The U.S. Additional Protocol to the U.S.-International Atomic Energy Agency (IAEA) Safeguards Agreement

Report Handbook for Sites of IAEA-Selected Facilities

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SECTION 1: INTRODUCTION

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Background

The United States signed an Additional Protocol (AP) to the Agreement Between the United States of America and the International Atomic Energy Agency (IAEA) for the Application of Safeguards in the United States, which requires reporting of certain aspects of the U.S. nuclear fuel cycle, including: buildings on the sites of certain nuclear facilities; mining and concentration of nuclear ores; nuclear-related equipment manufacturing, assembly, or construction; imports and exports of specified nuclear equipment and non-nuclear material; imports, exports, and other activities involving certain source material (i.e., source material that has not reached the composition and purity suitable for fuel fabrication or for being isotopically enriched); certain nuclear fuel cycle-related research and development activities not involving nuclear material; and other activities involving nuclear material not currently subject to the U.S.-IAEA Safeguards Agreement. The requirements of the AP are promulgated in the Department of Commerce (DOC) Additional Protocol Regulations (APR) – Title 15 of the U.S. Code of Federal Regulations (15 CFR) Parts 781 – 799 and Nuclear Regulatory Commission (NRC) US-IAEA Safeguards Agreement Regulations -- 10 CFR Parts 75 and 110. The DOC Bureau of Industry and Security (BIS) operates the national database and will collect reports from NRC- and DOC-regulated persons.

Handbook Overview

This Report Handbook for Sites should be used in conjunction with 10 CFR Parts 75 and 110 to complete DOC/NRC Forms AP-A through AP-Q. Sites of IAEA-Selected Facilities are required (by the NRC) to complete these forms and submit them to BIS. IAEA-Selected Facilities are nuclear facilities which the IAEA has selected from the U.S. Eligible Facilities List and for which the U.S. government has submitted a Design Information Questionnaire (DIQ) to the IAEA under the U.S.-IAEA Safeguards Agreement (INFCIRC/288). These facilities will complete the report forms in this Handbook rather than the report forms included in the Report Handbook for Locations.

Section 2 of this Handbook provides a brief overview of anticipated reporting requirements for sites of IAEA-Selected Facilities. A flow chart is provided to assist in understanding the requirements for the different types of reports. Table 1, "Deadlines for Submission of Reports and Amendments," lists the different types of reports, the forms to be included in each report, and the deadlines for submission of these reports to BIS.

Section 3 of the Handbook provides all of the report forms with detailed instructions for completing each form on the reverse side of the form. The number of forms each site submits will depend on the type of report being submitted and the activities that are relevant to the reporting site. Based on the type of report being submitted, each site of an IAEA-Selected Facility will be required to submit Forms AP-A and AP-B, and a separate Form AP-C for each building on the site, and the relevant activity-based forms that are applicable for the site. For example, a site with a building that manufactures zirconium tubes would submit Forms AP-A, AP-B, a separate Form AP-C for the building, and Form AP-F).

There are also three supplements to this Handbook.

Supplement 1 is a Glossary of Definitions and Terms and serves to define key words that are used in the Handbook as well as in the report forms.

Supplement 2 provides a list of the Nuclear Fuel Cycle-Related Manufacturing, Assembly and Construction Activities that are reported on Form AP-F. These activities and related definitions are defined in further detail in Supplement 2 of this Handbook.

Supplement 3 provides a detailed List of Specified Equipment and Non-Nuclear Material, for the reporting of Exports (AP-M) and Imports (AP-N).

Paperwork Reduction Act

Notwithstanding any other provision of law, no person is required to, nor shall any person be subject to a penalty for failure to comply with a collection of information, subject to the Paperwork Reduction Act (PRA), unless that collection of information displays a currently valid OMB Control Number. This rule proposes a collection of information subject to the requirements of the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.). The information collection contained in this proposed rule is part of a joint information collection by the Bureau of Industry and Security (BIS), in accordance with the proposed Additional Protocol Regulations (APR) (15 CFR Parts 781-799), and the Nuclear Regulatory Commission (NRC), in accordance with amendments to its regulations in 10 CFR Part 75 and 10 CFR Part 110. BIS has submitted this proposed collection to the Office of Management and Budget for approval. A total of approximately 129 respondents are expected to be subject to the information collection requirements set forth in these BIS and NRC rules. These information collection requirements are expected to involve an estimated 844 total burden hours per annum at a total estimated cost of $43,205 per annum.

BIS will use the information contained in reports submitted by U.S. persons to compile the U.S. Declaration as required by the Additional Protocol.

Forms

Report forms required by the APR may be downloaded from the Internet at **www.ap.gov**. You also may obtain these forms by contacting: Treaty Compliance Division, Bureau of Industry and Security, U.S. Department of Commerce, **Attn: Forms Request, 14th Street and Pennsylvania Avenue, N.W., Room 2705, Washington, DC 20230, Telephone: (202) 482-1001**.

SECTION 2: REPORTING REQUIREMENTS

Reportable activities

To ensure U.S. Government compliance with its commitments under the AP, sites of IAEA-Selected Facilities are required to report information on the following activities if they were conducted at their site during the previous calendar year:

1. A general description of all buildings on the site and a map of the site (AP-C);
2. Certain nuclear fuel cycle-related research and development activities (AP-D & AP-E);
3. Activities involving the manufacturing, assembly and construction of certain nuclear fuel cycle-related equipment and materials (AP-F);
4. Ore processing activities for uranium and thorium (AP-G);
5. Possession, import and export of impure source material (AP-H & AP-I); and
6. Possession of nuclear material on which IAEA Safeguards have been exempted or terminated (AP-J, AP-K, AP-L).

Upon request by the NRC, sites of IAEA-Selected Facilities may also be required to provide information on:

1. The import of certain nuclear fuel cycle-related equipment and materials (as defined in Supplement 3 of the Handbook) if the IAEA requests this information from the U.S. Government in its verification of export information provided by another State Party (AP-N); or
2. An area outside the site of an IAEA-Selected Facility that the IAEA has reason to believe may be engaged in activities that are functionally related to that site (AP-O); or
3. Clarification or amplification of information submitted in a report to the BIS, or provision of information about any location on which the IAEA requests information (AP-O).

Report Types

The following types of reports may be required:

INITIAL REPORT:
You must submit an Initial Report to BIS by January 31st, if you commenced nuclear fuel cycle-related activities during the previous calendar year, and have not previously reported activities to BIS.

ANNUAL REPORTING:
You must submit either an ANNUAL UPDATE REPORT or a NO CHANGES REPORT by January 31st, if, at any time during the previous calendar year, you continued to engage in nuclear fuel cycle-related activities at a site for which you submitted an Initial Report.

ANNUAL UPDATE REPORT:
You must submit an Annual Update Report (DOC/NRC Forms AP-A, AP-B, AP-C and required activity forms) by January 31st if you have updates or changes to report concerning your site or your site's activities during the previous calendar year. When preparing the Annual Update Report, you must complete the same report forms that you used for submitting your Initial Report on these activities. Additional report forms will be required if your site engaged in any new reportable activities

NO CHANGES REPORT:
If all of the information, including contact information and other administrative information on AP-A and AP-B, provided in your most recently submitted report has not changed, you may submit a No Changes Report (Form AP-Q) in lieu of an Annual Update Report.

AMENDED REPORT:
Changes to previously submitted information must be submitted on an Amended Report. Corrections to information regarding a reportable activity and corrections or changes to company information (e.g., corrections to address, changes in contact information, etc.) must be submitted using the same AP Forms used previously and the corrections must be submitted within 30 calendar days after the information has changed or the error identified. Amendments to previously reported information resulting from an IAEA complementary access must be submitted using the same AP Forms used previously and the corrections must be submitted within 30 calendar days after the date of the complementary access. Any amended AP Forms should be accompanied with a cover letter addressing the specific change made. If additional information is requested during a complementary access, beyond what is submitted as part of the annual update, Form AP-O should be used unless a preferred alternative is agree upon by either the Department of Commerce or the Nuclear Regulatory Commission.

PROCESSING OF IAEA SAFEGUARDS-TERMINATED WASTE MATERIAL REPORT:
Information on and dates of processing of waste material on which IAEA safeguards was terminated must be submitted to BIS at least 210 days before the processing of the waste begins (Forms AP-A, AP-B, AP-L).

EXPORT OF SPECIFIED EQUIPMENT OR NON-NUCLEAR MATERIALS REPORT:

If you export any of the items listed in Supplement No. 3 to this Handbook, you must submit an Export Report to BIS no later than 15 days following the end of the calendar quarter in which the items were exported – therefore, Export Reports must be submitted to BIS no later than January 15th, April 15th, July 15th, and/or October 15th each year.

IMPORT OF SPECIFIED EQUIPMENT OR NON-NUCLEAR MATERIALS CONFIRMATION REPORT: Within 30 working days of receiving notice from the NRC with a request for information pertaining to the import of specific materials or equipment, submit an Import Confirmation of Equipment and Non-Nuclear Material Report (Forms AP-A, AP-B, and AP-N) to BIS.

SUPPLEMENTAL INFORMATION REPORT: If you are contacted by the NRC with a request for new or additional information about activities conducted at your site, you must submit a Supplemental Information Report to BIS within 15 working days of receiving the request (Forms AP-A, AP-B, and AP-O).

Additional Protocol Reporting Requirements Flow Diagram

Figure 1, Additional Protocol Reporting Requirements Flow Diagram, provides information to assist you in determining the reports and forms that you may need to submit.

Reporting Deadlines

Table 1, Deadlines For Submission of Reports And Amendments, provides information on the reporting deadlines.

Figure 1: Additional Protocol Reporting Requirements Flow Diagram

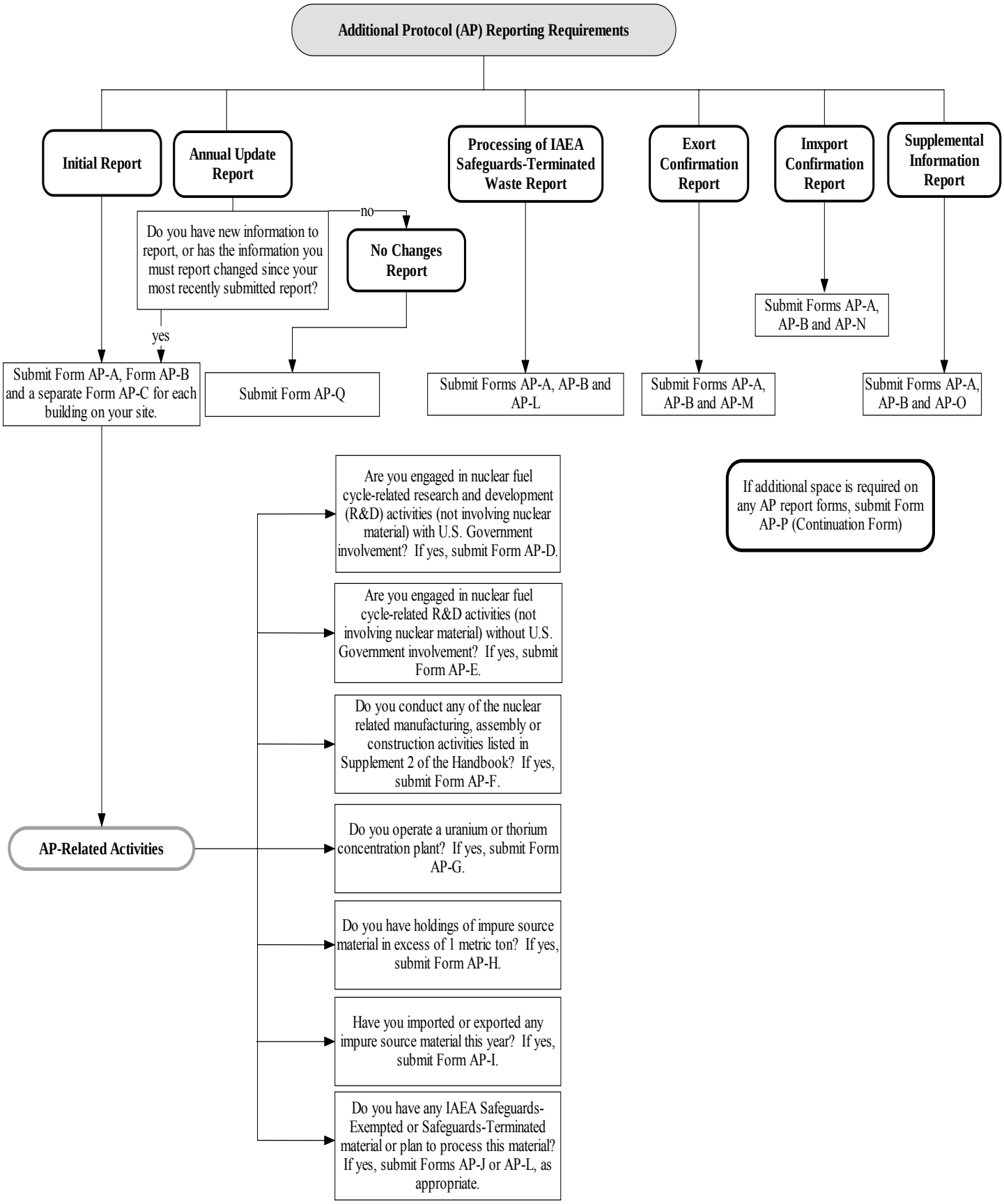
Additional Protocol (AP) Reporting Requirements
Initial Report
Annual Update Report
Processing of IAEA Safeguards-Terminated Waste Report
Exort Confirmation Report
Imxport Confirmation Report
Supplemental Information Report
Do you have new information to report, or has the information you must report changed since your most recently submitted report?
no
No Changes Report
yes
Submit Forms AP-A, AP-B and AP-N
Submit Form AP-A, Form AP-B and a separate Form AP-C for each building on your site.
Submit Form AP-Q
Submit Forms AP-A, AP-B and AP-L
Submit Forms AP-A, AP-B and AP-M
Submit Forms AP-A, AP-B and AP-O
If additional space is required on any AP report forms, submit Form AP-P (Continuation Form)
AP-Related Activities
Are you engaged in nuclear fuel cycle-related research and development (R&D) activities (not involving nuclear material) with U.S. Government involvement? If yes, submit Form AP-D.
Are you engaged in nuclear fuel cycle-related R&D activities (not involving nuclear material) without U.S. Government involvement? If yes, submit Form AP-E.
Do you conduct any of the nuclear related manufacturing, assembly or construction activities listed in Supplement 2 of the Handbook? If yes, submit Form AP-F.
Do you operate a uranium or thorium concentration plant? If yes, submit Form AP-G.
Do you have holdings of impure source material in excess of 1 metric ton? If yes, submit Form AP-H.
Have you imported or exported any impure source material this year? If yes, submit Form AP-I.
Do you have any IAEA Safeguards-Exempted or Safeguards-Terminated material or plan to process this material? If yes, submit Forms AP-J or AP-L, as appropriate.

Table 1: DEADLINES FOR SUBMISSION OF REPORTS AND AMENDMENTS

REPORTS	**APPLICABLE FORMS**	**DUE DATES**
Initial Report	AP-A, AP-B, AP-C and relevant nuclear fuel cycle-related activity forms	January 31st if you commenced nuclear fuel cycle-related activities during the previous calendar year and have not previously reported activities to BIS.
Annual Update Report	AP-A, AP-B, AP-C, and relevant nuclear fuel cycle-related activity forms	January 31st of the year following any calendar year in which the activities took place and there were changes to any previously reported activities or information.
No Changes Report	Form AP-Q	January 31st of the year following any calendar year in which the activities took place and there were no changes to any previously reported activities or information.
Supplemental Information Report	Forms AP-A, AP-B and AP-O, and any additional forms, as instructed	Within 15 working days of receiving notice from the NRC with a request for information or additional information about activities conducted at a location at your site.
Processing of IAEA Safeguards-Terminated Waste Materials Report	Forms AP-A, AP-B, and AP-L	At least 210 days before processing begins on the IAEA safeguards-terminated waste material.
Export of Specified Equipment and Non-Nuclear Material Report	AP-A, AP-B, and AP-M	Within 15 days from the end of each quarter. • April 15 (for January 1- March 31) • July 15 (for April 1 – June 30) • October 15 (for July 1 – September 30) • January 15 (for October 1 – December 31)
Import of Specified Equipment and Non-Nuclear Material Confirmation Report	AP-A, AP-B and AP-N	Within 30 working days of receiving notice from the NRC with a request for additional information pertaining to the import of specific materials or equipment.
Amended Report	AP-A, AP-B, AP-C, and any relevant nuclear fuel cycle-related activity forms	• 30 calendar days after change in report information. • 30 calendar days after change in company information. • 30 calendar days after receipt of a post-complementary access letter from NRC.

Section 3: U.S. Additional Protocol Report Forms and Instructions

FORM APPROVED: OMB NO. 0694-0135

U.S. DEPARTMENT OF COMMERCE **Bureau of Industry and Security** **U.S. NUCLEAR REGULATORY COMMISSION** **Office of Nuclear Materials Safety and Safeguards**	**Date Received (Leave Blank)**
ADDITIONAL PROTOCOL REPORT	
FORM AP-A: CERTIFICATION	

Provide the information requested below in Questions A.1 through A.6.

A.1	Company or Organization Name:		
A.2	Mailing Address:		
	City:	State:	Zip Code:
A.3	Name of Report Point of Contact (R-POC):		
	R-POC's Telephone Number:	ext.	
	R-POC's Fax Number:		
	R-POC's E-mail Address:		
A.4	**Type of Report (Check only one box)** ☐ INITIAL REPORT: For Reporting Year (YYYY): _____ ☐ ANNUAL UPDATE REPORT: For Reporting Year (YYYY): _____ ☐ PROCESSING OF IAEA SAFEGUARDS-TERMINATED WASTE MATERIAL REPORT ☐ EXPORT OF SPECIFIED EQUIPMENT & NON-NUCLEAR MATERIALS REPORT ☐ IMPORT OF SPECIFIED EQUIPMENT & NON-NUCLEAR MATERIALS CONFIRMATION REPORT ☐ SUPPLEMENTAL INFORMATION REPORT ☐ AMENDED REPORT: For Reporting Year (YYYY): _____		
A.5	**Forms Submitted (State the number of forms (non-zero) for each of the following)** AP-B: ___ AP-C: ___ AP-D: ___ AP-E: ___ AP-F: ___ AP-G: ___ AP-H: ____ AP-I: ___ AP-J: ___ AP-K:___ AP-L: ___ AP-M: ___ AP-N: ___ AP-O: ___ AP-P: ___		
A.6	**CERTIFICATION**		
	I hereby certify that I have reviewed the attached documents and that, to the best of my knowledge and belief, the submitted information is true and complete.		
	Name and Title of Responsible Official (type or print):		
	Signature:		
	Date Signed (MM-DD-YYYY):		

FORM AP-A: Certification

Reporting requirements are set forth in 10 CFR Parts 75 and 110 of the U.S. Nuclear Regulatory Commission (NRC) Regulations.

INSTRUCTIONS:
This form must be submitted for the following types of reports: Initial, Annual Update, Processing of IAEA Safeguards-Terminated Material, Import Confirmation, Supplemental Information, or Amended. Only NRC and Agreement State licensees with a site of an IAEA-Selected Facility should submit Forms AP-A through AP-Q. All other NRC and Agreement State licensees where reportable activities are conducted should use report Forms AP-1 through AP-17. A separate certification form must be submitted for each site with reportable activities.

Questions A.1 and A.2 Company or Organization Name and Mailing Address: Provide the name of your company or organization and the mailing address to which all general mailings will be sent.

Question A.3 Name of Report Point of Contact (R-POC) and Other Requested Information: Designate an R-POC. The R-POC should be a person whom the NRC or BIS may contact for the purposes of: (1) clarification of information provided in the report; and (2) for general information. The R-POC need not be the person who prepares the forms or certifies the report, but should be familiar with the content of the reports.

Question A.4 Type of Report: Check the box to indicate the type of report that is being submitted and indicate the date or year for which the information applies (where applicable). If submitting an Amended Report, check the box for Amended Report and the boxes for the reports for which you are submitting amendments.

INITIAL REPORT: A licensee with a site of an IAEA-Selected Facility must report all relevant nuclear fuel cycle-related activities that are active as of the date specified in the notification of reporting requirements letter received from the NRC. If you have already submitted an initial report and are adding a new activity at your site, you should submit the information using the Annual Update report.

ANNUAL UPDATE REPORT: You must submit either an Annual Update Report or a No Changes Report by January 31st, if, during the previous calendar year, you continued to engage in nuclear fuel cycle-related activities at a site for which you submitted an Initial Report. Submit an Annual Update Report if you have updates or changes to report concerning your site's activities during the previous calendar year. When preparing your Annual Update Report, you must complete the same report forms that you used for submitting your Initial Report on these activities. Additional report forms are required if your site engaged in new reportable activities.

AMENDED REPORT: You must submit an Amended Report to change or correct information in the last submitted report.

PROCESSING OF IAEA SAFEGUARDS-TERMINATED WASTE MATERIAL REPORT: You must submit this form to provide information, location, and dates for/of processing of waste material on which IAEA safeguards was terminated.

EXPORT OF EQUIPMENT & NON-NUCLEAR MATERIAL REPORT: You must submit this report quarterly to report the export of any item listed in Supplement 3 of this Handbook. Quarterly reports are due to BIS by April 15, July 15, October 15, and January 15.

IMPORT OF EQUIPMENT & NON-NUCLEAR MATERIAL CONFIRMATION REPORT: You must submit this report if you receive a notice from the NRC with a request for import information.

SUPPLEMENTAL INFORMATION REPORT: If you are contacted by the NRC with a request for new or additional information about activities conducted at your site, you must submit a Supplemental Information Report.

Question A.5 Forms Submitted: In the blank next to the form name state the number of each form included in the report. All reports must include Forms AP-A, AP-B, and AP-C, with the exception of a No Changes Report, which only includes Form AP-Q. Submit the applicable forms for each reportable activity conducted at your site:

Form	Reportable Activities
AP-B	Contact Information
AP-C	Building Information
AP-D	R&D with U.S. Government Involvement
AP-E	R&D without U.S. Government Involvement
AP-F	Manufacturing, Assembly, Construction Activities
AP-G	Concentration Plant Operations
AP-H	Holdings of Impure Source Materials
AP-I	Imports and Exports of Impure Source Material
AP-J	Holdings of IAEA Safeguards-Exempted Material
AP-K	Location of IAEA Safeguards-Terminated Waste Material
AP-L	Processing of IAEA Safeguards-Terminated Waste Material
AP-M	Export of Equipment & Non-Nuclear Materials Report
AP-N	Import of Equipment & Non-Nuclear Materials Confirmation Report
AP-O	Supplemental Information Report
AP-P	Continuation Form

Question A.6 Certification: The report must be signed and dated by a company or organization official who is authorized to certify the accuracy and completeness of the information submitted. The signature block must contain an original signature.

FORM APPROVED: OMB NO. 0694-0135

U.S. DEPARTMENT OF COMMERCE **Bureau of Industry and Security** **U.S. NUCLEAR REGULATORY COMMISSION** **Office of Nuclear Material Safety and Safeguards**	**Date Received (Leave Blank)**
ADDITIONAL PROTOCOL REPORT	
FORM AP-B: CONTACT INFORMATION FOR THE SITE OF AN IAEA-SELECTED FACILITY	

Submit this form to report information about the site where reportable activities are conducted. You must submit this form for an Initial, Annual Update, Amended, Processing of IAEA Safeguards-Terminated Waste, Export, Import Confirmation, or Supplemental Information Reports.

B.1	Site Name and Site Reporting Code (once assigned):		
B.2	Site Information Reporting Status: ☐ New information ☐ Information with no changes ☐ Information with changes		
B.3	Owner or Operator Name:		
	Telephone Number (24 hour):	Fax Number (24 hour):	
B.4	Street Address:		
	City:	State:	Zip Code:
B.5	Provide the geographic coordinates for the site where the reportable activity(ies) take place.		
	a. Latitude (Deg/Min/Sec/N):		
	b. Longitude (Deg/Min/Sec/W):		

Designate an Access Point of Contact (A-POC) and at least one Alternate A-POC for complementary access notifications involving this site.

B.6	Name of A-POC:	
	A-POC's Primary Telephone Number:	ext.
	A-POC's Alternate Telephone Number:	ext.
	A-POC's Fax Number:	
	A-POC's E-mail Address:	
B.7	Name of Alternate A-POC:	
	Alt. A-POC's Primary Telephone Number:	ext.
	Alt. A-POC's Alternate Telephone Number:	ext.
	Alt. A-POC's Fax Number:	
	Alt. A-POC's E-mail Address:	
B.8	☐ Check this box to confirm that a site map, drawn to scale, is attached.	
B.9	☐ Check this box if a Continuation Form (Form AP-P) has been used to provide additional information for any of the above questions.	

FORM AP-B: Contact Information for the Site of an IAEA-Selected Facility

Reporting requirements are set forth in 10 CFR Parts 75 and 110 of the U.S. Nuclear Regulatory Commission (NRC) Regulations.

INSTRUCTIONS:
This form must be submitted for the following types of reports: Initial, Annual Update, Processing of IAEA Safeguards-Terminated Material, Export, Import Confirmation, Supplemental Information or Amended.

Question B.1 Site Name and Site Reporting Code: Provide the name of your site. A unique site code will be assigned and provided to you after your Initial Report has been received by BIS. The site reporting code must appear on all future forms pertaining to this site.

Question B.2 Address Information Status: Indicate the current reporting status by checking the appropriate box (i.e., "New Information" to report information for the first time, "Information with no changes" or "Information with changes" if a report for this activity was previously submitted).

Question B.3 Owner or Operator Name and Contact Information: Provide the name, telephone and fax numbers of the site owner or operator. The telephone number provided must be a number that is answered either by a live operator or individual on a 24-hour basis and the fax number must be for a machine that is checked regularly on a 24-hour basis. Please do not provide numbers that are answered by an answering service or by voice-mail. The NRC must be able to notify the owner or operator immediately upon receipt of an IAEA request for complementary access.

Question B.4 Site Address: Provide the street address for the main gate, visitor control center or main office entrance for the site that would be sufficient to permit an IAEA inspector to find the site should the IAEA request complementary access. DO NOT PROVIDE A POST OFFICE BOX. Use Form AP-P as a continuation form, if necessary.

Question B.5 Latitude and Longitude: Provide the latitude and longitude for the center of the site using the following formats:

Latitude: 00(degree)/00(minutes)/00(seconds)/N
Longitude:
00(degree)/00(minutes)/00(seconds)/W

Questions B.6 and B.7 Designation of an Access Point of Contact (A-POC) and an Alternate A-POC: Designate an A-POC and an alternate A-POC for complementary access notifications involving this site. The A-POC should have sufficient authority to facilitate an IAEA complementary access. The primary or alternate telephone numbers provided for each individual must be a number that is answered either by a live operator or by the individual on a 24-hour basis. This number should not be answered by an answering service or by voice-mail. The NRC must be able to notify the A-POC or Alternate A-POC immediately upon receipt of an IAEA request for a complementary access.

Question B.8 Site Map Verification: Check the box to confirm that a site map drawn to scale is attached to your report. A site map must be attached to your Initial Report, and should only be attached to subsequent reports if there have been changes to the site or buildings located on the site.

Question B.9 Continuation Form: Check this box if a Continuation Form, Form AP-P, has been used to provide additional information for any of the above questions.

FORM APPROVED: OMB NO. 0694-0135

U.S. DEPARTMENT OF COMMERCE Bureau of Industry and Security U.S. NUCLEAR REGULATORY COMMISSION Office of Nuclear Materials Safety and Safeguards	Date Received (Leave Blank)
ADDITIONAL PROTOCOL REPORT	
FORM AP-C: BUILDING INFORMATION	

Submit this form for every building on your site. A separate form must be completed for each building.

C.1	Site Reporting Code (Once assigned):
C.2	Building Name or Number (as it appears on the attached site map):
C.3	Building Reporting Status ☐ New Building ☐ Building with no changes ☐ Building with changes ☐ Removed Building
C.4	If applicable, provide the IAEA Facility Code(s) for operations that occur within the building in the boxes below:
	| | | | | |
C.5	Number of Floors (include basements and sub-basements):
C.6	Provide the floor area (in square meters) for each floor of the building, starting from the bottom of the building up (include basements and sub-basements):
C.7	Specify the current use of the building:
C.8	Specify all prior nuclear-related uses of the building (if any):
C.9	☐ Check this box if a Continuation Form (Form AP-P) has been used to provide additional information for any of the above questions.

FORM AP-C: Building Information

Reporting requirements are set forth in 10 CFR Parts 75 and 110 of the U.S. Nuclear Regulatory Commission (NRC) Regulations.

INSTUCTIONS:
Submit a separate Form AP-C for each building identified on the site map submitted with Form AP-B.

Question C.1 Site Reporting Code: A site reporting code will be assigned and provided to you once your Initial Report has been received by BIS. The site reporting code must appear on all future forms pertaining to this site.

Question C.2 Building Information: Provide the name or number for the building, as it appears on the site map submitted with Form AP-B. This information will also be used to link the building with the site map and with nuclear-related activities, if any, that are performed within and reported on other forms.

Question C.3 Building Reporting Status: Indicate the current reporting status for the building by checking the appropriate box (i.e., "New Building" to report a building that was added to the site since the previous report, "Building with Changes" or "Building with No Changes" if a report on this building was previously submitted, and "Removed Building" when a previously reported building has been removed from the site (e.g., demolition or relocation of temporary structure/trailer).

Question C.4 IAEA Facility Code(s): If applicable, provide the IAEA Facility Code(s) for nuclear material operations that occur within the building. Please enter only one code per box.

Question C.5 Number of Floors: Provide the number of floors that this building has, including any basements or sub-basements.

Question C.6 Floor Area: Provide the floor area (in square meters – one square meter equals 10.76 square feet) for each floor of the building, starting from the bottom floor of the building and ending at the top floor (begin with basements and sub-basements, where applicable).

Question C.7 Current Use(s) of the Building: Specify all current uses of the building in general terms (e.g. laboratories, cafeteria, etc.).

Question C.8 Prior Nuclear-Related Use(s) of the Building: Specify all prior nuclear-related uses of the building (e.g., research laboratories, etc.).

Question C.9 Continuation Form: Check this box if a Continuation Form, Form AP-P, has been used to provide additional information for any of the above questions.

FORM APPROVED: OMB NO. 0694-0135

U.S. DEPARTMENT OF COMMERCE **Bureau of Industry and Security** **U.S. NUCLEAR REGULATORY COMMISSION** **Office of Nuclear Materials Safety and Safeguards**	**Date Received (Leave Blank)**
ADDITIONAL PROTOCOL REPORT	
FORM AP-D: NUCLEAR FUEL CYCLE-RELATED RESEARCH & DEVELOPMENT (NOT INVOLVING NUCLEAR MATERIAL) WITH U.S. GOVERNMENT INVOLVEMENT	

Submit a separate form for each research & development (R&D) project at your site that is funded, specifically authorized or controlled by, or carried out on behalf of the government of the United States.

D.1	Site Reporting Code (once assigned):
D.2	Project Number or ID:
D.3	Project Title:
D.4	Activity Reporting Status: ☐ New Activity ☐ Activity with no changes ☐ Activity with changes ☐ Ceased Activity
D.5	Identify building name(s)/number(s) (as it appears on the site map submitted with Form AP-B), and any additional information that more precisely defines where the reported activity occurs (e.g. room numbers):
D.6	Project Time Line: Start Date: (Estimated)Project End Date:
D.7	**Project Category (Fuel Cycle Stage):** ☐ Conversion of Nuclear Materials ☐ Enrichment of Nuclear Materials: ☐ Aerodynamic ☐ Chemical/Ion Exchange ☐ Electromagnetic ☐ Gas Centrifuge ☐ Gaseous Diffusion ☐ Laser ☐ Plasma Separation ☐ Other_____ ☐ Nuclear Fuel Fabrication ☐ Critical Facilities ☐ Nuclear Reactors ☐ Spent Fuel Management Installations ☐ Reprocessing of Nuclear Fuel ☐ Processing of Intermediate or High-Level Waste Containing Pu, U-233 or HEU
D.8	**Project Level (Check only one box):** ☐ Theoretical Analysis ☐ Experimental ☐ Conceptual Design ☐ Proof of Concept ☐ Demonstration ☐ Feasibility Study ☐ Prototype
D.9	Briefly Describe the R&D Activities:

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FORM AP-D (CONT.): NUCLEAR FUEL CYCLE-RELATED RESEARCH & DEVELOPMENT (NOT INVOLVING NUCLEAR MATERIAL) WITH U.S. GOVERNMENT INVOLVEMENT

D.10	Briefly State the Project Objective:
Principal U.S. Government Agency Involved:	
D.11	Department/Agency:
	Nature of Involvement:
	Street Address:
	City: State: Zip Code:
	Point of Contact (POC):
	POC's Telephone Number: Fax Number:
Provide the name and location of all other sponsors and/or collaborators, both domestic and foreign, for this R&D project. If applicable, provide additional information on Form AP-P.	
D.12.1	Organization Name:
	Street Address:
	City: State/Province: Country:
D.12.2	Organization Name:
	Street Address:
	City: State/Province: Country:
D.12.3	Organization Name:
	Street Address:
	City: State/Province: Country:
D.13	☐ Check this box if a Continuation Form (AP-P) has been used to provide additional information for any of the above questions.

FORM AP-D: Nuclear Fuel Cycle-Related R&D (Not Involving Nuclear Material) With U.S. Government Involvement

Reporting requirements are set forth in 10 CFR Parts 75 and 110 of the U.S. Nuclear Regulatory Commission (NRC) Regulations.

INSTRUCTIONS:
Submit a separate Form AP-D for each reportable nuclear fuel cycle-related R&D activity not involving nuclear material at your site that is funded by, authorized by, controlled by, or carried out on behalf of the U.S. Government. Reportable R&D includes technology development; safety related studies and computer modeling that extends knowledge resulting from theoretical or basic scientific research into a nuclear fuel cycle-related application are reportable activities. Reportable R&D activities do not include theoretical or basic scientific research; industrial radioisotope applications; medical, hydrological, and agricultural applications; health and environmental effects; or improved maintenance.

Question D.1 Site Reporting Code**:** A site code will be assigned and reported to you once your Initial report is received by BIS. The site reporting code must appear on all future forms pertaining to this site.

Questions D.2 and D.3 Project Number or ID and Project Title: Provide the R&D project number or ID assigned by project sponsor or organization conducting the activity, and the R&D project title.

Question D.4 Activity Reporting Status: Indicate the current reporting status by checking the appropriate box (i.e., "New Activity" to report an activity for the first time, "Activity with changes" or "Activity with no changes" if a report for this activity was previously submitted, or "Ceased Activity" for an activity that ended during the reporting year and will not be reported in future years). If the information previously reported for this specific activity has not changed, you are not required to complete the rest of this form, instead check the "Activity with no changes" box and submit along with Forms AP-A, AP-B, AP-C, and any other required activity forms.

Question D.5 Building Information: Provide the name or number for the building, as it appears on the site map submitted with Form AP-B, and, if needed, room number(s) and any additional information that more precisely defines where the reported activity occurs. This information will be used to link the building with the nuclear-related activities that are performed within.

Question D.6 Project Start and End Dates: Provide start and end dates for this project.

Question D.7 Project Category (Fuel Cycle Stage): Indicate the appropriate fuel cycle stage category and, if applicable, sub-category pertaining to this particular project by checking the appropriate box. Each fuel cycle stage category and subcategory identifies reportable R&D activities. If there is a question about whether or not certain information is reportable, contact the NRC for clarification.

Question D.8 Project Level: Indicate the project level that best describes the stage of development of the technology in the R&D project by checking the appropriate box.

Question D.9 Description of R&D Activities: Briefly describe the work that is being performed (e.g., design and testing of an induction-coil nuclear fuel pellet sintering oven). Where the work is part of a larger program, please identify that larger program.

Question D.10 Project Objective: Briefly describe the objective of the R&D project in the space provided (e.g., design of a sintering oven that meets a variety of specified temperature control requirements).

Question D.11 Principal U.S. Government Agency Involved: Identify the primary U.S. Government department or agency that this R&D project is funded by, authorized by, controlled by, or conducted on behalf of, its address and contact information for a point of contact at the department or agency.

FORM AP-D: Nuclear Fuel Cycle-Related R&D (Not Involving Nuclear Material) With U.S. Government Involvement (Continued)

Questions D.12.x Non-U.S. Government sponsors: Provide the name and address of all non-U.S. Government sponsors and collaborators (both foreign and domestic) of the program, including any foreign governments or organizations. If the site is wholly or partially owned by a foreign organization, that foreign organization should also be listed. Use Form AP-P as a continuation form for additional non-U.S. Government Sponsors and collaborators.

Question D.13 Continuation Form: Check this box if a Continuation Form, Form AP-P, has been used to provide additional information for any of the questions on Form AP-D.

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U.S. DEPARTMENT OF COMMERCE **Bureau of Industry and Security** **U.S. NUCLEAR REGULATORY COMMISSION** **Office of Nuclear Materials Safety and Safeguards**	**Date Received (Leave Blank)**
ADDITIONAL PROTOCOL REPORT	
FORM AP-E: NUCLEAR FUEL CYCLE-RELATED RESEARCH & DEVELOPMENT (NOT INVOLVING NUCLEAR MATERIAL) WITHOUT U.S. GOVERNMENT INVOLVMENT	

Submit a separate form for each R&D project at your site that is not funded, specifically authorized or controlled by, or carried out on behalf of the government of the United States.

E.1	Site Reporting Code (once assigned):
E.2	Project Number or ID:
E.3	Project Title:
E.4	Activity Reporting Status ☐ New activity ☐ Activity with no changes ☐ Activity with changes ☐ Ceased Activity
E.5	Identify building name(s)/number(s) (as it appears on the site map submitted with Form AP-B), and any additional information that more precisely defines where the reported activity occurs(e.g. room numbers):
E.6	Project Time Line: Start Date:_____ (Estimated) End Date: _____
E.7	**Project Category (Fuel Cycle Stage):** ☐ Enrichment of Nuclear Materials: ☐ Aerodynamic ☐ Chemical/Ion Exchange ☐ Electromagnetic ☐ Gas Centrifuge ☐ Gaseous Diffusion ☐ Laser ☐ Plasma Separation ☐ Other:_____ ☐ Reprocessing of Nuclear Fuel ☐ Processing of Intermediate or High-Level Waste Containing Pu, U-233 or HEU
E.8	**Project Level (Check only on box):** ☐ Theoretical Analysis ☐ Experimental ☐ Conceptual Design ☐ Proof of Concept ☐ Demonstration ☐ Feasibility Study ☐ Prototype
E.9	Briefly Describe the R&D Activities:

FORM AP-E (CONT.): NUCLEAR FUEL CYCLE-RELATED RESEARCH AND DEVELOPMENT (NOT INVOLVING NUCLEAR MATERIAL) WITHOUT U.S. GOVERNMENT INVOLVEMENT

E.10	Briefly State the Project Objective:

Provide the name and location of all sponsors and/or collaborators, both domestic and foreign, for this R&D project. If applicable, provide additional information on Form AP-P.

E.11.1	Organization Name:		
	Street Address:		
	City:	State/Province:	Country:
E.11.2	Organization Name:		
	Street Address:		
	City:	State/Province:	Country:
E.11.3	Organization Name:		
	Street Address:		
	City:	State/Province:	Country:
E.12	☐ Check this box if a Continuation Form (Form AP-P) has been used to provide additional information for any of the above questions.		

FORM AP-E: Nuclear Fuel Cycle-Related R&D (Not Involving Nuclear Material) Without U.S. Government Involvement

Reporting requirements are set forth in 10 CFR Parts 75 and 110 of the U.S. Nuclear Regulatory Commission (NRC) Regulations.

INSTRUCTIONS:

Submit a separate Form AP-E for each reportable nuclear fuel cycle-related research and development (R&D) activity not involving nuclear material at your site that is **not** funded by, authorized by, controlled by, or carried out on behalf of the U.S. Government. Reportable R&D activities include those related to enrichment of nuclear materials, reprocessing of nuclear fuel, and processing of intermediate or high-level waste containing Pu, U-233 or HEU, that extend knowledge resulting from theoretical or basic scientific research into a nuclear fuel cycle-related application. Reportable R&D activities do not include theoretical or basic scientific research; industrial radioisotope applications; medical, hydrological, and agricultural applications; health and environmental effects; or improved maintenance.

Question E.1 Site Reporting Code**:** A site code will be assigned and reported to you once your Initial report is received by BIS. The site reporting code must appear on all future forms pertaining to this site.

Questions E.2 and E.3 Project Number or ID and Project Title: Provide the R&D project number or ID (internal identification label), and the R&D project title (title assigned by sponsor or internal title).

Question E.4 Activity Reporting Status: Indicate the current reporting status by checking the appropriate box (i.e., "New Activity" to report an activity for the first time, "Activity with changes" or "Activity with no changes" if a report for this activity was previously submitted, or "Ceased Activity" for an activity that ended during the reporting year and will not be reported in future years). If the information previously reported for this specific activity has not changed, you are not required to complete the rest of the form, instead check the "Activity with no changes" box and submit along with Forms AP-A, AP-B, AP-C and any other required activity forms.

Question E.5 Building Information: Provide the name or number for the building, as it appears on the site map submitted with Form AP-B, and, if needed, room number(s) and any additional information that more precisely defines where the reported activity occurs. This information will be used to link the building with the nuclear-related activities that are performed within.

Question E.6 Project Time Line: Provide start and projected end dates for this project.

Question E.7 Project Category (Fuel Cycle Stage): Indicate the appropriate fuel cycle stage category and, if applicable, sub-category pertaining to this particular project by checking the appropriate box. Each fuel cycle stage category and subcategory identifies reportable R&D activities. If there is a question about whether or not certain information is reportable, contact the NRC for clarification.

Question E.8 Project Level: Indicate the project level that best describes the stage of development of the technology in the R&D project by checking the appropriate box.

Question E.9 Description of R&D Activities: Briefly describe the work that is being performed (e.g. design and testing of gas centrifuge internal components). Where the work is part of a larger program, please identify that larger program.

Question E.10 Project Objective: Briefly describe the objective of the R&D project in the space provided (e.g., design of the most efficient product scoop).

FORM AP-E: Nuclear Fuel Cycle-Related Research and Development (Not Involving Nuclear Material) without U.S. Government Involvement (Continued)

Questions E.11.x Non-U.S. Government Sponsors: Provide the name and address of all non-U.S. Government sponsors and collaborators (both foreign and domestic) of the program, including any foreign governments or organizations. If this location is wholly or partially owned by a foreign organization, that foreign organization should also be listed. If this R&D project is funded by, authorized by, controlled by, or carried out on behalf of the U.S. Government, use Form AP-D to report this project instead of this form (Form AP-E). Use Form AP-P as a continuation form for additional non-U.S. Government sponsors and collaborators.

Question E.12 Continuation Form: Check this box if a Continuation Form, Form AP-P, has been used to provide additional information for any of the questions on Form AP-E.

FORM APPROVED: OMB NO. 0694-0135

U.S. DEPARTMENT OF COMMERCE Bureau of Industry and Security U.S. NUCLEAR REGULATORY COMMISSION Office of Nuclear Materials Safety and Safeguards	Date Received (Leave Blank)
ADDITIONAL PROTOCOL REPORT	
FORM AP-F: NUCLEAR-RELATED MANUFACTURING, ASSEMBLY OR CONSTRUCTION ACTIVITIES	

Submit a separate form for each nuclear-related manufacturing, assembly or construction activity at your site.

F.1	Site Reporting Code (once assigned):
F.2	Activity Code (Select the proper code from the list below):

Activity Code	Nuclear-Related Manufacturing and Assembly Activities
1	Manufacture of certain **centrifuge rotor tubes** or the assembly of **gas centrifuges**
2	Manufacture of certain **diffusion barriers**
3	Manufacture or assembly of certain **laser-based systems**
4	Manufacture or assembly of certain **electromagnetic isotope separators**
5	Manufacture or assembly of certain **columns or extraction equipment**
6	Manufacture of certain **aerodynamic separation nozzles or vortex tubes**
7	Manufacture or assembly of certain **uranium plasma generation systems**
8	Manufacture of certain **zirconium tubes**
9	Manufacture or upgrading of **heavy water or upgrading of deuterium**
10	Manufacture of **nuclear grade graphite**
11	Manufacture of **flasks (e.g., transport or storage containers) for irradiated fuel**
12	Manufacture of **reactor control rods**
13	Manufacture of certain **critically safe tanks and vessels**
14	Manufacture of **irradiated fuel element chopping machines**
15	Construction of certain types of **hot cells**

F.3	Activity Reporting Status ☐ New activity ☐ Activity with no changes ☐ Activity with changes ☐ Ceased Activity
F.4	Identify building name(s)/number(s) (as it appears on the site map submitted with Form AP-B), and any additional information that more precisely defines where the reported activity occurs(e.g. room numbers):
F.5	Approximate annual production for the past calendar year : ☐ Items ☐ Kg
F.6	☐ Check this box if a Continuation Form (Form AP-P) has been used to provide additional information for any of the above questions.

FORM AP-F: Nuclear-Related Manufacturing, Assembly or Construction Activities

Reporting requirements are set forth in 10 CFR Parts 75 and 110 of the U.S. Nuclear Regulatory Commission (NRC) Regulations.

INSTRUCTIONS:
Submit a separate Form AP-F for each nuclear-related manufacturing, assembly or construction activity on the site. These activities are listed and further defined in Supplement 2 of the Additional Protocol Handbook.

Question F.1 Site Reporting Code**:** A site code will be assigned to your site by BIS once your Initial report is received. Your site's code will be communicated to you by the NRC. The site reporting code must appear on all future forms pertaining to this site.

Question F.2 Activity Code: Review the 15 activities listed in the chart, and enter the proper code for your activity. These activities are further defined in Supplement 2 of the Reporting Handbook.

Question F.3 Activity Reporting Status: Indicate the current reporting status by checking the appropriate box (i.e., "New Activity" to report an activity for the first time, "Activity with changes" or "Activity with no changes" if a report for this activity was previously submitted, or "Ceased Activity" for an activity that ended during the reporting year and will not be reported in future years). If the information previously reported for this specific activity has not changed, you are not required to complete the rest of this form, instead check the "Activity with no changes" box and submit along with Forms AP-A, AP-B and any other required activity forms.

Question F.4 Building Information: Provide the name or number for the building, as it appears on the site map submitted with Form AP-B, and, if needed, room number(s) and any additional information that more precisely defines where the reported activity occurs. This information will be used to link the building with the nuclear-related activities that are performed within.

Questions F.5 List of Manufacturing, Assembly or Construction Activities and Codes: Provide the approximate annual production of the manufacturing/ assembly/ construction process associated with the Activity Code you entered for Question F.2 in either units (e.g., items) or weight (i.e., kilograms), whichever is more meaningful, rounded to the nearest ten if the amount is more than 10 but less than 1000 items or kilograms (e.g., 27 to 30, 148 to 150, etc.). Round to the nearest two significant figures if 1000 or more items or kilograms (e.g. 1525 to 1500, 15782 to 16000, etc). If the amount is less than 10 items or kilograms report that exact number (e.g., 2, 4, 8, etc.). Check the appropriate box to indicate items or weight as the unit of measure for the production number being reported. If several manufacturing, assembly or construction activities are conducted at this address, submit a separate Form AP-F for each activity.

Question F.6 Continuation Form: Check this box if a Continuation Form, Form AP-P, has been used to provide additional information for any of the above questions.

FORM APPROVED: OMB NO. 0694-0135

U.S. DEPARTMENT OF COMMERCE Bureau of Industry and Security U.S. NUCLEAR REGULATORY COMMISSION Office of Nuclear Materials Safety and Safeguards	Date Received (Leave Blank)
ADDITIONAL PROTOCOL REPORT	
FORM AP-G: CONCENTRATION PLANT OPERATIONS	

Submit a separate form for each concentration plant.

G.1	Site Reporting Code (once assigned):
G.2	Activity Reporting Status ☐ New activity ☐ Activity with no changes ☐ Activity with changes ☐ Ceased Activity
G.3	Identify building name(s)/number(s) (as it appears on the site map submitted with Form AP-B), and any additional information that more precisely defines where the reported activity occurs(e.g. room numbers):
G.4	**Concentration Plant Type:** ☐ Conventional Mill ☐ Phosphate or other ore by-product plant ☐ In-situ Leach Mine ☐ Other Concentration Plant: _____
G.5	**Operational Status:** ☐ Operating ☐ Closed-down ☐ Decommissioned
G.6	Annual Elemental Uranium Production Capacity (in metric tons): Actual Annual Production (in metric tons):
G.7	Annual Elemental Thorium Production Capacity (in metric tons): Actual Annual Production (in metric tons):
G.8	☐ Check this box if a Continuation Form (Form AP-P) has been used to provide additional information for any of the above questions.

FORM AP-G: Concentration Plant Operations

Reporting requirements are set forth in 10 CFR Parts 75 and 110 of the U.S. Nuclear Regulatory Commission (NRC) Regulations.

INSTRUCTIONS:
Submit a separate Form AP-G for each concentration plant at your site where uranium and/or thorium is processed or produced. A concentration plant is where uranium and/or thorium are chemically concentrated from ore or by-product materials into a form for further processing.

Question G.1 Site Reporting Code**:** A site code will be assigned and reported to you once your Initial Report is received by BIS. The site reporting code must appear on all future forms pertaining to this site.

Question G.2 Activity Reporting Status: Indicate the current reporting status by checking the appropriate box (i.e., "New Activity" to report an activity for the first time, "Activity with changes" or "Activity with no changes" if a report for this activity was previously submitted, or "Ceased Activity" for an activity that ended during the reporting year and will not be reported in future years). If the information previously reported for this specific activity has not changed, you are not required to complete the rest of this form, instead check the "Activity with no changes" box and submit along with Forms AP-A, AP-B, AP-C and any other required activity forms.

Question G.3 Building Information: Provide the name or number for the building, as it appears on the site map submitted with Form AP-B, and, if needed, room number(s) and any additional information that more precisely defines where the reported activity occurs. This information will be used to link the building with the nuclear-related activities that are performed within. Satellite extraction facilities should be reported separately from centralized processing facilities.

Question G.4 Concentration Plant Type: For each concentration plant where uranium or thorium is processed or produced, check the appropriate box to indicate whether it is a conventional mill, a phosphate or other ore by-product plant, or an in-situ leach mine. If none of these options is applicable for your concentration plant, select the box labeled "Other Concentration Plant", and provide an accurate description of your concentration plant in the space provided.

Question G.5 Operational Status: Check the appropriate box to indicate the current operational status of the concentration plant: "Operating" for plant producing ore in any quantity, "Closed-down" for plant not operating but not fully decommissioned, and "Decommissioned".
Note: "Decommissioned" plant is reported only once.

Questions G.6 and G.7 Production Capacity: Provide the estimated annual production capacity of elemental uranium and/or thorium at the concentration plant in metric tons, rounded to the nearest ten if the amount is more than 10 but less than 1000 metric tons (e.g., 27 to 30, 148 to 150, etc.). Round to the nearest two significant figures if 1000 or more metric tons (e.g., 1525 to 1500, 15782 to 16000, etc.). If the amount is less than 10 metric tons report that exact number (e.g., 2, 4, 8, etc.). Also provide the actual annual production during the reporting period, rounded up to the nearest ten percent. Closed-down plants have a production capacity of zero.

Question G.8 Continuation Form: Check this box if a Continuation Form, Form AP-P, has been used to provide additional information for any of the above questions.

FORM APPROVED: OMB NO. 0694-0135

U.S. DEPARTMENT OF COMMERCE Bureau of Industry and Security U.S. NUCLEAR REGULATORY COMMISSION Office of Nuclear Materials Safety and Safeguards	Date Received (Leave Blank)
ADDITIONAL PROTOCOL REPORT	
FORM AP-H: HOLDINGS OF IMPURE SOURCE MATERIALS	

H.1	Site Reporting Code (once assigned):			
H.2	Activity Reporting Status ☐ New activity ☐ Activity with no changes ☐ Activity with changes ☐ Ceased Activity			
If you possess one or more metric tons of impure uranium, thorium, or a combination of both, provide the following for each chemical form of impure uranium or thorium at the site.				
H.3.1	a. Chemical Form:	b. Quantity on Hand (in metric tons):	c. Use or Intended Use: ☐ Nuclear ☐ Non-nuclear	d. Intended Use Description
	e. Identify building name(s)/number(s) (as it appears on the site map submitted with Form AP-B), and any additional information that more precisely defines where the impure uranium or thorium is held(e.g. room numbers):			
H.3.2	a. Chemical Form:	b. Quantity on Hand (in metric tons):	c. Use or Intended Use: ☐ Nuclear ☐ Non-nuclear	d. Intended Use Description
	e. Identify building name(s)/number(s) (as it appears on the site map submitted with Form AP-B), and any additional information that more precisely defines where the impure uranium or thorium is held(e.g. room numbers):			
H.3.3	a. Chemical Form:	b. Quantity on Hand (in metric tons):	c. Use or Intended Use: ☐ Nuclear ☐ Non-nuclear	d. Intended Use Description
	e. Identify building name(s)/number(s) (as it appears on the site map submitted with Form AP-B), and any additional information that more precisely defines where the impure uranium or thorium is held(e.g. room numbers):			
H.3.4	a. Chemical Form:	b. Quantity on Hand (in metric tons):	c. Use or Intended Use: ☐ Nuclear ☐ Non-nuclear	d. Intended Use Description
	e. Identify building name(s)/number(s) (as it appears on the site map submitted with Form AP-B), and any additional information that more precisely defines where the impure uranium or thorium is held(e.g. room numbers):			
H.4	☐ Check this box if a Continuation Form (Form AP-P) has been used to provide additional information for any of the above questions.			

FORM AP-H: Holdings of Impure Source Materials

Reporting requirements are set forth in 10 CFR Parts 75 and 110 of the U.S. Nuclear Regulatory Commission (NRC) Regulations.

INSTRUCTIONS:
Submit Form AP-H if one or more metric tons of uranium, thorium, or a combination of both, which has not reached the composition and purity suitable for fuel fabrication or for being isotopically enriched, is present at your site. Impure source material includes ore concentrates produced by concentration plants (e.g., uranium mills, in-situ leach mines, and ore by-product plants, etc.), intermediate products resulting from further processing of this material, or any other materials resulting from ore processing with a concentration greater than 0.05% uranium or thorium. There is no requirement to report information on impure source material once it is in a non-nuclear end-use form.

Question H.1 Site Reporting Code**:** A site code will be assigned and reported to you once your Initial report is received by BIS. The site reporting code must appear on all future forms pertaining to this site.

Question H.2 Activity Reporting Status: Indicate the current reporting status by checking the appropriate box (i.e., "New Activity" to report an activity for the first time, "Activity with changes" or "Activity with no changes" if a report for this activity was previously submitted, or "Ceased Activity" for an activity that ended during the reporting year and will not be reported in future years). If the information previously reported for this specific activity has not changed, you are not required to complete the rest of this form, instead check the "Activity with no changes" box and submit along with Forms AP-A, AP-B, AP-C, and any other required activity forms.

Questions H.3.x Source Material Information: Complete a separate Question H.3.x. for each chemical form of source material.

a) Chemical Form: Provide the chemical name or molecular formula for the source material (e.g., ThO_2, ammonium diuranate, U_3O_8, uranyl carbonate, etc.).

b) Quantity on Hand (MT): Provide the quantity of source material (in metric tons of elemental U or Th) present at your site as of the date specified in the notification of reporting requirements letter received from the NRC, if you are submitting an Initial Report. If submitting an Initial Report after the collection date specified, or an Annual Update Report, provide the quantity of source material present at your site as of the preceding December 31 in metric tons.

c) Intended Use: Check the box to indicate whether the end-use of the source material will be nuclear or non-nuclear.

d) Intended Use Description: Provide a brief description of the end-use of the source material, whether nuclear or non-nuclear (e.g., ceramics, electronic components, or conversion for uranium enrichment).

e) Building Information: Provide the name or number for the building, as it appears on the site map submitted with Form AP-B, and, if needed, room number(s) and any additional information that more precisely defines where the impure uranium or thorium is held.

Question H.4 Continuation Form: Check this box if a Continuation Form, Form AP-P, has been used to provide additional information for any of the above questions.

FORM APPROVED: OMB NO. 0694-0135

U.S. DEPARTMENT OF COMMERCE Bureau of Industry and Security U.S. NUCLEAR REGULATORY COMMISSION Office of Nuclear Materials Safety and Safeguards	Date Received (Leave Blank)
ADDITIONAL PROTOCOL REPORT	
FORM AP-I: IMPORTS AND EXPORTS OF IMPURE SOURCE MATERIAL	

Submit this form to report imports and exports of impure source material for non-nuclear end-use purposes. If applicable, provide information on additional imports and exports on Form AP-O.

I.1	Site Reporting Code (once assigned):	
I.2	Identify building name(s)/number(s) (as it appears on the site map submitted with Form AP-B), and any additional information that more precisely defines where the impure source material is or was located (e.g. room numbers):	
I.3.1	Identify **Imports** of Impure Source Material:	
I.3.2	Chemical Form:	Quantity (in metric tons):
	Date Imported (mm/dd/yyyy):	Exporting Country:
	Intended Use:	
I.3.3	Chemical Form:	Quantity (in metric tons):
	Date Imported (mm/dd/yyyy):	Exporting Country:
	Intended Use:	
I.4	Identify **Exports** of Impure Source Material:	
I.4.1	Chemical Form:	Quantity (in metric tons):
	Date Exported (mm/dd/yyyy):	Importing Country:
	Intended Use:	
I.4.2	Chemical Form:	Quantity (in metric tons):
	Date Exported (mm/dd/yyyy):	Importing Country:
	Intended Use:	
I.5	☐ Check this box if a Continuation Form (Form AP-P) has been used to provide additional information for any of the above questions.	

FORM AP-I: IMPORTS AND EXPORTS OF IMPURE SOURCE MATERIAL

Reporting requirements are set forth in 10 CFR Parts 75 and 110 of the U.S. Nuclear Regulatory Commission (NRC) Regulations.

INSTRUCTIONS:
Submit Form AP-I for each import and export of one or more metric tons of impure uranium or thorium, which has not reached the composition and purity suitable for fuel fabrication or for being isotopically enriched that is to be used for non-nuclear end-use purposes. The provision of this information does not require detailed nuclear material accountancy.

Question I.1 Site Reporting Code**:** A site code will be assigned and reported to you once your Initial Report is received by BIS. The site reporting code must appear on all future forms pertaining to this site.

Question I.2 Building Information: Provide the name or number for the building, as it appears on the site map submitted with Form AP-B, and, if needed, room number(s) and any additional information that more precisely defines where the material is or was located.

Questions I.3.x Information on Imported Impure Source Material: Provide the chemical name or formula and the quantity being imported (in metric tons U or Th) for the impure source material. Also provide the date the material was imported, the country that exported the material, and the intended use of the material. Information for each import shipment of material separated by chemical form (e.g., ThO_2, ammonium diuranate, U_3O_8, or uranyl carbonate, etc.) and date of arrival should be entered in a separate Question I.2.x. Use Form AP-P to provide information on additional imports.

Questions I.4.x Information on Exported Impure Source Material: Provide the chemical name or formula and the quantity being exported (in metric tons U or Th) for the impure source material. Also provide the date the material was exported, the country that imported the material, and the intended use of the material. Information for each export shipment of material separated by chemical name/molecular formula (e.g., ThO_2, ammonium diuranate, U_3O_8, uranyl carbonate, etc.) and date of export should be entered in a separate Question I.4.x. Use Form AP-P to provide information on additional exports.

Question I.5 Continuation Form: Check this box if a Continuation Form, Form AP-P, has been used to provide additional information for any of the above questions.

FORM APPROVED: OMB NO. 0694-0135

U.S. DEPARTMENT OF COMMERCE **Bureau of Industry and Security** **U.S. NUCLEAR REGULATORY COMMISSION** **Office of Nuclear Materials Safety and Safeguards**	**Date Received (Leave Blank)**
ADDITIONAL PROTOCOL REPORT	
FORM AP-J: HOLDINGS OF IAEA SAFEGUARDS-EXEMPTED MATERIAL	

Submit a separate form to report quantities of each nuclear material held at your site that were exempted under the U.S. – IAEA Safeguards Agreement.

J.1	Site Reporting Code (once assigned):	
J.2	Activity Reporting Status ☐ New activity ☐ Activity with no changes ☐ Activity with changes ☐ Ceased Activity	
J.3	Identify building name(s)/number(s) (as it appears on the site map submitted with Form AP-B), and any additional information that more precisely defines where the exempted materials are held(e.g. room numbers):	
IAEA Safeguards-Exempted Material on hand (Check One):		
J.4	☐ Thorium ☐ Plutonium ☐ Natural or Depleted Uranium ☐ Enriched Uranium – Isotope Percent: U-233:_____ U-235:_____	
J.5	Quantity on Hand (g):	
	Intended Use: ☐ Nuclear ☐ Non-Nuclear	Intended Use Description:
J.6	☐ Check this box if a Continuation Form (Form AP-P) has been used to provide additional information for any of the above questions.	

FORM AP-J: Holdings of IAEA Safeguards-Exempted Material

Reporting requirements are set forth in 10 CFR Parts 75 and 110 of the U.S. Nuclear Regulatory Commission (NRC) Regulations.

INSTRUCTIONS:
Submit a separate Form AP-J to report quantities of each nuclear material held at your site that were exempted under the U.S.-IAEA Safeguards Agreement. The NRC will inform those licensees who possess exempted quantities of nuclear materials of their obligation to report their holdings.

Question J.1 Site Reporting Code**:** A site code will be assigned and reported to you once your Initial Report is received by BIS. The site reporting code must appear on all future forms pertaining to this site.

Question J.2 Activity Reporting Status: Indicate the current reporting status by checking the appropriate box (i.e., "New Activity" to report an activity for the first time, "Activity with changes" or "Activity with no changes" if a report for this activity was previously submitted, or "Ceased Activity" for an activity that ended during the reporting year and will not be reported in future years). If the information previously reported for this specific activity has not changed, you are not required to complete the rest of this form, instead check the "Activity with no changes" box and submit along with Forms AP-A, AP-B, AP-C, and any other required activity forms.

Question J.3 Building Information: Provide the name or number for the building, as it appears on the site map submitted with Form AP-B, and, if needed, room number(s) and any additional information that more precisely defines where the IAEA Safeguards-Exempted materials are held.

Question J.4 IAEA Safeguards-Exempted Material On-Hand: Check the box beside the nuclear material, if it is present at your site as of or after the date specified in the notification of reporting requirements letter you received from NRC. If you have holdings of more than one type of IAEA Safeguards-Exempted nuclear material submit a separate form for each material held at your site. If you have holdings of enriched uranium, please provide the isotope percentage of U-233 or U-235 in the spaces provided. If multiple enrichments of uranium are present, provide the information on those materials on Form AP-P.

Question J.5 Quantity and Intended Use: Provide the quantity of IAEA Safeguards-exempted material in grams, indicate whether the intended end-use of the material is nuclear or non-nuclear, and provide a brief description of the end-use.

Question J.6 Continuation Form: Check this box if a Continuation Form, Form AP-P, has been used to provide additional information for any of the above questions.

FORM APPROVED: OMB NO. 0694-0135

U.S. DEPARTMENT OF COMMERCE **Bureau of Industry and Security** **U.S. NUCLEAR REGULATORY COMMISSION** **Office of Nuclear Materials Safety and Safeguards**	**Date Received (Leave Blank)**
ADDITIONAL PROTOCOL REPORT	
FORM AP-K: LOCATION OF IAEA SAFEGUARDS-TERMINATED WASTE MATERIAL	

Submit this form to report holdings of or changes in location of material on which IAEA Safeguards have terminated. A separate form should be submitted for each type of material held or moved.

K.1	Site Reporting Code (once assigned):		
K.2	Activity Reporting Status ☐ New activity ☐ Activity with no changes ☐ Activity with changes ☐ Ceased Activity		
K.3	Identify building name(s)/number(s) (as it appears on the site map submitted with Form AP-B), and any additional information that more precisely defines where the IAEA Safeguards-Terminated material is currently located(e.g. room numbers):		
K.4	Waste Type Prior to Conditioning:		
	Conditioned Form:	Quantity:	Units:
	Qty Pu (g):	Qty HEU (g):	Qty U-233 (g):
K.5	Prior Location: Identify building name(s)/number(s) (as it appears on the site map submitted with Form AP-B), and any additional information that more precisely defines the prior location on your site of the IAEA Safeguards-Terminated material(e.g. room numbers):		
K.6	OR Identify the address of the prior location, if previously located at a different address:		
	Street Address:		
	City:	State:	Zip Code:
K.7	☐ Check this box if a Continuation Form (Form AP-P) has been used to provide additional information for any of the above questions.		

FORM AP-K: Location of IAEA Safeguards-Terminated Material

Reporting requirements are set forth in 10 CFR Parts 75 and 110 of the U.S. Nuclear Regulatory Commission (NRC) Regulations.

INSTRUCTIONS:
Submit Form AP-K to report holdings of or changes in location of material on which IAEA Safeguards have terminated. If reporting holdings of this type of material, complete Questions K.1 through K.3. If reporting a change of location in this type of material, complete Questions K.1 through K.5. A separate form AP-K should be submitted for each type of material that is held or moved.

Question K.1 Site Reporting Code**:** A site code will be assigned and reported to you once your Initial Report is received by BIS. The site reporting code must appear on all future forms pertaining to this site.

Question K.2 Activity Reporting Status: Indicate the current reporting status by checking the appropriate box (i.e., "New Activity" to report an activity for the first time, "Activity with changes" or "Activity with no changes" if a report for this activity was previously submitted, or "Ceased Activity" for an activity that ended during the reporting year and will not be reported in future years). If the information previously reported for this specific activity has not changed, you are not required to complete the rest of this form, instead check the "Activity with no changes" box and submit along with Forms AP-A, AP-B, AP-C, and any other required activity forms.

Question K.3 Building Information: Provide the name or number for the building, as it appears on the site map submitted with Form AP-B, and, if needed, room number(s) and any additional information that more precisely defines where the IAEA Safeguards-Terminated material is currently located.

Question K.4 Description of IAEA Safeguards-Terminated Material: Describe what type of waste the material currently at your location was prior to its conversion to its IAEA Safeguards-Terminated form. Provide the form that this conditioned material is in now (e.g., vitrified waste or cemented waste), and the quantity and units (e.g., canisters, drums, etc.) of material present at your site. Round to the nearest ten if the amount is more than 10 but less than 1000 (e.g., 27 to 30, 148 to 150). Round to the nearest 2 significant figures if 1000 or more (e.g., 1525 to 1500, 15782 to 16000, etc.). Also provide the amount of plutonium, highly enriched uranium, and/or uranium-233 present in this material in grams.

Questions K.5 and K.6 Prior Location of IAEA Safeguards-Terminated Material: If the IAEA Safeguards-Terminated material was previously located in another building on your site, provide the appropriate building information in Question K.4 and leave the address in K.6 blank. If the material was previously located off-site, provide the address for the prior location of this material in the space provided in K.6.

Questions K.7 Continuation Form: Check this box if a Continuation Form, Form AP-P, has been used to provide additional information for any of the above questions.

FORM APPROVED: OMB NO. 0694-0135

U.S. DEPARTMENT OF COMMERCE Bureau of Industry and Security U.S. NUCLEAR REGULATORY COMMISSION Office of Nuclear Materials Safety and Safeguards	Date Received (Leave Blank)
ADDITIONAL PROTOCOL REPORT	
FORM AP-L: PROCESSING OF IAEA SAFEGUARDS-TERMINATED MATERIAL	

Submit this form to provide notice of intent to process material on which IAEA Safeguards have terminated. This form must be submitted at least 210 days prior to such processing.

L.1	Site Reporting Code (once assigned):
L.2	Activity Reporting Status ☐ New activity ☐ Activity with no changes ☐ Activity with changes ☐ Ceased Activity
L.3	Identify building name(s)/number(s) (as it appears on the site map submitted with Form AP-B), and any additional information that more precisely defines where the IAEA Safeguards-Terminated material will be processed (e.g. room numbers):
L.4	Waste Type Prior to Conditioning:
	Conditioned Form: Quantity: Units:
	Qty Pu (g): Qty HEU (g): Qty U-233 (g):
L.5	Processing Dates (mm/dd/yyyy): From: To:
	Processing Purpose:
L.6	☐ Check this box if a Continuation Form (Form AP-P) has been used to provide additional information for any of the above questions.

FORM AP-L: Processing of IAEA Safeguards-Terminated Material

Reporting requirements are set forth in 10 CFR Parts 75 and 110 of the U.S. Nuclear Regulatory Commission (NRC) Regulations.

INSTRUCTIONS:
Submit Form AP-L to provide notice of intent to process material on which IAEA Safeguards have terminated. This form must be submitted at least 210 days prior to such processing.

Question L.1 Site Reporting Code**:** A site code will be assigned and reported to you once your Initial Report is received by BIS. The site reporting code must appear on all future forms pertaining to this site.

Question L.2 Activity Reporting Status: Indicate the current reporting status by checking the appropriate box (i.e., "New Activity" to report an activity for the first time, "Activity with changes" or "Activity with no changes" if a report for this activity was previously submitted, or "Ceased Activity" for an activity that ended during the reporting year and will not be reported in future years). If the information previously reported for this specific activity has not changed, you are not required to complete the rest of this form, instead check the "Activity with no changes" box and submit along with Forms AP-A, AP-B, AP-C, and any other required activity forms.

Question L.3 Building Information: Provide the name or number for the building, as it appears on the site map submitted with Form AP-B, and, if needed, room number(s) and any additional information that more precisely defines where the IAEA Safeguards-Terminated waste material will be processed.

Question L.4 Description of IAEA Safeguards-Terminated Waste Material: Describe what type of waste the material currently at your location was prior to its conversion to its IAEA safeguards-terminated form. Provide the form that this conditioned material is in now (e.g., vitrified waste or cemented waste), and the quantity and units (e.g., canisters, drums, etc.) of material present at your site. Round to the nearest ten if the amount is more than 10 but less than 1000 (e.g., 27 to 30, 148 to 150). Round to the nearest 2 significant figures if 1000 or more (e.g., 1525 to 1500, 15782 to 16000, etc.). Also provide the amount of plutonium, highly enriched uranium, and/or uranium-233 present in this material in grams.

Question L.5 Intended Dates for Processing of IAEA Safeguards-Terminated Waste Material: Provide the intended beginning and ending dates for processing of the IAEA Safeguards-Terminated waste material in mm/dd/yyyy format, and also describe the purpose of this processing. Note that this Form AP-L must be submitted to BIS at least 210 days prior to the intended processing start date.

Questions L.6 Continuation Form: Check this box if a Continuation Form, Form AP-P, has been used to provide additional information for any of the above questions.

FORM APPROVED: OMB NO. 0694-0135

U.S. DEPARTMENT OF COMMERCE Bureau of Industry and Security U.S. NUCLEAR REGULATORY COMMISSION Office of Nuclear Material Safety and Safeguards	Date Received (Leave Blank)
ADDITIONAL PROTOCOL REPORT	
FORM AP-M: EXPORT OF EQUIPMENT AND NON- NUCLEAR MATERIALS	

Submit a separate form for each export of specified equipment or non-nuclear material listed in Supplement 3 of this Handbook from your site.

M.1	Site Reporting Code (once assigned):		
M.2	Annex II reference number:		
M.3	Identify the Exported Item:		
	Item Dimensions:		
	Capacity (Volume):		
	Throughput:		
	Material of Construction:		
	Serial or Model Number(s):		
	Name and address of manufacturer:		
	Key Specifications of non-nuclear material:		
	Any additional information that will help identify the item:		
M.4	Quantity exported:	☐ Items ☐ Kg ☐ Tons	
M.5	Name of importing company or organization:		
	Street Address:	City:	
	Province:	Country:	Postal Code:
M.6	Date of Export (mm-dd-yyyy):		
M.7	☐ Check this box if a Continuation Form (Form AP-P) has been used to provide additional information for any of the above questions.		

FORM AP-M: Exports of Specified Equipment and Non-Nuclear Material

Reporting requirements are set forth in 10 CFR Parts 75 and 110 of the U.S. Nuclear Regulatory Commission (NRC) Regulations.

INSTRUCTIONS:
Submit a separate Form AP-M for each export of specified equipment or non-nuclear material from your site. These items are listed in Supplement 3 of this handbook. The export report must be submitted to the IAEA quarterly and are due to BIS within 15 days of the end of each calendar quarter. Export reports are due by January 15th, April 15th, July 15th, and October 15th. In the event a quarterly export report due date falls on a federal holiday or a weekend the report is then due to BIS the following business day.

Question M.1 Site Reporting Code: A site code will be assigned and reported to you once your Initial Report has been received by BIS. The site reporting code must appear on all future forms pertaining to this site.

Question M.2 Annex II Reference Number: Provide the full paragraph number for the item being exported. For example, the full paragraph number for centrifuge rotor tubes would be 5.1.1(b). All Annex II items and their corresponding reference numbers are listed in Supplement 3 to this Handbook.

Question M.3 Identify Exported Item(s): Provide, as appropriate, item dimensions, capacity (volume), throughput, material of construction, identification or serial numbers, name and address of the manufacturer, key specifications of non-nuclear material, and any other information that will help identify the item(s)) including units on all measurements.

Question M.4 Quantity Exported: Provide the quantity of the item exported. In the case of equipment, the quantity should indicate the number of items. In the case of exports of non-nuclear material, the quantity should be the weight of the material in kilograms or tons as appropriate.

Question M.5 Name and Location of Importer: Provide the name of the importing company or organization and the physical address where the item(s) will be used.

Question M.6 Date of Export: Provide the date on which the export actually occurred or the date when the export was believed to have been made. A single date, not a range of dates, should be entered. If the export cannot be characterized by a single date, please provide an explanation on Continuation Form AP-P.

Question M.7 Continuation Form: Check this box if a Continuation Form, Form AP-P, has been used to provide additional information for any of the above questions.

FORM APPROVED: OMB NO. 0694-0135

U.S. DEPARTMENT OF COMMERCE Bureau of Industry and Security U.S. NUCLEAR REGULATORY COMMISSION Office of Nuclear Materials Safety and Safeguards	Date Received (Leave Blank)
ADDITIONAL PROTOCOL REPORT	
FORM AP-N: IMPORT OF SPECIFIED EQUIPMENT OR NON-NUCLEAR MATERIAL CONFIRMATION REPORT	

Submit this form in response to a request from NRC for confirmation of receipt of specified equipment or non-nuclear material at your site.

N.1	Site Reporting Code (once assigned):
N.2	Identify building name(s)/number(s) (as it appears on the site map submitted with Form AP-B), and any additional information that more precisely defines where the imported specified equipment or non-nuclear material is/was located(e.g. room numbers):
N.3	Type of imported equipment or material and Annex II reference number:
N.4	Date Import Received (mm/dd/yyyy):
N.5	Response to IAEA Import Information Request:
N.6	☐ Check this box if a Continuation Form (Form AP-P) has been used to provide additional information for any of the above questions.

FORM AP-N: Imports of Specified Equipment and Non-Nuclear Material

Reporting requirements are set forth in 10 CFR Parts 75 and 110 of the U.S. Nuclear Regulatory Commission (NRC) Regulations.

INSTRUCTIONS:
Submit Form AP-N if NRC requests you to confirm receipt of specified equipment or non-nuclear material at your site per an IAEA request. This information will help the IAEA to verify that your site received equipment or material that was specified as an export in the declaration from another country.

Question N.1 Site Reporting Code**:** Provide the site reporting code, assigned by BIS, that was reported to you after your Initial Report was received. If you have not previously reported information to BIS, a site reporting code will be assigned and provided to you with the request for this information.

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Question N.2 Building Information: Provide the name or number for the building, as it appears on the site map submitted with Form AP-B, and, if needed, room number(s) and any additional information that more precisely defines where the imported specified equipment or non-nuclear material is located.

Question N.3 Type of Imported Equipment or Material and Annex II Reference Number: Provide a brief description of the equipment or material imported and reference the paragraph number from Supplement 3 of this guidance that covers the imported equipment or material.

Question N.4 Date Import was Received: Provide the date (in mm/dd/yyyy format) on which the specified equipment or non-nuclear material was received at your site. If the equipment or material in question was never received at your site, please indicate so by writing/typing "not received" in the space provided.

Question N.5 Response to IAEA Import Information Request: Provide any further information that responds to questions submitted by the IAEA and that would clarify/further confirm that the specified equipment or material in question was or was not received at your site. Use Form AP-P if additional space is needed.

Questions N.6 Continuation Form: Check this box if a Continuation Form, Form AP-P, has been used to provide additional information for any of the above questions.

FORM APPROVED: OMB NO. 0694-0135

U.S. DEPARTMENT OF COMMERCE Bureau of Industry and Security U.S. NUCLEAR REGULATORY COMMISSION Office of Nuclear Materials Safety and Safeguards	Date Received (Leave Blank)
ADDITIONAL PROTOCOL REPORT	
FORM AP-O: SUPPLEMENTAL INFORMATION REPORT	

Submit this form in response to a supplemental information request from NRC.

O.1	Site Reporting Code (once assigned):
O.2	Identify building name(s)/number(s) (as it appears on the site map submitted with Form AP-B), and any additional information that more precisely defines where the activity in question occurs(e.g. room numbers):
O.3	Information Responding to an IAEA Request:
O.4	☐ Check this box if a Continuation Form (Form AP-P) has been used to provide additional information for any of the above questions.

FORM AP-O: Supplemental or Clarifying Information Responding to a Request

Reporting requirements are set forth in 10 CFR Parts 75 and 110 of the U.S. Nuclear Regulatory Commission (NRC) Regulations.

INSTRUCTIONS:
Submit Form AP-O if NRC requests you to clarify information contained in a previously provided report. Information may also be requested about a location on an adjoining address outside your site, which the IAEA suspects might be functionally related to the nuclear fuel cycle-related activities of your site. If such a request occurs, the NRC will provide you with instructions on how to report.

Question O.1 Site Reporting Code**:** Provide the site reporting code, assigned by BIS, that was reported to you after your Initial Report was received. If you have not previously provided information to BIS, a reporting Code will be assigned and provided to you with the request for this information.

Question O.2 Building Information: If applicable to the request, provide the name or number for the building, as it appears on the site map submitted with Form AP-B, and, if needed, room number(s) and any additional information that more precisely defines where the activity in question occurs.

Question O.3 Information Responding to an IAEA Request: Provide a response to the specific clarifying request made by the IAEA that was forwarded to you through the NRC. Use Form AP-P if additional space is needed.

Questions O.4 Continuation Form: Check this box if a Continuation Form, Form AP-P, has been used to provide additional information for any of the above questions.

FORM APPROVED: OMB NO. 0694-0135

U.S. DEPARTMENT OF COMMERCE Bureau of Industry and Security U.S. NUCLEAR REGULATORY COMMISSION Office of Nuclear Materials Safety and Safeguards	Date Received (Leave Blank)
ADDITIONAL PROTOCOL REPORT	
FORM AP-P: CONTINUATION FORM	

P.1	Site Reporting Code (once assigned):
P.2	Continuation Form for Form AP- _____, for Question Number_____:

FORM AP-P: Continuation Form

INSTRUCTIONS:
Submit Form AP-P if you need additional space to fully answer a question that was asked on any of the previous AP report forms. Submit a separate Form AP-P if you have more than one question that needs additional space for answering.

Question P.1 Site Reporting Code**:** A site code will be assigned and reported to you once your Initial Report is received by BIS. The site reporting code must appear on all future forms pertaining to this site.

Question P.2 Continuation Form: Indicate the AP Form and the question number for which you are providing additional information in the spaces provided. Should you need even more additional space, submit another Form AP-P with the same identifying information provided for Questions P.1 through P.2. Also provide a separate Form AP-P for each separate question where additional space is needed.

FORM APPROVED: OMB NO. 0694-0135

U.S. DEPARTMENT OF COMMERCE **Bureau of Industry and Security** **U.S. NUCLEAR REGULATORY COMMISSION** **Office of Nuclear Materials Safety and Safeguards**	**Date Received (Leave Blank)**
ADDITIONAL PROTOCOL REPORT	
FORM AP-Q: NO CHANGES REPORT	

This No Changes Report form may only be used by your site to certify that the information reported in your last submitted Initial, Annual Update or Amended Report has not changed. If you did not submit an Initial, Annual Update, Amended, or a No Changes Report last year, you may not use this form.

Q.1	Company or Organization Name:
Q.2	Site Name and Site Code:

NOTE: The company name as well as the Site Name and Site Code reported in Questions Q.1 and Q.2 must be the same as those reported in Forms AP-A and AP-B of last year's Initial, Annual Update, or Amended Report.

Q.3	CERTIFICATION
	I hereby certify that the information reported in last year's Initial, Annual Update, Amended or No Changes Report is unchanged for the reporting year listed in Question Q.4 below. To the best of my knowledge and belief, the submitted information is true and complete.
	Name and title of responsible official (type or print):
	Signature:
	Date Signed (MM-DD-YYYY):
Q.4	REPORTING YEAR (YYYY):

FORM AP-Q: No Changes Report

Reporting requirements are set forth in 10 CFR Parts 75 and 110 of the U.S. Nuclear Regulatory Commission (NRC) Regulations.

INSTRUCTIONS:
Submit this No Changes Report form only to certify that all of the information (including POC, address, and activity) reported in the last submitted Initial, Annual Update, Amended or No Changes Report for your site has not changed. If you have not previously submitted a report, you may not use this form.

Question Q.1 Company or Organization Name: Provide the name of the company or organization that controls activities for this site. This should be the same company or organization name that was provided on Form AP-A of your last submitted Initial, Annual Update, Amended, or No Changes Report.

Question Q.2 Site Name and Site Code: Provide the Site Name and Site Reporting Code of your site. The site name and site code must match those provided on the associated Form AP-B of your last submitted Initial or Annual Update Report.

Question Q.3 Certification: The report must be signed and dated by a company or organization official who certifies the accuracy and completeness of the information submitted. The signature block must contain an original signature.

Question Q.4 Reporting Year Information: Provide the reporting year for which this No Changes Report applies.

SUPPLEMENT 1

GLOSSARY OF TERMS

The following is an explanation of terms used in this Handbook.

Access Point of Contact (A-POC). The individual at a site who will be notified by NRC immediately upon receipt of an IAEA request for complementary access to a site. NRC must be able to contact the A-POC or alternate A-POC on a 24-hour basis. The NRC will conduct all interactions with the location for permitting and planning IAEA complementary access through the A-POC or the alternate A-POC, in the event the A-POC is unavailable.

Act (The). The United States Additional Protocol Implementation Act of 2006 (Public Law 109-401, Title 2).

Additional Protocol (AP). 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 on June 12, 1998 (Treaty DOC. 107-097), known as the Additional Protocol.

Additional Protocol Regulations (APR). Those regulations contained in 15 CFR parts 781 to 799 promulgated by the Department of Commerce and 10 CFR Part 75 promulgated by the NRC to implement and enforce the U.S. Additional Protocol.

Agreement State. Any State of the United State with which the Nuclear Regulatory Commission (NRC) has entered into an effective agreement under Subsection 274b, of the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 *et seq.*).

Bureau of Industry and Security (BIS). The Bureau of Industry and Security of the United States Department of Commerce, including the Office of Export Administration and the Office of Export Enforcement.

Complementary Access. The exercise of the IAEA's access rights as set forth in Articles 4 to 6 of the Additional Protocol.

Facility. A reactor, critical assembly, conversion plant, fabrication plant, reprocessing plant, an isotope separation plant or a separate storage installation; or any location where nuclear material in amounts greater than one (1) effective kg is customarily used.

Impure Source Material or Impure Uranium or Thorium. Uranium or thorium that has not reached the composition and purity suitable for fuel fabrication or for being isotopically enriched.

International Atomic Energy Agency (IAEA). The United Nations organization, headquartered in Vienna, Austria, that serves as the official international verification authority for the implementation of safeguards agreements concluded pursuant to the Treaty on the Non-proliferation of Nuclear Weapons (NPT).

IAEA-Selected Facility. A facility that the IAEA has chosen from the list of U.S. facilities eligible for IAEA inspections.

Location. Any geographic point or area declared or identified by the United States or specified by the IAEA (see "location specified by the IAEA," as defined in this section).

Location Specified by the IAEA. A location that is selected by the IAEA for the purpose of assisting the IAEA to draw conclusions about the absence of undeclared nuclear material or nuclear activities or to obtain information that the IAEA needs to amplify or clarify information in the U.S. declaration.

NRC. The U.S. Nuclear Regulatory Commission.

NRC location. A location subject to a construction, operating, possession, or use license or certificate with the NRC or an NRC Agreement State that is otherwise subject to inspection under the NRC regulations (10 CFR). Also means a location where nuclear fuel cycle-related activities are conducted inside the boundary of the controlled area or restricted area delineated on an NRC or an NRC Agreement State license or other location subject to NRC inspections under 10 CFR.

NRC regulations. Those regulations promulgated by the U.S. Nuclear Regulatory Commission contained in Title 10 of the Code of Federal Regulations (10 CFR). The regulations specific to the Additional Protocol requirements are contained in 10 CFR Part 75.

Nuclear Fuel Cycle-Related Research and Development Activity. Those activities that are specifically related to any process or system development aspect of any of the following:

1) Conversion of nuclear material;
2) Enrichment of nuclear material;
3) Nuclear fuel fabrication;
4) Reactors;
5) Critical facilities;
6) Reprocessing of nuclear fuel; or
7) 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.

Nuclear Material. Any source material or any special fissionable material as follows:

(1) Source material means uranium containing the mixture of isotopes occurring in nature; uranium depleted in the isotope 235; thorium; any of the foregoing in the form of metal, alloy, chemical or concentrate. The term source material shall not be interpreted as applying to ore or ore residue.
(2) Special fissionable material means plutonium 239; uranium 233; uranium enriched in the isotopes 235 or 233; any material containing one or more of the foregoing, but the term special fissionable material does not include source material.

Operational Status of a Plant:

Operating A plant that produces ore materials.

Closed-down A plant that is not operating but not fully decommissioned.

Decommissioned A plant that was decommissioned.

Person. Any individual, organization, corporation, partnership, firm, association, trust, estate, public or private institution, any State or any political subdivision thereof, or any political entity within a State, any foreign government or nation or any agency, instrumentality or political subdivision of any such government or nation, or other entity located in the United States.

Reportable Location. A location that must submit an *Initial Report*, *Annual Update Report*, or *No Changes Report* to BIS, in accordance with the provisions of either the APR or the NRC regulations, is considered to be a "reportable location" with reportable activities.

Report Form. A form to be submitted to BIS reporting certain nuclear fuel-cycle related activities.

Report Point of Contact (R-POC). A person whom BIS or NRC may contact for the purposes of clarification of information provided in report(s) and for general information. The R-POC need not be the person who prepares the forms or certifies the report(s), but should be familiar with the content of the reports.

Site. That area delineated by the United States in the relevant design information for a facility selected by the IAEA from the U.S. Eligible Facilities List.

Site Reporting Code. A unique site identification code assigned by BIS once your Initial Report is received.

United States. The several States of the United States, the District of Columbia, and the commonwealths, territories, and possessions of the United States, and includes all places under the jurisdiction or control of the United States, including any of the places within the provisions of paragraph (41) of section 40102 of Title 49 of the United States Code, any civil aircraft of the United States or public aircraft, as such terms are defined in paragraphs (1) and (37), respectively, of section 40102 of Title 49 of the United States Code, and any vessel of the United States, as such term is defined in section 3(b) of the Maritime Drug Enforcement Act, as amended (section 1903(b) of Title 46 App. of the United States Code).

U.S. Eligible Facilities List. A list, provided to the IAEA by the United States, of all facilities within the United States not associated with activities of direct national security significance.

You. The term "you" or "your" means any person (see also definition of "person"). With regard to the reporting requirements of the APR, "you" refers to persons that have an obligation to report certain activities under the provisions of the APR.

SUPPLEMENT 2: NUCLEAR FUEL CYCLE-RELATED MANUFACTURING, ASSEMBLY AND CONSTRUCTION ACTIVITIES

1) 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 Supplement 3.

   Gas centrifuges means centrifuges as described in the Introductory Note to entry 5.1 of Supplement 3.

2) The manufacture of diffusion barriers.

   Diffusion barriers means thin, porous filters as described in entry 5.3.1(a) of Supplement 3.

3) The manufacture or assembly of laser-based systems.

   Laser-based systems means systems incorporating those items as described in entry 5.7 of Supplement 3.

4) The manufacture or assembly of electromagnetic isotope separators.

   Electromagnetic isotope separators means those items referred to in entry 5.9.1 of Section 3 containing ion sources as described in 5.9.1(a) of Supplement 3.

5) 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 Supplement 3.

6) 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 Supplement 3.

7) 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 Supplement 3.

8) The manufacture of zirconium tubes.

   Zirconium tubes means tubes as described in entry 1.6 of Supplement 3.

9) 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.

10) 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.

11) 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.

12) The manufacture of reactor control rods.

Reactor control rods means rods as described in entry 1.4 of Supplement 3.

13) 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 Supplement 3.

14) The manufacture of irradiated fuel element chopping machines.

Irradiated fuel element chopping machines means equipment as described in entry 3.1 of Supplement 3.

15) The construction of hot cells.

Hot cells means a cell or interconnected cells totaling 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 3.2g/cm^3 or greater, outfitted with equipment for remote operations.

SUPPLEMENT 3: LIST OF SPECIFIED EQUIPMENT AND NON-NUCLEAR MATERIAL FOR THE REPORTING OF EXPORTS AND IMPORTS

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 defines 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 tope 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 fueling 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 prepare 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 x 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 percent, 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 recover, 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) 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) Aluminum alloy 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 0.15H/m (120,000 in CGS units) or more, or a remanence of 98.5% or more, or an energy product of greater than 80kJ/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 bearing 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 an 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 9-70°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 changes (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, aluminum, aluminum 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 percent or more nickel, aluminum oxide, or UF_6-resistant fully fluorinated hydrocarbon polymers having a purity of 99.9 percent 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 the 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 or 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 autoclave 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 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 fro 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 ft3/min) or more.

(b) Vacuum pumps especially designed for service in UF_6-bearing atmospheres made of, or lined with, aluminum, 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 (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, aluminum, aluminum alloys, aluminum 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, aluminum, aluminum 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.

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 our 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 the centrifugal force to separate the phases. Fro 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 fro 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 portion 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 $U3^{+}$ to $U4^{+}$ 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.

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 o 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 UF5 powder to UF6 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 increases 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 30GHz frequency and greater than 50kW 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 40kW 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.

5.8.4 Liquid uranium metal handling systems
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.

5.8.5 Uranium metal 'product' and 'tails' collector assemblies
Especially designed or prepared 'product' and 'tails' collector assemblies for uranium metal in solid form. These collector assemblies are made of or protected by materials resistant to the heat and corrosion of uranium metal vapor such as yttria-coated graphite or tantalum.

5.8.6 Separator module housings
Cylindrical vessels especially designed or prepared for use in plasma separation enrichment plants for containing the uranium plasma source, radio-frequency drive coil and the 'products' and 'tails' collectors.

EXPLANATORY NOTE
These housings have a multiplicity of ports for electrical feed-throughs, diffusion pump connections and instrumentation diagnostics and monitoring. They have provisions for opening and closure to allow for refurbishment of internal components and are constructed of a suitable non-magnetic material such as stainless steel.

5.9 Especially designed or prepared systems, equipment and components for use in electromagnetic enrichment plants

INTRODUCTORY NOTE
In the electromagnetic process, uranium metal ions produced by ionization of a salt feed material (typically UCL_4) are accelerated and passed through a magnetic field that has the effect of causing the ions of

different isotopes to follow different paths. The major components of an electromagnetic isotope separator include: a magnetic field for ion-beam diversion/separation of the isotopes, an ion source with its acceleration system, and a collection system for the separated ions. Auxiliary systems for the process include the magnet power supply system, the ion source high-voltage power supply system, the vacuum system, and extensive chemical handling systems for recovery of product and cleaning/recycling of components.

5.9.1 Electromagnetic isotope separators

Electromagnetic isotope separators especially designed or prepared for the separation of uranium isotopes, and equipment and components therefor, including:

(a) Ion sources

Especially designed or prepared single or multiple uranium ion source consisting of a vapor source, ionizer, and beam accelerator, constructed of suitable materials such as graphite, stainless steel, or copper, and capable of providing a total ion beam current of 50 mA or greater.

(b) Ion collectors

Collector plates consisting of two or more slits and pockets especially designed or prepared for collection of enriched and depleted uranium ion beam sand constructed of suitable materials such as graphite or stainless steel.

(c) Vacuum housings

Especially designed or prepared vacuum housings for uranium electromagnetic separators, constructed of suitable non-magnetic materials such as stainless steel and designed for operation at pressures of 0.1 Pa or lower.

EXPLANATORY NOTE

The housings are specially designed to contain the ion sources, collector plates and water-cooled liners and have provision for diffusion pump connections and opening and closure for removal and reinstallation of these components.

(d) Magnet pole pieces

Especially designed or prepared magnet pole pieces having a diameter greater than 2 m used to maintain a constant magnetic field within an electromagnetic isotope separator and to transfer the magnetic field between adjoining separators.

5.9.2 High voltage power supplies

Especially designed or prepared high-voltage power supplies for ion sources, having all of the following characteristics: capable of continuous operation, output voltage of 20,000 V or greater, output current of 1 A or greater, and voltage regulation of better than 0.01% over a time period of 8 hours.

5.9.3 Magnet power supplies

Especially designed or prepared high-power, direct current magnet power supplies having all of the following characteristics: capable of continuously producing a current output of 500 A or greater at a voltage of 100 V or greater and with a current or voltage regulation better than 0.01% over a period of 8 hours.

6. Plants for the production of heavy water, deuterium and deuterium compounds and equipment especially designed or prepared therefor

INTRODUCTORY NOTE

Heavy water can be produced by a variety of processes. However, the two processes that have proven to be commercially viable are the water-hydrogen sulfphide exchange process (GS process) and the ammonia-hydrogen exchange process.

The GS process is based upon the exchange of hydrogen and deuterium between water and hydrogen sulphide within a series of towers which are operated with the top section cold and the bottom section hot. Water flows down the towers while the hydrogen sulphide gas circulates from the bottom to the top of the towers. A series of perforated trays are used to promote mixing between the gas and the water. Deuterium migrates to the water at low temperatures and to the hydrogen sulphide at high temperatures. Gas or water, enriched in deuterium, is removed from the first stage towers at the junction of the hot and cold sections and the process is repeated in subsequent stage towers. The product of the last stage, water enriched up to 30% in deuterium, is sent to a distillation unit to produce reactor grade heavy water, i.e., 99.75% deuterium oxide.

The ammonia-hydrogen exchange process can extract deuterium from synthesis gas through contact with liquid ammonia in the presence of a catalyst. The synthesis gas is fed into exchange towers and to an ammonia converter. Inside the towers the gas flows from the bottom to the top while the liquid ammonia flows form the top to the bottom. The deuterium is stripped from the hydrogen in the synthesis gas and concentrated in the ammonia. The ammonia then flows in to an ammonia cracker at the bottom of the tower while the gas flows into an ammonia converter at the top. Further enrichment takes place in subsequent stages and reactor grade heavy water is produced through final distillation. The synthesis gas feed can be provided by an ammonia plant that, in turn , can be constructed in association with a heavy water ammonia-hydrogen exchange plant. The ammonia-hydrogen exchange process can also use ordinary water as a feed source of deuterium.

Many of the key equipment items for heavy water production plants using GS or the ammonia-hydrogen exchange processes are common to several segments of the chemical and petroleum industries. This is particularly so for small plants using the GS process. However, few of the items are available "off-the-shelf". The GS and ammonia-hydrogen processes require the handling of large quantities of flammable, corrosive and toxic fluids at elevated pressures. Accordingly, in establishing design and operating standards for plants and equipment using these processes, careful attention to the materials selection and specifications is required to ensure long service life with high safety and reliability factors. The choice of scale is primarily a function of economics and need. Thus, most of the equipment items would be prepared according to the requirements of the customer.

Finally, it should be noted that, in both the GS and the ammonia-hydrogen exchange processes, items of equipment which individually are not especially designed or prepared for heavy water production an be assembled into systems which are especially designed or prepared for producing heavy water. The catalyst production system used in the ammonia-hydrogen exchange process and water distillation systems used for the final concentration of heavy water to reactor-grade in either process are examples of such systems.

The items of equipment which are especially designed or prepared for the production of heavy water utilizing either the water-hydrogen sulphide exchange process or the ammonia-hydrogen exchange process include the following:

6.1 Water - Hydrogen Sulphide Exchange Towers

Exchange towers fabricated from fine carbon steel (such as ASTM A516) with diameters of 6 m (20 ft) to 9 m (30 ft), capable of operating at pressures greater than or equal to 2 MPa (300 psi) and with a corrosion allowance of 6 mm or greater, especially designed or prepared for heavy water production utilizing the water-hydrogen sulphide exchange process.

6.2 Blowers and Compressors

Single stage, low head (i.e., 0.2 MPa or 30 psi) centrifugal blowers or compressors for hydrogen-sulphide gas circulation (i.e., gas containing more than 70% H_2S) especially designed or prepared for heavy water production utilizing the water-hydrogen sulphide exchange process. These blowers or compressors have a throughput capacity greater than or equal to $56m^3$/second (120,000 SCFM) while operating at pressures greater than or equal to 1.8 MPa (260 psi) suction and have seals designed for wet H_2S service.

6.3 Ammonia-Hydrogen Exchange Towers

Ammonia-hydrogen exchange towers greater than or equal to 35 m (114.3 ft) in height with diameters of 1.5 m (4.9 ft) to 2.5 m (8.2 ft) capable of operating at pressures greater than 15 MPa (2225 psi) especially designed or prepared for heavy water production utilizing the ammonia-hydrogen exchange process. These towers also have at least on flanged axial opening of the same diameter as the cylindrical part through which the tower internal scan be inserted or withdrawn.

6.4 Tower Internals and Stage Pumps

Tower internals and stage pumps especially designed or prepared for towers for heavy water production utilizing the ammonia-hydrogen exchange process. Tower internals include specially designed stage contactors which promote intimate gas/liquid contact. Stage pumps include especially designed submersible pumps for circulation of liquid ammonia within a contacting stage internal to the stage towers.

6.5 Ammonia Crackers

Ammonia crackers with operating pressures greater than or equal to 3 MPa (450 psi) especially designed or prepared for heavy water production utilizing the ammonia-hydrogen exchange process.

6.6 Infrared Absorption Analyzers

Infrared absorption analyzers capable of "on-line" hydrogen /deuterium ratio analysis where deuterium concentrations are equal to or greater than 90%.

6.7 Catalytic Burners

Catalytic burners for the conversion of enriched deuterium gas into heavy water especially designed or prepared for heavy water production utilizing the ammonia-hydrogen exchange process.

7. Plants for the conversion of uranium and equipment especially designed or prepared therefor

INTRODUCTORY NOTE

Uranium conversion plants and systems may perform one or more transformations from one uranium chemical species to another, including: conversion of uranium ore concentrates to UO_3, conversion of UO_3 to UO_2, conversion of uranium oxides to UF_4 or UF_6, conversion of UF_4 to UF_6, conversion of UF_6 to UF_4, conversion of UF_4 to uranium metal, and conversion of uranium fluorides to UO_2. Many of the key equipment items for uranium conversion plants are common to several segments of the chemical process industry. For example, the types of equipment employed in these processes may include: furnaces, rotary kilns, fluidized bed reactors, flame tower reactors, liquid centrifuges, distillation columns and liquid-liquid extraction columns. However, few o t the items are available "off-the-shelf"; most would be prepared according to the requirements and specification of the customer. In some instances, special design and construction considerations are required to address the corrosive properties of some of the chemicals handled (HF, F_2, ClF_3, and uranium fluorides). Finally, it should be noted that, in all of the uranium conversion processes, items of equipment which individually are not especially designed or prepared for uranium conversion can be assembled into systems which are especially designed or prepared for use in uranium conversion.

7.1 Especially designed or prepared systems for the conversion of uranium ore concentrates to UO_3

EXPLANATORY NOTE

Conversion of uranium ore concentrates to UO_3 can be performed by first dissolving the ore in nitric acid and extracting purified uranyl nitrate using a solvent such as tributyl phosphate. Next, the uranyl nitrate is converted to UO_3 either by concentration and denitration or by neutralization with gaseous ammonia to produce ammonium diuranate with subsequent filtering, drying, and calcining.

7.2 Especially designed or prepared systems for the conversion of UO_3 to UF_6

EXPLANATORY NOTE

Conversion of UO_3 to UF_6 can be performed directly by fluorination. The process requires a source of fluorine gas or chlorine trifluoride.

7.3 Especially designed or prepared systems for the conversion of UO_3 to UO_2

EXPLANATORY NOTE
Conversion of UO_3 to UO_2 can be performed through reduction of UO_3 with cracked ammonia gas or hydrogen.

7.4 Especially designed or prepared systems for the conversion of UO_2 to UF_4

EXPLANATORY NOTE
Conversion of UO_2 to UF_4 can be performed by reacting UO_2 with hydrogen fluoride gas (HF) at 300-500°C.

7.5 Especially designed or prepared systems for the conversion of UF_4 to UF_6

EXPLANATORY NOTE
Conversion of UF_4 to UF_6 is performed by exothermic reaction with fluorine in a tower reactor. UF_6 is condensed from the hot effluent gases by passing the effluent stream through a cold trap cooled to -10°C. The process requires a source of fluorine gas.

7.6 Especially designed or prepared systems for the conversion of UF_4 to U metal

EXPLANATORY NOTE
Conversion of UF_4 to U metal is performed by reduction with magnesium (large batches) or calcium (small batches). The reaction is carried out at temperatures above the melting point of uranium (1130°C).

7.7 Especially designed or prepared systems for the conversion of UF_6 to UO_2

EXPLANATORY NOTE
Conversion of UF_6 to UO_2 can be performed by one of three processes. In the first, UF_6 is reduced and hydrolyzed to UO_2 using hydrogen and steam. In the second, UF_6 is hydrolyzed by solution in water, ammonia is added to precipitate ammonium diuranate, and the diuranate is reduced to UO_2 with hydrogen at 820°C. In the third process, gaseous UF_6, CO_2, and NH_3 are combined with water, precipitating ammonium uranyl carbonate. The ammonium uranyl carbonate is combined with steam and hydrogen at 500-600°C to yield UO_2. UF_6 to UO_2 conversion is often performed as the first stage of a fuel fabrication plant.

7.8 Especially designed or prepared systems for the conversion of UF_6 to UF_4

EXPLANATORY NOTE
Conversion of UF_6 to UF_4 is performed by reduction with hydrogen.