

Guidelines for the Management of Plutonium (INFCIRC/549): Background and Declarations

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In 1998, the International Atomic Energy Agency (IAEA) published *Guidelines for the Management of Plutonium* (INFCIRC/549). These guidelines, agreed to by the five declared nuclear weapon states, plus Belgium, Germany, Japan, and Switzerland, increase the transparency of the management of civil plutonium by publishing annual statements of each country's holdings of civil plutonium.

Background

In December 1992 the IAEA initiated a series of meetings involving those countries with the largest civil plutonium holdings in order to determine the necessity of international methods of managing plutonium.¹ These countries were concerned about the increasing amounts of civil separated plutonium and the large quantities of fissile material that were expected to result from the dismantling of nuclear weapons. One year later, the IAEA convened an unofficial study of ways to manage plutonium. Participants decided that the countries with separated plutonium stocks would agree to methods of plutonium management among themselves rather than to have the IAEA act as mediator. (However, the IAEA has provided a place to meet and published the guidelines and annual declarations.)

The nine countries listed above reached agreement in late 1997 on norms for responsible government management of inventories of separated, unirradiated plutonium. The guidelines and the first declarations were published in March 1998.

In principle, the guidelines cover all plutonium in all peaceful nuclear activities, but focus on the material that poses the most proliferation concern. The guidelines thus cover separated plutonium in storage, in unirradiated mixed-oxide (MOX) fuel elements, in other unirradiated fabricated forms, and in the course of manufacture or fabrication into these items. Although plutonium in spent fuel is not the focus of these guidelines, each country has agreed to publish annual estimates of the amount of plutonium in its spent nuclear fuel. The guidelines also cover plutonium declared excess to military nuclear programs.

The guidelines do not cover plutonium that is more than 80 percent plutonium 238, plutonium used in gram quantities, or plutonium on which IAEA safeguards have been terminated or exempted. They do not apply to the management of highly enriched uranium (HEU), but they do recognize the need to manage HEU with the same vigilance as separated plutonium.

The guidelines express agreement that civil plutonium should be handled in accordance with major nonproliferation treaties; international agreements or conventions on safety, physical protection, material accountancy and control, and safeguards; and rules on

international transfers of civil plutonium.² The countries also agreed to formulate national strategies on plutonium management, which will consider the risks of proliferation, especially during storage before irradiation or permanent disposal; the need to protect the environment, workers and the public; and the resource value of the material. These strategies are also to take into account the importance of balancing supply and demand, in essence trying to minimize the amount of separated or unirradiated plutonium as soon as practical.

A major accomplishment of these guidelines is the agreement by each of these nine nations to publish:

- Occasional brief statements explaining its national strategy for nuclear power and spent fuel, and its general plans for managing national holdings of plutonium;
- An annual statement of its holding of all plutonium subject to the guidelines; and
- An annual statement of its estimate of the plutonium contained in its holdings of spent civil reactor fuel.

The Declarations

Table 1 below shows the 2003 declarations for all of the INFCIRC/549 participating countries. Tables 2 through 10 show each country's submission for each year of the program.

This declaration system is now a mature program. Submissions are regularly offered in a timely manner. The submissions are available on the IAEA's website for anyone who wishes to review them. States continue to periodically provide narrative descriptions of their plutonium management policies in their declarations.

However, some states still do not provide all of the information asked for in the *Guidelines*. Germany does not reveal the amount of separated plutonium in Germany but owned by other states, or the amount of German separated plutonium held elsewhere. Belgium also does not supply the amount of unirradiated plutonium in Belgium that belongs to other countries.

Helpfully, three states now regularly disclose in their INFCIRC/549 declarations the amount of civil highly enriched uranium (HEU) they possess. These states are the United Kingdom, Germany, and France.

Not all nuclear weapon states appear willing to declare excess stocks of military plutonium at this time. The Russian Federation and China indicated in their submissions under INFCIRC/549 that they will include excess military plutonium in their declarations only after this material has been transferred to peaceful uses.

A few countries with stocks of separated plutonium are noticeably absent from this transparency effort. These countries include Netherlands, Sweden, Italy, India, and Spain.

In the declarations, the quantities of separated or unirradiated plutonium are rounded to 100 kilograms and the amounts of plutonium in spent fuel are rounded to 1,000 kilograms. However, values for separated and unirradiated material, particularly of recently separated plutonium, should be accurate to well within a hundred kilograms.

One issue affecting the accuracy of the plutonium values is whether the decay of plutonium 241 to americium 241 is factored into the inventory declarations. Plutonium 241, which is an isotope that comprises roughly 10 percent of civil plutonium, has a half-life of 13.2 years. Therefore, it decays relatively quickly to americium 241, reducing the total quantity of plutonium. If not taken into account, plutonium 241 decay would affect the size of older inventories of separated plutonium, such as those in Britain, Russia, and the United States. In addition, the declarations do not specify whether estimates of plutonium in spent fuel account for plutonium 241 decay.

Notes

¹ For a first hand summary of the origins of the guidelines, see the remarks of Jim Finucane, from the conference "Civil Separated Plutonium Stocks: Planning for the Future," sponsored by the Institute for Science and International Security, March 14, 2000. The proceedings are available online at http://www.isis-online.org/publications/civil_pu_conference/index.html.

² Facets of proper plutonium management are already covered by several international agreements. INFCIRC/549 reconfirms those pledges and develops guidelines for international transfers of plutonium more fully. A country's commitments to nonproliferation are described in the Nuclear Non-Proliferation Treaty and INFCIRC/153, while INFCIRC/225 Rev. 3 describes appropriate physical protection of plutonium.

Table 1: Civil Unirradiated Plutonium 2003*

	Belgium	China	France	Germany	Japan	Russia	Switzerland	UK	US
Was INFCIRC/549 declaration for 2003 submitted to the IAEA as of December 31, 2004?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No**
1. Unirradiated separated plutonium in product stores at reprocessing plants.	0	0	48.6	0	0.7	37.0	not submitted	92.7	0
2. Unirradiated separated plutonium in the course of manufacture or fabrication and plutonium contained in unirradiated semi-fabricated or unfinished products at fuel or other fabricating plants or elsewhere	2.1	0	13.3	0	3.2	not submitted	not submitted	1.0	<0.05
3. Plutonium contained in unirradiated MOX fuel or other fabricated products at reactor sites or elsewhere.	1.4	0	13.2	10.8	1.1	0.2	not submitted	1.9	4.6
4. Unirradiated separated plutonium held elsewhere.	p.m (negligible)	0	3.5	1.7	0.4	1.0	<.05	0.6	40.4
Note:									
(i) Plutonium included in lines 1-4 above belonging to foreign bodies.	not submitted	0	30.5	not submitted	0	not submitted	<.05	22.5	0
(ii) Plutonium in any of the forms in lines 1-4 above held in locations in other countries, therefore not included above.	0.4	0	<.05	not submitted	35.2	0.6	not submitted	0.9	0
(iii) Plutonium included in lines 1-4 above which is in international shipment prior to its arrival in the recipient State.	0	0	0	0	0	not submitted	not submitted	0	0

* All quantities in tonnes.

** US declaration for 2003 submitted July 12, 2005.

Table 2: Belgium -- Civil Unirradiated Plutonium 1996-2003*

	1996	1997	1998	1999	2000	2001	2002	2003
Was INFCIRC/549 declaration submitted to the IAEA?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1. Unirradiated separated plutonium in product stores at reprocessing plants.	0	0	0	0	0	0	0	0
2. Unirradiated separated plutonium in the course of manufacture or fabrication and plutonium contained in unirradiated semi-fabricated or unfinished products at fuel or other fabricating plants or elsewhere	2.6	2.8	2.8	2.5	2.1	1.9	1.9	2.1
3. Plutonium contained in unirradiated MOX fuel or other fabricated products at reactor sites or elsewhere.	0.1	0	1.0	1.4	0.6	1.0	1.5	1.4
4. Unirradiated separated plutonium held elsewhere.	negligible	negligible	negligible	negligible (p.m)	p.m.	p.m	p.m	p.m.
Note:								
(i) Plutonium included in lines 1-4 above belonging to foreign bodies.	not submitted	not submitted	not submitted	not submitted	not submitted	not submitted	not submitted	not submitted
(ii) Plutonium in any of the forms in lines 1-4 above held in locations in other countries, therefore not included above.	not submitted	0.8	1.0	0.9	0.6	1.0	0.4	0.4
(iii) Plutonium included in lines 1-4 above which is in international shipment prior to its arrival in the recipient State.	0	0	0	0	0	0	0	0

* All quantities in tonnes

Table 3: China -- Civil Unirradiated Plutonium 1996-2003 *

	1996	1997	1998	1999	2000	2001	2002	2003
Was INFCIRC/549 declaration submitted to the IAEA?	Yes	No	Yes	No	Yes	Yes	Yes	Yes
1. Unirradiated separated plutonium in product stores at reprocessing plants.	0		0		0	0	0	0
2. Unirradiated separated plutonium in the course of manufacture or fabrication and plutonium contained in unirradiated semi-fabricated or unfinished products at fuel or other fabricating plants or elsewhere	0		0		0	0	0	0
3. Plutonium contained in unirradiated MOX fuel or other fabricated products at reactor sites or elsewhere.	0		0		0	0	0	0
4. Unirradiated separated plutonium held elsewhere.	0		0		0	0	0	0
Note:								
(i) Plutonium included in lines 1-4 above belonging to foreign bodies.	0		0		0	0	0	0
(ii) Plutonium in any of the forms in lines 1-4 above held in locations in other countries, therefore not included above.	0		0		0	0	0	0
(iii) Plutonium included in lines 1-4 above which is in international shipment prior to its arrival in the recipient State.	0		0		0	0	0	0

* All quantities in tonnes

Table 4: France -- Civil Unirradiated Plutonium 1996-2003*

	1996	1997	1998	1999	2000	2001	2002	2003
Was INFCIRC/549 declaration submitted to the IAEA?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1. Unirradiated separated plutonium in product stores at reprocessing plants.	43.6	48.4	52.0	55.0	53.7	51.1	48.7	48.6
2. Unirradiated separated plutonium in the course of manufacture or fabrication and plutonium contained in unirradiated semi-fabricated or unfinished products at fuel or other fabricating plants or elsewhere	11.3	12.2	11.8	13.0	14.8	14.1	15.0	13.3
3. Plutonium contained in unirradiated MOX fuel or other fabricated products at reactor sites or elsewhere.	5.0	6.3	6.8	8.2	9.2	9.9	12.7	13.2
4. Unirradiated separated plutonium held elsewhere.	5.5	5.4	5.3	5.0	5.0	5.4	3.5	3.5
Note:								
(i) Plutonium included in lines 1-4 above belonging to foreign bodies.	30.0	33.6	35.6	37.7	38.5	33.5	32	30.5
(ii) Plutonium in any of the forms in lines 1-4 above held in locations in other countries, therefore not included above.	0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
(iii) Plutonium included in lines 1-4 above which is in international shipment prior to its arrival in the recipient State.	0	0	0	0	0	0	0	0

* All quantities in tonnes

Table 5: Germany -- Civil Unirradiated Plutonium 1996-2003*

	1996	1997	1998	1999	2000	2001	2002	2003
Was INFCIRC/549 declaration submitted to the IAEA?	Yes							
1. Unirradiated separated plutonium in product stores at reprocessing plants.	0	0	0	n.a.	n.a	n.a	0	0
2. Unirradiated separated plutonium in the course of manufacture or fabrication and plutonium contained in unirradiated semi-fabricated or unfinished products at fuel or other fabricating plants or elsewhere	0.4	0.3	0.4	0.58	0.44	0.3	0.1	0
3. Plutonium contained in unirradiated MOX fuel or other fabricated products at reactor sites or elsewhere.	2.7	3.9	4.8	5.48	7.58	9.0	9.3	10.8
4. Unirradiated separated plutonium held elsewhere.	1.8	1.8	1.3	1.13	1.10	1.6	1.7	1.7
Note:								
(i) Plutonium included in lines 1-4 above belonging to foreign bodies.	not submitted							
(ii) Plutonium in any of the forms in lines 1-4 above held in locations in other countries, therefore not included above.	not submitted							
(iii) Plutonium included in lines 1-4 above which is in international shipment prior to its arrival in the recipient State.	0	0	0	not submitted	not submitted	not submitted	0	0

* All quantities in tonnes

Table 6: Japan -- Civil Unirradiated Plutonium 1996-2003*

	1996	1997	1998	1999	2000	2001	2002	2003
Was INFCIRC/549 declaration submitted to the IAEA?	Yes							
1. Unirradiated separated plutonium in product stores at reprocessing plants.	0.6	0.5	0.5	0.5	0.6	0.8	0.8	0.7
2. Unirradiated separated plutonium in the course of manufacture or fabrication and plutonium contained in unirradiated semi-fabricated or unfinished products at fuel or other fabricating plants or elsewhere	3.1	3.3	3.2	3.1	3.1	2.9	3.0	3.2
3. Plutonium contained in unirradiated MOX fuel or other fabricated products at reactor sites or elsewhere.	0.9	0.8	0.8	1.2	1.2	1.5	1.1	1.1
4. Unirradiated separated plutonium held elsewhere.	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Note:								
(i) Plutonium included in lines 1-4 above belonging to foreign bodies.	0	0	0	0	0	0	0	0
(ii) Plutonium in any of the forms in lines 1-4 above held in locations in other countries, therefore not included above.	15.1	19.1	24.4	27.6	32.1	32.4	33.3	35.2
(iii) Plutonium included in lines 1-4 above which is in international shipment prior to its arrival in the recipient State.	0	0	0	0	0	0	0	0

* All quantities in tonnes

Table 7: Russia -- Civil Unirradiated Plutonium 1996-2003*

	1996	1997	1998	1999	2000	2001	2002	2003
Was INFCIRC/549 declaration submitted to the IAEA?	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
1. Unirradiated separated plutonium in product stores at reprocessing plants.	27.2		29.2	30.9	32.3	34.0	36.0	37.0
2. Unirradiated separated plutonium in the course of manufacture or fabrication and plutonium contained in unirradiated semi-fabricated or unfinished products at fuel or other fabricating plants or elsewhere	included in 27.2 above		not submitted					
3. Plutonium contained in unirradiated MOX fuel or other fabricated products at reactor sites or elsewhere.	0.063		0.2	0.2	0.2	0.2	0.2	0.2
4. Unirradiated separated plutonium held elsewhere.	0.87		0.9	0.9	0.9	1.0	1.0	1.0
Note:								
(i) Plutonium included in lines 1-4 above belonging to foreign bodies.	not submitted		not submitted					
(ii) Plutonium in any of the forms in lines 1-4 above held in locations in other countries, therefore not included above.	not submitted		not submitted	not submitted	0.0006	0.0006	0.0006	0.0006
(iii) Plutonium included in lines 1-4 above which is in international shipment prior to its arrival in the recipient State.	not submitted		not submitted					

* All quantities in tonnes

Table 8: Switzerland -- Civil Unirradiated Plutonium 1996-2003*

	1996	1997	1998	1999	2000	2001	2002	2003
Was INFCIRC/549 declaration submitted to the IAEA?	Yes							
1. Unirradiated separated plutonium in product stores at reprocessing plants.	not submitted							
2. Unirradiated separated plutonium in the course of manufacture or fabrication and plutonium contained in unirradiated semi-fabricated or unfinished products at fuel or other fabricating plants or elsewhere	not submitted							
3. Plutonium contained in unirradiated MOX fuel or other fabricated products at reactor sites or elsewhere.	0.1	0.6	not submitted	0.6	0.6	not submitted	0.8	not submitted
4. Unirradiated separated plutonium held elsewhere.	<0.05	0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Note:								
(i) Plutonium included in lines 1-4 above belonging to foreign bodies.	0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
(ii) Plutonium in any of the forms in lines 1-4 above held in locations in other countries, therefore not included above.	not submitted	0	not submitted					
(iii) Plutonium included in lines 1-4 above which is in international shipment prior to its arrival in the recipient State.	not submitted	0	not submitted					

* All quantities in tonnes

Table 9: United Kingdom -- Civil Unirradiated Plutonium 1996-2003 *

	1996	1997	1998	1999	2000	2001	2002	2003
Was INFCIRC/549 declaration submitted to the IAEA?	Yes							
1. Unirradiated separated plutonium in product stores at reprocessing plants.	52.1	57.4	66.1	69.5	75.1	79.9	86.5	92.7
2. Unirradiated separated plutonium in the course of manufacture or fabrication and plutonium contained in unirradiated semi-fabricated or unfinished products at fuel or other fabricating plants or elsewhere	0.5	0.5	0.8	0.8	0.8	0.8	0.9	1.0
3. Plutonium contained in unirradiated MOX fuel or other fabricated products at reactor sites or elsewhere.	2.2	2.2	2.2	2.2	2.2	1.7	1.9	1.9
4. Unirradiated separated plutonium held elsewhere.	0	0	0	0	0	0	1.5	0.6
Note:								
(i) Plutonium included in lines 1-4 above belonging to foreign bodies.	3.8	6.1	10.2	11.8	16.6	17.1	20.9	22.5
(ii) Plutonium in any of the forms in lines 1-4 above held in locations in other countries, therefore not included above.	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
(iii) Plutonium included in lines 1-4 above which is in international shipment prior to its arrival in the recipient State.	0	0	0	0	0	0	0	0

* All quantities in tonnes

Table 10: United States -- Civil Unirradiated Plutonium 1996-2003*

	1996	1997	1998	1999	2000	2001	2002	2003
Was INFCIRC/549 declaration submitted to the IAEA?	Yes							
1. Unirradiated separated plutonium in product stores at reprocessing plants.	0	0	0	0	0	0	0	0
2. Unirradiated separated plutonium in the course of manufacture or fabrication and plutonium contained in unirradiated semi-fabricated or unfinished products at fuel or other fabricating plants or elsewhere	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
3. Plutonium contained in unirradiated MOX fuel or other fabricated products at reactor sites or elsewhere.	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
4. Unirradiated separated plutonium held elsewhere.	<40.4	40.5	40.4	40.4	40.4	40.4	40.4	40.4
Note:								
(i) Plutonium included in lines 1-4 above belonging to foreign bodies.	0	0	0	0	0	0	0	0
(ii) Plutonium in any of the forms in lines 1-4 above held in locations in other countries, therefore not included above.	0	0	0	0	0	0	0	0
(iii) Plutonium included in lines 1-4 above which is in international shipment prior to its arrival in the recipient State.	0	0	0	0	0	0	0	0

* All quantities in tonnes