

August 1, 1979

SECY-79-58A

COMMISSIONER ACTION

For: The Commissioners

From: William J. Dircks, Director
Office of Nuclear Material Safety and Safeguards

Thru: Executive Director for Operations *WJ*

Subject: DECLARED ORIGIN OF NUCLEAR MATERIALS

Purpose: To report to the Commission on a study of the proliferation implications of "origin-swapping" transactions

Discussion:

1. A memorandum from S. J. Chilk to L. V. Gossick dated February 13, 1979, on the subject, "SECY-79-58 - Declared Origin of Nuclear Materials," directed the staff to collect and conduct a study of data on transactions made during 1978 and proposed in 1979 that effected a change in the declared "country of origin" of quantities of uranium. The staff was also directed to assess (a) the proliferation implications of these "origin-swapping" transactions, (b) the need for internationally agreed supplier controls regarding such transactions, and (c) the likelihood of achieving internationally agreed supplier controls.
2. The considerations of concern are somewhat broader than implied by the term "origin swapping." Exchanges on paper of quantities of uranium from different countries, without actual movement of the uranium, are more properly called "flag swapping" or "nationality swapping," and the "swapping" could relate to the countries (a) where the uranium was mined, (b) where it was enriched, (c) where it was irradiated, (d) where it was reprocessed, or (e) where special safeguards conditions were attached independently of any of the preceding activities. In previous communications with the Commission (cf. SECY-79-58), reference was made only to "origin swapping," and that term will be used throughout this paper for ease of discussion. Proliferation implications would be the same for any of the other "nationality swapping" transactions.
3. Commerce in uranium (buying, selling, trading of ownership, assignment of contract rights, etc.) is, at least to some extent,

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stimulated and complicated by the necessity to (a) achieve assurance of supply over a long time period, (b) comply with government regulations and -- in some cases -- intergovernmental agreements, (c) maintain economic stability, and (d) adjust to changes in these factors (see Appendix A).

4. Changes in ownership of or contract rights to uranium are common. Scores of transactions involving natural uranium took place in 1978, some of which were exchanges of ownership, or "swaps." Section 40.21 of 10 CFR Part 40 provides a general license to receive title to source material without regard to quantity. A similar general license to own, (but not to receive, possess, use, transfer, import, or export) special nuclear material is contained in 10 CFR 70.20.

5. Although ownership "swaps" are fairly common, few involve uranium of foreign origin (see data in Appendix B). Most transactions involving "origin swapping" appear to be occasioned by the need to comply with a DOE requirement originally established by the AEC in 1974 (see Appendix C). This requirement, which was established to help assure the development of an adequate domestic nuclear fuel supply, places limits on the amount of feed material of foreign origin that may be furnished by any customer to the U.S. government's enrichment facilities in any one year where the enriched product is intended to be used in a domestic reactor.

6. On all uranium of U.S. or foreign origin exported from the United States, tracking requirements are imposed, and retransfers, reprocessing, and other subsequent arrangements must be approved by the United States government. In order to avoid "multiple controls," the proposed U.S./Australia Agreement for Cooperation (SECY-79-302) includes a provision for voluntarily deferring to the country of origin to exercise such controls. This policy may be extended to other supplier nations on a case-by-case basis, as appropriate, in the process of negotiating future Agreements for Cooperation with other countries.

7. Three basic types of "swaps" are of possible concern. These are (1) "swaps" of material located entirely in the United States (i.e., domestic "swaps"), (2) "swaps" of material in the United States with material located abroad (i.e., domestic-foreign "swaps"), and (3) "swaps" of material located entirely abroad, or foreign-foreign "swaps." The proliferation significance of each of these types of "swaps" is analyzed below.

8. With respect to domestic "swaps," the amount of uranium under U.S. control is not reduced, and there is no possibility

of avoiding U.S. export conditions. Statutory export conditions would be applied to the uranium at the time of issuance of the required export license, regardless of country of origin, and the existence of any previous "swapping" arrangements would not affect U.S. proliferation controls.

9. In the case of domestic-foreign "swaps" between a quantity of uranium in this country and an equal quantity in a foreign country, the uranium in this country would be subject to domestic controls as long as it remained in the U.S. and would become subject to U.S. export controls at the time of export -- if ever it were to be exported. The quantity of uranium in the foreign country would likewise continue to be subject to U.S. export controls if it were subject to such controls prior to the "swap." The change in designated country of origin would not affect the necessity for compliance with U.S. requirements and, accordingly, there are no proliferation concerns with these types of "swaps."

10. In the case of foreign-foreign "swaps" involving quantities of uranium entirely in foreign countries, the United States would likely be unaware of the "swap." Nevertheless, any U.S. proliferation controls would not be avoided in such instances because any country that originally received material from the United States has formally agreed to subject the material to U.S. controls pursuant to the applicable Agreement for Cooperation and could not avoid U.S. controls by "swapping" material with another nation without at the same time violating their commitments to the U.S. under the Agreement. All combinations of domestic-foreign and foreign-foreign "swaps" are summarized in Appendix D.

11. The above analyses indicate that none of the possible types of "swaps" result in proliferation concerns in themselves. However, in one situation involving uranium exported from the United States a "swap" could occur even though it would not necessarily contribute to the proliferation concern. Such a situation would arise when material is exported to Country X, and Country X then exports an identical quantity of that material (but without U.S. export controls) to a third country, or uses an identical quantity itself. This transaction would not violate any commitments to the United States because a quantity of material remaining in Country X would be set aside and subjected to U.S. controls. (Note that it is immaterial to the discussion whether the material remaining in Country X is that which was exported from the U.S. or material originally in Country X that was "swapped" for the U.S. material and became subject to U.S. controls.) In effect, the transaction described would amount to U.S. exports for legitimate nuclear uses freeing up stocks of

material in a foreign country for possible nuclear explosive uses in that country or elsewhere. As a concrete example, it has been alleged that U.S. exports of high-enriched uranium to certain countries have freed up stocks of high-enriched uranium for domestic use or export to countries to which the United States may not wish to export nuclear materials. Under such circumstances, one recourse for the United States would be to cease all exports to the country involved.

12. Until now the discussion has been predicated on the "swapping" of physically and chemically identical quantities of material. A potential for a "swapping" problem unrelated to country of origin could exist in the "swapping" of quantities of uranium and/or plutonium that are not identical but are considered, on some other basis, to be equivalent. One example would be a "swap" of natural uranium for enriched uranium; another would be a "swap" of spent fuel for plutonium. Such "swaps" could be of potential proliferation concern because of the possibility of leapfrogging U.S. control requirements. This issue has not been subject to formal international discussions and agreement. Consideration of conditions for agreeing to such "swaps" and the criteria for determining equivalency may be an appropriate agenda item for the next meeting of the Nuclear Suppliers' Group or other appropriate international forum.

Conclusion:

The staff is in agreement that "origin swapping" transactions of quantities of identical material involve no proliferation concerns. Accordingly, the staff believes no rule changes or internationally agreed supplier controls are needed with respect to "origin swapping" of like materials. Because of possible concerns involving the "swapping" abroad of unlike materials, the staff believes this matter should be discussed further with the Executive Branch.

Recommendation:

That the Commission:

- a. Note the staff's conclusions regarding the "origin swapping" of like material.
- b. Authorize the staff to contact the Executive Branch to obtain confirmation that countries are not engaging in "swaps" of unlike material and to explore the possibility of establishing agreed international means of dealing with this matter. *

*SECY NOTE: There are no resource requirements associated with this action.

Coordination: The Office of International Programs concurs. The Office of the Executive Legal Director has no legal objections.



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Office of Nuclear Material Safety
and Safeguards

Enclosures:

- A. Some Considerations Relating To
Declared Origin of Nuclear Materials
- B. Data on the Frequency of "Origin Swapping"
- C. Federal Register Notice of
October 25, 1974
- D. Combinations In Which Transnational Uranium
"Swaps" Can Take Place

Commissioners' comments should be provided directly to the Office of the Secretary by c.o.b. Tuesday, August 14, 1979.

Commission Staff Office comments, if any, should be submitted to the Commissioners NLT August 8, 1979, with an information copy to the Office of the Secretary. If the paper is of such a nature that it requires additional time for analytical review and comment, the Commissioners and the Secretariat should be apprised of when comments may be expected.

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1403 005

ENCLOSURE A

1403 006

Appendix A

SOME CONSIDERATIONS RELATING TO DECLARED ORIGIN OF NUCLEAR MATERIALS

To be comprehensible, any discussion of "origin-swapping" transactions must be done within a framework of background considerations pertaining to the movement of uranium in international commerce. These considerations include the nature of uranium processing for use as nuclear fuel, the concept of fungibility, some factors that affect international commerce in uranium, and examples of transactions in which "origin swapping" has occurred.

Uranium Processing -- How It Flows And Where It Goes

In the course of its extraction from nature and use to produce electricity, uranium undergoes a number of industrial processes (Fig. 1). We shall not consider reprocessing or re-enrichment, as those processes are not now being engaged in commercially in this country.

Each of the listed processes can be carried out at different places and in different plants. Each step except mining can take place in a country other than the country of origin. Indeed, each step could conceivably take place in a country different from where all the other steps are carried out. NRC's import/export licensing experience indicates that conversion to UF_6 in one country, enrichment in another country, and conversion and fabrication in yet another is becoming more common. Essentially all uranium milled in the United States comes from mines in the United States because it is too costly to transport ore (with its low concentration of uranium) over long distances. In some cases, plants for the conversion of enriched UF_6 to oxide and fabrication of reactor fuel are collocated, in which only one storage step is involved between processes 5 and 6 in Figure 1. The amount so stored may be relatively small. On the other hand, huge quantities of yellowcake may be stored as feed to step 3, awaiting conversion to UF_6 . This feed normally includes many lots from a number of different customers, both domestic and foreign. A typical inventory so stored could consist of thousands of drums, each containing on the order of 700 lb (300 kg) of uranium in about 800 lb of yellowcake. Conversion plants and enrichment plants also maintain a sizeable inventory of uranium as UF_6 in cylinders. Uranium is also stored in connection with transportation. For example, yellowcake from Australia might be stored in a warehouse at the port of entry for a considerable time before it is sent to the conversion plant.

Particular attention is called to the conversion and enrichment processes because it is in connection with these processes that practically all "swapping" transactions occur.

Definitions: Fungibility and "Origin swapping"

Fungible goods are those that can be interchanged in commerce with other goods, as in meeting an obligation. The common (dictionary) definition suggests that fungibility relates to goods that can be counted, weighed, or

1. MINING
(Storage)
2. MILLING
(Storage)
3. CONVERSION (to UF_6)
(Storage)
4. ENRICHMENT (in the isotope U-235)
(Storage)
5. CONVERSION (usually to oxide)
(Storage)
6. FABRICATION of reactor fuel elements
(Storage)
7. IRRADIATION (in the reactor)
(Storage of spent fuel)

Fig. 1. - Processes undergone by uranium in its use
in the commercial production of electricity

1403 008

measured and that can be exchanged for an equivalent amount of material at another location having the same physical properties. Uranium meets these requirements. It can be weighed, and a quantity of yellowcake or UF_6 at one location is physically no different from a like quantity stored elsewhere. In other words, uranium atoms cannot be "tagged."

Although the concept of fungibility applies to many operations in the nuclear industry (and specifically to all transactions involving conversion to UF_6 and enrichment), the term is not ordinarily applied to strictly domestic operations. It is, rather, encountered when dealing with uranium that is moving in international commerce. This comes about because international transactions involve compliance with intergovernmental agreements and are therefore concerned with identifying "country of origin" in addition to the chemical and physical form of the material. Thus we define fungibility, as applied to uranium, as the interchange of all attributes, including country of origin, of two fully equivalent quantities of uranium. "Origin swapping" is the term applied to the exchange of otherwise fungible quantities of uranium that have different countries of origin. To our knowledge, the term "origin swapping" has come into use only because of special concern with that one attribute.

Uranium On The World Scene

Uranium is a commodity that is bought and sold in international trade. It is a strategic material -- important to the energy needs of many nations and to the military needs of some. Furthermore, it is a precious metal, worth roughly one dollar a gram at the low enrichments used in light-water reactors. For these reasons, commerce in uranium is subject to complicating factors that may not apply to other international commodities such as wheat or wool. Among these factors are the necessity for an assured future supply, regulatory, nonproliferation, and economic constraints, and the impact of unforeseen changes in these factors.

Assured Future Supply. Within the United States, some State utility commissions require many years of contracted assurance of fuel availability. Even where not so required, prudence warrants long-term contracts for supply and delivery. Large quantities of uranium still in the ground are therefore subject to commitments many years hence.

Regulatory Constraints. Trade in uranium is subject to conditions imposed by intergovernmental agreements, federal statute, and by some Federal agencies.

1403 009

One condition imposed by the Department of Energy is of special importance because of the extent to which it contributes to the incentive for "origin swapping." This condition sets limits on the enrichment of uranium of foreign origin at the government-owned enrichment plants. The purpose for establishing the condition was to assure the development of an adequate domestic nuclear fuel supply on a timely schedule. Originally, all uranium to be enriched for domestic use had to be of domestic origin. However, this requirement is now being phased out under criteria published on October 25, 1974. For example, in 1979 the foreign fraction is limited to 20%. This fraction increases each year, until in 1984 all the feed material may be of foreign origin.

Economic Constraints. The ultimate user (utility) may purchase uranium ore and contract with one or more companies in different countries for the various fuel processing activities and for the transporting of materials from place to place. Alternatively, the utility may buy fabricated fuel from a fuel supplier who takes care of the various manufacturing steps. In any case, the fuel processing decisions are made by the utility, the supplier, the manufacturer(s), and the transporters on the bases of such factors as economic costs, anticipated energy demands, the inflation rate, the world money market, available production capacity, and trade agreements. The constraints enumerated in this and the preceding paragraphs would be difficult enough to deal with in a static world of predictability; the real world is far different.

The "Fast Flux" Complication. Problems in international commerce in uranium are greatly aggravated because all the factors that affect the transactions are subject to relatively rapid flux compared with the long time that uranium is in the process chain. Thus, changing patterns of energy demand occur -- changes both in quantity, in location where needed, and in the form desired. The economics of alternate energy sources can be expected to change with changing technologies and intruding government policies. The inflation rate varies. Governments change, and successor regimes may espouse policies sharply at variance from those of their predecessors. Within stable governments, changes in intergovernmental agreements and government regulations occur that are particularly troublesome to the extent that they are not only unforeseen but are arbitrary and capricious. For these reasons, companies are faced with uranium fuel market conditions today that were completely unexpected ten or more years ago when contracts were entered into.

The "Who's On First" Problem

If there were only two people in the whole world -- a buyer and a seller -- things still wouldn't be too bad. But there are owners, agents, brokers, dealers, importers, exporters, processors, transporters, and regulators. Consider an instructive example: Operator A of an enrichment plant operated under contract for Country B may undertake to enrich some uranium for Importer C, who is an agent for Company D in Country E. Company D is actually an

1403 010

agency of Government E, which bought the uranium from Company F in Country G. The uranium was mined in Country H and may or may not have been processed in that country or in Country J by Company K before it was transported by Companies L, M, and N to Country B.

Actual transactions may be even more complex than this, because the lot of material at the enrichment plant may be the result of combining material from two or three purchases (having different origins) via more than one route. And it may be destined to power reactors in three or four different countries via fabrication operations in more than one country. Only workers from Companies A, K, L, M, and N have actually handled the material after it left the mine. To the other parties (Countries B, E, G, H, and J and Companies C, D, and F) the uranium exists only as entries on their books; they have neither seen nor handled it. Furthermore, Operator A has no way of knowing the origin of the material except to take the word of Importer C -- who must take the word of Company D.

How Things Work -- More or Less

Now that a setting has been established for the manufacturing processes involved and the constraints imposed on the movement of uranium in the international market, a picture can be given of how "origin swapping" comes about. Some reasons for uranium "swapping" transactions, not all of which involve "origin swapping," are listed in Table 1. However, the following two examples do involve "origin swapping."

Case 1. In early 1978, Allied Chemical had 75,000 pounds of U_3O_8 of foreign origin. United Nuclear Corporation had 75,000 pounds of U_3O_8 of U.S. origin, which it was preparing to export for conversion and enrichment outside the U.S. The United Nuclear material was shipped to Metropolis, where an "origin swap" was effected so that the material reshipped outside the U.S. was deemed to be of non-U.S. origin and the material remaining at Allied Chemical was deemed to be of U.S. origin. This "swap" provided Allied Chemical with feed material that could be enriched at the DOE enrichment plants within the criterion in the Federal Register notice of October 25, 1974.

Case 2. Babcock & Wilcox Company, Kerr-McGee, and the DOE enrichment plants have an agreement whereby feed material is shipped to the enrichment plants according to an agreed-upon schedule. Kerr-McGee found itself (for reasons not revealed to us) unable to meet its shipment schedule with U.S.-origin material required to comply with the Federal Register notice of October 25, 1974. It therefore arranged a "swap" with Allied Chemical of foreign-origin U_3O_8 possessed by Kerr-McGee for U.S.-origin material of the same composition and form.

In all cases, the material ending up designated as of foreign origin carries with it all conditions attached to the material originally of foreign origin: the conditions imposed by intergovernmental agreement attach to the designated origin and not to the atoms of uranium. There are therefore no implications relating to proliferation or nonproliferation not already addressed in the intergovernmental agreements that are in force.

1403 011

Table 1. Some Advantages of Uranium Swapping*

- Meet production commitment with material at Plant B when Plant A breaks down
- Adjust to changes in demand -- e.g., "swap" material on hand but not needed now because of licensing delays for other material to be delivered in the future
- Avoid unnecessary transportation costs
- Ability to comply with criterion imposed at U.S. enrichment plants by the Federal Register notice published on October 25, 1974 (39 FR 38016)
- Obtain "cheap" U.S. uranium in exchange for more expensive foreign material (cf. declining value of the dollar in the foreign money markets)
- Achieve better assurance of supply -- some countries have reportedly reneged on their supply commitments

*Note that the first three would not necessarily involve "origin swapping," but the last three would be predicated on such "swapping."

1403 012

ENCLOSURE B

1403 013

Appendix B

DATA ON THE FREQUENCY OF "ORIGIN-SWAPPING"

Data on "origin swaps" effected in 1978 and planned in 1979 were solicited from eight licensees and from the Department of Energy. Information from the Department of Energy is especially meaningful because (1) that agency owns the isotope enrichment plants where large quantities of material that would be candidate for "swaps" are stored, (2) a DOE requirement on feed materials for domestic reactors provided the only identifiable incentive for "origin swapping" in the transactions that were uncovered, and (3) DOE maintains the records on origins for compliance with their requirement. The sample of licensees surveyed included:

- The two UFG conversion plants that are the locations of most of the material subject to "origin swaps";
- Two low-enriched fuel fabrication plants with large throughputs of material;
- Three power reactor utilities;
- One international agent highly active in import and export activities.

This sample was chosen because it should elicit data on nearly all transactions that have taken place, and all types of licensees were represented.

1403 014

The data obtained are shown in the following table:

FREQUENCY OF "ORIGIN-SWAPPING" TRANSACTIONS

<u>Licensee or Agency</u>	<u>No. of "origin swaps"</u>		<u>Notes</u>
	<u>1978.</u>	<u>1979 (planned)</u>	
Kerr-McGee	1	1	One in 1977
Allied Chemical	1	*	
G.E./Wilmington	0	1	
Westinghouse	2	0	
Edlow International	2	*	
T.V.A.	0	0	One in 1977
Carolina P&L	0	0	
Commonwealth Edison	(no response)		
D.O.E.	1	*	Five or six since 1974

*Not yet determined

1403 015

ENCLOSURE C

1403 016

foreign origin when the enriched product is intended for use in a utilization facility (as defined in the Act) within or under the jurisdiction of the United States.

A proposed modification of the Criteria was published in the *Federal Register* on November 27, 1973 (38 FR 32595) with request for public comments by February 25, 1974. After consideration of the comments received and other relevant factors, the Commission has decided to adopt the schedule which was published November 27, 1973 for a gradual increase in the proportion of uranium of foreign origin that may be supplied by an enrichment services customer.

It is not anticipated that any change will be required in the schedule now being established. However, the AEC will monitor the extent of importation of foreign uranium for domestic use and its effect on the viability of the domestic uranium producing industry and on the President's objective of achieving a national capability for energy self-sufficiency. For this purpose the Commission, in addition to continuing its present program of monitoring uranium exploration activity, resource development, production capability and the general uranium market situation, will also monitor purchase or other arrangements involving import of any material destined for enrichment in private enriching facilities. If the extent of domestic use of foreign uranium should impair or threaten to impair the common defense and security, the Commission will institute such measures as are deemed necessary.

The Commission also plans to pursue an expanded and aggressive program directed toward obtaining a comprehensive assessment of the extent of potential domestic uranium resources, and toward improving exploration, mining and milling technology in order to help assure the development of an adequate domestic nuclear fuel supply on a timely schedule.

The proposed modification of the Criteria has been revised to indicate more clearly that the annual limitations will apply to all of the feed furnished by a customer under all of his enrichment contracts, rather than to each contract separately.

Paragraph 4. of the Criteria as published in the *Federal Register* on May 9, 1973 (38 FR 12180) is revised to read as follows:

"4. Enrichment of Uranium of Foreign Origin.—There is no restriction on the provision of enrichment services to persons furnishing as feed material uranium of foreign origin where the enriched product is not intended to be used in a utilization facility (as defined in the Act) within or under the jurisdiction of the United States. Where the enriched material is intended to be used in a domestic utilization facility, however, the fraction of feed material furnished by any customer, during a year under all of the customer's enrichment agreements with the

AEC that is feed material of foreign origin shall not exceed:

- (a) 10 percent at any time during 1977;
- (b) 15 percent at any time during 1978;
- (c) 20 percent at any time during 1979;
- (d) 30 percent at any time during 1980;
- (e) 40 percent at any time during 1981;
- (f) 60 percent at any time during 1982;
- (g) 80 percent at any time during 1983.

Thereafter, there shall be no restriction on the furnishing of feed material of foreign origin for the provision of enrichment services."

This notice shall become effective on October 25, 1974.

Dated at Germantown, Maryland, October 21, 1974.

For the Atomic Energy Commission.

PAUL C. BRIDGES,

Secretary of the Commission.

[FR Doc. 74-24269 Filed 10-24-74; 8:45 AM]

POOR ORIGINAL

FOREIGN URANIUM FOR DOMESTIC USE Modification of Restrictions on Enrichment

The U.S. Atomic Energy Commission hereby announces the revision of its Uranium Enrichment Services Criteria (the Criteria), as they apply to the restriction established pursuant to subsection 161v of the Atomic Energy Act of 1954 which sets forth the terms and conditions under which enrichment services will be offered for source or special nuclear material of

1403 017

ENCLOSURE D

POOR ORIGINAL

1403 018

Appendix D

COMBINATIONS IN WHICH TRANSNATIONAL URANIUM "SWAPS" CAN TAKE PLACE

- "Swaps" of declared origin between uranium in the U.S. of U.S. origin and uranium of foreign origin in a foreign country do not require U.S. approval (because no material is exported) and do not increase the amount of uranium available for proliferation purposes (case 1).
- "Swaps" of declared origin between U.S.-origin uranium in a foreign country and uranium (regardless of origin) in any other country do not affect the need to apply U.S. safeguards conditions to the material in the foreign country of U.S. origin -- even though the designated country of origin has been changed on paper. That country is still required, by terms of its Agreement for Cooperation with the U.S. government, to maintain controls on the quantity of uranium received from the U.S. (cases 2, 3, 5, and 6).
- "Swaps" of declared origin between uranium in the U.S. of foreign origin and uranium of foreign origin in a foreign country require (U.S. and/or Canadian/Australian) approval if the foreign-origin uranium in the U.S. has had supplier controls applied by, for example, Canada or Australia. If no supplier controls have been applied, no approval is required (case 4).
- "Swaps" of declared origin between foreign-origin uranium in a foreign country and other foreign-origin uranium in a different foreign country are free of U.S. controls (case 7).

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1403 019

Table D-1

COMBINATIONS IN WHICH TRANSNATIONAL URANIUM "SWAPS" CAN TAKE PLACE

Case 1

U.S. origin
material in
the U.S. "Identical"*
foreign-origin
material in
Country P

Case 5

U.S.-origin
material in
Country X "Identical"*
foreign-origin
material in
Country Y

Case 2

Foreign-origin
material in
the U.S. "Identical"*
U.S.-origin
material in
Country P

Case 6

U.S.-origin
material in
Country X "Identical"*
U.S.-origin
material in
Country Y

Case 3

U.S.-origin
material in
the U.S. "Identical"*
U.S.-origin
material in
Country P

Case 7

Foreign-origin
material in
Country X "Identical"*
foreign-origin
material in
Country Y

Case 4

Foreign-origin
material in
the U.S. "Identical"*
foreign-origin
material in
Country P

*The term "identical" is used to designate two quantities of uranium having the same physical and chemical characteristics, but differing in the designated country of origin.

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