours;

(ii) For access to any place on a site that is sought in conjunction with design information verification visits or ad hoc or routine inspections on that site, the period of advance notice shall, if the Agency so requests, be at least two hours but, in exceptional circumstances, it may be less than two hours.

c. Advance notice shall be in writing and shall specify the reasons for access and the activities to be carried out during such access.

d. In the case of a question or inconsistency, the Agency shall provide the United States with an opportunity to clarify and facilitate the resolution of the question or inconsistency. Such an opportunity will be provided before a request for access, unless the Agency considers that delay in access would prejudice the purpose for which the access is sought. In any event, the Agency shall not draw any conclusions about the question or inconsistency until the United States has been provided with such an opportunity.

e. Unless otherwise agreed to by the United States, access shall only take place during regular working hours.

f. The United States shall have the right to have Agency inspectors accompanied during their access by representatives of the United States, provided that the inspectors shall not thereby be delayed or otherwise impeded in the exercise of their functions.

Article 5

The United States shall provide the Agency with access to:

a. (i) Any place on a site;

(ii) Any location identified by the United States under Article 2.a.(v)-(viii);

(iii) Any decommissioned facility or decommissioned location outside facilities where nuclear material was customarily used.

b. Any location identified by the United States under Article 2.a.(i), Article 2.a.(iv), Article 2.a.(ix)(b) or Article 2.b., other than those referred to in paragraph a.(i) above, provided that if the United States is unable to provide such access, the United States shall make every reasonable effort to satisfy Agency requirements, without delay, through other means.

c. Any location specified by the Agency, other than locations referred to in paragraphs a. and b. above, to carry out location-specific environmental sampling, provided that if the United States is unable to provide such access, the United States shall make every reasonable effort to satisfy Agency requirements, without delay, at adjacent locations or through other means.

Article 6

When implementing Article 5, the Agency may carry out the following activities:

a. For access in accordance with Article 5.a.(i) or (iii): visual observation; collection of environmental samples; utilization of radiation detection and measurement devices; application of seals and other identifying and tamper indicating devices specified in Subsidiary Arrangements; and other objective measures which have been demonstrated to be technically feasible and the use of which has been agreed by the Board of Governors (hereinafter referred to as the "Board") and following consultations between the Agency and the United States.

b. For access in accordance with Article 5.a.(ii): visual observation; item counting of nuclear material; non-destructive measurements and sampling; utilization of radiation detection and measurement devices; examination of records relevant to the quantities, origin and disposition of the material; collection of environmental samples; and other objective measures which have been demonstrated to be technically feasible and the use of which has been agreed by the Board and following consultations between the Agency and the United States.

c. For access in accordance with Article 5.b.: visual observation; collection of environmental samples; utilization of radiation detection and measurement devices; examination of safeguards relevant production and shipping records; and other objective measures which have been demonstrated to be technically feasible and the

use of which has been agreed by the Board and following consultations between the Agency and the United States.

d. For access in accordance with Article 5.c.: collection of environmental samples and, in the event the results do not resolve the question or inconsistency at the location specified by the Agency pursuant to Article 5.c., utilization at that location of visual observation, radiation detection and measurement devices, and, as agreed by the United States and the Agency, other objective measures.

Article 7

a. Upon request by the United States, the Agency and the United States shall make arrangements for managed access under this Protocol in order to prevent the dissemination of proliferation sensitive information, to meet safety or physical protection requirements, or to protect proprietary or commercially sensitive information. Such arrangements shall not preclude the Agency from conducting activities necessary to provide credible assurance of the absence of undeclared nuclear material and activities at the location in question, including the resolution of a question relating to the correctness and completeness of the information referred to in Article 2 or of an inconsistency relating to that information.

b. The United States may, when providing the information referred to in Article 2, inform the Agency of the places at a site or location at which managed access may be applicable.

c. Pending the entry into force of any necessary Subsidiary Arrangements, the United States may have recourse to managed access consistent with the provisions of paragraph a. above.

Article 8

Nothing in this Protocol shall preclude the United States from offering the Agency access to locations in addition to those referred to in Articles 5 and 9 or from requesting the Agency to conduct verification activities at a particular location. The Agency shall, without delay, make every reasonable effort to act upon such a request.

Article 9

The United States shall provide the Agency with access to locations specified by the Agency to carry out wide-area environmental sampling, provided that if the United States is unable to provide such access it shall make every reasonable effort to satisfy Agency requirements at alternative locations. The Agency shall not seek such access until the use of wide-area environmental sampling and the procedural arrangements therefor have been approved by the Board and following consultations between the Agency and the United States.

Article 10

The Agency shall inform the United States of:

a. The activities carried out under this Protocol, including those in respect of any questions or inconsistencies the Agency had brought to the attention of the United States, within sixty days of the activities being carried out by the Agency.

b. The results of activities in respect of any questions or inconsistencies the Agency had brought to the attention of the United States, as soon as possible but in any case within thirty days of the results being established by the Agency.

c. The conclusions it has drawn from its activities under this Protocol. The conclusions shall be provided annually.

DESIGNATION OF AGENCY INSPECTORS

Article 11

a. (i) The Director General shall notify the United States of the Board's approval of any Agency official as a safeguards inspector. Unless the United States advises the Director General of its rejection of such an official as an inspector for the United States within three months of receipt of notification of the Board's approval, the inspector so notified to the United States shall be considered designated to the United States.

(ii) The Director General, acting in response to a request by the United States or on his own initiative, shall immediately inform the United States of the withdrawal of the designation of any official as an inspector for the United States.

b. A notification referred to in paragraph a. above shall be deemed to be received by the United States seven days after the date of the transmission by registered mail of the notification by the Agency to the United States.

VISAS

Article 12

The United States shall, within one month of the receipt of a request therefor, provide the designated inspector specified in the request with appropriate multiple entry/exit and/or transit visas, where required, to enable the inspector to enter and remain on the territory of the United States for the purpose of carrying out his/her functions. Any visas required shall be valid for at least one year and shall be renewed, as required, to cover the duration of the inspector's designation to the United States.

SUBSIDIARY ARRANGEMENTS

Article 13

a. Where the United States or the Agency indicates that it is necessary to specify in Subsidiary Arrangements how measures laid down in this Protocol are to be applied, the United States and the Agency shall agree on such Subsidiary Arrangements within ninety days of the entry into force of this Protocol or, where the indication of the need for such Subsidiary Arrangements is made after the entry into force of this Protocol, within ninety days of the date of such indication.

b. Pending the entry into force of any necessary Subsidiary Arrangements, the Agency shall be entitled to apply the measures laid down in this Protocol.

COMMUNICATIONS SYSTEMS

Article 14

a. The United States shall permit and protect free communications by the Agency for official purposes between Agency inspectors in the United States and Agency Headquarters and/or Regional Offices, including attended and unattended transmission of information generated by Agency containment and/or surveillance or measurement devices. The Agency shall have, in consultation with the United States, the right to make use of internationally established systems of direct communications, including satellite systems and other forms of telecommunication, not in use in the United States. At the request of the United States or the Agency, details of the implementation of this paragraph with respect to the attended or unattended transmission of information generated by Agency containment and/or surveillance or measurement devices shall be specified in the Subsidiary Arrangements.

b. Communication and transmission of information as provided for in paragraph a. above shall take due account of the need to protect proprietary or commercially sensitive information or design information which the United States regards as being of particular sensitivity.

PROTECTION OF CONFIDENTIAL INFORMATION

Article 15

a. The Agency shall maintain a stringent regime to ensure effective protection against disclosure of commercial, technological and industrial secrets and other confidential information coming to its knowledge, including such information coming to the Agency's knowledge in the implementation of this Protocol.

b. The regime referred to in paragraph a. above shall include, among others, provisions relating to:

(i) General principles and associated measures for the handling of confidential information;

(ii) Conditions of staff employment relating to the protection of confidential information;

(iii) Procedures in cases of breaches or alleged breaches of confidentiality.

c. The regime referred to in paragraph a. above shall be approved and periodically reviewed by the Board.

ANNEXES

Article 16

a. The Annexes to this Protocol shall be an integral part thereof. Except for the purposes of amendment of the Annexes, the term "Protocol" as used in this instrument means the Protocol and the Annexes together.

b. The list of activities specified in Annex I, and the list of equipment and material specified in Annex II, may be amended by the Board upon the advice of an open-ended working group of experts established by the Board. Any such amendment shall take effect four months after its adoption by the Board.

ENTRY INTO FORCE

Article 17

a. This Protocol shall enter into force on the date on which the Agency receives from the United States written notification that the United States' statutory and constitutional requirements for entry into force have been met.

b. The United States may, at any date before this Protocol enters into force, declare that it will apply this Protocol provisionally.

c. The Director General shall promptly inform all Member States of the Agency of any declaration of provisional application of, and of the entry into force of, this Protocol.

DEFINITIONS

Article 18

For the purpose of this Protocol:

a. Nuclear fuel cycle-related research and development activities means those activities which are specifically related to any process or system development aspect of any of the following:

- conversion of nuclear material,
- enrichment of nuclear material,
- nuclear fuel fabrication,
- reactors,
- critical facilities,
- reprocessing of nuclear fuel,
- processing (not including repackaging or conditioning not involving the separation of elements, for storage or disposal) of intermediate or high-level waste containing plutonium, high enriched uranium or uranium-233,

but do not include activities related to theoretical or basic scientific research or to research and development on industrial radioisotope applications, medical, hydrological and agricultural applications, health and environmental effects and improved maintenance.

b. Site means that area delimited by the United States in the relevant design information for a facility, including a closed-down facility, and in the relevant information on a location outside facilities where nuclear material is customarily used, including a closed-down location outside facilities where nuclear material was customarily used (this is limited to locations with hot cells or where activities related to conversion, enrichment, fuel fabrication or reprocessing were carried out). It shall also include all installations, co-located with the facility or location, for the provision or use of essential services, including: hot cells for processing irradiated materials not containing nuclear material; installations for the treatment, storage and disposal of waste; and buildings associated with specified activities identified by the United States under Article 2.a.(iv) above.

c. Decommissioned facility or decommissioned location outside facilities means an installation or location at which residual structures and equipment essential for its use have been removed or rendered inoperable so that it is not used to store and can no longer be used to handle, process or utilize nuclear material.

d. Closed-down facility or closed-down location outside facilities means an installation or location where operations have been stopped and the nuclear material removed but which has not been decommissioned.

e. High enriched uranium means uranium containing 20 percent or more of the isotope uranium-235.

f. Location-specific environmental sampling means the collection of environmental samples (e.g., air, water, vegetation, soil, smears) at, and in the immediate vicinity of, a location specified by the Agency for the purpose of assisting the Agency to draw

conclusions about the absence of undeclared nuclear material or nuclear activities at the specified location.

g. Wide-area environmental sampling means the collection of environmental samples (e.g., air, water, vegetation, soil, smears) at a set of locations specified by the Agency for the purpose of assisting the Agency to draw conclusions about the absence of undeclared nuclear material or nuclear activities over a wide area.

h. Nuclear material means any source or any special fissionable material as defined in Article XX of the Statute. The term source material shall not be interpreted as applying to ore or ore residue. Any determination by the Board under Article XX of the Statute of the Agency after the entry into force of this Protocol which adds to the materials considered to be source material or special fissionable material shall have effect under this Protocol only upon acceptance by the United States.

i. Facility means:

(i) A reactor, a critical facility, a conversion plant, a fabrication plant, a reprocessing plant, an isotope separation plant or a separate storage installation; or

(ii) Any location where nuclear material in amounts greater than one effective kilogram is customarily used.

j. Location outside facilities means any installation or location, which is not a facility, where nuclear material is customarily used in amounts of one effective kilogram or less.

DONE at Vienna on the 12th day of June 1998 in duplicate in the English language.

FOR THE UNITED STATES OF AMERICA:

FOR THE INTERNATIONAL ATOMIC ENERGY AGENCY:

ANNEX I

LIST OF ACTIVITIES REFERRED TO IN ARTICLE 2.a.(iv) OF THE PROTOCOL

(i) The manufacture of centrifuge rotor tubes or the assembly of gas centrifuges.

Centrifuge rotor tubes means thin-walled cylinders as described in entry 5.1.1(b) of Annex II.

Gas centrifuges means centrifuges as described in the Introductory Note to entry 5.1 of Annex II.

(ii) The manufacture of diffusion barriers.

Diffusion barriers means thin, porous filters as described in entry 5.3.1(a) of Annex II.

(iii) The manufacture or assembly of laser-based systems.

Laser-based systems means systems incorporating those items as described in entry 5.7 of Annex II.

(iv) The manufacture or assembly of electromagnetic isotope separators.

Electromagnetic isotope separators means those items referred to in entry 5.9.1 of Annex II containing ion sources as described in 5.9.1(a) of Annex II.

(v) The manufacture or assembly of columns or extraction equipment.

Columns or extraction equipment means those items as described in entries 5.6.1, 5.6.2, 5.6.3, 5.6.5, 5.6.6, 5.6.7 and 5.6.8 of Annex II.

(vi) The manufacture of aerodynamic separation nozzles or vortex tubes.

Aerodynamic separation nozzles or vortex tubes means separation nozzles and vortex tubes as described respectively in entries 5.5.1 and 5.5.2 of Annex II.

(vii) The manufacture or assembly of uranium plasma generation systems.

Uranium plasma generation systems means systems for the generation of uranium plasma as described in entry 5.8.3 of Annex II.

(viii) The manufacture of zirconium tubes.

Zirconium tubes means tubes as described in entry 1.6 of Annex II.

(ix) The manufacture or upgrading of heavy water or deuterium.

Heavy water or deuterium means deuterium, heavy water (deuterium oxide) and any other deuterium compound in which the ratio of deuterium to hydrogen atoms exceeds 1:5000.

(x) The manufacture of nuclear grade graphite.

Nuclear grade graphite means graphite having a purity level better than 5 parts per million boron equivalent and with a density greater than 1.50 g/cm^3 .

(xi) The manufacture of flasks for irradiated fuel.

A flask for irradiated fuel means a vessel for the transportation and/or storage of irradiated fuel which provides chemical, thermal and radiological protection, and dissipates decay heat during handling, transportation and storage.

(xii) The manufacture of reactor control rods.

Reactor control rods means rods as described in entry 1.4 of Annex II.

(xiii) The manufacture of criticality safe tanks and vessels.

Criticality safe tanks and vessels means those items as described in entries 3.2 and 3.4 of Annex II.

(xiv) The manufacture of irradiated fuel element chopping machines.

Irradiated fuel element chopping machines means equipment as described in entry 3.1 of Annex II.

(xv) The construction of hot cells.

Hot cells means a cell or interconnected cells totalling at least 6 m^3 in volume with shielding equal to or greater than the equivalent of 0.5 m of concrete, with a density of 3.2 g/cm^3 or greater, outfitted with equipment for remote operations.

ANNEX II

LIST OF SPECIFIED EQUIPMENT AND NON-NUCLEAR MATERIAL FOR THE REPORTING OF EXPORTS AND IMPORTS ACCORDING TO ARTICLE 2.a.(ix)

1. Reactors and equipment therefor

1.1. Complete nuclear reactors

Nuclear reactors capable of operation so as to maintain a controlled self-sustaining fission chain reaction, excluding zero energy reactors, the latter being defined as reactors with a designed maximum rate of production of plutonium not exceeding 100 grams per year.

EXPLANATORY NOTE

A "nuclear reactor" basically includes the items within or attached directly to the reactor vessel, the equipment which controls the level of power in the core, and the components which normally contain or come in direct contact with or control the primary coolant of the reactor core.

It is not intended to exclude reactors which could reasonably be capable of modification to produce significantly more than 100 grams of plutonium per year. Reactors designed for sustained operation at significant power levels, regardless of their capacity for plutonium production, are not considered as "zero energy reactors".

1.2. Reactor pressure vessels

Metal vessels, as complete units or as major shop-fabricated parts therefor, which are especially designed or prepared to contain the core of a nuclear reactor as defined in paragraph 1.1. above and are capable of withstanding the operating pressure of the primary coolant.

EXPLANATORY NOTE

A top plate for a reactor pressure vessel is covered by item 1.2. as a major shop-fabricated part of a pressure vessel.

Reactor internals (e.g. support columns and plates for the core and other vessel internals, control rod guide tubes, thermal shields, baffles, core grid plates, diffuser plates, etc.) are normally supplied by the reactor supplier. In some cases, certain internal support components are included in the fabrication of the pressure vessel. These items are sufficiently critical to the safety and reliability of the operation of the reactor (and, therefore, to the guarantees and liability of the reactor supplier), so that their supply, outside the basic supply arrangement for the reactor itself, would not be common practice. Therefore, although the separate supply of these unique, especially designed and prepared, critical, large and expensive items would not necessarily be considered as falling outside the area of concern, such a mode of supply is considered unlikely.

1.3. Reactor fuel charging and discharging machines

Manipulative equipment especially designed or prepared for inserting or removing fuel in a nuclear reactor as defined in paragraph 1.1. above capable of on-load operation or employing technically sophisticated positioning or alignment features to allow complex off-load fuelling operations such as those in which direct viewing of or access to the fuel is not normally available.

1.4. Reactor control rods

Rods especially designed or prepared for the control of the reaction rate in a nuclear reactor as defined in paragraph 1.1. above.

EXPLANATORY NOTE

This item includes, in addition to the neutron absorbing part, the support or suspension structures therefor if supplied separately.

1.5. Reactor pressure tubes

Tubes which are especially designed or prepared to contain fuel elements and the primary coolant in a reactor as defined in paragraph 1.1. above at an operating pressure in excess of 5.1 MPa (740 psi).

1.6. Zirconium tubes

Zirconium metal and alloys in the form of tubes or assemblies of tubes, and in quantities exceeding 500 kg in any period of 12 months, especially designed or prepared for use in a reactor as defined in paragraph 1.1. above, and in which the relation of hafnium to zirconium is less than 1:500 parts by weight.

1.7. Primary coolant pumps

Pumps especially designed or prepared for circulating the primary coolant for nuclear reactors as defined in paragraph 1.1. above.

EXPLANATORY NOTE

Especially designed or prepared pumps may include elaborate sealed or multi-sealed systems to prevent leakage of primary coolant, canned-driven pumps, and pumps with inertial mass systems. This definition encompasses pumps certified to NC-1 or equivalent standards.

2. Non-nuclear materials for reactors

2.1. Deuterium and heavy water

Deuterium, heavy water (deuterium oxide) and any other deuterium compound in which the ratio of deuterium to hydrogen atoms exceeds 1:5000 for use in a nuclear reactor as defined in paragraph 1.1. above in quantities exceeding 200 kg of deuterium atoms for any one recipient country in any period of 12 months.

2.2. Nuclear grade graphite

Graphite having a purity level better than 5 parts per million boron equivalent and with a density greater than 1.50 g/cm^3 for use in a nuclear reactor as defined in paragraph 1.1. above in quantities exceeding 3×10^4 kg (30 metric tons) for any one recipient country in any period of 12 months.

NOTE

For the purpose of reporting, the Government will determine whether or not the exports of graphite meeting the above specifications are for nuclear reactor use.

3. Plants for the reprocessing of irradiated fuel elements, and equipment especially designed or prepared therefor

INTRODUCTORY NOTE

Reprocessing irradiated nuclear fuel separates plutonium and uranium from intensely radioactive fission products and other transuranic elements. Different technical processes can accomplish this separation. However, over the years Purex has become the most commonly used and accepted process. Purex involves the dissolution of irradiated nuclear fuel in nitric acid, followed by separation of the uranium, plutonium, and fission products by solvent extraction using a mixture of tributyl phosphate in an organic diluent.

Purex facilities have process functions similar to each other, including: irradiated fuel element chopping, fuel dissolution, solvent extraction, and process liquor storage. There may also be equipment for thermal denitration of uranium nitrate, conversion of plutonium nitrate to oxide or metal, and treatment of fission product waste liquor to a form suitable for long term storage or disposal. However, the specific type and configuration of the equipment performing these functions may differ between Purex facilities for several reasons, including the type and quantity of irradiated nuclear fuel to be reprocessed and the intended disposition of the recovered materials, and the safety and maintenance philosophy incorporated into the design of the facility.

A "plant for the reprocessing of irradiated fuel elements" includes the equipment and components which normally come in direct contact with and directly control the irradiated fuel and the major nuclear material and fission product processing streams.

These processes, including the complete systems for plutonium conversion and plutonium metal production, may be identified by the measures taken to avoid criticality (e.g. by geometry), radiation exposure (e.g. by shielding), and toxicity hazards (e.g. by containment).

Items of equipment that are considered to fall within the meaning of the phrase "and equipment especially designed or prepared" for the reprocessing of irradiated fuel elements include:

3.1. Irradiated fuel element chopping machines

INTRODUCTORY NOTE

This equipment breaches the cladding of the fuel to expose the irradiated nuclear material to dissolution. Especially designed metal cutting shears are the most commonly employed, although advanced equipment, such as lasers, may be used.

Remotely operated equipment especially designed or prepared for use in a reprocessing plant as identified above and intended to cut, chop or shear irradiated nuclear fuel assemblies, bundles or rods.

3.2. Dissolvers

INTRODUCTORY NOTE

Dissolvers normally receive the chopped-up spent fuel. In these critically safe vessels, the irradiated nuclear material is dissolved in nitric acid and the remaining hulls removed from the process stream.

Critically safe tanks (e.g. small diameter, annular or slab tanks) especially designed or prepared for use in a reprocessing plant as identified above, intended for dissolution of irradiated nuclear fuel and which are capable of withstanding hot, highly corrosive liquid, and which can be remotely loaded and maintained.

3.3. Solvent extractors and solvent extraction equipment

INTRODUCTORY NOTE

Solvent extractors both receive the solution of irradiated fuel from the dissolvers and the organic solution which separates the uranium, plutonium, and fission products. Solvent extraction equipment is normally designed to meet strict operating parameters, such as long operating lifetimes with no maintenance requirements or adaptability to easy replacement, simplicity of operation and control, and flexibility for variations in process conditions.

Especially designed or prepared solvent extractors such as packed or pulse columns, mixer settlers or centrifugal contactors for use in a plant for the reprocessing of irradiated fuel. Solvent extractors must be resistant to the corrosive effect of nitric acid. Solvent extractors are normally fabricated to extremely high standards

(including special welding and inspection and quality assurance and quality control techniques) out of low carbon stainless steels, titanium, zirconium, or other high quality materials.

3.4. Chemical holding or storage vessels

INTRODUCTORY NOTE

Three main process liquor streams result from the solvent extraction step. Holding or storage vessels are used in the further processing of all three streams, as follows:

(a) The pure uranium nitrate solution is concentrated by evaporation and passed to a denitration process where it is converted to uranium oxide. This oxide is re-used in the nuclear fuel cycle.

(b) The intensely radioactive fission products solution is normally concentrated by evaporation and stored as a liquor concentrate. This concentrate may be subsequently evaporated and converted to a form suitable for storage or disposal.

(c) The pure plutonium nitrate solution is concentrated and stored pending its transfer to further process steps. In particular, holding or storage vessels for plutonium solutions are designed to avoid criticality problems resulting from changes in concentration and form of this stream.

Especially designed or prepared holding or storage vessels for use in a plant for the reprocessing of irradiated fuel. The holding or storage vessels must be resistant to the corrosive effect of nitric acid. The holding or storage vessels are normally fabricated of materials such as low carbon stainless steels, titanium or zirconium, or other high quality materials. Holding or storage vessels may be designed for remote operation and maintenance and may have the following features for control of nuclear criticality:

(1) walls or internal structures with a boron equivalent of at least two per cent, or

(2) a maximum diameter of 175 mm (7 in) for cylindrical vessels, or

(3) a maximum width of 75 mm (3 in) for either a slab or annular vessel.

3.5. Plutonium nitrate to oxide conversion system

INTRODUCTORY NOTE

In most reprocessing facilities, this final process involves the conversion of the plutonium nitrate solution to plutonium dioxide. The main functions involved in this process are: process feed storage and adjustment, precipitation and solid/liquor separation, calcination, product handling, ventilation, waste management, and process control.

Complete systems especially designed or prepared for the conversion of plutonium nitrate to plutonium oxide, in particular adapted so as to avoid criticality and radiation effects and to minimize toxicity hazards.

3.6. Plutonium oxide to metal production system

INTRODUCTORY NOTE

This process, which could be related to a reprocessing facility, involves the fluorination of plutonium dioxide, normally with highly corrosive hydrogen fluoride, to produce plutonium fluoride which is subsequently reduced using high purity calcium metal to produce metallic plutonium and a calcium fluoride slag. The main functions involved in this process are: fluorination (e.g. involving equipment fabricated or lined with a precious metal), metal reduction (e.g. employing ceramic crucibles), slag recovery, product handling, ventilation, waste management and process control.

Complete systems especially designed or prepared for the production of plutonium metal, in particular adapted so as to avoid criticality and radiation effects and to minimize toxicity hazards.

4. Plants for the fabrication of fuel elements

A "plant for the fabrication of fuel elements" includes the equipment:

(a) Which normally comes in direct contact with, or directly processes, or controls, the production flow of nuclear material, or

(b) Which seals the nuclear material within the cladding.

5. Plants for the separation of isotopes of uranium and equipment, other than analytical instruments, especially designed or prepared therefor

Items of equipment that are considered to fall within the meaning of the phrase "equipment, other than analytical instruments, especially designed or prepared" for the separation of isotopes of uranium include:

5.1. Gas centrifuges and assemblies and components especially designed or prepared for use in gas centrifuges

INTRODUCTORY NOTE

The gas centrifuge normally consists of a thin-walled cylinder(s) of between 75 mm (3 in) and 400 mm (16 in) diameter contained in a vacuum environment and spun at high peripheral speed of the order of 300 m/s or more with its central axis vertical. In order to achieve high speed the materials of construction for the rotating components have to be of a high strength to density ratio and the rotor assembly, and hence its individual components, have to be manufactured to very close tolerances in order to minimize the unbalance. In contrast to other centrifuges, the gas centrifuge for uranium enrichment is characterized by having within the rotor chamber a rotating disc-shaped baffle(s) and a stationary tube arrangement for feeding and extracting the UF_6 gas and featuring at least 3 separate channels, of which 2 are connected to scoops extending from the rotor axis towards the periphery of the rotor chamber. Also contained within the vacuum environment are a number of critical items which do not rotate and which although they are especially designed are not difficult to fabricate nor are they fabricated out of unique materials. A centrifuge facility however requires a large number of these components, so that quantities can provide an important indication of end use.

5.1.1. Rotating components

(a) Complete rotor assemblies:

Thin-walled cylinders, or a number of interconnected thin-walled cylinders, manufactured from one or more of the high strength to density ratio materials described in the EXPLANATORY NOTE to this Section. If interconnected, the cylinders are joined together by flexible bellows or rings as described in section 5.1.1.(c) following. The rotor is fitted with an internal baffle(s) and end caps, as described in section 5.1.1.(d) and (e) following, if in final form. However the complete assembly may be delivered only partly assembled.

(b) Rotor tubes:

Especially designed or prepared thin-walled cylinders with thickness of 12 mm (0.5 in) or less, a diameter of between 75 mm (3 in) and 400 mm (16 in), and manufactured from one or more of the high strength to density ratio materials described in the EXPLANATORY NOTE to this Section.

(c) Rings or Bellows:

Components especially designed or prepared to give localized support to the rotor tube or to join together a number of rotor tubes. The bellows is a short cylinder of wall thickness 3 mm (0.12 in) or less, a diameter of between 75 mm (3 in) and 400 mm (16 in), having a convolute, and manufactured from one of the high strength to density ratio materials described in the EXPLANATORY NOTE to this Section.

(d) Baffles:

Disc-shaped components of between 75 mm (3 in) and 400 mm (16 in) diameter especially designed or prepared to be mounted inside the centrifuge rotor tube, in order to isolate the take-off chamber from the main separation chamber and, in some cases, to assist the UF_6 gas circulation within the main separation chamber of the rotor tube, and manufactured from one of the high strength to density ratio materials described in the EXPLANATORY NOTE to this Section.

(e) Top caps/Bottom caps:

Disc-shaped components of between 75 mm (3 in) and 400 mm (16 in) diameter especially designed or prepared to fit to the ends of the rotor tube, and so contain the UF_6 within the rotor tube, and in some cases to support, retain or contain as an integrated part an element of the upper bearing (top cap) or to carry the rotating elements of the motor and lower bearing (bottom cap), and manufactured from one of the high strength to density ratio materials described in the EXPLANATORY NOTE to this Section.

EXPLANATORY NOTE

The materials used for centrifuge rotating components are:

(a) Maraging steel capable of an ultimate tensile strength of 2.05×10^9 N/m^2 (300,000 psi) or more;

(b) Aluminium alloys capable of an ultimate tensile strength of 0.46×10^9 N/m^2 (67,000 psi) or more;

(c) Filamentary materials suitable for use in composite structures and having a specific modulus of 12.3×10^6 m or greater and a specific ultimate tensile strength of 0.3×10^6 m or greater ('Specific Modulus' is the Young's Modulus in N/m^2 divided by the specific weight in N/m^3; 'Specific Ultimate Tensile Strength' is the ultimate tensile strength in N/m^2 divided by the specific weight in N/m^3).

5.1.2. Static components

(a) Magnetic suspension bearings:

Especially designed or prepared bearing assemblies consisting of an annular magnet suspended within a housing containing a damping medium. The housing will be manufactured from a UF_6-resistant material (see EXPLANATORY NOTE to Section 5.2.). The magnet couples with a pole piece or a second magnet fitted to the top cap described in Section 5.1.1.(e). The magnet may be ring-shaped with a relation between outer and inner diameter smaller or equal to 1.6:1. The magnet may be in a form having an initial permeability of 0.15 H/m (120,000 in CGS units) or more, or a remanence of 98.5% or more, or an energy product of greater than 80 kJ/m^3 (10^7 gauss-oersteds). In addition to the usual material properties, it is a prerequisite

that the deviation of the magnetic axes from the geometrical axes is limited to very small tolerances (lower than 0.1 mm or 0.004 in) or that homogeneity of the material of the magnet is specially called for.

(b) Bearings/Dampers:

Especially designed or prepared bearings comprising a pivot/cup assembly mounted on a damper. The pivot is normally a hardened steel shaft with a hemisphere at one end with a means of attachment to the bottom cap described in section 5.1.1.(e) at the other. The shaft may however have a hydrodynamic bearing attached. The cup is pellet-shaped with a hemispherical indentation in one surface. These components are often supplied separately to the damper.

(c) Molecular pumps:

Especially designed or prepared cylinders having internally machined or extruded helical grooves and internally machined bores. Typical dimensions are as follows: 75 mm (3 in) to 400 mm (16 in) internal diameter, 10 mm (0.4 in) or more wall thickness, with the length equal to or greater than the diameter. The grooves are typically rectangular in cross-section and 2 mm (0.08 in) or more in depth.

(d) Motor stators:

Especially designed or prepared ring-shaped stators for high speed multiphase AC hysteresis (or reluctance) motors for synchronous operation within a vacuum in the frequency range of 600 - 2000 Hz and a power range of 50 - 1000 VA. The stators consist of multi-phase windings on a laminated low loss iron core comprised of thin layers typically 2.0 mm (0.08 in) thick or less.

(e) Centrifuge housing/recipients:

Components especially designed or prepared to contain the rotor tube assembly of a gas centrifuge. The housing consists of a rigid cylinder of wall thickness up to 30 mm (1.2 in) with precision machined ends to locate the bearings and with one or more flanges for mounting. The machined ends are parallel to each other and perpendicular to the cylinder's longitudinal axis to within 0.05 degrees or less. The housing may also be a honeycomb type structure to accommodate several rotor tubes. The housings are made of or protected by materials resistant to corrosion by UF_6.

(f) Scoops:

Especially designed or prepared tubes of up to 12 mm (0.5 in) internal diameter for the extraction of UF_6 gas from within the rotor tube by a Pitot tube action (that is, with an aperture facing into the circumferential gas flow within the rotor tube, for example by bending the end of a radially disposed tube) and capable of being fixed to the central gas extraction system. The tubes are made of or protected by materials resistant to corrosion by UF_6.

5.2. Especially designed or prepared auxiliary systems, equipment and components for gas centrifuge enrichment plants

INTRODUCTORY NOTE

The auxiliary systems, equipment and components for a gas centrifuge enrichment plant are the systems of plant needed to feed UF_6 to the centrifuges, to link the individual centrifuges to each other to form cascades (or stages) to allow for progressively higher enrichments and to extract the 'product' and 'tails' UF_6 from the centrifuges, together with the equipment required to drive the centrifuges or to control the plant.

Normally UF_6 is evaporated from the solid using heated autoclaves and is distributed in gaseous form to the centrifuges by way of cascade header pipework. The 'product' and 'tails' UF_6 gaseous streams flowing from the centrifuges are also passed by way of cascade header pipework to cold traps (operating at about 203 K (-70 °C)) where they are condensed prior to onward transfer into suitable containers for transportation or storage. Because an enrichment plant consists of many thousands of centrifuges arranged in cascades there are many kilometers of cascade header pipework, incorporating thousands of welds with a substantial amount of repetition of layout. The equipment, components and piping systems are fabricated to very high vacuum and cleanliness standards.

5.2.1. Feed systems/product and tails withdrawal systems

Especially designed or prepared process systems including:

Feed autoclaves (or stations), used for passing UF_6 to the centrifuge cascades at up to 100 kPa (15 psi) and at a rate of 1 kg/h or more;

Desublimers (or cold traps) used to remove UF_6 from the cascades at up to 3 kPa (0.5 psi) pressure. The desublimers are capable of being chilled to 203 K (-70 °C) and heated to 343 K (70 °C);

'Product' and 'Tails' stations used for trapping UF_6 into containers.

This plant, equipment and pipework is wholly made of or lined with UF_6-resistant materials (see EXPLANATORY NOTE to this section) and is fabricated to very high vacuum and cleanliness standards.

5.2.2. Machine header piping systems

Especially designed or prepared piping systems and header systems for handling UF_6 within the centrifuge cascades. The piping network is normally of the 'triple' header system with each centrifuge connected to each of the headers. There is thus a substantial amount of repetition in its form. It is wholly made of UF_6-resistant materials (see EXPLANATORY NOTE to this section) and is fabricated to very high vacuum and cleanliness standards.

5.2.3. UF_6 mass spectrometers/ion sources

Especially designed or prepared magnetic or quadrupole mass spectrometers capable of taking 'on-line' samples of feed, product or tails, from UF_6 gas streams and having all of the following characteristics:

1. Unit resolution for atomic mass unit greater than 320;

2. Ion sources constructed of or lined with nichrome or monel or nickel plated;

3. Electron bombardment ionization sources;

4. Having a collector system suitable for isotopic analysis.

5.2.4. Frequency changers

Frequency changers (also known as converters or invertors) especially designed or prepared to supply motor stators as defined under 5.1.2.(d), or parts, components and sub-assemblies of such frequency changers having all of the following characteristics:

1. A multiphase output of 600 to 2000 Hz;

2. High stability (with frequency control better than 0.1%);

3. Low harmonic distortion (less than 2%); and

4. An efficiency of greater than 80%.

EXPLANATORY NOTE

The items listed above either come into direct contact with the UF_6 process gas or directly control the centrifuges and the passage of the gas from centrifuge to centrifuge and cascade to cascade.

Materials resistant to corrosion by UF_6 include stainless steel, aluminium, aluminium alloys, nickel or alloys containing 60% or more nickel.

5.3. Especially designed or prepared assemblies and components for use in gaseous diffusion enrichment

INTRODUCTORY NOTE

In the gaseous diffusion method of uranium isotope separation, the main technological assembly is a special porous gaseous diffusion barrier, heat exchanger for cooling the gas (which is heated by the process of compression), seal valves and control valves, and pipelines. Inasmuch as gaseous diffusion technology uses uranium hexafluoride (UF_6), all equipment, pipeline and instrumentation surfaces (that come in contact with the gas) must be made of materials that remain stable in

contact with UF_6. A gaseous diffusion facility requires a number of these assemblies, so that quantities can provide an important indication of end use.

5.3.1. Gaseous diffusion barriers

(a) Especially designed or prepared thin, porous filters, with a pore size of 100 - 1,000 Å (angstroms), a thickness of 5 mm (0.2 in) or less, and for tubular forms, a diameter of 25 mm (1 in) or less, made of metallic, polymer or ceramic materials resistant to corrosion by UF_6, and

(b) especially prepared compounds or powders for the manufacture of such filters. Such compounds and powders include nickel or alloys containing 60 per cent or more nickel, aluminium oxide, or UF_6-resistant fully fluorinated hydrocarbon polymers having a purity of 99.9 per cent or more, a particle size less than 10 microns, and a high degree of particle size uniformity, which are especially prepared for the manufacture of gaseous diffusion barriers.

5.3.2. Diffuser housings

Especially designed or prepared hermetically sealed cylindrical vessels greater than 300 mm (12 in) in diameter and greater than 900 mm (35 in) in length, or rectangular vessels of comparable dimensions, which have an inlet connection and two outlet connections all of which are greater than 50 mm (2 in) in diameter, for containing the gaseous diffusion barrier, made of or lined with UF_6-resistant materials and designed for horizontal or vertical installation.

5.3.3. Compressors and gas blowers

Especially designed or prepared axial, centrifugal, or positive displacement compressors, or gas blowers with a suction volume capacity of 1 m^3/min or more of UF_6, and with a discharge pressure of up to several hundred kPa (100 psi), designed for long-term operation in the UF_6 environment with or without an electrical motor of appropriate power, as well as separate assemblies of such compressors and gas blowers. These compressors and gas blowers have a pressure ratio between 2:1 and 6:1 and are made of, or lined with, materials resistant to UF_6.

5.3.4. Rotary shaft seals

Especially designed or prepared vacuum seals, with seal feed and seal exhaust connections, for sealing the shaft connecting the compressor or the gas blower rotor with the driver motor so as to ensure a reliable seal against in-leaking of air into the inner chamber of the compressor or gas blower which is filled with UF_6. Such seals are normally designed for a buffer gas in-leakage rate of less than 1000 cm^3/min (60 in^3/min).

5.3.5. Heat exchangers for cooling UF_6

Especially designed or prepared heat exchangers made of or lined with UF_6-resistant materials (except stainless steel) or with copper or any combination of those metals, and intended for a leakage pressure change rate of less than 10 Pa (0.0015 psi) per hour under a pressure difference of 100 kPa (15 psi).

5.4. Especially designed or prepared auxiliary systems, equipment and components for use in gaseous diffusion enrichment

INTRODUCTORY NOTE

The auxiliary systems, equipment and components for gaseous diffusion enrichment plants are the systems of plant needed to feed UF_6 to the gaseous diffusion assembly, to link the individual assemblies to each other to form cascades (or stages) to allow for progressively higher enrichments and to extract the 'product' and 'tails' UF_6 from the diffusion cascades. Because of the high inertial properties of diffusion cascades, any interruption in their operation, and especially their shut-down, leads to serious consequences. Therefore, a strict and constant maintenance of vacuum in all technological systems, automatic protection from accidents, and precise automated regulation of the gas flow is of importance in a gaseous diffusion plant. All this leads to a need to equip the plant with a large number of special measuring, regulating and controlling systems.

Normally UF_6 is evaporated from cylinders placed within autoclaves and is distributed in gaseous form to the entry point by way of cascade header pipework. The 'product' and 'tails' UF_6 gaseous streams flowing from exit points are passed by way of cascade header pipework to either cold traps or to compression stations where the UF_6 gas is liquefied prior to onward transfer into suitable containers for transportation or storage. Because a gaseous diffusion enrichment plant consists of a large number of gaseous diffusion assemblies arranged in cascades, there are many kilometers of cascade header pipework, incorporating thousands of welds with substantial amounts of repetition of layout. The equipment, components and piping systems are fabricated to very high vacuum and cleanliness standards.

5.4.1. Feed systems/product and tails withdrawal systems

Especially designed or prepared process systems, capable of operating at pressures of 300 kPa (45 psi) or less, including:

Feed autoclaves (or systems), used for passing UF_6 to the gaseous diffusion cascades;

Desublimers (or cold traps) used to remove UF_6 from diffusion cascades;

Liquefaction stations where UF_6 gas from the cascade is compressed and cooled to form liquid UF_6;

'Product' or 'tails' stations used for transferring UF_6 into containers.

5.4.2. Header piping systems

Especially designed or prepared piping systems and header systems for handling UF_6 within the gaseous diffusion cascades. This piping network is normally of the "double" header system with each cell connected to each of the headers.

5.4.3. Vacuum systems

(a) Especially designed or prepared large vacuum manifolds, vacuum headers and vacuum pumps having a suction capacity of 5 m^3/min (175 ft^3/min) or more.

(b) Vacuum pumps especially designed for service in UF_6-bearing atmospheres made of, or lined with, aluminium, nickel, or alloys bearing more than 60% nickel. These pumps may be either rotary or positive, may have displacement and fluorocarbon seals, and may have special working fluids present.

5.4.4. Special shut-off and control valves

Especially designed or prepared manual or automated shut-off and control bellows valves made of UF_6-resistant materials with a diameter of 40 to 1500 mm (1.5 to 59 in) for installation in main and auxiliary systems of gaseous diffusion enrichment plants.

5.4.5. UF_6 mass spectrometers/ion sources

Especially designed or prepared magnetic or quadrupole mass spectrometers capable of taking "on-line" samples of feed, product or tails, from UF_6 gas streams and having all of the following characteristics:

1. Unit resolution for atomic mass unit greater than 320;

2. Ion sources constructed of or lined with nichrome or monel or nickel plated;

3. Electron bombardment ionization sources;

4. Collector system suitable for isotopic analysis.

EXPLANATORY NOTE

The items listed above either come into direct contact with the UF_6 process gas or directly control the flow within the cascade. All surfaces which come into contact with the process gas are wholly made of, or lined with, UF_6-resistant materials. For the purposes of the sections relating to gaseous diffusion items the materials resistant to corrosion by UF_6 include stainless steel, aluminium, aluminium alloys, aluminium oxide, nickel or alloys containing 60% or more nickel and UF_6-resistant fully fluorinated hydrocarbon polymers.

5.5. Especially designed or prepared systems, equipment and components for use in aerodynamic enrichment plants

INTRODUCTORY NOTE

In aerodynamic enrichment processes, a mixture of gaseous UF_6 and light gas (hydrogen or helium) is compressed and then passed through separating elements wherein isotopic separation is accomplished by the generation of high centrifugal forces over a curved-wall geometry. Two processes of this type have been successfully developed: the separation nozzle process and the vortex tube process. For both processes the main components of a separation stage include cylindrical vessels housing the special separation elements (nozzles or vortex tubes), gas compressors and heat exchangers to remove the heat of compression. An aerodynamic plant requires a number of these stages, so that quantities can provide an important indication of end use. Since aerodynamic processes use UF_6, all equipment, pipeline and instrumentation surfaces (that come in contact with the gas) must be made of materials that remain stable in contact with UF_6.

EXPLANATORY NOTE

The items listed in this section either come into direct contact with the UF_6 process gas or directly control the flow within the cascade. All surfaces which come into contact with the process gas are wholly made of or protected by UF_6-resistant materials. For the purposes of the section relating to aerodynamic enrichment items, the materials resistant to corrosion by UF_6 include copper, stainless steel, aluminium, aluminium alloys, nickel or alloys containing 60% or more nickel and UF_6-resistant fully fluorinated hydrocarbon polymers.

5.5.1. Separation nozzles

Especially designed or prepared separation nozzles and assemblies thereof. The separation nozzles consist of slit-shaped, curved channels having a radius of curvature less than 1 mm (typically 0.1 to 0.05 mm), resistant to corrosion by UF_6 and having a knife-edge within the nozzle that separates the gas flowing through the nozzle into two fractions.

5.5.2. Vortex tubes

Especially designed or prepared vortex tubes and assemblies thereof. The vortex tubes are cylindrical or tapered, made of or protected by materials resistant to corrosion by UF_6, having a diameter of between 0.5 cm and 4 cm, a length to diameter ratio of 20:1 or less and with one or more tangential inlets. The tubes may be equipped with nozzle-type appendages at either or both ends.

EXPLANATORY NOTE

The feed gas enters the vortex tube tangentially at one end or through swirl vanes or at numerous tangential positions along the periphery of the tube.

5.5.3. Compressors and gas blowers

Especially designed or prepared axial, centrifugal or positive displacement compressors or gas blowers made of or protected by materials resistant to corrosion by UF_6 and with a suction volume capacity of 2 m^3/min or more of UF_6/carrier gas (hydrogen or helium) mixture.

EXPLANATORY NOTE

These compressors and gas blowers typically have a pressure ratio between 1.2:1 and 6:1.

5.5.4. Rotary shaft seals

Especially designed or prepared rotary shaft seals, with seal feed and seal exhaust connections, for sealing the shaft connecting the compressor rotor or the gas blower rotor with the driver motor so as to ensure a reliable seal against out-leakage of process gas or in-leakage of air or seal gas into the inner chamber of the compressor or gas blower which is filled with a UF_6/carrier gas mixture.

5.5.5. Heat exchangers for gas cooling

Especially designed or prepared heat exchangers made of or protected by materials resistant to corrosion by UF_6.

5.5.6. Separation element housings

Especially designed or prepared separation element housings, made of or protected by materials resistant to corrosion by UF_6, for containing vortex tubes or separation nozzles.

EXPLANATORY NOTE

These housings may be cylindrical vessels greater than 300 mm in diameter and greater than 900 mm in length, or may be rectangular vessels of comparable dimensions, and may be designed for horizontal or vertical installation.

5.5.7. Feed systems/product and tails withdrawal systems

Especially designed or prepared process systems or equipment for enrichment plants made of or protected by materials resistant to corrosion by UF_6, including:

(a) Feed autoclaves, ovens, or systems used for passing UF_6 to the enrichment process;

(b) Desublimers (or cold traps) used to remove UF_6 from the enrichment process for subsequent transfer upon heating;

(c) Solidification or liquefaction stations used to remove UF_6 from the enrichment process by compressing and converting UF_6 to a liquid or solid form;

(d) 'Product' or 'tails' stations used for transferring UF_6 into containers.

5.5.8. Header piping systems

Especially designed or prepared header piping systems, made of or protected by materials resistant to corrosion by UF_6, for handling UF_6 within the aerodynamic cascades. This piping network is normally of the 'double' header design with each stage or group of stages connected to each of the headers.

5.5.9. Vacuum systems and pumps

(a) Especially designed or prepared vacuum systems having a suction capacity of 5 m^3/min or more, consisting of vacuum manifolds, vacuum headers and vacuum pumps, and designed for service in UF_6-bearing atmospheres,

(b) Vacuum pumps especially designed or prepared for service in UF_6-bearing atmospheres and made of or protected by materials resistant to corrosion by UF_6. These pumps may use fluorocarbon seals and special working fluids.

5.5.10. Special shut-off and control valves

Especially designed or prepared manual or automated shut-off and control bellows valves made of or protected by materials resistant to corrosion by UF_6 with a diameter of 40 to 1500 mm for installation in main and auxiliary systems of aerodynamic enrichment plants.

5.5.11. UF_6 mass spectrometers/ion sources

Especially designed or prepared magnetic or quadrupole mass spectrometers capable of taking 'on-line' samples of feed, 'product' or 'tails', from UF_6 gas streams and having all of the following characteristics:

1. Unit resolution for mass greater than 320;

2. Ion sources constructed of or lined with nichrome or monel or nickel plated;

3. Electron bombardment ionization sources;

4. Collector system suitable for isotopic analysis.

5.5.12. UF_6/carrier gas separation systems

Especially designed or prepared process systems for separating UF_6 from carrier gas (hydrogen or helium).

EXPLANATORY NOTE

These systems are designed to reduce the UF_6 content in the carrier gas to 1 ppm or less and may incorporate equipment such as:

(a) Cryogenic heat exchangers and cryoseparators capable of temperatures of -120 °C or less, or

(b) Cryogenic refrigeration units capable of temperatures of -120 °C or less, or

(c) Separation nozzle or vortex tube units for the separation of UF_6 from carrier gas, or

(d) UF_6 cold traps capable of temperatures of -20 °C or less.

5.6. Especially designed or prepared systems, equipment and components for use in chemical exchange or ion exchange enrichment plants

INTRODUCTORY NOTE

The slight difference in mass between the isotopes of uranium causes small changes in chemical reaction equilibria that can be used as a basis for separation of the isotopes. Two processes have been successfully developed: liquid-liquid chemical exchange and solid-liquid ion exchange.

In the liquid-liquid chemical exchange process, immiscible liquid phases (aqueous and organic) are countercurrently contacted to give the cascading effect of thousands of separation stages. The aqueous phase consists of uranium chloride in hydrochloric acid solution; the organic phase consists of an extractant containing uranium chloride in an organic solvent. The contactors employed in the separation cascade can be liquid-liquid exchange columns (such as pulsed columns with sieve plates) or liquid centrifugal contactors. Chemical conversions (oxidation and reduction) are required at both ends of the separation cascade in order to provide for the reflux requirements at each end. A major design concern is to avoid contamination of the process streams with certain metal ions. Plastic, plastic-lined (including use of fluorocarbon polymers) and/or glass-lined columns and piping are therefore used.

In the solid-liquid ion-exchange process, enrichment is accomplished by uranium adsorption/desorption on a special, very fast-acting, ion-exchange resin or adsorbent. A solution of uranium in hydrochloric acid and other chemical agents is passed through cylindrical enrichment columns containing packed beds of the adsorbent. For a continuous process, a reflux system is necessary to release the uranium from the adsorbent back into the liquid flow so that 'product' and 'tails' can be collected. This is accomplished with the use of suitable reduction/oxidation chemical agents that are fully regenerated in separate external circuits and that may be partially regenerated within the isotopic separation columns themselves. The presence of hot concentrated hydrochloric acid solutions in the process requires that the equipment be made of or protected by special corrosion-resistant materials.

5.6.1. Liquid-liquid exchange columns (Chemical exchange)

Countercurrent liquid-liquid exchange columns having mechanical power input (i.e., pulsed columns with sieve plates, reciprocating plate columns, and columns with internal turbine mixers), especially designed or prepared for uranium enrichment using the chemical exchange process. For corrosion resistance to concentrated hydrochloric acid solutions, these columns and their internals are made of or protected by suitable plastic materials (such as fluorocarbon polymers) or glass. The stage residence time of the columns is designed to be short (30 seconds or less).

5.6.2. Liquid-liquid centrifugal contactors (Chemical exchange)

Liquid-liquid centrifugal contactors especially designed or prepared for uranium enrichment using the chemical exchange process. Such contactors use rotation to achieve dispersion of the organic and aqueous streams and then centrifugal force to separate the phases. For corrosion resistance to concentrated hydrochloric acid solutions, the contactors are made of or are lined with suitable plastic materials (such as fluorocarbon polymers) or are lined with glass. The stage residence time of the centrifugal contactors is designed to be short (30 seconds or less).

5.6.3. Uranium reduction systems and equipment (Chemical exchange)

(a) Especially designed or prepared electrochemical reduction cells to reduce uranium from one valence state to another for uranium enrichment using the chemical exchange process. The cell materials in contact with process solutions must be corrosion resistant to concentrated hydrochloric acid solutions.

EXPLANATORY NOTE

The cell cathodic compartment must be designed to prevent re-oxidation of uranium to its higher valence state. To keep the uranium in the cathodic compartment, the cell may have an impervious diaphragm membrane constructed of special cation exchange material. The cathode consists of a suitable solid conductor such as graphite.

(b) Especially designed or prepared systems at the product end of the cascade for taking the U^{4+} out of the organic stream, adjusting the acid concentration and feeding to the electrochemical reduction cells.

EXPLANATORY NOTE

These systems consist of solvent extraction equipment for stripping the U^{4+} from the organic stream into an aqueous solution, evaporation and/or other equipment to accomplish solution pH adjustment and control, and pumps or other transfer devices for feeding to the electrochemical reduction cells. A major design concern is to avoid contamination of the aqueous stream with certain metal ions. Consequently, for those parts in contact with the process stream, the system is constructed of equipment made of or protected by suitable materials (such as glass, fluorocarbon polymers, polyphenyl sulfate, polyether sulfone, and resin-impregnated graphite).

5.6.4. Feed preparation systems (Chemical exchange)

Especially designed or prepared systems for producing high-purity uranium chloride feed solutions for chemical exchange uranium isotope separation plants.

EXPLANATORY NOTE

These systems consist of dissolution, solvent extraction and/or ion exchange equipment for purification and electrolytic cells for reducing the uranium U^{6+} or U^{4+} to U^{3+}. These systems produce uranium chloride solutions having only a few parts per million of metallic impurities such as chromium, iron, vanadium, molybdenum and other bivalent or higher multi-valent cations. Materials of construction for portions of the system processing high-purity U^{3+} include glass, fluorocarbon polymers, polyphenyl sulfate or polyether sulfone plastic-lined and resin-impregnated graphite.

5.6.5. Uranium oxidation systems (Chemical exchange)

Especially designed or prepared systems for oxidation of U^{3+} to U^{4+} for return to the uranium isotope separation cascade in the chemical exchange enrichment process.

EXPLANATORY NOTE

These systems may incorporate equipment such as:

(a) Equipment for contacting chlorine and oxygen with the aqueous effluent from the isotope separation equipment and extracting the resultant U^{4+} into the stripped organic stream returning from the product end of the cascade,

(b) Equipment that separates water from hydrochloric acid so that the water and the concentrated hydrochloric acid may be reintroduced to the process at the proper locations.

5.6.6. Fast-reacting ion exchange resins/adsorbents (ion exchange)

Fast-reacting ion-exchange resins or adsorbents especially designed or prepared for uranium enrichment using the ion exchange process, including porous macroreticular resins, and/or pellicular structures in which the active chemical exchange groups are limited to a coating on the surface of an inactive porous support structure, and other composite structures in any suitable form including particles or fibers. These ion exchange resins/adsorbents have diameters of 0.2 mm or less and must be chemically resistant to concentrated hydrochloric acid solutions as well as physically strong enough so as not to degrade in the exchange columns. The resins/adsorbents are especially designed to achieve very fast uranium isotope exchange kinetics (exchange rate half-time of less than 10 seconds) and are capable of operating at a temperature in the range of 100 °C to 200 °C.

5.6.7. Ion exchange columns (Ion exchange)

Cylindrical columns greater than 1000 mm in diameter for containing and supporting packed beds of ion exchange resin/adsorbent, especially designed or prepared for uranium enrichment using the ion exchange process. These columns are made of or protected by materials (such as titanium or fluorocarbon plastics) resistant to corrosion by concentrated hydrochloric acid solutions and are capable of operating at a temperature in the range of 100 °C to 200 °C and pressures above 0.7 MPa (102 psia).

5.6.8. Ion exchange reflux systems (Ion exchange)

(a) Especially designed or prepared chemical or electrochemical reduction systems for regeneration of the chemical reducing agent(s) used in ion exchange uranium enrichment cascades.

(b) Especially designed or prepared chemical or electrochemical oxidation systems for regeneration of the chemical oxidizing agent(s) used in ion exchange uranium enrichment cascades.

EXPLANATORY NOTE

The ion exchange enrichment process may use, for example, trivalent titanium (Ti^{3+}) as a reducing cation in which case the reduction system would regenerate Ti^{3+} by reducing Ti^{4+}.

The process may use, for example, trivalent iron (Fe^{3+}) as an oxidant in which case the oxidation system would regenerate Fe^{3+} by oxidizing Fe^{2+}.

5.7. Especially designed or prepared systems, equipment and components for use in laser-based enrichment plants

INTRODUCTORY NOTE

Present systems for enrichment processes using lasers fall into two categories: those in which the process medium is atomic uranium vapor and those in which the process medium is the vapor of a uranium compound. Common nomenclature for such processes include: first category - atomic vapor laser isotope separation (AVLIS or SILVA); second category - molecular laser isotope separation (MLIS or MOLIS) and chemical reaction by isotope selective laser activation (CRISLA). The systems, equipment and components for laser enrichment plants embrace: (a) devices to feed uranium-metal vapor (for selective photo-ionization) or devices to feed the vapor of a uranium compound (for photo-dissociation or chemical activation); (b) devices to collect enriched and depleted uranium metal as 'product' and 'tails' in the first category, and devices to collect dissociated or reacted compounds as 'product' and unaffected material as 'tails' in the second category; (c) process laser systems to selectively excite the uranium-235 species; and (d) feed preparation and product conversion equipment. The complexity of the spectroscopy of uranium atoms and

compounds may require incorporation of any of a number of available laser technologies.

EXPLANATORY NOTE

Many of the items listed in this section come into direct contact with uranium metal vapor or liquid or with process gas consisting of UF_6 or a mixture of UF_6 and other gases. All surfaces that come into contact with the uranium or UF_6 are wholly made of or protected by corrosion-resistant materials. For the purposes of the section relating to laser-based enrichment items, the materials resistant to corrosion by the vapor or liquid of uranium metal or uranium alloys include yttria-coated graphite and tantalum; and the materials resistant to corrosion by UF_6 include copper, stainless steel, aluminium, aluminium alloys, nickel or alloys containing 60 % or more nickel and UF_6-resistant fully fluorinated hydrocarbon polymers.

5.7.1. Uranium vaporization systems (AVLIS)

Especially designed or prepared uranium vaporization systems which contain high-power strip or scanning electron beam guns with a delivered power on the target of more than 2.5 kW/cm.

5.7.2. Liquid uranium metal handling systems (AVLIS)

Especially designed or prepared liquid metal handling systems for molten uranium or uranium alloys, consisting of crucibles and cooling equipment for the crucibles.

EXPLANATORY NOTE

The crucibles and other parts of this system that come into contact with molten uranium or uranium alloys are made of or protected by materials of suitable corrosion and heat resistance. Suitable materials include tantalum, yttria-coated graphite, graphite coated with other rare earth oxides or mixtures thereof.

5.7.3. Uranium metal 'product' and 'tails' collector assemblies (AVLIS)

Especially designed or prepared 'product' and 'tails' collector assemblies for uranium metal in liquid or solid form.

EXPLANATORY NOTE

Components for these assemblies are made of or protected by materials resistant to the heat and corrosion of uranium metal vapor or liquid (such as yttria-coated graphite or tantalum) and may include pipes, valves, fittings, 'gutters', feed-throughs, heat exchangers and collector plates for magnetic, electrostatic or other separation methods.

5.7.4. Separator module housings (AVLIS)

Especially designed or prepared cylindrical or rectangular vessels for containing the uranium metal vapor source, the electron beam gun, and the 'product' and 'tails' collectors.

EXPLANATORY NOTE

These housings have multiplicity of ports for electrical and water feed-throughs, laser beam windows, vacuum pump connections and instrumentation diagnostics and monitoring. They have provisions for opening and closure to allow refurbishment of internal components.

5.7.5. Supersonic expansion nozzles (MLIS)

Especially designed or prepared supersonic expansion nozzles for cooling mixtures of UF_6 and carrier gas to 150 K or less and which are corrosion resistant to UF_6.

5.7.6. Uranium pentafluoride product collectors (MLIS)

Especially designed or prepared uranium pentafluoride (UF_5) solid product collectors consisting of filter, impact, or cyclone-type collectors, or combinations thereof, and which are corrosion resistant to the UF_5/UF_6 environment.

5.7.7. UF_6/carrier gas compressors (MLIS)

Especially designed or prepared compressors for UF_6/carrier gas mixtures, designed for long term operation in a UF_6 environment. The components of these compressors that come into contact with process gas are made of or protected by materials resistant to corrosion by UF_6.

5.7.8. Rotary shaft seals (MLIS)

Especially designed or prepared rotary shaft seals, with seal feed and seal exhaust connections, for sealing the shaft connecting the compressor rotor with the driver motor so as to ensure a reliable seal against out-leakage of process gas or in-leakage of air or seal gas into the inner chamber of the compressor which is filled with a UF_6/carrier gas mixture.

5.7.9. Fluorination systems (MLIS)

Especially designed or prepared systems for fluorinating UF_5 (solid) to UF_6 (gas).

EXPLANATORY NOTE

These systems are designed to fluorinate the collected UF_5 powder to UF_6 for subsequent collection in product containers or for transfer as feed to MLIS units for additional enrichment. In one approach, the fluorination reaction may be accomplished within the isotope separation system to react and recover directly off

the 'product' collectors. In another approach, the UF_5 powder may be removed/transferred from the 'product' collectors into a suitable reaction vessel (e.g., fluidized-bed reactor, screw reactor or flame tower) for fluorination. In both approaches, equipment for storage and transfer of fluorine (or other suitable fluorinating agents) and for collection and transfer of UF_6 are used.

5.7.10. UF_6 mass spectrometers/ion sources (MLIS)

Especially designed or prepared magnetic or quadrupole mass spectrometers capable of taking 'on-line' samples of feed, 'product' or 'tails', from UF_6 gas streams and having all of the following characteristics:

1. Unit resolution for mass greater than 320;

2. Ion sources constructed of or lined with nichrome or monel or nickel plated;

3. Electron bombardment ionization sources;

4. Collector system suitable for isotopic analysis.

5.7.11. Feed systems/product and tails withdrawal systems (MLIS)

Especially designed or prepared process systems or equipment for enrichment plants made of or protected by materials resistant to corrosion by UF_6, including:

(a) Feed autoclaves, ovens, or systems used for passing UF_6 to the enrichment process

(b) Desublimers (or cold traps) used to remove UF_6 from the enrichment process for subsequent transfer upon heating;

(c) Solidification or liquefaction stations used to remove UF_6 from the enrichment process by compressing and converting UF_6 to a liquid or solid form;

(d) 'Product' or 'tails' stations used for transferring UF_6 into containers.

5.7.12. UF_6/carrier gas separation systems (MLIS)

Especially designed or prepared process systems for separating UF_6 from carrier gas. The carrier gas may be nitrogen, argon, or other gas.

EXPLANATORY NOTE

These systems may incorporate equipment such as:

(a) Cryogenic heat exchangers or cryoseparators capable of temperatures of -120 °C or less, or

(b) Cryogenic refrigeration units capable of temperatures of -120 °C or less, or

(c) UF_6 cold traps capable of temperatures of -20 °C or less.

5.7.13. Laser systems (AVLIS, MLIS and CRISLA)

Lasers or laser systems especially designed or prepared for the separation of uranium isotopes.

EXPLANATORY NOTE

The laser system for the AVLIS process usually consists of two lasers: a copper vapor laser and a dye laser. The laser system for MLIS usually consists of a CO_2 or excimer laser and a multi-pass optical cell with revolving mirrors at both ends. Lasers or laser systems for both processes require a spectrum frequency stabilizer for operation over extended periods of time.

5.8. Especially designed or prepared systems, equipment and components for use in plasma separation enrichment plants

INTRODUCTORY NOTE

In the plasma separation process, a plasma of uranium ions passes through an electric field tuned to the U-235 ion resonance frequency so that they preferentially absorb energy and increase the diameter of their corkscrew-like orbits. Ions with a large-diameter path are trapped to produce a product enriched in U-235. The plasma, which is made by ionizing uranium vapor, is contained in a vacuum chamber with a high-strength magnetic field produced by a superconducting magnet. The main technological systems of the process include the uranium plasma generation system, the separator module with superconducting magnet and metal removal systems for the collection of 'product' and 'tails'.

5.8.1. Microwave power sources and antennae

Especially designed or prepared microwave power sources and antennae for producing or accelerating ions and having the following characteristics: greater than 30 GHz frequency and greater than 50 kW mean power output for ion production.

5.8.2. Ion excitation coils

Especially designed or prepared radio frequency ion excitation coils for frequencies of more than 100 kHz and capable of handling more than 40 kW mean power.

5.8.3. Uranium plasma generation systems

Especially designed or prepared systems for the generation of uranium plasma, which may contain high-power strip or scanning electron beam guns with a delivered power on the target of more than 2.5 kW/cm.