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DOMESTIC UTILITY ATTITUDES TOWARD FOREIGN URANIUM SUPPLY

MASTER

NUCLEAR RESOURCES INTERNATIONAL

Atlanta, Georgia

June 1981

PREPARED FOR THE U.S. DEPARTMENT OF ENERGY
Grand Junction Office, Colorado

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PREPARED FOR THE U.S. DEPARTMENT OF ENERGY
ASSISTANT SECRETARY FOR NUCLEAR ENERGY
GRAND JUNCTION OFFICE, COLORADO
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EXECUTIVE SUMMARY

The current embargo on the enrichment of foreign-origin uranium for use in domestic utilization facilities is currently scheduled to be removed in 1984. The pending removal of this embargo, complicated by a depressed worldwide market for uranium, has prompted consideration of a new or extended embargo within the U.S. Government. As part of its on-going data collection activities, Nuclear Resources International (NRI) has surveyed 50 domestic utility/utility holding companies (representing 60 lead operator-utilities) on their foreign uranium purchase strategies and intentions. The most recent survey was conducted in early May 1981.

The 50 survey respondents were divided into six groups based on the total capacity of their nuclear programs as currently expected in the year 2000. Quantitative results are presented by group on an aggregated basis in order to respect the confidentiality provisions under which some of the data were collected. This report analyzes and documents the data available on foreign purchase preferences and presents some significant observations made by NRI during the course of the survey.

Quantitative foreign uranium purchase limits were collected for a 76.4% sample based on the total generating capacity of the respondents (124 GWe out of 163 GWe total). The responses of the utilities in this sample were organized into the Base Case in order to report aggregated results requiring no assumptions by NRI. As a result of this grouping, the Base Case captures 34 of the 40 utilities with unfilled requirements in the period 1983-1990. The foreign uranium purchase limits for each group were calculated on a weighted average basis using the total planned nuclear capacity in the year 2000 for each utility as the weighting factor. The utilities in the Base Case were found to have an average weighted purchase limit of 29.7% of total uranium requirements.

A partially disaggregated analysis of unfilled requirements was also performed using the Base Case. This analysis is presented by group for each year during the period. Of the 104,400,000 lbs. U₃O₈ of total unfilled requirements during the period 1983-1990, a maximum of 48,000,000 lbs. U₃O₈ or 46% of unfilled requirements (and 28.3% of total requirements) is available for domestic utility direct purchases of foreign uranium. Comparing the aggregated and disaggregated analyses, the foreign purchase limit differs by 1.4% (29.7% versus 28.3%) which translates to 2.5 million lbs. U₃O₈ (or 5% of the unfilled requirements available to foreign suppliers).

The results of the disaggregated analysis were combined with data on existing foreign purchase commitments to gain some insight into the maximum expected penetration of non-U.S. uranium supplies into the domestic uranium market. The average penetration ranges from 22%-23% for the high and low cases used in the analysis during the period 1983-1990.

Since it is desirable to have some method of estimating the possible foreign purchasing activity of all the utilities, the data of the Base Case was expanded using appropriate assumptions about the expected behavior of the remaining utilities. The result of this expansion was to increase the average weighted foreign purchase limit from 29.7% to 35.6%. Also, the six utilities with unfilled requirements before 1991 but without quantifiable purchase limits were now included with the other utilities having unfilled requirements to get a revised estimate of the maximum average purchase limit possible during the period 1983-1990. This inclusion raised the 29.7% Base Case limit to 30.5%.

Two conclusions are drawn from this analysis. First, a foreign uranium purchase limit of 30.5% appears appropriate for the period 1983-1990. Second, during the period 1991-2000 when all utilities will have unfilled requirements, an average purchase limit of 35.6% may be appropriate. However, it should be noted the foreign purchase preferences have been observed to be a somewhat dynamic subject, particularly sensitive to changes in the uranium market conditions.

A number of qualitative observations were made during the course of the survey. The major observations are:

- domestic utility views toward foreign uranium purchase are dynamic;
- all but three utilities had some considered foreign purchase strategy;
- some utilities have problems with buying foreign uranium from particular countries;
- an inducement is often required by some utilities to buy foreign uranium;
- opinions varied among utilities concerning the viability of the domestic uranium industry; and
- many utilities could have foreign uranium fed through their domestic uranium contracts (indirect purchases).

The above observations are expanded in the final section of the report. However, it should be noted that two of the observations are particularly important and should be seriously considered in formulation of foreign uranium import restrictions. These important observations are the dynamic nature of the subject matter and the potentially large and imbalanced effect the indirect purchases could have on utility foreign uranium procurement.

SECTION 1
Introduction

On October 25, 1974, the AEC announced a revision to the Uranium Enrichment Services Criteria (31 F.R. 16479, December 23, 1966, as amended) which allowed the enrichment of uranium feed of non-U.S. origin (foreign fuel) for use in a domestic utilization facility (nuclear reactor power plant). The removal of the previous "embargo" occurs on the graduated scale shown in Table 1.1 below.

TABLE 1.1
Annual Percentage Limits on Enrichment/Use of Foreign Uranium

<u>Year</u>	<u>Foreign Feed Allowed (1)</u>
1977	10%
1978	15%
1979	20%
1980	30%
1981	40%
1982	60%
1983	80%
1984-on	100%

In theory, from 1984-on, all of the uranium requirements of U.S. utilities could be met by purchases of foreign uranium.

Ever since the inception of the U.S. nuclear power industry, it has been recognized that the degree to which U.S. utilities purchase uranium of foreign origin will have an important impact on the future development of both the domestic and worldwide uranium markets and industries. Nuclear Resources International (NRI), as part of its normal, on-going data collection activities, has been collecting data on U.S. utility preferences for foreign (non-U.S.) and/or domestic uranium.

(1) The restriction on foreign feed is applied to the total feed delivered by a given utility customer during a given year under all of that company's individual DOE enrichment contracts.

The main thrust of NRI's research has been to ascertain whether or not U.S. utilities would buy foreign uranium; and if so, what portion of their future purchases might be available to foreign uranium suppliers. NRI discovered that many U.S. utilities have self-imposed or de facto limits on their purchases of foreign uranium. Other market insights were also be gained in the course of research, such as the circumstances under which U.S. utilities would buy foreign uranium, the problems perceived in buying foreign uranium, and utility concerns on the viability of the U.S. uranium producing industry.

It is important to recognize that U.S. utility policies on purchases of foreign uranium are embryonic and dynamic. Thus, their corporate policies and preferences/non-preferences for foreign uranium are subject to change (and do change). Some utilities acknowledge the dynamics attendant to their particular fuel supply situation. They point out that their opinions or policies could well change before they actually go out into the market to buy. This is easily understandable since, in some cases, such market entry might be 10 years or more in the future. Further, some utilities are still in the process of formulating their policies and strategies toward foreign uranium. Before a firm decision is made on a foreign purchase policy, they intend to actually test the market. Finally, and perhaps most importantly, in many cases the foreign purchase policy of an individual utility is often a function of the market conditions (particularly price) and so changes with time.

Since the nature of the data is dynamic, "snapshots" (in the form of surveys) at regular intervals provide useful insights into the issues surrounding utility preferences toward foreign uranium purchases. These insights, in turn, allow certain market observations and conclusions to be drawn. Between 1980 and 1981, for example, NRI was able to observe several changes in U.S. utility policies toward foreign uranium purchases. During this time, it was apparent that many U.S. producers withdrew from the long-term market (and thus were not responding to long-term requests for quotation). The purpose of this report is to objectively document the data on this subject as of May 1981.

SECTION 2

Organization of the Survey and Report

2.1 The Survey of the U.S. Utilities

NRI is in routine contact with the U.S. utilities operating or planning to operate nuclear power plants. Occasionally, to collect consistent data on a subject of current interest, NRI will survey the utilities on that particular subject in a short time period. The resulting "snapshot" improves the quality of the data by providing both more current data and patterns of change. Such a survey was performed in early May 1981 on NRI's own account to research the self-imposition by the U.S. utilities of limits on the amount of foreign-origin uranium that they would be willing to purchase against their current levels of unfilled demand. The objective of the survey was to be able to quantify, on an aggregated basis, a maximum limit for purchases of foreign uranium yet to be made by U.S. utilities for the period 1983 through 1990.

Over a period of approximately two weeks, NRI contacted 44 utilities and 6 holding companies to obtain the required information. This population of companies represents 60 lead utility companies with lead responsibility for nuclear power programs. The data presented in this report have been aggregated to respect the confidentiality provisions under which much of the data was collected. For presentation of the data, therefore, the 50 respondents are divided into six groups according to the projected installed capacity of each nuclear power program. The six groups are:

<u>Group</u>	<u>Program Size (MWe)</u>
1	1 - 1000
2	1001 - 2000
3	2001 - 3000
4	3001 - 4000
5	4001 - 6000
6	greater than 6000

The utilities in each group are presented in Table 2.1.1 following.

TABLE 2.1.1
The Major Nuclear Utility/Holding Companies of the United States

<u>Group 1</u>	<u>Group 2</u>	<u>Group 3</u>	<u>Group 4</u>	<u>Group 5</u>	<u>Group 6</u>
0-1000 MWe*	1001-2000 MWe	2001-3000 MWe	3001-4000 MWe	4000-6000 MWe	> 6000 MWe
Boston Edison	Baltimore G&E	AEP/Ind. & Mich.	Arizona PS	CAPCO (3)	Carolina P&L
Cincinnati G&E	Detroit Edison	Consumers PCo.	Florida P&L	Mid South (3)	Commonwealth Ed.
Con. Edison	GPU (2)	Pacific G&E	Houston L&P	Philadelphia E	Duke Power
Nebraska PPD	Gulf States	Pennsylvania P&L	Northeast U (2)	PSE&G (N.J.)	Tennessee VA
No. Ind. PSCO	Kansas G&E	PS Indiana	Portland GE	So. Services (2)	Washington PPSS
Omaha PPD	Niagara Mohawk	PS Oklahoma	Yankee Group (4)	Virginia EPCO	
P.S. Colorado	Northern SP	So. Cal. Edison			
Sacramento MUD	Power Auth. SNY	Texas USI			
So. Carolina E&G	Rochester G&E	Union Electric			
Wisconsin EPCO					
Wisconsin PS					
Florida P. Corp.					
Illinois Power					
Iowa EL&P					
Long Island LCO					

() = The number of primary nuclear utilities in the holding company.

* The program size of the respondents was determined by the installed capacities currently operating, under construction, or currently planned to be brought on line by the year 2000 (a total of 163 GWe).

2.2 The Organization of this Report

It may be important to briefly explain what this report presents and what it does not present. What the report does is to show:

1. the maximum percentage of total requirements available for sales by foreign producers based upon utility purchase strategies as weighted by nuclear program size;
2. the unfilled requirements for uranium of the U.S. utilities for the period 1983 to 1990, inclusive, as perceived by the nuclear fuel managers with the buying responsibility;
3. the upper limits to the quantities of foreign uranium which might be purchased by U.S. utilities which have unfilled requirements in the period 1983-1990; and
4. the maximum quantity of foreign uranium so predicted to be purchased stated as a percentage (%) of:
 - a) unfilled requirements, and
 - b) total requirements for those U.S. utilities which will be in the market to purchase U₃O₈ between 1983 and 1990.

In short, this study shows the maximum quantity of foreign uranium that may be bought from May-1981 on for delivery over the 1983-1990 period based upon the foreign purchase policies extant at the time of this study among U.S. utility nuclear fuel managers.

What this report does not specify are those quantities of foreign uranium which have already been purchased directly by U.S. utilities and those quantities of foreign uranium coming into the United States and being delivered to U.S. utilities by U.S. domestic uranium producers under existing sales contracts, both values for which DOE already knows from its annual Market Survey; and total U.S. requirements for nuclear fuel during the period 1983-1990, which DOE knows from its own supply/demand studies.

In reviewing the data and findings in this report, it is important to note that in the assimilation of the basic data, there is necessarily a distinction to be made between quantitative and qualitative (and sometimes subjective) information. These distinctions, which can be recognized in a disaggregated analysis, are to some extent lost in an aggregated presentation such as this. The Observations section of this report will ameliorate this effect to the extent possible.

SECTION 3

Survey Results

3.1 Base Case - Overview

In its survey of U.S. utilities, NRI contacted 50 U.S. companies representing 60 U.S. utilities with 163 GWe of active or planned nuclear power plants projected to operate by the year 2000. NRI found that 46 companies had some form of policy or strategy concerning the purchasing of non-U.S. natural uranium concentrates. These policies ranged from formally established corporate policies in two cases to a whole spectrum of informal approaches. When the nuclear capacity of utilities with quantified limits for foreign purchases (i.e. requiring no assumptions by NRI to establish a limit), is compared to the total population of respondents, it can be seen that quantitative data was collected for a 76.4% sample (124 GWe). The data associated with these 124 GWe represent the Base Case analysis in this report.

Not all of the companies that had policies on foreign uranium purchases, however, needed to purchase uranium during the period of the study. In fact, only 40 utilities have unfilled requirements between 1983 and 1990, and only 34 of these utilities are represented in the Base Case. The unfilled requirements and total requirements for these companies are presented in Table 3.1.1 following. The values for total requirements become important when one realizes that most utilities express their percentage limits of foreign purchases in terms of total requirements (as opposed to the percent of unfilled requirements or an absolute amount of uranium).

TABLE 3.1.1
Distribution of Total and Unfilled Requirements: 1983-1990
 (000 lbs U₃O₈)

<u>Group #</u>	<u># Utilities Surveyed</u>	<u># Utilities With Unfilled Requirements</u>	<u>Total Unfilled Requirements</u>	<u>Total * Requirements</u>
1	15	8	11650	14680
2	10	8	13110	21850
3	9	5	9380	17620
4	10	8	12620	18810
5	11	8	23050	43090
6	<u>5</u>	<u>3</u>	<u>34595</u>	<u>53615</u>
TOTAL	60	40	104405	169665

* For utilities with Unfilled Requirements.

Of the 46 utilities among the six groups in the Base Case, only 4 companies had unrestricted (100%) foreign purchase limits. Those four companies had a total among them of seven reactors totaling 6650 MWe. Conversely, 5 companies with 10 reactors totaling 8250 MWe maintained policies of no foreign purchases (0%) for their long-term supplies. The basic overview data from the survey are presented in Table 3.1.2 following.

TABLE 3.1.2
Constraints on Purchase of Foreign-Origin Uranium
Summary of Limits Weighted by MWe

BASE CASE

<u>Group</u>	<u># of Utilities In Group</u>	<u>For Companies with Quantifiable Policies</u>		
		<u># with Policies</u>	<u>Projected MWe</u>	<u>Purchase Limits</u>
1	15	8	6108	46.1%
2	10	9	14043	27.5%
3	9	6	13718	44.6%
4	10	10	21214	36.0%
5	11	10	28873	25.0%
6	<u>5</u>	<u>3</u>	<u>40418</u>	<u>23.1%</u>
TOTALS	60	46	124374	29.7%

The purchase limits shown in the last column, with a weighted average of 29.7% is the basic algorithm which was developed in this report to reflect current maximum foreign purchase intentions by group. An example on how to use this algorithm is presented in Section 3.3 of this report.

3.2 Base Case - Detailed Data

A more detailed breakdown of unfilled requirements collected in the survey is presented by group and year in the following Table 3.2.1.

TABLE 3.2.1
Summary by Group of U.S. Unfilled Requirements for Uranium
(000 lbs U₃O₈)

<u>Group</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>TOTAL</u>
1	995	995	1160	1560	1310	2010	2010	1610	11650
2	-	-	370	1680	2680	2800	2700	2880	13110
3	-	-	700	1060	1560	1820	1820	2420	9380
4	-	70	110	650	2605	2900	2915	3370	12620
5	-	-	2200	3250	3550	4500	4050	5500	23050
6	<u>955</u>	<u>2125</u>	<u>3890</u>	<u>2920</u>	<u>5160</u>	<u>6605</u>	<u>5530</u>	<u>7410</u>	<u>34595</u>
TOTAL	1950	3190	8430	11120	16865	20635	19025	23190	104405

It should be noted that while in most cases data on unfilled requirements was received directly from the utilities, in certain cases it was necessary to calculate and/or estimate unfilled requirements. These calculations were aided in most instances by information on total requirements and existing supply commitments of utilities, so the total unfilled requirements are considered to be largely reasonable.

For those utilities which have unfilled requirements in the 1983-1990 period, the corresponding total requirements are presented in Table 3.2.2 following. As pointed out earlier, these total requirements are significant because it is in terms of these values that most utility nuclear fuel managers think when they apply their foreign purchase policies, strategies and limits.

TABLE 3.2.2
Summary by Group of Total U.S. Uranium Requirements
For Utilities With Unfilled Requirements: 1983-1990
(000 lbs U₃O₈)

<u>Group</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>TOTAL</u>
1	1325	1325	1655	2055	1655	2355	2355	1955	14680
2	-	-	1550	2860	3860	4560	4460	4560	21850
3	-	-	1970	2700	3000	3000	3000	3950	17620
4	-	1190	362	2760	3560	3375	3500	4060	18807
5	-	-	3660	5840	6810	8810	8320	9650	43090
6	<u>1830</u>	<u>6030</u>	<u>6855</u>	<u>5175</u>	<u>7415</u>	<u>8860</u>	<u>7785</u>	<u>9665</u>	<u>53615</u>
TOTAL	3155	8545	16052	21390	26300	30960	29420	33840	169662

By having specific discrete data on each individual utility, NRI has been able to do a disaggregated analysis for each utility. The process is simple but requires one iterative double-check step. First the foreign purchase (%) limit is applied to each utility's total requirements for each year. The calculated maximum quantity in each year is then compared with that year's unfilled requirement for that utility. If the calculated maximum foreign purchase amount exceeds the unfilled requirement, then the unfilled requirement becomes the effective limit. If the uranium requirement exceeds the calculated foreign purchase amount, that limit is accepted as the maximum quantity. This process is repeated for each utility for each year until a complete matrix is developed. The result is a table by utility by year of foreign purchase limit quantities. The summary results of that analysis are presented in the following Table 3.2.3, not by utility, but aggregated by utility group.

TABLE 3.2.3
Summary by Group of Maximum U.S. Utility Direct Purchases
Of Foreign Uranium
(000 lbs U₃O₈)

<u>Group</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>TOTAL</u>
1	570	570	735	935	735	1085	1085	885	6600
2	-	-	170	795	1135	1295	1265	1375	6035
3	-	-	700	1060	1160	1420	1420	1560	7320
4	-	70	90	450	940	890	940	1140	4520
5	-	-	570	1788	2055	2305	2352	2687	11757
6	<u>500</u>	<u>1125</u>	<u>1280</u>	<u>990</u>	<u>1588</u>	<u>1950</u>	<u>1890</u>	<u>2480</u>	<u>11803</u>
TOTAL	1070	1765	3545	6018	7613	8945	8952	10127	48035
% of Unfilled Requirements	55	55	42	54	45	43	47	44	46
Unfilled Requirements	1950	3190	8430	11120	16865	20635	19025	23190	104405
% of Total Requirements	34	21	22	28	29	29	30	30	28
Total Requirements *	3155	8545	16052	21390	26300	30960	29420	33840	169662

* For utilities with unfilled requirements

3.3 Comparison of Disaggregated and Aggregated Analyses

NRI provided a basic algorithm in Table 3.1.2 by which a market analyst with his own projections of requirements can approximate the results of NRI's utility-by-utility analysis for foreign uranium purchase preferences. A comparison of results under the "macro" (aggregated) and "micro" (disaggregated) systems are presented in Table 3.3.1 below.

TABLE 3.3.1
Comparison of Results in Report "Macro" and "Micro" Projections
(000 lbs U₃O₈)

<u>Group</u>	<u>Foreign Purchase Limits (Table 3.1.2)</u>	<u>Total Requirements (Table 3.2.2)</u>	<u>Maximum Foreign Purchases</u>		
			<u>(Col 2x3) "MACRO"</u>	<u>NRI Discrete Data "MICRO"</u>	<u>Actual %</u>
1	46.1%	14640	6760	6600	45.1%
2	27.5%	21850	6000	6030	27.6%
3	44.6%	17620	7860	7320	41.5%
4	36.0%	18810	6770	4520	24.0%
5	25.0%	43090	10770	11760	27.3%
6	<u>23.1%</u>	<u>53615</u>	<u>12380</u>	<u>11800</u>	<u>22.0%</u>
TOTALS	29.7%	169625	50540	48030	28.3%

As can be seen, NRI's simple algorithm yields an aggregated result within 2.5 million pounds (a difference of 5%) of the more detailed microscopic calculation. Thus, the analyst can use the simple method in conjunction with his own total demand numbers for each group with a reasonable degree of confidence in his estimation of foreign purchase limits in the period 1983-1990. The underlying assumption in this comparison is that those 6 utilities with unfilled requirements not included in the Base Case will have an average weighted foreign purchase limit of 29.7%. This assumption will be relaxed in Section 3.5 when purchase limits are assigned to the excluded 6 utilities.

3.4 An Application of the Disaggregated Results

The data in the previous sections have focused on the maximum amounts of foreign uranium that the utilities would be willing to purchase based upon their internal uranium supply strategies. However, the results of the disaggregated analysis may be combined with existing foreign uranium purchases to gain some insight into the maximum expected penetration of non-U.S. suppliers into the domestic uranium market. Certain external data are needed to perform this analysis:

- existing foreign purchase commitments, and
- total uranium requirements

These data are readily available within DOE. The foreign purchase commitments are published in DOE's Survey of United States Uranium Marketing Activity. In addition, total uranium requirements are projected on a regular basis by certain organizations within DOE (OUEA and EIA, for example). However, for the purposes of this analysis, NRI used its own data for total uranium requirements and modified DOE's 1980 Survey data on foreign purchase commitments to reflect recent purchases. The resulting analysis is shown in Table 3.4.1.

The maximum future foreign purchases based on the data in this study were added to the modified existing foreign purchase commitments to arrive at a maximum total for foreign purchases. This foreign total is then compared against NRI's high and low total uranium requirements to estimate the maximum foreign share in each case. It is apparent from this analysis that while increasing modestly throughout the decade, no overwhelming domination of the U.S. market by foreign suppliers can be expected. The average penetration ranges from 22%-23% during the eight year period for the high and low case respectively.

TABLE 3.4.1
Application of the Disaggregated Data to Internal NRI Demand Analyses
 (000 lbs U₃O₈)

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1983-90 TOTAL</u>
Foreign Purchases									
Future (this study)	1070	1765	3545	6018	7613	8945	8952	10127	48035
Existing (DOE 1980 Market Survey, mod*)	<u>5700</u>	<u>5700</u>	<u>5630</u>	<u>2830</u>	<u>2830</u>	<u>2830</u>	<u>2830</u>	<u>2830</u>	<u>31180</u>
TOTAL	6770	7465	9175	8848	10443	11775	11782	12957	79215
NRI'S TOTAL REQUIREMENTS									
(High)	47400	45600	48400	43600	42200	42000	41800	42200	353200
-15- Total Maximum Foreign Share	14%	16%	19%	20%	25%	28%	28%	30%	22%
NRI'S TOTAL REQUIREMENTS									
(Low)	45000	43200	48800	41000	40000	40600	40400	40400	339400
Total Maximum Foreign Share	15%	17%	19%	22%	26%	29%	29%	32%	23%

* mod = as modified by NRI to include several foreign purchase contracts not executed at time of DOE's January 1980 Market Survey.

3.5 Expansion of the Base Case

We have seen that only those utilities stating some sort of quantified limits on the amount of foreign uranium they would buy were included in the Base Case. While the Base Case does represent the possible foreign purchasing activity of three quarters of the utilities, it is desirable to have some method of estimating the possible foreign purchasing activity of all of the utilities. In order to do this, however, it is necessary to make assumptions about the behavior of the utilities not represented in the Base Case. The results generated will be presented below, along with the assumptions utilized in expanding the data base.

The data expansion was completed in two steps. First, there were four utilities who stated their purchase policy limit as "up to the DOE limit" (i.e. the current embargo limit). Since the allowable foreign feed under the embargo reaches 100% in 1984, it was assumed that these utilities would consider purchasing all of their requirements from foreign sources. The second step was to assume limits for utilities who could not describe what those limits might be.

Whenever a utility indicated that it would consider foreign uranium, but did not indicate a limit, it was necessary to assign that utility a limit in order to obtain a complete data base. In those other cases, other available information, such as past purchases of foreign uranium or the utility's general procurement strategy were used in estimating a limit. For example, if a utility had purchased foreign uranium in the past, that could be used as an indication of what they might do in the future. As another example, when a utility has a general purchase strategy of having at least two suppliers, and indicated that it would not use foreign uranium for all of its requirements, the assigned limit would be 50%. Of course, when several pieces of data were available, they were considered together to assign an appropriate limit.

It should also be recognized that in assigning limits, the convention was to err on the high side. This approach is valid since we were estimating the maximum amount of foreign uranium a utility would buy, not the most likely amount.

The results of assigning foreign uranium limits to those utilities not represented in the Base Case, and expanding the analysis to include all of the utilities is presented in Table 3.5.1. In comparison with Table 3.1.2, it is evident that most of the changes in limits occurred in Groups 3 and 6, with the limit in Group 3 increasing by 14% and that of Group 6 by 11%. It is interesting to note that while the size of Group 1 almost doubled, the purchase limit remained virtually the same.

TABLE 3.5.1
CONSTRAINTS ON PURCHASE OF FOREIGN-ORIGIN URANIUM
Summary of Weighted Limits for All Utilities

<u>Group</u>	<u># of Utilities In Group</u>	<u># of Additions to Base Case</u>	<u>Projected MWe</u>	<u>Foreign Purchase Limits</u>
1	15	7	10978	46.8%
2	10	1	15829	28.1%
3	9	3	20546	58.7%
4	10	0	21214	36.0%
5	11	1	33270	23.0%
6	<u>5</u>	<u>2</u>	<u>60861</u>	<u>34.4%</u>
TOTAL	60		162698	35.6%

Looking back to the aggregated analysis of Section 3.3, it was assumed that the six utilities with unfilled requirements not included in the Base Case had a weighted average foreign purchase limit of 29.7%. Since we have now assigned limits to those utilities, a reworking of the analysis concludes that the assumed policies of those utilities raise the average limit used in the analysis to 30.5% (an increase of only 0.8%).

Upon examination of the data in both the Base Case, as revised above, and this expanded case, the observation can be made that for the period 1983-1990, the average weighted Foreign Purchase Limit of 30.5% may be more appropriate. On the other hand, for the period 1991-2000, the percentage limits shown in Table 3.5.1 above should be used.

SECTION 4

Observations Related to the Data

4.1 Dynamics of Utility Views on Buying Foreign Uranium

As mentioned in the introduction, U.S. utility views toward buying foreign uranium can change over time - that is, they are dynamic. Because NRI has surveyed U.S. utilities more than once, we have been able to investigate these dynamics. The initial, and probably most important, observation is that a change could be noted in the views of 7 of the 60 utilities surveyed. The fact that only slightly over 10% of the utilities changed their viewpoint attests to the relative stability of utility views as a whole toward foreign uranium. However, it should also be mentioned that in most cases these changes have occurred in a period of three quarters of a year. As time goes by and market conditions are more universally perceived, utility views could be expected to change even more.

The types of changes in utility views toward buying foreign uranium can be divided into three categories, with each category mentioned three times. (Note that a utility can change its policy in more than one area.) The first category of change is where a utility did not have a view or strategy concerning foreign uranium, but now has given more thought to it. In each case where more thought is being given to foreign uranium, the utilities are now favorably considering foreign purchases, as opposed to rejecting the possibility of buying it. The second category that can be discussed is utilities changing their maximum limit with respect to buying foreign. In each case the amount of foreign uranium a utility will buy (expressed as a percentage) now is greater than before, the difference ranging from where the limit was raised slightly to where there is now no limit at all. The third category involves the situation where the utility now wants to buy a minimum amount of foreign uranium as opposed to stating no minimum before. In two cases this minimum was expressed as a percentage and in the third case it was simply that the utility wanted to have both domestic and foreign supply.

4.2 Nature of Utility Opinion/Policy Toward Buying Foreign Uranium

An attempt was made in the surveys to characterize the nature of utility opinion toward buying foreign, if such opinion existed. In three cases it was discovered that the utilities had no opinion at all on buying foreign uranium. In the rest of the cases, these opinions ranged from very informal views to formal corporate policies, although there were only two of the latter. In between this spectrum, there were opinions that could be labelled as informal policies and semi-formal strategies. The point is that wherever some opinion existed, some thinking had been done on the subject of buying foreign uranium. Further, the fact that for 88% of U.S. utilities these opinions had not changed much over the past three quarters of a year indicate they represent some basis for decision making. And, what is important is not so much whether or not a policy is written down, but whether or not it is acted upon, although it can be argued that a formal policy is more difficult to change and thus is a more definitive indicator of what a utility might do.

4.3 U.S. Utility Problems With Buying Foreign Uranium

During the course of the surveys, a number of problems were mentioned by the utilities with respect to buying foreign uranium. While responses to the general question of problems with foreign supply were often solicited, specific problem areas were generally not identified beforehand. Thus, the specific problems identified by utilities were basically spontaneous in nature and represent what they perceive to be the major concerns. Table 4.3.1 lists those problems with foreign uranium mentioned by at least three utilities, and ranks them according to how frequently they were identified. Basically, there were seven problem areas identified; one - "Lack of Assurance of Foreign Supply and Additional Risk Associated With Foreign Uranium" - being fairly general in nature, since every area relates to additional risk of one sort or another.

The two problems listed the most concern uranium export policies of foreign governments, primarily Canada and Australia. Price controls and upgrading of uranium to higher forms were the main problems that utilities had with these export policies, and in some cases these problems were serious enough to preclude a utility from buying uranium from a particular country. It is interesting to note that no utility mentioned having problems with the export policies of Niger and Gabon, which are very similar to those of Canada and Australia with respect to price. The political and transportation problems relate both to the relationship between the U.S. and a foreign government (or country) and within that country itself. For example, a utility may be concerned that the opposition party will take power in Australia, thus upsetting uranium contracts in place, or it may not want to buy uranium from South Africa because of policies in that country which come in conflict with those in the United States. In transportation, some utilities would prefer to buy uranium from Canada because it is closer, and others are concerned whether or not the uranium can get out of Australia (get from the mine to the ports) on a timely basis.

TABLE 4.3.1

U.S. Utility Problems With Buying Foreign Uranium

<u>Category</u>	<u>Responses</u>
Foreign Price Controls, Government Approval of Prices, Price Formulae	13
Upgrading of Uranium (UF ₆ Conversion, Enrichment) Tied to Uranium Purchase	10
Lack of Assurance of Foreign Supply, or Additional Risk Associated with Foreign Uranium	8
Political Problems with and in Foreign Governments, Stability of Foreign Governments	6
Transportation of Uranium From and Within a Foreign Country	5
Concern About U.S. Government Placing a Tighter Restriction on U.S. Use of Foreign Uranium	3
Unfavorable Past Experiences with Foreign Suppliers	3

Note: Some respondents made more than one observation, and all categories are not mutually exclusive.

In three cases, utilities expressed concern about future purchases of foreign uranium based on past problems with foreign supplies. Of the three cases where utilities had unfavorable experience buying foreign uranium, in two of the cases the experience was so bad that they indicated that they would not buy uranium from that country any time soon. In all three cases the exporting country was Canada. Thus, the problems the utilities had related more to the nature of Canadian export controls over uranium rather than to a specific producer.

Another of the problems listed relates to the perception of possible changes in policies of the United States. Recent discussion about the possibility of re-instituting or strengthening restrictions against use of foreign uranium presents a concern to those utilities, although it should be pointed out that one other utility said it favors such restriction. Other problems mentioned include technical problems with foreign supply (quality of product), possible dependence on foreign uranium, and foreign prohibition against U.S. legal sanctions. Finally, it should be understood that we are presenting perceptions of problems voiced by utilities and not necessarily actual problems, although to the extent that utilities base their actions on these perception the distinction between real versus perceived problems becomes moot.

4.4 Need for an Inducement to Buy Foreign Uranium

One of the most striking and clear-cut observations that can be made in this report is the need on the part of U.S. utilities to have some inducement or advantage (over domestic supplies) before they will buy foreign uranium. Over 70% of all utilities surveyed and an even greater percentage of those who indicated they would buy foreign uranium stated the need for such an inducement. The message was clear: foreign and domestic uranium were not perceived as being equal by the vast majority of U.S. utilities, and thus it is necessary for foreign producers to offer more attractive contract terms to overcome or neutralize this difference.

The concession most often mentioned by U.S. utilities before they would buy foreign uranium was price. No utility was able to pin down the exact amount of the price concession, but this is understandable because:

- 1) the market is constantly changing and many utilities are not now in it; and
- 2) price is but one of a number of variables in a contract.

Another contract feature, mentioned several times, that could influence a utility to purchase foreign uranium was flexibility of supply. Some utilities indicated they would need a more attractive "economic package" to buy foreign uranium, implying that a combination of favorable contract features would induce them to buy foreign.

Up until now we have been seeing that U.S. utilities need some sort of price or other discount to buy foreign uranium. The logical mirror image of this statement would be to say that U.S. utilities will pay a premium for domestic uranium. However, if the differential in price between domestic and foreign uranium became large enough, this premium would be exceeded and U.S. utilities would buy relatively more foreign uranium. The point here is that the magnitude of the limits on utilities buying foreign are partly a function of economics (basically price). Some utilities might buy all foreign uranium given a low enough price, while others would still have a limit no matter what the price.

4.5 Utility Concerns About Viability of U.S. Producing Industry

In the course of the survey, some utilities were asked whether they were concerned about the future viability of the U.S. uranium producing industry. The results and observations generated by asking the question are extremely informative. Of 18 utilities questioned on this issue, 11 responded they were concerned (some very or extremely concerned), 3 somewhat concerned, and 4 not (or not really) concerned. Some of those utilities which expressed concern noted that since they did not need uranium, they could not help the U.S. producers by purchasing domestic uranium; and, two of these indicated the most they could do was honor their existing contracts with domestic producers, pointing out that they did not need all of the uranium. One utility said the future viability of domestic producers would definitely impact its decision on whether or not to buy foreign.

Other utility views on the viability of the U.S. producing industry are summarized below:

- current cut-backs in U.S. production are a natural result of market forces and should occur;
- despite the current depressed state of the market, the U.S. industry will remain viable on its own;
- U.S. preference for domestic uranium will keep the U.S. industry afloat;
- there are enough low cost producers in the U.S. to keep the industry viable; and
- the big oil companies will stay in the uranium business regardless of today's economics.

It is interesting to note that the possibility of U.S. producers going out of business represents a potential problem for some U.S. utilities doing business with them. For this reason, some utilities did not want to restrict themselves to buying too little foreign uranium in case there is not enough domestic supply capacity in the future. Thus, in this sense

the non-viability of U.S. producers is not a function of U.S. utility purchases of foreign uranium, but U.S. utility purchases of foreign uranium could become a function of the non-viability of the domestic industry. However, as was pointed out above, some U.S. utilities indicated they are taking or would take action to help assure the viability of domestic producers, so the question is at what point does the viability of the U.S. uranium producing industry or individual producers become so diminished that the preference for U.S. supply also becomes diminished.

Another point that should be made is that U.S. utilities are not necessarily being altruistic in their concern for U.S. producers. Many cannot take advantage of the current low prices, and they are concerned that when they do have to buy uranium, they may find themselves in the "boom" phase of a boom/bust cycle that has been characteristic of the uranium market. They also say that they recognize the benefit of having a stable source of uranium supply in the United States, and are willing to pay some sort of premium for it. But again, no U.S. utility put a dollar or percentage value on the premium they would be willing to pay. In fact, when a utility talks of a price differential, the survey experience shows that invariably the utility think and speak of the price differential in terms of a discount for foreign purchases instead of a premium for U.S. purchases. This may be because U.S. utilities think in terms of U.S. prices and the Nuexco Exchange Value as the U.S. price basis.

4.6 Utility Utilization of Foreign Uranium Delivered Through Contracts With U.S. Domestic Producers

Over the course of conversations with utilities the subject came up several times that utilities were reaching their limits on usage of foreign uranium or those imposed by the Department of Energy (DOE) by virtue of foreign uranium supplied to them through contracts with domestic producers. In a number of other cases, utilities indicated they were receiving or would receive some foreign origin uranium from domestic producers. Although the fact that some domestic producers supplement their domestic production with supplies purchased from a foreign producer and/or produced by a foreign subsidiary is nothing new, the prevalence of this activity seems to be growing, and moreover, could possibly increase further in the future.

According to NRI's records, 12 U.S. utility/holding companies have contracted directly with foreign suppliers for uranium and are distributed among utility groups as shown in Table 4.6.1. It appears that 13 utilities or holding companies (and in all cases except one, a different group from those that have purchased foreign uranium directly) have received, are receiving, and/or are scheduled to receive foreign uranium through contracts with domestic suppliers. Thus, 24 (or approximately half) of the utility/holding companies have received or are scheduled to receive foreign uranium. It is interesting to note that while the utilities receiving foreign uranium are almost equally distributed among the six utility groups, 75% of the companies purchasing (or having purchased) foreign uranium directly are found in the larger utilities in Groups 4-6, while 75% of those receiving (or having received) foreign uranium through contracts with domestic suppliers are found in the smaller utilities of Groups 1-3.

Since it is known that a number of contracts between U.S. utilities and U.S. producers contain a provision that allows for delivery of non-U.S. origin uranium, there is the potential for a greater number of U.S. utilities than indicated in Table 4.6.1 to use some foreign uranium in the future. Furthermore, several utilities indicated that they are

TABLE 4.6.1
Distribution by Groups of Utilities That Have Used or Are Scheduled
To Use Foreign Uranium

<u>Group</u>	<u>Total Buyers</u>	<u>Direct Purchases</u>	<u>Delivered Through Contract With Domestic Supplier</u>	<u>Total Receiving Foreign Uranium</u>
1	15	1	3	4
2	9	1	3	4
3	9	1	4	4
4	6	2	1	3
5	6	2	2	4
6	<u>5</u>	<u>5</u>	<u>0</u>	<u>5</u>
TOTAL	50	12	13	24

much more willing to take foreign uranium through a contract with a domestic producer than to contract for it directly. In fact, it could be said that the two circumstances of receiving foreign uranium are entirely different. Thus, the magnitude of such future deliveries probably depends more on the decision of U.S. producers than U.S. utilities.

Several general observations can be made at this point:

- 1) The population of U.S. utilities that either have used or will use foreign uranium is essentially doubled when one takes into account delivery of foreign-origin uranium by domestic producers to U.S. utilities. This is so because the groups that have purchased foreign uranium directly and have received it through contracts with domestic producers are almost mutually exclusive.
- 2) Utilities with smaller nuclear projects are more likely to take foreign uranium indirectly (through domestic suppliers), while utilities with larger nuclear projects are more likely to purchase foreign uranium directly.
- 3) The subjects of contracting for foreign uranium directly and using foreign uranium delivered by U.S. suppliers are also very separate.

From the above three observations, a further observation can be made. If one is concerned about U.S. dependency on foreign uranium, U.S. utility use of foreign uranium delivered by domestic producers can lead to a much more insidious dependency than that relating to direct purchases of foreign uranium by the utilities themselves. This is because unless data are collected with respect to U.S. producer intentions to supply foreign uranium to U.S. utilities, the possible future dependency on foreign uranium will not be known until such supply arrangements had been established. This could be a serious problem if U.S. producers decide to supplant versus supplement their domestic supply with foreign uranium. Further, if the U.S. Government placed restrictions on the use of foreign uranium without understanding this situation, and U.S. producers were planning to deliver larger percentages of foreign uranium to U.S. utilities in the future, then a non-optimal restriction could be developed.

4.7 Other Observations

Below are listed several miscellaneous observations stemming from discussions with the utilities.

4.7.1 Effect on Demand of Buying Foreign Uranium

Some utilities indicated that they would compensate for the added risk of foreign supply by holding relatively more uranium in inventory. Thus, in case of a supply disruption, they would have enough uranium to utilize until the problem was resolved, or other supply arrangements could be made. In one sense a utility could calculate the price discount necessary to buy foreign uranium by taking into account the cost of holding this additional inventory. In any case, one could expect the purchase of foreign uranium by U.S. utilities to have some incremental effect on demand through the holding of inventories.

4.7.2 Spot versus Long-Term Purchases of Foreign Uranium

In a number of cases there was a distinct difference in utility attitudes with respect to buying foreign uranium on a spot versus long-term basis. Some utilities that were not inclined to buy foreign uranium in a long-term contract had no problem buying it on the spot market. This phenomenon is understandable when you consider that there is no assurance of supply problems when you take immediate delivery of uranium. But, since a relatively small percentage of total uranium sales is made on the spot market, this difference in attitude is not extremely important in determining how much foreign uranium may be purchased by U.S. utilities, but it may have some effect on spot market prices.

4.7.3 Tendency to Accept Foreign Supply Only if a Utility Already has a Contract with a Domestic Supplier

This finding may seem self-evident considering that most utilities have limits as to how much foreign uranium they will buy, but it has a subtle message. The point is that some utilities would buy foreign only if they first have domestic supplies. Thus, some utilities would want a base load of domestic uranium, which is somehow independent of the foreign versus domestic price issue. Further, such utilities would not enter into a contract with a foreign producer in years in which a long-term domestic contract was not already in place. So the message from some utilities is domestic supply first, then foreign, but only foreign supply in the years for which domestic supply has already been arranged.