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Power System Programs

Global Spent Fuel Logistics Systems Study (GSFLS)

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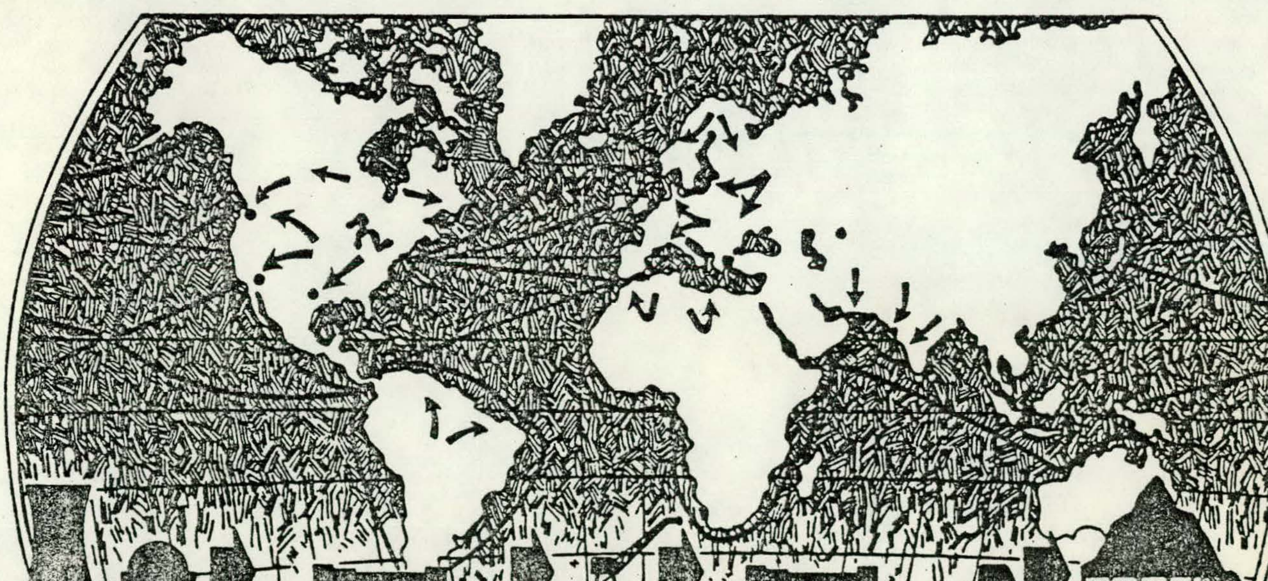
Volume 2: GSFLS Visit Findings & Evaluations



Interim Report

January 31, 1978

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NOTICE

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ABSTRACT

This report is a part of the interim report documentation for the Global Spent Fuel Logistics System (GSFLS) Study. This report describes a global framework that evaluates spent fuel disposition requirements, influencing factors and strategies. A broad sampling of foreign governmental officials, electric utility spokesmen and nuclear power industry officials responsible for GSFLS policies, plans and programs were surveyed as to their views with respect to national and international GSFLS related considerations. The results of these GSFLS Visit findings are presented herein. These findings were then evaluated in terms of technical, institutional and legal/regulatory implications. The GSFLS evaluations, in conjunction with perceived U. S. spent fuel objectives, formed the basis for selecting a set of GSFLS strategies which are reported herein.

KEY WORDS

European Basin	Policies/Plans/Programs
Institutional	Spent Fuel
Legal/Regulatory	Strategies
Nuclear Power	Technical
Pacific Basin	U. S. Spent Fuel Objectives

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1.0 INTRODUCTION

An inevitable by-product of the world's existing and future Light Water Reactor (LWR) nuclear power programs is the generation and discharge of spent nuclear fuel from operating reactors. The policies and programs associated with the disposition of existing and projected spent fuel populations have and will continue to be the subject of intense local, national and international debate amongst diverse but interested parties including, but not limited to, the general public, government, electric utilities and the nuclear power industry.

An important element in the implementation of national and international energy policies is the creation of viable systems for transporting, handling, storing, and disposing of the world's spent nuclear fuel (i.e. "Global Spent Fuel Logistics Systems" or GSFLS). There is an urgent need to implement selected global spent fuel logistic systems that are able to bridge the interests of the U.S. and key non-communist countries throughout the world. The immediate need in the creation of these systems is the evaluation and establishment of realistic options as well as definition of necessary planning and implementation frameworks. The viability of these systems depends upon their compatibility with stated governmental policies; their adequacy in support of projected global nuclear power programs; and their adaptation to realistic institutional constraints.

The Global Spent Fuel Logistics System (GSFLS) Study was contracted by the Department of Energy in order to help assess the needs, examine options and develop preliminary plans for viable spent fuel logistics sytem that might bridge the interests of the U.S. and selected non-communist countries.

This report (Volume 2) is part of the following interim period documentation of the GSFLS study:

(Ref.)	Volume 1:	Executive Summary
	Volume 2:	GSFLS Visit Findings and Evaluations
(Ref.)	Volume 2A:	GSFLS Visit Findings and Evaluations (Appendices)
(Ref.)	Volume 3:	GSFLS Technical and Financial Analyses
(Ref.)	Volume 3A:	GSFLS Technical and Financial Analyses (Appendices)
(Ref.)	Volume 4:	Preliminary Pacific Basin GSFLS Concepts
(Ref.)	-	Preliminary Designs for Interim Report

A synopsis of the different sections within Volume 2 is described below. The logic flow of Volume 2 is shown in Figure 1-1.

Section 2: Summary GSFLS Framework

Section 2 provides a summary framework (perspective) for evaluating GSFLS strategies. The subject framework accounts for the existing forces (needs and constraints) as well as the interactions of national and international spent fuel disposition policies, plans and programs. Section 2 draws on information obtained during various GSFLS country visit findings (Ref: Section 3) as well as evaluated GSFLS influences, strategies and consequences (Ref: Section 4,5).

Section 3: GSFLS Visit Findings

Section 3 provides a description of key perceived policies, plans and programs (GSFLS related) for each country visited by a GSFLS survey team. Section 3 also provides quantitative spent fuel discharge and disposition profiles as well as discussions of relevant GSFLS technical, legal/regulatory and institutional factors.

Finally, Section 3 provides a summary discussion of perceived views regarding alternative spent fuel disposition programs.

Section 4: U.S. Spent Fuel Policy Objectives

Section 4 discusses perceived U.S. spent fuel policy objectives as they relate to general global concerns and to specific European Basin and Pacific Basin considerations. In addition, Section 4 develops rationale for establishing international and multinational spent fuel facilities that support U.S. spent fuel objectives.

Section 5: Evaluation and Strategy Formulation

Section 5 evaluates the data developed in Section 3 (GSFLS Visit Findings) in light of U.S. worldwide and regional objectives developed in Section 4. Section 5 then formulates test strategy options for further development of GSFLS options.

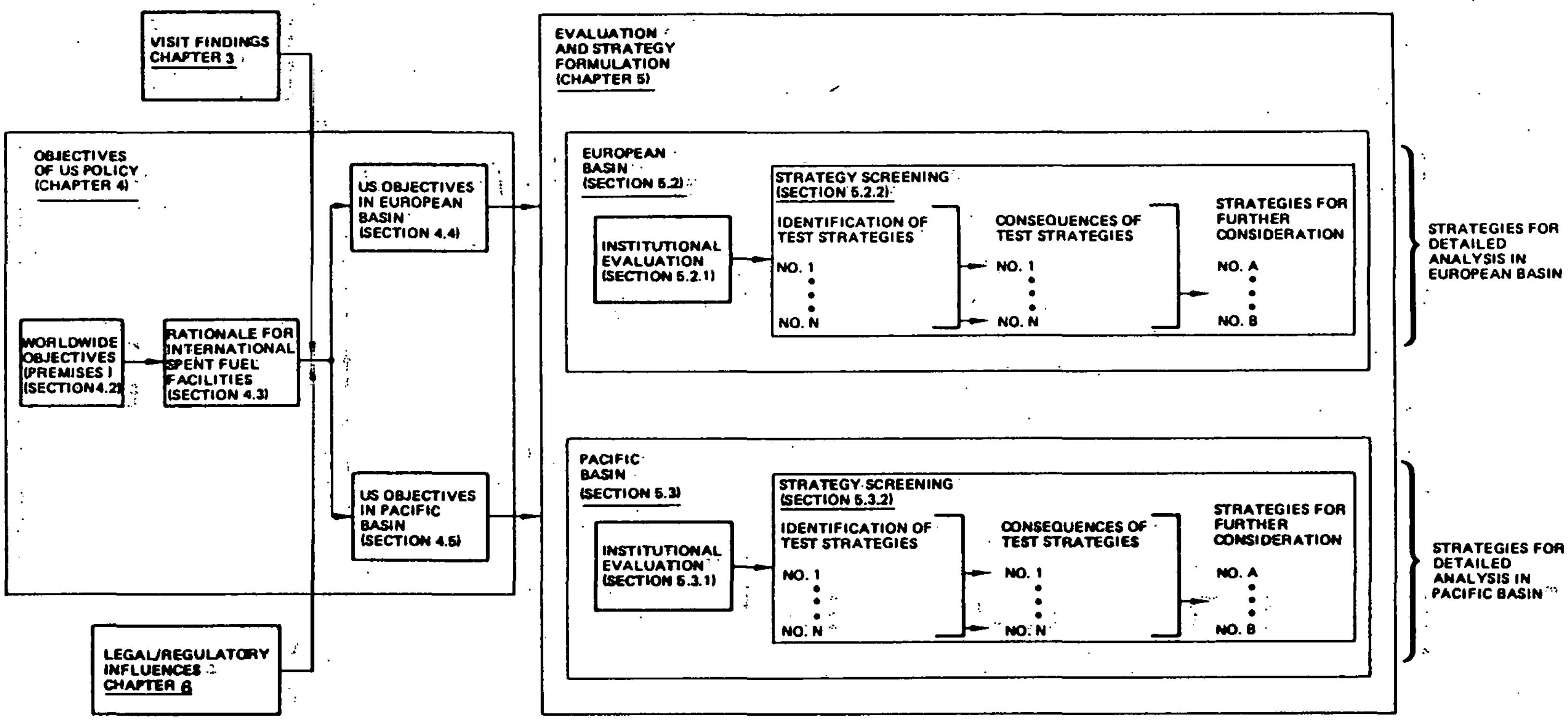


Figure 1.1: Logic Flow of Interim Report — Volume 2

2.0 SUMMARY GSFLS FRAMEWORK

2.1 Introduction

The framework for global spent fuel logistics system (GSFLS) is based on need for spent fuel disposition sytems; GSFLS options that are available to fulfill specific spent fuel disposition needs; policy and programmatic preferences for certain GSFLS options; and internal and external forces (constraints) which often guide the GSFLS selection and implementation process.

Section 2 develops a summary GSFLS framework from (a) projections of global nuclear power programs and resulting spent fuel generation profiles; (b) assessment of GSFLS visit findings (Ref. Section 3 and 5); (c) perceptions of GSFLS policy objectives (Ref. Section 4); (d) definition of possible GSFLS strategy scenarios (Ref. Section 5); and (e) preliminary strategic, technical and economic evaluations of specific GSFLS strategies (Ref. Section 5 and Volume 3: GSFLS Technical and Financial Analyses).

2.2 Nuclear Power Profiles

Figures 2-1 through 2-3 characterize forecasted nuclear power profiles that form the basis for this study. The rationale for these forecasts is described below.

Nuclear power growth forecasts are conventionally based on projections of total energy and electricity growth. Any uncertainty in either the energy or electricity projections will tend to be propagated and to some extent, amplified in the nuclear growth forecasts. The evaluation of data for nuclear plants either already in operation, under construction or "firmly" planned, minimizes uncertainty through about the mid-eighties. Since nuclear growth forecasts for the longer term are generally obtained from econometric and energy network flow analyses, and judgments as to nuclear power contributions to electricity generation, they are subject to some considerable uncertainty.

FIGURE 2-1
SUMMARY OF NUCLEAR POWER GROWTH FORECASTS
FOR FOREIGN COUNTRIES STUDIED

(Gigawatt Electric)

COUNTRY	YEAR 1977	1985	1990	2000
Japan	8.0	27	50	90
Korea	-	2.4	4	10
Taiwan	-	3.1	7	12
Philippines	-	0.6	0.6	2
Pacific Basin:	8.0	33.1	61.6	114
United Kingdom*	8.1	10	15	35
France*	4.9	35	55	90
F.R.G.*	6.4	20	35	70
Sweden	3.9	9.4	11	16
Finland	0.4	2.1	4	8
Denmark*	-	-	1	3
Belgium*	1.7	5.4	7	10
Netherlands*	0.5	0.5	1.4	
Switzerland	1.1	5.9	8	12
Luxembourg*	-	1.2	2.4	2.4
Spain	1.1	12	16	25
Italy*	0.6	4.3	10	17
Austria	-	0.7	2	5
Yugoslavia	-	0.6	1.2	3
Europe:	28.7	107.1	169	299
Argentina	0.3	0.9	2	8
Brazil	-	1.9	7	20
Mexico	-	1.3	4	12
Canada	4.0	12	24	60
Iran	-	4.2	12	30
India	0.6	1.8	5	15
Other:	4.9	22.1	54	145
Total:	41.6	162.3	285	558

*European Economic Community countries; Republic of Ireland not listed above.

FIGURE 2-2

SUMMARY OF NUCLEAR POWER GROWTH FORECASTS
FOR NON-CPE* WORLD

(Gigawatt Electric)

REGION/COUNTRY	1977	1985	1990	2000
Europe:				
Norway	-	-	1	2
Portugal	-	-	1	2
Ireland	-	-	0.6	1.5
Greece	-	-	1	3
Turkey	-	-	1	3
Table 1 Countries	28.7	107	169	299
Subtotal	28.7	107	174	310
Pacific Basin:				
Australia	-	-	-	2
New Zealand	-	-	-	1
Table 1 Countries	8.0	33	62	114
Subtotal	8.0	33	62	117
Asia/Africa:				
Iran	0	4.2	12	30
India	0.6	1.8	5	15
Pakistan	0.1	0.1	2	6
South Africa	-	0.9	2	6
Egypt	-	-	1	4
Israel	-	-	1	4
Others	-	-	2	20
Subtotal	0.7	7.0	25	85
Americas:				
U.S.A.	47	113 (a)	195 (b)	380 (b)
Canada	4	12	24	60
Argentina	.3	.9	2	8
Brazil	-	1.9	7	20
Mexico	-	1.3	4	12
Others	-	-	1	8
Subtotal	51.3	129	233	488
Foreign Total	42	163	299	620
World Total	89	276	494	1000

*Non-CPE means non Centrally Planned Economy countries.

(a) FEA, September 1977
(b) ERDA, GJO, October 1977

FIGURE 2-3

SUMMARY OF NUCLEAR POWER FORECASTS
FOR MAJOR* CONTRIBUTING NON-CPE WORLD COUNTRIES

(Gigawatt Electric)

Country	YEAR 1977	1985	1990	2000
U.S.A	47	113	195	380
France	4.9	35	55	90
Japan	8.0	27	50	90
F.R. Germany	6.4	20	35	70
Canada	4.0	12	24	60
United Kingdom	8.1	10	15	35
Italy	0.6	4.3	10	17
Iran	-	4.2	12	30
Sweden	3.9	9.4	11	16
Total:	83	235	407	788
Percent of World Totals:	93	85	82	78

Note: Data rounded.

*Based on a forecast of greater than 10 GWe in 1990.

In the year or so following the October 1973 Arab-Israeli war and associated oil embargo, many countries determined to increase their reliance on the nuclear option, and thus nuclear power forecasts became overly optimistic. However, even though relatively low fuel costs favor the nuclear option, high and escalating capital costs, fuel supply uncertainties, proliferation concerns, unresolved waste disposal issues, public acceptance problems, and the general lack of clear-cut energy policies in the industrially developed countries, have resulted in a state of pessimistic nuclear growth forecasts, each more so than its predecessor.

While it is possible to conceive of nuclear commitments for the near term being accelerated within the limitations of available lead time, it is easier to visualize the further slippage and cancellation of existing commitments. In short, through the mid-eighties, negative uncertainty is perceived as being larger than positive uncertainty. In the longer term, into the nineties and beyond, the lead times are long enough to accelerate nuclear power installations if energy policies so dictate.

In this section, recently published forecast data and related information were analyzed to derive a reasonably "valid" set of nuclear power growth projections through the end of the century for the countries of primary interest. The results are given in Figure 2-1. In order to present as complete a perspective as possible, up to date growth projections for other non-centrally planned economy (CPE) countries outside the scope of the study were reviewed. The results are given in Figure 2-2.

A comparison of the Figures 2-1 and 2-2 data show that the foreign growth totals in Figure 2-1 represent essentially all forecasted foreign nuclear growth through the mid-eighties and more than 90 percent through the end of the century. This of itself confirms the appropriateness of the list of countries selected for the GSFLS study.

The Figures 2-1 and 2-2 data show that the European Community currently represents about three-quarters of Western Europe's operating nuclear power and it is projected that the Community will maintain this position through the end of the century and possibly beyond. Western Europe as a whole is forecasted to have an installed nuclear capacity level approaching that of the U.S. Almost half of the nuclear power growth forecast for the next 20 to 30 years, will be sited in either North or South America; about four-fifths of this capacity is expected to be U.S. The Pacific Basin countries, including the U.S., Canada and Mexico, are forecasted to represent about 57 percent of future world growth, these countries currently represent about 77 percent of world operating capacity. As shown in Figure 2-3, as few as nine countries are forecasted to represent four-fifths of the world's nuclear power capacity through the end of the century; all of these countries, and no others, are forecasted, to have at least 10 GWe in operation by 1990.

It is estimated that the Figure 2-1 aggregate foreign forecasts have an uncertainty of plus 5 percent and minus 15 percent in 1985. The year 2000 forecasts are estimated to have a plus/minus uncertainty of about 40 percent. The long term negative uncertainty is derived from the possibility of either continuing moratorium situation or program cut-backs in many countries whereas the positive uncertainty is derived from what can be reasonably expected and obtained within available time frames. It is acknowledged that the positive uncertainty could be considered to be larger in the event of a dramatically increased acceptance of the nuclear option and the emergence of alternative energy supply difficulties.

The forecasts assume that the light water reactor (LWR) will predominate over the period of interest, and represent about 85 percent of the future foreign market through the end of the century. It is estimated that the LWR will tend to be distributed about 65 percent PWR and 35 percent BWR. The foreign growth forecast in 1985 is distributed approximately as follows: LWR - 80 percent, CANDU - 10 percent; GCR - 5 percent; AGR - 4 percent; and FBR, etc. - 1 percent. For the years 1990 and 2000, the distribution is approximately: LWR - 85 and 85 percent; CANDU - 10 and 11 percent; GCR - 2 and 1 percent; AGR - 2 and 1 percent; and FBR - 1 and 2 percent, respectively. The GCR (5.2 GWe) and the AGR (6.2 GWe) types are those already operating or under construction in the U.K. and the GCR (2.3 GWe) types; no further commitment of these types are foreseen. The CANDU is forecasted to be the only type installed in Canada. It is anticipated that the CANDU/HWR type may represent an additional total of 5 to 10 GWe distributed in countries such as Italy, Korea, Argentina, Pakistan, India and other nations in Africa, Asia, and South America by the nineties.

For 1985, the European Economic Community is currently forecasting an installed nuclear capacity of 84.5 to 94.5 GWe, or a mean of about 90 GWe; Figure 2-1 and 2-2 project 76 GWe as more likely. This lower number is based on the latest 1977 updated F.R.G. energy program passed by the Bonn Cabinet, the recent Italian revised National Energy Program, the latest French considerations, and the "holding" status of the U.K. nuclear program.

Most countries in Western Europe have been facing siting opposition from environmental and political groups. This is especially true in Germany, Sweden, Italy and the Netherlands. Spain has recently determined to reduce its further commitment to nuclear power by half by 1987 (only 13 or 14 plants will be operating and not 20 as anticipated earlier) and thus by the late eighties, only about 10 percent of Spanish energy demand will be served by nuclear power. In the Orient, Japan has reduced its nuclear power commitments for 1985 to between 26 and 35 GWe, as compared to 60 GWe only a year or two ago. In order for the 26 GWe level to be exceeded, the public acceptance and political climate must improve in the very near future.

It is noted that early in 1977, the IAEA forecasted a total of 26 to 40 GWe of installed nuclear power generating capacity in the developing countries by 1985, and that by the year 2000, 36 developing countries, six of which are Eastern European, will have a total of 293 to 437 GWe. These are believed to be somewhat optimistic projections.

On the positive side, there are indications of increasing awareness of the value of the nuclear option. This has recently been evidence by some general political events in both the energy programs which appear to recognize the long term advantages of substituting nuclear power for imported oil. Again, as in the cases of Germany and France, the export of nuclear technology is being used to trade for energy resources. An example of this is the Iranian export of oil balanced against nuclear plants from West Germany, France and the U.S. Iran currently plans an installed nuclear capacity of 23 GWe by 1994, and to that end has entered into procurement commitments for 9 GWe to be in operation by 1987. The Italian commitment for two 600 MWe CANDU units is based to some extent on the supply of uranium from Canada.

2.3 Spent Fuel Generation Profiles

Figure 2-4 shows the global distribution of spent fuel profiles projected to be generated by foreign reactors. Figure 2-5 tabulates the values shown in Figure 2-4. The basis for the above figures is as follows:

1) Wherever possible, actual reactor discharge data is used for known reactor programs - i.e., those in operation, under construction or planned reactors (see Section 3 for specifics).

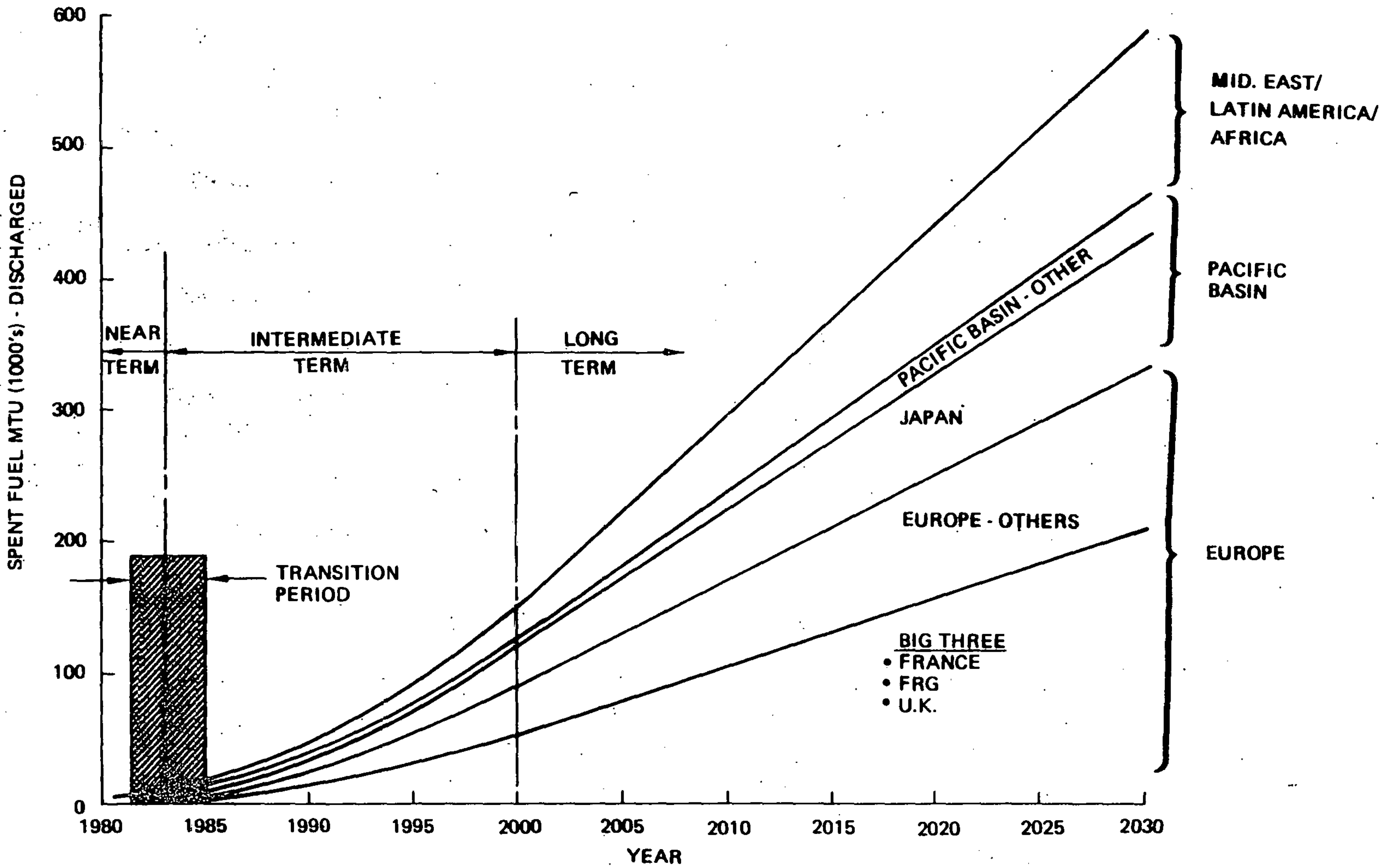


Figure 2-4: Spent Fuel Discharge Profile

FIGURE 2-5 FOREIGN SPENT FUEL GENERATION PROFILE

REGION	YEAR 1985	1990	1995	2000	2030
EUROPE					
a) "BIG 3"[1] - GW_e	66	104	147	194	194
1000 MTU (cum)	8.8	19.3	35.2	57.0	209.6
b) OTHERS[2] - GW_e	41	65	88	110	110
1000 MTU (cum)	5.4	12.3	22.3	35.1	122.9
PACIFIC BASIN					
a) JAPAN - GW_e	27	50	70	90	90
1000 MTU (cum)	4.2	9.4	17.4	28.0	101.0
b) OTHERS[3] - GW_e	7	12	18	27	27
1000 MTU (cum)	0.7	1.8	3.7	6.5	27.9
MID EAST/LATIN AMERICA/ AFRICA[4]	10	36	82	128	128
1000 MTU (cum)	0.9	3.6	10.8	24.0	124.3
TOTAL FOREIGN[5]					
- GW_e	151	267	405	549	549
1000 MTU (cum)	20.0	46.4	89.4	150.6	585.7

1) France/U.K./FRG (and Luxembourg)
2) All other European countries in Figures 2-1 & 2-2
3) All Pacific Basin countries (except Japan) in Figure 2-1 and 2-2
4) All mid-East/Latin America/Africa countries in Figure 2-1 and 2-2
5) Excludes Canada (and other Magnox and HWR)

2) Future reactor growth profiles are based on data given in Figures 2-1 through 2-3. For non-defined (future) reactors, it is assumed that spent fuel is discharged at 26 MTU per 1000 MWe per year starting one year after reactor start-up.

3) Only foreign (non-U.S.) and non-Central Planned Economies (CPE) reactors are included.

4) Spent fuel from Magnox and Heavy Water reactors are not included.

5) It is assumed, for the purposes of the GSFLS study, that the GSFLS reactor population remains constant between the years 2000 and 2030.

Figure 2-4 illustrates a fundamental "truism" that is an important consideration within the GSFLS framework, namely that there are three distinctly different generic phases (time periods) which must be reconciled within the GSFLS framework. The three phases are characterized as follows:

<u>Near Term</u> (Pre 1983 (±2 years))

The near term phase has relatively small cumulative spent fuel quantities yet, as will be shown later, there are severe spent fuel disposition constraints that make this a difficult phase to implement.

<u>Intermediate Term</u> (1983 to 2000)

The intermediate term is characterized by appreciable, but not overwhelming, quantities of spent fuel. The intermediate term phase, as will be shown later, has the greatest potential for implementing major GSFLS options.

<u>Long Term</u> (2000 to 2030)

The long term phase is characterized by very large quantities of spent fuel that have to be disposed of.

In addition, a major part of the long term spent fuel discharge profile is dependent on projected - and hence relatively speculative - nuclear power growth forecasts (see Section 2.2).

2.4 Spent Fuel Disposition Profiles

2.4.1 Near Term Spent Fuel Disposition

2.4.1.1 Near Term Status (General)

The near term initial phase extends to about 1981-1985 and is principally occupied with problems of developing sufficient interim storage space, domestic or foreign.

As indicated from GSFLS visit findings (Ref. Section 3), there is a near term balancing effort between the expansion of at-reactor storage (ARS); implementing national away-from reactor storage (AFR) programs; and shipment to BNFL/COGEMA. The alternative of interim storage in the U.S. under the "umbrella" of the October 17 U.S. Spent Fuel Policy - is of interest to several countries, but there is a general recognition that consideration of that policy - as applied to foreign countries - is quite early in the planning stage and hence of limited use to solve near-term problems (Ref. Section 3).

At-reactor storage expansion programs, particularly for operating reactors in countries such as Japan, Germany, Sweden, Italy, Spain, Switzerland, Netherlands and Austria is considered to be difficult and, if even accomplished, provide only a short-term solution.

National away-from-reactor storage programs are in the planning stage in some countries, with start-up dates in the 1983-1985 period, which is the bounding date of the near-term phase. These national AFR solutions tend to focus on continuation of national fuel cycle programs (i.e., they are likely to evolve into national reprocessing programs).

Finally, the existing European reprocessors with their existing and planned receiving storage basis represents a buffer solution to countries who are lagging in ARS solutions. BNFL/COGEMA have put in place or are planning spent fuel logistics systems serving both Europe and the Pacific. These systems may have shortages or weaknesses, but they have credibility to most users and are perceived as the "only game in town" for now.

Permanent storage programs are lagging in this phase. Only Germany has committed to a program to complete the fuel cycle. The reprocessing exporting countries offer no permanent storage services to their customers and finesse the issue domestically with fairly long-term surface storage. The European users are seeking permanent storage of HLW which is planned to be returned from BNFL and COGEMA. There is significant pressure in Germany and the non-reprocessing countries of Northern Europe to require the agreement in permanent storage programs as a condition for continued reactor plant development. That pressure does not extend to the Mediterranean countries or to the Pacific Basin at the present time.

The "nuclear dust bin" issue - the public concern over storage of foreign fuel or HLW - predominates most of Europe and Japan, but is not as emphasized in the Mediterranean countries.

Reprocessing rationale derives from LWR recycle, breeder RD&D and commercialization and waste management approaches, with the LWR recycle issue poorly defined or justified in several countries. At present, the emphasis on program reappraisal caused by the examination of nonproliferation concerns has caused some countries to present what are believed to be surrogate issues in the defense of their nuclear programs.

This period is when countries must commit to reprocessing deferral scenarios or become positioned for available reprocessing. With the exception of the U.K., France, Germany and possibly Belgium, countries which would attempt to embark on reprocessing programs are excellent targets for deferral scenarios.

There are at least three pressures which are driving countries such as Italy and Spain to plan national disposition programs, namely:

- The perception that BNFL/COGEMA terms and conditions are stringent.
- The concern over foreign currency payments.
- The desire to have national control over nuclear program continuity.

2.4.1.2 Near Term Spent Fuel Disposition Flows

Figure 2-5 characterizes the near term (cum to 1983) spent fuel disposition flows in the following way:[1)]

a) The cum discharge from reactors in the countries of interest totals 11850 MTU (8600 Europe/3250 Japan)

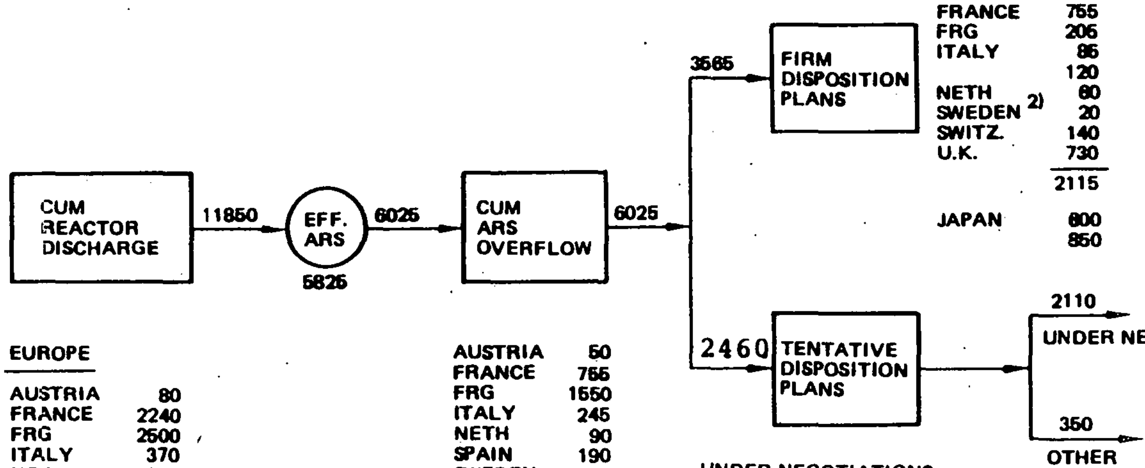
b) Using (1) existing ARS capacities for operating reactors, (2) planned basic expansions for new reactors and (3) observance of Full Core Reserve Criteria, it is estimated that approximately 6025 MTU will overflow ARS by 1983, (4575 Europe/1450 Japan) and will require one or more of the following disposition alternatives.

- Further expansion of ARS basins
- Shipment to a national AFR
- Shipment to an external interim storage facility either for long term storage in future reprocessing.

c) Of the 6025 MTU identified in (b), 3865 MTU are firmly committed to identifiable disposition plans - primarily to European reprocessors (BNFL or COGEMA) for interim storage and downstream reprocessing.

d) Of the remaining 2515 MTU, approximately 94% - ~ 2100 MTU of spent fuel is currently the subject of negotiations between various countries and either BNFL or COGEMA.

[1)] Figure 2-5 was developed from a composite of GSFLS information (Ref: Section 3) and other available data.



FIRM DISPOSITION PLANS

FRANCE	755	COGEM
FRG	205	1)
ITALY	85	BNFL
	120	AVOGAD.
NETH 2)	60	COGEM
SWEDEN	20	BNFL
SWITZ.	140	BNFL/COGEMA
U.K.	730	BNFL
	2115	
JAPAN	600	BNFL
	850	COGEMA

CUM REACTOR DISCHARGE

EUROPE	
AUSTRIA	80
FRANCE	2240
FRG	2500
ITALY	370
NETH.	120
SPAIN	660
SWEDEN	1210
SWITZ.	500
U.K.	920
	8600
PACIFIC	
JAPAN	2900
KOREA	80
ROC	270
	3250

CUM ARS OVERFLOW

AUSTRIA	50
FRANCE	755
FRG	1550
ITALY	245
NETH	90
SPAIN	190
SWEDEN	600
SWITZ.	365
U.K.	730
	4575
JAPAN	1450
KOREA	0
ROC	0
	1450

UNDER NEGOTIATIONS WITH REPROCESSORS

AUSTRIA	50	COGEM
FRG	1225	COGEM
NETH.	30	COGEM
SWITZ.	115	COGEM
	110	BNFL
SWEDEN 2)	580	COGEM
	2110	

OTHER

FRG	120
ITALY	40
SPAIN	190
	350

1) DISPOSITION TO VARIOUS REPROCESSORS (BNFL/COGEMA/GWK/EVROCH)

2) ESTIMATED. DETAILED PLANS NOT REVEALED

Figure 2-5: Near Term Spent Fuel Disposition Flows (Cum MTU to 1983)

2.4.1.3 Near Term Spent Fuel Disposition Alternatives

2.4.1.3.1 European Reprocessors

A major attraction of the European reprocessor's current offer is as follows:

a) They are currently willing to commit to take spent fuel from various countries - prior to 1983 - and thus relieve near term at-reactor storage problems within those countries.

b) They have relatively firm plans for large interim storage AFR facilities and spent fuel transportation systems to cum on-line in the 1980-1983 time period.

Correspondingly, no other global entities, including U.S. firms, have to date been willing to offer comparable GSFLS service in the same time frame.

Figure 2-6 shows the projected supply/demand relationship for interim storage at BNFL and COGEMA and clearly illustrates that both entities are planning to meet projected near-term needs for large scale foreign AFR storage (as a lead-in to reprocessing).

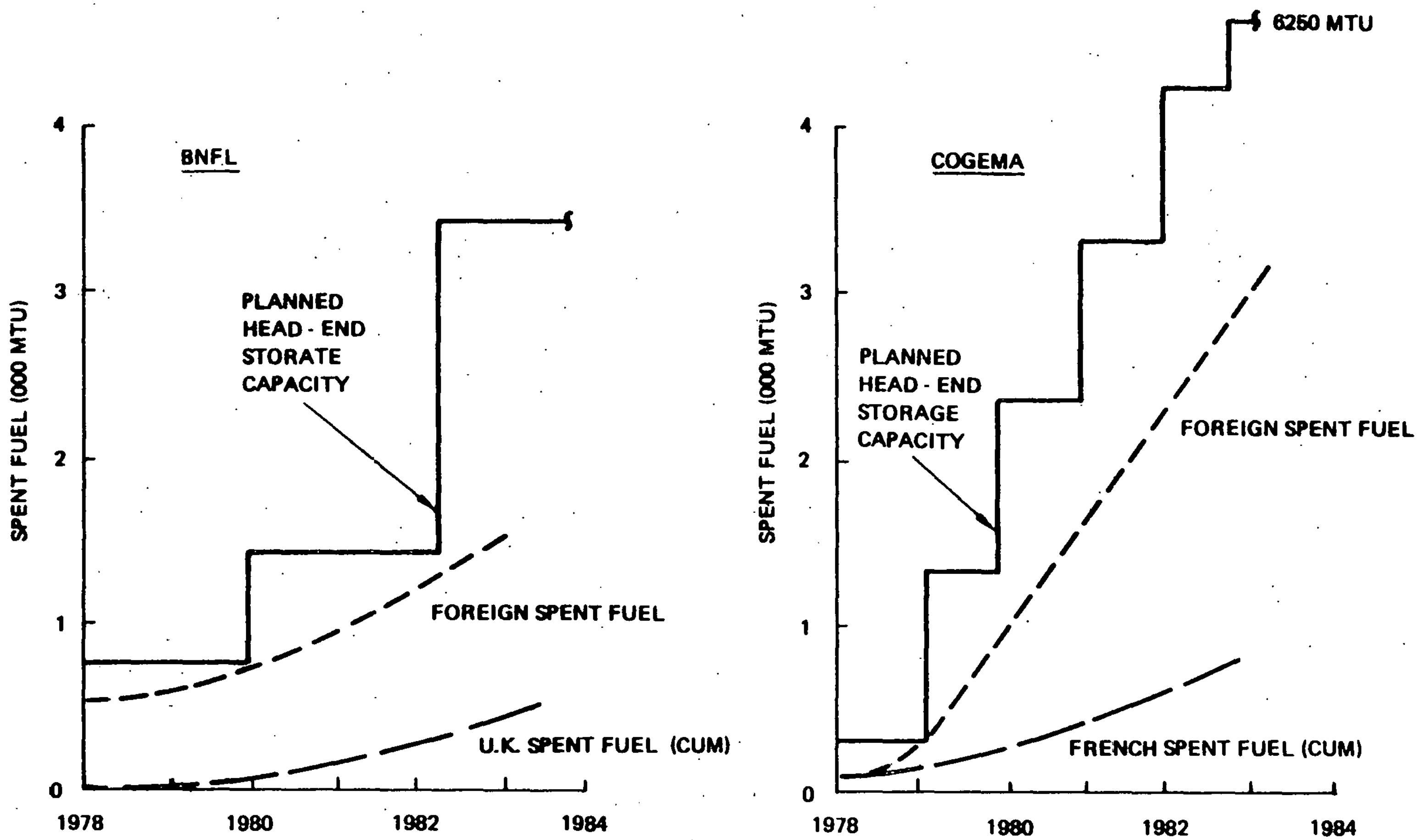


Figure 2-6: European Reprocessors Interim Storage - Supply/Demand

2.4.1.3.2 Additional ARS Expansion Alternative

Figure 2-7 illustrates the impact of using additional ARS expansion to solve a spent fuel disposition problem. In the case of FRG (as shown in Figures 2-5 and 2-7) there is approximately 1550 MTU of ARS overflow (cum to 1983) of which 205 MTU is already committed to reprocessing.

By expanding from an average ARS of 1.6 x core to 2.5 x core, it is possible to diminish the ARS overflow to 713 MTU; and if maximum ARS storage is used at all reactors (i.e., 3.7 x core = 11/3 x core) then it is possible to reduce ARS overflow to 91 MTU.

Although it appears unreasonable to expect that all ARS can be expanded to 11/3 x core, it is significant that FRG away from reactor disposition needs could be reduced by probably 700-1000 MTU through an aggressive ARS expansion program in the pre-1983 time period.

It appears that even if FRG undertook an aggressive ARS expansion program during the pre-1983 period, it would have to ship between 300-500 MTU to an external AFR.

Although, values for the ARS expansion alternatives are not shown for the other countries in Figure 2-6, the same conclusions apply, namely:

1) An aggressive national ARS expansion program could solve a significant portion of the currently projected ARS overflow problem.

2) In the case where large overflows are projected, even if major ARS expansions are undertaken, a nominal amount of spent fuel would have to be shipped to external AFRs.

FIGIRE 2-7: EFFECT OF ARS EXPANSION (FRG)

REACTOR	CORE SIZE	ORIGINAL ARS X CORE	ORIGINAL ARS MTU	POTENTIAL ARS PLAN	POTENTIAL ARS MAX*	ADDIT. ARS PLAN	ADDIT. ARS MAX	ARS OVERFLOW (CUM 1983) ORIGIN	ARS OVERFLOW (CUM 1983) PLAN ARS	ARS OVERFLOW (CUM 1983) MAX ARS
FRG										
Gundermingun	45	1.6	73	104	165[1)]	31	92	126	95	34
Obrigheim	34	1.8	61	156	156	95	95	132	37	37
Lingen	32	1.6	51	72	117	21	66	79	58	13
Stade	55	1.5	80	124	202	44	122	104	60	-0-
Biblis A	103	1.6	171	308	378	137	207	204	67	-0-
Neckar 1	63	1.5	95	109	231	14	136	129	115	7
Wuergussen	87	1.5	129	249	319	120	190	142	22	0
Isar	108	1.5	173	200	395	27	222	97	70	0
Biblis B	103	1.6	171	309	378	138	207	136	0	0
Phillipsburg[1]	119	1.7	181	254	421	73	240	69	0	0
Unterweser	103	1.6	169	229	378	60	209	186	126	0
Kruemmel	156	1.6	250	308	572	58	322	121	63	0
Brunsbuettel	103	1.7	171	308	378	137	207	65	0	0
	1107		1775	2730	4090			1550	713	91
			(1.6 x core)	(2.5 x core)	(3.7 x core)					

1) Assumes max FRG ARS expansion is 3.7 x core.

2.4.1.3.3 Shipment to Non-European Reprocessor AFR Storage Alternative (Prior to 1983)

It appears reasonable to bound the potential demand for non-European reprocessor AFR storage in the following way:

Scenario	Demand for AFR (MTU)	Reference
1) All unconfirmed spent fuel is shipped to external (non-European reprocessors) AFR	2515	Figure 2-5
2) All nations pursue an aggressive near term ARS expansion program.	600-1200	25%-50% of projected load. (See Discussion in Section 2.4.1.3.2)

Note:

It should be noted that the above quantities do not account for any of the spent fuel that has already been committed to the European reprocessors, namely, 3565 MTU (Ref. Figure 2-5).

In order to support the above program, the following GSFLS requirements are needed (assuming spent fuel is shipped to the U.S.).

GSFLS Requirements

Item	Quantities
• AFR Storage Basins	1500-3000 MTU
• Casks	10 large casks (4.6 MTU each)
• Spent Fuel Transport Ships	2 (4 cask ships)

A review of GSFLS inventory within the U.S. shows the following:

AFR Storage Status[1)]

Facility	Storage Inventory + Commitments (MTU)	Current Basin Capacity (MTU)	Potential Near Term Expanded Capacity (MTU)	Status
NFS	165	295	---	Standby
Morris (G.E)	365	700	1800	No commitment
Barnwell (AGNS)	0	360	660	No commitment

U.S. Spent Fuel Casks[2)]

Cask	Capacity (Assy.) (PWR/BWR)	Status: Operating	Status: Under Const. or Ordered
NFS-4	1/2	6	-
NLI 1/2	1/2	3	-
TN-8	3/0	-	2
TN-9	0/7	-	3
IF-300	7/18	4	-
NLI-10/24	10/24	-	4

The situation appears to be one in which (a) no major U.S. supplier has committed to providing enlarged AFR storage service; (b) very limited excess private AFR capacity is available in the near term; (c) there are no U.S. government AFR facilities that could be used in the near term and (d) U.S. (domestic) utilities have a critical near term ARS situation and are likely to need domestic AFR facilities (Note: DOE is currently evaluating utility demand for and supplier interest in providing domestic AFR storage capacity).

1) Reference: U.S. and Non-U.S. LWR Spent Fuel Storage (July 1977) Prepared for DOE by NAC
2) Reference: Regional Fuel Cycle Center Study (IAEA-1977)

2.4.1.4 Summary of Near Term Spent Fuel Disposition Situation

The principal observations that can be made about the near term (prior to 1983) spent fuel disposition situation is as follows:

1) A relatively large percentage of the at-reactor storage overflow within the period of interest is already committed to European reprocessors. Specifically, of the projected 6025 MTU of ARS overflow, approximately 3565 MTU or 59% is in that category.

2) Another 2110 MTU or 35% of projected ARS overflow, is currently the subject of negotiations between European reprocessors and various countries.

3) The European reprocessors are currently committing to provide sufficient AFR interim storage (i.e. "head-end of their reprocessing plants) and spent fuel transportation systems necessary to support the demand stated in (1) and (2).

4) No other entity, including the U.S. has, to date, been willing to commit in support of providing suitable GSFLS requirements to reduce international ARS pressures.

5) Aggressive near-term ARS expansion programs by individual nations could alleviate the above needs; however, even then there would be a nominal requirement (probably around 1000 MTU) for external AFR storage and transportation systems.

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[1] ARS overflow is defined as that amount of spent fuel that exceeds current ARS allowable capacities.

2.4.2 Intermediate Term Spent Fuel Disposition

2.4.2.1 Intermediate Term Description (General)

This phase of activity and planning extends from 1983-1985 to 2000, or to the time when reprocessing (recovery) or permanent storage programs come into being.

The planned AFRs would start operation at the beginning of the period and act as a bridge to either reprocessing (recovery) or permanent storage programs. At the same time, countries would be arriving at decisions on permanent solutions. The permanent storage of HLW or spent fuel would be close to technical solution and political agreement; however, it is conceivable that permanent storage could be an unresolved political question for many countries in the early intermediate term.

If countries had developed national AFRs in the near-term, there would be pressure for national programs in the back-end of the fuel cycle. Conversely, if AFRs were established on an international or multi-national basis, the subsequent back-end fuel cycle programs would more likely develop on an international basis, with a lesser number of host countries performing reprocessing (recovery) and/or permanent storage functions for a greater number of user countries. The concept of each nation providing its own permanent storage would not predominate in the latter approach.

The capacity requirements and duration of the interim storage program would become evident during the early years of the period, which augers for a modular approach to AFR development. The interim storage duration requirements for spent fuel would depend upon the timing of more permanent solutions. The duration requirements would determine whether water basis interim storage is sufficient or whether vault-type storage should be developed in the intermediate term for longer periods of storage. It is possible that in some instances interim storage facilities could be used for HLW from reprocessing until more suitable permanent storage capabilities are operational.

2.4.2.2 Intermediate Term Spent Fuel Disposition Flows

Figure 2-8 characterizes the intermediate term (cum to year 2000) spent fuel disposition flows in the following way:

a) The cumulative reactor discharges within the countries of interest totals 151,000 MTU (61% Europe; 23% Pacific Basin and 16% others).

b) Using existing ARS capacities for operating reactors and allowing 3 to 5 years of at-reactor storage for future reactors, 58,000 MTU of discharged fuel is in global ARS inventories and 95,000 MTU is sent to AFR disposition. It should be noted that these numbers are highly dependent on ARS/AFR decisions such as desired spent fuel ARS "cooling" periods, available AFR disposition alternatives, etc.

c) Of the 95,000 MTU, it is probable that 50,000 MTU will follow the early "commitment to reprocessing" route. These quantities will likely include 39,000 MTU (78% of total reprocessing load) from the United Reprocessing Countries; 4500 MTU from Japan which includes 1300 MTU of existing reprocessing contracts (to 1984) and 3200 MTU of new contracts[1] with COGEMA and BNFL; 4000 MTU from other European countries and 2500 MTU from other countries (e.g., Iran, Brazil, etc.).

d) If a "reprocessing deferral" scenario is at all reasonable[2], then it is possible that at least

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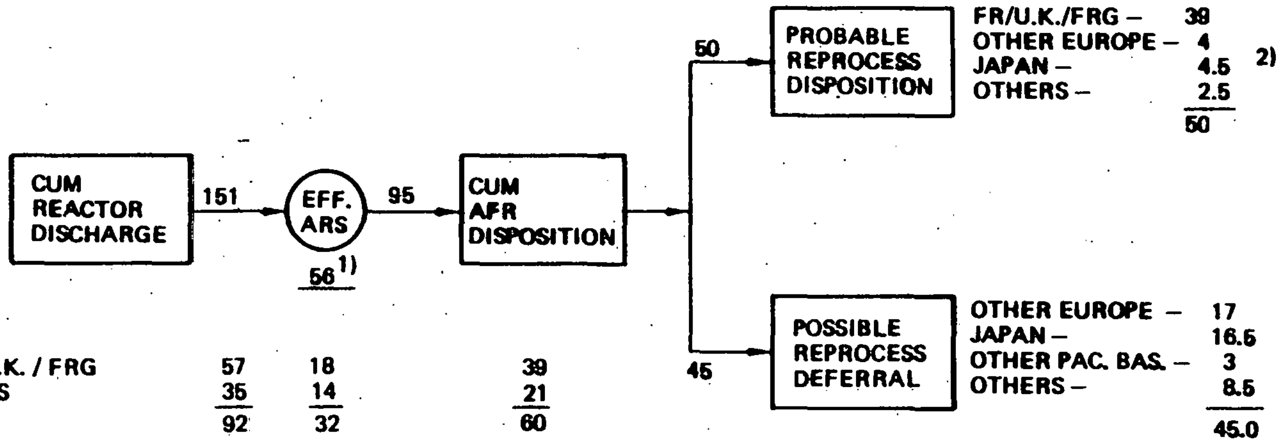
[1] Still to be ratified by all parties.

[2] See technical and financial comparative evaluations in Volume 3 - GSFLS Technical and Financial Analyses; and Sections 4 and 5 of this report.



EUROPE			
• FRANCE / U.K. / FRG	57	18	39
• ALL OTHERS	35	14	21
	92	32	60
PACIFIC BASIN			
• JAPAN	28	7	21
• ALL OTHERS	7	4	3
	35	11	24
MID-EAST / LATIN AMERICA / AFRICA			
• IRAN	7	3	4
• BRAZIL	4	2	2
• ALL OTHERS	13	8	5
	24	13	11

1) ASSUMES (6/3 to 8/3) x CORE ARS CAPACITIES FOR FUTURE REACTORS.

2) ASSUMES BNFL & COGEMA FILL UP_3 AND WINDSCALE FOREIGN ORDERS AND INCLUDES ORDER TO DATE.

Figure 2-8: Intermediate Term Spent Fuel Disposition Flows (Cum to Year 2000 – In 1000 MTU)

45,000 MTU of spent fuel could be positioned for that alternative. The countries of interest would be as follows:

a) Non "big three" European countries principally centered in Spain, Italy and Sweden.

b) Japan and other Pacific Basin countries.

c) Iran and other non-European countries would make up the balance.

It should be noted that the stated spent fuel population (i.e., 45,000 MTU) for the "reprocessing deferral alternative" could increase dramatically if the world perceived this alternative as a realistic solution within a timely enough manner to re-orient away from large national ARS expansion and national AFR programs.

2.4.3 Long Term Spent Fuel Disposition

2.4.3.1 Long Term Description (General)

According to the studies on uranium resources implications on fuel cycle selection based on proliferation grounds, conducted by the Argonne National Laboratory, if once-through cycles only are allowed, the nuclear electric program faces a phase-out starting in the first or second decade after the year 2000. In implementing the once-through cycle, the transition from interim to final storage depends on the start-up date of permanent storage facilities. It would appear that electric utilities would prefer to avoid interim storage charges as much as possible and deposit directly to permanent storage. However, at this time, there is essentially no support from the utilities for once-through cycles although there are strong technical and financial arguments for "deferring reprocessing" for a period around the year 2000 (see Volume 3, GSFLS Technical and Financial Analysis).

If the long-term picture includes reprocessing or some recovery program, there would be interest in co-locating that program with interim storage where possible. Engineering and economic analysis would indicate whether all of the fuel in interim storage should be reprocessed (recovered) or whether some would best go directly to permanent storage. There are already countries which require or recommend reprocessing as a pre-conditioning to permanent storage. It is assumed that these countries would be the first to reprocess and that they would not have as much of a problem of excessive feed stock for reprocessing.

The ultimate solution in the long-term may resemble the complete back-end of the fuel cycle co-located as is planned in Germany. The implications of co-locating reprocessing (recovery) facilities with permanent storage include the improved ability to dispose of the reprocessing (recovery) facility. Co-location of interim storage and permanent storage is more difficult than for interim storage and reprocessing.

2.4.3.2 Long Term Spent Fuel Disposition Flows

As shown in Figure 2-9, the magnitude of spent fuel that would have to be disposed-off by year 2030 is significantly greater than that for year 2000. Correspondingly, there is an important long term decision point that occurs sometime in the "intermediate phase"- (between 1985 and 2000) in which the world (or nations) will have to decide on the spent fuel disposition path that can adequately and effectively handle these large volumes of spent fuel.

FIGURE 2-9 CUMULATIVE SPENT FUEL FOR AFR DISPOSITION

- - - 1000 MTU - - -

COUNTRY	YEAR 2000		YEAR 2030	
Europe				
France	20		89	
United Kingdom	6		28	
FRC	13		67	
Luxembourg	Neg.		2	
		39		186
Austria	1		5	
Belgium	3		10	
Denmark	Neg.		2	
Finland	1		8	
Italy	3		17	
Netherlands	Neg.		2	
Spain	4		22	
Sweden	5		18	
Switzerland	3		13	
Europe-Others	1		10	
		21		107
Pacific				
Japan	21		93	
Korea	1		9	
R.O.C.	2		11	
Pacific Others	Neg.		4	
		24		117
Mid East/Latin America/Africa				
Iran	4		26	
Brazil	2		17	
All Others	5		65	
		11		108
Foreign Total (1)		95		518

(1) Does not include Canada or Magnox/HWR reactor spent fuel (i.e predominantly LWR reactors)

2.5 U.S. Spent Fuel Policy Objectives

The conduct of the study requires knowledge of U.S. spent fuel policy objectives as they would apply to specific world regions and countries. A statement of these objectives as understood by the study group has been made to support the development of international or multi-national spent fuel storage strategies.

United States policy with respect to the disposition of spent fuel is an integral part of its policy directed toward the deferral of reprocessing and the consequent accumulation and dispersion of weapons-useable plutonium. While spent nuclear fuel from present day light water or heavy water reactors is not a weapons-useable material, it represents a proliferation risk in two respects:

- The accumulation of spent fuel, especially in sensitive countries or regions, constitutes a source of plutonium if and when a country in which it is located decided upon and achieves a reprocessing capability, and the ready availability of spent fuel may even stimulate a decision to engage in reprocessing for military reasons.
- In some countries, the long-term storage of spent fuel is viewed as unacceptable, creating pressures for reprocessing as a means of alleviating the storage problem.

These two considerations could imply significantly different policy objectives on the part of the U.S., with correspondingly different solutions. To the extent that spent fuel is regarded as a proliferation hazard per se, the indicated objective would be to encourage or require the removal from national control of the maximum possible amount of spent fuel. To the extent that spent fuel is regarded with concern only when it provides the rationale or motivation to engage in reprocessing, the corresponding objective would be to offer concerned countries an alternative to the national accumulation and storage of spent fuel to the extent that such material would otherwise be reprocessed. A considerably less aggressive policy might satisfy this objective than that required to offer positive encouragement to the transfer of spent fuel inventories. These two objectives are not necessarily mutually exclusive. The second objective may be regarded as the minimum, with the first objective a desirable collateral goal, especially with respect to countries deemed to represent especially serious proliferation risks.

Discussions with responsible U.S. officials, as well as consideration of U.S. policy actions to date, including the spent fuel policy statement of October 18, 1977, has led us to conclude that emphasis has been and continues to be given to the second of the above objectives in the formulation of U.S. policy toward foreign spent fuel disposition.

Another factor supportive of this conclusion is that substantial plutonium inventories are inevitably present in operating reactors, as well as in spent fuel not yet sufficiently cooled for transfer from a reactor site. In light of these inventories, even a very aggressive policy of spent fuel removal cannot deprive nations with even a small nuclear power program of significant stocks of unseparated plutonium should they choose to violate or abrogate international undertakings.

A policy of deferral of reprocessing is vulnerable to the criticism that it creates what, for a number of countries, is an unacceptable requirement for the long-term storage of spent fuel, unless a credible alternative means of disposing of spent fuel can be offered. The viability of United States policy for deferral of reprocessing may, therefore, depend heavily on the ability of the United States to offer, or at least to be instrumental in the developemnt of, acceptable spent fuel storage alternatives.

The exploration of possible multi-national or international options for spent fuel storage, especially under the circumstances of limited U.S. receptivity to spent fuel return to the United States, can be an important and perhaps the principal element in U.S. efforts to develop solutions for foreign spent fuel disposition. An additive benefit of such a development, which has been identified as at least a secondary U.S. policy objective, is to demonstrate the viability of multi-national fuel cycle solutions which could evolve into a broader role in the nuclear fuel cycle, either on the front-end or the back-end, in combination with acceptable technical modifications to the fuel cycle designed to avoid production of weapons-useable material. Spent fuel storage, due to the immediacy of its need and its relatively less demanding technology, may lean itself more readily to the creation of multi-national or international institutions than any other fuel cycle activity.

United States policy calls for indefinite deferral of reprocessing in its conventional mode - that is, any process which, as in the case of present day solvent extraction techniques, leads to the separation of weapons-useable plutonium. At the same time, the search for and evaluation of alternative processes which may allow recovery and utilization of the energy values of spent fuel at acceptable proliferation risks, is also an integral and important part of U.S. policy. This search and evaluation is institutionalized in the International Nuclear Fuel Cycle Evaluation - INFCE. This overall policy has provided the indispensable backdrop for the study described in this preliminary report, and has been given uppermost consideration in both the inquiry and evaluative activities undertaken in the study.

A close and perhaps necessary relationship, exists in United States policy between, on the one hand, deferral and indeed, avoidance of reprocessing in its conventional, proliferation-prone form, and, on the other hand, a comprehensive search for more attractive alternative fuel cycle. In a similar manner, an early indication of the inquiry phase of this study is that a close connection is made on the part of a number of foreign industrial and governmental officials between the arrangements for storage of spent fuel and the institutional and technical conditions under which final disposition of this spent fuel would take place.

In short, the consideration of storage options cannot be entirely divorced from consideration of the arrangements by which storage would be terminated, either by permanent disposal or recovery of energy values. A recognition of this linkage, as viewed by many concerned foreign officials and an evaluation of its implications for the study objectives, is a necessary and important feature of this report.

2.6 Rationale of International or Multi-National Facilities for Implementation of U.S. Spent Fuel Policy Objectives

The evaluation and strategy development process of this study draws on imputed nonproliferation values of international or multi-national arrangements in dealing with spent fuel management. The approach centers on the concept of centralized large scale spent fuel storage under international or multinational auspices or control. The concept does not imply affirmative decision-making for reprocessing, nor does it rule out reprocessing if agreement has been reached on the technical and institutional conditions required to make reprocessing an accepted activity from the nonproliferation standpoint. The concept is structured to relieve short-term fuel logistics pressures and provide a basis for accommodating longer-term decisions on fuel cycle management. Specifically, the approach suggests putting in place now a system which can adjust to the technical and institutional nonproliferation solutions as they are developed and accepted by nations.

Important factors in international or multi-national spent fuel storage and related fuel cycle arrangements are:

1. Siting

   Siting is among the most important decisions in establishing an international spent fuel storage facility (with possibilities of serving other fuel cycle functions).

2. Organization Considerations

   There is general agreement that an international or multi-national regime for fuel cycle operation can provide important nonproliferation benefits, which are of two kinds:

   - Multi-national or international staffing can improve the diversion detection capabilities beyond that obtainable through safeguards alone by, in effect, providing a "built-in" inspection capability.

- The existence of a properly constituted international or multi-national regime might not prevent, but could provide considerably greater assurances against abrogation and seizure of materials and facilities by the host country, than those obtainable through safeguards and nonproliferation undertakings alone.

3. Release Criteria and Mechanism

In establishing an international or multi-national spent fuel storage system, it would be necessary for the participants to agree in advance on the rules, procedures, and decision-making criteria (including which entities make decisions) for the release of spent fuel and nuclear material. The release mechanism has often been recognized as among the most critical of the issues in the construction of an international or multinational regime for the conduct of fuel-cycle operations. It affects directly and perhaps conclusively both the acceptability of the regime to the intended participants and the effectiveness of the regime from the nonproliferation viewpoint.

4. Spent fuel storage requirements versus complete fuel cycle requirements

The concept of centralized interim spent fuel storage as the initial international or multi-national activity is attractive in that the technology is simple and can be put in place easily from a technical point of view.

The transition of this activity from interim storage only to either reprocessing (recovery) or permanent storage requires more demanding technology and organizational implications. These factors could be developed while the interim storage is in place and operating.

In an optimized co-located scheme, the interim storage would serve as the receiving end of either reprocessing (recovery) or permanent storage.

5. Ability of multi-national systems to perform functions user nations are incapable of accomplishing

An international or multi-national consortium potentially can provide vital functions which a user nation would require for its nuclear power program, but cannot perform itself, such as permanent storage. In exchange for these functional availabilities, the user nation might be more inclined to accept nonproliferation criteria associated with joining a consortium.

2.7 Regional Application of U.S. Spent Fuel Policy

The focus of our investigation and analysis has been in Europe and the Pacific, reflecting that our proposed visits to the Mid-East and South America has been cancelled or deferred.

The possible U.S. objectives in Europe, beginning with the least restrictive, are:

Possible Regional Objective #1: Reprocessing Deferral

The possible U.S. objective could be to allow European coutnries to reprocess, but not at present. Within this general category there are several alternative approaches, including, in order of increasing restriction:

Objective #1.1	Postponement of reprocessing to a fixed date, say year 2000.
Objective #1.2	Postponement of reprocessing until identified criteria are met; i.e., it is acceptably demonstrated as cost-effective, proliferation concerns being resolved, or until it is needed for breeders.
Objective #1.3	Postponement of a decision on whether or not to reprocess until some future criteria are established.
Objective #1.4	Indefinite deferral; i.e., acceptance of reprocessing only when the U.S. decides it is appropriate.

Possible Regional Objective #2: Containing Reprocessing

The possible U.S. objective could be to confine reprocessing to countries with plans or existing facilities. The U.K. and France are firmly in this category. The F.R.G. planning is firm. Belgium planning (Mol) reprocessing plant is firm, but also includes reprocessing services from COGEMA. Spain and Italy's plans are considered not firm.

Possible Regional Objective #3: Internationalization

The possible U.S. objective could be to assure that reprocessing occurs on an international rather than national basis. This objective could take two forms:

Objective #3.1 Internationalize any reprocessing project still in the non-firm planning stage.

Objective #3.2 Internationalize existing and firmly planned reprocessing facilities.

Possible Regional Objective #4: Combination of Deferring Reprocessing, Containing Reprocessing and Internationalization

The possible U.S. objective could be to assure that:

- national reprocessing decisions are delayed as long as possible, and/or
- if a reprocessing decision does occur, it is through internationalized facilities.
- Switzerland, Sweden, Netherlands, Austria, Denmark and Finland are assessed as possibly supportive of the most restrictive criteria, providing they are given permanent fuel disposition solutions.
- These countries are joined by Spain, and Italy in the middle road restrictive deferral criteria (with a fixed date or criteria).
- The major reprocessors of Europe - U.K., France, and the F.R.G. - along with Belgium have little room for discussions within these deferral scenarios. Luxembourg follows German decision-making in that regard.

As indicated in the following table, the feasible ground with the greatest European flexibility for discussion is in the area of reprocessing deferral with an identified date or established criteria.

U.S. Objectives in the Pacific

The U.S. objectives in the Pacific must reflect that the Japanese spent fuel concerns dominate that basin and tend to provide simpler approaches for the basin as a whole. Having already come to the decision to reprocess LWR spent fuel, the Japanese are concerned with their ability to implement that decision in time to prevent a spent fuel disposition problem. The Japanese therefore can be expected to show little initiative in formulating any spent fuel disposition strategy other than reprocessing. Japanese involvement in an international strategy, other than reprocessing, is therefore likely to be motivated by favorable economics or as a means of placating U.S. pressure. There is an important further dimension to the Japanese position: their resolve to reprocess LWR fuel may be stimulated by a fear that deferral of LWR reprocessing may interfere with breeder deployment. If so then reprocessing of spent LWR fuel looms as a surrogate issue for the Japanese.

Other nations in the Pacific Basin - Korea, Taiwan and the Philippines - have no domestic spent fuel problem to speak of. The only motivation for being involved in any international spent fuel arrangement would be economic or to placate external diplomatic pressure.

With these motivations taken as premise, we can identify three obstacles which migh impede any international spent fuel disposition scheme:

First, if institutions interested in reprocessing thought that such a scheme would preclude that option, they might be reluctant to enter into related discussions. This is a strong factor in dealing with Japan; probably of lesser consequence when dealing with Korea, Taiwan and the Philippines. It might be a problem within the U.S., since an attempt to create an institutional obstacle to domestic reprocessing might be expected to create an institutional obstacle to domestic reprocessing might be expected to engender strong domestic opposition.

The second potential obstacle to any international option would be unfavorable economics. This is less a problem in the U.S. than elsewhere since the U.S., taking the initiative for foreign policy reasons, is presumed to be less determined to avoid financial loss. However, other Pacific Basin nations, resistant to the scheme in the first place, can be expected to be highly critical of unfavorable economics.

Finally, an international arrangement on spent fuel would be impeded if any nation or significant subnational interest group perceived it as a give-away of an important national resource.

Given these constraints and motivations, there are only a few objectives which are not likely to run into strong objections by some Pacific Basin nation. The one suggested here is:

- to provide a means of storing LWR spent fuel so as to reduce the pressure to reprocess as a means of spent fuel disposition.

2.8 Strategy Formulation

Strategy formulation involves identifying commonalities between countries which lead to logical partnerships and institutional obstacles to such partnerships. National characteristics are developed and compared across countries. The characteristics compared are:

1) Storage situation
2) Special material concerns over spent fuel or related matters
3) Objectives for the nuclear fuel cycle
4) Industrial/economic strength
5) Relevant international ties
6) Receptivity to U.S. regional objectives and to additional international partnerships relevant to spent fuel
7) Quality as a host nation.

To seek the international or multi-national strategies, it is necessary to find unifying principles. These are developed by comparing the salient characteristics of each country and searching for common themes, situations, requirements, and complementary capabilities. Each of the test strategies present:

1) U.S. objectives to be obtained if the strategy is successful
2) Spent fuel flow condition
3) Major obstacles to implementation
4) Mitigation of major obstacles
5) Chances of successful implementation.

In Europe the grouping of nations, as developed in Chapter 5, is based on permanent waste disposal as a unifying theme. The European grouping is summarized in the following table (Exhibit 5-3).

(Reference: EXHIBIT 5-3)

Grouping of European Nations Based on
Permanent Waste Disposal as a Unifying Theme

GROUP	SIMILAR CHARACTERISTICS	COUNTRIES
A	National Reprocessing Industrialized Mature Nuclear Program Existing or Potential Export Objectives	France United Kingdom F.R.G. Belgium
B	Legal or Political Pressure to Solve Permanent Disposition Problems Not Vitally Interested in LWR Recycle (Now) Not Yet Mature Nuclear Programs	Netherlands Austria Denmark Finland
C	Legal or Political Pressure to Solve Permanent Disposition Problems Not Vitally Interested in LWR Recycle National AFR Plans Maturing Nuclear Programs Being Driven Toward COGEMA/BNFL Reprocessing	Switzerland Sweden
D	Minimal Internal Political or Legal Back-End Problem Maturing Nuclear Industry Capital Short Economy Possibility as Host of a Permanent Disposition Site Do Not Wish to Deal With COGEMA/BNFL Long-Term Plans for National Reprocessing	Spain Italy

Seven European candidate test strategies are developed for screening and include the following:

- National AFRs - European Test Strategy Reference

  All European countries are potentially involved in the strategy, except France, the FRG, and the U.K. Involvement would primarily be on a bilateral basis between the U.S. and a particular country.

- Mediterranean Storage - European Test Strategy #1

  --- Spain as Host - Variation #1

  Spain would be the recipient country for spent fuel storage. The customers would include Sweden, Finland, Norway, Denmark, the Netherlands, Belgium, Luxembourg, Switzerland, Italy, and finally Spain itself.

  --- Italy as Host - Variation #2

  Italy would be the recipient country for spent fuel storage. The customers would be the same as in the above Test Strategy - Variation #1.

- URG Storage - European Test Strategy #2

  --- F.R.G. as Host - Variation #1

  The FRG would be the recipient country for spent fuel storage. The customers would be the same as in the two above Test Strategies and Variations.

  --- U.K. as Host - Variation #2

  The U.K. would be the recipient country for spent fuel storage. The customers would be the same as in the above Test Strategies and Variations.

  --- France as Host - Variation #3

  France would be the recipient country for spent fuel storage. The customers would be the same as in the above Test Strategies and Variations.

- U.S./Canadian Storage - European Test Strategy #3

  --- Barnwell as Candidate Host - Variation #1

  The U.S. and Canada would be the recipient countries for spent fuel storage. The customers would be the same as in the above Test Strategies and Variations.

With the exception of the two first Test Strategies, none of them are mutually exclusive, and the ultimate magnitude of spent fuel flows to be sent to each recipient country would vary accordingly to possible combinations.

The European Test Strategies selected for further analysis follow and have been identified on the basis of the following two criteria: (1) chances of successful implementation, and (2) effectiveness in achieving U.S. regional objectives in Europe. These are:

- Spain as Host - Variation #1 (of Test Strategy #1)
- Italy as Host - Variation #2 (of Test Strategy #1)

followed by other non-mututally exclusive Variations, which can also be implemented in parallel or under Test Strategy #1, Variation #1 or Variation #2:

- Barnwell as Candidate Host - Variation #1 (ETS #3.1)
- U.K. as Host - Variation #2 (of Test Strategy #2)
- FRG as Host - Variation #1 (of Test Strategy #2).

The Pacific Basin is characterized by a dichotomy in the nuclear sophistication of the countries. Japan is a modern industrialized state with full economic, industrial, and management capabilities. It has an aggressive nuclear program and as a result faces immediate spent fuel disposition problems. The ROC and ROK have early nuclear programs and much weaker capabilities.

The Pacific Basin is therefore dominated by Japan, and any Pacific Basin arrangement should consider Japan as a principal. However, for a Basin solution to be effective from the U.S. point of view, it is important that ROC, ROK, and the Philippines participate.

It is possible that in the Pacific Basin, direct U.S. participation as a customer and/or host may be reasonable. This would help to solve both the siting impasse and allow a single facility to serve a large customer base.

Grouping of Pacific countries by similar characteristics is shown in Exhibit 5-4.

Three Pacific Test Strategies are identified for screening:

- <u>Pacific Test Strategy Reference (PTSR) - National Storage</u>

  All spent fuel is maintained in nations where it is generated. In ROC and ROK this occurs in ARSs and domestic AFRs to be built when needed. Japan continues its contracted shipment to the URG for reprocessing and fully operates Tokai; however, all other Japanese fuel is placed in an AFR with no commercial scale reprocessing in Japan.

- <u>Pacific Test Strategy #1 (PTS#1) - Pacific Island Host</u>

  All spent fuel beyond that already committed to URG is shipped to an interim AFR in the Central Pacific. The U.S. ships fuel to the island only for load balancing or achieving scale economics. No commercial scale reprocessing in Japan.

- <u>Pacific Test Strategy #2 (PTS#2) - U.S.* Host</u>

  Same as PTS#1, but located in the U.S., nominally at Hanford. Under this strategy, the facility might also be large enough to store substantial amounts of U.S. fuel. No commercial scale reprocessing in Japan.

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* Canada will also be considered as a host country. It is speculated that Canada would not rule out storage of foreign spent fuel, particularly from Canadian raw material, should this prove desirable in light of Canada's strong non-proliferation policy. There would be Canadian public opposition; however, it might be tempered if the storage took place in support of Canada's non-proliferation policy.

The strategies selected for further examination are PTS#1 - Pacific Island, and PTS#2 - U.S. or Canada as Host. PTSR - National Storage - is a do nothing program that does not seem to help anybody and is not further developed.

(Reference: EXHIBIT 5-4)

Grouping of Pacific Basin Nations
Based on Immediacy of Spent
Fuel Problem as a Unifying Theme

GROUP	SIMILAR CHARACTERISTICS	COUNTRIES
A	Immediate physical problem of spent fuel Immediate internal pressure to solve back end Industrialized Mature nuclear industry	U.S., Japan
B*	Intermediate-term spent fuel problem only No pressure to solve back end Early in nuclear development Industrializing	ROC, ROK

*The Philippines are not rated, but are categorized as a Group B country for purposes of strategy screening.

Section 3.0 GSFLS VISIT FINDINGS

3.1 Introduction

During the GSFLS study a selected set of countries were visited by a GSFLS study team. The team interviewed officials from government, electric utilities, and nuclear power industry who are significantly involved with GSFLS related issues and decisions.

Section 3.2 provides the visit itinerary for the GSFLS visits.

Section 3.3 provides the visit guide which was used to guide the GSFLS study team during the subject visits.

Section 3.4.1 provides a synthesis of the visit findings for the countries visited. Section 3.4.2 provides a brief description for selected countries that were not visited during the past period. Countries not visited were excluded for one of the following reasons:

- GSFLS team prohibited from visiting country at this time.
- Country to be visited in near future during remaining period and study.
- Country not significantly involved in influencing GSFLS related matters.

Section 3.2 Visit Itineraries and Principal Contacts

Pacific Trip (Japan, Korea, Taiwan) - October 8 - 21, 1977

Japan

Ministry for International Trade and Industry (MITI)

Mr. Koshi Yamamoto, Director, President's Secretariat, Agency of Natural Resources and Energy (ANRE)

Mr. Kazuhiko Hida, Deputy Director, Nuclear Energy Industry Division, Agency of Natural Resources and Energy (ANRE)

Science and Technology Agency

Mr. Shigefumi Tamiya, Minister's Special Advisor for the Science and Technology Agency, Advisor to the Chairman, Enrichment and Reprocessing Group

Mr. Kaoru Naito, Nuclear Safety Bureau

Mr. Toshio Yamaga, Safeguards Division, Nuclear Safety Bureau

Mr. Koki Kato, Nuclear Fuels Division, Atomic Energy Bureau

Mr. Saichiro Yoshimura, Research and International Affairs Division, Atomic Energy Bureau

Tokyo Electric Power Company (TEPCO)

Mr. Toshio Fukuda, Director and Assistant General Manager, Nuclear Power Development Operation

Mr. Shin Miyaki, General Manager, Nuclear Fuels Department

Mr. Fugio Sakagami, Assistant General Manager, Nuclear Fuels Department

Mr. Matsuo, Nuclear Fuels Department

Mr. Koide, Nuclear Fuels Department

Mr. Kojima, Nuclear Fuels Department

Power Reactor and Nuclear Fuel Development Corporation (PNC)

Mr. Shigeru Sato, Manager, Plant Management Section, Reprocessing Division

Japan Atomic Industrial Forum, Inc. (JAIF)

Mr. Kazuhisa Mori, Managing Director and Secretary General

Mr. Nobuo Ishizuka, Assistant Chief, Section for Industrial Programs and Technology

Japan Atomic Power Company (JAPCO)

Dr. Ryukichi Imai, General Manager, Engineering Department

Mr. Yoshioka

Mr. Tonuja

Japan Atomic Energy Research Institute (JAERI)

Dr. Mitsuho J. Hirata, Head of Fast Breeder Reactor Laboratory

Dr. Hiroshito Okashita, Head of Nuclear Chemistry Laboratory

Nuclear Transport Services Co., Limited (NTS)

Mr. Keisuke Kage, Executive Vice President

Mr. Toshiaki Tsuchiya, Manager of General Affairs

Mr. Katsuhiko Uchino, Technical Engineering Division

Japan Nuclear Security System Co., Limited

Mr. Minoru Enomoto, President

Mr. Teruo Ishizaki, Executive Vice President

Mr. Joseph Y. Konko, Deputy Section Manager, General Affairs Division

C. Itoh and Company, Limited

Mr. H. Nagao, Deputy Manager, Nuclear Energy Department

Taiwan

Atomic Energy Council

Mr. Victor Chen-Hua Cheng, Member and Secretary General, Executive Yuan (Dean, College of Nuclear Science, National Tsing Hua University)

Mr. Kuo-Yueh Liu, Director, Division of Techniques

Mr. Chi Tsao Yuong, Acting Director, Planning Division

Mr. Yu Hao Lee, Deputy Director, Institute of Nuclear Energy Research

Taiwan Power Company

Mr. Bruce Pao-Hsi Chu, Vice President

Mr. E. Lin, Deputy Director, Atomic Power Department

Mr. Pei-Chi Su, Deputy Director, Atomic Power Department

Korea

Ministry of Science and Technology (MOST)

Dr. Bak-Kwang Kang, Director, National System of Safeguards and International Cooperation Directorate

Mr. Park Heung Yil, Assistant Director, National System of Safeguards and International Cooperation Directorate

Dr. Keung-Shik Park, Deputy Assistant Minister for Technology Development

Mr. Yeong-Hak Baek, Director General, Atomic Energy Bureau

Mr. Kim Young Jung, Chief, Nuclear Planning

Mr. Lee Gun Bac, Chief, Reactor Technology

Korea Electric Company (KECO)

Mr. Koh Joong Myung, Vice President

Mr. Roh Eun Rae, Nuclear Engineer, Atomic Power Department

Mr. Rhee Jung Hahn

Korea Atomic Energy Research Institute (KAERI)

Dr. You Sun Kim, Vice President

Mr. Jung Do

Mr. Ji Bok Lee

Korea Nuclear Engineering Sercies, Inc. (KNE)

Mr. Jae Yun Ha, Manager, Project Development

Mr. I-Yong Kwon, Section Chief, Project Development

Mr. Jea Hoon Kim, Assistant Manager, Project Development

Mr. Jae Do Chung

Kyung in Energy Co., Limited

Mr. Yong Chul Park, Vice President, General Affairs

European Trip I (Sweden, Denmark, Netherlands, Switzerland and Austria) - November 12 - 23, 1977

Sweden

Ministry of Industry

Mr. Per Anders Örtendahl, Undersecretary of State and Director, Energy Division

Mr. Lars Hjorth, Director, Energy Policy Division

Swedish Energy Commission

Mr. Alf Larsson, Nuclear Power Inspectorate, and Representative to INFCR meetings

Oskarshamnsverkts Kraftgrupp (OKG)

Mr. Olle G. Gimstedt, Managing Director

Swedish Nuclear Fuel Supply Company

Mr. Bo Gustafsson

Mr. R. Hagberta

Mr. Ingemar Lindholm

Denmark

Governmental Committee on the Nuclear Fuel Cycle

Mr. Niels W. Holm, Director, Riso National Laboratory

Mr. Ole Bech, Under Secretary, Ministry of Foreign Affairs

Mr. H. C. Mortensen, Chief Engineer, Environment Board

Mr. H. O. Christiansen, Under Secretary, Ministry of Commerce

Mr. H. Buhl, Vice President, Kraftimport I/S

Mr. G. Lund-Jensen, General Manager, ELSAM

Mr. K. Singer, Executive Secretary, Riso National Laboratory

Mr. H. J. Koch, Legal Advisor, Ministry of Commerce

Mr. Erik Lyrtoft-Peterson, Director, Ministry for Foreign Affairs

Mr. E. Bastrup-Birk, Deputy Director, Dansih Energy Agency

Netherlands

Ministry of Economics

Mr. Bouvy, Deputy Director, Directorate of Electricity and Nuclear Energy

Mr. Schoustra

Ministry of Health

Mr. Op den Kamp

Ministry of Social Affairs

Mr. Versteeg

Ministry of Foreign Affairs

Mr. B. Brands, Bureau of Scientific Cooperation

Borssele and Dodewaard Nuclear Power Stations

Mr. Tiktak, Director of the Borssele Nuclear Power Station

Mr. Brand, Specialist at the Dodewaard Nuclear Power Station

Switzerland

Federal Office of Energy

Professor Claude Zangger, Vice Director, and Swiss representative to INFCE

Dr. B. Hausherr, Assistant to Professor Zangger, Security and Nuclear Affairs

Mrs. Husler, Assistant to Professor Zangger

Swiss Foreign Office

Dr. H. von Arx, Nuclear Desk

Bernische Kraftwerke

Dr. Jacques Rognon, Fuel Management Director, Nuclear Fuels Department; Chairman of the Commission of Nuclear Fuel for Swiss Utilities

West Swiss Utilities

Mr. Alain Colomb

Austria

Austrian Governmental Advisory Committee on Atomic Energy

Mr. Richard Polaczek, Prime Minister's Office, Director

Foreign Office

Mr. Johann Manz, Minister of Section for Council of Europe, Space and Atomic Matters, and Delegate to INFCE Organizing Conference

Austro Atom

Mr. Thomas Dobner, Secretary General

Dr. Arentasi

Austrian Study Group for Atomic Energy

Mr. Peter Krejsa

Mr. G. Burgscher

Ministry of Trade

Dr. Wilhelm Frank, Section Chief, Energy Section

General Nuclear Energy Works, Tullnerfeld

Mr. Friedrich Staudinger, Director

Dr. Peter Dierkes

Austrian Electric Industry

Dr. Wilhelm Oszusky

European Trip II (European Community, United Kingdom, Spain and France) - November 12 - 23, 1977

European Community

Mr. Caccia Dominioni Falmizio, Director for Nuclear Research and Development and Policy

Mr. Gian Prino Alessi, Legal Services

Mr. Jean Gabolde, Scientific Coordinator, Joint Research Center

Mr. Lafontaine

Mr. Kaut

United Kingdom

United Kingdom Atomic Energy Agency (UKAEA)

Sir John Hill, Chairman

Mr. Arnold Allen, Assistant to Sir Hill

British Nuclear Fuels Limited (BNFL)

Mr. Con Allday, Managing Director

Mr. Don G. Avery, Deputy Managing Director

Mr. Jim Bryce, Planning

Central Electricity Council

Mr. Frank Toombs

Central Electricity Generating Board (CEGB)

Mr. Roy Matthews, Nuclear Health and Safety

Department of Energy

Mr. Peter Fullerton, Uranium Division

Ms. Mary Aitcheson

Nuclear Power Company

Mr. Ned Franklin

Spain

Junta de Energia Nucleare

Dr. Francisco Pascual Martinez, Vice President and Director General

Forum Atomico Espanol

Mr. Alfonso Alvarez Miranda, President

Mr. Jose Antonio Gallego Gredilla, Director General

Union Electrica

Mr. Pablo Blanc Perez, Industrial Engineer, Nuclear Reactor Group

Empresa Nacional Hidroelectrica de Ribagorzana SA (ENHER)

Mr. Jose Luis Saenz de Tejada

Mr. Francisco Massana Bonastre, Industrial Engineer

Mr. Julio Barcelo Vernet, Industrial Engineer

Centrales Nucleares del Norte, SA (NUCLENOR)

Mr. Jose Luis Sanchez Perez, Administration General Manager

Mr. Vicente Molina

Hidroelectrica Espanola SA

Mr. Jose Luis Hernandez Varela, Industrial Engineer

Mr. Jose L. Mochon

Iberduero

Dr. Joaquin Cervera y Cervera, Industrial Engineer

Empresa Nacional des Uranio SA (ENUSA)

Mr. Carlos Melches, Assistant Director of General Affairs

Almaraz and Valdecaballeros Nuclear Projects

Mr. Francisco Bosch

Mr. Juan M. Blanco

FENOSA

Mr. Alvaro Gil

France

Commissariat a l'Energie Atomique (CEA)

Mr. Bertram Goldschmidt, International Relations

Mr. Jean Lefevre, Assistant Delegate of Nuclear Materials

Mr. Andre Finkelstein

Mr. Jean-Loup Picard, Counselor of Industrial Affairs, International Relations

Compagnie Generale des Matieres Nucleaires (COGEMA)

Mr. Claude Ayçoberry, Director of Reprocessing

Mr. Georges Besse, Director General; President and Director General of COREDIF

Electricite de France

Mr. François Minnard, Chef Adjoint des Services des Combustibles

Trip III (Italy, Luxembourg, F.R.G.) - December 5 - 9, 1977

Italy

Comitato Nazionale Per l'Energie Nucleare (CNEN)

Professor Maurizio Zifferero

Ente Nazionale Idrocarburi

Mr. Alessandro Pellei

ENEL

Mr. Raffaello de Felice, ENEL/DCO, Nuclear Division

Mr. Zaffiro

Luxembourg

Mr. Faust, Ministry of Foreign Affairs

Mr. Kaiser, Ministry of Public Health

Federal Republic of Germany

Ministry for Reserach and Technology

Dr. Manfred Popp

DWK

Mr. Gunther H. Scheuten

Dr. jur. Wolfgang Strasburg

Dr. Carsten Salander, Development, Research and Licensing

Dipl.-Ing. Joachim Mischke, Planning

RWE

Dr. Heinrich Mandel, Chairman of the Board

Dr. Ites, Construction and Planning

Dr. Klaus-Peter Messer, Head of Fuels Planning

German Atomic Forum

Dr. Thomas Roser

Wirtschaftsverband Kernbrennstoffkreislauf E.V.

Dr. Felix Oboussier

West German Embassy, Washington, DC

Dr. Christian F. J. Patermann, Counsellor, Science and Technology Affairs

Section 3.3 Study of Centralized Spent Nuclear Fuel Transportation and Storage Systems

Introduction

1. Study Purpose and Approach

The United States Department of Energy (formerly ERDA) has contracted with Boeing Engineering and Construction (BEC), a division of the Boeing Company, and its subcontractors, International Energy Associates Limited (IEAL) and the firm, Doub, Purcell, Muntzing & Hansen, to conduct a study of the issues and options in establishing centralized spent nuclear fuel transportation and storage system(s). The purpose is to investigate the feasibility and possibl interest in such system(s).

The scope of the study inclu es technical, economic, financial, regulatory and other institutional factors. Options will be developed for consideration reflecting differing modes of operation, siting, ownership, terms and conditions of agreements and contracts, and control, with emphasis on developing realistic options which are operationally and financially viable and have the broadest base of prospective support by potential participants in planning, financing, and using such systems.

The study is scheduled to assess by early 1978 an indication of possible interest on the part of countries participating in the study and a final report by mid-1978 defining options and prospective support.

The study will be based upon information and views obtained from visits with responsible governmental, industrial and electric utility officials in all countries involved. IEAL is responsible for conducting visits.

Countries to be studied include Pacific Basin, Americas, Europe and Mid-East. Pacific Basin countries are: Australia, Japan, Korea, Philippines, Republic of China.

Study Approach

1. Understand current policies, plans and programs for spent fuel disposition.

2. Assess possible utility/industry interest in multinational spent fuel disposition.

3. Assess existing, committed or planned logistics conditions for multi-national systems.

4. Assess institutional factors which influence the development of logistics options.

5. Perform international assessment of (1)-(4) through contacts and visits. (Initial visit)

6. Develop requirements analysis for multi-national spent fuel disposition systems.

7. Develop and evaluate alternative spent fuel disposition concepts.

8. Assess international utility/industry interest of (6)-(7) through contacts and visits. (Follow-up visit in 1978)

2. International Visits

The purpose is to obtain information and views of responsible officials in participating countries. The areas of concentration are on the business development aspects of multi-national spent nuclear fuel transportation and storage systems.

Meeting Agenda (will vary with different groups)

1. Areas of interest

- Review current policies, plans and programs for spent fuel.
- Review of spent fuel discharge profiles and in-country storage availability.
- Review country's plans to increase efficient utilization of existing spent fuel storage capacity.
- Review spent fuel technical characteristics.

- Review of spent fuel shipping and storage experience and shipping capabilities.

- Review of present and projected spent fuel disposition

  - at reactor storage
  - away from reactor storage
  - transportation
  - spent fuel energy recovery alternatives
  - terminal storage.

- Review of treaties, regulations and policies which affect spent fuel shipping and storage.

- Shipping and storage services and associated terms or conditions of possible interest.

- Financial and business aspects of private, non-government utility/industry involvement in spent fuel storage and logistics consortia.

- Storage siting.

- Conditions of spent fuel title, liabilities, and ultimate fuel disposition.

- Concepts for multi-national design, construction, and equipment supply sources.

- Private sector views on their possible input to the management of a consortia established to deal with logistics of spent nuclear fuel.

2. Type of information requested

   - Available documents, reports and data summaries.
   - Discussion of data, projections and special circumstances.
   - Response to questionnaire in technical areas.

3. Meeting duration

   - Estimate one-half to one working day (per meeting)
   - Planning to leave a questionnaire behind for completion of detailed aspects of the visit.

4. Study progress information

   - Team will provide study progress information as it related to national organization's interest.

Spent Nuclear Fuel Transportation and Storage Visit Guide

Use of This Guide

1. This instrument is for use by the visit team as a guide to discussion. The guide is not classified or private and may be provided to the parties visited if appropriate.

2. There are two approaches for developing detailed information requirements which evolve during discussion:
   a. Prepared questionnaires are attached for areas considered likely to require detailed information.
   b. In the event the questionnaires are inadequate in scope or content or the party visited has alternatively available information, make suitable arrangements.

3. Interview Structure
   a. Initiate discussion with general questions.
   b. Develop information on current program and requirements (Reference Base). This area concentrates on present facts.
   c. Develop facts and opinion related to interest and options in participating in a multinational system.
   d. Using the inputs of (a)-(c), begin the definition process of a multi-national system.
   e. Develop organizational and financial approaches to the system defined in (d).

4. Applicability of Visit Guide

   The guide is meant to be comprehensive for the study's needs. The team must select the appropriate guide areas for the particular groups visited.

5. <u>Contents of the Guide</u>

Introduction	– to be given to party visited at the start of meeting
Section I	General Questions
Section II	Current Program and Requirements (Reference Base)
Section III	Country Inputs to Definition of Spent Fuel Transportation and Storage Concepts (for Option Consideration)
Section IV	Multi-National Business Consortia Matters Relating to Transportation and Storage System Concept(s) Definition Process
Section V	Organization and Financing of Selected Transportation and Storage Concepts

Section I. General Questions

(for use in initiating discussion)

1. Can you briefly review the policies, plans and programs for the storage and disposition of spent nuclear fuel?

2. Are there significant changes related to the deferral of spent fuel reprocessing?

3. Are there joint studies or agreements underway with other countries?

4. What can be done to ease the burden of spent fuel storage and maintain or strengthen non-proliferation objectives in areas such as:

   - transportation
   - basin design
   - casks
   - carrier services
   - financing
   - technology exchange
   - interim system of storage
   - economic evaluation
   - etc.

5. What are the impediments to cooperative, business-oriented, multi-national efforts? Or what are the issues to be addressed in a cooperative effort?

   in areas such as:

   - assurance of returns
   - title
   - L.E.U. assurance
   - liabilities
   - centralized fuel storage
   - political acceptability
     - as host
     - as partner
   - value for spent fuel
   - capital investment
   - conditions of participation
   - acceptance of cost penalties on delayed or cancelled recycle

6. What is the best vehicle to initiate organization and development of business-oriented multi-national systems?

Section II. Current Program and Requirements (Reference Base)

1. Nuclear power forecast - by year - Questionnaire 1

   a. reference
   b. low
   c. high

2. Spent fuel generation - by year - Questionnaire 2

   a. associated with reference forecast
   b. associated with any high probability variance (high or low)

3. Reactor discharge management requirements

   a. full core reserve
   b. normal discharge
   c. discussion of possible changes in requirements
   d. identification of extremis conditions

4. Spent fuel AFR storage requirements under fuel cycle conditions as perceived by country. These requirements would be governed by plans (timing, capacities, usage duration) for recovery, interim and permanent storage of fuel elements and permanent disposition of reprocessing high level waste. It would be helpful if response would include a brief discussion of the factors that have influenced planning.

5. Current (existing; building; contractually and financially committed) spent fuel disposition program - by year:

   a. At reactor storage, by reactor - Questionnaire 3

      (1) capacity and usage by year
      (2) program to increase storage capacity
      (3) costs, terms or conditions (non-proprietary information)

   b. Away from reactor storage - national (in-country) - Questionnaire 4

      (1) Location(s)
      (2) Storage description:
         (a) capacity and usage, by year
         (b) facility lifetime(s)

(c) significant maintenance operation (general description)
(d) cost, terms or conditions (forward commitment and/or spot service) - non-proprietory information

(3) Storage site suitability for co-location of permanent storage or energy recovery alternatives. Give basis of determination.

(4) General description of transportation system: Questionnaire 5.

(a) casks
(b) vehicles
(c) routes
(d) handling equipment
(e) carriers/suppliers
(f) shipping duration
(g) cost,terms or conditions (forward commitment and/or spot service) - non-proprietory information

(5) Safeguards considerations - approach and criteria

(a) design
(b) operations

c. Away from reactor storage - multi-national business arrangements - Questionnaire 4

(1) storage location(s)
(2) storage description

(a) size
(b) usage allotment or quota (from each participating country)
(c) lifetime
(d) cost, terms or conditions - non-proprietory information

(3) storage site suitability for co-location of permanent storage or energy recovery alternatives. Give rationale.

(4) general description of transportation system - Questionnaire 5:

(a) casks
(b) vehicles
(c) routes
(d) handling equipment
(e) port facilities
(f) carriers/suppliers
(g) shipping duration
(h) cost, terms of conditions

(5) safeguards considerations - approach and criteria

(a) design
(b) operation

(6) description of multi-national business agreements re:

(a) identification of participants
(b) storage allotment - by year
(c) return of spent fuel
(d) fuel reprocessing

timing
terms or conditions
disposition of fissile material
disposition of reprocessing waste

(e) cancellation or modification
(f) other contingencies

6. Spent fuel storage short-f ll (by year) based on (1)-(5). Questionnaire 6.

7. Spent fuel disposition future plans (planned, but not contractually or financially committed).

a-c. Repeat items under (5)
d. Identify go/no-go decision factors, timing of decision and contingency planning

8. Spent fuel storage short-fall (by year) based on (1)-(7). Questionnaire 6.

9. With respect to current program (5) and future plans (7), identify spent fuel movement and AFR storage constraints.

a. Transport infrastructure capability
b. Regulations, agreements - Doub, et al guide
c. Public acceptance
d. National policy

Section III <u>Country Inputs to Definition of Spent Fuel Transportation and Storage Concepts (For Option Consideration)</u>

1. Candidate spent fuel amounts and schedule available for new concepts. (This may complement current program or partially or completely replace current program).

   a. Normal
   b. Handling extremis conditions
   c. Reference service terms and conditions

2. Candidate AFR storage location (multi-national business basis)

   a. Suitability for AFR interim storage requirements

      (1) duration of AFR storage and basis (range of considerations)

         (a) long-term (2030) hold of spent fuel pending disposition decision
         (b) mid-term (1990-2000) hold of spent fuel for energy recovery operations, at which time AFR provides storage buffer for recovery operations and receives recovery waste. No permanent storage decision prior to 2030.
         (c) same as (b), except permanent storage operations are in place in mid-term (1990-2000) to receive recovery waste and any unrecovered spent fuel not scheduled for recovery. AFR serves as storage buffer for recovery and permanent storage operations.
         (d) Other (identify)

      (2) environmental and service support requirements for AFR interim storage

         (a) geography and demography
         (b) meteorology
         (c) weather - tsunami, typhoon, cyclone
         (d) hydrology
         (e) minimum land area at proper elevation
         (f) water supply
         (g) port access
         (h) labor/industrial base
         (i) other

      (3) location with respect to countries served

   b. Site suitability for recovery process co-location with AFR

(1) Environmental and service support requirements

(a) geography and demography
(b) meteorology
(c) weather - tsunami, typhoon, cyclone
(d) hydrology
(e) minimum land area at proper elevation
(f) water supply
(g) port access
(h) labor/industrial base
(i) other

(2) Ability to decommission recovery plant with environmental acceptability

(a) by deep permanent storage at recovery site
(b) by other means

c. Site suitability for permanent storage

(1) geography and demography
(2) meteorology
(3) weather - tsunami, typhoon, cyclone
(4) hydrology
(5) minimum land area at proper elevation
(6) water supply
(7) port access
(8) labor/industrial base
(9) other

d. Possible participation of business sector in development of:

(1) AFR interim storage - associated conditions
(2) Recovery services - associated conditions
(3) Permanent storage - associated conditions

3. Likely business participants in centralized storage area

a. Location of facility
b. Business acceptability
c. Definition of barriers to acceptability
d. Definition of incentives required

4. Conditions of spent fuel title (for spent fuel entering centralized AFR)

a. Conditions

(1) Remains with user
(2) Shifts to storing entity (host nation, consortium)
(3) Other

b. Timing (when title shifts)

(1) On shipment
(2) At arrival storage
(3) On determination of residual value

5. Spent fuel custody shift to storing activity. Include liabilities discussion.

a. At reactor gate
b. At user border
c. At host nation border
d. At storage facility

6. Requirements for return of fissile material

a. LWR recycle program - start date ________________
b. Breeder program - start date ____________________
c. Substitution of uranium and separative work in lieu of a. and b.

7. Fissile material release mechanism

a. On U.S.G. determination (for U.S. controlled fuel)
b. On demand by user
c. On storing entity determination (host nation, consortium)
d. Other criteria

8. Character of fissile material release

a. Equivalent energy material (identify)
b. Equivalent fissile material
c. Money
d. Return of spent fuel

9. Spent fuel movement and AFR storage constraints

a. Transport infrastructure capability
b. Laws, regulations, agreements
c. Public acceptance
d. National policy

10. Interest of utility/industry re: interim or permanent storage spent fuel or recovery waste

a. Conditions (requirements) to store in national basin
b. Incentives country would provide to have stored in another country
c. Regulations, agreements - Doub, et al guide
d. Public acceptance
e. National policy

11. Interest of business community in use of indigenous suppliers (design, engineering, construction, manufacturer, carriers, service operations)

Section IV. Multi-National Business Consortia Matters Relating To Transportation and Storage System Concept(s) Definition Process (using inputs of Sections I and II and Technical Addendum)

1. Selection of storage location

   a. For AFR with no co-location requirements
   b. For AFR with contingent requirement for co-located recovery operations (if considered)
   c. For AFR with contingent requirement for co-located permanent storage operations (if considered)

2. Selection of participating consortia

3. AFR service requirements - amounts (allotments) and schedule for participating countries

   a. Normal (forward commitment) service
   b. Spot (extremis) service
   c. Contingency for termination of service requirements, and basis
   d. Duration of storage requirements and basis.

4. AFR requirements

   a. Size
   b. Storage lifetime capability
   c. End-use preparation capability (as the head end of follow-on disposition process)
   d. Construction and operation schedule

5. Transportation system definition

   a. Regulations, agreements affecting
   b. Routing constraints and optimization
   c. Cask requirements: description, numbers, scheduling (considering spent fuel and recovered waste as appropriate)
   d. Vehicle requirements: description, numbers and scheduling
   e. Terminal facility requirements
   f. Carriers

6. Possible influence of international business agreements on spent fuel movement and storage

7. Definition of system concept economics

8. System concept terms and conditions

9. Relationship and interdependencies with country reference base program (as seen by business sector)

   a. Comparison of terms and conditions
   b. Other competitive comparisons
   c. Market capture factors

Section V. Organization and Financing of Selected Transportation and Storage System Concepts

1. Definition of organization functions.

   a. Design, construction, equipment supply
   b. System operations
   c. Safeguards operations
   d. Authority for movement and disposition of fissile material.

2. Alignment of organization functions (1) which involve national and/or multi-national consortia.

3. Alignment of organizational functions (1) which involve financing, economics, contract performance, industrial concerns.

4. Investment formulae alternatives

   a. Based on options of national income, nuclear generating capacity, commitment to use services, equal basis for all participants; other bases
   b. Consideration could be given to different classes of ownership interests, with different rights of services, particularly where these are significant differences in investment
   c. Service charge basis, with private sector making investment
   d. Investment parties could include:

      (1) private
      (2) mixed public-private

5. Management operations for:

   a. Design, construction, equipment supply
   b. System operations
   c. Safeguards operations
   d. Authority for movement and disposition of fissile material

6. Design, construction, equipment and service supply sources.

QUESTIONNAIRE 2

Spent Fuel Generation Forecast

1. Quantity of Spent Fuel Discharged

a. Provide reactor-by-reactor/year-by-year forecast of spent fuel discharge rates for known BWR reactors as follows:

	Year					
	Before 1977	1977	1978	1979	1980	Etc. to End of Forecast
BWR Reactor 1						
BWR Reactor 2						
•						
•						
•						
BWR Reactor n						

b. Provide reactor-by-reactor/year-by-year forecast of spent fuel discharge rates for known PWR reactors as in a. above.

c. Provide year-by-year forecast of spent fuel discharge rates for BWR and PWR growth reactors that will be required in the future to support electrical growth forecasts:

	Year				
	1980	1981	1982	1983	Etc. to End of Forecast
Reference BWR Growth					
High BWR Growth					
Low BWR Growth					
Reference PWR Growth					
High PWR Growth					
Low PWR Growth					

Note: Reference growth is the best estimate, high and low are alternatives that are thought to bracket the reasonable range of uncertainty.

d. Provide reactor discharge characteristics for each known and typical growth reactors.

Reactor core size?
% of core removed on each discharge?

e. U.S. ERDA has developed the following: "U.S. and Free World Discharged Nuclear Fuel Storage and Transportation Analyses" (prepared by Nuclear Assurance Corp.) April 1977. Would a study based upon this data be credible, based upon your vision of spent fuel discharge.

2. Physical Description of Spent Fuel Assemblies

a. What are the physical characteristics of the spent fuel assemblies:

	PWR			BWR		
	Type 1	Type 2	Type n	Type 1	Type 2	Type n
Weight						
Length						
Width						
Height						
Manufacturer						

b.

3. Heat Rejection/Radiation Characteristics of the Spent Fuel Assemblies

a. What are the heat/radiation characteristics of the spent fuel assemblies:

	PWR			BWR		
	Type 1	Type 2	Type n	Type 1	Type 2	Type
Initial Enrichment						
Specific Power Level MegW/MTHM						
Burn-Up Level MegW days/MTHM						
Heat Rejection Watts/MTHM						
(1) 160 days after discharge						
365 days after discharge						
(2) 5 years after discharge						
10 years after discharge						

4. Condition of Spent Fuel Leaving Reactor Pool and Entering the Logistics System

   a. Based on your experience, what percentage of spent fuel shipped will involve failed fuel assemblies (i.e. assemblies in which cladding has been broken and fuel particles may be entering the container)? What is failure rate in pool storage?

   b. Based on your experience, what percentage of fuel assemblies will be shipped in canned units (i.e. failed fuel detected and canned before shipping)?

   c. Based on your experience, what percentage of spent fuel will involve leaking assemblies (i.e. assemblies which are off gassing radioactive gas)?

QUESTIONNAIRE 3

A. Firm* Plans for At Reactor Storage

1. Provide Reactor-By-Reactor description of Characteristics of Storage Pools at Known BWR Reactors as Follows:

Characteristic	Reactor #1	Reactor #2 ----	Reactor #n
Storage Capacity (Assemblies)			
Basis of Capacity Poisoned Geometric			
Present Amount in Storage (Assy)			
Pool Availability (Date)			

2. Will any of the BWR pools be enlarged? If so, which pool, how will enlargement be accomplished, and when will enlarged capacity be available? What limitations are there to densification programs?

3. Provide reactor-by-reactor description of characteristics of storage pools at known PWR reactors as shown in 1. above.

4. Will any of the PWR pools be enlarged? If so, which pool, how will enlargement be accomplished, and when will enlarged capacity be available?

5. What do you estimate is the cost of spent fuel storage in the reactor storage?

   a. Capital costs

   b. Operating and maintenance costs

   c. Total cost (dollars/year/assembly)

6. If new away from reactor storage facilities were committed to be built, could any of the present at reactor storage basins be used temporarily as storage for fuel from other reactors?

* Firm - Equals existing under construction or financially committed by specified date.

7. U.S. ERDA has developed the following document, "US and NON US Light Water Reactor Spent Fuel Storage" July 1977, prepared by Nuclear Assurance Corporation. This document shows the current reactors which are approaching loss of full core reserve. Based on your knowledge, would a study using the information be considered credible?

QUESTIONNAIRE 3
(Continued)

B. Future Plans for At Reactor Storage

1. What criteria will be used to size future reactor pools (e.g. 3 x full core?)?

2. Will future reactor pools use poisoned or geometric assembly spacing criteria?

3. What is the availability schedule for new reactor pools?

4. Could any future reactor pools be constructed in advance of the reactors to serve temporarily to augment present capacity?

5. What do you estimate is a reasonable time to construct a water basin including licensing and satisfying other regulatory requirements?

6. What do you estimate will be the cost of spent fuel storage in future reactor storage?

QUESTIONNAIRE 4

A. Firm* Plans for Away Frcm Reactor Storage

1. Provide facility-by-facility description of characteristics of presently available or firmly planned away from reactor storage.

Characteristic	Facility #1	Facility #2 ----	Facility #n
Location			
Storage Capacity (Assemblies & Type or MTU)			
Basis of Capacity Poisoned Geometric			
Present Amount in Storage (MTU)			
Pool Availability (Date)			
Estimated Lifetime			

2. What operation and maintenance activities are associated with these storage facilities?

3. What do you estimate is the cost of storage of spent fuel in these facilities (a. Capital cost, b. Operating and maintenance costs and c. Total costs in dollars/year/MTU)?

4. What is the anticipated storage requirements associated with these facilities?

	Before 1977	1977	1978	1979	Etc. to end of forecast
Facility #1					
Facility #2					
•					
•					
•					
Facility #n					

5. Which reactors supply the fuel stored in these facilities?

*Firm - Existing, in construction, or financially committed.

QUESTIONNAIRE 4
(Continued)

B. Future Plans for Away From Reactor Storage

1. What future plans do you have for away from reactor storage? What characteristics describe these plans?

Characteristic	Facility #1	Facility #2 ----	Facility #n
Location			
Storage Capacity (Assemblies & Type of MTU)			
Basis of Capacity Poisoned Geometric			
Present Amount in Storage (MTU)			
Pool Availability (Date)			
Estimate Lifetime			

2. What operation and maintence activities do you expect to be associated with these storage facilities?

3. What do you estimate will be the cost of storage of spent fuel in these facilities ($/year/assembly)

4. What is the anticipated storage requirements associated with these facilities?

	BEFORE 1977	1977	1978	1979	Etc. to end of forecast
Facility #1					
Facility #2					
:					
:					
Facility #n					

5. Which reactors supply fuel stored in these locations?

QUESTIONNAIRE 5

Description of Transportation System

1. Interface of Reactor Sites with Transportation System

   a. Which reactor sites have direct access to rail lines, roads, and dock facilities?

   b. What size cranes are available at reactors for loading casks on to transporters?

   c. Describe your method of loading casks, i.e. what pool space is available and how long does it take to load a cask and place it on a transporter?

   d. Are there any reactors at which special operations requiring increased loading time would be required (e.g. removal of fencing, walls, etc.)

2. Casks

   a. How many casks are currently in your inventory? Do you have firm plans to obtain more? What are your future plans in regard to additional casks?

   b. Describe these casks as follows:

	Cask Type	PWR Capacity	BWR Capacity	Shielding	Heat Removal	Transport Weight	Transport Mode
In inventory							
#1							
#2							
...#n							
Firm plans							
#1							
#2							
...#n							
Future plans							
#1							
#2							
...#n							

   c. Initial indications are that a standardized cask design of a large size such as the 10/24 rail cask will prove to be the lowest cost transport medium. Do you foresee any thing that could prevent use of the standard large cask for most transport to storage centers?

3. Transporters

a. How many special transporters are in inventory? Do you have firm plans to obtain more? What are your future plans in regard to additional transporters?

b. Describe these transporters as follows:

	Casks Transported	Quantity Transported	Average Transport Speed
In inventory			
#1			
#2			
...#n			
Firm plans			
#1			
#2			
...#n			
Future plans			
#1			
#2			
...#n			

4. Routes

Describe routes from reactors to sea ports in terms of the following:

	Distance	Speed	Weight Limits	Maximum* Convoy Size	Hazards**
Road Routes					
#1					
#2					
...#n					
Rail Routes					
#1					
#2					
...#n					

* Number of casks that can be transported in a convoy.

** Population centers or other items requiring special consideration during transport.

5. Handling Equipment

What special handling equipment is in inventory or in your plans for the spent fuel assemblies and casks in association with transport from reactors to seaports?

6. Seaport Facilities

a. What port facilities will be used for each reactor?

b. Are there any limits on ship size at any of these ports?

c. Does the port have facilities for loading heavy rail casks?

d. Does the port have facilities that could be set aside for cask shipment with appropriate safeguards?

7. Airport Facilities

a. If air transport were found to be an economical method of transport to a fuel center, are there any considerations that would prevent or restrict its use?

b. If air transport were used, what airports could be used? Where are they located?

c. Would these airports have facilities for loading heavy casks and for handling the large wide-body aircraft?

d. Would these airports have facilities that could be set aside for cask shipment with appropriate safeguards?

8. Common Carriers

Have commercial transport firms been carrying spent fuel including road, rail, ship and air modes?

9. Ships

a. Has any of your spent fuel been transported by ship? If so, how much and what provisions were made?

b. Do you have any ships or plan to obtain any ships for spent fuel transfer? If so, what is the nature of the arrangements in terms of the following:

Ship	Size of Cask	Quantity of Casks	Lease/ Buy	New/ Modified	Ship Size
#1					
#2					
...#n					

c. If a dedicated ship were available for transport of spent fuel from your reactors to a fuel center, would special design requirements be imposed on the ship? Examples:

- maximum capacity of ship in MTU?
- double hull provisions (e.g. longitudinal bulkhead 1/5 of width into cargo compartment)?
- transverse bulkheads forming multiple water tight compartments?
- maximum transport speeds?
- crew size?

10. Shipping Costs

a. What are the transportation costs associated with movement of spent fuel as you expect to experience them? For example:

Special train charges	-	$/mile
Rail tarriffs	-	$/ton-mile
Hazardous cargo charge	-	$/ton
Empty cask charge	-	$/ton
Berthage, wharfage, etc.	-	$/cask
Road tarriff	-	$/ton-mile

b. What are the times associated with movement of spent fuel as you expect to experience them? For example:

Time to load spent fuel into cask and cask on to transporter	hours
Time for removal from road/rail transporters	hours
Time to load casks on to ship	hours
Time for delays or stopovers in route	hours

QUESTIONNAIRE 6

Spent Fuel Storage Short Fall

1. What is your perception of the spent fuel storage short fall based upon your firm plans? What is your perception of the short fall based upon firm and future forecasts?

	1977	1978	1979	Etc. to end of forecast
Firm Storage Short Fall (MTU)				
Forecasted Short Fall (MTU)				
• Best estimate				
• High estimate				
• Low estimate				

QUESTIONNAIRE 7

Spent Fuel Available for Global Spent Fuel Logistics System Input

1. In Questionnaire 2, Spent Fuel Generation Forecast, data was solicited on the total spent fuel discharge within your area of interest. Provide a forecast of which portion of the total fuel could be included in a new spent fuel logistics system as follows:

	Before 1977	1977	1978	1979	1980	1981	Etc. to end of forecast
BWR Reactor #1							
BWR Reactor #2							
... BWR #n							
PWR Reactor #1							
PWR Reactor #2							
... PWR #n							
BWR Growth (Reference)							
BWR Growth (High)							
BWR Growth (Low)							
PWR Growth (Reference)							
PWR Growth (High)							
PWR Growth (Low)							

2. In Questionnaire #2 spent fuel description, heat rejection/radiation, and spent fuel condition was solicited. Which of these data applies to spent fuel available to a new spent fuel logistics system?

SPENT FUEL QUESTIONNAIRE

A) REACTOR: ______________________ OPER. DATE ______________
MONTH/YEAR

SIZE: ______________ MWE TYPE: ______________________
EXAMPLE: (BWR1/G.E.)

CORE SIZE: ______________ ASSEMBLIES
______________ MTU

B) PROJECTED SPENT FUEL DISCHARGE*

PRE 1978	1979	1980	1981	1982	1983	1984	1985	1986
________	_____	_____	_____	_____	_____	_____	_____	_____

1987	1988	1989	1990	1991 & ON
_____	_____	_____	_____	________ (ANNUAL)

C) CURRENT AT-REACTOR STORAGE (ARS)

CURRENT CAPACITY* ______________________

JAN. 1, 1978 SPENT FUEL
INVENTORY IN (ARS)* ______________________

D) FUTURE AT-REACTOR STORAGE (ARS)

PLANNED CAPACITY* ______________________

OPERATIONAL DATE ______________________

EXPANSION APPROVAL DATE ______________________

TYPE OF EXPANSION ______________________

IS FURTHER EXPANSION
POSSIBLE? __________ MAXIMUM
YES/NO (ARS) SIZE* __________

* SPENT FUEL ASSEMBLIES

(REACTOR: ______________________)

E) REPROCESSING PLANS:

	PRE 1978	1979	1980	1981	1982
SHIPMENT TO REPROCESSORS* (OR CENTRAL STORAGE):	____	____	____	____	____

	1983	1984	1985	1986	1987&ON
SHIPMENTS* (CONTINUED):	____	____	____	____	____ (ANNUAL)

REPROCESSING CONTRACT STATUS:

	TIME PERIOD	AMOUNT*	REPROCESSOR	CONTRACT STATUS
1.	____	____	____	____
2.	____	____	____	____
3.	____	____	____	____

F) SPENT FUEL TRANSPORTATION

1. SPENT FUEL TRANSPORTATION MODE: ____ TRUCK ____ RAIL ____ WATER

2. INTERNATIONAL SHIPMENTS: PORT: ______________________
   FINAL DESTINATION: ______________

	TRANSPORT TIME	DISTANCE	WEIGHT LIMITS
REACTOR TO PORT	____	____	____
REACTOR TO FINAL DESTINATION	____	____	____

3. POTENTIAL SPENT FUEL CASKS (FLASKS)

TYPE	TRANSPORT WEIGHT	PWR/BWR
____	____	___/___ ASSY
____	____	___/___ ASSY

* SPENT FUEL ASSEMBLIES

SPENT FUEL QUESTIONNAIRE (CONTINUED)

(COUNTRY: ________________)

G) AWAY FROM REACTOR STORAGE

1. SITE/OWNERSHIP: ______________/______________

2. PROJECTED CAPACITY*:

	1978	1979	1980	1981	1982	1983	1984	1985
BWR								
PWR								
OTHER								

	1986	1987	1988	1989	1990	1991 - 1995
BWR						
PWR						
OTHER						

3. PROJECTED INVENTORY*

	1978	1979	1980	1981	1982	1983	1984	1985	1985-1990
NATIONAL									
OTHER COUNTRIES:									

4. SPENT FUEL THROUGHPUT RATE*

	1978	1979	1980	1981	1982	1983	1984	1985	1985-1990
SPENT FUEL									
BWR									
PWR									
OTHER									
NO. OF CASKS									
TRUCK(1)									
RAIL(2)									

(1) TRUCK CASK SIZE*: (____/____) PWR BWR

(2) RAIL CASK SIZE*: (____/____) PWR BWR

*MTU OR SPENT FUEL ASSEMBLIES

Section 3.4.1 GSFLS Visit Findings

(COUNTRIES VISITED)

Europe

- Austria
- Denmark
- France
- Federal Republic of Germany
- Italy
- Luxembourg
- Netherlands
- Spain
- Sweden
- Switzerland
- United Kingdom

Pacific

- Japan
- Korea
- Republic of China

Americas

- Canada

Section 3.4.2 GSFLS Findings

(COUNTRIES NOT VISITED)

- Belgium
- Finland
- India
- Philippines
- Yugoslavia

3.AT Visit Findings - Austria

3.AT.1 Introduction

3.AT.1.1 Organizations Visited

The Austrian organizations visited were: the Austrian Governmental Advisory Committee on Atomic Energy, the Foreign Office - Section for Council of Europe Space and Atomic Matters, General Nuclear Energy Works - Tullnerfeld, the Austrian Study Group for Atomic Energy, the Austria Electric Industry, the Ministry of Trade - Energy Section, and Austro Atom.

3.AT.1.2 Spent Fuel Disposition Highlights

Policy, Plans and Programs

Austria has adopted a policy (although not yet a law) requiring permanent disposition of highly radioactive materials from reactors before a new reactor can be fueled. At present the Austrians are considering expanding their at-reactor storage and planning a national AFR. These interim storage programs are not consistent with their permanent disposition policy, and consequently Austria is investigating various alternative spent fuel disposition programs including the following:

1. Negotiations with a European reprocessor for a limited amount of reprocessing services (1981 to 1990)
2. Discussions with the F.R.G. regarding participation in the Gorleben program
3. Contract with the U.S.S.R. for fuel supply and spent fuel disposition for their second reactor
4. Discussions with Iran on permanent disposition
5. Discussions with the U.S. on implication of the U.S. spent fuel policy.

At this time, all the alternatives have one or more or the following drawbacks:

a. Do not guarantee permanent disposition of Austrian high level waste.

b. Too preliminary for Austrian planning needs

c. Involve politically sensitive alliance.

Even though Austrian officials believe they have satisfactory geological conditions (granite) for a national repository, local opposition has inhibited start-up of an exploratory geological drilling program, thus further impeding an Austrian solution for permanent disposition.

Principal Concerns

The resolution of spent fuel disposition problem is imperative to the continuation of their nuclear reactor program. The inability to start-up the first reactor plant in 1978 would have a serious impact on the Austrian economy.

Additional concerns relate to possible impact of the MB-10 process on the effective implementation of a European reprocessing alternative currently under negotiations.

Spent Fuel Disposition Profile

The Austrians are planning to provide at-reactor storage capacity equal to full core reserve plus one discharge for their first reactor (Tullnerfeld). The Tullnerfeld reactor will have its initial discharge in 1981.

The Austrians are currently negotiating with COGEMA to handle 223 MTU of spent fuel during the 1981 through 1990 time period.

The following cumulative discharge profile reflects anticipated spent fuel generation for the committed Austrian LWR reactor program (firm) and anticipated future Austrian LWR reactor program (projected).

Cumulative Discharge Profile (MTU)

Year	Firm	Projected	Total
1985	126	0	126
1990	231	0	231
2000	441	689	1130

The following away-from-reactor (AFR) spent fuel disposition profile is based on removing spent fuel from ARS only when a full core reserve (FCR) limit has been reached:

Cumulative AFR Profile (MTU)

Year	Firm	Projected	Total
1985	96	0	96
1990	201	0	201
2000	411	247	658

Views Regarding Alternative Spent Fuel Disposition Programs

(Deleted)

3.AT.2 Nuclear Power Profile

Austria's energy profile is oil - 50 percent; coal - 21 percent, gas - 17 percent, and hydro - 11 percent. Fifty percent of the supplies of the first four resources are imported. In the winter, when hydropower is low, electricity is imported from Germany, then exported back in the summer. Austria's total installed electric capacity is 7,000 MWe; approximately 70 percent is provided by hydropower, with the remainder supplied by a combination of coal and oil.

Seven years ago, Austria embarked on a nuclear power program in an effort to offset the anticipated increasing dependence on imported fuel. The first power plant, a 700 MWe boiling water reactor (BWR), is scheduled for criticality in early 1978. Yet in response to growing public concern for proper and safe waste management, the government has delayed the startup until more comprehensive solutions are discovered. Plans to order a 1,000 MWe light water reactor (LWR) in the early 1980s, and one more each for 1984, 1987 and 1990 have been deferred for the same reason, thus nuclear power additions will not occur until the late 1980's or early 1990's.

Table 3.AT-1 summarizes the present Austrian nuclear power program.

Table 3.AT-2 shows the profile for the presently perceived Austrian nuclear program (firm) and anticipated future reactor growth (projected). The total Austrian nuclear power generating capacity was 0 GWe in 1977. The projected capacities will reach .7 GWe in 1985, 2 GWe in 1990 and 5 GWe in 2000.

Table 3.AT-1: Nuclear Power Program - Austria

REACTOR	UTILITY	MWe	REACTOR TYPE	OPERATION DATE	STATUS
Tullnerfeld 1	Gemeinschaftskernkraft-werk Tullnerfeld	692	BWR	5/78	Under Construction

Table 3AT-2
NUCLEAR POWER GENERATING CAPACITY PROFILE — AUSTRIA

YEAR	GENERATING CAPACITY (MWE) FIRM	PROJECTED	TOTAL
1977	0.	0.	0.
1978	692.	0.	692.
1979	692.	0.	692.
1980	692.	0.	692.
1981	692.	0.	692.
1982	692.	0.	692.
1983	692.	0.	692.
1984	692.	0.	692.
1985	692.	0.	692.
1986	692.	0.	692.
1987	692.	0.	692.
1988	692.	0.	692.
1989	692.	0.	692.
1990	692.	1300.	1992.
1991	692.	1600.	2292.
1992	692.	1900.	2592.
1993	692.	2200.	2892.
1994	692.	2500.	3192.
1995	692.	2800.	3492.
1996	692.	3100.	3792.
1997	692.	3400.	4092.
1998	692.	3700.	4392.
1999	692.	4000.	4692.
2000	692.	4300.	4992.
2010	692.	4300.	4992.
2020	692.	4300.	4992.
2030	692.	4300.	4992.

3.AT.3 Spent Fuel Disposition Policies, Plans and Programs

Austria has adopted a policy (although not yet a law) requiring permanent disposition of highly radioactive materials from reactors before a new reactor can be fueled. To date, Austria has been unable to define a program which will satisfy the above policy.

For the time being, the Austrians are relying on interim storage. They are considering a rack densification program for the basin of their first reactor, which will allow it a 10-year life without AFR storage. Moreover, they have designed a 500 MTU national interim storage facility which will help satisfy their storage requirements until the 1990's. Unfortunately, these plans do not provide permanent solutions and cannot satisfy the new policy.

As a result of difficulties in arriving at a satisfactory program to implement the policy of an "acceptable permanent disposition for high level wastes", Austrian officials are investigating several alternatives, namely:

1. Negotiations are currently underway with COGEMA to reprocess 222 MTU of spent fuel during the 1981 to 1990 time period. COGEMA cannot offer, at present, permanent disposition in their "terms and conditions" and has the option to return high level waste to the country of origin.

2. Discussions have been held with DWK - the Federal Republic of Germany's (F.R.G.) utility for implementing the F.R.G. "back-end" fuel cycle programs - regarding inclusion of Austria's spent fuel within F.R.G.'s program. No decisions have been made due to the sensitive state of the F.R.G. program.

3. Austrians have contracted with the U.S.S.R. to supply fuel for their second reactor. The U.S.S.R. takes back all spent fuel, thus providing a permanent disposition for the Austrians.

4. Discussions were being held with Iran regarding possible permanent disposition of high level waste in Iran.

5. Austrians expressed interest in the October 1977 U.S. spent fuel storage policy; have had some preliminary meetings with U.S. officials on this subject; and expressed concern at the current "indefiniteness" of the subject policy with respect to the immediate needs.

Principal hurdles to an Austrian permanent disposal solution are as follows:

1. Currently available external programs (e.g., European reprocessing services) do not provide a guaranteed permanent disposition of high level wastes and have an option to return these wastes to the country of origin.

2. Other external options are too preliminary to satisfy Austrian near and interim term needs.

3. A domestic program to site a geologic repository is encountering local resistance even at its preliminary stage. Austrian officials believe they may have suitable geologic conditions (granite) for permanent storage, but are unable to start a drilling program due to local resistance.

3.AT.4 Spent Fuel Disposition Profiles

Operating Reactor Disposition Profile

The first Austrian reactor (Tullnerfeld) will begin operation in 1978 and make its initial spent fuel discharge in 1980. Currently the Austrians have provided for an ARS capacity of Full Core Reserve plus one discharge load.

Spent Fuel Reprocessing Arrangements

Currently, Austria is negotiating with COGEMA to dispose of 223 MTU during the 1981-1990 time period. The contemplated shipment schedule to Cap La Hague (COGEMA) is given below:

Projected Disposition to COGEMA

Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Annual (MTU)	32	25	20	18	23	21	21	21	21	21
Cum (MTU)	32	57	77	95	118	139	160	181	202	223

Centralized AFR Storage

Austrians have designed a 500 MTU national interim storage facility as an alternative means of satisfying their storage requirements until the 1990's.

Projected Spent Fuel Disposition Profiles

In order to provide a quantitative framework for evaluating spent fuel disposition requirements, the following exhibits are included:

Table 3.AT-3 summarizes the reactor and at-reactor storage characteristics associated with the currently defined Austrian nuclear power program. Correspondingly, Table 3.AT-4 summarizes the spent fuel generation and away-from-reactor (AFR) disposition requirements for the currently defined nuclear power program.

Table 3.AT-5 provides (a) the annual spent fuel generation profile and (b) the annual AFR disposition profile (based on a Full Core Reserve criteria) for both the currently defined reactor program (firm) and for anticipated future reactor additions (projected). Table 3.AT-6 provides cumulative information for the same categorization.

Technical Factors

Austria forsess no technical problems in implementing an interim storage program should their policy-makers decide that such a program is acceptable. The basic requirements of such a program are shown below:

Program Element	Basin Size Current	Basin Size Planned	Date Required
ARS Densification	1 year discharge	10 year discharge	By 1980
Central Storage	-0-	500 MTU	By Mid to Late 1980's

Should Austria elect to ship their spent fuel to COGEMA, they would avail themselves of spent fuel transportation (see projected shipment schedule in Section 3.AT.4) with the following characteristics:

Consideration	Description
Casks	TN 17/75 metric tons LK 80/80 metric tons
Weight Limitation	80 metric tons
Shipment	Approximately 1500 km to Cap La Hague 1 week flow time (one way)

Table 3AT-3
REACTOR CHARACTERISTICS - AUSTRIA

FIRM REACTORS

REACTOR	MWE	START UP	CORE SIZE (MTU)	ANNUAL DISCHARGE (MTU)	EFFECTIVE ARS (MTU)
TULLNER. B	692	1978	90	21	30
PROJECTED REACTORS			MWE	(MTU PER 1000 MWE)	
		1989-1990	1300.	26.	130.
		1990-2000	3000.	26.	130.

Table 3AT-4
FIRM REACTOR SPENT FUEL PROFILE — AUSTRIA

FACILITY	DIS START YEAR	ANN DIS	EFF ARS	BEG AFR YEAR	1985 DIS	1985 AFR	1990 DIS	1990 AFR	2000 DIS	2000 AFR	2030 DIS	2030 AFR
TULLNER. B	1980	21	30	1981	126.	96.	231.	201.	441.	411.	1071.	1041.

CUMULATIVE (MTU)

Table 3AT-5

ANNUAL SPENT FUEL PROFILE — AUSTRIA

YEAR	ANNUAL DISCHARGE (MTU) FIRM	PROJECTED	TOTAL	ANNUAL AFR REQMT. (MTU) FIRM	PROJECTED	TOTAL
1977	0.	0.	0.	0.	0.	0.
1978	0.	0.	0.	0.	0.	0.
1979	0.	0.	0.	0.	0.	0.
1980	21.	0.	21.	0.	0.	0.
1981	21.	0.	21.	12.	0.	12.
1982	21.	0.	21.	21.	0.	21.
1983	21.	0.	21.	21.	0.	21.
1984	21.	0.	21.	21.	0.	21.
1985	21.	0.	21.	21.	0.	21.
1986	21.	0.	21.	21.	0.	21.
1987	21.	0.	21.	21.	0.	21.
1988	21.	0.	21.	21.	0.	21.
1989	21.	0.	21.	21.	0.	21.
1990	21.	0.	21.	21.	0.	21.
1991	21.	34.	55.	21.	0.	21.
1992	21.	42.	63.	21.	0.	21.
1993	21.	49.	70.	21.	0.	21.
1994	21.	57.	78.	21.	0.	21.
1995	21.	65.	86.	21.	0.	21.
1996	21.	73.	94.	21.	34.	55.
1997	21.	81.	102.	21.	42.	63.
1998	21.	88.	109.	21.	49.	70.
1999	21.	96.	117.	21.	57.	78.
2000	21.	104.	125.	21.	65.	86.
2010	21.	112.	133.	21.	112.	133.
2020	21.	112.	133.	21.	112.	133.
2030	21.	112.	133.	21.	112.	133.

Table 3AT-6
CUMULATIVE SPENT FUEL PROFILE —AUSTRIA

YEAR	CUM DISCHARGE (1000 MTU) FIRM	PROJECTED	TOTAL	CUM AFR RCMT, (1000 MTU) FIRM	PROJECTED	TOTAL
1977	0.000	0.000	0.000	0.000	0.000	0.000
1978	0.000	0.000	0.000	0.000	0.000	0.000
1979	0.000	0.000	0.000	0.000	0.000	0.000
1980	.021	0.000	.021	0.000	0.000	0.000
1981	.042	0.000	.042	.012	0.000	.012
1982	.063	0.000	.063	.033	0.000	.033
1983	.084	0.000	.084	.054	0.000	.054
1984	.105	0.000	.105	.075	0.000	.075
1985	.126	0.000	.126	.096	0.000	.096
1986	.147	0.000	.147	.117	0.000	.117
1987	.168	0.000	.168	.138	0.000	.138
1988	.189	0.000	.189	.159	0.000	.159
1989	.210	0.000	.210	.180	0.000	.180
1990	.231	0.000	.231	.201	0.000	.201
1991	.252	.034	.286	.222	0.000	.222
1992	.273	.075	.348	.243	0.000	.243
1993	.294	.125	.419	.264	0.000	.264
1994	.315	.182	.497	.285	0.000	.285
1995	.336	.247	.583	.306	0.000	.306
1996	.357	.320	.677	.327	.034	.361
1997	.378	.400	.778	.348	.075	.423
1998	.399	.489	.888	.369	.125	.494
1999	.420	.585	1.005	.390	.182	.572
2000	.441	.689	1.130	.411	.247	.658
2010	.651	1.807	2.458	.621	1.248	1.869
2020	.861	2.925	3.786	.831	2.366	3.197
2030	1.071	4.043	5.114	1.041	3.484	4.525

3AT.5 Legal And Regulatory Factors

A. Reactor Requirements

1. Minimum Holding Period at Reactor

Austria has no provision in its laws or regulations requiring a specific cooling off period for irradiated fuel.

2. Storage Capacity at Reactor

While the lack of an operating reactor makes any statement about the requirements for at-reactor spent fuel storage capacity uncertain, it now appears that the Ministry of Health and Ministry of Construction and Technology will require that the utility provide a minimum capacity. This determination will be made on a case-by case basis.

3. Disposition Plans for Spent Fuel as a Reactor License Requirement

The Austrian Government has concluded that a reactor may be operated only if the waste issue is settled. Austria officials informally say this condition could be met through either (1) a reprocessing contract, or (2) an agreement to store the fuel rods either under multinational auspices or in the United States. This, however, is a political decision, not binding on future governments.

Although the utilities could force the government to make a decision by filing an application with the Federal Ministry of Health and appealing the lack of a decision to the Court of Appeals, this practically will not happen given the Federal Government's 51 percent ownership of the utilities.

B. Custody and Licensing of Spent Fuel and its Handling

1. Custody

Custody of spent fuel is prohibited in this absence of a license from the Minister of Transport and Traffic (Appendix 0-1 §10).

2. Transport Including Packaging.

Under the Radiation Protection Act the Ministry of Transport and Traffic issues licenses based on the technical expertise and reliability of the applicant (Appendix 0-1). An IAEA-approved package must be used (id. §§7(4)b-c). The transporter must also advance notice to the Federal Chancellory prior to each shipment.

There are no restrictions as to the nationality of the transporter.

3. Storage License.

a. At Reactor.

Storage basins are considered an integral part of a reactor and are licensed as part of the reactor licensing process. For a description of the facility licensing process, see subsection b. of this section.

The enlargement of a reactor storage basin requires a license amendment which the Ministry of Health in coordination with the Ministry of Construction must approve (Appendix 0-1 §§6, 7 and 8). In determining whether to grant approval the Ministries will consider an array of health with the applicant as the only party which may present its views.

b. Away From Reactor.

In seeking a license for the construction of a centralized spent fuel storage facility an applicant must seek approval from a number of national and subnational authorities. Each will examine the application from its own area of expertise. These authorities include (with competences in parentheses):

- Ministry of Health (Nuclear Safety) (Appendix 0-1 §41(5))

- Ministry of Construction (Nuclear Safety) (id. §41(5))

- Ministry of Social Affairs (Occupational Health and Safety) (id. §41(1)i)

- The local Burgermaster (Building Permit) (id. §41(1))

- The affected Province (Site Permit) (id. §41(1))

4. Import Requirements

Nuclear imports are subject to the import controls imposed by the Austrian Foreign Trade Act.

5. Export Requirements

The Federal Chancellor after consulting with all affected ministries must approve the export of all nuclear materials and equipment. (Equipment falling under this category goes beyond the Zangger List and includes heavy water plants.) Exports will be made only to those nations which apply IAEA/NPT-type safeguards. In making this determination, the Federal Chancellor must exclude any considerations of economic profit (Appendix 0-3).

C. Supplemental Legal Requirements

1. Radiation Health and Safety

As is true with similar statutes in other countries, the primary purpose of the Radiation Protection Act is to protect the health of persons from radiation hazards. This includes both occupational and general public health and safety considerations.

The Act provides that the Ministries of Health and of Social Affairs (Appendix 0-1 §43(7)) shall provide detailed provisions as to:

- the radiation doses to which the human body may be exposed (id. §36(e)).
- the conditions to be met by installations or equipment emitting radiation (id. §63(a)).
- the handling of nuclear materials (id. §63(c), (g), (h)).

Thus far, most government decision making on these matters has been on an ad hoc basis. No implementing regulations have been published other than those contained in the Ordinance on Radiation Protection of 1972, which deals primarily with permissible dose-rates, methods of measurements and required precautions (Appendix 0-2).

2. Safeguards and Physical Security

a. International Requirements

Austria has a number of safeguards obligations imposed by international agreements, including, inter alia, with the United States and the International Atomic Energy Agency (IAEA). It also has ratified the Non-Proliferation Treaty as a non-nuclear weapons state.

Taken together, these international agreements impose strict supervision of spent fuel through on-site inspections by the Federal Chancellory and the IAEA. Under this scheme the facility operator is responsible for keeping records of all incoming fuel, its origin, designation and location. U.S. approval must be obtained prior to the retransfer or reprocessing of U.S. supplied fuel.

b. Domestic Requirements

A Materials Accounting Ordinance was issued in January, 1976, to implement the Austria-IAEA safeguards agreement.

In the near future the Federal Chancellory will submit a Physical Protection Act to the Parliament. This proposal is based on INFCIRC 225 as revised. Currently physical protection requirements are imposed as license conditions.

Special transport safeguards requirements include policy escorts and advance notification of shipments.

3. Environmental Requirements

The Radiation Protection Act gives the national government -- specifically the Ministry of Health (Appendix 0-1 S27(c)) -- authority to regulate air, water and soil pollution. All licensees must conduct their activities in accordance with these requirements.

On the whole, however, environmental matters are within the purview of the provinces and localities. As is the case for all industrial buildings, an applicant who seeks to build a facility must seek a building permit from the local Burgermaster. He has great discretion in applying the local law which governs. However, he must explain his actions, and a dissatisfied party may appeal his decision first to the Community Council and then to the Court of Appeals.

Additionally, an applicant must seek provincial approval. This occurs after the Minister of Health gives his approval to an applicant's proposed site. Currently there is a dispute over the extent of a province's jurisdiction in this regard, and it is likely the matter will be settled in the Constitutional Court.

4. Third Party Liability

The operator of a nuclear facility is absolutely liable for damage caused by a nuclear incident involving nuclear materials in his installation or directly originating therefrom (Appendix 0-4 S3(1)). This liability extends to incidents occurring until such time as the materials have been taken in custody by another operator of a nuclear facility situated in Austria (id., S3(2)). Thus, the operator of the facility is liable for a nuclear incident occurring during the transport of the materials until the materials:

- are taken into custody by the operator of another installation situated in Austria; or
- in the case of export are unloaded by the carrier at their foreign destination (id. S4(1)).

There are two exceptions to this rule. First, in the case of export, the consignee operator, with his written consent, is liable from the time the nuclear substances are unloaded abroad from the means of transport (id. S4(2)). Secondly, the carrier may be liable (1) where nuclear substances are merely in transit through Austria, or (2) where the materials are sent to Austria without the written consent of the operator of the nuclear facility situated in Austria, or (3) when the nuclear substances are not consigned to a facility, or such a facility cannot be identified (id., S4(3)).

This liability is limited to a maximum amount per incident of 500 million Austrian Shillings (id., S15(1)). To cover this liability, facility operators and carriers must provide financial security of 130 million Austrian Shillings (id., S17(1)). Such security must be maintained until ten years after the nuclear incident (id., S17(2)). If this amount should prove not sufficient in case of an incident, the Austrian Government will indemnify all persons liable under the Act up to the maximum amount (id., S21(1) and S23(1)).

The Austrian Third-Party Liability Act applies to incidents occurring and damage suffered in Austria where a nuclear incident occurring in Austria causes damage abroad. The Act applies only if the claimant is an Austrian citizen or derives his claim from an Austrian citizen, or in the case of death the deceased person was an Austrian citizen (id., S33).

5. Reporting and Inspection

All licensees must fulfill detailed reporting requirements. Nuclear facilities are inspected at least once a year; those facilities which are considered as giving rise to particular hazards are inspected at least every three months.

6. Public Participation

With regard to facilities licenses, such as a spent fuel facility, the directly affected public (neighbors, etc.) may participate in a legislative-type public hearing. The directly affected public is defined much narrower than the standing concept in the United States.

3.AT.6 Views Regarding Alternative Spent Fuel Disposition Program

(Deleted)

3.DN Visit Findings - Denmark

3.DN.1 Introduction

3.DN.1.1 Organizations Visited

The Danish organizations visited were: the Ris National Laboratory, the Ministry of Foreign Affairs, the Environment Board, the Ministry of Commerce, Kraftimport I/S, ELSAM, and the Danish Energy Agency.

3.DN.1.2 Spent Fuel Disposition Highlights

Policies, Plans and Programs

Denmark has no nuclear reactors in operation or under construction. Policy makers are seeking a solution that avoids permanent disposition in Denmark of spent fuel or HLW. Interim storage is considered inadequate and permanent storage not feasible in Denmark.

Principal Concerns

The policy objectives are not attainable in Denmark through present international offerings.

Spent Fuel Disposition Profile

The following cumulative discharge profile reflects projected spent fuel generation for the Danish LWR reactor program.

Cumulative Discharge Profile (MTU)

Year	Firm	Projected	Total
1985	0	0	0
1990	0	0	0
2000	0	494	494

The following cumulative away-from-reactor (AFR) spent fuel disposition profile is based on removing spent fuel from ARS only when a full core reserve (FCR) limit has been reached. A five year effective ARS storage capability is assumed for each reactor.

Cumulative AFR Profile (MTU)

Year	Firm	Projected	Total
1985	0	0	0
1990	0	0	0
2000	0	182	182

Views Regarding Alternative Spent Fuel Disposition Programs

(Deleted)

3.DN.2 Nuclear Power Profile

Even though Denmark has no nuclear reactors in existence or under construction, the draft of a national energy policy* does provide for the first LWR by 1985. This policy, presently the object of considerable national discussion, calls for 5,000 MWe nuclear by the early 1990's, which should constitute approximately two-thirds of their electricity production by that time. The policy, however, suffered a setback in August 1976, when the government postponed submitting to Parliament a law that would have initiated the policy's implementation. Approval would have enabled the government to initiate the construction process for the first nuclear power plant planned for Jutland. Public opinion was so divided, however, that the policy was not voted upon at that time. It is now unlikely that there will be any nuclear capacity before 1990. Denmark's only nuclear activity at the moment, other than planning and research, involves the development of its uranium resources in Greenland.

Table 3.DN-1 shows the profile for the presently perceived Danish nuclear program (firm) and the anticipated future reactor growth (projected). The total Danish nuclear power generating capacity was 0 GWe in 1977. The projected capacities will be 0 GWe in 1985, 1 GWe in 1990 and 3 GWe in 2000.

Table 3DN-1
NUCLEAR POWER GENERATING CAPACITY PROFILE — DENMARK

YEAR	GENERATING CAPACITY (MWE) FIRM	PROJECTED	TOTAL
1977	0.	0.	0.
1978	0.	0.	0.
1979	0.	0.	0.
1980	0.	0.	0.
1981	0.	0.	0.
1982	0.	0.	0.
1983	0.	0.	0.
1984	0.	0.	0.
1985	0.	0.	0.
1986	0.	0.	0.
1987	0.	0.	0.
1988	0.	0.	0.
1989	0.	0.	0.
1990	0.	1000.	1000.
1991	0.	1200.	1200.
1992	0.	1400.	1400.
1993	0.	1600.	1600.
1994	0.	1800.	1800.
1995	0.	2000.	2000.
1996	0.	2200.	2200.
1997	0.	2400.	2400.
1998	0.	2600.	2600.
1999	0.	2800.	2800.
2000	0.	3000.	3000.
2010	0.	3000.	3000.
2020	0.	3000.	3000.
2030	0.	3000.	3000.

3.DN.3 Spent Fuel Disposition Policies, Plans and Programs

Spent fuel policy*in Denmark is characterized by a "wait and see" attitude. Policymakers are seeking a "perfect" solution that avoids permanent disposition in Denmark of spent fuel and HLW. Storage of such materials in large at-reactor basins, or even a centralized, national storage basin, is considered an interim solution which evades the ultimate need for permanent disposal. Denmark is geologically unsuited for either deep granite or saltdome burial, and feels that the problem is not one they can solve alone.

3.DN.4 Spent Fuel Disposition Profiles

Table 3DN-2 provides (a) the annual spent fuel generation profile and (b) the annual AFR disposition profile (based on a Full Core Reserve criteria) for anticipated future reactor additions (projected). Table 3.DN-3 provides cumulative information for the same categorization.

*Danish Energy Policy - 1976.

Table 3DN-2
ANNUAL SPENT FUEL PROFILE — DENMARK

YEAR	ANNUAL DISCHARGE (MTU) FIRM	PROJECTED	TOTAL	ANNUAL AFR REQMT. (MTU) FIRM	PROJECTED	TOTAL
1977	0.	0.	0.	0.	0.	0.
1978	0.	0.	0.	0.	0.	0.
1979	0.	0.	0.	0.	0.	0.
1980	0.	0.	0.	0.	0.	0.
1981	0.	0.	0.	0.	0.	0.
1982	0.	0.	0.	0.	0.	0.
1983	0.	0.	0.	0.	0.	0.
1984	0.	0.	0.	0.	0.	0.
1985	0.	0.	0.	0.	0.	0.
1986	0.	0.	0.	0.	0.	0.
1987	0.	0.	0.	0.	0.	0.
1988	0.	0.	0.	0.	0.	0.
1989	0.	0.	0.	0.	0.	0.
1990	0.	0.	0.	0.	0.	0.
1991	0.	26.	26.	0.	0.	0.
1992	0.	31.	31.	0.	0.	0.
1993	0.	36.	36.	0.	0.	0.
1994	0.	42.	42.	0.	0.	0.
1995	0.	47.	47.	0.	0.	0.
1996	0.	52.	52.	0.	26.	26.
1997	0.	57.	57.	0.	31.	31.
1998	0.	62.	62.	0.	36.	36.
1999	0.	68.	68.	0.	42.	42.
2000	0.	73.	73.	0.	47.	47.
2010	0.	78.	78.	0.	78.	78.
2020	0.	78.	78.	0.	78.	78.
2030	0.	78.	78.	0.	78.	78.

Table 3DN-3
CUMULATIVE SPENT FUEL PROFILE —DENMARK

YEAR	CUM DISCHARGE (1000 MTU) FIRM	PROJECTED	TOTAL	CUM AFR RQMT. (1000 MTU) FIRM	PROJECTED	TOTAL
1977	0.000	0.000	0.000	0.000	0.000	0.000
1978	0.000	0.000	0.000	0.000	0.000	0.000
1979	0.000	0.000	0.000	0.000	0.000	0.000
1980	0.000	0.000	0.000	0.000	0.000	0.000
1981	0.000	0.000	0.000	0.000	0.000	0.000
1982	0.000	0.000	0.000	0.000	0.000	0.000
1983	0.000	0.000	0.000	0.000	0.000	0.000
1984	0.000	0.000	0.000	0.000	0.000	0.000
1985	0.000	0.000	0.000	0.000	0.000	0.000
1986	0.000	0.000	0.000	0.000	0.000	0.000
1987	0.000	0.000	0.000	0.000	0.000	0.000
1988	0.000	0.000	0.000	0.000	0.000	0.000
1989	0.000	0.000	0.000	0.000	0.000	0.000
1990	0.000	0.000	0.000	0.000	0.000	0.000
1991	0.000	.026	.026	0.000	0.000	0.000
1992	0.000	.057	.057	0.000	0.000	0.000
1993	0.000	.094	.094	0.000	0.000	0.000
1994	0.000	.135	.135	0.000	0.000	0.000
1995	0.000	.182	.182	0.000	0.000	0.000
1996	0.000	.234	.234	0.000	.026	.026
1997	0.000	.291	.291	0.000	.057	.057
1998	0.000	.354	.354	0.000	.094	.094
1999	0.000	.421	.421	0.000	.135	.135
2000	0.000	.494	.494	0.000	.182	.182
2010	0.000	1.274	1.274	0.000	.884	.884
2020	0.000	2.054	2.054	0.000	1.664	1.664
2030	0.000	2.834	2.834	0.000	2.444	2.444

3.DN.5 Legal and Regulatory Factors

Although Denmark has no Nuclear reactors in operation or under construction, its legal regime for nuclear activities is relatively well-defined. There is one caveat however, the Law of 4th of May 1976 on Measures of Safety and Environmental Protection relating to Nuclear Installations which will provide the keystone for the legal structure, but its coming into force depends upon the passage of a so-called "Initiation Law." Originally scheduled to be transmitted to the Parliament in September, 1976, the government delayed its transmittal to await a clarification of the necessary physical protection, waste management and capital investment requirements.

A. Reactor requirements

1. Minimum holding period at reactor

Not having a reactor in operation or under construction. Denmark has no provision in its law or regulations requiring a specific cooling off period for irradiated fuel.

2. Storage capacity at reactor

This information has not yet been obtained from Denmark.

3. Disposition plans for spent fuel as a reactor license requirement

There is no requirement currently that an applicant submit a plan to dispose of his spent fuel prior to receiving his reactor operating license. Whether the bill implementing the law of May 4, 1976 includes a requirement that a reactor present disposition plans for spent fuel prior to operation when it is ultimately transmitted to the Parliament will depend upon the prevailing political climate at that time.

B. Custody and licensing of spent fuel and its handling

1. Custody

A license to hold spent fuel must be obtained from the Minister of Environment. (Appendix D-1, §2). In making his decision on the application, the Minister must consider whether the proposed activity would be dangerous to public health and safety or "other vital public interests" (id.).

2. Transport including packaging

Under the Law of May 4, 1976, on Measures of Safety and Environmental Protection Relating to Nuclear Installations, a license is required for the carriage of nuclear fuel in radioactive products (id.). This license will be granted by the Minister for the Environment if he finds that the activity will not be dangerous to the public health and safety or "other vital public interests" (id.). If the license is granted, the competent authorities must insure the greatest possible safety measures (Appendix D-4, §3). There is no requirement that the licensee be a Danish National. Denmark ascribes to the IAEA regulations governing packaging.

3. Storage license

a. At reactor

This information has not yet been obtained from Denmark.

b. Away from reactor

The licensing procedure for nuclear installations involves three permits: site approval, construction permit and operation permit. These licenses are granted by the Minister of Environment, and the Minister's approval may include such license conditions deemed necessary with regard to safety or other vital public interests. These conditions may, at any time, be replaced by other conditions.

Site approval

The nuclear safety aspects of an application for site approval are dealth with by the Agency of Environmental Protection and the National Health Service. These agencies submit recommendations to the Minister for the Environment. In fulfilling this task the Agency is assisted by the Inspectorate of Nuclear Installations, which is an institution under the Agency: Recommendations to the Minister submitted by the Agency shall be accompanied by statements prepared by the Inspectorate.

Construction permit

The nuclear safety aspects of a construction permit application are examined by the Agency of Environmental Protection and the National Health Service. These agencies then submit recommendations to the Minister for the Environment.

Operating permit

Applications for operating permits follow the same procedures as those for construction permits.

Common statutory requirements

In making his decision on the application, the Minister of Environment must consider whether the proposed activity would be dangerous to public health and safety or "other vital interests" (Appendix D-1, §2).

4. Import requirements

The import of nuclear materials is governed by the transportation regulations laid down in the order relating to the Use of Radioactive Materials (Appendix D-6, §4).

5. Export requirements

Following its ratification of the Non-Proliferation Treaty, Denmark entered into an agreement with the IAEA on March 1, 1972 designed to prevent nuclear materials from being used for production of nuclear weapons or other nuclear explosive devices. In order to implement this agreement, the Ministry of Education (Appendix D-6, §1) issued an order which provides that the permission of the Atomic Energy Commission (Appendix D-6, §2) is needed for the possession and export of nuclear materials. The AEC may approve such requests only if the applicant agrees to--

- keep records of the nuclear materials, or, insofar as operators of nuclear facilities are concerned, maintain records of operational conditions; and
- submit reports on the above matters.

The order authorizes AEC inspectors to enter installations containing nuclear materials in order to take the necessary control measures such as examination of records, stocks and facilities, measurements and sampling.

C. Supplemental legal requirements

1. Radiological health and safety

All applications must be considered against the statutory test of whether the approval of the application would be "dangerous to the public health" (Appendix D-1, §2). To this end an applicant for a facility license must submit a technical report -- as outlined in Section B. 3.b. This document must contain the applicant's assessment and conclusions concerning nuclear safety for the proposed facility, including a description of the site and its surroundings and any supplementary information necessary for the handling of the application by the relevant authorities. If the agency approves the request, it may impose license conditions to insure the greatest possible safety measures (Appendix D-1, §5).

2. Safeguards and physical security

a. International requirements

Denmark has safeguards obligations imposed by several international agreements, including, inter alia, with EURATOM. It also has ratified the Non-Proliferation Treaty as a non-nuclear weapons state.

These international obligations impose strict supervision of spent fuel through on-site inspections of the Danish authorities and EURATOM. Under this scheme the facility operator is responsible for keeping records of all incoming fuel, its origin, designation, and location.

b. Domestic requirements

Denmark generally follows IAEA proposed safeguards requirements. Currently, it has adopted the guidelines for physical security suggested in INFCIRC 225, as revised. The Danish Government, however, has delayed submitting the "Initiation Laws" to the Parliament for, among other reasons, a lack of clarity on international physical protection requirements.

Danish law especially provides for the observance of the general recommendations issued at any time by the International Commission on Radiological Protection insofar as they concern the general public (Appendix D-4, §1). Additionally, the National Health Service not only determines the maximum release of radiation permitted during the normal operation of the plant, but also lays down the maximum radiation doses to persons which should not be exceeded in the case of an accident (Appendix D-3, §1). Specifically, radiological materials must be organized in such a way that no hazard to health may occur, including those which might arise from fire (Appendix D-4, §4(4)).

3. Environmental requirements

Environmental aspects, other than the nuclear safety aspects, are examined in the light of the legislation within the jurisdiction of the Minister for the Environment, including the Environmental Protection Act and the Safety and Environmental Act. Permits, approvals, etc., are granted by the Minister himself, also in cases where it is necessary to overrule other legislation within his jurisdiction. In this respect, the Minister can decree departures from the procedural provisions. In connection with an application for site approval, Parliament must be informed beforehand of the necessity for any such departures.

4. <u>Third-party liability</u>

As a general rule, the operator of a nuclear facility is solely responsible for any nuclear damage occurring in the facility or during shipments of material to and from the facility. This liability attaches even if the damage is fortuitous (Appendix D-5, §7 & 8(1). An exception involves cases where the damage is due to nuclear materials stored in the facility incidental to their carriage to and from a nuclear installation situated in the territory of a party to the Paris Convention (id., §10). In the case of damage caused by materials transported through Danish territory and for which no operator has responsibility, under the Ace liability is borne by the carrier (id., §9(3)). In the case of the international transport of nuclear materials, the operator liable must deliver to the carrier a certificate issued by a person who has furnished the financial security to cover the liability (id., §38). Without the certificate the carrier will not be authorized to transport the material through Denmark.

To cover this liability, the operator of a nuclear facility situated in Denmark must take out insurance to provide financial security which the Minister of Justice deems adequate (id., §26(1), §29(3)).

The liability of the operator is limited to 75 million Kroner for any one nuclear incident (id., §21 (1)). The state may intervene in the payment of compensation for nuclear damage either where the financial security of the operator liable is deficient, the rights to claim compensation are extinguished or under the Brussels Supplementary Convention where the financial security proves insufficient (id., §30).

In general, nuclear damage occurring in a state not a party to the Paris Convention is not covered by the Act unless the damage was caused by an incident occurring in Denmark (id., §5(1)). Nevertheless, compensation may be sought for damage caused by an incident occurring in a non-contracting state against a Danish nuclear operator where the damage arose in a contracting state or on the high-seas (id., §52).

5. Reporting and inspection

A nuclear facility, during its construction and during its operation, is subject to continuous control and inspection by the Ministry of Environment and the National Health Service. These authorities may require any information relevant to their statutory tasks and must be granted access to the installation at any time.

All licensees must maintain detailed records.

6. Public participation

Public hearings are held on the site application for a nuclear reactor. The hearings are held by the Minister for the Environment in cooperation with the regional and minicipal authorities concerned, prior to the submission of recommendations from the Agency of Environmental Protection to the Minister. During these hearings, information is provided on the assessments of safety and environmental protection submitted in connection with the application.

The regional and municipal authorities concerned submit statements on all applications for facilities in their areas.

Additionally, the final decision on a facility license is made by Parliament and is therefore political in nature. If one-third of the members of Parliament desire, a national referendum may be held to determine whether a particular parliamentary decision will be upheld.

3.DN.6 Views Regarding Alternative Spent Fuel Disposition Programs

(Pages 3DN-17 and 3DN-18 deleted)

3.FR Visit Findings - France

3.FR.1 Introduction

3.FR.1.1 Organizations Visited

The French organizations visited were: the Commisariat a l'Energie Atomique (CEA), Electricite de France (EdF) and Compagnie Generale des Matieres Nucleaires (COGEMA).

3.FR.1.2 Spent Fuel Disposition Highlights

Policies, Plans and Programs

The French are dedicated to reprocessing EdF fuel and foreign fuel, the latter particularly to increase their worldwide influence in nuclear programs and to continue momentum toward breeder decisions (in which they have a leading position). EdF at-reactor-storage will not be expanded in favor of centralized storage at La Haque. Reprocessing waste will be maintained in surface engineered storage with no schedule pressures for permanent storage.

Principal Concerns

Completion of foreign order taking for UP-3A capacity is a near term priority for financial reasons. There does not appear to be a concern over the possibilities of deferring or cancelling the French reprocessing program.

Spent Fuel Disposition Profile

The projected cumulative spent fuel discharges and away-from-reactor (AFR) disposition profiles for the EdF is given below:

Cumulative Discharge Profile (MTU)

Year	Firm	Projected	Total
1985	3381	530	3911
1990	6631	2896	9527
2000	13131	14843	27974

Cumulative AFR Profile (MTU)

Year	Firm	Projected	Total
1985	1415	0	1415
1990	4481	796	5277
2000	10981	8973	19954

The French intend to reprocess their spent fuel with the following reprocessing plant schedule:

Reprocessing Plant	Phase	Application
UP-2	- Currently 400 MTU/yr	- EdF fuel
	- 800 MTU/yr in 1980	- Small foreign fuel
UP-3A	800 MTU/yr in operation around 1985	- Foreign fuel for first 10 to 15 years - EdF fuel beyond
UP-3B	800 MTU/yr in operation around 1988	- EdF fuel

The French intend to have 6000 MTU head-end storage capacity at La Hague by 1985 with the initial 2000 MTU to be completed by 1980.

Views Regarding Alternative Spent Fuel Disposition Programs

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3.FR.2 Nuclear Power Profile

The energy scenario in France is similar to those of other countries included in this study - sparse indigenous resources, significant quantities of imported fuels and high energy costs. France's limited coal, oil, gas and hydro-electric resources have forced France to turn to nuclear energy, particularly to development of the LMFBR, as essential for stabilizing the cost of energy. Hence, French energy policy emphasizes continued nuclear power development with corresponding pricing and subsidy policies to encourage the utilization of electric power rather than gas and oil. In 1975, 60% of France's energy was provided by oil and only 1% by nuclear. A significant reverse trend is predicted for 1985 with oil falling to 41% and nuclear rising to 23%.

France's nuclear energy program, present and proposed, is impressive. Eight large-scale nuclear power plants currently operate in France (five GCR's, two PWR's and one LMFBR). The 1973 energy crisis stimulated the French to accelerate their program by ordering six 900 MWe reactors in 1974, six in 1975, and five 900 MWe and one 1300 MWe unit in 1976. France has the most advanced fast breeder reactor program of all the nuclear nations. The 240 MWe PHENIX fast breeder reactor reached criticality in 1973, was brought to full power in 1975. A temporary shutdown reduced its progress, but by 1977 it was functioning again, at 2/3 capacity. Plans are under way to construct a successor to PHENIX, the 1200 MWe commercial breeder SUPER PHENIX. Estimated criticality is in 1982. Table 3.FR-1 summarizes the present French nuclear power program.

The projected total French nuclear power generating capacity will reach 55 GWe by 1990 and 90 GWe by 2000.

Table 3.FR-2 shows the profile for the presently perceived French nuclear program (firm) and anticipated future reactor growth (projected).

Table 3.FR-1: Nuclear Power Program - France

REACTOR	UTILITY	MWe	REACTOR TYPE	OPERATION DATE	STATUS
Marcoule G2	Electricite de France (EdF)	40	GCR	4/59	O
Marcoule G3	EdF	40	GCR	5/60	O
Chinon 2	EdF	210	GCR	2/65	O
SENA	Societe d'Energie Nucleaire Franco-Belge des Ardennes	310	PWR	4/67	O
Monts d'Arree (Finistere)	EdF	70	GCHWR	7/67	O
Chinon 3	EdF	400	GCR	8/67	O
St. Laurent des Eaux 1	EdF	460	GCR	3/69	O
St. Laurent des Eaux 2	EdF	515	GCR	8/71	O
Bugey 1	EdF	540	GCR	4/72	O
Phenix	EdF	233	LMFBR	12/73	O
Fessenheim 1	EdF	890	PWR	7/77	O
Fessenheim 2	EdF	890	PWR	9/77	O
Bugey 3	EdF	925	PWR	10/77	C
Bugey 2	EdF	925	PWR	6/78	C
Bugey 4	EdF	905	PWR	2/79	C
Bugey 5	EdF	905	PWR	5/79	C
Tricastin 1	EdF	925	PWR	5/79	C
Gravelines B1	EdF	925	PWR	7/79	C
Dampierre 1	EdF	905	PWR	9/79	C
Tricastin 2	EdF	925	PWR	10/79	C
Gravelines B2	EdF	925	PWR	12/79	C

O = Operational
C = Under Construction
P = In Planning

Table 3.FR-1 (con't)

REACTOR	UTILITY	MWe	REACTOR TYPE	OPERATION DATE	STATUS
Dampierre 2	Electricite de France (EdF)	905	PWR	3/80	C
Tricastin 3	EdF	925	PWR	3/80	C
Gravelines B3	EdF	925	PWR	5/80	C
Dampierre 3	EdF	905	PWR	7/80	C
Tricastin 4	EdF	925	PWR	9/80	C
St. Laurent des Eaux B1	EdF	905	PWR	2/81	C
Gravelines B4	EdF	925	PWR	2/81	C
Blayais 1	EdF	925	PWR	2/81	C
Dampierre 4	EdF	905	PWR	4/81	C
St. Laurent des Eaux B2	EdF	905	PWR	6/81	C
Blayais 2	EdF	925	PWR	9/81	C
Chinon B1	EdF	905	PWR	2/82	C
Chinon B2	EdF	905	PWR	6/82	C
Super Phenix	EdF	1200	LMFBR	/82	P
Paluel 1	EdF	1300	PWR	2/83	C
Creys Malville	EdF	1200	LMFBR	2/83	P
Paluel 2	EdF	1300	PWR	5/83	P

O = Operational
C = Under Construction
P = In Planning

Table 3FR-2
NUCLEAR POWER GENERATING CAPACITY PROFILE — FRANCE-FCR

YEAR	GENERATING CAPACITY FIRM	PROJECTED	(MWE) TOTAL
1977	3015.	0.	3015.
1978	3940.	0.	3940.
1979	10355.	0.	10355.
1980	14940.	0.	14940.
1981	20430.	2040.	22470.
1982	22240.	4080.	26320.
1983	24840.	6120.	30960.
1984	24840.	8160.	33000.
1985	24840.	10200.	35040.
1986	24840.	14200.	39040.
1987	24840.	18200.	43040.
1988	24840.	22200.	47040.
1989	24840.	26200.	51040.
1990	24840.	30200.	55040.
1991	24840.	33700.	58540.
1992	24840.	37200.	62040.
1993	24840.	40700.	65540.
1994	24840.	44200.	69040.
1995	24840.	47700.	72540.
1996	24840.	51200.	76040.
1997	24840.	54700.	79540.
1998	24840.	58200.	83040.
1999	24840.	61700.	86540.
2000	24840.	65200.	90040.
2010	24840.	65200.	90040.
2020	24840.	65200.	90040.
2030	24840.	65200.	90040.

3.FR.3 Spent Fuel Disposition Policies, Plans and Programs

The French policy objectives are quite simple. First, France will develop the breeder for the European market. Second, France will not overlook opportunities for breeder royalties or direct participation in the North American market. And third, France will offer reprocessing and associated interim storage to foreign customers who earn a place in the contract line. Foreign reprocessing waste will be returned to the country of origin at a later date.

The lead time for the breeder, upon which the French reprocessing program is founded, involved rapid demonstration and commercialization. Reprocessing must proceed expeditiously to first extract plutonium from LWR spent fuel, and then, to reprocess breeder fuel. The prinicipal thrust of reprocessing is aimed at the breeder and not at LWR recycle. France presently needs 15 tons of plutonium to prepare three breeder cores.

Breeder reactor development is the primary influence on the LWR interim storage and reprocessing program. Requirements and programs for spent fuel permanent disposition are not as critical to the continuation of the on-going French LWR program as they are in other countries, for example Germany. Permanent storage solutions will come eventually, but in the meantime engineered surface storage of conditioned reprocessing waste is an acceptable solution.

International spent fuel transport, storage and reprocessing services offered by COGEMA serve a number of purposes. They increase French worldwide influence in nuclear programs, and they continue momentum toward breeder decisions in which the French have a leading position. The French program promotes favorable reprocessing facility investment conditions which can be used to enhance balance of trade conditions and improve support of internal EdF program. Finally, COGEMA offers provide a strong fuel cycle program associated with the export sale of French supplied reactor plants.

In a procedure covered by the Treaty of Rome, the French utility, EdF, is treated as a preferential customer from a reprocessing pricing standpoint. The reprocessing waste from foreign spent fuel will be returned in a vitrified condition (glassified in stainless steel containers). COGEMA interim storage of foreign fuel will be done only in support of reprocessing contracts.

In support of these policies, COGEMA is implementing an aggressive modular build-up of reprocessing plant capacities (see Spent Fuel Disposition Profiles - Section 3.FR.4) and through its association with Nuclear Transport Limited (NTL) can offer extensive spent fuel transportation services.

Nuclear Transport Limited, a joint venture between the British, French and Germans, plans to provide transportation services, principally to COGEMA clients in Europe. The German utilities, however, are interested in seeing competitive transport service develop beyond NTL. Sea transport serving Japan, and possibly Sweden, would be provided by Pacific Nuclear Transport Limited (PNTL).

The estimated cost by COGEMA for reprocessing in the UP-3A plant is between $300 and $400/KgU, which covers storage, reprocessing and glassification of reprocessing waste. The French did not elaborate upon the terms offered to foreign clients, but the terms have been revealed in meetings with several client countries. COGEMA favors cost type contracts with a 25 percent fee or profit. The client must support the capital investment in the plant, pursuant to his share of the first ten year output, by advancing an interest free loan. This cost plus fee or profit arrangement is in effect for the initial ten years of plant operation, starting in 1985. Capital charges are included in the cost payments minus the prepayments. At the end of the initial ten year period, the client has an option to extend usage of the plant for a limited number of years (for Germany, five years) at commercial rates.

COGEMA contracts are either finalized or developing with Austria, Netherlands, Spain, Sweden, Germany, Switzerland, Belgium and Japan. Under these arrangements, the fuel title remains with the foreign utility. Japan is the largest foreign customer with obligations approximating $2.2 billion that cover the basic price, inflation and profit. The Germans are the next largest foreign client with plans to spent 2 billion DM.

3.FR.4 Spent Fuel Disposition Profile

Operating Reactor Disposition Profile

The French at-reactor-storage designs are as follows:

Reactor	ARS Capacity
• Fessenheim and Bugey Reactors	1 and 1/3 core
• CP-1 Program (includes 16 reactors in the 900 MWe to 1300 MWe range)	1 and 4/3 core

It is intended that spent fuel be transferred to the La Hague head-end facility for reprocessing.

Centralized AFR Storage

The head-end storage facilities at La Hague will be expanded in order to serve COGEMA's reprocessing requirements. Expansion plans are as follows:

Time Period	Pool Capacity
Current	250 MTU
By 1980	2250 MTU
By 1982-83	6250 MTU

Spent Fuel Reprocessing

In regard to COGEMA reprocessing developments, the UP1 plant reprocesses graphite reactors for military purposes. The UP2 reprocessing plant is to be expanded from 400 to 800 MTU per year and will start reprocessing in 1980. The UP-3A reprocessing plant, at 800 MTU/year, is planned to be committed to the foreign market for ten years starting in 1985. The French hope to get 6000 MTU in foreign order commitments for those ten years and they are planning to use the foreign market to support the development of the UP-3A plant during its initial operations. The plant may either remain dedicated to the foreign market or shift to EdF requirements after its initial 10-15 years of operation depending on foreign market conditions and French planning desires. The UP-3B reprocessing plant, at 800 MTU/year, is planned for EdF fuel starting in 1988, at which time the French will have a capacity for reprocessing 2400 MTU/year. EdF spent fuel generation will be at a rate of 800 MTU/year in 1985 and 1500 MTU/year in 1990.

Projected Spent Fuel Disposition Profiles

In order to provide a quantitative framework for evaluating spent fuel disposition requirements, the following exhibits are included:

Table 3.FR-3 summarizes the reactor and at-reactor-storage characteristics associated with the currently defined French nuclear power program. Correspondingly, Table 3.FR-4 summarizes the spent fuel generation and away-from-reactor (AFR) disposition requirements for the currently defined nuclear power program.

Table 3.FR-5 provides (a) the annual spent fuel generation profile and (b) the annual AFR disposition profile (based on a Full Core Reserve criteria) for both the currently defined reactor program (firm) and for anticipated future reactor additions (projected). Table 3.FR-6 provides cumulative information for the same categorization.

Technical Factors

Shipments to La Hague will be by water, rail and/or oversized truck. As a measure of cask traffic to La Hague, five casks will be received daily during full operations of the UP-3A plant. In order to meet health and radiation standard under this high throughput rate, COGEMA is designing an improved cask. COGEMA indicated that it will have the new cask design licensed by the end of 1979 and that the specifications are such that casks will not be interchangeable between COGEMA and BNFL operations.

Table 3FR-3
REACTOR CHARACTERISTICS - FRANCE-FOR

FIRM REACTORS

REACTOR		MWE	START UP	CORE SIZE (MTU)	ANNUAL DISCHARGE (MTU)	EFFECTIVE ARS (MTU)
SENA	P	310	1967	38	12	12
FESSEN-1	P	890	1977	70	23	23
FESSEN-2	P	890	1977	70	23	23
BUGEY-3	P	925	1977	72	23	23
BUGEY-2	P	925	1978	72	23	23
BUGEY-4	P	905	1979	70	23	23
BUGEY-5	P	905	1979	70	23	23
TRICASE-1	P	925	1979	72	24	96
GRAVEL-B1	P	925	1979	72	24	96
DAMP-1	P	905	1979	72	24	96
TRICASE-2	P	925	1979	72	24	96
GRAVEL-B2	P	925	1979	72	24	96
DAMP-2	P	905	1980	72	24	96
TRICASE-3	P	925	1980	72	24	96
GRAVEL-B2	P	925	1980	72	24	96
DAMP-3	P	905	1980	72	24	96
TRICASE-4	P	925	1980	72	24	96
ST.LAUR-1	P	905	1981	72	24	96
GRAVEL-4	P	925	1981	72	24	96
BLAYAS-1	P	925	1981	72	24	96
DAMP-4	P	905	1981	72	24	96
ST.LAUR-2	P	905	1981	72	24	96
BLAYAS-2	P	925	1981	72	24	96
CHIN-B1	P	905	1982	72	24	96
CHIN-B2	P	905	1982	72	24	96
PALUEL-1	P	1300	1983	102	34	136
PALUEL-2	P	1300	1983	102	34	136

PROJECTED REACTORS

	MWE	(MTU PER 1000 MWE)	
1980-1985	10200.	26.	104.
1985-1990	20000.	26.	104.
1990-2000	35000.	26.	104.

Table 3FR-4

FIRM REACTOR SPENT FUEL PROFILE — FRANCE-FCR

FACILITY		DIS START YEAR	ANN DIS	EFF ARS	BEG AFR YEAR	CUMULATIVE (MTU) 1985 DIS	1985 AFR	1990 DIS	1990 AFR	2000 DIS	2000 AFR	2030 DIS	2030 AFR
SENA	P	1968	12	12	1969	216.	204.	276.	264.	396.	384.	756.	744.
FESSEN-1	P	1978	23	23	1979	184.	161.	299.	276.	529.	506.	1219.	1196.
FESSEN-2	P	1978	23	23	1979	184.	161.	299.	276.	529.	506.	1219.	1196.
BUGEY-3	P	1978	23	23	1979	184.	161.	299.	276.	529.	506.	1219.	1196.
BUGEY-2	P	1979	23	23	1980	161.	138.	276.	253.	506.	483.	1196.	1173.
BUGEY-4	P	1980	23	23	1981	138.	115.	253.	230.	483.	460.	1173.	1150.
BUGEY-5	P	1980	23	23	1981	138.	115.	253.	230.	483.	460.	1173.	1150.
TRICASE-1	P	1980	24	96	1984	144.	48.	264.	168.	504.	408.	1224.	1128.
GRAVEL-B1	P	1980	24	96	1984	144.	48.	264.	168.	504.	408.	1224.	1128.
DAMP-1	P	1980	24	96	1984	144.	48.	264.	168.	504.	408.	1224.	1128.
TRICASE-2	P	1980	24	96	1984	144.	48.	264.	168.	504.	408.	1224.	1128.
GRAVEL-B2	P	1980	24	96	1984	144.	48.	264.	168.	504.	408.	1224.	1128.
DAMP-2	P	1981	24	96	1985	120.	24.	240.	144.	480.	384.	1200.	1104.
TRICASE-3	P	1981	24	96	1985	120.	24.	240.	144.	480.	384.	1200.	1104.
GRAVEL-B2	P	1981	24	96	1985	120.	24.	240.	144.	480.	384.	1200.	1104.
DAMP-3	P	1981	24	96	1985	120.	24.	240.	144.	480.	384.	1200.	1104.
TRICASE-4	P	1981	24	96	1985	120.	24.	240.	144.	480.	384.	1200.	1104.
ST.LAUR-1	P	1982	24	96	1986	96.	0.	216.	120.	456.	360.	1176.	1080.
GRAVEL-4	P	1982	24	96	1986	96.	0.	216.	120.	456.	360.	1176.	1080.
BLAYAS-1	P	1982	24	96	1986	96.	0.	216.	120.	456.	360.	1176.	1080.
DAMP-4	P	1982	24	96	1986	96.	0.	216.	120.	456.	360.	1176.	1080.
ST.LAUR-2	P	1982	24	96	1986	96.	0.	216.	120.	456.	360.	1176.	1080.
BLAYAS-2	P	1982	24	96	1986	96.	0.	216.	120.	456.	360.	1176.	1080.
CHIN-B1	P	1983	24	96	1987	72.	0.	192.	96.	432.	336.	1152.	1056.
CHIN-B2	P	1983	24	96	1987	72.	0.	192.	96.	432.	336.	1152.	1056.
PALUEL-1	P	1984	34	136	1988	68.	0.	238.	102.	578.	442.	1598.	1462.
PALUEL-2	P	1984	34	136	1988	68.	0.	238.	102.	578.	442.	1598.	1462.

Table 3FR-5
ANNUAL SPENT FUEL PROFILE — FRANCE-FCR

YEAR	ANNUAL DISCHARGE FIRM	PROJECTED	(MTU) TOTAL	ANNUAL AFR REQMT. FIRM	PROJECTED	(MTU) TOTAL
1977	12.	0.	12.	12.	0.	12.
1978	81.	0.	81.	12.	0.	12.
1979	104.	0.	104.	81.	0.	81.
1980	270.	0.	270.	104.	0.	104.
1981	390.	0.	390.	150.	0.	150.
1982	534.	53.	587.	150.	0.	150.
1983	582.	106.	688.	150.	0.	150.
1984	650.	159.	809.	270.	0.	270.
1985	650.	212.	862.	390.	0.	390.
1986	650.	265.	915.	534.	53.	587.
1987	650.	369.	1019.	582.	106.	688.
1988	650.	473.	1123.	650.	159.	809.
1989	650.	577.	1227.	650.	212.	862.
1990	650.	681.	1331.	650.	265.	915.
1991	650.	785.	1435.	650.	369.	1019.
1992	650.	876.	1526.	650.	473.	1123.
1993	650.	967.	1617.	650.	577.	1227.
1994	650.	1058.	1708.	650.	681.	1331.
1995	650.	1149.	1799.	650.	785.	1435.
1996	650.	1240.	1890.	650.	876.	1526.
1997	650.	1331.	1981.	650.	967.	1617.
1998	650.	1422.	2072.	650.	1058.	1708.
1999	650.	1513.	2163.	650.	1149.	1799.
2000	650.	1604.	2254.	650.	1240.	1890.
2010	650.	1695.	2345.	650.	1695.	2345.
2020	650.	1695.	2345.	650.	1695.	2345.
2030	650.	1695.	2345.	650.	1695.	2345.

Table 3FR-6

CUMULATIVE SPENT FUEL PROFILE —FRANCE-FCR

YEAR	CUM DISCHARGE (1000 MTU) FIRM	PROJECTED	TOTAL	CUM AFR RQMT. (1000 MTU) FIRM	PROJECTED	TOTAL
1977	.120	0.000	.120	.108	0.000	.108
1978	.201	0.000	.201	.120	0.000	.120
1979	.305	0.000	.305	.201	0.000	.201
1980	.575	0.000	.575	.305	0.000	.305
1981	.965	0.000	.965	.455	0.000	.455
1982	1.499	.053	1.552	.605	0.000	.605
1983	2.081	.159	2.240	.755	0.000	.755
1984	2.731	.318	3.049	1.025	0.000	1.025
1985	3.381	.530	3.911	1.415	0.000	1.415
1986	4.031	.796	4.827	1.949	.053	2.002
1987	4.681	1.165	5.846	2.531	.159	2.690
1988	5.331	1.638	6.969	3.181	.318	3.499
1989	5.981	2.215	8.196	3.831	.530	4.361
1990	6.631	2.896	9.527	4.481	.796	5.277
1991	7.281	3.682	10.963	5.131	1.165	6.296
1992	7.931	4.558	12.489	5.781	1.638	7.419
1993	8.581	5.525	14.106	6.431	2.215	8.646
1994	9.231	6.583	15.814	7.081	2.896	9.977
1995	9.881	7.732	17.613	7.731	3.682	11.413
1996	10.531	8.973	19.504	8.381	4.558	12.939
1997	11.181	10.304	21.485	9.031	5.525	14.556
1998	11.831	11.726	23.557	9.681	6.583	16.264
1999	12.481	13.239	25.720	10.331	7.732	18.063
2000	13.131	14.843	27.974	10.981	8.973	19.954
2010	19.631	31.795	51.426	17.481	25.015	42.496
2020	26.131	48.747	74.878	23.981	41.967	65.948
2030	32.631	65.699	98.330	30.481	58.919	89.400

3.FR.5 Legal and Regulatory Factors

A. Reactor requirements on spent fuel

1. Minimum holding period at reactor

This information has not yet been obtained from France.

2. Storage capacity at reactor

This information has not yet been obtained from France.

3. Disposition plans for spent fuel as a reactor license requirement

This information has not yet been obtained from France.

B. Custody and licensing of spent fuel and its handling

1. Custody

The Decree of March 15, 1967, (Appendix F-1), requires governments authorization before obtaining custody of spent fuel.

2. Transport including packaging

France has adopted IAEA proposed transport regulations, including those for packaging and operating procedures.

The regulations contained within the Interministerial Order of June 24, 1974, (Appendix F-2), lay down a number of general packaging and package design requirements, which ensure that the transport takes place without exposing transport and storage personnel, as well as members of the public, to radiation in excess of the permitted doses. Accordingly, the packaging must be so designed that the package can be easily handled and can be properly secured in, or on, the conveyance during transport. The additional requirements refer, among other things to the dimensions of the packaging, external surfaces, resistance to variations in temperature, the physical and chemical compatibility of the package with its contents, etc.

The Annexes to the regulations set out a number of tests to which the different packaging types may be subjected in order to demonstrate the ability of the packaging to prevent loss or dispersal of the radioactive contents and any increase of the maximum radiation level recorded or calculated at the external surface before the test. The tests include testing of the integrity of containment and shielding, tests for demonstrating the ability to withstand normal conditions of transport and tests for demonstrating the ability to withstand accident conditons. Certain packaging types have to be approved by the Minister for Transport, who delivers a certificate containing specific information pertinent to the packaging and its contents. A package containing radioactive material may not contain any other items except the articles and documents which are necessary for the use of the radioactive material.

The regulations require the approval for the shipment of a number of specified packages. The application for shipment approval must include the period of time for which the approval is sought, the actual contents, the expected modes of transport, the probable or proposed route, etc. For spent fuel, advance transport notice has to be given to the National Service for Civil Protection.

Packages of radioactive materials may not be loaded in the same means of transport ad dangerous goods, which could adversely affect the integrity of the packaging of these radioactive materials under accident conditions. In addition, the quantity of packages, which may be transported on the same means of transport is limited to a certain maximum. Once the vehicle has been loaded, nobody may come near the radioactive materials during the transport.

a. At reactor

The French consider the construction of a spent fuel basin as incidental to the reactor licensing process (Appendix F-3, §3). For a discussion of the facility licensing process, see subsection b. of this section.

If the licensee should desire to significantly modify his storage basin, he must follow the same basic procedure as he did in obtaining his original license (*id.*, §4).

4. Import requirements

and

5. Export requirements

This information has not yet been obtained from France.

C. Supplemental legal requirements

1. Radiation health and safety

The Decree of December 11, 1963, as amended (Appendix F-3), makes no reference to a safety examination. Thus, French administrative practice has placed the emphasis on procedures for the assessment of nuclear safety. Certain measures are planned along these lines, but the aim would seem to fix targets rather than impose methods or standards upon the operator.

Decree No. 73-278 of March 13, 1973, established two bodies relating to radiological health and safety (Appendix F-5). First, it created an independent Higher Council for Nuclear Safety, an advisory body the purpose of which is to raise issues of concern. It also established a central service for safety of nuclear installations to --

- prepare technical regulations to a general character or relating to a specific installation
- follow research efforts being conducted domestically and internationally
- conduct inspections of installations

The Interministerial Committee created by the 1963 Decree (Appendix F-3, §7) must review all regulations for protection of workers or the public health and safety.

2. Safeguards and physical security

a. International requirements

The EURATOM safeguards system presently applies to all U.S.-supplied special nuclear material exported to France. Under the U.S.-EURATOM Agreement, the principles of the EURATOM safeguards system are compatible with and based upon those required by the IAEA and followed by that agency in the implementation of safeguards under the NPT. Further, under the Agreement the standards of the U.S. materials accountability system and that of EURATOM are required to be reasonably comparable.

France is a nuclear weapons state but under the provisions of the EURATOM Agreement is committed to use U.S.-supplied nuclear material, pursuant to that agreement, solely for peaceful purposes. Additionally, in an address to the General Assembly of the United Nations in 1968, the French Representative stated that France "will behave in the future in this field exactly as the States adhering to the Treaty."

b. Domestic requirements

This information has not yet been obtained from France.

3. Environmental requirements

The Act of August 2, 1961 (Appendix F-6), charges SCPRI with responsibility for monitoring radiation levels in areas adjoining nuclear installations. The Act calls for subsequent Council of State Decrees to establish conditions under which nuclear installations are constructed, operated and inspected.

The Decree of December 11, 1968, (Appendix F-3) establishes a special regime for nuclear installations in accordance with provisions in the act concerning atmospheric pollution. Under this Decree, the SCPRI maintains systematic surveillance of the environment under annual agreements made between the Ministry responsible for public health and the CEA or Electricite de France (Ministry for Scientific and Industrial Development).

Section 7 of the same Decree requires any regulations designed to protect the environment be reviewed by the Interministerial Committee.

The Act of December 16, 1964, (Appendix F-7), along with subsequent orders and decrees, establishes methods of examining and controlling amounts of radioactivity in drinking water are also established. The Act forbids discharge or submergence of harmful atomic wastes in sea water, unless the Prefect of the Department, after a public inquiry, authorizes and regulates such discharges.

4. Third-party liability

As a general rule, the operator of a nuclear facility is solely responsible for any nuclear damage occurring in the facility or during shipments of material to and from the facility. This liability attaches even if the damage is fortuitous (Appendix F-4, §3). A carrier of nuclear materials may apply to be substituted for the operator liable, with the agreement of such operator, provided that he meets the requirements relating to financial security (id., §2).

To cover this liability, the operator of a nuclear facility situated in France must take out insurance or provide financial security of not less than 50 million francs (id., §9). In the case of transport over French territory, proof must be provided of the existence of financial security of at least 600 million frances (id.).

The liability of the operator is limited to 50 million francs for any one nuclear incident (id., §6). The state may intervene in the payment of compensation, up to a maximum of 600 million francs (id., §5).

In general, nuclear damage occurring in a state not a party to the Paris Convention is not covered by the Act unless the damage was caused by an incident occurring in France (id., §20). Nevertheless, compensation may be sought for damage caused by an incident occurring in a non-contracting state against a French nuclear operator where the damage arose in a contracting state or on the high-seas (id.). The Act is applicable to the French overseas possessions.

5. Reporting and inspections

All licensees must establish and maintain a detailed reporting system. Additionally, all are subject to inspection either by officials of the Central Service for Protection against Ionizing Radiations (SCPRI) or those of large nuclear installations (Appendix F-3, §11). In the exercise of these functions these officials shall keep in close contact with the departmental services concerned (id.)

6. Public participation

French law requires compulsory public proceedings for the construction and operation of LNIs. This participation is entirely written; French law provides no mechanism for oral hearings. Any person whose rights may be affected may intervene, and the definition of rights has been defined by French case law to include moral rights (see Appendix F-5, 910). Licenses can be appealed in the administrative courts.

3.FR.6 Views Regarding Alternative Spent Fuel Disposition Programs

(Deleted)

3.DE Visit Findings - Federal Republic of Germany

3.DE.1 Introduction

3.DE.1.1 Organizations Visited

The German organizations visited were: the Ministry for Research and Technology, Rheinisch-Westfalisches Elektrizitatswerk (RWE), the major German utility company, Deutsche Gesellschaft fue Wiederaufarbertung von Kerbrennstoffen (DWK), the newly formed fuel cycle company, Wirtschaftsverband Kernbrennstoffkreislauf E.V., the association of German nuclear fuel cycle suppliers, and Geschaftsfuher Deutsches Atomforum E.V., the German Atomic Forum.

3.DE.1.2 Spent Fuel Disposition Highlights

Policies, Plans and Programs

"Closure of the back-end" of the nuclear fuel cycle in order to recover plutonium for the breeder and achieve an acceptable permanent disposition of high level waste (HLW) is the cornerstone of F.R.G. spent fuel disposition policy.

All F.R.G. factions agree that a final solution for the disposition of HLW is required in order that reactor plant construction can proceed.

The Gorleben fuel cycle center is a key element in implementing the F.R.G. spent fuel disposition policy in that it will provide an integrated fuel cycle center including a reprocessing plant and geologic disposal facility.

Since the Gorleben reprocessing facility will not be operational until at least 1990, an interim spent fuel disposition plan is essential. The F.R.G. is evaluating several alternatives including:

(1) Densification of at-reactor-storage basins
(2) Building of a head-end spent fuel storage facility as early as possible at Gorleben
(3) Building a stand-alone AFR apart from Gorleben
(4) Contracting for reprocessing services from COGEMA.

In order to meet interim spent fuel disposition needs, three out of these four alternatives must be implemented. Yet all the above alternatives have obstacles and drawbacks associated with them.

Principal Concerns

The near term concerns are (a) to maintain scheduled momentum of LWR plant development by visibility of moving towards solution of the waste management issue and (b) to solve the interim spent fuel disposition problem.

Long term concern is supporting the breeder program.

Spent Fuel Disposition Profile

The F.R.G. anticipates generating approximately 7000 MTU of spent fuel by 1990. A reasonable spent fuel disposition distribution is as follows:

Disposition	Amount (Cum MTU to 1990)
At-Reactor-Storage	1500 (No densification)
	2800 MTU (Densification of new plants)
Gorleben AFR	Up to 3000 MTU depending on licensing and construction schedule
Stand-Alone AFR	1500 MTU
COGEMA	Up to 1700 MTU depending on need

The following cumulative spent fuel discharge and away-from-reactor profiles are projected for the F.R.G. nuclear power program:

Cumulative Discharge Profile (MTU)

Year	Firm	Projected	Total
1985	3734	0	3734
1990	6814	645	7459
2000	12974	7964	20938

Cumulative AFR Profile (MTU)

Year	Firm	Projected	Total
1985	2180	0	2180
1990	3855	0	3855
2000	9830	3167	12997

Views Regarding Alternative Spent Fuel Disposition Programs

(Deleted)

3.DE.2 Nuclear Power Profile

The current Federal Republic of Germany (F.R.G.) energy requirements are provided by a combination of fossil fuels, notably oil (50 percent), hard coal (18 percent), lignite (10 percent), and natural gas (16 percent). F.R.G. is almost entirely dependent upon imports for its oil supplies (95 percent), primarily from the Middle East. In order to reduce dependence on imports for energy supplies, a partial substitution of oil by coal is a basic aim of the F.R.G. energy program. Some F.R.G. officials have mentioned that difficulties exist within F.R.G.'s coal power industry as evidenced by the fact that eight proposed coal power plants are experiencing licensing problems. Additionally, F.R.G. hard coal is expensive and difficult to mine and already is a subsidized industry. Lignite is very inexpensive, but is in limited quantity.

The need to replace fossil energy sources has also led to governmental support for development of nuclear energy. It is anticipated that nuclear energy will become steadily more significant in the years to come, providing 45 percent of the F.R.G.'s energy by 1985. The F.R.G. policy on energy growth, however, chooses nuclear energy as the last alternative. The Ministry of Research and Technology hopes this will still allow moderate nuclear growth.

The F.R.G. is dedicated to the concept that the breeder reactor is essential to the future viability of the F.R.G.'s highly industrialized economy. Despite the F.R.G.'s successful maintenance of foreign trade surplus while simultaneously absorbing the more than four-fold increase in oil prices, the heavy dependence on imported, cartel-regulated oil is unacceptable. The virtual absence of domestic uranium resources makes a reliance on once-through light water reactor cycle equally unattractive. For these reasons, the breeder reactor is a crucial variable in the F.R.G. energy scenario.

Table 3.DE-1 describes the current F.R.G. nuclear power program.

Table 3.DE-2 shows the profile for the presently perceived F.R.G. nuclear program (firm) and anticipated future growth (projected). The total F.R.G. nuclear generating capacity is projected to reach 35 GWe by 1990 and 70 GWe by 2000.

Table 3.DE-1: Nuclear Power Program - Federal Republic of Germany

REACTOR	UTILITY	MWe	REACTOR TYPE	OPERATION DATE	STATUS
Karlsruhe MZRF	Kernforschungszentrum Karlsruhe	52	PHWR	10/62	O
KRB 1 Block A	Kernkraftwerk RWE - Bayernwerk GmbH	237	BWR	4/67	O
Lingen KWL	Kernkraftwerk Hamm GmbH	256	BWR	10/68	O
Obrigheim KWO	Kernkraftwerk Obrigheim GmbH	328	PWR	3/69	O
KWW	Preussiche Elektrizitats AG	640	BWR	3/72	O
Stade KKS	Kernkraftwerk Stade GmbH	630	PWR	5/72	C
Biblis A	Rheinisch-Westfalisches	1146	PWR	6/74	O
GKN 1	Gemeinschaftkernkraftwerk Neckar	805	PWR	10/76	O
Biblis B		1240	PWR	12/76	O
Brunsbuettel	Kernkraftwerk Brunsbuettel GmbH	771	BWR	2/77	O
KKU	Kernkraftwerk Unterwesser GmbH	1230	PWR	3/77	O
Isar KKI	Kernkraftwerk Isar	870	BWR	7/77	C
KKP 1	Kernkraftwerk Philippsburg	864	BWR	/78	C
Upper Rhine	Kernkraftwerk Sud GmbH	1300	PWR	6/79	P
Grafenrheinfeld KKG	Bayernwerk AG	1225	PWR	9/79	C

O = Operational
C = Under Construction
P = In Planning

REACTOR	UTILITY	MWe	REACTOR TYPE	OPERATION DATE	STATUS
Kaerlich		1228	PWR	/79	C
Kruemmel KKK	Kernkraftwerk Kruemmel GmbH	1260	BWR	2/80	C
THTH 300	Hochtemperatur-Kern-Kraftwerk GmbH	300	THTR	/80	P
KRB II Block C		1249	BWR	7/81	C
GKN 2		805	PWR	/81	P
Hamm	Kernkraftwerk Hamm GmbH	1300	PWR	/81	P
KWG	Gemeinschaftkernkraft-werk Grchnde GmbH	1294	PWR	/81	C
KRB II Block B		1249	BWR	7/82	C
KKP 2		1281	PWR	/82	P
Biblis C		1228	PWR	/82	P
Kalkar SNR-300	Schnell-Bruter-Kern-kraftwerksgesellschaft	282	LMFBR	/82	C
Brokdorf	Kerndraftwerk Brokdorf GmbH	1290	PWR	/83	P
Neupotz 1		1300	PWR	/83	P
Neupotz 2		1300	PWR	/85	P

O = Operational
C = Under Construction
P = In Planning

Table 3DE-2
NUCLEAR POWER GENERATING CAPACITY PROFILE — FRG-FCR

YEAR	GENERATING CAPACITY (MWE) FIRM	PROJECTED	TOTAL
1977	8516.	0.	8516.
1978	9416.	0.	9416.
1979	13327.	0.	13327.
1980	13327.	0.	13327.
1981	15998.	0.	15998.
1982	22618.	0.	22618.
1983	22618.	0.	22618.
1984	22618.	0.	22618.
1985	22618.	0.	22618.
1986	22618.	2480.	25098.
1987	22618.	4960.	27578.
1988	22618.	7440.	30058.
1989	22618.	9920.	32538.
1990	22618.	12400.	35018.
1991	22618.	15900.	38518.
1992	22618.	19400.	42018.
1993	22618.	22900.	45518.
1994	22618.	26400.	49018.
1995	22618.	29900.	52518.
1996	22618.	33400.	56018.
1997	22618.	36900.	59518.
1998	22618.	40400.	63018.
1999	22618.	43900.	66518.
2000	22618.	47400.	70018.
2010	22618.	47400.	70018.
2020	22618.	47400.	70018.
2030	22618.	47400.	70018.

3.DE.3 Spent Fuel Disposition Policies, Plans and Programs

The F.R.G. nuclear energy discussion focusses on waste disposal. The government plan has always been for reprocessing and waste treatment. The possible savings associated with LWR recycle are relevant, but even more important is the fact that all political elements agree on final solution of nuclear waste being a condition of continued reactor plant licensing. The government policy is to reprocess before final storage and also that the government would have responsibility for permanent waste disposition. The licensing process for power reactors requires the planned capability of reprocessing and permanent storage of waste as a pre-condition for new construction permits.

A specific fuel cycle policy was articulated more by the interested private sector than by the Federal Government. Deutsche Gesellschaft Fur Wiederaufarbeitung Von Kernbrennstoffen (DWK), the company formed by the F.R.G. electric utilities to perform fuel cycle services (excluding permanent disposal) and RWE (a major F.R.G. electric utility) both expressed the "F.R.G. policy" for spent fuel disposition to be:

(1) reprocessing,

(2) burn up of plutonium in LWR recycle and breeder reactors, and

(3) conditioning and permanent storage of reprocessing waste.

Even if enriched uranium supply were or is available to F.R.G. utilities with attractive economics in comparison with reprocessing, the present F.R.G. requirements on fuel disposition would force the utilities to a reprocessing scenario.

The F.R.G sees possible stable uranium prices up to the year 2000, but beyond that they see the need for the breeder "or something". The interest in LWR recycle seems to have three paths in F.R.G. attitudes. The first is that recycle can save some 30% of uranium requirements and 25% in enrichment capacity requirements. The second path assesses that with relatively stable uranium prices (possibly through 2000), electric utilities would be just as advantaged to purchase LEU until the breeder is commercialized. The final and controlling path is that the reprocessing and permanent waste storage programs must maintain momentum or the German political support for continued LWR licensing would be lost.

Historically FRG utilities were interested in reprocessing as an economic measure. The value of recovered material had to be in excess of prices for the takeover of spent fuel assemblies by a reprocessor. Economic uncertainties and strong competition at a very early stage discouraged reprocessing investment by industry. Reprocessing development was the government's responsibility, and industries were expected to take over the developed processes which had successfully demonstrated experience. However, the FRG chemical industry did see the proper returns-on-investment to proceed with commercialization. The Government retained responsibility for permanent storage but required the private sector do the rest. The FRG utilities under the leadership of RWE moved quickly to form and finance a private company, DWK, to complete the fuel cycle.

Spent fuel interim storage focusses on the FRG planning to close the nuclear fuel cycle through an integrated facility to be operated by DWK in the state of Lower Saxony at Gorleben, about five miles from the East Germany border. This facility would have co-located spent fuel interim storage, reprocessing, uranium product buffer storage, MOX fuel fabrication (for LWR or FBR), reprocessing waste treatment and interim storage, and terminal storage of conditioned waste.

The flow of material associated with Gorleben would be:

- spent fuel going from power reactors to Gorleben

- fresh uranium or MOX fabricated fuel bundles going from Gorleben to the power reactors
- uranium products from Gorleben for conversion and enrichment.

No plutonium in a refined, pure and easily accessible form would leave the Gorleben facility.

DWK is responsible for all Gorleben operations except terminal storage of conditioned waste, which will be conducted by the government through the agency Physikalisch-Technische Bundesanstalt (PBT).

The Gorleben schedule estimates are:

- license application submitted - 1977
- licensed approved - 1981
- interim spent fuel storage start date - 1985
- reprocessing start date - 1990
- peramennt storage start date - 1995

The cost estimate for the entire Gorleben facility, including perament storage, is in the range of 5 billion DM (1976). The range of processing cost is 500-1000 DM/kg U. The Gorleben planners are interested in good cost control to assure that electric utilities do not abort the program in the early 1980's before the major investments are required. The indications are that the government and the utilities are steadfast in supporting Gorleben at this time.

The Gorleben facility is expected to require four years in the licensing process including the licensing of the permanent storage facility. No construction of any elements of the facility, such as interim spent fuel storage, may proceed until the entire facility is licensed. Because of this, interim storage facilities are planned in another FRG state at Ahaus.

Since the Ahaus AFR (1500 MTU) will not fully meet near and interim term spent fuel disposition requirements prior to start up of Gorleben, the FRG is considering increasing at-reactor storage capacities and contracting for spent fuel reprocessing services with COGEMA.

3.DE.4 Spent Fuel Disposition Profile

Operating Reactor Disposition Profile

FRG officials indicated that previously at-reactor storage capacities were designed for 5/3 core total pool capacity and that densification programs at new reactors will have up to 11/3 core total pool capacity.

The apparent [1] situation at operating FRG reactors is as follows:

	---------- MTU ----------				
Reactor	Core Size	Pool Size Total	Pool Size LFCR	1-78 Spent Fuel Inventory	1978&1979 Discharge
Gundremingern	45	73	28	10	22
Obrigheim	34	56	22	30	22
Lingen	32	51	19	39	14
Stade	55	91	36	58	56
Biblis A	103	171	68	64	68
Neckar	63	95	32	23	46
Wuergassen	87	129	36	44	42
		666[2]			

As can be seen from the above table, all operating FRG reactions have critical at-reactor storage situations.

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1) FRG provided overall program data but did not provide specific reactor related data (as of 1/15/78).

2) DWK indicated that current FRG at-reactor storage is 600 MTU.

Even though the at-reactor-storage can be easily expanded from 5/3 to 11/3 core using existing densification design, current German licensing requirements mandate that the entire plant be updated to current safety specifications, which is a practical impossibility for RWE. The limiting factor is the containment building which would require increased resistance to direct aircraft impact (now based on Phantom, previously was Starfighter). The concept of FCR on a site versus plant basis is not yet accepted. New reactor plants can easily accommodate 11/3 core at-reactor-storage capacity through compact spacing.

Spent Fuel Reprocessing Arrangements

To date, FRG has contracted for the following reprocessing services[1]:

Reactor	Reprocesser	Spent Fuel (MTU) Storage	Spent Fuel (MTU) Reprocessed
Gundremingern	BNFL	21	--
	GOGEMA	26	--
	Eurochemic	--	18
	GWK	7	5
Obrigheim	COGEMA	33	--
	GWK	13	15
Lingen	BWFL	12	4
Stade	COGEMA	52	--

1) Reference: U.S. and non-U.S. LWR Spent Fuel Storage prepared for U.S. D.O.E. by NAC (July 1977).

FGR is currently negotiating with COGEMA to seek approximately 1700 MTU of additional reprocessing services. Approximately 1700 MTU of deliveries would be made to COGEMA between 1978 and 1984 according to the following schedule:

	------ Deliveries to COGEMA (MTU) ------						
	1978	1979	1980	1981	1982	1983	1984
Total FRG Program	200	270	0	285	310	360	285
RWE	--	178	56(?)	78	78	150	118

FRG expects to begin shipping spent fuel to the Gorleben "head-end" facility beginning in 1984-1985. Initial annual shipments in the 1985-1986 period will be at 250-350 MTU/YR.

Centralized AFR Storage

The FRG projects a need for approximately 4500 MTU of centralized AFR storage prior to 1990. The FRG plans to build the following facilities:

Facility	Size (MTU)	Operational Date
Interim Storage (Ahaus)	1500	1983-84
Gorleben "Head-End"	3000	1985-86

Projected Spent Fuel Disposition Profiles

The following table compares data from DWK (total FRG reactor program), RWE (RWE reactors only) and GSFLS analysis (total FRG reactor program) on spent fuel discharge profiles.

--- Cum Discharge from 1978 (MTU) ---					
END OF YEAR	1978	1979	1980	1981	1982
Total FRG (DWK)	200	470	730	1010	1360
Total FRG (GSFLS)	243	556	869	1249	1629
RWE only	50	136	214	292	442
	1983	1984	1985	1986	1987
Total FRG (DWK)	1740	2340	2940	3620	4360
Total FRG (GSFLS)	2077	2693	3309	3926	4605
RWE only	---	---	---	632	857
	1988	1989	1990		
Total FRG (DWK)	5160	6010	6885		
Total FRG (GSFLS)	5350	6159	7033		
RWE only	1112	1402	1757		

In order to provide a quantitative framework for evaluating spent fuel disposition requirements, the following exhibits are included:

Table 3.DE-3 summarizes the reactor and at-reactor-storage characteristics associated with the currently defined FRG nuclear power program. Correspondingly, Table 3.DE-4 summarizes the spent fuel generation and away-from-reactor (AFR) disposition requirements for the currently defined nuclear power program.

Table 3.DE-5 provides (a) the annual spent fuel generation profile and (b) the annual AFR disposition profile (based on a Full Core Reserve criteria) for both the currently defined reactor program (firm) and for anticipated future reactor additions (projected). Table 3.DE-6 provides cumulative information for the same categorization.

Table 3DE-3

FIRM REACTOR SPENT FUEL PROFILE — FRG-FCR

FACILITY		DIS START YEAR	ANN DIS	EFF ARS	BEG AFR YEAR	CUMULATIVE (MTU) 1985 DIS	1985 AFR	1990 DIS	1990 AFR	2000 DIS	2000 AFR	2030 DIS	2030 AFR
GUNDR-A	B	1970	11	28	1972	176.	148.	231.	203.	341.	313.	671.	643.
OBRIG	P	1970	11	22	1972	176.	154.	231.	209.	341.	319.	671.	649.
LINGEN	B	1970	7	19	1972	112.	93.	147.	128.	217.	198.	427.	408.
WUERGAS	B	1976	23	42	1977	230.	188.	345.	303.	575.	533.	1265.	1223.
STADE	P	1974	14	36	1976	168.	132.	238.	202.	378.	342.	798.	762.
BTBLIS-A	P	1976	34	68	1978	340.	272.	510.	442.	850.	782.	1870.	1802.
BRUNSB	B	1978	23	73	1981	184.	111.	299.	226.	529.	456.	1219.	1146.
NECKAR-1	P	1977	23	32	1978	207.	175.	322.	290.	552.	520.	1242.	1210.
ISAR	B	1978	27	65	1980	216.	151.	351.	286.	621.	556.	1431.	1366.
BIBLIS-B	P	1978	34	68	1980	272.	204.	442.	374.	782.	714.	1802.	1734.
PHILI-1	B	1979	27	66	1981	189.	123.	324.	258.	594.	528.	1404.	1338.
UNTUR	P	1978	36	66	1979	288.	222.	468.	402.	828.	762.	1908.	1842.
KRUEM	B	1979	43	94	1981	301.	207.	516.	422.	946.	852.	2236.	2142.
MVUHL	P	1981	32	288	1990	160.	0.	320.	32.	640.	352.	1600.	1312.
GRAFEN	P	1981	35	272	1988	175.	0.	350.	78.	700.	428.	1750.	1478.
GUNDR-B	B	1983	34	274	1991	102.	0.	272.	0.	612.	338.	1632.	1358.
GROHNDE	P	1983	34	274	1991	102.	0.	272.	0.	612.	338.	1632.	1358.
BROCK	P	1984	34	274	1992	68.	0.	238.	0.	578.	304.	1598.	1324.
PHILI-2	P	1984	34	274	1992	68.	0.	238.	0.	578.	304.	1598.	1324.
WYHL -1	P	1984	34	274	1992	68.	0.	238.	0.	578.	304.	1598.	1324.
BASF -1	P	1984	11	93	1992	22.	0.	77.	0.	187.	94.	517.	424.
HAMM	P	1984	34	274	1992	68.	0.	238.	0.	578.	304.	1598.	1324.
NECKAR-2	-	1984	21	168	1992	42.	0.	147.	0.	357.	189.	987.	819.

Table 3DE-4

ANNUAL SPENT FUEL PROFILE — FRG-FCR

YEAR	ANNUAL DISCHARGE FIRM	PROJECTED	(MTU) TOTAL	ANNUAL AFR REQMT. FIRM	PROJECTED	(MTU) TOTAL
1977	123.	0.	123.	53.	0.	53.
1978	243.	0.	243.	114.	0.	114.
1979	313.	0.	313.	129.	0.	129.
1980	313.	0.	313.	209.	0.	209.
1981	380.	0.	380.	289.	0.	289.
1982	380.	0.	380.	313.	0.	313.
1983	448.	0.	448.	313.	0.	313.
1984	616.	0.	616.	313.	0.	313.
1985	616.	0.	616.	313.	0.	313.
1986	616.	0.	616.	313.	0.	313.
1987	616.	64.	680.	313.	0.	313.
1988	616.	129.	745.	321.	0.	321.
1989	616.	193.	809.	348.	0.	348.
1990	616.	258.	874.	380.	0.	380.
1991	616.	322.	938.	444.	0.	444.
1992	616.	413.	1029.	603.	64.	667.
1993	616.	504.	1120.	616.	129.	745.
1994	616.	595.	1211.	616.	193.	809.
1995	616.	686.	1302.	616.	258.	874.
1996	616.	777.	1393.	616.	322.	938.
1997	616.	868.	1484.	616.	413.	1029.
1998	616.	959.	1575.	616.	504.	1120.
1999	616.	1050.	1666.	616.	595.	1211.
2000	616.	1141.	1757.	616.	686.	1302.
2010	616.	1232.	1848.	616.	1232.	1848.
2020	616.	1232.	1848.	616.	1232.	1848.
2030	616.	1232.	1848.	616.	1232.	1848.

Table 3DE-5

CUMULATIVE SPENT FUEL PROFILE --FRG-FCR

YEAR	CUM DISCHARGE (1000 MTU) FIRM	PROJECTED	TOTAL	CUM AFR RQMT. (1000 MTU) FIRM	PROJECTED	TOTAL
1977	.425	0.000	.425	.187	0.000	.187
1978	.668	0.000	.668	.301	0.000	.301
1979	.981	0.000	.981	.430	0.000	.430
1980	1.294	0.000	1.294	.639	0.000	.639
1981	1.674	0.000	1.674	.928	0.000	.928
1982	2.054	0.000	2.054	1.241	0.000	1.241
1983	2.502	0.000	2.502	1.554	0.000	1.554
1984	3.118	0.000	3.118	1.867	0.000	1.867
1985	3.734	0.000	3.734	2.180	0.000	2.180
1986	4.350	0.000	4.350	2.493	0.000	2.493
1987	4.966	.064	5.030	2.806	0.000	2.806
1988	5.582	.193	5.775	3.127	0.000	3.127
1989	6.198	.387	6.585	3.475	0.000	3.475
1990	6.814	.645	7.459	3.855	0.000	3.855
1991	7.430	.967	8.397	4.299	0.000	4.299
1992	8.046	1.381	9.427	4.902	.064	4.966
1993	8.662	1.885	10.547	5.518	.193	5.711
1994	9.278	2.480	11.758	6.134	.387	6.521
1995	9.894	3.167	13.061	6.750	.645	7.395
1996	10.510	3.944	14.454	7.366	.967	8.333
1997	11.126	4.813	15.939	7.982	1.381	9.363
1998	11.742	5.772	17.514	8.598	1.885	10.483
1999	12.358	6.822	19.180	9.214	2.480	11.694
2000	12.974	7.964	20.938	9.830	3.167	12.997
2010	19.134	20.288	39.422	15.990	14.126	30.116
2020	25.294	32.612	57.906	22.150	26.450	48.600
2030	31.454	44.936	76.390	28.310	38.774	67.084

Technical Factors

With respect to spent fuel transportation, the FRG utilities would like to see one to three companies offering services. Very little planning has gone into transportation at this point. The utilities want to influence these companies in areas such as shipping cask availability. DWK will have to coordinate with COGEMA to assure that cask designs can serve both La Hague, Corleben and Ahaus facilities. If FRG consumates a contract with COGEMA it will be shipping spent fuel to La Hague via truck or rail. The expected "trip" flow time is 12-18 days. COGEMA will probably use NTL 14 (78 ton) and TN2 (36-38 ton) spent fuel casks.

3.DE.5 Legal and Regulatory Factors

A. Reactor requirements on spent fuel

1. Minimum holding period at reactor

This information will need to be secured.

2. Storage capacity at reactor

The capacity and margins for spent fuel storage at a reactor site are not controlled by German law but are handled by administrative procedures. The current approach has been to require a four-thirds core of capacity. With high-density racking this can rise to eleven-thirds core. The margin approach is to keep full-core reserve at all times. This is a matter that is handled in the licensing procedures.

3. Disposition plans for spent fuel as a reactor license requirement

The basic German law does not require a solution to the back end of the fuel cycle before a reactor license can be issued. However, government policy does use such an approach and therefore, as a reactor license condition, the utility must describe the fuel cycle in the construction permit. By law the Federal Government is responsible for the ultimate disposal of high-level waste. However, industry is responsible for storage, transportation, reprocessing, recycle and waste preparation of spent fuel materials. The licensing of a nuclear power reactor is subject to proof of disposal provisions. There is a diffentiation in proof; one concerns proof of disposal provisions for authorizing the first partial construction and the other for the operation of the power reactor. Before the first partial construction of a power reactor is authorized it is necessary to provide that sufficient spent fuel storage capacity will be provided for interim storage; and also that sufficient steps are taken for the reprocessing and final disposal of nuclear waste. Operating a nuclear power reactor, proof of a secure spent fuel storage for a period of six years from the start-up is required. It is mandatory to supply this proof during the whole period of a power reactor.

B. Custody and licensing of spent fuel and its handling

1. Custody

Spent nuclear fuel is required to be kept in government custody (Appendix G-2, §5(1)) or by persons possessing a license to store spent fuel (Appendix G-2, §6) or to hold it for transport, export or import (Appendix G-2, §4, 5(2)). A utility must have a license to possess spent fuel elements at reactor sites and must secure a license to transport the spent fuel to storage or reprocessing facilities. It transferred to a storage or reprocessing facility, the responsibility at those locations shifts to Deutsche Gesellashaft Suer Wiederausarbertung Zon Kerndrenn-stoffen (DWK). DWK in turn is required to secure a government license to design, construct and operate storage and reprocessing facilities. After reprocessing, the responsibility for the residual high-level waste shifts to the Federal Government, and here the Federal Institute of Physics and Technology is the competent authority for government custody (Appendix G-2, §23(1)). The question as to exactly when title passes from the utility to DWK is not at this moment clear.

2. Transport including packaging

For transport of spent fuel outside a controlled area, a license is required from the "Physikalisch-Technische Bundesanstalt" (Federal Department of Physical Engineering) (Appendix G-2 §§ 4 (1), 23(1)(3)).

The license is granted to the consignor or the transporter (id. §4(1)), and a separate license is required for each carriage except a general license may be obtained for a period of up to three years (*id.*, § 4(4)).

The conditions necessary for grant of a license are: conclusions on reliability of applicant (*id.*, §4 (2)(1)), applicant's knowledge of hazards (*id.*, (2)(2)), conformity with dangerous goods regulations for that mode of carriage (*id.*, (2)(3), financial security (*id.*, (2)(4)); physical protection (*id.*, (2)(5)); and finally, that the choice of mode, time and route are not contrary to the public interest (*id.*, (2)(6)).

Other dangerous goods regulations must also be followed (Appendix G-2, §4(6)), such as the Act Concerning the Carriage of Dangerous Goods (Appendix G-6), which covers carriage by rail, road and water. Shipping of spent fuel on the Rhine River and other federal waterways except the Danube and the Moselle is regulated by a special act (Appendix G-15). Local jurisdictions may impose additional non-safety requirements on those due to special local conditions. International transport is governed by treaty.

Getting a license for the transport of nuclear spent fuel does not depend on the nationality of the carrier.

3. Storage license

a. At reactor

Any person who stores nuclear fuel outside government custody requires a license (Appendix G-2, §6(1)). The conditions for granting a storage license are similar to those for a transport license, namely, reliability of applicant, financial security and physical security (Appendix G-2, §6(2)), plus additional requirements that there is a need for the storage, that the storage installation operator is competent and that every necessary state-of-the-art precaution has been taken to prevent injury (id.). Fees for cost of storage by the government of spent fuel are stated as a range, 0.2--10 units per 1000 units of value per month of storage, such value being before irradiation.

Two other regulations govern, being that government is required to supervise spent fuel transport and storage as well as license the activity (G-2 §19(1)), and for a facility, a nuisance license may be necessary (Appendix G-2 §8(2)).

Because of the limited capacity at existing reactors in Germany such as Biblis A and B, an important issue concerns the regulatory requirements in the event an application is filed to increase the capacity of the spent fuel storage facilities at the reactor site. Under German law if a proposed change is deemed to be significant for the entire plant, then "open procedures" are required whereby in the course of considering the proposed change the entire power plant status is reviewed. While there tends to be a certain degree of uncertainty, it has been indicated by Federal Government authorities that a proposed change of the spent fuel storage pool capacity at reactors would be considered a significant event requiring open procedures for the plant and thus a complete review of the plant's ability to meet current safety requirements.

b. Away from reactor

The general licensing provisions for a storage facility at the reactor apply to a facility away from the reactor. In this instance, however, the applicant will be DWK rather than the utility. Plans are underway by DWK to apply for a license for an interim storage facility called Ahaus. Since this would be an interim storage facility only, separate from a reactor or reprocessing facility, the application would not be filed under Section 7 of German nuclear law that is applicable to reactors and reprocessing facilities. Rather, the application would be filed under Section 6 of German nuclear law. Public hearings are not required under Section 6, and because of the current political situation in Germany, this may create difficulties. A final conclusion has not been reached, but it is anticipated that if the application is filed under Section 7, special procedures will be used that will provde for certain additional procedural approaches such as public hearings.

In addition, DWK filed an application on March 31, 1977, at Gorleben for authority to construct interim storage, reprocessing, mixed oxide fabrication, and high-level waste preparation facilities. This application will proceed under Section 7 of German law, with full public hearings. On July 28, 1977, the government filed an application for an ultimate disposal facility also at Gorleben, proceeding under Section 9B of German law.

Government regulatory policy requires that the license for the entire fuel park be filed as opposed to just an application for interim storage facilities. Because of the added time that this will take, as opposed to doing just an interim storage facility, it was necessary to move to another concept, such as Ahaus.

4. <u>Import requirements, including license</u>

As of this time, German policy does not contemplate the importation into Germany of spent fuel from other nations. This is due to the political difficulties that could arise prior to the resolution of issues concerning the back end of the fuel cycle. However, future changes in this position are not ruled out completely, including the possibility that with the International Nuclear Fuel Cycle Evaluation some proposals may arise which could affect this approach. Should a decision be reached that nuclear spent fuel can be imported into Germany, an import license would be required (Appendix G-2, §3(1)). An exception to the German policy of not permitting imports is the import from the Remerschen nuclear plant in Luxembourg based on the concept that it is 50 percent owned by DWK and that the electricity will principally flow into Germany.

As with license for storage and transport, detailed conditions for grant of the license are listed, including reliability of the importer (id., §3(2)(1)), and that the spent fuel will be used in conformity with the basic law (Appendix G-2) and other relevant ordinances and international obligations (id., (2)(2)).

The competent authority for import as well as export licenses is the Federal Office of Trade and Industry (Bundesamt fur gewerbeliche Wirtshaft (Appendix G-2(22)(1)), while control of imports and exports is by the Federal Minister of Finance (id., §22(2)). The basic law states that other import laws are not affected by these regulations (Appendix G-2, §3(4)).

5. Export requirements, including license

Export of spent fuel has requirements in the basic law similar to those required for an import license, plus a requirement that the export will not affect internal or external security of Germany (Appendix G-2, §3(3)(2)).

The principal export of spent nuclear fuel now being contemplated by Germany would be an export to France for reprocessing at COGEMA. The contract for this arrangement, however, has not been concluded. There are no governmental restrictions essentially on the export of spent fuel from Germany.

In January, 1976, the Suppliers' Club set up rules for nuclear exports. The Federal Republic of Germany adopted these rules in her nuclear list of foreign trade laws. Exports of sensitive elements and technologies have to be authorized.

C. Supplemental legal requirements

1. Radiation health and safety

German law includes as one of its purposes "to protect life, health and property from hazards of nuclear energy and from harmful effects of ionizing radiation" (Appendix G-2, §1(2)). The law also contains enabling provisions for an ordinance for the protection of individuals and the public including air and water concentrations of radioisotopes and accumulated dose measurements, together with appropriate record-keeping (Appendix G-2, §12). The competent authority for radiation health and safety is the Federal Minister of the Interior.

As authorized by German law, an ordinance on radiation protection was promulgated, and the latest version was published in 1976 (Appendix G-4). Radiation protection norms of EURATOM (1966) and OECD (1968) provide guidelines for this ordinance. Some guiding principles of interest include dose limits for workers, and application of the concept of "as low as practicable" (id.). A "radiation passport" is required in order to provide protection for workers employed on a "supra-regional basis."

Other applicable regulations include Convention No. 115 concerning protection of workers against ionizing radiation (Appendix G-16), and the Nuisance

Act (Appendix G-8) governing hazards and harmful affects of ionizing radiation. Several provisions of other laws include the requirement that "such precautions as are necessary in the light of existing scientific knowledge and technology shall be taken to prevent damage resulting from such [use]" (Appendix G-2, §5(1), 4(2)(3), 6(2)(2)).

Finally, any person who constructs or operates an installation in which nuclear fuel is handled has to insure that residual radioactive substances as well as radioactive parts removed or dismantled are utilized without harmful effects and disposed of as radioactive waste in an orderly manner (Appendix G-2, §9a(1)).

In discussing the German policy with regard to reprocessing, authorities tend to emphasize that the need for reprocessing is a safety consideration as opposed to an economic one. This is based upon the concept of reducing the volume of the waste and plutonium to minimum amounts and concentration. Such a requirement does not specifically appear in the law, but it is the type of issue that may be expected to be used in the licensing process.

2. Safeguards and physical security

a. International agreements

Germany is a party to the EURATOM Treaty and therefore uses the safeguards requirements contained in that Treaty. In addition, Germany is a signatory to the Non-Proliferation Treaty.

Both the IAEA and EURATOM have visited DWK, and it is possible that they may want different requirements, which could create some difficulties. At this time DWK would expect to meet the requirements of the IAEA.

b. Domestic requirements

German law requires that "necessary protection shall be provided against disturbance or other interference by third parties" (Appendix G-2, §5(1), 6(2) (4), 4(2) (5); G-3, §6, §10).

With regard to physical security, DWK at Gorleben anticipates providing the principal physical security, and the government's role is not clear.

3. Environmental requirements

The radiological environmental requirements have been described above. The nonradiological environmental requirements will be provided.

4. Third-party liabilities

One of the purposes of German law is "to provide compensation for damage caused by nuclear energy or ionizing radiation" (Appendix G-2, §1(2)). The regime for third-party liability is based on the several important European treaties on the subject, which include the Paris Convention (PC) (Appendix G-10), the Brussels Supplementary Convention (BSC) (Appendix G-11), and the Brussels Convention of 1971 (BC or IMCO Convention) (Appendix G-12).

General provisions of the PC, BSC and BC are discussed in connection with the European community. However, to outline the third-party liability regime in Germany, major subject areas include financial security, insurance, indemnity, liability limit, exoneration and exclusions, and territorial applicability.

German law specifies that financial security shall be determined by the competent authority during licensing proceedings, as to type, terms and amount; this determination must be reviewed every two years (Appendix G-3, §13(1)). The ordinance then states that such security can be either by insurance or indemnity (Appendix G-3, §1). There are special provisions for financial security for "irradiated nuclear fuel" (*id.*, §14). The amounts depend on the amount of fuel being transported or stored, and aggregates the license mass of fissionable materials (Appendix G-3, Annex 1), plus the standard coverage for the total licensed activity (*id.*, Annex 2), to give a single figure required. The amount of financial security for a person handling several batches of spent fuel under one or more licenses shall be separately determined for each activity (Appendix G-3, §18(1)), and the total shall be required if the separate batches are as dangerous as if all the material were handled in one batch (id., (2)).

If financial security is provided by insurance, such insurance is governed by a separate Insurance Contracts Act (Appendix G-2, §14(1)). Indemnity is allowed a Nuclear Installation Operator in the realm of the basic act who is legally liable to pay compensation for damage from a nuclear incident either under the Paris Convention, or under foreign law (Appendix G-2, §34(1)).

The liability of an operator of a nuclear installation is limited to DM 1000 million per nuclear incident. If the operator is liable for damage suffered in other states, if they are Contracting States to the PC for which the BSC is in force, the above limit applies only in excess of 120 million EMA u/a (European Monetary Agreement Units of Account) and then only to the extent that the other Contracting State has reciprocity. Otherwise, the limit is 15 million EMA u/a (Appendix G-2, §31(1)). As to exceptions and exoneration, the Bund (Federal Government) and the Lander (states) are excepted from the liability provisions, but the FEDERAL GERMAN RAILWAYS are included (Appendix G-2, §13(4)). The exoneration provisions of PC Art. (3)(a)(ii)(2)) for damage to the means of transport is not applicable in Germany (id., §25(3)).

As to territorial limitations for liability of the nuclear installation operator, there are none; he is liable wherever an incident may occur without the territorial restrictions contained in PC Art. 9 (Appendix G-2, §25(5)).

For international carriage of spent fuel, the requirement of §4(2)(4) of the basic law is satisfied if the PC Art. 4(c) certificate relates to a nuclear installation operator in a PC Contracting State (Appendix G-2, §4a(1)). If the BSC is not in force for that Contracting State, a transport license under Section 4 of the basic law may have as a condition that the maximum liability of the nuclear installation operator is DM 50 million for carriage within the realm of Germany (Appendix G-2, 4a(3)). If the transfer involves import or export into a PC Contracting State without the BSC, a similar condition may state that a German Nuclear Installation Operator undertakes liability for incidents occurring in the realm of the basic act if the maximum liability of the other state is not sufficient based on the nature or amount of the spent fuel carried (Appendix G-2 4a(a)).

5. Reporting and inspection

This material will be provided.

6. Public participation

As discussed above under Storage Licenses, if a storage facility is associated with a reactor, then the license application proceeds under Section 7 of the German nuclear law and public hearings are required. These hearings are held by the local states where the facility is to be located and the decision is made there, although a favorable opinion by the federal government is also required. If the spent nuclear fuel facility is not located or associated with a reactor or reprocessing plant, then the proceeding may go forth under Section 6 of the German nuclear law, which does not require a public hearing. However, because of the present political situation in Germany, it is anticipated that special procedures will be adopted whereby hearings are held on storage facilities that might not otherwise be required. The expected licensing time for Ahaus is approximately one and one-half to two years.

DWK's application for an interim storage facility at Gorleben, having associated with a reprocessing plant, must proceed under Section 7 of the nuclear law and will require a public hearing. It is anticipated that the review process of public hearings at Corleben will take three to four years before a decision is reached.

The Gorleben site was selected because of its capacity for disposal of high-level waste in the salt dome located there. The government's application for approval of a final high-level waste repository will proceed under Section 9B of German law and is parallel with the DWK application. According to § 9 b, Section 1, Atomic Law, the licensing authority to grant permission for the construction and operation of the final desposition site is the "Planfest-stellungsbehorde" (Planning Coordination Authority) which is the Secretary of Social Affairs in Lower-Saxony. The execution of the licensing procedure is specified in § 9 b Atomic Law.

Local municipalities do not issue important licenses. However, each involved municipality is given the opportunity to comment extensively on the project. Furthermore, according to the Nuclear-Proceedings-Law the public can participate; each citizen will have the opportunity to examine all documents for two months and then he can inform the licensing authority of his objections.

7. Labor laws

This material will be provided.

8. Other relevant considerations

The courts in Germany have become involved in the nuclear process and in fact in one instance stopped a reactor with questions concerning the nuclear fuel cycle. This has prompted the current political discussion and reevaluation of the nuclear program, particularly the back end of the fuel cycle. The courts will continue to play an important part in the nuclear program of Germany. While the review and licensing of a reactor or fuel cycle facility can be completed in two to four years, depending on the complexity, the additional participation of the courts means that the entire licensing process can take six to seven years.

3.DE.6 Views Regarding Alternative Spent Fuel Disposition Programs

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3.1T Visit Findings - Italy

3.1T.1 Introduction

3.1T.1.1 Organizations Visited

The Italian organizations visited were: the Comitato Nazionale Energia Nucleare (CNEN), Ente Nazionale per l'Energia Electtrica (ENEL), Ente Nazionale Idrocarbur and Aqip Nuclear (AGN).

3.1T.1.2 Spent Fuel Disposition Highlights

Policies, Plans and Programs

- Italy's underlying long-term spent fuel disposition policy objective is to reprocess spent fuel through a national reprocessing program in order to support a national breeder program (primary) and to support a national LWR recycle program (secondary). Italy expects to have a national reprocessing capability by the mid- or late-1990's.
- Italy is adopting an interim spent fuel storage program as a result of (a) past and present difficulties with external reprocessing services; (b) adverse "terms and conditions" for new reprocessing services and (c) desire to stockpile spent fuel for a national reprocessing program. Italy's interim spent fuel storage program consists of a two part plan, namely:
  - (a) Increase at-reactor-storage (ARS) and expand an existing decommissioned pool AVOGADRO to solve storage needs until 1986.
  - (b) Provide additional centralized storage, after 1986, as needed to support spent fuel disposition needs.

Principal Concerns

- Difficulties with present spent fuel disposition programs due to problems with existing reprocessing contracts (near-term concern).

- Inadequate internal financial resources to support a national reprocessing program (long-term concern).

Spent Fuel Disposition Profile

Italy has a critical near-term ARS problem at its operating reactor stations and intends to use a decommissioned reactor pool (AVOGADRO) as a near-term AFR to relieve this problem.

The spent fuel disposition profile for Italy's two operating LWR reactors (i.e., Trino and Garigliano) is shown below:

------------------------------MTU------------------------------

Reactor	Core Size	Pool Size Total	Pool Size LFCR	1-78 Spent Fuel Inventory	1978 & 1979 Discharge	Shipments to Reproc.[1] Past	Shipments to Reproc.[1] Future
Trino (PWR)	40	53	13	39	13	53	-0-
Garigliano (BWR)	46	55	11	34	10	31	-0-

1) All existing contracted shipments have been completed and contracts terminated.

Italy is not considering additional reprocessing contracts at this time.

The following cumulative discharge profile reflects anticipated spent fuel generation for the committed Italian LWR reactor program (firm) and anticipated future Italian LWR reactor program (projected).

Cumulative Discharge Profile (MTU)

Year	Firm	Projected	Total
1985	460	0	460
1990	1119	341	1460
2000	2639	2434	5073

The following cumulative away-from-reactor (AFR) spent fuel disposition profile is based on removing spent fuel from ARS only when a full core reserve (FCR) limit has been reached.

Cumulative AFR Profile (MTU)

Year	Firm	Projected	Total
1985	337	0	337
1990	567	0	567
2000	1936	1160	3096

Views Regarding Alternative Spent Fuel Disposition Programs

(Deleted)

3.IT.2 Nuclear Power Profile

Italy's diversified industries bring value-added benefits at the cost of a large non-indigenous energy input. Imported oil accounts for over 70% of Italian energy needs. A National Energy Program - formulated in 1975 - reinforced an earlier national resolve to make nuclear power a sole alternative to oil-based power in order to decrease, or at least stabilize, oil imports by 1985. The 1975 Plan foresaw, amongst other measures, the near-term construction of 20,000 MWe nuclear power capacity over a ten year span. At this time it appears that the above goal was fairly ambitious and will not be achieved due to financial constraints.

Table 3.IT-1 summarizes the present Italian nuclear power program. It was stated that the Italian government wants an immediate construction start-up of eight additional reactors (up to ENEL 12) over and above the current operating reactors. However, it is believed by some sources that existing financial constraints, coupled with some local opposition to nuclear power, will likely slow up such an ambitious program. Table 3.IT-2 shows the profile for the presently perceived Italian nuclear program (firm) and anticipated future reactor growth (projected). Total Italian nuclear power generating capacity was .6 GWe in 1977. The projected capacities will reach 5.2 GWe in 1985, 12 GWe in 1990 and 2 GWe in 2000.

Table 3.IT-1: Nuclear Power Program - Italy

Reactor	Utility	MWe	Reactor Type	Operation Date	Status
Latina	Ente Nazionale per l'Energia Elettrica (ENEL)	150	GCR	1/64	O
Garigliano	ENEL	150	BWR	6/64	O
Trino Vercellese	ENEL	247	PWR	1/65	O
Caorso	ENEL	840	BWR	/78	C
Cirene	ENEL	40	LWCHW	/81	C
ENEL 6	ENEL	982	BWR	/83	P
ENEL 8	ENEL	982	BWR	/84	P
ENEL 5	ENEL	952	PWR	/84	P
ENEL 7	ENEL	952	PWR	/84	P

O = Operational
C = Under Construction
P = In Planning

Table 3IT-2
NUCLEAR POWER GENERATING CAPACITY PROFILE — ITALY-FCR

YEAR	GENERATING CAPACITY (MWE) FIRM	PROJECTED	TOTAL
1977	397.	0.	397.
1978	1237.	0.	1237.
1979	1237.	0.	1237.
1980	1237.	0.	1237.
1981	1237.	0.	1237.
1982	1237.	0.	1237.
1983	1237.	0.	1237.
1984	2219.	0.	2219.
1985	3201.	1100.	4301.
1986	4153.	1860.	6013.
1987	5105.	2620.	7725.
1988	5105.	3380.	8485.
1989	5105.	4140.	9245.
1990	5105.	4900.	10005.
1991	5105.	5600.	10705.
1992	5105.	6300.	11405.
1993	5105.	7000.	12105.
1994	5105.	7700.	12805.
1995	5105.	8400.	13505.
1996	5105.	9100.	14205.
1997	5105.	9800.	14905.
1998	5105.	10500.	15605.
1999	5105.	11200.	16305.
2000	5105.	11900.	17005.
2010	5105.	11900.	17005.
2020	5105.	11900.	17005.
2030	5105.	11900.	17005.

3.IT.3 Spent Fuel Disposition Policies, Plans and Programs

Italy's underlying long term spent fuel disposition policy is to reprocess spent fuel through a national reprocessing program. The objectives of this policy are to support a national breeder option (primary objective) and a national LWR recycle program (secondary objective). Italy perceives that its indigenous capability is not sufficiently mature to establish a national reprocessing capability until the mid- or late-1990's. At that time, Italy perceives a sufficient justification to bring on-line a small (approximately 300-400 MTU/year) national reprocessing plant compatible with international safeguards and capable of supporting a 10-15 Italian reactor population.

Italy is planning to adopt an interim spent fuel storage program to bridge the gap between the present and the time when its projected reprocessing plant will meet spent fuel disposition needs. The perceived interim spent fuel storage program consists of the following options:

(a) Expand new at-reactor-storage (ARS) basin capacities from current design practices of approximately two year spent fuel storage capability (allowing full core reserve) to ten year spent fuel storage capability.

(b) Expand the basin at an old research reactor station (Avogadro) to a 120 MTU capacity. It is expected that this capability will be available by mid-1979.*

(c) Bring on-line additional centralized spent fuel storage capacity to meet AFR needs until the national reprocessing plant begins to meet spent fuel disposition needs. CNEN and ENI (the National Hydrocarbon Company) are studying the feasibility of a "large" AFR which might be placed in service in 1986. The investment decision will be made in 1981, and construction start-up would begin in 1982.

* Italy estimates that steps (a) and (b) will meet all requirements until 1986 or 1987.

Italy perceives three principal motivations for adopting a national interim storage program, namely:

(a) Dissatisfaction with past and present external reprocessing arrangements. It was indicated that difficulties were being experienced with existing reprocessing constraints and that the reprocessors have asked for permission to modify present contract terms.

(b) Perception that "terms and conditions" for any new near- or intermediate-term external reprocessing services are relatively harsh.

(c) Desire to stockpile spent fuel for a national reprocessing program.

Two factors may impede the implementation of an Italian spent fuel disposition program, namely (a) adequate financial resources and (b) resolution of pragmatic planning and implementation approaches between the National Nuclear Energy Committee (CNEN) and the National Electricity Agency (ENEL).

In addition to the above spent fuel disposition programs, Italy has a waste management R&D program including activities in waste conditioning (vitrification) and geologic storage of high level waste. For the latter area, Italy is currently conducting "cold" lab tests and anticipates a pilot plant demonstration by 1980.

CNEN and ENI/AGN have formed a collaboration and are working to set up a joint-venture company to handle Italy's "back-end" fuel cycle activities. To that extent, they have set up working groups to study and plan in the following areas:

(1) Design and assessment
(2) Siting
(3) Shipping containers
(4) Storage
(5) Reprocessing
(6) Mixed oxide

3.IT.4 Spent Fuel Disposition Profile

Operating Reactor Disposition Profile

The spent fuel disposition profile for Italy's two generating reactors (i.e., Trino and Garigliano) is shown gelow:

	MTU						
	Core	Pool Size		1-78 Spent	1978 & 1979	Shipments to Rep.	
Reactor	Size	Total	LFCR	Fuel Inventory	Discharge	Past	Future
Trino (PWR	40	53	13	39	13	53	-0-
Garigliano (BWR)	46	55	11	34	10	31	-0-

1) All existing contracted shipments have been completed and contracts terminated.

The situation at these reactors is as follows:

1. Existing spent fuel inventory in the ARS are close to or exceed Loss of Full Core Reserve (LFCR) criteria.
2. Current plans are to modify an existing decommissioned reactor pool (AVOGADRO) to solve near term disposition needs, for Trino and Garigliano.

Spent Fuel Reprocessing Arrangements

All prior arrangements with reprocessors have been terminated. Italy has transported 54 MTU to BNFL and 31 MTU to Eurochemic through prior arrangements.

Centralized AFR Storage

Italy is planning to reactivate the storage pond at the Avogadro (Scelusia) reactor to serve as a near-term AFR. It is projected that spent fuel will be transported to Avogadro according to the following schedule:

	MTU						
	1978	1979	1980	1981	1982	1983	TOTAL
BWR	0	0	20	10	10	--	40
PWR	0	15	20	20	15	10	80
							120

Two S.F.A. truck casks will be used to accomplish the above shipments. Each of the truck casks can carry 7 PWR/12 BWR assembly or approximately 3 MTU (PWR 1/2 MTU (BWR).

Additional centralized AFR capacity will be provided beyond the 1986 time period to supplement planned ARS capacities.

Projected Spent Fuel Disposition Profiles

In order to provide a quantitative framework for evaluating spent fuel disposition requirements, the following exhibits are included:

Table 3.IT-3 summarizes the reactor and at-reactor storage characteristics associated with the currently defined Italian nuclear power program. Correspondingly, Table 3.IT-4 summarizes the spent fuel generation and away-from-reactor (AFR) disposition requirements for the currently defined nuclear power program.

Table 3.IT-5 provides (a) the annual spent fuel generation profile and (b) the annual AFR disposition profile (based on a Full Core Reserve criteria) for both the currently defined reactor program (firm) and for anticipated future reactor additions (projected). Table 3.IT-6 provides cumulative information for the same categorization.

Tables 3.IT-7, 3.IT-8 and 3.IT-9 provide similar information for an at-reactor storage (ARS) criteria wherein five year or older spent fuel is shipped away from reactor beginning in 1985 - unless prior period spent fuel to ARS exceed FCR criteria (in which case spent fuel would be shipped away from reactor as soon as FCR limits were reached).

Technical Factors

At present, all movement of spent fuel is via truck transportation due to lack of rail ties to existing stations. All present stations have 50 ton crane capacities.

Table 3IT-3
REACTOR CHARACTERISTICS - ITALY-FCR

FIRM REACTORS			MTU		
REACTOR	MWE	START UP	CORE SIZE	ANNUAL DISCHARGE	EFFECTIVE ARS
GARIG B	150	1964	46	7	10
TRINO P	247	1965	40	10	13
CAORS(E4)B	840	1978	104	29	100
MONAL(E6)B	982	1984	114	29	178
MONAL(E8)B	982	1985	114	29	178
TERMO(E5)P	952	1986	73	24	112
TERMO(E7)P	952	1987	73	24	112
PROJECTED REACTORS			MWE	(MTU PER 1000 MWE)	
		1984-1985	1100.	26.	130.
		1985-1990	3800.	26.	130.
		1990-2000	7000.	26.	130.

Table 3IT-4

FIRM REACTOR SPENT FUEL PROFILE — ITALY-FCR

FACILITY		DIS START YEAR	ANN DIS	EFF ARS	BEG AFR YEAR	1985 DIS	1985 AFR	1990 DIS	1990 AFR	2000 DIS	2000 AFR	2030 DIS	2030 AFR
GARIG	B	1968	7	10	1969	126.	116.	161.	151.	231.	221.	441.	431.
TRINO	P	1970	10	13	1971	160.	147.	210.	197.	310.	297.	610.	597.
CAORS(E4)	B	1980	29	100	1983	174.	74.	319.	219.	609.	509.	1479.	1379.
MONAL(E6)	B	1986	29	178	1992	0.	0.	145.	0.	435.	257.	1305.	1127.
MONAL(E8)	B	1987	29	178	1993	0.	0.	116.	0.	406.	228.	1276.	1098.
TERMO(E5)	P	1987	24	112	1991	0.	0.	96.	0.	336.	224.	1056.	944.
TERMO(E7)	P	1988	24	112	1992	0.	0.	72.	0.	312.	200.	1032.	920.

CUMULATIVE (MTU)

Table 3IT-5

ANNUAL SPENT FUEL PROFILE — ITALY-FCR

	ANNUAL DISCHARGE (MTU)			ANNUAL AFR REQMT. (MTU)		
YEAR	FIRM	PROJECTED	TOTAL	FIRM	PROJECTED	TOTAL
1977	17.	0.	17.	17.	0.	17.
1978	17.	0.	17.	17.	0.	17.
1979	17.	0.	17.	17.	0.	17.
1980	46.	0.	46.	17.	0.	17.
1981	46.	0.	46.	17.	0.	17.
1982	46.	0.	46.	17.	0.	17.
1983	46.	0.	46.	33.	0.	33.
1984	46.	0.	46.	46.	0.	46.
1985	46.	0.	46.	46.	0.	46.
1986	75.	29.	104.	46.	0.	46.
1987	128.	48.	176.	46.	0.	46.
1988	152.	68.	220.	46.	0.	46.
1989	152.	88.	240.	46.	0.	46.
1990	152.	108.	260.	46.	0.	46.
1991	152.	127.	279.	54.	29.	83.
1992	152.	146.	298.	103.	48.	151.
1993	152.	164.	316.	148.	68.	216.
1994	152.	182.	334.	152.	88.	240.
1995	152.	200.	352.	152.	108.	260.
1996	152.	218.	370.	152.	127.	279.
1997	152.	237.	389.	152.	146.	298.
1998	152.	255.	407.	152.	164.	316.
1999	152.	273.	425.	152.	182.	334.
2000	152.	291.	443.	152.	200.	352.
2010	152.	309.	461.	152.	309.	461.
2020	152.	309.	461.	152.	309.	461.
2030	152.	309.	461.	152.	309.	461.

Table 3IT-6
CUMULATIVE SPENT FUEL PROFILE —ITALY-FCR

YEAR	CUM DISCHARGE (1000 MTU) FIRM	PROJECTED	TOTAL	CUM AFR RQMT. (1000 MTU) FIRM	PROJECTED	TOTAL
1977	.150	0.000	.150	.127	0.000	.127
1978	.167	0.000	.167	.144	0.000	.144
1979	.184	0.000	.184	.161	0.000	.161
1980	.230	0.000	.230	.178	0.000	.178
1981	.276	0.000	.276	.195	0.000	.195
1982	.322	0.000	.322	.212	0.000	.212
1983	.368	0.000	.368	.245	0.000	.245
1984	.414	0.000	.414	.291	0.000	.291
1985	.460	0.000	.460	.337	0.000	.337
1986	.535	.029	.564	.383	0.000	.383
1987	.663	.077	.740	.429	0.000	.429
1988	.815	.145	.960	.475	0.000	.475
1989	.967	.233	1.200	.521	0.000	.521
1990	1.119	.341	1.460	.567	0.000	.567
1991	1.271	.468	1.739	.621	.029	.650
1992	1.423	.614	2.037	.724	.077	.801
1993	1.575	.777	2.352	.872	.145	1.017
1994	1.727	.959	2.686	1.024	.233	1.257
1995	1.879	1.160	3.039	1.176	.341	1.517
1996	2.031	1.378	3.409	1.328	.468	1.796
1997	2.183	1.615	3.798	1.480	.614	2.094
1998	2.335	1.869	4.204	1.632	.777	2.409
1999	2.487	2.142	4.629	1.784	.959	2.743
2000	2.639	2.434	5.073	1.936	1.160	3.096
2010	4.159	5.528	9.687	3.456	3.981	7.437
2020	5.679	8.622	14.301	4.976	7.075	12.051
2030	7.199	11.716	18.915	6.496	10.169	16.665

Table 3IT-7
FIRM REACTOR SPENT FUEL PROFILE — ITALY-5Y-1985

FACILITY		DIS START YEAR	ANN DIS	EFF ARS	BEG AFR YEAR	1985 DIS	1985 AFR	1990 DIS	1990 AFR	2000 DIS	2000 AFR	2030 DIS	2030 AFR
GARIG	B	1968	7	10	1969	126.	116.	161.	151.	231.	221.	441.	431.
TRINO	P	1970	10	13	1971	160.	147.	210.	197.	310.	297.	610.	597.
CAORS(E4)	B	1980	29	100	1983	174.	74.	319.	219.	609.	509.	1479.	1379.
MONAL(E6)	B	1986	29	145	1991	0.	0.	145.	0.	435.	290.	1305.	1160.
MONAL(E8)	B	1987	29	145	1992	0.	0.	116.	0.	406.	261.	1276.	1131.
TERMO(E5)	P	1987	24	112	1991	0.	0.	96.	0.	336.	224.	1056.	944.
TERMO(E7)	P	1988	24	112	1992	0.	0.	72.	0.	312.	200.	1032.	920.

CUMULATIVE (MTU) applies to the 1985–2030 columns.

Table 3IT-8

ANNUAL SPENT FUEL PROFILE — ITALY-5Y-1985

	ANNUAL DISCHARGE	(MTU)		ANNUAL AFR REQMT.	(MTU)	
YEAR	FIRM	PROJECTED	TOTAL	FIRM	PROJECTED	TOTAL
1977	17.	0.	17.	17.	0.	17.
1978	17.	0.	17.	17.	0.	17.
1979	17.	0.	17.	17.	0.	17.
1980	46.	0.	46.	17.	0.	17.
1981	46.	0.	46.	17.	0.	17.
1982	46.	0.	46.	17.	0.	17.
1983	46.	0.	46.	33.	0.	33.
1984	46.	0.	46.	46.	0.	46.
1985	46.	0.	46.	46.	0.	46.
1986	75.	29.	104.	46.	0.	46.
1987	128.	48.	176.	46.	0.	46.
1988	152.	68.	220.	46.	0.	46.
1989	152.	88.	240.	46.	0.	46.
1990	152.	108.	260.	46.	0.	46.
1991	152.	127.	279.	83.	29.	112.
1992	152.	146.	298.	136.	48.	184.
1993	152.	164.	316.	152.	68.	220.
1994	152.	182.	334.	152.	88.	240.
1995	152.	200.	352.	152.	108.	260.
1996	152.	218.	370.	152.	127.	279.
1997	152.	237.	389.	152.	146.	298.
1998	152.	255.	407.	152.	164.	316.
1999	152.	273.	425.	152.	182.	334.
2000	152.	291.	443.	152.	200.	352.
2010	152.	309.	461.	152.	309.	461.
2020	152.	309.	461.	152.	309.	461.
2030	152.	309.	461.	152.	309.	461.

Table 3IT-9

CUMULATIVE SPENT FUEL PROFILE —ITALY-5Y-1985

YEAR	CUM DISCHARGE (1000 MTU) FIRM	PROJECTED	TOTAL	CUM AFR RQMT. (1000 MTU) FIRM	PROJECTED	TOTAL
1977	.150	0.000	.150	.127	0.000	.127
1978	.167	0.000	.167	.144	0.000	.144
1979	.184	0.000	.184	.161	0.000	.161
1980	.230	0.000	.230	.178	0.000	.178
1981	.276	0.000	.276	.195	0.000	.195
1982	.322	0.000	.322	.212	0.000	.212
1983	.368	0.000	.368	.245	0.000	.245
1984	.414	0.000	.414	.291	0.000	.291
1985	.460	0.000	.460	.337	0.000	.337
1986	.535	.029	.564	.383	0.000	.383
1987	.663	.077	.740	.429	0.000	.429
1988	.815	.145	.960	.475	0.000	.475
1989	.967	.233	1.200	.521	0.000	.521
1990	1.119	.341	1.460	.567	0.000	.567
1991	1.271	.468	1.739	.650	.029	.679
1992	1.423	.614	2.037	.786	.077	.863
1993	1.575	.777	2.352	.938	.145	1.083
1994	1.727	.959	2.686	1.090	.233	1.323
1995	1.879	1.160	3.039	1.242	.341	1.583
1996	2.031	1.378	3.409	1.394	.468	1.862
1997	2.183	1.615	3.798	1.546	.614	2.160
1998	2.335	1.869	4.204	1.698	.777	2.475
1999	2.487	2.142	4.629	1.850	.959	2.809
2000	2.639	2.434	5.073	2.002	1.160	3.162
2010	4.159	5.528	9.687	3.522	3.981	7.503
2020	5.679	8.622	14.301	5.042	7.075	12.117
2030	7.199	11.716	18.915	6.562	10.169	16.731

CNEN/ENEL are currently developing Italy's own spent fuel cask design and perceives an 80 ton (7 PWR assy/12 BWR assy) as being suitable for its needs. Although a decision has not been made yet, it is anticipated that now the new cask design would be a rail cask. Other related cask information is as follows:

(a) Forged steel/water-filled cavity cask design
(b) Prototype cask available in 1979
(c) Operating cask profile
1981 - four units
1990 - ten units

3.IT.5 Legal and Regulatory Factors

A. Reactor requirements on spent fuel.

1. Minimum holding period at reactor

Italian law contains no specific provisions setting a minimum holding period for spent fuel at a reactor. In addition, government and industry officials advise that there are no formal requirements concerning the retention period of spent fuel at the reactor.

2. Storage capacity at reactor

No formal legal requirements govern the storage capacity or margins at reactors for spent fuel. ENEL officials state that their policy concerning margins is a one-core margin based upon the need for operational flexibility and not for any safety or other purposes. With regard to the size of the storage pool at the reactor, currently the approach is 160 percent of one core, or approximately the size of one full core and two reloads. Consideration, however, is being given to having a ten-year capacity at the reactor for future reactors.

3. Disposition plans for spent fuel as a reactor license requirement.

There currently appears to be no special reactor license requirements for the handling of spend fuel. The principal concern is with regard to the reactor itself, and there currently is not a great deal of concern about the back end of the nuclear fuel cycle. Although this could change, there now does not exist any legal requirements for spent fuel disposition in connection with a reactor license.

B. Custody and licensing of spent fuel and its handling.

1. Custody

The basic nuclear energy act requires persons possessing spent fuel to report the fact to the Ministry for Industry, Commerce and Crafts (MICC) within five days (Appendix IT-1 § 3). The National Committee for Nuclear Energy (CNEN) is the competent authority over spent fuel so reported. Such reports must be updated at the end of each calendar year. A later Ministerial Decree requires a person possessing spent fuel to also request from MICC authorization for its use. (Appendix IT-2), following EURATOM Directives.

2. Transport including packaging

The basic act requires authorization by MICC for carriage of spent fuel (Appendix IT-1 § 5; IT-3). The act also prescribes a Decree regulating spent fuel transport, in conformity with the basic standards laid down by EURATOM (id.).

3. Storage license

a. At reactor

Italian law requires authorization for construction of nuclear installations which is defined as including among other items, "facilities for the storage of nuclear materials other than storage incidental to the carriage of such materials" (Appendix IT-1 § 1(B)). Such authorization is by decree of MICC after consultation with CNEN (id., §6).

The applicant must show proof of adequate technical and financial capability. He shall submit the plans for the plant, showing in particular the location selected, the arrangements for the dispersal and disposal of radioactive waste, the expenditure and time required for construction, and the arrangements for provisions of financial security (id.)

b. Away from reactor

Italian policy contemplates the storage of fuel for a period of time possibly away from the reactor. Such a facility would be viewed as a nuclear installation and would require approval comparable to a storage facility at the reactor site. An old swimming pool reactor named Avogadro is being considered for possible spent fuel storage. Since it appears to have been decommissioned, a new authorization for spent fuel storage would need to be obtained. In addition, Italian law provides that any alterations of plants shall require prior approval of MICC having consulted with CNEN.

4. Import requirements, including license

Authorization for import of spent fuel, "when required by existing financial and currency control regulations," is to be issued by the Ministry of Foreign Trade, having consulted with MICC (Appendix IT-1 §4).

5. Export requirements, including license

The basic law (Appendix IT-1 §4) sets the same regulations for export of spent fuel as it does for import of spent fuel as described in the previous section.

c. Supplemental legal requirements

1. Radiation health and safety

Italian law requires than an authorization Decree granted for the operation of a spent fuel storage facility include "operating conditions considered necessary for the protection of public safety..." (Appendix IT-1 §6). The act requires enactment, by Decree of the President of the Republic, of regulations for safety of nuclear plants, including spent fuel storage facilities (Appendix IT-1 §4). These regulations are to provide for health protection of workers and the population against hazards of ionizing radiations resulting from the operation of spent fuel storage facilities (id.). The act specifies that the regulations must be in conformity with EURATOM and IAEA standards, and any other such principles adopted by international organizations (id.).

A Decree was subsequently adopted setting health and safety standards related to the handling and use of radioactive substances, including spent fuel (Appendix IT-4). The Decree contains detailed provisions on health and safety.

A subsequent Decree by the Ministry of Labor sets maximum permissible doses and concentrations of radioactivity to which workers around spent fuel can be exposed (Appendix IT-8). Another Decree, by the Ministry of Health, sets maximum permissible doses and concentrations of radioactivity to which the general population can be exposed (Appendix IT-9).

2. Safeguards and physical security

a. International agreements

Italy, as a member of EURATOM, subscribes to safeguards provisions set forth in the EURATOM Treaty and appears to have no additional supplemental laws regarding nuclear safeguards.

b. Domestic requirements

There appears to be no special provisions concerning domestic requirements over and above the international arrangements.

3. Environmental requirements

The radiological environmental requirements have been discussed above, and the non-radiological requirements are to be developed.

4. Third-party liability

The basic law contains Italy's third-party liability provisions and has been amended to include provisions implementing the Paris Convention (PC) (Appendix IT-11) and the Brussels Supplementary Convention (BSC) (Appendix IT-12; IT-10, p.95).

The operator of a spent fuel storage facility is liable for any damage caused by a nuclear incident in the facility or "in connection with" the facility (Appendix IT-1 §15). If more than one nuclear installation or spent fuel storage facility has handled materials causing a nuclear incident, the operator who had possession of the materials at the time of the incident is liable (Appendix IT-1 §17).

Liability lies with the consigning operator in the event of an incident occurring during carriage or storage in the course of carriage of spent fuel (Appendix IT-1 §16). The consigning operator is no longer liable at such time as the spent fuel is taken in charge by the operator of another nuclear installation or until such time as liability is taken over by another operator of a nuclear installation by previous written agreement (id.).

When exporting spent fuel to a territory in a non-Contracting State to the Paris Convention, the consigning operator in Italy is liable for any damage caused by the spent fuel before it is unloaded in the territory of the State which is its final destination (id.).

A consignee operator importing spent fuel from a territory in a non-Contracting State is liable from the time the spent fuel is loaded on the means of transport by which it is to be carried from the territory of that State (id.).

A carrier of spent fuel may assume liability in the place of an operator with consent of that operator and authorization from MICC. The carrier is then treated, in respect to nuclear incidents occurring during carriage, as an operator of a nuclear installation (id.).

Italian law sets an amount of 7,500 million lire as maximum compensation due by an operator of a nuclear installation for damage caused by a nuclear incident (Appendix IT-1§9). If compensation is warranted exceeding the amount for which the operator is liable, the State must pay compensation up to an amount of 43,750 million lire (id.). If even further compensation is warranted, the remaining amount, up to a total of 45,000 million lire, will be paid by the Contracting Parties to the PC and BSC (id.).

An operator of a nuclear installation is required to take out and maintain an insurance policy for an amount equal to his maximum liability or to furnish equivalent financial security subject to approval by MICC (Appendix IT-1 §22).

Authorization for carriage of spent fuel across Italy is subject to proof of existence of financial security of an amount equal to an operator's maximum liability (Appendix IT-1 §21).

5. Reporting and inspection

Persons possessing spent fuel are required to report to MICC (Appendix IT-1 §3). CNEN carries out inspection of spent fuel storage facilities (Appendix IT-4 §13; IT-10, p. 231). CNEN inspectors have the right of access to all storage facilities. They are authorized to inspect equipment, check compliance with technical instructions in operation of a plant, and obtain confidential information regarding health and safety protection. Inspectors file a report after each inspection (Appendix IT-4 S13; IT-10, p. 232). Inspections are also sone by the competent Government department, and can be conducted jointly with CNEN inspections (Appendix IT-4 S14).

6. Public participation

There are three levels of approval required for reactors in Italy that affect storage facilities at the reactor site. The first level is exercised by the Central Government. The second is that exercised by municipalities. At the moment there do not exist particular problems with regard to the first two authorities, with the principal difficulties involving the third where the public is involved at the municipal level. The details of this public participation will be developed.

7. Other relevant considerations

Italian policy favors reprocessing spent fuel, but Italy is not currently in a position to build its own reprocessing facility. This is due to the economics of size with Italian policy designed not to throw away resources for reprocessing. Thus, their program contemplates storage for a while or reprocessing outside of the country as opposed to reprocessing within Italy. Italian authorities are considering three options, namely, (1) sending spent fuel abroad, (2) erecting large storage pools of their own, such as at Avogadro or some other site, or (3) enlarging existing pools. As indicated previously, any of these activities would require governmental approval either for exporting, altering existing facilities or licensing new facilities.

In addition, Italian policy favors accepting fuel from other countries on a mutual exchange basis. These exchanges would require import and export licenses as previously described.

Under current law, CNEN is prevented from being in the industrial arena. Consideration is being given, however, to modifying the law so that there can be cooperation between CNEN and industry. Plans are being considered for such modifications in the back end of the fuel cycle. At the moment there are various working groups involving CNEN and industry that have informally been established that include such subjects as central storage, shipping containers, reprocessing, mixed oxide fuels, waste disposal and modifications of existing facilities. This informal arrangement may be changed by amendments to the law in the future.

3.IT.6 View Regarding Alternative Spent Fuel Disposition Programs

(Deleted)

3.LX Visit Findings - Luxembourg

3.LX.1 Introduction

3.LX.1.1 Organizations Visited

The Luxembourg organizations visited were: the Ministry of Foreign Affairs and the Ministry of Public Health of Luxembourg. The Ministry of Public Health has the lead responsibility in technical matters relating to Luxembourg's one nuclear project, a joint venture with RWE of Germany on a 1300 MWe PWR located in Luxembourg on the Mosel Rhine border between Germany and Luxembourg.

3.LX.1.2 Spent Fuel Disposition Highlights

Policy, Plans and Programs

Luxembourg has one planned nuclear power plant project which is a co-venture with the German utility, RWE. The Luxembourg fuel cycle policy and planning approaches will follow German leadership, including the use of the Gorleben facility. In effect, the Remerschen plant in Luxembourg should be treated as a German plant. Luxembourg will, however, resist German efforts involving expansion of at-reactor-storage or AFR's in Luxembourg.

Principal Concerns

Health and safety areas are of most concern at this time. The avoidance of additional fuel cycle support facilities in Luxembourg is also a concern.

Spent Fuel Disposition Profile

The projected spent fuel disposition profile for Luxembourg is below:

	Cum Discharge (MTU)			Cum AFR Profile (MTU)		
	Firm	Proj	Total	Firm	Proj	Total
1990	96	0	96	0	0	0
2000	416	286	702	200	143	343

Views Regarding Alternative Spent Fuel Disposition Programs

(Deleted)

3.LX.2 Nuclear Power Profile

Table 3.LX-1 summarizes the present Luxembourg power program.

Table 3.LX-2 shows the profile for the presently perceived Luxembourg nuclear power program (firm) and anticipated future reactor growth (projected). The total Luxembourg nuclear power generating capacity was 0 GWe in 1977. The projected capacities will reach 1.2 GWe in 1985, 2.4 GWe in 1990 and 2.4 GWe in 2000.

Table 3.LX-1: Nuclear Power Program - Luxembourg

REACTOR	UTILITY	MWe	REACTOR TYPE	OPERATION DATE	STATUS
Remerschen	Luxembourg Nuclear Power Company	1250	PWR	1985-86	P

O = Operational
C = Under Construction
P = In Planning

Table 3LX-2
NUCLEAR POWER GENERATING CAPACITY PROFILE — LUXEMBOURG-FCR

YEAR	GENERATING CAPACITY (MWE) FIRM	PROJECTED	TOTAL
1977	0.	0.	0.
1978	0.	0.	0.
1979	0.	0.	0.
1980	0.	0.	0.
1981	0.	0.	0.
1982	0.	0.	0.
1983	0.	0.	0.
1984	0.	0.	0.
1985	0.	0.	0.
1986	1295.	0.	1295.
1987	1295.	0.	1295.
1988	1295.	0.	1295.
1989	1295.	0.	1295.
1990	1295.	1100.	2395.
1991	1295.	1100.	2395.
1992	1295.	1100.	2395.
1993	1295.	1100.	2395.
1994	1295.	1100.	2395.
1995	1295.	1100.	2395.
1996	1295.	1100.	2395.
1997	1295.	1100.	2395.
1998	1295.	1100.	2395.
1999	1295.	1100.	2395.
2000	1295.	1100.	2395.
2010	1295.	1100.	2395.
2020	1295.	1100.	2395.
2030	1295.	1100.	2395.

3.LX.3 Spent Fuel Disposition Policies, Plans and Programs

The principal Luxembourg policies to be established on reprocessing and waste management would appear to follow German policy in that the Germans have technical leadership in the joint project, the Remerschen nuclear power plant. Luxembourg, however, will provide health and safety judgments for the plant. The Germans have asked for increased at-reactor-storage (11/3 core). Luxembourg has responded with the intent of remaining at a minimum storage capacity (5/3 core). The Luxembourg policy is to avoid locating within Luxembourg any centralized storage or other fuel cycle services for Remerschen or any other nuclear plant.

Luxembourg is co-venturing with RWE, on a shared financial basis, the development and operation of the Remerschen (1300 MWe PWR) to be located just across the border from Germany. RWE makes the technical program decisions, and the project technical director must be German. The plant operational date is 1985-86. The German reactor regulatory standards are being adopted in principal for the plant. For most practical purposes, Remerschen is treated as a German plant.

The initial load requirements upon the plant by Luxembourg will be 15-20% of output, with the balance going to Germany. As Luxembourg demand grows, the load will shift in the direction of Luxembourg. In effect, the arrangement appears to be a bargain for both sides. Luxembourg, which currently imports 99% of its electricity, receives one-half interest in a 1300 MWe power plant, with rights to take power output as the Luxembourg demand grows over time. Germany, which currently has a range of problems in advancing reactor plant licensing, receives the bulk of the output of the power plant for an extended period of time without facing into the difficulties of licensing a reactor plant in Germany, and even has the capitalization of its plant shared by Luxembourg.

3.LX.4 Spent Fuel Disposition Profiles

Projected Spent Fuel Disposition Profile

Table 3.LX-3 summarizes the spent fuel generation and away from reactor (AFR) disposition requirements for the currently defined nuclear power program.

Table 3.LX-4 provides (a) the annual spent fuel generation profile and (b) the annual AFR disposition profile (based on a Full Core Reserve criteria) for both the currently defined reactor program (firm) and for anticipated future reactor additions (projected).

Table 3.LX-5 provides cumulative information for the same categorization.

Technical Factors

Luxembourg will use IAEA spent fuel transportation guidelines. Although the transportation mode has not been established as of yet, it is likely that a truck-barge mixed mode will be considered for spent fuel transportation to the Gorelaben site for away-from-reactor disposition.

Table 3LX-3

FIRM REACTOR SPENT FUEL PROFILE — LUXEMBOURG-FCR

FACILITY		DIS START YEAR	ANN DIS	EFF ARS	BEG AFR YEAR	1985 DIS	1985 AFR	1990 DIS	1990 AFR	2000 DIS	2000 AFR	2030 DIS	2030 AFR
REMER.	P	1988	32	216	1994	0.	0.	96.	0.	416.	200.	1376.	1160.

CUMULATIVE (MTU)

Table 3LX-4
ANNUAL SPENT FUEL PROFILE — LUXEMBOURG-FCR

YEAR	ANNUAL DISCHARGE (MTU) FIRM	PROJECTED	TOTAL	ANNUAL AFR REQMT. (MTU) FIRM	PROJECTED	TOTAL
1977	0.	0.	0.	0.	0.	0.
1978	0.	0.	0.	0.	0.	0.
1979	0.	0.	0.	0.	0.	0.
1980	0.	0.	0.	0.	0.	0.
1981	0.	0.	0.	0.	0.	0.
1982	0.	0.	0.	0.	0.	0.
1983	0.	0.	0.	0.	0.	0.
1984	0.	0.	0.	0.	0.	0.
1985	0.	0.	0.	0.	0.	0.
1986	0.	0.	0.	0.	0.	0.
1987	0.	0.	0.	0.	0.	0.
1988	32.	0.	32.	0.	0.	0.
1989	32.	0.	32.	0.	0.	0.
1990	32.	0.	32.	0.	0.	0.
1991	32.	29.	61.	0.	0.	0.
1992	32.	29.	61.	0.	0.	0.
1993	32.	29.	61.	0.	0.	0.
1994	32.	29.	61.	8.	0.	8.
1995	32.	29.	61.	32.	0.	32.
1996	32.	29.	61.	32.	29.	61.
1997	32.	29.	61.	32.	29.	61.
1998	32.	29.	61.	32.	29.	61.
1999	32.	29.	61.	32.	29.	61.
2000	32.	29.	61.	32.	29.	61.
2010	32.	29.	61.	32.	29.	61.
2020	32.	29.	61.	32.	29.	61.
2030	32.	29.	61.	32.	29.	61.

Table 3LX-5

CUMULATIVE SPENT FUEL PROFILE —LUXEMBOURG-FCR

YEAR	CUM DISCHARGE (1000 MTU) FIRM	PROJECTED	TOTAL	CUM AFR RQMT. (1000 MTU) FIRM	PROJECTED	TOTAL
1977	0.000	0.000	0.000	0.000	0.000	0.000
1978	0.000	0.000	0.000	0.000	0.000	0.000
1979	0.000	0.000	0.000	0.000	0.000	0.000
1980	0.000	0.000	0.000	0.000	0.000	0.000
1981	0.000	0.000	0.000	0.000	0.000	0.000
1982	0.000	0.000	0.000	0.000	0.000	0.000
1983	0.000	0.000	0.000	0.000	0.000	0.000
1984	0.000	0.000	0.000	0.000	0.000	0.000
1985	0.000	0.000	0.000	0.000	0.000	0.000
1986	0.000	0.000	0.000	0.000	0.000	0.000
1987	0.000	0.000	0.000	0.000	0.000	0.000
1988	.032	0.000	.032	0.000	0.000	0.000
1989	.064	0.000	.064	0.000	0.000	0.000
1990	.096	0.000	.096	0.000	0.000	0.000
1991	.128	.029	.157	0.000	0.000	0.000
1992	.160	.057	.217	0.000	0.000	0.000
1993	.192	.086	.278	0.000	0.000	0.000
1994	.224	.114	.338	.008	0.000	.008
1995	.256	.143	.399	.040	0.000	.040
1996	.288	.172	.460	.072	.029	.101
1997	.320	.200	.520	.104	.057	.161
1998	.352	.229	.581	.136	.086	.222
1999	.384	.257	.641	.168	.114	.282
2000	.416	.286	.702	.200	.143	.343
2010	.736	.572	1.308	.520	.429	.949
2020	1.056	.858	1.914	.840	.715	1.555
2030	1.376	1.144	2.520	1.160	1.001	2.161

3.LX.5 Legal and Regulatory Factors

The principal legal and regulatory requirements in Luxembourg affecting the Remerschen nuclear power plant spent fuel storage will be governed by an agreement between the Republic of Germany and the Grand-Duchy of Luxembourg. (See Volume II, Appendices, Luxembourg L-4.)

The purpose of this agreement is to place the Remerschen plant on the same basis as German nuclear power plants. Thus, for decisions affecting the Luxembourg nuclear plant, the approach and requirements will be essentially the same as those used in Germany.

A. Reactor requirements on spent fuel

1. Minimum holding period at reactor

There are no legal or regulatory requirements requiring a minimum holding period in Luxembourg. The holding period will be comparable to that used in Germany.

2. Storage capacity at reactor

Storage capacity for Remerschen is expressed as "five-thirds of plant capacity." By this it is meant that there will be storage capacity of one core plus two reloads. There is nothing in Luxembourg's law or regulations requiring storage margins at the reactor. It is expected that the same margins used in Germany will also be used at Remerschen, namely one full core.

3. Disposition plans for spent fuel as a reactor license requirement

The agreement between Luxembourg and Germany provides that Remerschen shall be given equal treatment with equivalent German nuclear plants regarding reprocessing and final disposal. Since Germany requires as a license condition reprocessing and disposal capability, it is expected that the same will be required in Luxembourg. Under Luxembourg law an applicant for a nuclear installation such as a power reactor is required to provide detailed information on disposal of radioactive waste (Appendix L-3, §2(3)).

B. Custody and licensing of spent fuel and its handling

1. Custody

Use of radioactive substances such as spent fuel, including its possession, transport, import and storage, is subject to control by the Government (Appendix L-1, §2; L-3, Ch. 2). The Minister of Public Health is the authority governing nuclear power in Luxembourg.

A company established to study nuclear power in Luxembourg is expected to be converted into the Societe Luxembourgeoise d'Energie Nucleaire S.A. (SENU). SENU will be owned one-half by Rheinisch-Westfaelisches Elektrizitaetswerk A.G. (RWE) and one-half by the Luxembourg Government. While the financing will be 50 percent, RWE will provide the technical direction for the facility.

2. Transport including packaging

Transport of spent fuel requires prior authorization of the Minister of Public Health (MPH) (Appendix L-1, §3). Luxembourg uses the same transportation standards as established by the International Atomic Energy Agency and includes them in its regulations. Because of the position of the Remerschen plant on the river, the principal transportation from Luxembourg is expected to be water transportation.

3. Storage license

a. At reactor

The law in Luxembourg requires that establishments having on their premises one or more nuclear reactors or irradiated nuclear fuel (class I facilities) secure authorization from the Minister for Public Health for such facilities.

There is a two-step process for licensing of a facility that includes spent fuel storage, namely, a construction authroization and an operating license. Application for each authorization requires identity of applicant; major purpose and detail of facilities; staff competence; financial security; demographic and geologic information; and a safety report including details of waste disposal.

b. Away from reactor

As a matter of policy and because of geological limitations, Luxembourg does not contemplate the storage of spent fuel away from the reactor within Luxembourg or the long-term disposal of waste within Luxembourg. However, if this policy should change for any reason, the appropriate regulations for the licensing of such a facility would be the same as those described above in connection with a storage license at the reactor site.

4. Import requirements, including license

As a matter of policy, Denmark does not contemplate importing spent nuclear fuel into Luxembourg.

In the event that any imports were to be permitted, the Minister of Public Health would be required to give prior authorization. An applicant is required to give information on intended use, characteristics of the spent fuel, and details of financial security. The spent fuel material could then be brought only through customs stations designated in the order granting the import authorization.

5. Export requirements, including license

The agreement between the Government of Luxembourg and the Government of Germany is expected to control the export of the spent fuel from Luxembourg to Germany. Transportation of the spent fuel is contemplated under that agreement and would be expected to be authorized in connection with the issuance of any licenses therefore likely negating the requirement for an individual export license each time a shipment is made.

C. Supplemental legal requirements

1. Radiation health and safety

Storage facilities at the reactor site are in the same category with reactors and thus are subject to the same health and safety standards. Luxembourg law sets standards to protect the public and workers. The design and operation of a storage facility must meet the same general criteria. With regard to standards for radiation health and safety, it is generally expected that the standards used in Germany will be used. Therefore, as conflicts between Germany and

Luxembourg standards occur, it is expected that it will be resolved by using the appropriate standards in Germany.

2. Safeguards and physical security

a. International agreements

Luxembourg is a member of the European Economic Community and EURATOM, so that its safeguards provisions and requirements are the same as the EURATOM requirements.

b. Domestic requirements

Luxembourg law requires control of access to spent fuel storage facilities. In addition, signs and symbols are required and physical checks on workers are also required. Responsibility for this is with the Minister for Public Health and the Minister of Labor. Luxembourg is expected to use the standards used in Germany with regard to physical security arrangements.

3. Environmental requirements

The radiological environmental impacts are described above under the Health and Safety section. Non-radiological environmental requirements are expected to be comparable to German standards.

4. Third-party liability

The agreement between Luxembourg and Germany provides that the Government of Luxembourg will not issue an operating license for Remerschen unless Luxembourg has signed the Paris Convention of July 20, 1960, and the Brussels addendum to the agreement of January 31, 1963. The agreement further provides that Luxembourg will given assurance that liability extends above the amounts in the Paris and Brussels Liability Conventions to a maximum of the equivalent 500 million German marks. The agreement specifically provides that these provisions shall apply as well to the transport of nuclear fuel elements. It is the intention of the Luxembourg Government to ratify the Treaties of Paris and Brussels.

5. Reporting and inspection

A nuclear installation such as a spent fuel storage facility is required to be supervised by the Medical Inspector responsible for the installation, assisted technically by a Radiation Protection Expert. The reports of the Medical Inspectors are sent to the Minister for Public Health.

Any loss or theft of spent fuel must be reported immediately to the Medical Inspector and thereby to the Minister of Public Health so that appropriate action can be taken.

6. Public participation

No provisions were found that would allow public participation in licensing of spent fuel storage or handling.

7. Other relevant considerations

Under Luxembourg law, an operator of a nuclear power reactor and a spent fuel storage facility when requesting authorization must specify in detail the measures proposed for the processing and disposal of any radioactive wastes. The authorization may establish conditions concerning the methods of management of such waste. Since the agreement between Luxembourg and Germany provides that the question of reprocessing and waste disposal will be handled on the same basis as if the Remerschen reactor were a German reactor, with the program in Germany for reprocessing and waste disposal will be used for the Luxembourg facility.

3.LX.6 Views Regarding Alternative Spent Fuel Disposition Programs

(Deleted

3.NL Visit Findings - the Netherlands

3.NL.1 Introduction

3.NL.1.1 Organizations Visited

The Dutch organizations visited were: the Ministry of Economics - Directorate of Electricity and Nuclear Energy, the Ministry of Health, the Ministry of Social Affairs (equivalent to U.S. NRC), the Ministry of Foreign Affairs, and the Borssele and Dodewaard Nuclear Power Stations.

3.NL.1.2 Spent Fuel Disposition Highlights

Policies, Plans and Programs

The Netherlands has contracted for reprocessing services with United Reprocessors, is currently negotiating for additional service contracts for the 1980-89 period with COGEMA, but has agreed to not consummate contract arrangements during the INFCE period. The new government has not moved on a program for expanding at-reactor-storage capacity or developing an AFR and cannot pursue such an approach for an idefinite time period. In the meantime, the Borssele reactor could lose FCR by 1981 or 1982 if the Netherlands cannot re-order with COGEMA or find some other solution by the end of the INFCE period.

Principal Concerns

Continued reactor operations during resolution of spent fuel disposition is a major concern.

Spent Fuel Disposition Profile

The spent fuel disposition profile for the Borssele reactor is shown below:

------------------------MTU------------------------

Reactor	Core Size	Pool Size Total	Pool Size LFCR	1/78 Spent Fuel Inventory	1978&1979 Discharge	Reprocessing Contracts Existing	Reprocessing Contracts Future
Borssele	39	65	26	21	26	70	135

Current and prospective spent fuel reprocessing arrangements are as follows:

Reactor	Time Period	Amount (MTU)	Reprocessor	Status
Borssele	1978-1979	70	URG	Active Contract
	1980-1989	135	COGEMA	Under Negotiation Pending INFCE

The following cumulative discharge profile reflects anticipated spent fuel generation for the committed Dutch LWR reactor program (firm) and anticipated Dutch LWR reactor program (projected).

Cumulative Discharge Profile (MTU)

Year	Firm	Projected	Total
1985	143	0	143
1990	208	47	255
2000	338	386	724

The following away-from-reactor (AFR) spent fuel disposition profile is based on removing spent fuel from ARS only when a full core reserve (FCR) limit has been reached:

Year	Firm	Projected	Total
1985	117	0	117
1990	182	0	182
2000	312	187	499

Views Regarding Alternative Spent Fuel Disposition Programs

(Deleted)

3.NL.2 Nuclear Power Profile

The only energy resource in the Netherlands, apart from solar and wind energy, is natural gas which should last another thirty years. Thus, the Netherlands has long recognized the potential importance of nuclear power and has resolved to keep abreast of developments in this area. The Netherlands' first power plant, a 55 MWe boiling water reactor (BWR), went critical in 1969.

Table 3.NL-1 summarizes the present Dutch nuclear power program. The total Dutch nuclear power generating capacity was .5 GWe in 1977. The projected capacity will reach .5 GWe in 1985, 1.4 GWe in 1990 and 2.3 GWe in 2000.

Table 3.NL-2 shows the profile for the presently perceived Dutch nuclear program (firm) and anticipated future reactor growth (projected).

Table 3.NL-1: Nuclear Power Program - The Netherlands

REACTOR	UTILITY	MWe	REACTOR TYPE	OPERATION DATE	STATUS
Dodewaard	Gemeenschappelijke Kernenergiecentrale Nederland NV	55	BWR	3/69	O
Borssele	NV Provinciale Zeeuwse Energie Maatschappij	448	PWR	10/73	O

O = Operational
C = Under Construction
P = In Planning

Table 3NL-2
NUCLEAR POWER GENERATING CAPACITY PROFILE — NETHERLANDS

	GENERATING CAPACITY (MWE)		
YEAR	FIRM	PROJECTED	TOTAL
1977	469.	0.	469.
1978	469.	0.	469.
1979	469.	0.	469.
1980	469.	0.	469.
1981	469.	0.	469.
1982	469.	0.	469.
1983	469.	0.	469.
1984	469.	0.	469.
1985	469.	0.	469.
1986	469.	180.	649.
1987	469.	360.	829.
1988	469.	540.	1009.
1989	469.	720.	1189.
1990	469.	900.	1369.
1991	469.	990.	1459.
1992	469.	1080.	1549.
1993	469.	1170.	1639.
1994	469.	1260.	1729.
1995	469.	1350.	1819.
1996	469.	1440.	1909.
1997	469.	1530.	1999.
1998	469.	1620.	2089.
1999	469.	1710.	2179.
2000	469.	1800.	2269.
2010	469.	1800.	2269.
2020	469.	1800.	2269.
2030	469.	1800.	2269.

3.NL.3 Spent Fuel Disposition Policies, Plans and Programs

The Netherland's spent fuel disposition policies, plans and programs were originally based upon reprocessing, recycling and eventually going into breeders. However, when the Dutch government changed in the spring of 1977, the nuclear program planning was put in suspension.

The Netherlands has always been in the vanguard of nations concerned about nuclear weapons proliferation and was immediately supportive of President Carter's new nonproliferation policies, including INFCE.

The Netherlands has reprocessing contracts with both BNFL (Godewaard reactor) and COGEMA (Borselle reactor). The COGEMA contract expires in 1980 and poses a problem for the Netherlands. Since the Dutch are so supportive of INFCE, they have promised to refrain from signing new contracts until INFCE has ended. They are worried, however, that in the two-year interim, other countries will book all of COGEMA's reprocessing capacity, thus endangering the Netherlands' Full Core Reserve (FCR) by 1981 or 1982. This dilemma could be lessened by an amendment to the Borssele reactor's license that could allow for a re-racking and densification program. The new government, however, is avoiding action on nuclear issues at the present time, and is not considering a plan for expanding ARS in any plant. The premise is that the new government will be able to consider such a plan after some time in office.

3.NL.4 Spent Fuel Disposition Profiles

Operating Reactor Disposition Profile

The spent fuel disposition profile for the Borssele reactor is shown below:

-----------------------MTU-----------------------

Reactor	Core Size	Pool Size Total	Pool Size LFCR	1/78 Spent Fuel Inventory	1978&1979 Discharge	Reprocessing Contracts Existing	Reprocessing Contracts Future
Borssele	39	65	26	21	26	70	135

Even though the Netherlands has contracted for reprocessing services and is negotiating for another increment of service, it has evaluated the possibility of densifying the Borssele at-reactor-storage (ARS) in the following way:

-----------------------MTU-----------------------

Reactor	Core Size	Original ARS Capacity	Potential ARS Capacity
Borssele	39	65	168

In spite of the technical possibility for ARS expansion, the Netherlands perceives difficulties in obtaining a license to expand capacity due to strong anti-nuclear pressures.

Spent Fuel Reprocessing Arrangements

The chronology of Dutch spent fuel reprocessing arrangements is tabulated below:

Reprocessing Arrangements

Reactor	Time Period	Amount (MTU)	Reprocessor	Status
Borssele	1978-1979	70	URG	Active Contract
	1980-1989	135	COGEMA	Under Negotiation Pending INFCE

Centralized AFR Storage

No current plans for centralized AFR storage.

Projected Spent Fuel Disposition Profiles

In order to provide a quantitative framework for evaluating spent fuel disposition requirements, the following exhibits are included:

Table 3.NL-3 summarizes the reactor and at-reactor storage characteristics associated with the currently defined Dutch nuclear power program. Correspondingly, Table 3.NL-4 summarizes the spent fuel generation and away-from-reactor (AFR) disposition requirements for the currently defined nuclear power program.

Table 3.NL-5 provides (a) the annual spent fuel generation profile and (b) the annual AFR disposition profile (based on a Full Core Reserve criteria) for both the currently defined reactor program (firm) and for anticipated future reactor additions (projected). Table 3.NL-6 provides cumulative information for the same categorization.

Technical Factors

As discussed earlier, execution of existing arrangements with United Reprocessors through the 1979 period will serve to maintain adequate at-reactor storage conditions for the next several years. Truck transport mode will be used to ship fuel from the Borssele plant to COGEMA's La Haue facility. The transport distance is approximately 600 kilometers and requires about two days transport time. Spent fuel casks are provided by COGEMA.

Table 3NL-3

REACTOR CHARACTERISTICS - NETHERLANDS

FIRM REACTORS

REACTOR	MWE	START UP	CORE SIZE (MTU)	ANNUAL DISCHARGE (MTU)	EFFECTIVE ARS (MTU)
BORSSELE P	469	1973	39	13	28

PROJECTED REACTORS

	MWE	(MTU PER 1000 MWE)	
1985-1990	900.	26.	130.
1990-2000	900.	26.	130.

Table 3NL-4

FIRM REACTOR SPENT FUEL PROFILE — NETHERLANDS

FACILITY	DIS START YEAR	ANN DIS	EFF ARS	BEG AFR YEAR	CUMULATIVE (MTU) 1985 DIS	1985 AFR	1990 DIS	1990 AFR	2000 DIS	2000 AFR	2030 DIS	2030 AFR
BORSSELE P	1975	13	26	1977	143.	117.	208.	182.	338.	312.	728.	702.

Table 3NL-5

ANNUAL SPENT FUEL PROFILE — NETHERLANDS

YEAR	ANNUAL DISCHARGE (MTU) FIRM	PROJECTED	TOTAL	ANNUAL AFR REQMT. (MTU) FIRM	PROJECTED	TOTAL
1977	13.	0.	13.	13.	0.	13.
1978	13.	0.	13.	13.	0.	13.
1979	13.	0.	13.	13.	0.	13.
1980	13.	0.	13.	13.	0.	13.
1981	13.	0.	13.	13.	0.	13.
1982	13.	0.	13.	13.	0.	13.
1983	13.	0.	13.	13.	0.	13.
1984	13.	0.	13.	13.	0.	13.
1985	13.	0.	13.	13.	0.	13.
1986	13.	0.	13.	13.	0.	13.
1987	13.	5.	18.	13.	0.	13.
1988	13.	9.	22.	13.	0.	13.
1989	13.	14.	27.	13.	0.	13.
1990	13.	19.	32.	13.	0.	13.
1991	13.	23.	36.	13.	0.	13.
1992	13.	26.	39.	13.	5.	18.
1993	13.	28.	41.	13.	9.	22.
1994	13.	30.	43.	13.	14.	27.
1995	13.	33.	46.	13.	19.	32.
1996	13.	35.	48.	13.	23.	36.
1997	13.	37.	50.	13.	26.	39.
1998	13.	40.	53.	13.	28.	41.
1999	13.	42.	55.	13.	30.	43.
2000	13.	44.	57.	13.	33.	46.
2010	13.	47.	60.	13.	47.	60.
2020	13.	47.	60.	13.	47.	60.
2030	13.	47.	60.	13.	47.	60.

Table 3NL-6

CUMULATIVE SPENT FUEL PROFILE —NETHERLANDS

YEAR	CUM DISCHARGE (1000 MTU) FIRM	PROJECTED	TOTAL	CUM AFR RQMT. (1000 MTU) FIRM	PROJECTED	TOTAL
1977	.039	0.000	.039	.013	0.000	.013
1978	.052	0.000	.052	.026	0.000	.026
1979	.065	0.000	.065	.039	0.000	.039
1980	.078	0.000	.078	.052	0.000	.052
1981	.091	0.000	.091	.065	0.000	.065
1982	.104	0.000	.104	.078	0.000	.078
1983	.117	0.000	.117	.091	0.000	.091
1984	.130	0.000	.130	.104	0.000	.104
1985	.143	0.000	.143	.117	0.000	.117
1986	.156	0.000	.156	.130	0.000	.130
1987	.169	.005	.174	.143	0.000	.143
1988	.182	.014	.196	.156	0.000	.156
1989	.195	.028	.223	.169	0.000	.169
1990	.208	.047	.255	.182	0.000	.182
1991	.221	.070	.291	.195	0.000	.195
1992	.234	.096	.330	.208	.005	.213
1993	.247	.124	.371	.221	.014	.235
1994	.260	.154	.414	.234	.028	.262
1995	.273	.187	.460	.247	.047	.294
1996	.286	.222	.508	.260	.070	.330
1997	.299	.260	.559	.273	.096	.369
1998	.312	.300	.612	.286	.124	.410
1999	.325	.342	.667	.299	.154	.453
2000	.338	.386	.724	.312	.187	.499
2010	.468	.854	1.322	.442	.620	1.062
2020	.598	1.322	1.920	.572	1.088	1.660
2030	.728	1.790	2.518	.702	1.556	2.258

3.NL.5 Legal and Regulatory Factors

A. Reactor requirements on spent fuel

1. Minimum holding time at reactor

The Netherlands requires reactor licensees to leave irradiated fuel in the storage basin for a minimum of one year after its removal from the core.

2. Storage capacity at reactor

As a matter of policy the Dutch government requires a storage basin capacity of 1 1/3 cores.

3. Disposition plans for spent fuel as a reactor license requirement

At this time an applicant for an operating license need not arrange for spent fuel disposition prior to the granting of the operating license. Their two reactors, however, were licensed to operate in 1968 and 1973. Dutch officials believe that the next reactor licensed may be required to present disposition plans for spent fuel prior to beginning operation.

B. Custody and licensing of spent fuel and its handling

1. Custody

Section 15(a) of the Nuclear Energy Act (Appendix N-1) requires the issuance of a license prior to obtaining custody over spent fuel. The license is issued jointly by the Ministers of Economic Affairs and of Social Affairs and Public Health. Factors considered in determining whether to grant a license include--the purposes for which the applicant wishes to have the materials, protective measures taken, and the applicants technical qualifications. Custody licenses are not restricted to Dutch Nationals.

2. Transport including packaging

Section 15(a) of the Nuclear Energy Act prohibits the transport of spent fuel without a license issued jointly by the Minister of Economic Affairs and of Social Affairs and Public Health.

Decree 405 of September 4, 1969 (Appendix N-2) contains all regulations governing the transport of spent fuel. These regulations adopt IAEA-suggested requirements set forth in the International Treaty on Goods Transport by Rail and the Draft European Agreement concerning the Transport of Dangerous Goods by Inland Waterway. Pending agreement on an international agreement on sea transport, the Dutch have adopted the latter as governing sea transport.

Additionally, the Netherlands will accept IAEA-approved packages. If a container is not so certified, the Dutch will conduct an independent design review.

For both health and safety as well as safeguards reasons, licenses may be conditioned so as to require a police escort and the following of a specified route.

Local jurisdictions have no role in regulating the transport of spent fuel if the material is not stored in the Netherlands pending or during transport. There are neither government ecnomic controls exerted over such shipments nor nationality requirements for transporters.

Certain international shipments are exempted from the license requirement. For a discussion of these, see Section B.4.

3. Storage license

a. At reactor

Storage basins are considered an integral part of a reactor and are licensed as part of the reactor licensing process. For a description of the facility licensing process, see subsection b. of this section.

The enlargement of a reactor storage basin requires a license amendment. The application for the amendment must include a reference to the previous license, a description of the proposed modification, and a supplementary safety report. Approval must be given jointly by the Ministers of Economic Affairs and of Social Affairs and Public Health (Appendix N-3, §3).

b. Away from reactor

If an applicant seeks to build an offsite centralized spent fuel storage facility, he must seek approval from a number of sources. The Nuclear Energy Act requires the applicant to receive a joint license from the Ministries of Economic Affairs and of Social Affairs, and Public Health. Factors considered include--

- full particulars of the site of the establishment, including geographical, geological, and climatological conditions;
- the chemical content and physistate form of the materials;

- the approximate number of employees, including the number of those to be directly concerned with storage and the technical competence of supervisory personnel;
- a safety report; and
- the financial security to be provided (Appendix N-3, §7).

Upon receipt of the application the Ministries of Economic Affairs and of Social Affairs and Public Health will transmit it to the Executive Council of the province where the facility will be located. If the proposed establishment is to be within ten kilometers from the boundary of another province, the Executive Council of that provice is also notified (Appendix N-1, §17; N-3, §15).

The provincial Executive Council will immediately notify the Municipal Council concerned, together with the neighboring Municipal Council if the proposed site is within ten kilometers of its boundary. The provincial Executive Council must also notify the bodies responsible for prevention of surface waters in the province within ten kilometers of the proposed site (Appendix N-3, §16).

After receiving comments from these and other bodies, as well as the holding of a public hearing, the Ministries of Economic Affairs and of Social Affairs and Public Health, in consultation with any other agencies involved, will make a joint decision (Appendix N-1, §18). If the application is refused, the decision must state the grounds on which it is based. Within one week of the decision all objectors must be informed and if the license has been granted, the points which have been taken into account must be stated. The Provincial and Municipal Councils must also be informed of the decision (Appendix N-1, §30).

4. Import requirements

Section 29 of the Nuclear Energy Act gives the Minister of Social Affairs and Public Health authority to regulate the importation of spent fuel. In exercising this jurisdiction, the Minister may set the routes by which such material is imported (Appendix N-3, §29). The Netherlands does not specifically require a license for the import of either related hardware or facility construction materials.

Certain international shipments are exempted from import and export license requirements. These include--

- fissionable materials that are held available or have been or may be imported under a license required by the national laws of Belgium or Luxembourg, provided the stipulations or conditions attached to the said license are observed;
- fissionable materials not intended for Belgium or Luxembourg that pass in transit through Netherlands territory, provided

the materials are not unloaded from the means of transport on Netherlands territory (Appendix N-3, §31).

5. Export requirements

The Ministry of Social Affairs and Public Health also regulates exports. In deciding upon an application the Ministry will review it against Dutch obligations imposed by the Non-Proliferation Treaty and NATO strategic goods list.

C. Supplemental legal requirements

1. Radiation health and safety

The licensing process for all licenses under the Nuclear Energy Act requires consideration of health and safety considerations. As a result, licenses may be conditioned for "the protection of persons, animals, plants and goods" (Appendix N-7, §19) and may include provisions covering --

- permissible radiation levels, including occupational doses
- protection against fire or other loss
- expertise of personnel
- maintenance of equipment (Appendix N-3, §§31, 32, 36).

Radiological health and safegy matters are examined from a broad number of perspectives. The agencies involved and their particular areas of concern include --

- Minister of Social Affairs and Public Health (general jurisdiction)
- Minister of Agriculture and Fisheries (soil, water and air)
- Minister of Transport, Water Control and Public Works (surface water) (Appendix N-1, §§38(1), 40, 41)

Although radiological health and safety is primarily regulated by the National government, the burgomaster of a municipality may take emergency action to preserve the public health or protect the environment. Before acting he must consult the National authorities (Appendix N-1, §44).

Additionally, the burgomaster may at any time request the Minister of Social Affairs and Public Health to impose new conditions on the license. (Appendix N-1, §38(2)).

2. Safeguards and physical security

a. International requirements

The Netherlands has a number of safeguards obligations imposed by international agreements under its umbrella agreement with EURATOM. It also ratified the Non-Proliferation Treaty as a non-nuclear weapons state.

Taken together, these international agreements impose strict supervision of spent fuel through on-site inspections. Under this scheme the facility operator is responsible for keeping records of all incoming fuel, its origin, designation, and location.

Under the U.S./EURATOM Agreement, the principals of the EURATOM safeguards system are compatible with and based upon those required by the IAEA and followed by that agency in the implementation of safeguards under the NPT. Further, under this Agreement the standards of the U.S. materials accountability system and that of EURATOM are required to be reasonably comparable.

b. Domestic requirements

The Nuclear Energy Act allows Dutch authorities to impose detailed licensing conditions concerning the storage and guarding of fissionable materials and ore. Additionally, Dutch law provides that the authorities may promulgate rules concerning the secrecy of a number of nuclear matters if the interest of the state so requires. Depending on the case involved, the competent authority to impose such an obligation can be the Minister for Economic Affairs, the Minister for Defense, the Minister for Foreign Affairs, the Minister for Home Affairs, the Minister of Transport Water Control and Public Works, the Minister of Education and Science, the Minister of Agriculture and Fisheries or the Minister for Social Affairs and Public Health. In order to insure secrecy several precautions may be required:

- grounds, buildings and areas in which nuclear activities are carried out may be required to have adequate physical protection;

- the activities mentioned may only be entrusted to persons who are regarded as reliable to handle such information;
- the knowledge of data relating to the nuclear activities may be accessible only to persons who are directly involved in the activities (Appendix N-4).

Special transport safeguards requirements include police escorts and the designation of specified routes.

3. Environmental requirements

Although environmental considerations are an integral part of the framework governing health and safety considerations (see section C.1), the Nuclear Energy Act does designate several agencies whose primary responsibility is to protect the environment. The Environment Hygiene Inspectorate of the Government Public Health Inspectorate is responsible for the protection of the environment. The Water Control and Public Works Department supervises the discharge of fissionable materials, ores and radioactive materials into water. The Veterinary Department and the General Inspectorate of the Ministry of Agriculture and Fisheries are responsible for examining the exposure of animals and agricultural produce to contamination by radiation and radioactive materials (Appendix N-1).

Additionally, the burgomaster of a muncipality and Provincial Council has responsibilities as outlined in section C.1.

4. Third-party liability

The Act of October 27, 1965, as amended, contains provisional regulations based on the Paris Convention and the Brussels Supplementatry Convention, which have not yet entered into force for the Netherlands (Appendix N-5). However, the Netherlands is at present considering a Draft Act approving the Paris Convention and the Brussels Supplementary Convention irrespective of additional protocols. Since approval and ratification are expected in the near future, this section is based on the Draft Act.

As a general rule, the operator of a nuclear facility is solely responsible for any nuclear damage occurring in the facility during shipments of material to and from the facility. This liability attaches even if the damage is fortuitous (id., §1).

If a nuclear incident occurs in the Netherlands and it cannot be proven that an operator is liable, both the consignor and the carrier of the nuclear substance are liable for the damage up to a maximum amount of 430 million Guilders. This provision would be applicable to where the material was being transported through the territory of the Netherlands in the course of shipment to or from a nation not a party to the Paris Convention.

To cover this liability, the operator of a nuclear facility situated in the Netherlands must take out insurance or provide financial security which the Minister of Finance deems adequate (id., §8).

The liability of the operator is limited to 100 million Guiders for any one nuclear incident (id., §3(1)). The state may intervene in the payment of compensation for nuclear damage either where the financial security of the operatior liable is deficient, the rights to claim compensation are extinguished or under the Brussels Supplementary Convention where the financial security proves insufficient (id., §9(1) and (2)). Where a Dutch operator may be held liable for nuclear damage under provisions other than the Paris Convention and the Act, the Minister of Finance is empowered to conclude, on behalf of the state, insurance agreements or to provide guarantees up to a maximum amount of 430 million Guilders per nuclear incident.

The operator of a nuclear installation situated in the Netherlands is liable for damage in the Netherlands wherever the nuclear incident occurred. Furthermore, he is liable for damage suffered outside the Netherlands and resulting from a nuclear incident occurring in the Netherlands (id., §26).

5. Reporting requirements

All licensees are required to maintain records and submit to inspections. Additionally, the National government maintains a register of all licenses and it is the licensee's duty to ensure that his license is so entered. Inspections are made by both National and local officials (Appendix N-1, §58).

6. Public participation.

Facility licenses including spent fuel storage facilities

After the Municipal Council has been notified of the application, it must make a public announcement within two weeks and insure that all adjoining land owners and occupiers recieve written notice. The application will then be made available for public inspection in the municipalities. A copy of a safety report will be included in the material made available (Appendix N-1, §17).

Interested parties may submit objections against the application on the grounds of danger, damage or nuisance. The provincial and municipal councils may also submit objections for reasons other than danger, damage or nuisance. (For example, because of incompatibility with a development plan, objections raised by the board which advises the municipal executive on the aesthetic aspects of building plans, etc., (Appendix N-7, §17).

Such objectives may be made either verbally or in writing to a committee nominated by the Ministries of Economic Affairs and of Social Affairs and Public Health to receive such objections. This committee will include the Provincial Exeuctive Council, the Inspector of Public Health for the district, the district head of the Labor Inspectorate and a representative of the State Institute for Purification of Waste Water. The committee must hold a public session where objections can be made. Copies of all objections of the minutes of the committee meetings are then sent to the two ministries responsible for setting up the committee (Appendix N-3, §19).

The committee must inform the applicant for the license of all objectives received and he may make written observations theron (Appendix N-3, §30).

The decision on the application is then made by an order of the Ministries of Economic Affairs and of Social Affairs and Public Health jointly, in agreement with other ministries involved.

Directly affected persons may appeal the decision to the Queen (with a hearing held by the Council of State).

7. Facility licensing amendments

Interested parties may object on the grounds of fear of danger, damage or nuisance in writing to the Ministers conceived within three weeks after the application is published in the Official Gazette (Appendix N-3, §17(1)). Directly affected persons may appeal the decision to the Queen.

8. Other licenses

There is no provision for public participation in the licensing process of applications not including facilities.

3.NL.6 Views Regarding Alternative Spent Fuel Disposition Programs

(Deleted)

3.ES Visit Findings - Spain

3.ES.1 Introduction

3.ES.1.1 Organizations Visited

The Spanish organizations visited were: the Junta de Energia Nuclear, the Empresa Nacional de Uranio S.A., the Forum Atomico Espanol and a representation of Spanish electric utilities involved in nulcear power programs.

3.ES.1.2 Spent Fuel Disposition Highlights

Policies, Plans and Programs

To date, Spain's spent fuel disposition program has been based on the reprocessing option and Spain has contracts with BNFL for limited reprocessing services for spent fuel from its Cabrera and St. Maria de Garona reactors. Spain is currently experiencing considerable difficulty in disposing of spent fuel from these reactors due to (a) problems with current reprocessing arrangements, in general, and perceived constraints imposed by the U.S. MB-10 process in particular; (b) lack of existing at-reactor-storage (ARS); and (c) difficulty in expanding existing ARS basins.

Spain is planning an interim spent fuel storage program as a reaction to (a) difficulties with present reprocessing arrangements, and (b) lack of attractive terms and conditions for any new reprocessing services. Spain is proceeding with plans to expand (densify) ARS for reactors presently under construction or in planning. In addition, Spain is evaluating the need and schedule for an away-from-reactor (AFR) centralized spent fuel storage facility alternative.

Spanish officials perceive that, over the long term, economics favor a reprocessing alternative and due to "balance of payment" considerations they favor a national reprocessing program. Start-up of a 750 MTU/year Spanish reprocessing plant is perceived to be justified around 1993.

Principal Concerns

Near-term concerns focus on:

a) Continuation of reactor operations while maintaining appropriate at-reactor-storage conditions
b) Resolution of spent fuel transfer problems, particularly in relation to MB-10 process
c) Establishment of a viable interim storage program.

Long-term concerns focus on:

a) Assured fuel supply conditions with minimum dependence on "external" sources
b) Foreign currency payments required to support fuel cycle programs.

Spent Fuel Disposition Profile

Spain has a severe near-term ARS problem at its operating reactor stations and will have to move spent fuel to an AFR facility within the next two years or densify the existing basins. The following tabulation illustrates the situation:

	MTU						
Reactor	Core Size	Pool Size Total	Pool Size LFCR	1-78 Spent Fuel Inventory	1978 & 1979 Discharge	BNFL Shipments[1)] Past	BNFL Shipments[1)] Future
Cabrera (PWR)	18.1	24.1	6.0	5.8	10.4	29.5	-0-
St. Maria (BRW)	74	115	41	46	29	34	58

1) Under existing contract with BNFL

Spain is considering reprocessing contract extensions, but would prefer other alternatives if available.

The following cumulative discharge profile reflects anticipated spent fuel generation for the committed Spanish LWR reactor program (firm) and anticipated future Spanish LWR reactor program (projected).

Cumulative Discharge Profile (MTU)

Year	Firm	Projected	Total
1985	1,068	0	1,068
1990	2,624	179	2,803
2000	6,074	1,778	7,852

The following cumulative away-from-reactor (AFR) spent fuel disposition profile is based on removing spent fuel from ARS only when a full core reserve (FCR) limit has been reached.

Cumulative AFR Profile (MTU)

Year	Firm	Projected	Total
1985	236	0	257
1990	485	0	485
2000	3,004	686	3,690

Views Regarding Alternative Spent Fuel Disposition Programs

(Deleted)

3.ES.2 Nuclear Power Profile

Spain's indigenous oil and natural gas resources are negligible and coal reserves are modest. Most of hydro-electric potential is being utilized. Accordingly, Spain has launched a significant nuclear power program to satisfy electric generation needs.

Spain's first nuclear power reactor (Jose Cabrera) became operational in 1968. Table 3.ES-1 describes Spain's current nuclear power program. It should be noted that Spain has recently conducted an extensive review of its nuclear power program and is preparing to release a revised program plan in the near future.

Table 3.ES-2 shows the profile for the presently perceived Spanish LWR nuclear program (firm) and anticipated future LWR growth (projected). The total Spanish nuclear power generating capacity was 1.1 GWe in 1977. The projected capacities will reach 12 GWe in 1985, 16 GWe in 1990 and 25 GWe in 2000.

Table 3.ES-1: Nuclear Power Program - Spain

REACTOR	UTILITY	MWe	REACTOR TYPE	OPERATION DATE	STATUS
Jose Cabrera	U.E.	153	PWR	8/69	O
Santa Maria de Garona	I.D. & E.V.	440	BWR	3/71	O
Vandellos 1	EdF, FECSA, ENHER, HEC & SEGRE	480	GCR	7/72	O
Almaraz I	HE, UE & CSE	900	PWR	/77	O
Almaraz II	HE, UE & CSE	900	PWR	/78	C
Lemoniz I	ID	900	PWR	1/79	C
Asco I	FESCA	890	PWR	6/79	C
Asco II	FECSA, ENHER, HEC & SEGRE	890	PWR	12/79	C
Lemoniz II	ID	900	PWR	1/80	C
Cofrentes	HE	930	BWR	7/80	C
Cabo Cope	HE	1000		/81	P
Vandellos 2	ENHER, HEC, SEGRE & FECSA	900	PWR	12/81	P
Valdecaballeros I	HE & CSE	937	BWR	/81	P
Valdecaballeros II	HE & CSE	937	BWR	/82	P
Santillan	EDV	970	BWR	/82	P
Trillo I	UE, ERZ & EIA	997	PWR	6/82	P
Trillo II	UE, ERZ & EIA	997	PWR	/85	P
Regodola	FENOSA, EV & HC	930		/86	P
Vandellos III	FECSA	950		/87	P

O = Operational
C = Under Construction
P = In Planning

Utilities:

UE:	Unión Eléctrica	....
ID:	Iberduero	....
E.V.:	Electra de Viesgo	....
E.D.F.:	Electricité de France	....
FECSA:	Fuerzas Eléctricas de Cataluña	....
ENHER:	Empresa Nacional Hidroeléctrica del Ribagorzana	....
H.E.C.:	Hidroeléctrica de Cataluña	....
SEGRE:	Fuerzas Eléctricas del Segre	.....
H.E.:	Hidroeléctrica Española	....
C.S.E.:	Compañía Sevillana de Electricidad	.
E.R.Z.:	Eléctricas Reunidad de Zaragoza	...
E.I.A.:	Energía e Industrias Aragonesas	...
FENOSA:	Fuerzas Eléctricas del Noroeste	...
H.C.:	Hidroeléctrica del Cantábrico	.....

Table 3ES-2

NUCLEAR POWER GENERATING CAPACITY PROFILE — SPAIN-FCR

YEAR	GENERATING CAPACITY (MWE) FIRM	PROJECTED	TOTAL
1977	620.	0.	620.
1978	1550.	0.	1550.
1979	3410.	0.	3410.
1980	5270.	0.	5270.
1981	7175.	0.	7175.
1982	7175.	0.	7175.
1983	8125.	0.	8125.
1984	10125.	0.	10125.
1985	11095.	900.	11995.
1986	12975.	1140.	14115.
1987	13925.	1380.	15305.
1988	13925.	1620.	15545.
1989	13925.	1860.	15785.
1990	13925.	2100.	16025.
1991	13925.	3000.	16925.
1992	13925.	3900.	17825.
1993	13925.	4800.	18725.
1994	13925.	5700.	19625.
1995	13925.	6600.	20525.
1996	13925.	7500.	21425.
1997	13925.	8400.	22325.
1998	13925.	9300.	23225.
1999	13925.	10200.	24125.
2000	13925.	11100.	25025.
2010	13925.	11100.	25025.
2020	13925.	11100.	25025.
2030	13925.	11100.	25025.

3.ES.3 Spent Fuel Disposition Policies, Plans and Programs

Following the letter and spirit of the 1974 bilateral agreement with the U.S., Spain's policy has allowed for the reprocessing of spent nuclear fuel. Spanish preference for this option is based on long term economics and the recovery of valuable energy resources. The Spanish believe that start-up of a 750 MTU/year national reprocessing plant might be justifiable by approximately 1993. Spanish government authorities postulate a possible fuel cost savings of $7 million per year for a 1,000 MWe reactor as the rationale to proceed with LWR recycle, drawing the savings estimate from the GESMO proceedings. The stated principal policy objective for a national reprocessing plant is to reduce payments in hard foreign currency.

More recently, however, Spain has experienced considerable difficulty in implementing its reprocessing policy and is considering adopting an interim spent fuel storage policy. The difficulties stem from conflicts with U.S. MB-10 arrangements and the lack of attractive terms and conditions for new reprocessing service contracts. Spain is not extending its arrangements with BNFL and considers proposed reprocessing terms and conditions to be difficult in pricing and lacking technical guarantees. It believes it will not need reprocessing until the mid-1990's and therefore favors interim storage solutions.

As a result of the major review of the Spanish nuclear power program mentioned in Section 3.ES.2, Spanish utilities and ENUSA (Spanish company formed by the government - 60%, and the utilities - 40% to plan and provide fuel cycle services) will be responsible for implementing a program which will likely include (a) expansion of ARS capacities,

(b) consideration of a centralized spent fuel storage alternative and (c) consideration of downstream reprocessing plans and schedules.

Spain is at the preliminary stage of planning for a centralized away-from-reactor (AFR) storage facility, estimated to accommodate 1500 MTU and to begin operation in the 1982-1984 time period. To date, planning has been of a generic nature and no firm siting decisions have been made. Officials believe the project would not present technical difficulties; would face public opposition; and would cost $100 million or more. Siting criteria includes finding a location suitable for interim storage and capable of accommodating other fuel cycle elements.

ENUSA has been conducting spent fuel disposition studies in support of the government nuclear power planning activities. The referenced study evaluated three alternatives for disposing of Spain's spent fuel until the year 2012. The three alternatives considered include (a) a long term Spanish centralized spent fuel storage program; (b) a European reprocessing service program beginning in 1993, supplemented by limited Spanish centralized storage and (c) a Spanish national reprocessing program beginning in 1993, supplemented by a limited Spanish centralized storage. The results of the referenced study are summarized below:

Case	Cum AFR Requirement to Year 2012 (MTU)	Cum Reprocess Reqmt. to Year 2012 (MTU)	Costs ($bil.)[1] 1977$	Current$[2]
A	15,484	0	.93	12.5
B	4,527	10,912	<.05>[3]	.43
C	1,327	14,419	.81	11.2

Other related Spanish nuclear programmatic factors are as follows:

- The Spanish nuclear power program has focused on developing a significant amount of product through indigenous industry. This has been successfully demonstrated in its reactor plant construction program and in the development of a small scale reprocessing facility.
- Currently, Spain is doing some early R&D and conducting limited drilling activities in conjunction with geologic storage options. Terminal storage programs are the responsibility of the Spanish government.
- Spain has no defined program for incorporating the breeder reactor at this time even though there are concerns over the potential scarcity of long-term energy supplies.

In addition to the above factors, Spain is not a signator of the Non-Proliferation Treaty (NPT) nor is it a member of NATO or the European Community.

[1] Costs shown are converted from referenced report values, using $1 = 80 Ptas.

[2] 10% annual escalation.

[3] < > designates credit.

3.ES.4 Spent Fuel Disposition Profile

Operating Reactors Disposition Profile

The spent fuel disposition profile for Spain's two operating LWR reactors (Cabrera and St. Maria) is shown below:

	MTU							
Reactor	Core Size	Pool Size Total	Pool Size LFCR	1-78 Spent Fuel Inventory	1978 & 1979 Discharge	BNFL Shipments[1] Past	BNFL Shipments[1] Future
Cabrera (PWR)	18.1	24.1	6.0	5.8	10.4	29.5	-0-
St. Maria (BWR)	74	115	41	46	29	34	58

[1] Under existing contract with BNFL.

The situation at these reactors is as follows:

1. Existing spent fuel inventory in the ARS are close to or exceed Loss of Full Core Reserve (LFCR) criteria.

2. Current plans are to densify ARS at both reactor stations, in the 1978-1979 time frame; however, "go-ahead" decisions are still pending. Current plans are to provide the following future ARS capacities:

	LFCR (MTU) Present	LFCR (MTU) Future
Cabrera	6	60
St. Maria	41	178

3. In order to densify the existing ARS basins, approximately 91 MTU (i.e., current inventory plus 1978 and 1979 discharges) might have to be transported to an AFR disposition during the modification activity.

Spanish officials expressed a major frustration in trying to maintain FCR for their operating reactors. The requirement for Full Core Reserve is neither a Spanish law nor a regulation, but is a firm policy on the part of the electric utilities. These authorities indicated that the MB-10 approval process by the U.S. does not provide sufficient lead time for proper spent fuel shipment planning to maintain FCR conditions. Utility difficulties stem from coordinating MB-10 negotiations and accommodating those decisions with spent fuel shipment constraints (i.e., schedules, cask availabilities, etc.).

Spent Fuel Reprocessing Arrangements

Spain has had an existing contract with BNFL to reprocess approximately 122 MTU of spent fuel for its Cabrera and St. Maria reactors. The existing arrangements will expire in 1979 when the current unfilled portion (58 MTU) is exercised.

Due to a severe need for near term AFR storage for its operating reactors (i.e., as shown above, Spain has to transport 91 MTU to an AFR in the 1978-79 time period if it is to expand existing basins), Spain is trying to negotiate extensions to its present reprocessing arrangements. However, at this time it appears that new contract terms are not favorable and Spain would welcome other alternatives.

Centralized AFR Storage

As discussed in Section 3.ES.3, Spain is evaluating the need and schedule for a centralized AFR storage facility and envisions a need for a 1500 MTU facility in the 1982-84 time frame.

Projected Spent Fuel Disposition Profiles

In order to provide a quantitative framework for evaluating spent fuel disposition requirements, the following exhibits are included:

Table 3.ES-3 summarizes the reactor and at-reactor-storage characteristics associated with the currently defined Spanish nuclear power program. Correspondingly, Table 3.ES-4 summarizes the spent fuel generation and away-from-reactor (AFR) disposition requirements for the currently defined nuclear power program.

Table 3.ES-5 provides (a) the annual spent fuel generation profile and (b) the annual AFR disposition profile (based on a Full Core Reserve criteria) for both the currently defined reactor program (firm) and for anticipated future reactor additions (projected). Table 3.ES-6 provides cumulative information for the same categorization.

Tables 3.ES-7, 3.ES-8 and 3.ES-9 provide similar information for an at-reactor-storage (ARS) criteria wherein five year or older spent fuel is shipped away from reactor beginning in 1985 - unless prior period spent fuel to ARS exceed FCR criteria (in which case spent fuel would be shipped away from reactor as soon as FCR limits were reached).

Technical Factors

Spain's major near-term technical considerations are as follows:

1. Transportation of spent fuel to BNFL's Windscale facility in a timely manner

2. Feasibility of expanding at-reactor-storage (ARS) at the Cabrera and St. Maria stations.

As was pointed out earlier, approximately 91* MTU (16 MTU of PWR/75 MTU of BWR) might have to be transported to an AFR - presumably BNFL's Windscale facility - within the next two years. It is expected that NTL casks will be used for these spent fuel shipments in the following ways:

Station	Potential Casks	Cask Payload (Assy)	1978-79 Shipment Requirements (Assy)*
Cabrera	NTL-3	7 PWR	62
St. Maria	NTL-9 (present) NTL-11 (future)	7 BWR 17 BWR	403

*Based on need to empty existing basins for densification project.

International over-water shipment for the above spent fuel will be made from Bilbao, Spain to Southhampton, U.K.

Utility officials indicated that the ARS densification program for the existing reactor pools (Note: Densification "go-ahead" decision is still pending) would be difficult due to (a) pool contamination and (b) seismic considerations.

Table 3ES-3

REACTOR CHARACTERISTICS - SPAIN-FCR

FIRM REACTORS

REACTOR		MWE	START UP	CORE SIZE (MTU)	ANNUAL DISCHARGE (MTU)	EFFECTIVE ARS (MTU)
CABRERA	P	160	1969	18	5	6
ST. MARIA	B	460	1971	74	16	41
ALMARAZ1	P	930	1978	73	20	209
ALMARAZ2	P	930	1979	73	20	209
LEMONIZ1	P	930	1979	73	20	163
LEMONIZ2	P	930	1980	73	20	163
ASCO1	P	930	1980	73	25	198
ASCO2	P	930	1981	73	25	198
COFRENT	B	975	1981	118	28	449
TRILLO1	P	1030	1984	82	28	192
SAYAGO	P	950	1986	83	20	194
VALDECAB1	B	970	1984	114	29	209
VALDECAB2	B	970	1985	114	29	209
VANDELL2	P	950	1983	73	20	210
VANDELL3	P	950	1987	73	20	210
REGODOLA	P	930	1986	73	20	210

PROJECTED REACTORS

	MWE	(MTU PER 1000 MWE)	
1984-1985	900.	26.	130.
1985-1990	1200.	26.	130.
1990-2000	9000.	26.	130.

Table 3ES-4

FIRM REACTOR SPENT FUEL PROFILE — SPAIN-FCR

FACILITY		DIS START YEAR	ANN DIS	EFF ARS	BEG AFR YEAR	CUMULATIVE (MTU) 1985 DIS	1985 AFR	1990 DIS	1990 AFR	2000 DIS	2000 AFR	2030 DIS	2030 AFR
CABRERA	P	1971	5	6	1972	75.	69.	100.	94.	150.	144.	300.	294.
ST. MARIA	B	1973	16	41	1975	208.	167.	288.	247.	448.	407.	928.	887.
ALMARAZ1	P	1980	20	209	1990	120.	0.	220.	11.	420.	211.	1020.	811.
ALMARAZ2	P	1981	20	209	1991	100.	0.	200.	0.	400.	191.	1000.	791.
LEMONIZ1	P	1981	20	163	1989	100.	0.	200.	37.	400.	237.	1000.	837.
LEMONIZ2	P	1982	20	163	1990	80.	0.	180.	17.	380.	217.	980.	817.
ASCO1	P	1981	25	198	1988	125.	0.	250.	52.	500.	302.	1250.	1052.
ASCO2	P	1982	25	198	1989	100.	0.	225.	27.	475.	277.	1225.	1027.
COFRENT	B	1982	28	449	1998	112.	0.	252.	0.	532.	83.	1372.	923.
TRILLO1	P	1985	28	192	1991	28.	0.	168.	0.	448.	256.	1288.	1096.
SAYAGO	P	1988	20	194	1997	0.	0.	60.	0.	260.	66.	860.	666.
VALDECAB1	B	1986	29	209	1993	0.	0.	145.	0.	435.	226.	1305.	1096.
VALDECAB2	B	1987	29	209	1994	0.	0.	116.	0.	406.	197.	1276.	1067.
VANDELL2	P	1985	20	210	1995	20.	0.	120.	0.	320.	110.	920.	710.
VANDELL3	P	1989	20	210	1999	0.	0.	40.	0.	240.	30.	840.	630.
REGODOLA	P	1988	20	210	1998	0.	0.	60.	0.	260.	50.	860.	650.

Table 3ES-5

ANNUAL SPENT FUEL PROFILE — SPAIN-FCR

YEAR	ANNUAL DISCHARGE (MTU) FIRM	PROJECTED	TOTAL	ANNUAL AFR REQMT. (MTU) FIRM	PROJECTED	TOTAL
1977	21.	0.	21.	21.	0.	21.
1978	21.	0.	21.	21.	0.	21.
1979	21.	0.	21.	21.	0.	21.
1980	41.	0.	41.	21.	0.	21.
1981	106.	0.	106.	21.	0.	21.
1982	179.	0.	179.	21.	0.	21.
1983	179.	0.	179.	21.	0.	21.
1984	179.	0.	179.	21.	0.	21.
1985	227.	0.	227.	21.	0.	21.
1986	256.	23.	279.	21.	0.	21.
1987	285.	30.	315.	21.	0.	21.
1988	325.	36.	361.	23.	0.	23.
1989	345.	42.	387.	65.	0.	65.
1990	345.	48.	393.	119.	0.	119.
1991	345.	55.	400.	146.	23.	169.
1992	345.	78.	423.	179.	30.	209.
1993	345.	101.	446.	202.	36.	238.
1994	345.	125.	470.	231.	42.	273.
1995	345.	148.	493.	247.	48.	295.
1996	345.	172.	517.	257.	55.	312.
1997	345.	195.	540.	263.	78.	341.
1998	345.	218.	563.	314.	101.	415.
1999	345.	242.	587.	335.	125.	460.
2000	345.	265.	610.	345.	148.	493.
2010	345.	289.	634.	345.	289.	634.
2020	345.	289.	634.	345.	289.	634.
2030	345.	289.	634.	345.	289.	634.

Table 3ES-6

CUMULATIVE SPENT FUEL PROFILE —SPAIN-FCR

YEAR	CUM DISCHARGE (1000 MTU) FIRM	PROJECTED	TOTAL	CUM AFR RQMT. (1000 MTU) FIRM	PROJECTED	TOTAL
1977	.115	0.000	.115	.068	0.000	.068
1978	.136	0.000	.136	.089	0.000	.089
1979	.157	0.000	.157	.110	0.000	.110
1980	.198	0.000	.198	.131	0.000	.131
1981	.304	0.000	.304	.152	0.000	.152
1982	.483	0.000	.483	.173	0.000	.173
1983	.662	0.000	.662	.194	0.000	.194
1984	.841	0.000	.841	.215	0.000	.215
1985	1.068	0.000	1.068	.236	0.000	.236
1986	1.324	.023	1.347	.257	0.000	.257
1987	1.609	.053	1.662	.278	0.000	.278
1988	1.934	.089	2.023	.301	0.000	.301
1989	2.279	.131	2.410	.366	0.000	.366
1990	2.624	.179	2.803	.485	0.000	.485
1991	2.969	.234	3.203	.631	.023	.654
1992	3.314	.312	3.626	.810	.053	.863
1993	3.659	.413	4.072	1.012	.089	1.101
1994	4.004	.538	4.542	1.243	.131	1.374
1995	4.349	.686	5.035	1.490	.179	1.669
1996	4.694	.858	5.552	1.747	.234	1.981
1997	5.039	1.053	6.092	2.010	.312	2.322
1998	5.384	1.271	6.655	2.324	.413	2.737
1999	5.729	1.513	7.242	2.659	.538	3.197
2000	6.074	1.778	7.852	3.004	.686	3.690
2010	9.524	4.664	14.188	6.454	3.221	9.675
2020	12.974	7.550	20.524	9.904	6.107	16.011
2030	16.424	10.436	26.860	13.354	8.993	22.347

Table 3ES-7

FIRM REACTOR SPENT FUEL PROFILE — SPAIN-5Y-1985

FACILITY		DIS START YEAR	ANN DIS	EFF ARS	BEG AFR YEAR	CUMULATIVE (MTU) 1985 DIS	1985 AFR	1990 DIS	1990 AFR	2000 DIS	2000 AFR	2030 DIS	2030 AFR
CABRERA	P	1971	5	6	1972	75.	69.	100.	94.	150.	144.	300.	294.
ST. MARIA	B	1973	16	41	1975	208.	167.	288.	247.	448.	407.	928.	887.
ALMARAZ1	P	1980	20	100	1985	120.	20.	220.	120.	420.	320.	1020.	920.
ALMARAZ2	P	1981	20	100	1986	100.	0.	200.	100.	400.	300.	1000.	900.
LEMONIZ1	P	1981	20	100	1986	100.	0.	200.	100.	400.	300.	1000.	900.
LEMONIZ2	P	1982	20	100	1987	80.	0.	180.	80.	380.	280.	980.	880.
ASCO1	P	1981	25	125	1986	125.	0.	250.	125.	500.	375.	1250.	1125.
ASCO2	P	1982	25	125	1987	100.	0.	225.	100.	475.	350.	1225.	1100.
COFRENT	B	1982	28	140	1987	112.	0.	252.	112.	532.	392.	1372.	1232.
TRILLO1	P	1985	28	140	1990	28.	0.	168.	28.	448.	308.	1288.	1148.
SAYAGO	P	1988	20	115	1993	0.	0.	60.	0.	260.	145.	860.	745.
VALDECAB1	B	1986	29	145	1991	0.	0.	145.	0.	435.	290.	1305.	1160.
VALDECAB2	B	1987	29	145	1992	0.	0.	116.	0.	406.	261.	1276.	1131.
VANDELL2	P	1985	20	100	1990	20.	0.	120.	20.	320.	220.	920.	820.
VANDELL3	P	1989	20	100	1994	0.	0.	40.	0.	240.	140.	840.	740.
REGODOLA	P	1988	20	100	1993	0.	0.	60.	0.	260.	160.	860.	760.

Table 3ES-8
ANNUAL SPENT FUEL PROFILE — SPAIN-5Y-1985

	ANNUAL DISCHARGE (MTU)			ANNUAL AFR REQMT. (MTU)		
YEAR	FIRM	PROJECTED	TOTAL	FIRM	PROJECTED	TOTAL
1977	21.	0.	21.	21.	0.	21.
1978	21.	0.	21.	21.	0.	21.
1979	21.	0.	21.	21.	0.	21.
1980	41.	0.	41.	21.	0.	21.
1981	106.	0.	106.	21.	0.	21.
1982	179.	0.	179.	21.	0.	21.
1983	179.	0.	179.	21.	0.	21.
1984	179.	0.	179.	21.	0.	21.
1985	227.	0.	227.	41.	0.	41.
1986	256.	23.	279.	106.	0.	106.
1987	285.	30.	315.	179.	0.	179.
1988	325.	36.	361.	179.	0.	179.
1989	345.	42.	387.	179.	0.	179.
1990	345.	48.	393.	227.	0.	227.
1991	345.	55.	400.	256.	23.	279.
1992	345.	78.	423.	285.	30.	315.
1993	345.	101.	446.	310.	36.	346.
1994	345.	125.	470.	345.	42.	387.
1995	345.	148.	493.	345.	48.	393.
1996	345.	172.	517.	345.	55.	400.
1997	345.	195.	540.	345.	78.	423.
1998	345.	218.	563.	345.	101.	446.
1999	345.	242.	587.	345.	125.	470.
2000	345.	265.	610.	345.	148.	493.
2010	345.	289.	634.	345.	289.	634.
2020	345.	289.	634.	345.	289.	634.
2030	345.	289.	634.	345.	289.	634.

, **Table 3ES-9**

CUMULATIVE SPENT FUEL PROFILE —SPAIN-5Y-1985

YEAR	CUM DISCHARGE (1000 MTU) FIRM	PROJECTED	TOTAL	CUM AFR RQMT. (1000 MTU) FIRM	PROJECTED	TOTAL
1977	.115	0.000	.115	.068	0.000	.068
1978	.136	0.000	.136	.089	0.000	.089
1979	.157	0.000	.157	.110	0.000	.110
1980	.198	0.000	.198	.131	0.000	.131
1981	.304	0.000	.304	.152	0.000	.152
1982	.483	0.000	.483	.173	0.000	.173
1983	.662	0.000	.662	.194	0.000	.194
1984	.841	0.000	.841	.215	0.000	.215
1985	1.068	0.000	1.068	.256	0.000	.256
1986	1.324	.023	1.347	.362	0.000	.362
1987	1.609	.053	1.662	.541	0.000	.541
1988	1.934	.089	2.023	.720	0.000	.720
1989	2.279	.131	2.410	.899	0.000	.899
1990	2.624	.179	2.803	1.126	0.000	1.126
1991	2.969	.234	3.203	1.382	.023	1.405
1992	3.314	.312	3.626	1.667	.053	1.720
1993	3.659	.413	4.072	1.977	.089	2.066
1994	4.004	.538	4.542	2.322	.131	2.453
1995	4.349	.686	5.035	2.667	.179	2.846
1996	4.694	.858	5.552	3.012	.234	3.246
1997	5.039	1.053	6.092	3.357	.312	3.669
1998	5.384	1.271	6.655	3.702	.413	4.115
1999	5.729	1.513	7.242	4.047	.538	4.585
2000	6.074	1.778	7.852	4.392	.686	5.078
2010	9.524	4.664	14.188	7.842	3.221	11.063
2020	12.974	7.550	20.524	11.292	6.107	17.399
2030	16.424	10.436	26.860	14.742	8.993	23.735

3.ES.5 Legal and Regulatory Factors

A. Reactor requirements

1. Minimum holding period at reactor.

This material has not yet been obtained from Spain.

2. Storage capcity at reactor.

This material has not year been obtained from Spain.

3. Disposition plans for spent fuel as a reactor license requirement.

This material has not yet been obtained from Spain.

B. Custody licensing of spent fuel and its handling.

1 Custody.

A person may not take custody of spent fuel unless expressly authorized to do so by the Minister for Industry following a report by the Junta de Energia Nuclear (JEN) (Appendix SP-1, § 31).

2. Transport including packaging.

Spain follows IAEA-suggested regulations as the basis for its legal regime governing transportation (See, e.g., Appendix SP-2).

3. Storage License.

a. At reactor.

Spain has not yet responded to a request for the extent to which it considers a spent fuel basin in the initial facility licensing process. For a general discussion of this process, see subsection b. of this section.

The alteration or enlargement of the basin is subject to prior authorization by the Minister for Industry (Appendix SP-3).

b. Away from reactor.

The construction and establishment of a spent fuel facility requires authorization from the Minister for Industry following the receipt of a report from the JEN. There are three stages in this process - a "prior authorization" which includes "public consultation", an authorization for the construction and equipment of the facility as well as approval to bring them into operation (Appendix SP-1, § 28-29). During construction the JEN is responsible for supervising the construction and ensuring that it conforms with the construction authorization (Id., § 29).

Under the 1972 regulations prior authorization signifies official recognition of the purpose of the facility as well as of its location, thereby precluding disapproval by the municipalities (Appendix SP-4).

4. Import.

This material has not yet been obtained from Spain.

5. Export.

This material has not yet been obtained from Spain.

C. Supplemental legal requirements.

1. <u>Radiological health and safety.</u>

Pending the promulgation of regulations to implement the Nuclear Energy Act, the Order of December 22, 1959 (Appendix SP-5) as amended, governs health and safety considerations. The provisions of this order were based on the recommendations of the International Commission on Radiological Protection (ICRP) and the OECD.

The authorities consider health and safety issues at all stages of the facility licensing process. The procedures include on-site inspections and the submissions of detailed technical reports (Appendix SP-4).

Additionally, the authorities license all staff who handle or supervise control equipment in a facility (Id.).

2. <u>Safeguards and physical security.</u>

a. <u>International requirements.</u>

The U.S., Spain and the IAEA have concluded a trilateral agreement, under which the IAEA administers safeguards - including inspections - which otherwise would be administered by the United States. The presence of the trilateral agreement does not affect the provision of the U.S./Spain Agreement which guarantees that material generated in U.S.-supplied equipment, whatever its source, will be subject only to peaceful use; or the provision that any retransfer of U.S.-supplied equipment or devices may be made only with U.S. approval, or the provision reserving to the U.S. a right of prior safeguards approval for any future reprocessing of U.S.-supplied fuel. Article XII of the Agreement for Cooperation provides U.S. bilateral safeguards are suspended in favor of IAEA safeguards only during the period that the United States Government agrees that other safeguards being applied are adequate.

b. Domestic requirements.

This material has not yet been forwarded by the Spanish authorities.

3. Environmental requirements.

Spanish authorities have not yet responded to a request for information on this subject.

4. Third party liability.

As a general rule, the operator of a nuclear facility is solely responsible for any nuclear damage occurring in the facility or during shipments of material to and from the facility. This liability attaches even if the damage is fortuitous (Appendix SP4, § 45). An exception involves cases where the damage is due to nuclear materials stored in the facility incidental to their carriage to or from a nuclear installation situated in the territory of a party to the Paris Convention (id., § 10). In the case of damage caused by material transported through Spanish territory and for which no operator has responsibility, the consigning operator will be liable if the facility is situated within Spanish territory and liability has not been assumed by another operator (id., § 47). If the material involved in the incident is an import, the consignee operator is liable from the time he takes charge of the material. International conventions apply in the case of transit across Spanish territory.

To cover this liability, the operator of a nuclear facility situated in Spain must take out insurance or provide financial security (id., § 54).

The liability of the operator is limited to 350 million peasta for any one nuclear incident (id., § 57). This figure may be increased automatically to the level required by the international conventions ratified by Spain.

The Spanish Act contains no specific provisions relating to its territorial scope. Spain, however, has ratified the Paris Convention, the Brussels Supplementary Convention and the 1971 Brussels Conventions, and one may infer that the extraterritoriality sections of those conventions would apply.

5. Reporting and inspection.

All licensees must establish and maintain a detailed system of record-keeping.

Independently of the inspection carried out by the JEN prior to the operation of a facility, Ministry of Industry officials inspect facilities prior to operation and periodically thereafter. These inspections are designed to check safety measures and ensure that license conditions are met (Appendix SP-1, § 35).

6. Public participation.

The requirement for "prior authorization" for a nuclear facility includes public "consultation" (Appendix SP-3). Information relating to the extent of this consultative process and its applicability to other licenses has not yet been received from Spain.

3.ES.6 Views Regarding Alternative Spent Fuel Disposition Programs

(Deleted)

3.SE Visit Findings - Sweden

3.SE.1 Introduction

3.SE.1.1 Organizations Visited

The Swedish organizations visited were: the Ministry of Industry - Energy Division, Ministry of Industry - Energy Policy Division, the Swedish Department of State, the Swedish Energy Commission, Oskarshamnverkts Graftgrupp (OKG), and the Swedish Nuclear Fuel Supply Company.

3.SE.1.2 Spent Fuel Disposition Highlights

Policies, Plans and Programs

1977 law establishes requirements for a reactor license: either (1) reprocesses and permanently store HLW, or (2) permanently store unreprocessed spent fuel. Sweden is proceeding with a national AFR and is developing a technical program for permanent storage capacity in granite. Reactor storage capacity is being expanded. The government's policy is to withhold export licenses for spent fuel to COGEMA until the conclusion of INFCE unless the utilities can offer valid reasons why export is crucial in that time frame. The possible return of HLW by COGEMA can stop a new reactor; however, an exception by the government has allowed one new plant to operate until 1979.

Principal Concerns

The relationship between permanent storage solutions and continued reactor plant development is the main concern.

Spent Fuel Disposition Profile

Sweden did not respond sufficiently to the study questionnaire for a determination to be made as to ARS near term problems with operating reactors. The estimated spent fuel profile for operating reactors is shown below.

Reactor	Annual SF Discharges	SF Cum Discharge 1/78	At Reprocessor	ARS Inventory 1/78
Oskarshamn 1	16	69	19 (BNFL)	50
Oskarshamn 2	19	34	0	34
Ringhals 2	24	48	0	48

The following cumulative discharge profile reflects anticipated spent fuel generation for the committed Swedish LWR reactor program (firm) and anticipated future Swedish LWR reactor program (projected).

Cumulative Discharge Profile (MTU)

Year	Firm	Projected	Total
1985	1700	0	1700
1990	3000	62	3142
2000	5830	959	6789

The following away-from-reactor (AFR) spent fuel disposition profile is based on removing spent fuel from ARS only when a full core reserve (FCR) limit has been reached:

Cumulative AFR Profile (MTU)

Year	Firm	Projected	Total
1985	1101		1101
1990	2074	0	2074
2000	4824	348	5172

Views Regarding Alternative Spent Fuel Disposition Programs

(Deleted

3.SE.2 Nuclear Power Profile

In Sweden, nuclear power is expected to play a major role in the energy program as a complement to extensive hydroelectric power in the north and to oil imports. Hydroelectricity is the most important indigenous energy source and covers approximately 70-75% of the total electricity production, or 12-15% of total energy supply. 70-75% of the total energy supply is met with oil imports (about 70%) and coal (about 5%) (1975 data). Even though Sweden lacks extensive coal and natural gas deposits, reasonably assured U_3O_8 resources total 350,000 short tons. Moreover, estimated additional resources total 52,000 short tons (1973 data).

Sweden launched its nuclear power program in the mid-1960s and put its first reactor on line in 1972. Six reactors (five BWRs and one PWR) are currently operating and account for 18 percent of Sweden's electricity. In addition, five units are under construction (three BWRs and two PWRs); two other BWR units are planned and actual planning for commercial operation is 1985-1986.

Table 3.SE-1 describes the current Swedish nuclear power program.

Table 3.SE-2 shows the profile for the presently perceived Swedish nuclear power program (firm) and anticipated future growth (projected). The total Swedish nuclear power generating capacity was 3.9 GWe in 1977, and is projected to reach 9.4 GWe in 1985, 11 GWe in 1990 and 16 GWe in 2000.

Table 3.SE-1: Nuclear Power Profile - Sweden

REACTOR	UTILITY	MWe	REACTOR TYPE	OPERATION DATE	STATUS
Oskarshamn 1	Oskarshamnsverkets Kraftgrupp AB	440	BWR	2/72	O
Oskarshamn 2	"	580	BWR	12/74	O
Ringhals 2	Statens Vattenfalls-verk	809	PWR	5/75	O
Barsebaeck 1	Sydsvenka Kraft AB	580	BWR	7/75	O
Ringhals 1	Statens Vattenfalls-verk	760	BWR	2/76	O
Barsebaeck 2	Sydsvenka Kraft AB	580	BWR	7/77	O
Ringhals 3	Statens Vattenfalls-verk	900	PWR	12/77	O
Forsmark 1	"	900	BWR	7/78	C
Ringhals 4	"	900	PWR	7/79	C
Forsmark 2	"	900	BWR	7/80	C
Forsmark 3	"	1000	BWR	/82	P
Oskarshamn 3	Oskarshamnsverkets Kraftgrupp AB	1060	BWR	12/83	P

O = Operational
C = Under Construction
P = In Planning

Table 3SE-2

NUCLEAR POWER GENERATING CAPACITY PROFILE — SWEDEN-FCR

YEAR	GENERATING CAPACITY (MWE) FIRM	PROJECTED	TOTAL
1977	4872.	0.	4872.
1978	4872.	0.	4872.
1979	6765.	0.	6765.
1980	7698.	0.	7698.
1981	7698.	0.	7698.
1982	7698.	0.	7698.
1983	9818.	0.	9818.
1984	9818.	0.	9818.
1985	9818.	0.	9818.
1986	9818.	240.	10058.
1987	9818.	480.	10298.
1988	9818.	720.	10538.
1989	9818.	960.	10778.
1990	9818.	1200.	11018.
1991	9818.	1700.	11518.
1992	9818.	2200.	12018.
1993	9818.	2700.	12518.
1994	9818.	3200.	13018.
1995	9818.	3700.	13518.
1996	9818.	4200.	14018.
1997	9818.	4700.	14518.
1998	9818.	5200.	15018.
1999	9818.	5700.	15518.
2000	9818.	6200.	16018.
2010	9818.	6200.	16018.
2020	9818.	6200.	16018.
2030	9818.	6200.	16018.

3.SE.3 Spent Fuel Disposition Policies, Plans and Programs

The new coalition government has enacted a recent law known as the Conditions (or Stipulations) Act in the spring of 1977. According to the Act, utilities must satisfy three requirements before a reactor license will be granted. The owner of a reactor must: (1) provide for the safe reprocessing of spent nuclear fuel, including the management of plutonium; (2) demonstrate how and where the final disposition of HLW will occur; and (3) satisfy final disposition requirements if the direct deposition of spent fuel without reprocessing option is chosen.

As a result of policy developments, new programs for the disposal of spent fuel are being developed by a research team (KBS) organized in a $7 million effort by the utilities. Two facets of their study which are substantially developed and are of particular interest to the GSFL study discuss plans for a national spent fuel interim storage facility and plans for a HLW permanent disposal facility. These plans are in the process of being submitted to the government for review and discussion. The interim spent fuel storage facility (3,000 MTU) is expected to meet the national requirements up to the 1990s. Much progress has been made in gaining public acceptance for this proposed facility. The public believes that the safety risk will be minimal, that storage will be nonpermanent, and that the facility will provide economic benefits to their local community. Three locations are actually bidding for the facility. A coastal location is favored for the interim facility, as for reactors, because the preferred method of spent fuel transport is by ship.

The KBS team feels "very good" about their plans for the permanent disposal of HLW buried 500 meters deep in granite bedrock, but only in a technical sense. Information on various locations under consideration indicate public opposition for a permanent sotrage facility.

Eventual acceptance of such a facility by some locality is crucial to the Federal Government. Under their new policies, there will have to be permanent disposal of either the HLW from reprocessing (COGEMA and BNFL both insist on the option to return HLW to Sweden), or, if the spent fuel is not reprocessed, permanent disposal of the highly radioactive Pu-filled fuel rods. Since no other country is willing to accept either HLW or spent fuel on other than a temporary or emergency basis, the new Swedish government will have to force some local community to take them, or else renege on its promise for permanent, safe disposition of all high-level radioactive material. A third alternative, no more nuclear power, is not considered a viable long-term solution either.

Even though the central spent fuel storage facility, if approved, will buy considerable time beyond the planned densification of reactor basins, the basic plan for Sweden still calls for reprocessing and recycling. Sweden is therefore most anxious to have its MB-10s processed so that contracts with COGEMA and BNFL may proceed.

An interesting situation is occurring in Sweden which is contrary to the policies embodied in the Conditions Act. The Swedish government has allowed the Barseback 2 reactor, which came on line in the summer of 1977, to operate until 1979. The government has made this exception even though the export for reprocessing contract with COGEMA is not final. After 1979, Sydraft, Barseback 2's owner, must have further authorization under the Conditions Act to continue operation.

In honor of INFCE and due to the present government's non-nuclear bias, Sweden's policy of exporting spent fuel for reprocessing has been revised. New export licenses will not be granted until INFCE is concluded in 1979 unless the utilities can offer valid reasons why export is crucial within the next two years.

Therefore, the Swedish government has directed the nuclear power inspectorate (SKI) to immediately study Sweden's need to export spent fuel for reprocessing. SKI shall indicate in its study what might happen should export not occur.

Several other policies follow. First, before any spent fuel can be exported from Sweden, negotiations with France are required, regarding the return of HLW to Sweden, its manner of transport, and the management of plutonium as well as its physical protection. U.S. consent will also be required prior to shipment.

Second, in order to evaluate Sweden's overall energy scenario, an Energy Commission has been newly appointed. It has the task of devising a national energy plan by spring 1978 that will extend through 1990. Several alternatives to nuclear energy programs will be formulated and at least one must provide for a gradual phase-out of nuclear power by the mid-1990s.

Third, Sweden is <u>most</u> anxious for further details regarding the U.S. spent fuel storage offer for a "limited" number of foreign utilities. If Sweden could obtain creditable assurances thathte U.S. would take Swedish spent fuel on a routine non-emergency basis, then the Swedish public would have an acceptable answer to their safe spent fuel disposition problem.

3.SE.4 Spent Fuel Disposition Profiles

Operating Reactor Disposition Profile

Sweden did not respond sufficiently to the study questionnaire for a determination to be made as to ARS near term problems with operating reactors. The estimated spent fuel profile for operating reactors is shown below.

Reactor	Annual SF Discharge	SF Cum Discharge 1/78	At Reprocessor	ARS Inventory 1/78
Oskarshamn 1	16	69	19 (BNFL)	50
Oskarshamn 2	19	34	0	34
Ringhals 2	24	48	0	48

Centralized AFR Storage

On November 30, 1977, the KBS research team submitted a site application to the Swedish government for a 3,000 MTU interim storage facility which is expected to meet national requirements until the 1990s.

Projected Spent Fuel Disposition Profiles

In order to provide a quantitative framework for evaluating spent fuel disposition requirements, the following exhibits are included:

Table 3.SE-3 summarizes the reactor and at-reactor storage characteristics associated with the currently defined Swedish nuclear power program. Correspondingly, Table 3.SE-4 summarizes the spent fuel generation and away-from-reactor (AFR) disposition requirements for the currently defined nuclear power program.

Table 3.SE-5 provides (a) the annual spent fuel generation profile and (b) the annual AFR disposition profile (based on a Full Core Reserve criteria) for both the currently defined reactor program (firm) and for anticipated future

reactor additions (projected). Table 3.SE-6 provides cumulative information for the same categorization.

Table 3SE-3

REACTOR CHARACTERISTICS - SWEDEN-FCR

FIRM REACTORS

REACTOR		MWE	START UP	CORE SIZE (MTU)	ANNUAL DISCHARGE (MTU)	EFFECTIVE ARS (MTU)
OSKAR1	B	460	1972	91	18	33
OSKAR2	B	600	1874	94	18	25
RINGH2	P	860	1975	71	24	100
BARSB1	B	600	1975	81	17	45
RINGH1	B	792	1976	115	28	65
RINGH3	P	960	1977	71	24	153
BARSB2	B	600	1977	81	17	69
FOSMAR1	B	933	1979	122	26	108
RINGH4	P	960	1979	71	24	153
FOSMAR2	B	933	1980	122	26	108
FOSMAR3	B	1060	1983	125	28	165
OSKAR3	B	1060	1983	125	27	63

PROJECTED REACTORS

	MWE	(MTU PER 1000 MWE)	
1985-1990	1200.	26.	130.
1990-2000	5000.	26.	130.

Table 3SE-4

FIRM REACTOR SPENT FUEL PROFILE — SWEDEN-FCR

		DIS		EFF	BEG	CUMULATIVE (MTU)							
		START	ANN	ARS	AFR	1985		1990		2000		2030	
FACILITY		YEAR	DIS		YEAR	DIS	AFR	DIS	AFR	DIS	AFR	DIS	AFR
OSKAR1	B	1974	18	33	1975	216.	183.	306.	273.	486.	453.	1026.	993.
OSKAR2	B	1975	18	25	1976	198.	173.	288.	263.	468.	443.	1008.	983.
RINGH2	P	1977	24	100	1981	216.	116.	336.	236.	576.	476.	1296.	1196.
BARSB1	B	1977	17	45	1979	153.	108.	238.	193.	408.	363.	918.	873.
RINGH1	B	1978	26	65	1980	208.	143.	338.	273.	598.	533.	1378.	1313.
RINGH3	P	1979	24	153	1985	168.	15.	288.	135.	528.	375.	1248.	1095.
BARSB2	B	1979	17	69	1983	119.	50.	204.	135.	374.	305.	884.	815.
FOSMAR1	B	1981	26	108	1985	130.	22.	260.	152.	520.	412.	1300.	1192.
RINGH4	P	1981	24	153	1987	120.	0.	240.	87.	480.	327.	1200.	1047.
FOSMAR2	B	1982	26	108	1986	104.	0.	234.	126.	494.	386.	1274.	1166.
FOSMAR3	B	1985	28	165	1990	28.	0.	168.	3.	448.	283.	1288.	1123.
OSKAR3	B	1985	27	63	1987	27.	0.	162.	99.	432.	369.	1242.	1179.

Table 3SE-5

ANNUAL SPENT FUEL PROFILE — SWEDEN-FCR

YEAR	ANNUAL DISCHARGE (MTU) FIRM	PROJECTED	TOTAL	ANNUAL AFR REQMT. (MTU) FIRM	PROJECTED	TOTAL
1977	77.	0.	77.	47.	0.	47.
1978	103.	0.	103.	36.	0.	36.
1979	144.	0.	144.	42.	0.	42.
1980	144.	0.	144.	66.	0.	66.
1981	194.	0.	194.	99.	0.	99.
1982	220.	0.	220.	103.	0.	103.
1983	220.	0.	220.	119.	0.	119.
1984	220.	0.	220.	120.	0.	120.
1985	275.	0.	275.	157.	0.	157.
1986	275.	0.	275.	192.	0.	192.
1987	275.	6.	281.	229.	0.	229.
1988	275.	12.	287.	247.	0.	247.
1989	275.	19.	294.	247.	0.	247.
1990	275.	25.	300.	250.	0.	250.
1991	275.	31.	306.	275.	0.	275.
1992	275.	44.	319.	275.	6.	281.
1993	275.	57.	332.	275.	12.	287.
1994	275.	70.	345.	275.	19.	294.
1995	275.	83.	358.	275.	25.	300.
1996	275.	96.	371.	275.	31.	306.
1997	275.	109.	384.	275.	44.	319.
1998	275.	122.	397.	275.	57.	332.
1999	275.	135.	410.	275.	70.	345.
2000	275.	148.	423.	275.	83.	358.
2010	275.	161.	436.	275.	161.	436.
2020	275.	161.	436.	275.	161.	436.
2030	275.	161.	436.	275.	161.	436.

Table 3SE-6

CUMULATIVE SPENT FUEL PROFILE --SWEDEN-FCR

YEAR	CUM DISCHARGE (1000 MTU) FIRM	PROJECTED	TOTAL	CUM AFR RQMT. (1000 MTU) FIRM	PROJECTED	TOTAL
1977	.167	0.000	.167	.068	0.000	.068
1978	.270	0.000	.270	.104	0.000	.104
1979	.414	0.000	.414	.146	0.000	.146
1980	.558	0.000	.558	.212	0.000	.212
1981	.752	0.000	.752	.311	0.000	.311
1982	.972	0.000	.972	.414	0.000	.414
1983	1.192	0.000	1.192	.533	0.000	.533
1984	1.412	0.000	1.412	.653	0.000	.653
1985	1.687	0.000	1.687	.810	0.000	.810
1986	1.962	0.000	1.962	1.002	0.000	1.002
1987	2.237	.006	2.243	1.231	0.000	1.231
1988	2.512	.019	2.531	1.478	0.000	1.478
1989	2.787	.037	2.824	1.725	0.000	1.725
1990	3.062	.062	3.124	1.975	0.000	1.975
1991	3.337	.094	3.431	2.250	0.000	2.250
1992	3.612	.138	3.750	2.525	.006	2.531
1993	3.887	.195	4.082	2.800	.019	2.819
1994	4.162	.265	4.427	3.075	.037	3.112
1995	4.437	.348	4.785	3.350	.062	3.412
1996	4.712	.445	5.157	3.625	.094	3.719
1997	4.987	.554	5.541	3.900	.138	4.038
1998	5.262	.676	5.938	4.175	.195	4.370
1999	5.537	.811	6.348	4.450	.265	4.715
2000	5.812	.959	6.771	4.725	.348	5.073
2010	8.562	2.571	11.133	7.475	1.765	9.240
2020	11.312	4.183	15.495	10.225	3.377	13.602
2030	14.062	5.795	19.857	12.975	4.989	17.964

3.SE.5 Legal and Regulatory Factors

A. Reactor requirements

1. Minimum holding period at reactor

Although Swedish utilities currently attempt to ship irradiated material off-site within two years after its removal from the core, they do this as a business judgment and not because it is mandated by the authorities.

2. Storage capacity at reactor

For business reasons utilities build storage basins with a full core reserve. Currently there is no legal requirement to do so, but this situation may change.

3. Disposition plans for spent fuel as a reactor license requirement

Under the recently passed "Stipulations Law", a reactor cannot be operated unless the Government finds that the applicant --

1. has produced a contract, which adequately provides for the reprocessing of spent fuel, and has also demonstrated how and where the final deposition of the highly radioactive waste resulting from the reprocessing can be effected with absolute safety, or
2. has shown how and where the spent but not reprocessed nuclear fuel can be stored with absolute safety (Appendix S-2, § 2).

The legislation grandfathers one facility which had already submitted its application for final approval for operation at the time of enactment. In this situation the applicant need only show by the end of 1977 that he --

1. has a contract which adequately provides for the reprocessing of spent fuel or
2. has shown that the spent but not reprocessed fuel can be managed in an absolutely safe way (Appendix S-2, § 3).

Since no reactor has been licensed under this 1977 law, one cannot say with certainty the arrangements which the Government will find satisfactory to meet the conditions. With regard to Barsebaeck II -- the grandfather plant mentioned above, the Nuclear Power Inspectorate has found compliance with the law where the applicant referenced a reprocessing contract with COGEMA. The Government however will make the final decision, and it has not yet done so. This instance need not, and does not, address the ultimate disposition problem. The next facility to be licensed, Ringhaus III, will attempt to satisfy this requirement by citing a utility-generated KBS study which is expected to find that the waste can be disposed of safely. In reviewing this question the Government plans not to restrict its findings as to the effect of the arrangements upon Sweden. According to Swedish officials, it will consider the safety aspects of the extra-territorial disposition, the recipient's occupational health and safety standards, as well as the recipient's safeguards and physical security.

B. Custody and Licensing of Spent Fuel and its Handling

1. <u>Custody</u>

Swedish law requires government approval prior to the obtaining of custody of spent fuel (Appendix S-1, § 1).

2. <u>Transport Including Packaging</u>

The Atomic Energy Act requires a person to obtain a license prior to the transporting of nuclear materials

(Appendix S-1, § 1). Prior to obtaining a license, an applicant must indicate his intent to comply with applicable IAEA packaging standards and, where appropriate, the physical security standards of INFCIRC 225/ Rev. 1. Sweden adheres to the Convention of Transportation of Dangerous Goods and has been a leader in the movement to adopt an international convention on physical security. Although most transport of nuclear materials is by sea -- given the coastal location of its nuclear facilities, no particular mode of transportation is mandated. The Swedes do not restrict transport licenses to Nationals.

3. Storage License

a. At Reactor

Sweden has always viewed the spent fuel storage basin as an integral part of the reactor and licensed it as part of the reactor licensing process. For a description of the facility licensing process, see subsection b. of this section.

Enlargement of a spent fuel basin requires a license amendment. In such an instance the licensee must submit a new safety report to the Swedish Nuclear Power Inspectorate and satisfy the statutory test that the proposed modification is safe and in the public interest. (Appendix S-1, § 4)

b. Away from Reactor

Currently the Atomic Energy Act does not cover a central spent fuel storage facility. The Swedish Nuclear Fuel Supply Company's (SKBF) proposal in this regard has prompted the Nuclear Power Inspectorate to recommend that the Act be extended for this purpose.

Although the Government has yet to submit such a proposal to the Parliament, passage of an amendment to the Act would be relatively non-controversial and seems relatively assured sometime in 1978. Once the Government has this authority, it plans to license independent spent fuel storage facilities under the same procedures which it currently reviews other nuclear installations.

Under this framework the Government gives the license to construct and operate a nuclear facility (Appendix S-1, § 3). Aside from the approval required by the Urban Planning and Building Act (discussed in section C.3.), the applicant must seek a license under the Atomic Energy Act. In this submittal, the applicant must supply the Nuclear Power Inspectorate a preliminary safety analysis report--i.e., a description of the plant, design conditions, safety analyses and quality assurance measures.

A number of National agencies will then examine the application from various viewpoints. These include the Board of Environmental Protection, the Radiation Protection Institute, the Meterological and Hydrological Institute, the Fishery Board, and the Nuclear Power Inspectorate. In this review the Inspectorate acts as the lead agency, coordinating the statements of the above agencies and making its recommendations to the Government.

4. Import Requirements

The Atomic Energy Act does not require a special license for importing nuclear materials or equipment. However, once the import enters Swedish territory a transport license is necessary.

5. Export Requirements

Swedish freedom to export equipment and material is limited by several international obligations. As a party to the Treaty on the Non-Proliferation of Nuclear Weapons, Sweden amended its Atomic Energy Act in 1972 to provide that the Government must approve exports of equipment or material especially designed or prepared for the processing, use or production of special fissionable materials. Under the Swedish agreement for cooperation with the United States, Sweden must obtain U.S. approval prior to the retransfer of any U.S.-supplied material.

C. Supplementary Legal Requirements

1. Radiation health and safety

Two agencies have primary jurisdiction over health and safety matters (Appendix S-3, § 4). The National Institute of Radiation Protection is responsible for all aspects of radiation protection, including the promulgation of occupational and general emissions standards. The Nuclear Power Inspectorate then ensures compliance with these standards in individual cases.

Both agencies may attach conditions designed to protect health and safety to licenses issues under the Atomic Energy Act and Radiation Protection Act. These conditions vary widely as they are dependent on the use and individual circumstances of a particular application.

2. Safeguards and Physical Security

a. International Agreements

Sweden has a number of safeguards obligations imposed by international agreements, including, *inter alia*, with the United States and the

International Atomic Energy Agency (IAEA), it also has ratified the Non-Proliferation Treaty as a non-nuclear weapons state.

Taken together, these international agreements impose strict supervision of spent fuel through on-site inspections by the Swedish Nuclear Power Inspectorate and the IAEA. Under this scheme the facility operator is responsible for keeping records of all incoming fuel, its origin, designation, and location. U.S. approval must be obtained prior to retransfer or reprocessing of U.S.-supplied fuel.

Sweden has been a leader in the movement to adopt an international convention on physical security.

b. Domestic Requirements

Special transport safeguards requirements include compliance with INFCIRC 221/Revision 1.

3. Environmental Requirements

Swedish law primarily provides for environmental reviews at the facility licensing stage. First, the Urban Planning and Building Act (Appendix S-4, § 1) requires that applicants for "large industrial plants causing environmental impact" seek governmental approval before construction begins. In deciding upon this application, several National authorities, the province government, and the commune governments comment upon the application. Under the Act the affected commune may veto the application.

Additionally, several National agencies review an application for its environmental effects. Briefly described, these agencies and their activities include --

- The Board of Environmental Protection will examine the application for its environmental effects
- the Meterological and Hydrological Institute will examine it for its effect upon Sweden's weather and water balance
- the Fishery Board will review the proposal for its effect upon the Nation's fisheries

The agencies, however, limit their review to environmental effects other than specific radiation hazards.

4. Third Party Liability

As a general rule, the operator of a nuclear facility is solely responsible for any nuclear damage occurring in the facility or during shipments of material to and from the facility. This liability attaches even if the damage is fortuitous (Appendix S-5, § 5 and 11(2)). An exception involves cases where the damage is due to nuclear materials stored in the facility incidentally to their carriage to or from a nuclear installation situated in the territory of a party to the Paris Convention (id., § 7(c)).

To cover this liability, the operator of a nuclear facility situated in Sweden must take our insurance or provide financial security which the Government deems adequate (id., § 22(a)).

The liability of the operator is limited to 50 million Kronor for any one nuclear incident (id., § 17(a)). The state may intervene in the payment of compensation for nuclear damage either where the security of the operator liable is deficient, the rights to claim compensation are extinguished or under the Brussels Supplementary Convention where the financial security proves insufficient (id., § 28).

The Act does not apply to nuclear damage resulting from nuclear incidents occurring in the territory of a state not a party to the Paris Convention. Where liability lies with the operator of a facility situated in Sweden, the Act applies to nuclear damage sustained in a non-contracting state only if the nuclear incident occurred in Sweden, and then the Government must provide compensation only to the extent that the non-contracting state would honor the reciprocal situation (Appenedix S-5, § 3).

5. <u>Reporting and inspection</u>

All licensees must keep and maintain detailed records as well as submit to periodic inspections (Appendix S-1, § 6).

6. <u>Public Participation</u>

The public may submit written comments on facility licenses under various environmental statutes, but there is no mandatory public hearing. The decision on a facility license, however, is made by the Government as a whole and therefore can be expected to be influenced by political considerations.

3.SE.6 Views Regarding Alternative Spent Fuel Disposition Programs

(Deleted)

3.CH Visit Findings - Switzerland

3.CH 1 Introduction

3.CH.1.1 Organizations Visited

The Swiss organizations visited were: the Federal Office of Energy; the Swiss Foreign Office - Nuclear Desk; Bernische Kraftwerk; the Commission of the Nuclear Fuel for Swiss Utilities; and West Swiss Utilities.

3.CH.1.2 Spent Fuel Disposition Highlights

Policy, Plans and Programs

To date, Swiss spent fuel disposition policies, plans and programs are based on obtaining external reprocessing services. Existing reprocessing service contracts have largely expired and, even though the Swiss are in the process of negotiating new reprocessing service contracts, concerns about their commercial negotiations posture vis-a-vis the European reprocessors and/or possible U.S.-caused reprocessing deferrals, have caused them to examine the following alternatives:

a) Expansion of at-reactor storage capacities
b) Development of a centralized spent fuel storage facility
c) Consideration of the October 17, U.S. spent fuel storage policy

Regardless which of the above alternatives are pursued, the Swiss will require near term movement of spent fuel from at-reactor storage in order to avoid plant shutdowns. Therefore, the need for appropriate MB-10 approvals and coordination of spent fuel transportation are particularly critical.

The Swiss had hoped to be prepared for permanent disposition of high level wastes (HLW) by 1990, however local reactions to even preliminary drilling operations have likely impacted that schedule.

Principal Concerns

Continuation of existing reactor operations in face of critical shortages of at-reactor storage (ARS) space; need to move ARS spent fuel inventory in order to accomplish required ARS expansion; and spent fuel transportation needs and constraints are principal near-term concerns.

Resolution of the permanent disposition of high level waste is a key intermediate term concern.

Spent Fuel Disposition Profile

The Swiss have a severe near-term ARS problem at their operating reactor stations and might have to move spent fuel to an AFR facility within the next two years in order to densify the existing basins. The following tabulation illustrates the situation:

Reactor	Core Size	Pool Size Total	Pool Size LFCR	1-78 Spent Fuel Inventory	1978&1979 Discharge	Reprocessing Contracts: Remaining[1] Existing	Reprocessing Contracts: Future[2]
Beznau 1	40	54	14	27	20	3	300
Beznau 2	40	54	14	53	26		
Muhleberg	44	55	11	15	22	18	100

The following cumulative discharge profile reflects anticipated spent fuel generation for the committed Swiss LWR reactor program (Firm) and anticipated future Swiss LWR reactor program (Projected).

Cumulative Discharge Profile (MTU)

Year	Firm	Projected	Total
1985	709	25	734
1990	1444	319	1763
2000	2984	1348	4499

[1] Initial contract amounted to 139 MTU.

[2] Future contracts in negotiation.

The following away-from-reactor (AFR) spent fuel disposition profile is based on removing spent fuel from ARS only when a full core reserve (FCR) limit has been reached:

Cumulative AFR Profile (MTU)

Year	Firm	Projected	Total
1985	434	0	434
1990	678	25	703
2000	1923	787	2710

Views Regarding Alternative Spent Fuel Disposition Programs

(Deleted)

3.CH.2 Nuclear Power Profile

Twelve years ago in Switzerland, power production was completely hydroelectric. Now, however, hydroelectric plants, producing 75 percent of the total electric capacity are already employed to optimum capacity and conventional thermal plants (except for one) have been rejected for environmental reasons. Therefore, Switzerland's primary alternative is nuclear energy.

Table 3.CH-1 describes the current Swiss nuclear power program. It should be noted that the Swiss government is currently conducting a major review of its nuclear energy program in the context of drafting a comprehensive national energy plan to the Year 2000. The subject plant will be submitted for parliamentary approval by spring of 1978.

Table 3.CH-2 shows the profile for the presently perceived Swiss nuclear program (firm) and anticipated future growth (projected). The total Swiss nuclear power generating capacity was 1.1 GWe in 1977, and is projected to reach 5.9 GWe in 1985, 8 GWe in 1990 and 12 GWe in 2000.

Table 3.CH-1: Nuclear Power Program - Switzerland

REACTOR	UTILITY	MWe	REACTOR TYPE	OPERATION DATE	STATUS
Beznau I	Nordostscheizerische Kraftwerke AG	350	PWR	12/69	O
Beznau II		350	PWR	3/72	O
Muhleberg	Bernische Kraftwerke	306	BWR	10/72	O
Goesgen	Kernkraftwerk Goesgen-Daniken AG	920	PWR	12/78	C
Leibstadt	Kernkraftwerk Leib-stadt AG	955	BWR	/80	P
Graben I		1140	BWR	/82	P
Reuth		900		/84(?)	P
Kaiseraugst	Kerkraftwerk Kaiser-augst AG	925	BWR	/85(?)	P

O = Operational
C = Under Construction
P = In Planning
(?) = Date shown is questionable

Table 3CH-2

NUCLEAR POWER GENERATING CAPACITY PROFILE — SWITZERLAND-FCR

	GENERATING CAPACITY	(MWE)	
YEAR	FIRM	PROJECTED	TOTAL
1977	1064.	0.	1064.
1978	1064.	0.	1064.
1979	2034.	0.	2034.
1980	2034.	0.	2034.
1981	2034.	0.	2034.
1982	3033.	0.	3033.
1983	3033.	0.	3033.
1984	3995.	950.	4945.
1985	3995.	1900.	5895.
1986	5209.	2080.	7289.
1987	5209.	2260.	7469.
1988	5209.	2440.	7649.
1989	5209.	2620.	7829.
1990	5209.	2800.	8009.
1991	5209.	3200.	8409.
1992	5209.	3600.	8809.
1993	5209.	4000.	9209.
1994	5209.	4400.	9609.
1995	5209.	4800.	10009.
1996	5209.	5200.	10409.
1997	5209.	5600.	10809.
1998	5209.	6000.	11209.
1999	5209.	6400.	11609.
2000	5209.	6800.	12009.
2010	5209.	6800.	12009.
2020	5209.	6800.	12009.
2030	5209.	6800.	12009.

3.CH.3 Spent Fuel Disposition Policies, Plans and Programs

To date, Swiss spent fuel disposition policy called for utilization of external reprocessing services. Existing reprocessing service contracts for 139 MTU (65 MTU to BNFL/74 MTU to COGEMA) had been sized and approximately 118 MTU have already been transported to those reprocessors. As an indication of the eagerness with which the Swiss have coupled their nuclear program to reprocessing, Swiss LWR fuel was the first to go through the UP-2 reprocessing plant at La Hague (COGEMA). Currently, the Swiss and the European reprocessors are negotiating on new reprocessing contracts (primarily to handle the spent fuel load between 1981 to 1990) amounting to 545 MTU.

Because of general uncertainties associated with the outcome of global concerns with reprocessing and specific uncertainties associated with negotiating favorable new reprocessing arrangements, the Swiss are considering several interm storage alternatives namely

a) Expansion of the at-reactor storage (ARS) capacities

b) Development of a centralized spent fuel storage facility

The Swiss are busy planning to re-rack their pools. Work on the first one will start next spring, at which time they will remove the spent fuel from the pool to give workmen access it. The survey team was told that the current plan calls for temporary storage of the removed spent fuel at COGEMA, therefore, the Swiss are most anxious to get an MB-10 in time to support this plan. The spent fuel disposition situation in Switzerland is critical. The oldest Swiss reactor, Beznau-1, lost its full core reserve 2 years ago, and the basin of Beznau-2 is now also full. Without reprocessing or re-racking of the basins, the three Swiss operating reactors will have to go down, one each year, staring in 1979. (Note: Supportive profiles are provided in Section 3.CH.4)

An 800 MTU national spent fuel storage basin is being planned for installation in the cavern at Lucens, the location of Switzerland's first experimental reactor. Hopefully selection of this previously designated nuclear site will minimize the severe siting acceptance problems.

In addition to their interim spent fuel storage plans, the Swiss are trying to implement a high level waste (HLW) permenent storage program. The lastest COGEMA and BNFL contracts give the reprocessors the option of returning the high level wastes (HLW) to the country of origin. Thus, even if Switzerland's plans for reprocessing their spent fuel were to go ahead as originally planned, they would have to be prepared for permanent disiposition of HLW by 1990. This would call for a construction permit (assuming deep geological disposition) by 1985, and in view of the fact that the local burghermeisters won't even let them drill a hole to get the necessary data, the time is rather short to develop a HLW disposal facility and time-test it to public satisfaction.

3.CH.4 Spent Fuel Disposition Profiles

Operating Reactor Disposition Profile

The spent fuel disposition profile at each operating reactor is shown below:

------------------------MTU----------------------------

Reactor	Core Size	Pool Size Total	Pool Size LFCR	1-78 Spent Fuel Inventory	1978&1979 Discharge	Reprocessing Contracts Remaining[1] Existing	Reprocessing Contracts Future[2]
Beznau 1	40	54	14	27	20	3	300
Beznau 2	40	54	14	53	26		
Muhleberg	44	55	11	15	22	18	100

Several observations are evident from the above table namely:

a) Existing spent fuel inventory in all the subject ARS have exceeded the Loss of Full Core Reserve (LFCR) criteria and the Beznau 2 inventory approximates total pool capacity.

b) In order to densify the existing reactor basins approximately 163 MTU (i.e., current inventory plus 1978 and 1979 discharges) would have to be transported to an AFR disposition. Note that only 21 MTU remains to be exercised from the existing reprocessing contracts.

All of the above clearly indicates the pressure that is imposed on the Swiss to arrive at a solution to relieve their critical near term spent fuel disposition problem without shutting down reactor operations.

Spent Fuel Reprocessing Arrangements

The chronology of Swiss spent fuel reprocessing arrangements is tabulated below:

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[1] Initial contract amounted to 139 MTU

[2] Future contracts in negotiations

Reprocessing Arrangements

Reactor	Time Period	Amount (MTU)	Reprocessor	Status
Beznau 1 & 2	1969-1973	65	BNFL	62 MTU delivered
	1974-1990	300	BNFL and/or COGEMA	Negotiating
Muehlberg	1975-1980	74	COGEMA	Signed
	1981-1990	100	COGEMA	Negotiating
Goesgen	1981-1990	145	COGEMA	Negotiating

Centralized AFR Storage

An 800 MTU centralized spent fuel storage basin is being planned for installation in the cavern at Lucens, the location of Switzerland's first experimental reactor.

Projected Spent Fuel Disposition Profiles

In order to provide a quantitative framework for evaluating spent fuel disposition requirements, the following exhibits are included:

Table 3.CH-3 summarizes the reactor and at-reactor storage characteristics associated with the currently defined Swiss nuclear power program. Correspondingly, Table 3.CH-4 summarizes the spent fuel generation and away from reactor (AFR) disposition requirements for the currently defined nuclear power program.

Table 3.CH-5 provides (a) the annual spent fuel generation profile and (b) the annual AFR disposition profile (based on a Full Core Reserve criteria) for both the currently defined reactor program (firm) and for anticipated future reactor additions (projected). Table 3.CH-6 provides cumulative information for the same categorization.

Tables 3.CH-7, 3.CH-8 and 3.CH-9 provide similar information for an at-reactor storage (ARS) criteria wherein 5 years or older spent fuel is shipped away from reactor beginning in 1985 - unless prior period spent fuel to ARS exceed FCR criteria (in which case spent fuel would be shipped away from reactor as soon as FCR limits were reached).

Technical Factors

Switzerland's major near term technical considerations are as follows:

1) Timely spent fuel transportation to either BNFL's Windscale facility; COGEMA's Cap La Hague facility or some alternative AFR location.

2) Feasibility of densifying at-reactor storage (ARS) at the Beznau 1 and 2 and Muehleberg stations.

As was pointed out in Section 3.CH-4 approximately 163 MTU (126 MTU of PWR and 37 MTU of BWR) of spent fuel will have to be transported to an AFR - presumably either Windscale, Cap La Hague or both - within the next two years. It is expected that NTL casks will be used in the following ways:

Station	Potential Casks	Cask Payload (Assy)	1978-79 Shipment Reqmt. (Assy)	Transport Route
Beznau 1&2	NTL 4/5	5 PWR	381	- To Windscale - Rail/water - 15 days
Muehlberg	NTL 11	7 BWR	202	- To La Hague - Truck - 7 days

It is expected that pool densification at the existing reactor stations will begin in the spring or summer of 1978 and the work will be completed in late 1979. The densification program is as follows:

MTU				
Reactor	Core Size	Annual Discharge	Pool Size Old	Pool Size New
Beznau 1	40	10	54	107
Beznau 2	40	13	54	107
Muehleberg	44	11	55	123

Table 3CH-3

REACTOR CHARACTERISTICS - SWITZERLAND-FCR

FIRM REACTORS			——MTU——		
REACTOR	MWE	START UP	CORE SIZE	ANNUAL DISCHARGE	EFFECTIVE ARS
BEZANAU1 P	364	1969	39	10	14
BEZNAU2 P	364	1971	39	13	14
MUEHLBERGB	336	1972	45	11	11
GOESGEN P	970	1979	71	24	190
LEIBSTADTB	999	1982	118	31	272
KAISERGSTB	962	1984	111	30	240
GRABEN B	1214	1986	136	35	320
PROJECTED REACTORS			MWE	(MTU PER 1000 MWE)	
		1983-1985	1900.	26.	130.
		1985-1990	900.	26.	130.
		1990-2000	4000.	26.	130.

Table 3CH-4

FIRM REACTOR SPENT FUEL PROFILE — SWITZERLAND-FCR

FACILITY		DIS START YEAR	ANN DIS	EFF ARS	BEG AFR YEAR	1985 DIS	1985 AFR	1990 DIS	1990 AFR	2000 DIS	2000 AFR	2030 DIS	2030 AFR
						CUMULATIVE (MTU)							
BEZANAU1	P	1971	10	14	1972	150.	136.	200.	186.	300.	286.	600.	586.
BEZNAU2	P	1973	13	14	1974	169.	155.	234.	220.	364.	350.	754.	740.
MUEHLBERG	B	1972	11	11	1973	154.	143.	209.	198.	319.	308.	649.	638.
GOESGEN	P	1980	24	190	1987	144.	0.	264.	74.	504.	314.	1224.	1034.
LEIBSTADT	B	1984	31	272	1992	62.	0.	217.	0.	527.	255.	1457.	1185.
KAISERGST	B	1985	30	240	1993	30.	0.	180.	0.	480.	240.	1380.	1140.
GRABEN	B	1987	35	320	1996	0.	0.	140.	0.	490.	170.	1540.	1220.

Table 3CH-5

ANNUAL SPENT FUEL PROFILE — SWITZERLAND-FCR

YEAR	ANNUAL DISCHARGE FIRM	PROJECTED	(MTU) TOTAL	ANNUAL AFR REQMT. FIRM	PROJECTED	(MTU) TOTAL
1977	34.	0.	34.	34.	0.	34.
1978	34.	0.	34.	34.	0.	34.
1979	34.	0.	34.	34.	0.	34.
1980	58.	0.	58.	34.	0.	34.
1981	58.	0.	58.	34.	0.	34.
1982	58.	0.	58.	34.	0.	34.
1983	58.	0.	58.	34.	0.	34.
1984	89.	0.	89.	34.	0.	34.
1985	119.	25.	144.	34.	0.	34.
1986	119.	49.	168.	34.	0.	34.
1987	154.	54.	208.	36.	0.	36.
1988	154.	59.	213.	58.	0.	58.
1989	154.	63.	217.	58.	0.	58.
1990	154.	68.	222.	58.	25.	83.
1991	154.	73.	227.	58.	49.	107.
1992	154.	83.	237.	65.	54.	119.
1993	154.	94.	248.	119.	59.	178.
1994	154.	104.	258.	119.	63.	182.
1995	154.	114.	268.	119.	68.	187.
1996	154.	125.	279.	149.	73.	222.
1997	154.	135.	289.	154.	83.	237.
1998	154.	146.	300.	154.	94.	248.
1999	154.	156.	310.	154.	104.	258.
2000	154.	166.	320.	154.	114.	268.
2010	154.	177.	331.	154.	177.	331.
2020	154.	177.	331.	154.	177.	331.
2030	154.	177.	331.	154.	177.	331.

Table 3CH-6

CUMULATIVE SPENT FUEL PROFILE --SWITZERLAND-FCR

YEAR	CUM DISCHARGE (1000 MTU) FIRM	PROJECTED	TOTAL	CUM AFR RQMT. (1000 MTU) FIRM	PROJECTED	TOTAL
1977	.201	0.000	.201	.162	0.000	.162
1978	.235	0.000	.235	.196	0.000	.196
1979	.269	0.000	.269	.230	0.000	.230
1980	.327	0.000	.327	.264	0.000	.264
1981	.385	0.000	.385	.298	0.000	.298
1982	.443	0.000	.443	.332	0.000	.332
1983	.501	0.000	.501	.366	0.000	.366
1984	.590	0.000	.590	.400	0.000	.400
1985	.709	.025	.734	.434	0.000	.434
1986	.828	.074	.902	.468	0.000	.468
1987	.982	.128	1.110	.504	0.000	.504
1988	1.136	.187	1.323	.562	0.000	.562
1989	1.290	.250	1.540	.620	0.000	.620
1990	1.444	.319	1.763	.678	.025	.703
1991	1.598	.391	1.989	.736	.074	.810
1992	1.752	.475	2.227	.801	.128	.929
1993	1.906	.568	2.474	.920	.187	1.107
1994	2.060	.672	2.732	1.039	.250	1.289
1995	2.214	.787	3.001	1.158	.319	1.477
1996	2.368	.911	3.279	1.307	.391	1.698
1997	2.522	1.047	3.569	1.461	.475	1.936
1998	2.676	1.192	3.868	1.615	.568	2.183
1999	2.830	1.348	4.178	1.769	.672	2.441
2000	2.984	1.515	4.499	1.923	.787	2.710
2010	4.524	3.282	7.806	3.463	2.399	5.862
2020	6.064	5.050	11.114	5.003	4.166	9.169
2030	7.604	6.818	14.422	6.543	5.934	12.477

Table 3CH-7

FIRM REACTOR SPENT FUEL PROFILE — SWITZERLAND-5Y-1985

FACILITY	DIS START YEAR	ANN DIS	EFF ARS	BEG AFR YEAR	CUMULATIVE (MTU) 1985 DIS	1985 AFR	1990 DIS	1990 AFR	2000 DIS	2000 AFR	2030 DIS	2030 AFR
BEZANAU1 P	1971	10	14	1972	150.	136.	200.	186.	300.	286.	600.	586.
BEZNAU2 P	1973	13	14	1974	169.	155.	234.	220.	364.	350.	754.	740.
MUEHLBERGB	1972	11	11	1973	154.	143.	209.	198.	319.	308.	649.	638.
GOESGEN P	1980	24	120	1985	144.	24.	264.	144.	504.	384.	1224.	1104.
LEIBSTADTB	1984	31	155	1989	62.	0.	217.	62.	527.	372.	1457.	1302.
KAISERGSTB	1985	30	150	1990	30.	0.	180.	30.	480.	330.	1380.	1230.
GRABEN B	1987	35	175	1992	0.	0.	140.	0.	490.	315.	1540.	1365.

Table 3CH-8

ANNUAL SPENT FUEL PROFILE — SWITZERLAND-5Y-1985

YEAR	ANNUAL DISCHARGE (MTU) FIRM	PROJECTED	TOTAL	ANNUAL AFR REQMT. (MTU) FIRM	PROJECTED	TOTAL
1977	34.	0.	34.	34.	0.	34.
1978	34.	0.	34.	34.	0.	34.
1979	34.	0.	34.	34.	0.	34.
1980	58.	0.	58.	34.	0.	34.
1981	58.	0.	58.	34.	0.	34.
1982	58.	0.	58.	34.	0.	34.
1983	58.	0.	58.	34.	0.	34.
1984	89.	0.	89.	34.	0.	34.
1985	119.	25.	144.	58.	0.	58.
1986	119.	49.	168.	58.	0.	58.
1987	154.	54.	208.	58.	0.	58.
1988	154.	59.	213.	58.	0.	58.
1989	154.	63.	217.	89.	0.	89.
1990	154.	68.	222.	119.	25.	144.
1991	154.	73.	227.	119.	49.	168.
1992	154.	83.	237.	154.	54.	208.
1993	154.	94.	248.	154.	59.	213.
1994	154.	104.	258.	154.	63.	217.
1995	154.	114.	268.	154.	68.	222.
1996	154.	125.	279.	154.	73.	227.
1997	154.	135.	289.	154.	83.	237.
1998	154.	146.	300.	154.	94.	248.
1999	154.	156.	310.	154.	104.	258.
2000	154.	166.	320.	154.	114.	268.
2010	154.	177.	331.	154.	177.	331.
2020	154.	177.	331.	154.	177.	331.
2030	154.	177.	331.	154.	177.	331.

Table 3CH-9

CUMULATIVE SPENT FUEL PROFILE —SWITZERLAND-5Y-1985

YEAR	CUM DISCHARGE (1000 MTU) FIRM	PROJECTED	TOTAL	CUM AFR RQMT. (1000 MTU) FIRM	PROJECTED	TOTAL
1977	.201	0.000	.201	.162	0.000	.162
1978	.235	0.000	.235	.196	0.000	.196
1979	.269	0.000	.269	.230	0.000	.230
1980	.327	0.000	.327	.264	0.000	.264
1981	.385	0.000	.385	.298	0.000	.298
1982	.443	0.000	.443	.332	0.000	.332
1983	.501	0.000	.501	.366	0.000	.366
1984	.590	0.000	.590	.400	0.000	.400
1985	.709	.025	.734	.458	0.000	.458
1986	.828	.074	.902	.516	0.000	.516
1987	.982	.128	1.110	.574	0.000	.574
1988	1.136	.187	1.323	.632	0.000	.632
1989	1.290	.250	1.540	.721	0.000	.721
1990	1.444	.319	1.763	.840	.025	.865
1991	1.598	.391	1.989	.959	.074	1.033
1992	1.752	.475	2.227	1.113	.128	1.241
1993	1.906	.568	2.474	1.267	.187	1.454
1994	2.060	.672	2.732	1.421	.250	1.671
1995	2.214	.787	3.001	1.575	.319	1.894
1996	2.368	.911	3.279	1.729	.391	2.120
1997	2.522	1.047	3.569	1.883	.475	2.358
1998	2.676	1.192	3.868	2.037	.568	2.605
1999	2.830	1.348	4.178	2.191	.672	2.863
2000	2.984	1.515	4.499	2.345	.787	3.132
2010	4.524	3.282	7.806	3.885	2.399	6.284
2020	6.064	5.050	11.114	5.425	4.166	9.591
2030	7.604	6.818	14.422	6.965	5.934	12.899

3.CH.5 Legal & Regulatory Factors

A. Reactor requirements

1. Minimum holding period at reactor

Switzerland does not require spent fuel to be stored in a reactor basin for any certain period of time pending shipment off-site.

2. Storage capacity at reactor

Although Swiss utilities are now building storage basins sufficient to hold 2.5 cores, that is a business decision and not a regulatory requirement.

3. Disposition plans for spent fuel as a reactor license requirement

Switzerland does not have a law requiring an applicant to have provided for the disposition of the irradiated fuel prior to the operation of the reactor.

B. Custody and licensing of spent fuel and its handling

1. Custody

Section 4 of the Atomic Energy Act (Appendix SW-1) requires a person to obtain a license from the Department of Energy (DOE) prior to gaining custody over spent fuel. In determining whether to approve an application, DOE will examine the public health and safety aspects of an application as well as the applicant's technical and financial qualifications. Custody licenses are not restricted to Swiss Nationals.

2. Transport including packaging

Section 4 of the Atomic Energy Act also requires transporters to obtain licenses. The licensing procedure is similar to that outlined in the preceding section.

Switzerland follows IAEA recommendations with regard to transportation and packaging. It does, however, require police escorts and imposes a thirty-five ton weight limit on trucks.

3. Storage license

a. At reactor

The Swiss regard storage basins as incidental to the plant itself and examine them within the reactor licensing process. For a description of the facility licensing process, see subsection b. of this section. The enlargement of an existing storage basin requires DOE approval of a license amendment. In reviewing this application, DOE will examine a number of factors, including the problems caused by additional weight, seismic issues and cooling questions. The review process will consist of government studies, questions and answers and informal meetings. (Appendix SW-1, §4.)

b. Away from reactor

An away from reactor centralized storage facility requires several levels of approval. Although the extent of the authority is now being litigated, all new industrial sites except those to be located in Berne and Geneva cantons require canton and community approval to assure compliance with the appropriate siting, building, fire and water regulations. (If the facility were located on a site which previously had been designated a nuclear site, no canton or community approval would be necessary.)

The prospective operator must also seek approval from DOE. Within this Department, the Office of Energy Economy will examine the applicants safety report and consider factors such as meterology, geology and hydrology. (Appendix SW-1, §7.) After consulting the affected canton, DOE will approve the facility if it determines that its operation would not be detrimental to Swiss national security, the nation's internal commitments or the protection of persons, property or valuable rights. (Appendix SW-1, §8.)

The license may be conditioned to require that at least two-thirds of the members of the board of management be Swiss citizens living in the country and that the body corporate be located in Switzerland. (Appendix SW-1, §5.)

Under amendments the Swiss government has recently proposed to the Federal Assembly either the Assembly or the Federal Council rather than the Department of Energy would make the final decision on a license. These amendments would also prohibit the licensing of facilities unless the licensing body found it met an undefined need. (Appendix SW-2.)

4. Import requirements

The Department of Energy licenses imports under the same criteria outlined in Section B.1.

5. Export requirements

DOE also licenses exports. Here, however, the DOE will review the application vis-a-vis the criteria mandated by Swiss ratification of the Non-Proliferation Treaty and its participation in the London Suppliers Conference. These factors are all considered within the broad "interests of Switzerland" statutory test. (Appendix SW-1, §5.)

C. Supplemental legal requirements

1. Radiological health and safety

Under Section 10 of the Atomic Energy licenses, including spent fuel facility licenses, must take all measures suggested by experience and the current state of technology to protect public health and safety. To this end, the Federal Council promulgated the Radiation Protection Ordinance of 1963. (Appendix SW-3.) This ordinance adopts the law as practicable concept and is based on the recommendations of the International Commission on Radiological Protection.

2. Safeguards and physical security

a. International requirements

Switzerland has a number of safeguards obligations imposed by international agreements, including, inter alia, with the United States and the International Atomic Energy Agency (IAEA). It also has ratified the Non-Proliferation Treaty as a non-nuclear weapons state.

Taken together, these international agreements impose strict supervision of spent fuel through on-site inspections by both Swiss authorities and the IAEA. Under this scheme the facility operator is responsible for keeping records of all incoming fuel, its origin, designation and location. U.S. approval must be obtained prior to the retransfer or reprocessing of U.S.-supplied fuel.

b. Domestic requirements

Special transport requirements include police escorts.

3. Environmental requirements

The Swiss consider environmental matters within the facility licensing process. As noted in Section B., 3. b., facility licenses must receive canton and community approval to assure compliance with the appropriate siting, building, fire and water regulations. Additionally, proposed amendments to the Atomic Energy Act would authorize the licensing authorities to refuse construction of facilities unless the proposed facility meets a need. (Appendix SW-2.)

4. Third party liability

Switzerland is not a party to the multi-national treaties on third-party liability, although many of the provisions governing the subject are similar. Under Section 12 of the Atomic Energy Act, the operator of a nuclear facility is liable for nuclear damage caused during its operation. He is also liable for damage caused by shipments of nuclear fuel or waste to and from his installation and which at the time of the incident were not the responsibility of the operator of another facility. This authority, however, may be shifted to the carrier where an authorized carrier assumes liability in the place of the operator and where the carrier receives agreement of the competent authorities as well as provides financial security.

Every facility licensee is required to take out insurance up to a maximum of 40 million Swiss Francs covering his third-party liability. The liability of the operator is limited to the amount of such insurance. The Federal Council may raise or lower the ceiling on the basis of the public interest. Additionally, a facility operator or authorized carrier must contribute to the Fund for Delayed Atomic Damage which provides compensation for those damages which cannot be claimed under the above provisions due to the lapse of time before such damage becomes apparent (Appendix SW-1, §18.) The amoung of such contributor is fixed by order of the Federal Council, but may not exceed 1/3 of the premiums payable for the compulsory third-party liability insurance. At present, the rate of contribution is fixed at 10% of the insurance premium.

For disasters of such gravity that the insurance appears insufficient to satisfy all claims for compensation, the Confederation must make payments in respect of damages not covered by insurance (Appendix SW-1 §27.)

The Act makes no special provision concerning its territorial scope.

5. Reporting and inspection

All licensees are required to establish and maintain detailed records. Additionally, the Federal Council and bodies designated by it may inspect activities conducted or facilities operated under the license at any time. (Appendix SW-1, §8.)

6. Public participation

Currently Swiss law makes no provision for public participation in the licensing process.

Under the recently proposed amendments to the Atomic Energy Act public participation in facility licensing decision would increase. This proposal requires that the government decision would increase. This proposal requires that the government invite all interested parties to put forward their comments. In addition, the amendments would make final facility licensing decisions the responsibility of either the Federal Council or the Federal Assembly, thereby making this determination a political matter. (Appendix SW-2.)

7. <u>Other relevant considerations</u>

The Swiss government currently plans to submit a complete revision of the Atomic Energy Act to the Federal Assembly in either 1981 or 1982.

3.CH.6 Views Regarding Alternative Spent Fuel Disposition Programs

(Pages 3CH-27 and 3CH-28 deleted)

3.GB Visit Findings - United Kingdom

3.GB.1 Introduction

3.GB.1.1 Organizations Visited

The British organizations visited were: the U.K. Atomic Energy Authority, the Central Electricity Council, the Central Electricity Generating Board (CEGB), the Department of Energy, British Nuclear Fuels Limited (BNFL), and the Nuclear Power Company.

3.GB.1.2 Spent Fuel Disposition Highlights

Policies, Plans and Programs

U.K. policy maintains that reprocessing and vitrification are the best ways to condition spent fuel for permanent storage, and favors a few large reprocessing plants to handle international orders rather than allowing numerous small national reprocessing plants to evolve. The U.K. is not interested in interim storage or in permanent storage of other countries' spent fuel or high level waste (HLW). Current plans and programs uphold U.K. policy. For example: BNFL has international reprocessing contracts, but has the option to send HLW back to the country of origin. The foreign contracts assist U.K. in the financing of its reprocessing program and improve overall economics. U.K. is interested in Pu reprocessing for its Breeder needs as opposed to LWR recycle needs. However, U.K. is interested in recovering uranium from spent fuel.

Windscale Hearings represent a major hurdle in moving U.K.'s international LWR reprocessing program forward. Positive decision is expected. Windscale currently reprocesses 1500 tons per year of Magnox fuel. BNFL expects to have 212 MTU of foreign LWR fuel into Windscale by 1978 and currently has contracts for reprocessing 1200 MTU of foreign fuel. If the Windscale addition (Thorp) is approved then 6000 MTU of spent fuel (including 2850 MTU of foreign fuel) will be reprocessed at Windscale between 1987 and 1997. Additional 4750 MTU of spent fuel storage facilities are planned for the Windscale program. The Windscale site will not accommodate further expansion once the Thorp project is implemented. HLW will go into engineered storage and will remain there until vitrification begins in the late 1980's or early 1990's. The UKAEC is doing some very preliminary R&D in geologic storage. No surveys to date.

Principal Concerns

Maintaining positive momentum for a Windscale reprocessing program through favorable rulings from Windscale Hearings; and favorable public and international reaction to overall reprocessing programs is of critical importance.

Granting of MB-10 approvals to foreign customers for transfer of spent fuel to BNFL is a major requirement for a successful Windscale program.

Decisions, approvals and actions supportive of Breeder program are important interim/long-term concerns.

Spent Fuel Disposition Profile

The U.K. perceives a potential of approximately 30,000 MTU of spent fuel available for reprocessing by 1990 within its market of interest. Of that amount, it hopes to contract for 6000 MTU[(1)] as a base load for a 1200 MTU/year reprocessing plant operation lasting between 1987 and 1997.

Views Regarding Alternative Spent Fuel Disposition Programs

(Deleted)

[(1)] Includes 3150 MTU from U.K. reactors and 2850 MTU from foreign reactors.

Views Regarding Alternative Spent Fuel Disposition Programs, (continued from page 3GB-2)

(Deleted)

3.GB.2 Nuclear Power Profile

From now until the early part of the next century, the United Kingdom (U.K.) can rely primarily on its energy from the North Sea. A favorable gas pricing policy and an abundance of gas supplies has shifted the U.K.'s energy emphasis from nuclear to gas. Despite this development, the U.K.'s nuclear energy program is highly sophisticated and quite viable. The evolution of nuclear power can be outlined in three phases.

The First Program commenced in 1955 when the government instituted a 10-year program to design and develop the Magnox reactor. Four 50 MWe reactors began operation in 1956; nine twin reactor stations were scheduled to produce 5,000 MWe by 1969, but fell short by only producing approximately 4,100 MWe in mid-1971. In the Second Program starting in 1964, the U.K.'s Atomic Energy Agency (UKAEA) progressed to Advanced Gas-cooled Reactors (AGR) with a 32 MWe Windscale reactor as prototype. The Third Program was announced in 1974 and signaled the development of the 600-660 MWe Steam Generating Heavy Water Reactor (SGHWR). Due to difficulties with scaling up the design from a 100 MWe experimental unit to a 660 MWe sized plant, the government has proposed that the SGHWR be abandoned and that emphasis be shifted to the Pressurized Water Reactor (PWR) and the AGR. In addition to the SGHWR, U.K. reactor efforts have focused on two improved concepts: the High-Temperature Gas-Cooled Reactor (HTR) and the Sodium-cooled Fast Breeder Reactor.

Until approximately 1972, breeder reactor development was avidly pursued as the key to assuring U.K.'s long-term energy supply and to reducing future energy costs. Subsequently, large increases in program development costs coupled with North Sea potential have diminished U.K.'s enthusiasm for the breeder. The government still supports breeder development but has deemphasized support for breeder demonstration.

The projected total U.K. nuclear power generating capacity is 10 GWe by 1985, 15 GWe in 1990 and 35 GWe by 2000. Table 3GB-1 summarizes the present U.K. nuclear power program.

Table 3.GB-1: United Kingdom Nuclear Power Program

REACTOR	UTILITY	MWe	REACTOR TYPE	OPERATION DATE	STATUS
Calder Hall 1	British Nuclear Fuels	50	GCR	9/56	0
Calder Hall 2	BNFL	50	GCR	9/56	0
Calder Hall 3	BNFL	50	GCR	9/56	0
Calder Hall 4	BNFL	50	GCR	9/56	0
Chapel Cross 1	BNFL	50	GCR	11/58	0
Chapel Cross 2	BNFL	50	GCR	11/58	0
Chapel Cross 3	BNFL	50	GCR	11/58	0
Chapel Cross 4	BNFL	50	GCR	11/58	0
Berkeley 1	Central Electricity Generating Board (CEGB)	138	GCR	6/62	0
Bradwell 1	CEGB	150	GCR	6/62	0
Berkeley 2	CEGB	138	GCB	10/62	0
Bradwell 2	CEGB	138	GCB	11/62	0
Windscale	United Kingdom Atomic Energy Authority (UKAEA)	132	AGR	2/63	0
Hunterston A1	South of Scotland Electricity Board (SSEB)	160	GCR	5/64	0
Hunterston A2	SSEB	160	GCR	9/64	0
Trawsfyndd 1	CEGB	250	GCR	2/65	0
Trawsfyndd 2	CEGB	250	GCR	3/65	0
Hinkley Point A1	CEGB	250	GCR	5/65	0

O = Operational
C = Under Construction
P = In Planning

Table 3.GB-1 (con't)

REACTOR	UTILITY	MWe	REACTOR TYPE	OPERATION DATE	STATUS
Hinkley Point A2	CEGB	250	GCR	5/65	O
Dungeness A1	Central Electricity Generating Board (CEGB)	275	GCR	9/65	O
Dungeness A2	CEGB	275	GCR	12/65	O
Sizewell A1	CEGB	290	GCR	1/66	O
Sizewell A2	CEGB	290	GCR	3/66	O
Oldbury 1	CEGB	300	GCR	1/68	O
Oldbury 2	CEGB	300	GCR	1/68	O
Winfrith SGHWR	United Kingdom Atomic Energy Authority (UKAEA)	92	HWLWR	2/68	O
Wylfa 1	CEGB	590	GCR	11/71	O
Wylfa 2	CEGB	590	GCR	1/72	O
Hinkley Point B1	CEGB	625	AGR	6/76	O
Hunterston B1	SSEB	6625	AGR	6/76	O
Dounreay PFR	UKAEA	250	LMFBR	8/76	O
Hinkley Point B2	CEGB	625	AGR	1/77	O
Hunterston B2	SSEB	625	AGR	5/77	O
Dungeness B1	CEGB	625	AGR	4/79	C
Dungeness B2	CEGB	600	AGR	8/79	C
Hartlepool 1	CEGB	625	AGR	2/80	C
Hartlepool 2	CEGB	625	AGR	9/80	C
Heysham 1	CEGB	625	AGR	4/80	C
Heysham 2	CEGB	625	AGR	12/80	C

O = Operational
C = Under Construction
P = In Planning

3.GB.3 Spent Fuel Disposition Policies, Plans and Programs

The Windscale Inquiry concerning the future of oxide fuel reprocessing provides an excellent insight into U.K. views.* British Nuclear Fuels Limited (BNFL) presented its case for reprocessing in the hearings as follows:

- BNFL originally identified three options for the disposal of oxide fuel in the U.K.:

  1. domestic and foreign fuel reprocessing
  2. domestic fuel reprocessing
  3. domestic fuel storage.

  However, through study, all but the combination of domestic and foreign fuel reprocessing were eliminated as impractical, primarily for economic considerations.

- Therefore, BNFL and the U.K. are firmly committed to reprocessing. BNFL sees reprocessing as the only reliable method of waste management, believing that glassified reprocessed waste is the only sufficiently stable form of HLW suitable for permanent storage. BNFL also advocates reprocessing as an economic and conservation measure since more power can be generated from the same amount of raw material. Therefore, the recovered uranium will be immediately returned for use in thermal reactors. Finally, the perceived U.K. future need for plutonium adds to the desirability of reprocessing.

- BNFL supports large scale reprocessing on an international level for economic reasons. A BNFL cost analysis determined that the price of domestic reprocessing would decrease with the addition of foreign fuel commitments at the Windscale reprocessing plant. Further, a large plant, in the 1200 tons/year range, would merely cost 20% more than a plant half that size.

- BNFL views long-term storage as unnecessary procrastination of a solution of spent fuel and HLW disposal. Magnox fuel, for example, cannot be stored for long periods and must be reprocessed shortly after discharge from the reactor because its magnesium cladding corrodes and fails in moisture or water. It would require storage in an N_2 environment or would require encapsulation for longer storage. BNFL believes that while oxide fuel is easily stored for ten years, it is not being considered by BNFL for longer periods of storage. Such stored material, in the opinion of BNFL, would have to be eventually reprocessed for safe, permanent

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* An abstract of pertinent Windscale hearings testimony is provided in Appendix ___.

disposal. They, therefore, prefer to deal with that problem in the near term using known methods.

- BNFL advocates strict international control and release of plutonium under international safeguards and further desires that the power of the IAEA be increased in this regard.

- BNFL's reprocessing contract terms require:
  - retention of the option, as demanded by the U.K. government, to return reprocessing waste to the customer country.
  - advance payment in order to finance construction and to insure full recovery of costs.
  - government approvals for the return of recovered uranium and plutonium to the customer with proper safeguards.

- BNFL's support for reprocessing in not dependent upon the existance of either a fast-breeder reactor program or of nuclear-based U.K. power system. However, they emphasize that the existance of reprocessing leaves the option of a fast breeder program open since it would increase the availability of plutonium fuel. Further, the breeder would use uranium fuel approximately 50 times more efficiently.

- The spent fuel discharge from the Advanced Gas-cooled Reactors (AGR) of the U.K. second generation of power stations requires the existance of the THORP (oxide fuel reprocessing facility) plant. This discharge has been estimated by BNFL at approximately 3,000 tons of spent fuel by 1995.

- A single recycle of uranium and plutonium fuels, through reprocessing, would enable 30-40% more power to be generated from the same amount of uranium ore.

- BNFL believes that enough business exists to justify the construction of the THORP reprocessing plant.

- BNFL emphasizes that the reprocessing technology is a tested one and that the company can use its own experience with the B204 plant and the experience of its partners in France and Germany.

- The Nuclear Installations Inspectorate asserts that THORP will meet high standards of safety, while the National Radiological Protection Board denied that the effect of the discharge of radioactive wastes from Windscale on the public health warranted rejection of the project completely.

- BNFL asserts that Britain should not deny itself the reprocessing capability on grounds of non-proliferation since the U.K. is already a nuclear-weapons state. However, BNFL further asserts that, by offering a reprocessing service to nations without significant indigenous uranium resources, the U.K. is assisting non-proliferation goals, since these nations would no longer be pressured to develop the technology themselves.

- Finally, BNFL denies that terrorism or its problems would cease if reprocessing were banned. The illegal acquisition of plutonium for the development of a crude nuclear weapon would still be possible, albeit more difficult. This problem requires a decision on the relative importance of the solution of terrorist activities versus the abandonment of a viable and useful energy source.

Beyond these stated policies, U.K. spent fuel views outlined by officials during the study interviews are listed below:

- The U.K. is not interested in storing other countries' fuel or in interim storage as a spent fuel disposition solution, primarily due to public disapproval.

- The U.K. espouses large scale reprocessing plants rather than small national plants.

- The electric utilites prefer storage expansion at the reprocessing plant versus central station plant site.

- Plutonium storage conditions are adequate in the U.K.

- The timing and form of return of reprocessed uranium, plutonium and waste material depends upon international acceptance by IAEA, USA, EURATOM, and the U.K.

- International cartel-like operations in reprocessing are important in protecting non-proliferation interests in that there is an avoidance of competitive cost cutting which could impair safeguards abilities. Nevertheless, the facilities must be run by a professional national organization although the inspection function is international.

- Reprocessing should not be deferred because:

  - it is inevitable

  - experience is required to demonstrate proper environmental controls in reprocessing.

- Recovered plutonium is primarily required for the commericial breeder program which would be committed in the next five years. The U.K. does not believe that LWR recycle is economic.

- Recycle options, such as spiking, do not appear particularly attractive.

BNFL has implemented the U.K.'s reprocessing policies in both its current programs and its plans for the future.

Currently, BNFL is operating a MAGNOX fuel reprocessing plant at Windscale which handles both domestic and foreign fuel. Approximately 1500 tons of MAGNOX fuel from the U.K., Latina, and Tokai-Mura are being reprocessed annually. This reprocessing will continue as MAGNOX fuel cannot be stored for long periods of time without cladding corrosion and failure.

Previously, BNFL operated a second plant at Windscale, the B204 oxide reprocessing plant. B204 closed down in 1973 because of an accidential release of radiation shortly before it was due to shut down for renovation and expansion. BNFL originally intended to close the plant in 1974, increase its capacity to 300-400 tons/year and restart the plant in 1976. While the B204 plant will eventually recommence reprocessing, it will only handle a few hundred tons of fuel and cannot be relied upon to meet contractual obligations. The restart of the B204 plant is not subject to the outcome of the Windscale Inquiry.

By 1978 the U.K. expects to have an inventory of 212 MTU of foreign LWR spent fuel as well as contracts to reprocess 1200 tons of foreign LWR fuel. These contracts are with Italy, Switzerland, Germany, Spain, the Netherlands, Sweden and Japan and will run into the early 1980's and are all subject to MB-10's.

The U.K.'s current waste management program reflects its reprocessing policy. The program involves the removal of uranium and plutonium from spent fuel through reprocessing, preparation for surface storage of HLW engineered storage and eventual vitrification of the HLW for permanent disposal. The status of permanent storage, however, remains in the early planning stage with no schedule specifics.

BNFL contract terms bear out the lack of interest in permanently or indefinitely storing either foreign spent fuel ore reprocessing wastes. BNFL retains the options to return high level reprocessing wastes to the country of origin and to return recovered uranium and plutonium to the customer with proper safeguards. Foreign fuel storage facility approval comes under the jurisdication of the Town and Country Planning Act which specifies local planning requirements. The only foreign fuel stored by BNFL is that awaiting reprocessing at Windscale.

BNFL plans to augment its reprocessing capability and, thus, its nation's spent fuel policies by constructing a 1200 ton/year capacity reprocessing plant, Thorp, at Windscale which will be committed to oxide fuels. If this planned expansion of Windscale proceeds, BNFL would contract to reprocess an additional 1800 tons of foreign LWR fuel by the early 1990's. At present, contracts are being negotiated with Japan, Germany, Sweden and Switzerland. The construction of this plant will permit domestic oxide fuel to be reprocessed at a lower unit cost, will apportion the cost of construction between U.K. and overseas customers and will contribute toward correcting the U.K. balance of trade.

Through reprocessing, the U.K. is attempting to build up the plutonium inventory for its breeder program. The U.K. has provided plutonium to France and Canada in the past. The current inventory of 20 tons of plutonium, not including the inventory of weapons program plutonium, is sufficient to fuel a 250 MWe breeder prototype. The U.K.'s breeder program, designed to counteract the estimated high price of uranium in the period 2000-2030, has the following decision path:

1. U.K. government approval, decision in principal
2. 3 years to do pre-arrangements
3. 8 years to build
4. 1 year to commission, say about 1991
5. Main commercial program in effect in the late 1990s.

The U.K. does not desire to wait for implementation of the breeder program before allowing reprocessing to begin. It prefers to proceed with operations in order to check out the plant under environmental controls.

The U.K. has two nuclear fuel transport services which will expand operations if the Windscale reprocessing plant is built. The spent fuel transport capabilities of Nuclear Transport Limited (NTL) and Pacific Nuclear Transport Limited (PNTL) could possibly be made available to transport spent fuel to U.S. basins should such need arise in implementing the U.S. Spent Fuel Policy.

With respect to multi-national cooperation, the U.K. is involved with France and West Germany in the United Reprocessors' Group (URG). The URG contractual requirements for joint planning and technology transfer demand that any questions of cooperation involving BNFL must go to URG. The United Reprocessors Group ownership is shared equally by the three countries. The purpose of URG has been to better manage market conditions, control the price of reprocessing in Europe, and provide better plant load balancing. Spent fuel had been distributed first to the Windscale facility until its capacities became full and the LaHague facility came on line. Since that time, La Hague has been receiving all spent fuel until it is full and the Gorleben facility is operable.

3.GB.4 Spent Fuel Disposition Profile

Operating Reactor Disposition Profile

The U.K. at reactor storage capacity is minimized as a result of the time limitations for storing Magnox fuel in a water basin.

Projected Spent Fuel Disposition Profile

The U.K. perceives the following potential need for reprocessing services within its market of interest. U.K. plans to acquire approximately 2800 MTU of foreign oxide reprocessing orders (1200 MTU existing and 1600 MTU new).

------------CUMULATIVE SPENT FUEL (MTU)*------------				
	1980	1985	1990	1995
U.K.	350	1275	2450	4600
Europe	2000	7000	17500	N.A.
Japan	1000	3000	8000	N.A.
Rest of Western World	500	1000	4500	N.A.
	3850	12275	32450	N.A.

*(Excludes U.K., U.S., France and CPE nations)

Figures 3GB-2 and 3GB-3 are reproduced from Windscale Hearing Testimony and reflect U.K.'s plans with respect to spent fuel deliveries, reprocessing and storage. The following information is provided:

(a) BNFL will acquire 2800 MTU of foreign spent fuel by 1992 in order to feed the Thorp reprocessing plant. The breakdown on delivery is as follows:

Customer	Period	Amount	Status
Japan	to 1984	600 MTU	Existing contract
	1984-1992	1600 MTU	Negotiating
Europe	to 1984	600 MTU	Existing contract

Table 3.GB-2*

THORP PLANT AS PROPOSED

REPROCESSING AND POND STOCKS (TONNES U)

Financial Year	CUMULATIVE DELIVERIES					CUMULATIVE REPROCESSED				POND STOCKS				
	UK Prototypes	CAGR	Future UK	Overseas	Total	UK Prototypes	CAGR	Overseas	Total	UK Prototypes	CAGR	Future UK	Overseas	Total
End 1976/7	31			251	282					31			251	282
77/8	50			372	422					50			372	422
78/9	63	65		546	674					63	65		546	674
79/80	75	150		691	916					75	150		691	916
80/1	88	275		806	1,169					88	275		806	1,169
81/2	95	440		911	1,446					95	440		911	1,446
82/3	100	615		1,039	1,754					100	615		1,039	1,754
83/4	105	800		1,179	2,084					105	800		1,179	2,084
84/5	110	1,000		1,272	2,382					110	1,000		1,272	2,382
85/6	115	1,200		1,416	2,731					115	1,200		1,416	2,731
86/7	120	1,400		1,626	3,146					120	1,400		1,626	3,146
87/8	125	1,600		1,873	3,598	5	100	95	200	120	1,500		1,778	3,398
88/9	130	1,800		2,049	3,979	15	300	285	600	115	1,500		1,764	3,379
89/90	135	2,000	50	2,261	4,446	32	638	605	1,275	103	1,362	50	1,656	3,171
90/91	140	2,200	150	2,473	4,963	49	976	925	1,950	91	1,224	150	1,548	3,013
91/2	145	2,400	300	2,685	5,530	65	1,315	1,245	2,625	80	1,085	300	1,440	2,905
92/3	150	2,600	500	2,830	6,080	82	1,653	1,565	3,300	68	947	500	1,265	2,780
93/4	155	2,800	700	2,840	6,495	100	1,990	1,885	3,975	55	810	700	955	2,520
94/5	160	3,000	930	2,850	6,940	116	2,329	2,205	4,650	44	671	930	645	2,290
95/6	165	3,200	1,240	2,850	7,455	130	2,667	2,525	5,322	35	533	1,240	325	2,133
96/7	170	3,400	1,655	2,850	8,075	150	3,000	2,850	6,000	20	400	1,655	-	2,075

*Ref: Windscale Hearing Testimony

CASE A No CAGR will be stored for more than 10 years
No LWR or prototype fuel will be stored for more than 15 years

Table 3.GB-3*

CAPITAL EXPENDITURE FOR THORP PLANT AS PROPOSED

Financial Years		To 81/82	82/83 To 86/87	87/88 To 91/92	92/93 To 96/97	Total
Receipt and Storage						
Includes B27 T-Bay extension (750 te), 4 x 1,000 te Thorp ponds and associated receipt facilities and oxide portion of pond water treatment plant costs.						
T Bay extension fully operational 1980/81 Site construction commences early 1978	T Bay	10	-			10
Thorp 1 and 2 ponds fully operational 1982/83 Site Construction commences 1978/79	Thorp Ponds 1 & 2	70	30			100
Thorp 3 and 4 Ponds fully operational 1984/85 Site construction commences 1979/80	Thorp Ponds 3 & 4	10	30			40
Reprocessing Plant						
Includes head end treatment, primary separation, U and Pu finishing, HA MA and salt evaporation, LA effluent treatment, gaseous effluent treatment. Plant design capacity = 1,200 te pa						
Commissioning 1986/87 Site construction commences 1980/81 Operational 1987/88		45	250	5		300
HA Storage Tanks Provision of HA tanks for 6,000 te U			57	43		100
Research and Development (on-going technical support included in operating costs)		18	11	1		30
TOTAL CAPITAL FOR THORP		153	378	49		580
Harvest Plant				29	36	65
Commissioning 1991/2 Operational 1992/3 Site construction commences 1988/9	Based on conceptual plant layouts and including provision for pond storage of containers					
TOTAL		153	378	78	36	645

NOTES: (1) Assumes planning permission for Reprocessing Plant and signature of new overseas reprocessing contracts before the end of 1977

(2) Figures include Site Services directly attributable to the THORP project

**Ref: Windscale Hearing Testimony

(b) BNFL will reprocess the 2800 MTU of foreign fuel between 1987 and 1997.

(c) BNFL will add-on 4750 MTU of storage capacity to their 700 MTU existing basin.

Technical Factors

The U.K., through its participation in Nuclear Transport Limited (NTL) and Pacific Nuclear Transport Limited (PNTL), has access to the world's most expansive spent fuel transportation system in existence at this time. A description of U.K.'s spent fuel transport system is provided below:[1]

Present Movements By Road, Rail and Sea

1. All irradiated fuel is transported to Windscale in containers known as "flasks". These are substantial steel vessels which usually weigh in the region of 40-100 tons and usually contain between 1 and 3 tons of fuel.

2. At the present time by far the largest proportion of irradiated fuel transport to Windscale takes place within the U.K., i.e. from the domestic nuclear power programme and consists almost entirely of Magnox-clad natural uranium fuel. Some 1,100 tonnes (about 600 flask loads) are transported each year from the UK Generating Boards' stations. The Central Electricity Generating Board and the

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[1]Ref: C.J. Edney - Manager, Nuclear Transport Reprocessing Division, Risley - Reproduced from Testimony given by C.J. Edney at Windscale Hearings

South of Scotland Electricity Board own the flasks in which the fuel is transported and are responsible for these movements. The movements are made entirely by rail, apart from a short road movement from power station to the nearest railhead.

3. About 100 tonnes (about 40 flask loads) per annum of Magnox fuel is moved by road, a distance of 70 miles, from BNFL's Chapelcross Works to Windscale. BNFL is responsible for these movements. (A similar quantity is moved from the Calder reactors, which are within the Windscale perimeter fence and so this is an "on site" movement only.)

4. Only small quantities of AGR-enriched uranium oxide fuel are at present moved by the Electricity Boards within the UK, numbered in a few tonnes per annum at most. In addition a few tonnes per annum of oxide fuel is moved to Windscale from the URAEA reactor SGHWR, at Winfrith, and across the Windscale Site from the Windscale prototype AGR.

5. BNFL uses two specifically fitted out charter ships to import fuel from abroad. The m.v. "LEVEN FISHER" is in

continuous use carrying the Magnox and oxide fuel from Japan, making about two voyages a year. A second ship, the m.v. "POOL FISHER" is employed for about six months each year, bringing Magnox and oxide fuel from Italy and oxide fuel from other European countries, mainly Spain and Sweden. Both ships dock at Barrow where the fuel is transhipped and transported by rail to Windscale.

6. The present position as regards imported fuel is that about 100 tonnes (approx 40 flask loads) per annum of Magnox fuel is shipped to Windscale by BNFL or its subsidiary company Pacific Nuclear Transport Limited (PNTL), half coming from Japan, and half coming from Italy. About 100 tonnes (40 flask loads) per annum of oxide fuel is also brought to Windscale from Europe and about 14 tonnes (6 flask loads) per annum from Japan. This fuel from Japan and about 20 tonnes (10 flask loads) of the oxide fuel from Europe are brought to Windscale by charter ship. The remaining oxide fuel from European reactors is transported by through rail and road movements using the short sea ferry routes, roughly 40 tonnes per annum (20 flask loads) by road and 40 tonnes per annum (20 flask loads) by rail. The responsibility for carrying out these movements lies with Nuclear Transport Limited (NTL), an international company jointly owned by BNFL, Transnucleaire France, and Transnuklear Germany.

Future Movement

7. The volume of Magnox fuel transport will remain constant for the foreseeable future. Transport of oxide fuel from the existing UK AGR power stations will be carried out by the Electricity Boards and has not yet fully commenced but in 1978 it is expected that up to 50 tonnes (50 flask loads) may be moved. By 1981 the annual tonnage should have increased to about 2-300 tonnes (2-300 flask loads), which will be the equilibrium figure for the AGR system.

The means of transport for this fuel will be similar to that used for Magnox fuel from UK stations, that is a short road journey from the reactor to the nearest rail-head and then to Windscale by rail.

8. The growth of further additional arisings of domestic oxide fuel transport in the UK will depend on decisions concerning future installations of nuclear power stations (SGHWR's etc) and clearly the timescale in which such stations could be built is such that no sizeable increase will be made on the volume of transport before the late 1980's.

9. As regards overseas business, the first significant increase in the existing level of transport movements will arise as a consequence of the Japanese reprocessing contracts negotiated in 1974. These entail the transport by BNFL/PNTL of approximately 600 tonnes (250 flask loads) of oxide fuel from Japan to Windscale (as well as another 750 tonnes from Japan to France) in the period up to 1984. This increase to Windscale and to France requires that the m.v. "LEVEN FISHER" should be replaced by three larger ships, one in 1978, two in 1979. Peak deliveries under these contracts to Windscale will be about 180 tonnes (70 flask loads) in 1983.

10. Under the additional Japanese contracts now being negotiated the transport programme would be extended to 1992 with an additional 1,600 tonnes (approx. 700 flask loads) delivered to Windscale with a peak rate of about 300 tonnes p.a. (125 flask loads). BNFL/PNTL would also transport a similar quantity from Japan to France. In total BNFL and PNTL may need to operate 5 or 6 ships in the later 1980's, half of this capacity for deliveries to Windscale and half for delivery to France. The increase in traffic through the port of Barrow may involve the need to expand the port handling facilities.

11. Transport of oxide fuel from Europe will also increase, and the number of movements may double to something like 200 to 300 tonnes (80 - 120 flask loads) per annum. Most of this increase is likely to be accommodated by rail movements and, where appropriate, by shipments by charter ship. These transport operations will be carried out by the BNFL associate company NTL.

12. In summary, the increase in the volume of oxide fuel transport in the next 15 years will be considerably less than the present volume of Magnox and oxide fuel transport, i.e., an increase of 600-700 tonnes per annum on the present total of about 1400 tonnes per annum of Magnox and oxide fuel.

UK Regulatory Requirements and Practices

13. The International Atomic Energy Agency (IAEA) Vienna, has issued "Regulations for the Safe Transport of Radioactive Materials", which are accepted throughout the world. These were first published in 1961 and amended in 1967 and 1973 to take account of developments in the transport field. The current Regulations are the 1973 Revised Edition.

14. These IAEA Regulations form the basis for the domestic regulations of the UK and other countries. In the UK the transport of radioactive materials by road, rail, sea and air is covered by a number of Statutory Regulations and Codes of Practice, which are listed at the end of this proof. The UK Regulations and Conditions of Carriage are all in accordance with the IAEA Regulations, except for minor variations to allow for special UK conditions.

15. The design of containers to carry irradiated nuclear fuel is assessed against the IAEA and UK Regulations by a Sub-Section of the Nuclear Transport Section of BNFL

before submission to the UK competent authority for its separate safety assessment. An assessment of the container design is carried out by the UK competent authority and if it is satisfied that the requirements of the Regulations are shown to be met, a Package Design Approval Certificate is issued. The UK competent authority is the Transport Radiological Adviser of the Department of Transport, acting on behalf of the Secretary of State for Transport in respect of inland surface transport, and the Secretary of State for Trade in respect of sea and air transport.

Transport of Irradiated Fuel By Land

16. Both the UK and IAEA regulations and Codes of Practice lay down specific rules for the transport of radioactive materials by land covering both rail and road transport. These rules are followed by the transport organisation involved, e.g. British Rail. The vast majority of movements to Windscale have been and will be by rail. Initially British Rail wagons were used modified as necessary but increasingly purpose designed wagons are coming into use.

17. The accident conditions which the flask has to survive are incorporated in the regulations and are designed to meet the most severe conditions likely to be experienced.

18. Typical flasks in use for the transport of irradiated fuel to Windscale are shown in Pictures 1 and 2.*

19. The first picture is of the cubical flask used for Magnox fuel, weighing about 45 tonnes, about 8 feet per side and carrying about 2 tonnes of fuel. The other picture shows an Excellox flask used for transporting oxide fuel from overseas reactors. It is cylindrical in shape, being about 6 feet in diameter and about 18 feet long. It weighs about 75 tonnes and carries about 2-1/2 tonnes of fuel.

*Note: Pictures are not attached.

The Transport of Irradiated Fuel By Sea

20. Both the UK and IAEA regulations and Codes of Practice lay down specific conditions for the transport of irradiated fuel by sea. In the case of shipments by routine commercial voyages, simple rules are given so that the master of the ship may safely stow in his ship a number of containers containing radioactive materials.

21. In the case of shipments from Japan and certain European countries, BNFL employs specially chartered ships. The large ships to be brought into service in 1978/1979 will carry up to 26 flasks in each ship. BNFL has completed over 60 voyages carrying irradiated fuel in special ships.

22. The existing ships incorporate special safety features such as fire fighting equipment, cooling capacity to remove residual heat from the flasks, and additional navigational equipment. In the ships to be brought into service in 1978/79 these features will be enhanced and other features added such as structural reinforcement and compartmentalisation.

23. The structural strengthening of the ship has been undertaken to minimize the risk of loss of ship and not specifically to protect the flasks from collision. The flasks used will be the same as those used for overland transport.

3.GB.5 Legal and Regulatory Factors

A. Reactor Requirements on Spent Fuel

1. Minimum holding period of reactor

British law contains no specific provisions setting a minimum holding period for spent fuel at a reactor.

Of the 14 nuclear power stations in operation in United Kingdom, approximately nine utilize the "Magnox" technology which, because of its nature, requires reporcessing with a relatively short period of time. Inquiries during the survey into the question of long-term storage of "Magnox" fuel produced a uniformity of opinion that two to three years is the maximum storage period possible for this fuel without recapsulating (recanning), which would be an economically unfeasible alternative. The present policy apparently with regard to "Magnox" fuel is to store it for approximately 100 days at the reactor and then to ship it to the Windscale reprocessing plant where it is stored for approximately 6 months.

There are no specific provisions relating to the approximately five AGR plants (four presently operating) relating to a minimum holding period at a reactor. The AGR plants, because of the existence of Windscale, were designed for minimum storage.

2. Storage capacity at reactor

There are no formal legal requirements governing the storage capacity or margins at reactors for spent fuel.

3. Disposition plans for spent fuel as a reactor licensing requirement

The United Kingdom does not require the applicant to produce a plan for spent fuel disposition prior to allowing the operation of a reactor.

B. Custody and licensing of spent fuel and its handling

1. Custody

No person may have custody of spent fuel unless he is registered with the Secretary of State for the Environment (Appendix UK-1, Sec. 1). The government's role is not ministerial; it may grant the registration subject to limitations and conditions, or it may be refused altogether. Criteria which the Secretary of State considers include the amount and character of the radioactive waste likely to arise (id.)

2. Transport, including packaging

The United Kingdom Atomic Energy Agency IUKAEA) has general authority to transport spent fuel but all other persons must meet transport regulations which are organized according to mode of transport. The Secretary of State regulates road carriage (Appendix UK-2). Carriage by sea is governed by regulations of the Secretary of State for Trade (Appendix UK-3,4). The Ministry of Environment has issued a code of Practice for the carriage of nuclear materials through ports (Appendix UK-5). Other authorities regulate other means of transport.

The U.K. has relied upon IAEA proposals for the transport of nuclear materials, adopting them by statute for road shipment and administratively for rail and air shipments.

3. Storage licensing

a. At reactor

Spent fuel storage basins have always been considered incidental to reactor operation and have been considered at the operating license stage.

If a licensee seeks to expand his storage basin, he must seek approval from the appropriate Minister**. If the Minister is satisfied as to the safety of the proposals, the existing license is revoked and a new license incorporating the request issued.

b. Away from reactor

No person other than the UKAEA may construct a centralized spent fuel storage facility without approval from the appropriate Minister (Appendix UK-6, Sec. 1(1)). The license is granted with respect to the site, not the installation itself, and the Minister may treat two or more facilities in the vicinity of one another as being on the same site for the purpose of a license (id., Sec. 3(2)). A license may be granted only to a corporate body (id., Sec. 3(1)).

Apart from the Minister's discretionary authority to require applicants to file notice of his applications to various local bodies as discussed in C.3. (id., Sec. 3(3)), UK law does not require any formal procedure. In practice, filing of the application is usually preceded by informal consultation between the applicant and the Chief Inspector of Nuclear Installations in the Department

**The appropriate Minister will vary depending on the site of the facility.

of Trade and Industry. Informal guidance is given on the acceptability of the particular site and on the proposed facility. If the results of this consultative process are favorable, the applicant may make the more detailed proposals needed in a formal application.

4. Import requirements

and

5. Export requirements

The Radioactive Substances Act of 1948 authorizes the Secretary of State for Trade and Industry to prohibit or regulate by Order the import into or the export from the U.K. of nuclear materials and equipment, but these discretionary powers have never been used (Appendix UK-2, Sec. 2). In the absence of such an exercise of authority, the same Minister reviews such requests under the general powers vested in the Department to regulate all imports and exports. In the latter case, however, the Minister's discretion is tempered by the U.K.'s adherence to the Non-Proliferation Treaty and its participation in the London Suppliers Conference.

C. Supplemental legal requirements

1. Radiological health and safety

Control over nuclear installations is enforced by a system of licensing of nuclear sites imposed by the Nuclear Installations Act, 1965 (Appendix UK-6). The purpose of the Act is to ensure, by a system of licensing and inspection, that nuclear facilities on land are made effectively subject to control in the interest of public safety (Appendix UK-6). Subject to some exceptions, such as limits to radiation doses, license requirements do not specify detailed technological controls but set out basic principal requirements for safety. It is then the responsibility of a licensee to submit to the Health and Safety Executive technology and procedural documents which are subject to informal consideration and formal approval. The authority of the Health and Safety Executive to amend, add to, or revoke licenses at any time is quite broad.

The appropriate Minister may attach to the license whatever written conditions appear to him necessary and/or desirable in the interests of safety (Appendix UK-2, Sec. 4). In general, the basic standards of radiological protection conform with the current international standards. For a facility these include conditions -

- regulating the design, siting, construction, installation, operation, modification and maintenance of the facility;
- devising a system for detecing and recording the presence and intensity of radioactive emissions;
- controlling the discharge of any substance on or from the site; and
- limiting occupational and general public radiation exposures.

2. Safeguards

a. International agreements

The United Kingdom has a number of safeguards obligations imposed by international agreements, including those required by its membership in EURATOM. It also has ratified the Non-Proliferation Treaty as a nuclear weapons state, and, although no obligation is imposed by the Treaty to do so, the U.K. has requested the IAEA to apply safeguards to certain peaceful activities.

b. Domestic requirements

Before the licensee is permitted to operate a facility the authorities will consider the security of the site (Appendix UK-7). Guards at such facilities have broad authority to carry firearms and conduct searches (Appendix UK-8).

3. Environmental requirements

The Secretary of State for the Environment has responsibility for all aspects of environmental pollution, including the coordination of the activities of the various Government Departments in this field. To assist him, a permanent Royal Commission has been established.

The principal responsibilities of the various Government Departments are (with their respective jurisdictions in parentheses) --

- Department of the Environment (air pollution, waste disposal, radioactive substances and Water Resources Board);
- Department of Trade and Industry (Government laboratories and industrial research associations);
- Ministry of Agriculture, Fisheries and Food (protection of fisheries and agriculatural supply); and

- Department of Education and Science (Research Councils).

In addition, various local authorities have powers and responsibilities for various aspects of pollution. For facilities the appropriate Minister may at his discretion direct an applicant for a license to serve notice on local authorities, river boards, fisheries committees, water boards, and other similar bodies. (See, e.g., Appendix UK-9). The Minister must consider any comments rendered and not grant a license until three months after the service of the last notice.

4. Third-party liability

A licensee is under duty to provide financial security against any nuclear incident within the scope of the license (Appendix UK-6, Sec. 7(1)). This includes imports from a country which is not a party to a "relevant nuclear international agreement" (id., Sec. 7(s)). Any relevant foreign operator will be liable for a nuclear incident in the course of carriage on his behalf, if the incident takes place wholly or partly within the United Kingdom. In this instance, the operator will be responsible if the incident occurs outside the U.K. if a U.K. operator is also involved in the incident (id., Sec. 10).

To cover this liability, the licensee must take out insurance or provide financial security (id., Sec. 19(3)).

Where the person liable is a licensee, the UKAEA or the Crown, the liability is limited to 5 million per nuclear incident (id., Sec. 16(1)). In the case of a relevant foreign operator, he will only be required to pay compensation to the extent his own national law provides for this and only up to an amount equal to that established by his own law (id., Sec. 16(2)). If any other person is responsible for a nuclear incident in the course of carriage within the United Kingdom, his is liable without financial limit (id., Sec. 11).

The state will pay all claims within the U.K. which exceed the licensee's limited liability (id., Sec. 16(3)).

5. Reporting requirements

All licensees must keep detailed records for all activities within the scope of their licenses (see, e.g., Appendix UK-6, Sec. 4(3)).

Any official of the Nuclear Installations Inspectorate may enter any licensed site at all reasonable times. The inspector may require the licensee to provide him with information or to permit him to inspect any documents concerning the license (Appendix UK-2, Sec. 24).

6. Public participation

Under the Town and Country Planning Act of 1971 (Appendix UK-10) the appropriate Minister must consult with local planning authorities. Where these authorities object to the issuance of the proposed license a public inquiry may be held.

7. Other relevant considerations

None.

3.GB.6 Views Regarding Alternative Spent Fuel Disposition Programs

(Deleted)

3.JP Visit Findings - Japan

3.JP.1 Introduction

3.JP.1.1 Organizations Visited

The Japanese organizations visited were: Science and Technology Agency, Ministry of International Trade and Industry, Japan Atomic Industrial Forum, Inc., Japan Atomic Energy Research Institute, Tokyo Electric Power Company, Inc., Japan Atomic Power Company, the Enrichment and Reprocessing Group and Nuclear Transport Services Company, Ltd.

3.JP.1.2 Spent Fuel Disposition Highlights

Policies, Plans and Programs

The Japanese are pressing for national reprocessing and interim reprocessing services by BNFL and COGEMA. It was suggested that if major nations such as the U.K., France and West Germany chose not to reprocess, then Japan would follow suit. The logistics system to support BNFL and COGEMA storage and reprocessing services is in place and demonstrated, and the siting survey and organizational preparation for a national commercial scale reprocessing plant are underway. The Japanese are planning an away-from-reactor (AFR) storage basin as the "head-end" to a commercial scale reprocessing plant.

Principal Concerns

The near term government concern is to persuade the U.S. to allow resolution of the Japanese spent fuel disposition problem through near term spent fuel reprocessing arrangements. The electric utilities are concerned that there be a timely working solution to spent fuel disposition.

The longer term national concern is to place the breeder program into being as the main source of power generation.

Spent Fuel Disposition Profile

The following cumulative discharge profile reflects anticipated spent fuel generation for the committed Japanese LWR reactor program (firm) and anticipated future Japanese LWR reactor program (projected).

Cumulative Discharge Profile (MTU)

Year	Firm	Projected	Total
1985	4038	138	4176
1990	7238	2023	9351
2000	13908	14061	27969

The following away-from-reactor (AFR) spent fuel disposition profile is based on using: a) actual-non-expanded at-reactor-storage (ARS) basic capacities for all operating reactors, and b) ARS basin capacities equal to 2 x core for all reactors starting up in 1978 or later. Full Core Reserve (FCR) is assumed at all at-reactor-storage basins.

Cumulative AFR Profile (MTU)

Year	Firm	Projected	Total
1985	2303	0	2303
1990	5068	533	5601
2000	11648	9357	21005

To date the Japanese have made, or are currently negotiating, the following spent fuel deliveries to external reprocessing organizations:

Time Period	Spent Fuel Deliveries (MTU)	Reprocessor	Status
Up to 1984	600	BNFL	Firm
	750	COGEMA	Firm
1984-1992	1600	COGEMA	Firm[1)]
	1600	BNFL	Under[2)] Negotiations

1) Firm subject to approval from governments involved.

2) Same as 1) except subject to outcome of Windscale Hearings

Views Regarding Alternative Spent Fuel Disposition Programs

(Deleted)

3.JP.2 Nuclear Power Profile

Japan is now the world's third greatest energy consumer, following the United States and the Soviet Union. Rapid economic growth has caused Japan's dependence on imported oil to rise from 19 percent in 1955 to 90 percent in 1973.

An energy supply and demand estimate was defined by the Advisory Committee for Energy in August, 1975. The following policies were planned to reduce Japanese dependence on imported oil and to diversify non-petroleum energies: (a) employ indigenous energy sources (hydropower, geothermal, continental shelf petroleum, domestic coal); (b) diversify imported energies (coal and LNG); and (c) promote nuclear power. If alternative energy sources are developed and energy conservation is promoted, it is possible that in 1990, the Japanese petroleum dependence rate might drop to approximately 57%.

The major emphasis of Japan's energy policy is on expansion of the indigenous nuclear industry. It is important to note that Japan is one of six nations with a breeder reactor program, for not only does Japan believe that nuclear energy is the best alternative to imported fossil fuels, but also that the breeder is the best method of extricating the country from dependence on imported uranium.

Various organizations in Japan have attempted to forecast Japan's nuclear generating capacity for 1985. The Japan Atomic Energy Commission in June 1977 estimated 49,000 megawatts electric (MWe) while the Ministy of International Trade and Industry lowered the estimate to 27,000-33,000 MWe by 1985 and 45,000-60,000 MWe by 1990. For purposes of this study is is projected that total Japanese nuclear power generating capacity will reach 50 GWe by 1990 and 90 GWe by 2000.

Table 3.JP-1 provides reactor data for Japan's nuclear power program. Table 3.JP-2 shows the profile for the presently perceived Japanese program (firm) and anticipated future reactor growth (projected).

Table 3.JP-1: Nuclear Power Program - Japan

REACTOR	UTILITY	MWe	REACTOR TYPE	OPERATION DATE	STATUS
Tokai 1	Japan Atomic Power	159	GCR	7/66	O
Tsuruga	"	340	BWR	3/70	O
Mihama 1	Kansai Electric Power	320	PWR	11/70	O
Fukushima One 1	Tokyo Electric Power	460	BWR	3/71	O
Mihama 2	Kansai Electric Power	470	PWR	7/72	O
Shimane	Chugoku Electric Power	439	BWR	3/74	O
Fukushima One 2	Tokyo Electric Power	784	BWR	7/74	O
Takahama 1	Kansai Electric Power	781	PWR	11/74	O
Genkai 1	Kyushu Electric Power	529	PWR	10/75	O
Takahama 2	Kansai Electric Power	781	PWR	11/75	O
Hamaoka 1	Chubu Electric Power	516	BWR	3/76	O
Fukushima One 3	Tokyo Electric Power	784	BWR	3/76	O
Mihama 3	Kansai Electric Power	781	PWR	12/76	O
Ikata 1	Shikoku Electric Power	538	PWR	9/77	C
Tokai 2	Japan Atomic Power	1067	BWR	12/77	O
Fukushima One 5	Tokyo Electric Power	784	BWR	4/78	C
Ohi 1	Kansai Electric Power	1122	PWR	6/78	C
Fugen, ATR	Power Reactor and Nuclear Fuel Development Corp. (PNC)	200	LWCHW	6/78	C
Hamaoka 2	Chubu Electric Power	814	BWR	9/78	C
Fukushima One 4	Tokyo Electric Power	784	BWR	10/78	C

O = Operational
C = Under Construction
P = In Planning

Table 3.JP-1 (con't)

REACTOR	UTILITY	MWe	REACTOR TYPE	OPERATION DATE	STATUS
Ohi 2	Kansai Electric Power	1122	PWR	12/78	C
Fukushima One 6	Tokyo Electric Power	1100	BWR	10/79	C
Onagawa	Tohoku Electric Power	500	BWR	8/80	P
Genkai 2	Kyushu Electric Power	529	PWR	3/81	C
Ikata 2	Shikoku Electric Power	538	PWR	10/81	P
Fukushima Two 1	Tokyo Electric Power	1100	BWR	5/82	C
Monju	Power Reactor & Nuclear Fuel Development Corp.	300	LMFBR	1/85	P
Hamaoka 3	Chubu Electric Power	1066	BWR	/85	P

O = Operational
C = Under Construction
P = In Planning

Table 3JP-2

NUCLEAR POWER GENERATING CAPACITY PROFILE — JAPAN-FCR

YEAR	GENERATING CAPACITY (MWE) FIRM	PROJECTED	TOTAL
1977	8928.	0.	8928.
1978	13686.	0.	13686.
1979	14786.	0.	14786.
1980	15310.	0.	15310.
1981	16435.	0.	16435.
1982	17535.	0.	17535.
1983	19525.	1767.	21292.
1984	21725.	3533.	25258.
1985	21725.	5300.	27025.
1986	21725.	9900.	31625.
1987	21725.	14500.	36225.
1988	21725.	19100.	40825.
1989	21725.	23700.	45425.
1990	21725.	28300.	50025.
1991	21725.	32300.	54025.
1992	21725.	36300.	58025.
1993	21725.	40300.	62025.
1994	21725.	44300.	66025.
1995	21725.	48300.	70025.
1996	21725.	52300.	74025.
1997	21725.	56300.	78025.
1998	21725.	60300.	82025.
1999	21725.	64300.	86025.
2000	21725.	68300.	90025.
2010	21725.	68300.	90025.
2020	21725.	68300.	90025.
2030	21725.	68300.	90025.

3.JP.3 Spent Fuel Disposition Policies, Plans and Programs

The Japanese government (Science and Technology Agency - STA) provided the study team with a hard line spent fuel policy. Simply stated, the policy advocates:

(1) Storing spent fuel one year in at-reactor-storage

(2) Then reprocessing

(3) Reusing the recovered uranium and plutonium as reactor fuels

(4) Disposing of vitrified reprocessing waste

STA further indicated that Japanese government planning does not have a reprocessing delay scenario and that there are no current planning considerations for alternatives to reprocessing. This statement was slightly contradicted by an avowed interest in INFCE and IAEA studies, and indicated that government policies remain firm for the time being. It was stated that if major nations, such as the United Kingdom, France and West Germany, chose not to recycle, then Japan would follow suit. Yet, STA also referred to the sensitivity of an inferred divergence in Japanese spent fuel policy during the renegotiations of the current reprocessing agreement with the U.S. which will occur within the next two years. In any case, a technicality prevents, or at least impedes the deferral of reprocessing. The Japanese Nuclear Safety Commission criteria requires that spent fuel reprocessing arrangements be provided as a requirement for reactor plant licensing.

The reprocessing agreements with BNFL and COGEMA call for 1600 MTU of reprocessing each. The Windscale hearings are delaying the BNFL agreement and the COGEMA agreement has been signed subject to MITI endorsement, to the Japan Export Import Bank's willingness to extend the necessary funds, and to Japanese acceptance of their own returned reprocessing wastes.

STA indicated that it shall meet future reprocessing needs through: a) purchase of external reprocessing services, b) operations of the Tokai Reprocessing Facility, and c) operations of a national commercial-scale reprocessing plant with plant start-up occurring in the 1990 time period. Presently, several extenualities such as U.S. restraints, INFCE deliberations, BWFL's Windscale Hearings, etc., are causing a delay in Japan's reprocessing plans.

The reprocessing delay is stimulating the government to include an interim storage facility as an annex to the planned commercial plant. The location of the plant is a delicate matter with respect to local opposition. There are many candidate areas. Siting is at an advanced stage, but land has not been acquired nor has there been public notification. (JAPCO noted that the U.S. - Japanese reprocessing agreement of September 1977 allows the Japanese to proceed with authorizing legislation, formation of a private company and siting for the planned commercial plant.)

In meetings with the Ministry of International Trade and Industry (MITI), the government's policy of reprocessing was reiterated, stressing the favorable economics of recycle as identified in U.S. ERDA studies, and more important to MITI, stressing the long-range shortage of uranium. MITI indicated that although it oversees the electric utilities, the utilities would have to cope with reprocessing delay and interim storage, should that occur.

Tokyo Electric Power Company (TEPCO) agreed to act as the liaison between the study and the Federation of Electric Power companies of Japan. Although TEPCO is not the spokesman for all the regional utilities, it coordinates the utilities' positions. TEPCO acknowledged Japanese government policy positions on the need for reprocessing, but indicated that the study of multi-national interim storage concepts might be valuable to TEPCO as a contingency plan, should one be required due to planned or unplanned slippage of reprocessing schedules. TEPCO assigned a principal contact to support the study information requirements for the duration of the effort.

TEPCO indicated that its plans up to 1990 are based on reprocessing at Tokai, BNFL and COGEMA, and that beyond 1990, it was looking to a second Japanese reprocessing plant. TEPCO is expanding the at-reactor-storage capacity of its plants from a range of 150% full core to 225% in order to have enough flexibility to circumvent any delays in the plan. TEPCO noted that Tokai is already delayed, and indicated an interest in exploring storage alternatives. With regard to away-from-reactor (AFR) storage in Japan, TEPCO suggested that the Japanese public would not readily accept such a facility. Yet if the study would locate an appropriate site (country) capable of public acceptance, TEPCO would be interested.

The Japan Atomic Power Company (JAPCO) believes that the history of LWR performance makes the Full Core Reserve requirement essential. The JAPCO at-reactor-storage expansion program is similar in scope to the TEPCO program.

JAPCO indicated its leadership role in forming the joint venture, Pacific Nuclear Transport Limited, for spent fuel transportation from Japan through the Panama Canal to Europe. Pacific Nuclear Transport Limited consists of BNFL, several Japanese trading companies and four Japanese utilities. Japanese law covers third party liability in Japanese waters, and the United Kingdom provides coverage outside. In order to receive liability coverage, the U.S. Price-Anderson Act requires that spent fuel be shipped in U.S. flag vessels which, from previous evaluations, apparently causes a significant increase in overall spent fuel transportation costs.

Nuclear Transport Services Co. Ltd. (NTS) was formed to provide shipment of spent fuel from Japanese reactors to the Tokai facility. NTS is a joint venture between the ten utility companies (including JAPCO), five trading houses, and five transportation companies. NTS, which is presently organized for domestic shipments only, indicates it will start planning a second intercoastal ship in 1978 and that, including regulatory approvals, it requires 1-1/2 to 2 years to plan and construct a ship.

Finally, the government agencies have indicated that a research program is underway to determine the existance of any appropriate sites in Japan for permanent high level waste disposal. It was reported that none have yet been identified and that there is no assurance that any satisfactory site will be identified.

3.JP.4 Spent Fuel Disposition Profile

Note: The Japanese data (i.e., response to GSFLS questionaires) required to determine specific near term spent fuel disposition profiles has not been transmitted to the GSFLS study team as of 1/15/78. GSFLS analysis has been perfomed using information obtained during GSFLS visit and other available information.

Projected Spent Fuel Disposition Profile

In order to provide a quantitative framework for evaluating spent fuel disposition requirements, the following exhibits are included. Tables 3-JP-3 through 3-JP-5 provide spent fuel profiles for the following items:

- 3-JP-3: Spent Fuel profiles for specific identifiable Japanese reactors
- 3-JP-4: Annual spent fuel profiles
- 3-JP-5: Cumulative spent fuel profiles

Technical Factors

Principal technical factors affecting Japanese near-term spent fuel disposition relate to the following:

1. Increasing at-reactor-storage capacities
2. Transporting spent fuel from reactor basins to away-from-reactor disposition.

Tsuruga-1 reflects an extreme Japanese at-reactor-storage situation in that its basin is virtually full and proposed modifications to increase storage capacities through storage rack densification programs will be difficult to accomplish. Difficulties arise from several sources, namely:

(a) Seismic design conditions are limiting factors in maximizing at-reactor-storage capacity. Tsuruga's ARS capacity will be increased from 150% core to 190% core.

(b) Existing pool contamination poses a significant problem in the storage rack retrofit program (i.e., pool densification).

(c) Transfer of existing spent fuel to an away-from-reactor (AFR) must be accomplished in order to proceed with the retrofit program.

Spent fuel transportation from Japanese reactors is accomplished entirely through a water transport mode. All Japanese reactors have facilities which can accommodate ships up to 3000 dead weight tons. Intercoastal routes are planned for shipment of spent fuel from at-reactor-storage to a centralized storage and/or reprocessing center. As was discussed in Section 3.JP.4, Nuclear Transport Services Co. Ltd. (NTS) was formed to provide such shipment. NTS has modified a conventional powered intercoastal cargo ship, the Hinoura Maru, which can carry the following types of casks:

Cask	Type	Payload
Excellox IIIA	Air cooled	5 PWR/12 BWR
HZ 75T	Water cooled	7 PWR/17 to 19 BWR

NTS indicated that a minimum of eight casks are required to support one ship system (four active and four reserve casks).

Japanese criteria for a spent fuel transport ship requires that it be "unsinkable," provide safety for the crew, and prevent radioactive leakage. In order to achieve that criteria, Japanese spent fuel transport ships will have to be designed as double-hulled vessels.

Table 3JP-3

FIRM REACTOR SPENT FUEL PROFILE — JAPAN-FCR

FACILITY	DIS START YEAR	ANN DIS	EFF ARS DIS	BEG AFR YEAR	CUMULATIVE (MTU) 1985 DIS	1985 AFR	1990 DIS	1990 AFR	2000 DIS	2000 AFR	2030 DIS	2030 AFR
TSURUGA B	1970	14	30	1972	224.	194.	294.	264.	434.	404.	854.	824.
MIHAMA1 P	1972	13	28	1974	182.	154.	247.	219.	377.	349.	767.	739.
FUKUSH1-1B	1973	16	40	1975	208.	168.	288.	248.	448.	408.	928.	888.
MIHAMA2 P	1974	16	63	1977	192.	129.	272.	209.	432.	369.	912.	849.
SHIMANE B	1976	16	39	1978	160.	121.	240.	201.	400.	361.	880.	841.
FUKUSH1-2B	1975	25	52	1977	275.	223.	400.	348.	650.	598.	1400.	1348.
TAKAHAMA1P	1977	23	118	1982	207.	89.	322.	204.	552.	434.	1242.	1124.
GENKAI-1 P	1977	16	79	1981	144.	65.	224.	145.	384.	305.	864.	785.
TAKAHAMA2P	1977	24	24	1978	216.	192.	336.	312.	576.	552.	1296.	1272.
FUKUSH1-3B	1978	26	53	1980	208.	155.	338.	285.	598.	545.	1378.	1325.
HAMAOKA1 B	1978	17	36	1980	136.	100.	221.	185.	391.	355.	901.	865.
MIHAMA3 P	1978	24	24	1979	192.	168.	312.	288.	552.	528.	1272.	1248.
IKATA1 P	1978	16	15	1978	128.	113.	208.	193.	368.	353.	848.	833.
TOKAI2 B	1978	36	204	1983	288.	84.	468.	264.	828.	624.	1908.	1704.
FUKUSH1-4B	1980	26	107	1984	156.	49.	286.	179.	546.	439.	1326.	1219.
OHI -1 P	1980	30	89	1982	180.	91.	330.	241.	630.	541.	1530.	1441.
FUKUSH1-5B	1980	26	107	1984	156.	49.	286.	179.	546.	439.	1326.	1219.
HAMAOKA2 B	1980	25	105	1984	150.	45.	275.	170.	525.	420.	1275.	1170.
OHI -2 P	1980	30	89	1982	180.	91.	330.	241.	630.	541.	1530.	1441.
FUKUSH1-6B	1981	33	142	1985	165.	23.	330.	188.	660.	518.	1650.	1508.
ONAGAWA-1B	1982	18	81	1986	72.	0.	162.	81.	342.	261.	882.	801.
GENKAI-2 P	1983	16	48	1986	48.	0.	128.	80.	288.	240.	768.	720.
IKATA2 P	1983	16	48	1986	48.	0.	128.	80.	288.	240.	768.	720.
FUKUSH2-1B	1984	33	141	1988	66.	0.	231.	90.	561.	420.	1551.	1410.
SENDAI1 P	1985	24	72	1988	24.	0.	144.	72.	384.	312.	1104.	1032.
FUKUSH2-2B	1985	33	142	1989	33.	0.	198.	56.	528.	386.	1518.	1376.
FUKUSH2-3B	1986	33	142	1990	0.	0.	165.	23.	495.	353.	1485.	1343.
NIIGATA-1B	1986	33	142	1990	0.	0.	165.	23.	495.	353.	1485.	1343.

Table 3JP-4

ANNUAL SPENT FUEL PROFILE — JAPAN-FCR

YEAR	ANNUAL DISCHARGE (MTU) FIRM	PROJECTED	TOTAL	ANNUAL AFR REQMT. (MTU) FIRM	PROJECTED	TOTAL
1977	163.	0.	163.	67.	0.	67.
1978	282.	0.	282.	118.	0.	118.
1979	282.	0.	282.	164.	0.	164.
1980	419.	0.	419.	204.	0.	204.
1981	452.	0.	452.	208.	0.	208.
1982	470.	0.	470.	245.	0.	245.
1983	502.	0.	502.	318.	0.	318.
1984	535.	46.	581.	408.	0.	408.
1985	592.	92.	684.	442.	0.	442.
1986	658.	138.	796.	493.	0.	493.
1987	658.	257.	915.	502.	46.	548.
1988	658.	377.	1035.	550.	92.	642.
1989	658.	497.	1155.	582.	138.	720.
1990	658.	616.	1274.	638.	257.	895.
1991	658.	736.	1394.	658.	377.	1035.
1992	658.	840.	1498.	658.	497.	1155.
1993	658.	944.	1602.	658.	616.	1274.
1994	658.	1048.	1706.	658.	736.	1394.
1995	658.	1152.	1810.	658.	840.	1498.
1996	658.	1256.	1914.	658.	944.	1602.
1997	658.	1360.	2018.	658.	1048.	1706.
1998	658.	1464.	2122.	658.	1152.	1810.
1999	658.	1568.	2226.	658.	1256.	1914.
2000	658.	1672.	2330.	658.	1360.	2018.
2010	658.	1776.	2434.	658.	1776.	2434.
2020	658.	1776.	2434.	658.	1776.	2434.
2030	658.	1776.	2434.	658.	1776.	2434.

Table 3JP-5

CUMULATIVE SPENT FUEL PROFILE —JAPAN-FCR

	CUM DISCHARGE (1000 MTU)			CUM AFR ROMT. (1000 MTU)		
YEAR	FIRM	PROJECTED	TOTAL	FIRM	PROJECTED	TOTAL
1977	.504	0.000	.504	.196	0.000	.196
1978	.786	0.000	.786	.314	0.000	.314
1979	1.068	0.000	1.068	.478	0.000	.478
1980	1.487	0.000	1.487	.682	0.000	.682
1981	1.939	0.000	1.939	.890	0.000	.890
1982	2.409	0.000	2.409	1.135	0.000	1.135
1983	2.911	0.000	2.911	1.453	0.000	1.453
1984	3.446	.046	3.492	1.861	0.000	1.861
1985	4.038	.138	4.176	2.303	0.000	2.303
1986	4.696	.276	4.972	2.796	0.000	2.796
1987	5.354	.533	5.887	3.298	.046	3.344
1988	6.012	.910	6.922	3.848	.138	3.986
1989	6.670	1.407	8.077	4.430	.276	4.706
1990	7.328	2.023	9.351	5.068	.533	5.601
1991	7.986	2.759	10.745	5.726	.910	6.636
1992	8.644	3.598	12.242	6.384	1.407	7.791
1993	9.302	4.542	13.844	7.042	2.023	9.065
1994	9.960	5.590	15.550	7.700	2.759	10.459
1995	10.618	6.742	17.360	8.358	3.598	11.956
1996	11.276	7.998	19.274	9.016	4.542	13.558
1997	11.934	9.357	21.291	9.674	5.590	15.264
1998	12.592	10.821	23.413	10.332	6.742	17.074
1999	13.250	12.389	25.639	10.990	7.998	18.988
2000	13.908	14.061	27.969	11.648	9.357	21.005
2010	20.488	31.819	52.307	18.228	26.491	44.719
2020	27.068	49.577	76.645	24.808	44.249	69.057
2030	33.648	67.335	100.983	31.388	62.007	93.395

3.JP.5 Legal and Regulatory Factors

A. Reactor requirements on spent fuel

1. Minimum holding period at reactor

There is no legally required minimum holding period.

2. Storage capacity at reactor

There is likewise no legally required storage capacity or margin at reactor. However, sources at the U.S. Embassy in Tokyo state that the Nuclear Safety Bureau of the Science and Technology Agency (STA) has an informal requirement that one full core margin always be maintained.

3. Disposition plans for spent fuel as a reactor license requirement

An application for a reactor license must include the proposed method for disposal of spent fuel (Appendix J-2, Art. 23 viii).

B. Custody and licensing of spent fuel and its handling

1. Custody

The basic law requires a license for anyone possessing spent fuel (Appendix J-1, Art. 12), and the Regulation Law sets forth the conditions under which a person may receive it (Appendix J-2, Art. 61). The competent authority for regulation of nuclear fuel materials is the Nuclear Safety Bureau.

2. Transport including packaging

The basic law subjects transport of spent fuel to Government authority (Appendix J-1, Art. 10). The Regulation Law (Appendix J-2, Art. 59) provides that the regulations applicable depend upon the mode of transport. General transport standards are contained in orders of the Prime Minister (Appendix J-8, Sec. 5;

J-9, Sec. 2(12)), while transport by rail and light vehicles is by order of the Minister of Transportation (Appendix J-10, Sec. 18). Ship transport of spent fuel is governed by requirements of the Ships Safety Act (Appendix J-12, Sec. 28) and its implementing regulations (Appendix J-13, Secs. 87-91). There are also harbor laws regulating handling of hazardous materials such as spent fuel (Appendix J-14, Secs. 21-23; J-14, Secs. 12-14). During the study team's visit, industry officials stated that spent fuel transport laws are being revised, and the new draft is expected in early 1978.

As to standards for design and testing of transport containers for spent fuel, IAEA has published general revisions of its Regulations for the Safe Transport of Radioactive Materials. Based on the latest (1973) revision, the Japanese Atomic Energy Commission has published its own safety standards (Appendix J-16), which, while not law, provide guidance on container design.

Industry officials told the study team that for ship transport of spent fuel, the regulations governing ship and cask design are quite restrictive. Efforts to comply with them have resulted in project delays and high costs.

3. Storage license

a. At reactor

There are no special provisions governing storage at a reactor of spent fuel generated there. This activity is considered part of normal reactor operation. Therefore, storage and facilities for it are regulated by the laws governing reactor operation, and the operating license includes authority to store spent fuel.

b. Away from reactor

Japanese nuclear regulations do not specifically cover interim storage of spent fuel. There is a catch-all regulation on "use" of nuclear fuel material which apparently would govern spent fuel storage (Appendix J-2, Art. 52). Information required in an application for such a "user" license is specified, and includes purpose and method of use, kind and quantity of spent fuel, location of use, duration, and description of the facilities (id., Art. 52(2)). The applicant must also demonstrate his technical competence, and show that the facility is designed safely (id., Art. 53). Persons storing spent fuel must also comply with technical provisions of an Order of the Prime Minister (id., Art. 60).

4. Import requirements, including license

The basic law provides for Government regulations of import of spent fuel materials (Appendix J-1, Art. 12). Import of spent fuel, and any other use besides reprocessing, requires a license (Appendix J-8). The applicant must submit information similar to that required for a user license, as described in Sec. B(3)(b) above.

5. Export requirements, including license

A license is required for export of spent fuel. Information required in a license application is the same as that required for a used license, as set forth in Sec. B(3)(b) above.

C. Supplemental legal requirements

1. Radiation health and safety

The basic law provides that a separate law shall set forth regulations on protection against radiation hazards (Appendix J-1, Art. 20). That separate law, called the Prevention Law, provides detailed regulations to ensure public safety (Appendix J-3). There are special emergency merasures to be taken in case of accidents involving nuclear fuel materials (id., Art. 33; J-2, Art. 64), as well as special transportation standards (Appendix J-3, Sec. 18; J-11, Sec. 18).

Workers are protected against occupational radiation hazards by several ordinances of the Minister of Labor, and any person handling spent fuel must comply with them.

2. Safeguards and physical security

a. International agreements

Japan is a party to the Non-Proliferation Treaty (NPT), and to an IAEA safeguards agreement pursuant to it which entered into force in December 1977. Thus, Japan has accepted IAEA safeguards which apply to spent fuel during its storage and transport. While IAEA safeguards are in effect pursuant to this agreement, earlier trilateral safeguards agreements with Canada, U.K., and the U.S. are suspended (Appendix J-5, J-6, J-20).

b. Domestic requirements

One of the requirements for a license to use spent fuel (which includes its possession, transport, storage, import and export), is that the applicant demonstrate that it will not be used for nonpeac (Appendix J-2, Art. 53(i). There are no other major domestic safeguards provisions governing spent fuel.

3. Environmental requirements

Any radioactive waste generated by an interim storage facility cannot be disposed of without authorization from the Science and Technology Agency (Appendix J-3, Sec. 2). During its visit, the study team learned from industry officials that control over non-nuclear environmental effects is by local jurisdictions, not by the central government.

4. Third-party liability

Injury to persons or property from accidental criticality during spent fuel handling is covered by provisions of Japanese law. For an accident during storage, the person liable is the operator of the storage facility; for accidents during transport, it is the operator of the facility consigning the spent fuel elsewhere (Appendix J-17, Secs. 3, 4).

The operator, whose liability is not limited under Japanese law, must provide financial security to compensate injured persons (id., Sec. 6). The amount required is 1 billion Yen if the activity is transportation of spent fuel incidental to reactor or reprocessing operations (Appendix J-19, Sec. 3). This amount of security can be provided by insurance, or deposit of cash or securities, or by any equivalent method approved by the Science and Technology Agency (STA) (Appendix J-17, Secs. 8, 10).

If the operator chooses the insurance option, he must also pay a fee and enter into an indemnity agreement with STA which provides that STA will cover losses in excess of insurance limits (Appendix J-18, Secs. 2, 3, 17).

5. Reporting and inspection

Any person handling spent fuel must keep at his place of business records on its use (Appendix J-2) Art. 56-2). A spent fuel storage facility must undergo a Government inspection before it can be used (*id.*, Art. 55-2). The competent minister has the general authority to inspect spent fuel or its storage facilities at any time (*id.*, Art. 68).

6. Public participation

During our visit to Japan, industry officials indicated there would be considerable public opposition to a spent fuel facility, primarily by powerful Japanese fishermens' organizations. These disputes are usually negotiated and a cash settlement is reached. There is no provision for public hearings, however, on the issue of whether a spent fuel storage facility should be authorized.

3.JP.6 Views Regarding Alternative Spent Fuel Disposition Programs

(Pages 3JP-23 and 3JP-24 deleted)

3.RC Visit Findings - Republic of China (ROC)

3.RC.1 Introduction

3.RC.1.1 Organizations Visited

The Republic of China (ROC) organizations visited were: the Atomic Energy Council - Executive Yuan, the Taiwan Power Company, and the Institute of Nuclear Energy Research.

3.RC.1.2 Spent Fuel Disposition Highlights

Policies, Plans and Programs

The ROC has adopted an interim spent fuel storage program in deference to (a) global uncertainties with respect to "back-end" and nonproliferation decisions; (b) present lack of attractive reprocessing "terms and conditions" and (c) desire to be supportive of U.S. policies. This alternative is viewed as an acceptable solution for the next ten to twenty years.

The current ROC at-reactor-storage (ARS) densification program will satisfy spent fuel disposition needs until 1990. A decision regarding post-1990 disposition alternatives will have to be made by 1985 in order to support a timely implementation program.

Principal Concerns

The near-term concern is that a viable spent fuel disposition consensus is arrived at in the global scene which will allow the ROC to make their spent fuel disposition in 1985.

Principal ROC long range concerns are with respect to long term storage of spent fuel and relate to (a) economic uncertainties associated with potential uranium shortages over the long-term and (b) technical uncertainties associated with long-term storage of spent fuel.

Spent Fuel Disposition Profile

The following cumulative discharge profile reflects projected spent fuel generation for the ROC LWR reactor program.

Cumulative Discharge Profile (MTU)

Year	Firm	Projected	Total
1985	492	0	492
1990	1212	49	1261
2000	2652	1128	3780

The folowing cumulative away-from-reactor (AFR) spent fuel disposition profile is based on removing spent fuel from ARS only when a full core reserve (FCR) limit has been reached.

Cumulative AFR Profile (MTU)

Year	Firm	Projected	Total
1985	0	0	0
1990	57	0	57
2000	1145	426	1571

Views Regarding Alternative Spent Fuel Disposition Programs

(Deleted)

3.RC.2 Nuclear Power Profile

Energy demand in the Republic of China (ROC) is increasing due to the rapid economic development, the expanding scale of industry, and the rising standard of living. The increase was from 4,900,000 Kl of oil equivalent in 1960 to 17,000,000 Kl in 1974. The percentage of indigenous energy, primarily from coal, natural gas, and hydro power in the total supply declined, from 74% to 30% indicating an insufficient indigenous energy supply and a heavy dependence on imported energy.

The primary considerations for ROC power development decisions are (a) diversification (b) reliability (c) technical maturity (d) economics and (e) environmental. Based on these considerations, ROC has launched an aggressive nuclear power implementation program

Table 3.RC-1 describes the current ROC nuclear power program. Taiwan Power anticipates that the next increment of nuclear power generation (beyond the present firm reactors) will come on line in 1988.

Taiwan Power estimates that ROC nuclear generating capacity could reach 9.2 GW by year 1990 and 15.8 GW by year 2000, but recognizes that these projections are highly dependent on economic growth, governmental policy and overall nuclear power considerations. For the purposes of this study, it is projected that the total ROC nuclear power generating capacity will reach 7 GWe by 1980 and 12 GWe by 2000.

Table 3.RC-2 shows the profile for the presently perceived ROC nuclear program (firm) and anticipated future reactor growth (projected).

Table 3.RC-1: Nuclear Power Program - Republic of China

REACTOR	UTILITY	MWe	REACTOR TYPE	OPERATION DATE	STATUS
Chin-shan 1	Taiwan Power Company (TPC)	604	BWR	/77	O
Chin-shan 2	TPC	604	BWR	/78	C
Kuosheng 1	TPC	951	BWR	4/80	C
Kuosheng 2	TPC	951	BWR	4/81	C
Nuclear No. 5	TPC	907	PWR	4/83	C
Nuclear No. 6	TPC	907	PWR	4/84	C

O = Operational
C = Under Construction
P = In Planning

Table 3RC-2

NUCLEAR POWER GENERATING CAPACITY PROFILE — REP. OF CHINA-FCR

YEAR	GENERATING CAPACITY (MWE) FIRM	PROJECTED	TOTAL
1977	0.	0.	0.
1978	636.	0.	636.
1979	1272.	0.	1272.
1980	1272.	0.	1272.
1981	2257.	0.	2257.
1982	3242.	0.	3242.
1983	3242.	0.	3242.
1984	4193.	0.	4193.
1985	5144.	0.	5144.
1986	5144.	0.	5144.
1987	5144.	0.	5144.
1988	5144.	633.	5777.
1989	5144.	1267.	6411.
1990	5144.	1900.	7044.
1991	5144.	2400.	7544.
1992	5144.	2900.	8044.
1993	5144.	3400.	8544.
1994	5144.	3900.	9044.
1995	5144.	4400.	9544.
1996	5144.	4900.	10044.
1997	5144.	5400.	10544.
1998	5144.	5900.	11044.
1999	5144.	6400.	11544.
2000	5144.	6900.	12044.
2010	5144.	6900.	12044.
2020	5144.	6900.	12044.
2030	5144.	6900.	12044.

3.RC.3 Spent Fuel Disposition Policies, Plans and Programs

At present, the ROC has adopted an interim spent fuel storage policy pending the resolution of certain global fuel cycle uncertainties. Previously the ROC pursued a "closed" fuel cycle policy and planned to have their spent fuel reprocessed abroad and the separated plutonium sent to the U.S.

ROC adopted their present policy based on the following considerations:

1. The perceived economic benefits of LWR to be recycled, as opposed to the "once-through" cycle, are viewed as marginal particularly when considered against today's economic uncertainties associated with reprocessing.
2. The "terms and conditions" associated with currently available reprocessing service contracts are believed to be excessive. Several years ago, the ROC sought to purchase reprocessing services. Following competitive bidding by two commercial reprocessors, one was selected for further contract discussions. Discussions continued for some time and were finally suspended when it became obvious to the ROC that the climate for reprocessing was changing, and "terms and conditions" offered by the reprocessors were becoming increasingly severe.
3. The ROC is uncertain as to the outcome of critical global "back-end" fuel cycle and nuclear nonproliferation decisions and does not want to prematurely prejudice its long-term options.
4. The ROC wishes to be supportive of U.S. policies and looks to the U.S. for guidance in fuel cycle technology and policy directions.

The ROC, though favoring an interim storage policy, is skeptical about the realism of a long-term (over 20 years) storage policy. Major concerns with the latter policy are perceived to be as follows:

1. Resource scarcity over the long term argue for a means of recovering energy value from spent fuel.

2. Lack of an adequate body of knowledge regarding the acceptability of long term storage and disposition of unreprocessed spent fuel implies major uncertainties.

Taiwan Power Company is implementing the ROC interim spent fuel storage policy by increasing storage capacities for all reactor basins. The increased storage capacities will be achieved through fuel rack densification programs.

The ROC does not, in its current planning, intend to build an ROC centralized away-from-reactor (AFR) storage facility.

The ROC Institute of Nuclear Energy Research has a waste management program called the Lan-Yu project. The objectives of the Lan-Yu project are to provide a national repository for medium and low level radioactive solid and solidified liquid waste.* Although the project was scheduled to be completed in 1978, objections from the Bureau of Tourism against using the Lan-Yu Islet for radioactive waste storage have stalled project completion. Negotiations were in progress during October 1977 and, at that time, it was not possible to set a completion date for the project.

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* It should be noted that the specific intended use of the Lan-Yu complex is not for spent fuel energy.

3.RC.4 Spent Fuel Disposition Profiles

Operating Reactor Disposition Profile

Although none of the ROC reactors have become operational, the ROC has undertaken an at-reactor storage (ARS) densification program. A comparison of the densified capacity to the originally planned capacity is shown below:

------------------------MTU--------------------------

Reactor	Core Size	Original ARS Capacity	Present Planned Capacity
Chinshan 1	75	122	258
Chinshan 2	75	122	258
Kuosheng 1	114	228	434
Kuosheng 2	114	228	434
Maanshan 1	64	107	295
Maanshan 2	64	107	295

Based on present planning, Chinshan 1 will lose its Full Core Reserve (FCR) in 1987-88. However, since it will be possible to shuffle fuel (if necessary) to Chinshan 2 basin, the ROC believes that 1990 is the critical time wherein additional spent fuel disposition capacity must be available for the early ROC reactors. In order to support that eventuality, the ROC believes that 1985 is the cut-off date for resolving fuel disposition decisions supportive of 1990 actions.

Spent Fuel Reprocessing Arrangements

ROC has had considerable discussions - in the past - with various organizations concerning possible reprocessing services but has not consumated any arrangements.

Centralized AFR Storage

The ROC is not presently considering a centralized storage alternative.

Projected Spent Fuel Disposition Profiles

In order to provide a quantitative framework for evaluating spent fuel disposition requirements, the following exhibits are included:

Table 3.RC-3 summarizes the reactor and at-reactor storage characteristics associated with the currently defined Spanish nuclear power program. Correspondingly, Table 3.RC-4 summarizes the spent fuel generation and away-from-reactor (AFR) disposition requirements for the currently defined nuclear power program.

Table 3.RC-5 provides (a) the annual spent fuel generation profile and (b) the annual AFR disposition profile (based on a Full Core Reserve criteria) for both the currently defined reactor program (firm) and for anticipated future reactor additions (projected). Table 3.RC-6 provides cumulative information for the same categorization.

Tables 3.RC-7, 3.RC-8 and 3.RC-9 provide similar information for an at-reactor storage (ARS) criteria wherein five year or older spent fuel is shipped away from reactor beginning in 1985 - unless prior period spent fuel to ARS exceed FCR criteria (in which case spent fuel would be shipped away from reactor as soon as FCR limits were reached.

Technical Factors

As mentioned earlier, the ROC's major technical concerns regarding spent fuel disposition are as follows:

1. Feasibility of long-term storage of unreprocessed spent fuel
2. Terminal storage of spent fuel.

The ROC believes that Taiwan is technically unsuitable for geologic storage due to its geologic categorization as a "new land mass".

ROC spent fuel logistics considerations are as follows:

(1) All reactors have at least 125 ton crane capacity.

(2) Spent fuel would be handled over the road within the ROC. Cask weight limitations would likely be around 70 tons as governed by highway bridge loading limitations.

(3) 70 tons road casks capable of carrying 12 BWR/5 PWR assemblies would likely be used.

(4) Overseas cask shipment would be sent through two central harbors:

(a) Spent fuel from northern reactors would be sent to Keelung Harbor (approximately one hour travel time from any northern reactor)

(b) Spent fuel from southern reactors would be sent to Kaohsiung Harbor (approximately two hours travel time from any southern reactor).

(5) Cask turn-around time estimates provided by the ROC are as follows:

		Est. Hours
(a)	Load cask to trailor at ship	4
(b)	Road journey to reactor site	4
(c)	Clean and prepare cask to pond	8
(d)	Load fuel to cask	6
(e)	Cask out, decontamination and leak test	12
(f)	Road journey to ship	4
(g)	Load cask to ship	4
(h)	Contingency	6
	Total =	48

Table 3RC-3

REACTOR CHARACTERISTICS - REP. OF CHINA-FCR

FIRM REACTORS			MTU		
REACTOR	MWE	START UP	CORE SIZE	ANNUAL DISCHARGE	EFFECTIVE ARS
CHINSHAN1B	636	1978	75	20	183
CHINSHAN2B	636	1979	75	20	222
KUOSHENG1B	985	1981	114	30	320
KUOSHENG2B	985	1982	114	30	320
MAANSHAN1P	951	1984	64	22	231
MAANSHAN2P	951	1985	64	22	231
PROJECTED REACTORS			MWE	(MTU PER 1000 MWE)	
		1987-1990	1900.	26.	130.
		1990-2000	5000.	26.	130.

Table 3RC-4

FIRM REACTOR SPENT FUEL PROFILE — REP. OF CHINA-FCR

FACILITY	DIS START YEAR	ANN DIS	EFF ARS	BEG AFR YEAR	1985 DIS	1985 AFR	1990 DIS	1990 AFR	2000 DIS	2000 AFR	2030 DIS	2030 AFR
					CUMULATIVE (MTU)							
CHINSHAN1B	1979	20	183	1988	140.	0.	240.	57.	440.	257.	1040.	857.
CHINSHAN2B	1980	20	222	1991	120.	0.	220.	0.	420.	198.	1020.	798.
KUOSHENG1B	1982	30	320	1992	120.	0.	270.	0.	570.	250.	1470.	1150.
KUOSHENG2B	1983	30	320	1993	90.	0.	240.	0.	540.	220.	1440.	1120.
MAANSHAN1P	1985	22	231	1995	22.	0.	132.	0.	352.	121.	1012.	781.
MAANSHAN2P	1986	22	231	1996	0.	0.	110.	0.	330.	99.	990.	759.

Table 3RC-5

ANNUAL SPENT FUEL PROFILE — REP. OF CHINA-FCR

YEAR	ANNUAL DISCHARGE (MTU) FIRM	PROJECTED	TOTAL	ANNUAL AFR REQMT. (MTU) FIRM	PROJECTED	TOTAL
1977	0.	0.	0.	0.	0.	0.
1978	0.	0.	0.	0.	0.	0.
1979	20.	0.	20.	0.	0.	0.
1980	40.	0.	40.	0.	0.	0.
1981	40.	0.	40.	0.	0.	0.
1982	70.	0.	70.	0.	0.	0.
1983	100.	0.	100.	0.	0.	0.
1984	100.	0.	100.	0.	0.	0.
1985	122.	0.	122.	0.	0.	0.
1986	144.	0.	144.	0.	0.	0.
1987	144.	0.	144.	0.	0.	0.
1988	144.	0.	144.	17.	0.	17.
1989	144.	16.	160.	20.	0.	20.
1990	144.	33.	177.	20.	0.	20.
1991	144.	49.	193.	38.	0.	38.
1992	144.	62.	206.	50.	0.	50.
1993	144.	75.	219.	80.	0.	80.
1994	144.	88.	232.	100.	16.	116.
1995	144.	101.	245.	111.	33.	144.
1996	144.	114.	258.	133.	49.	182.
1997	144.	127.	271.	144.	62.	206.
1998	144.	140.	284.	144.	75.	219.
1999	144.	153.	297.	144.	88.	232.
2000	144.	166.	310.	144.	101.	245.
2010	144.	179.	323.	144.	179.	323.
2020	144.	179.	323.	144.	179.	323.
2030	144.	179.	323.	144.	179.	323.

Table 3RC-6

CUMULATIVE SPENT FUEL PROFILE —REP. OF CHINA-FCR

	CUM DISCHARGE (1000 MTU)			CUM AFR RQMT. (1000 MTU)		
YEAR	FIRM	PROJECTED	TOTAL	FIRM	PROJECTED	TOTAL
1977	0.000	0.000	0.000	0.000	0.000	0.000
1978	0.000	0.000	0.000	0.000	0.000	0.000
1979	.020	0.000	.020	0.000	0.000	0.000
1980	.060	0.000	.060	0.000	0.000	0.000
1981	.100	0.000	.100	0.000	0.000	0.000
1982	.170	0.000	.170	0.000	0.000	0.000
1983	.270	0.000	.270	0.000	0.000	0.000
1984	.370	0.000	.370	0.000	0.000	0.000
1985	.492	0.000	.492	0.000	0.000	0.000
1986	.636	0.000	.636	0.000	0.000	0.000
1987	.780	0.000	.780	0.000	0.000	0.000
1988	.924	0.000	.924	.017	0.000	.017
1989	1.068	.016	1.084	.037	0.000	.037
1990	1.212	.049	1.261	.057	0.000	.057
1991	1.356	.099	1.455	.095	0.000	.095
1992	1.500	.161	1.661	.145	0.000	.145
1993	1.644	.237	1.881	.225	0.000	.225
1994	1.788	.325	2.113	.325	.016	.341
1995	1.932	.426	2.358	.436	.049	.485
1996	2.076	.541	2.617	.569	.099	.668
1997	2.220	.668	2.888	.713	.161	.874
1998	2.364	.809	3.173	.857	.237	1.094
1999	2.508	.962	3.470	1.001	.325	1.326
2000	2.652	1.128	3.780	1.145	.426	1.571
2010	4.092	2.922	7.014	2.585	2.025	4.610
2020	5.532	4.716	10.248	4.025	3.819	7.844
2030	6.972	6.510	13.482	5.465	5.613	11.078

Table 3RC-7

FIRM REACTOR SPENT FUEL PROFILE — REP OF CHINA-5Y-1985

FACILITY	DIS START YEAR	ANN DIS	EFF ARS	BEG AFR YEAR	CUMULATIVE (MTU) 1985 DIS	1985 AFR	1990 DIS	1990 AFR	2000 DIS	2000 AFR	2030 DIS	2030 AFR
CHINSHAN1B	1979	20	120	1985	140.	20.	240.	120.	440.	320.	1040.	920.
CHINSHAN2B	1980	20	100	1985	120.	20.	220.	120.	420.	320.	1020.	920.
KUOSHENG1B	1982	30	150	1987	120.	0.	270.	120.	570.	420.	1470.	1320.
KUOSHENG2B	1983	30	150	1988	90.	0.	240.	90.	540.	390.	1440.	1290.
MAANSHAN1P	1985	22	110	1990	22.	0.	132.	22.	352.	242.	1012.	902.
MAANSHAN2P	1986	22	110	1991	0.	0.	110.	0.	330.	220.	990.	880.

Table 3RC-8

ANNUAL SPENT FUEL PROFILE -- REP OF CHINA-5Y-1985

	ANNUAL DISCHARGE	(MTU)		ANNUAL AFR REQMT.	(MTU)	
YEAR	FIRM	PROJECTED	TOTAL	FIRM	PROJECTED	TOTAL
1977	0.	0.	0.	0.	0.	0.
1978	0.	0.	0.	0.	0.	0.
1979	20.	0.	20.	0.	0.	0.
1980	40.	0.	40.	0.	0.	0.
1981	40.	0.	40.	0.	0.	0.
1982	70.	0.	70.	0.	0.	0.
1983	100.	0.	100.	0.	0.	0.
1984	100.	0.	100.	0.	0.	0.
1985	122.	0.	122.	40.	0.	40.
1986	144.	0.	144.	40.	0.	40.
1987	144.	0.	144.	70.	0.	70.
1988	144.	0.	144.	100.	0.	100.
1989	144.	16.	160.	100.	0.	100.
1990	144.	33.	177.	122.	0.	122.
1991	144.	49.	193.	144.	0.	144.
1992	144.	62.	206.	144.	0.	144.
1993	144.	75.	219.	144.	0.	144.
1994	144.	88.	232.	144.	16.	160.
1995	144.	101.	245.	144.	33.	177.
1996	144.	114.	258.	144.	49.	193.
1997	144.	127.	271.	144.	62.	206.
1998	144.	140.	284.	144.	75.	219.
1999	144.	153.	297.	144.	88.	232.
2000	144.	166.	310.	144.	101.	245.
2010	144.	179.	323.	144.	179.	323.
2020	144.	179.	323.	144.	179.	323.
2030	144.	179.	323.	144.	179.	323.

Table 3RC-9

CUMULATIVE SPENT FUEL PROFILE.--REP OF CHINA-5Y-1985

YEAR	CUM DISCHARGE (1000 MTU) FIRM	PROJECTED	TOTAL	CUM AFR RQMT. (1000 MTU) FIRM	PROJECTED	TOTAL
1977	0.000	0.000	0.000	0.000	0.000	0.000
1978	0.000	0.000	0.000	0.000	0.000	0.000
1979	.020	0.000	.020	0.000	0.000	0.000
1980	.060	0.000	.060	0.000	0.000	0.000
1981	.100	0.000	.100	0.000	0.000	0.000
1982	.170	0.000	.170	0.000	0.000	0.000
1983	.270	0.000	.270	0.000	0.000	0.000
1984	.370	0.000	.370	0.000	0.000	0.000
1985	.492	0.000	.492	.040	0.000	.040
1986	.636	0.000	.636	.080	0.000	.080
1987	.780	0.000	.780	.150	0.000	.150
1988	.924	0.000	.924	.250	0.000	.250
1989	1.068	.016	1.084	.350	0.000	.350
1990	1.212	.049	1.261	.472	0.000	.472
1991	1.356	.099	1.455	.616	0.000	.616
1992	1.500	.161	1.661	.760	0.000	.760
1993	1.644	.237	1.881	.904	0.000	.904
1994	1.788	.325	2.113	1.048	.016	1.064
1995	1.932	.426	2.358	1.192	.049	1.241
1996	2.076	.541	2.617	1.336	.099	1.435
1997	2.220	.668	2.888	1.480	.161	1.641
1998	2.364	.809	3.173	1.624	.237	1.861
1999	2.508	.962	3.470	1.768	.325	2.093
2000	2.652	1.128	3.780	1.912	.426	2.338
2010	4.092	2.922	7.014	3.352	2.025	5.377
2020	5.532	4.716	10.248	4.792	3.819	8.611
2030	6.972	6.510	13.482	6.232	5.613	11.845

3.RC.5 Legal and Regulatory Factors

A. Reactor requirements on spent fuel

1. Minimum holding period at reactor

No legal regulation governs, but sources with the Republic of China (ROC) Atomic Energy Council (CAEC) indicate an informal minimum requirement of one year for cooling and radioactive decay of spent fuel.

2. Storage capacity at reactor

Similar to the situation with minimum holding period, there is no written regulation, but CAEC sources note an informal minimum capacity of two full cores, depending on reactor design.

3. Disposition plans for spent fuel as a reactor license requirement

There is currently no requirement, and CAEC and industry officials say none is imminent.

B. Custody and licensing of spent fuel and its handling

1. Custody

The usual requirement that a license is necessary to possess fuel does not appear in the law of the ROC. However, storage requires CAEC approval, as explained in Sec. B (3) following, and utilization of nuclear fuel materials, including spent fuel, requires CAEC approval (Appendix CH-6, Art. 22).

2. Transport including packaging

The ROC has a three-tier legal framework governing spent fuel transport by rail, road and sea. Packaging regulations follow those of the International Atomic Energy Agency (IAEA).

General principles in the basic atomic energy law head the three-tier framework, requiring that transport and storage of nuclear fuel materials be according to CAEC regulations, and that CAEC must inspect these activities (Appendix CH-6, Art. 22 IV). Enforcement rules for the basic law comprise the middle tier (Appendix CH-9, CH-10, Arts. 22-32), and govern transport of "special nuclear material" in a gram quantity that appears to cover even one spent fuel bundle (Appendix CH-10, Art. 5). Activities not covered by these rules are governed by the bottom tier, Safety Rules for Transport of Radioactive Materials (Appendix CH-8; CH-10, Art. 22). CAEC sources indicate the latter document, while not translated into English, is direct from IAEA Safety Series #6 of similar title, Rev. 2 of 1964.

Details of the middle tier regulations are of most interest. They require CAEC approval of spent fuel transport, after the applicant has submitted a transport plan (id., Art. 23), proposing the most direct route possible (id., Art. 28). Road and rail transport have detailed requirements at Arts. 24 and 25 respectively, including compliance with the "Transport Schemes" (not defined) of the military and police along the route. Both modes have detailed safeguards and physical protection rules discussed in Section C(2) following. Road transport is favored, rail transport discouraged (Appendix CH-10, Art. 25). Carriage by road must comply with IAEA regulations (Appendix CH-8, CH-10, Art. 24(3)), and with highway load limits, different for each road, plus related permit requirements. A license is required for any movement of spent fuell off-site, CAEC officials confirm.

For carriage of spent fuel by sea, the transport scheme must comply with the approved transport plan (not defined) of the port authorities, and military and police transport officials (Appendix CH-10, Art. 26). Separation of the spent fuel into a sealed, locked compartment, with guard, is required (id., 26(1)). On arrival, ROC law requires immediate delivery under guard of the spent fuel (id., 26(2)), but for delivery in a foreign country, foreign law would govern.

Turning finally to packaging and cask design requirements, sources at CAEC say these follow IAEA guidelines, (Appendix CH-8) which are less stringent than U.S. criteria.

3. Storage license

a. At reactor

The basic law specifically requires that storage of nuclear fuel materials, which include spent fuel, comply with CAEC regulations (Appendix CH-9, CH-10). These, in turn, provide three classifications of areas related to the storage of the fuel materials (Appendix CH-10, Art. 29). Special requirements govern how the storage building shall be constructed, and specify how access shall be controlled (id., Arts. 29, 30). CAEC sources indicate storage at reactor for any period is authorized by the reactor operating license.

b. Away from reactor

The regulations described above apply to both at reactor storage and storage away from the reactor, without distinction. CAEC sources say a separate license is required for storage in the ROC away from the reactor.

4. Import requirements, including license

Import of nuclear material, such as spent fuel, requires approval of CAEC (Appendix CH-6, Art. 22 V).

5. Export requirements, including license

Export of spent fuel requires approval from CAEC (Appendix CH-6, Art. 22 V). Enforcement regulations of the basic law apply to spent fuel export (Appendix CH-10, Art. 22), and they require exporters to submit a plan covering transport and physical protection for CAEC approval (id., Art. 23).

Agreements between the ROC and the U.S. provide certain U.S. control of spent fuel. No special nuclear material produced through fuel provided the ROC by U.S. suppliers may be transferred to the jurisdiction of any other Government without approval of the U.S. (Appendix CH-12, Art. II(3), CH-11 Art. X(3)). Hence, shipment of spent fuel from the ROC to any country other than the U.S., would require U.S. consent.

C. Supplemental legal requirements

1. Radiation health and safety

The basic law sets the guiding principle, that to ensure health and safety, the CAEC shall propose specific regulations to the Executive Yuan (legislature). (Appendix CH-6, Art. 24). The standards enacted (Appendix CH-14), are in Chinese only. Being direct from the International Council on Radiation Protection (ICRP), according to CAEC sources, they need no translation. Other relevant details of the basic law require manual laborers (such as spent fuel handlers) to receive radiation protection training and to be licensed by CAEC (Appendix CH-6, Art. 26 III), and mandate that relevant records be retained for any future CAEC investigation.

On board ship, the laws of the ship's country of registry apply. Thus, ROC health and safety regulations apply if a ROC-flag vessel carries the fuel.

2. Safeguards and physical security

a. International agreements

ROC is a signatory to the Non-Proliferation Treaty. While not a member of the IAEA, ROC applies IAEA safeguards. The ROC has also guaranteed that it will apply U.S. safeguards, unless suspended (as at present) in favor of those of IAEA (Appendix CH-11, Art. X(1), XI(B)). CAEC officials confirm ROC's intention to comply with IAEA agreements and regulatory guidance notwithstanding that ROC is no longer an IAEA member.

b. Domestic requirements

For the primary mode, road transport, detailed provisions cover speed of the convoy and driver rest (Appendix CH-10, Art. 24(1)), escort vehicles, arms and communciations (id., (2)), and traffic control (id. (4)). Similarly for rail transport, special trains are required (id., Art. 25(1)), as is coordination with the Railroad Authority and police (id., (2), (3)) and immediate delivery without storage at the destination (id., (4)). If there should be any temporary storage, areas for it must be rigidly controlled (Appendix CH-10, Art. 29, 30). Inventory of the spent fuel must be checked periodically (id., Art. 31(5)), and damaged or stolen material reported immediately to CAEC (id., Art. 32).

In case of carriage of spent fuel by ship, responsibility for applying safeguards shifts from facility owner to carrier at the time the cask is hoisted from the dock onto the ship, according to sources at Taiwan Power Company.

4. Third-party liability

The coverage applies inside the territory of the ROC, including its waters to 12 miles offshore (Appendix CH-7). For any incident in this area from spent fuel being transported to a foreign country from a nuclear installation in the ROC, the nuclear installation operator who is consignor of the fuel is liable (Appendix CH-7, Art. 13 (d)). An exception is made in the event of storage of spent fuel incidental to transport when an agreement specifies the custodian is liable (id., Art. 3).

The limit of coverage is "70 million silver dollars" plus interest and litigation costs (id., Art. 23). This liability should be covered by insurance (id., Art. 24), and policy covering transport accidents cannot be terminated (id., Art. 25). A government indemnity agreement for damages in excess of insurance coverage is not required, but can be arranged (id., Art. 21), and any excess needed will be loaned by the Government (id., Art. 26).

A few typical exceptions apply (id., Arts. 17, 20(a)) including damage to transport equipment (id., Art. 20(b). The U.S. is exonerated by treaty from liability for damage from U.S.-supplied fuel (Appendix CH-12, Art. II(f). In addition, the ROC has signed (May 21, 1963) the Vienna Convention on third-party liability. However, the Convention has not yet entered into force, lacking the required number of states ratifying.

ROC law applies within ROC territorial waters. On the high seas, there is no treaty or other agreement covering injury to third parties from an incident involving spent fuel.

5. Reporting and inspection

Periodic reports on use of spent fuel must be submitted to CAEC , which must inspect spent fuel transport and storage activities and facilities (Appendix CH-6, Arts, 21 V and 23 VIII).

Inspection and reporting requirements on specific related subjects are discussed in the sections dealing with that subject, e.g., health and safety and physical security. Transfer of special fissiel material such as spent fuel from the ROC to the U.S. requires notice to IAEA (Appendix CH-4, §9(b) (ii)). There is a similar requirement in case of transfer to anyone not under the jurisdiction of either of these Governments (id., §5), as in the case of sending spent fuel to a non-U.S. international storage facility.

6. Public participation

There is no provision in the laws of the ROC for public participation in licensing of spent fuel handling or storage.

3.RC.6 Views Regarding Alternative Spent Fuel Disposition Programs

(Pages 3RC-25 and 3RC-26 deleted)

3.KR Visit Findings - Korea

3.KR 1 Introduction

3.KR.1.1 Organizations Visited

The Korean organizations visited were: the Ministry of Science and Technology - Atomic Energy Bureau; the Korea Electric Company, the Korea Atomic Energy Research Institute; and the Korea Nuclear Engineering Services, Inc.

3.KR.1.2 Spent Fuel Disposition Highlights

Policies, Plans and Programs

Korea is expanding at-reactor-storage capacities to accommodate discharged fuel up to the year 2000 if required. They see no requirement for centralized national storage. Korea has no permanent storage plans or programs. The basic policy has been toward reprocessing, principally looking toward international solutions.

Principal Concerns

Korea has no internal requirement to move precipitously toward any particular spent fuel proposal.

Spent Fuel Disposition Profile

The following cumulative discharge profile reflects anticipated spent fuel generation for the committed Spanish LWR reactor program (firm) and anticipated future Spanish LWR reactor program (projected).

Cumulative Discharge Profile (MTU)

Year	Firm	Projected	Total
1985	128	0	128
1990	288	135	423
2000	608	1513	2121

The following cumulative away-from-reactor (AFR) spent fuel disposition profile is based on removing spent fuel from ARS only when a full core reserve (AFR) limit has been reached.

Cumulative AFR Profile (MTU)

Year	Firm	Projected	Total
1985	0	0	0
1990	0	0	0
2000	235	629	S64

Views Regarding Alternative Spent Fuel Disposition Programs

(Deleted)

3.KR.2 Nuclear Power Profile

The energy profile of the Republic of Korea (ROK) illustrates a considerable dependence on imported fuels, principally oil. The nation's rapidly expanding economy required 154.8 million barrels of imported oil in 1977 and will require an estimated 233.7 million barrels by 1981. Since electric energy demand has risen 17.2 percent annually between 1972 and 1976 and promises to rise at an expected rate of 14.7 percent, Korea has placed great emphasis on the development of nuclear energy. Korea's first nuclear plant (564 MWe) is now in the testing phase and should go critical in early 1978.

Table 3.KR-1 summarizes the present Korean nuclear power program. The projected total Korean nuclear power generating capacity will reach 2.4 GWe by 1985, 4 GWe by 1990 and 10 GWe by 2000.

TABLE 3.KR-1: NUCLEAR POWER PROGRAM - REPUBLIC OF KOREA

REACTOR (Korea)	UTILITY	MWe	REACTOR TYPE	OPERATION DATE	STATUS
Ko-Ri 1	Korea Electric Company	564	PWR	11/77	C
Wolsung 1		605	PWR	11/82	C
Ko-Ri 2		629	PHWR	4/82	C

O=Operational
C=Under Construction
P=In Planning

Table 3KR-2

NUCLEAR POWER GENERATING CAPACITY PROFILE — REP.OF KOREA-FCR

YEAR	GENERATING CAPACITY (MWE) FIRM	PROJECTED	TOTAL
1977	0.	0.	0.
1978	595.	0.	595.
1979	595.	0.	595.
1980	595.	0.	595.
1981	595.	0.	595.
1982	595.	0.	595.
1983	595.	0.	595.
1984	1245.	0.	1245.
1985	1245.	0.	1245.
1986	1245.	520.	1765.
1987	1245.	1040.	2285.
1988	1245.	1560.	2805.
1989	1245.	2080.	3325.
1990	1245.	2600.	3845.
1991	1245.	3200.	4445.
1992	1245.	3800.	5045.
1993	1245.	4400.	5645.
1994	1245.	5000.	6245.
1995	1245.	5600.	6845.
1996	1245.	6200.	7445.
1997	1245.	6800.	8045.
1998	1245.	7400.	8645.
1999	1245.	8000.	9245.
2000	1245.	8600.	9845.
2010	1245.	8600.	9845.
2020	1245.	8600.	9845.
2030	1245.	8600.	9845.

3.KR 3 Spent Fuel Disposition Policies, Plans and Programs

The basic thrust of the ROK spent fuel policy, as explained by the Atomic Energy Bureau (AEB) of the Ministry of Science and Technology (MOST), is towards reprocessing, both domestic and multinational. Since the planned at-reactor-storage capacity of the Korea Electricity Company (KECO) can hold discharged fuel up to the year 2000 (with spent fuel relocated among reactors), the government does not see a need to precipitously move toward AFR solutions, unless those solutions favor the ROK long-term interest. The AEB believes that U.S. policy is an important factor for ROK planning and characterizes Korean planning as waiting for U.S. and free world thinking on nuclear proliferation and associated fuel cycle planning to stabilize. The AEB saw such planning to be in a state of flux, but was unable to predict when U.S. and world policies would stabilize.

Immediately prior to the GSFL study team's meeting with MOST officials, a press release announced the U.S. policy on spent fuel. The study team explained to the MOST officials the contents of the policy and the latter declined to comment pending the opportunity to reflect on the information. The MOST officials did express concern, however, that the U.S. might be proposing to take title to other entities' spent fuel while simultaneously charging a fee. They pointed out that, logiscally, they have no need to respond quickly to the offer.

The ROK has no permanent storage plans or programs and is waiting for U.S. leadership in that area. The planned at-reactor-storage, however, is being expanded for PWR reactors such that the initial plant, KORI 1, will have planned storage capacity until 1993 and will maintain full core reserve also. The storage expansion is being designed by Korea Nuclear Engineering Services, Inc. (KNE), an organization associated with the Korea Atomic Energy Research Institute. KNE has recommended to MOST and KECO that, based on current KNE evaluation of PWR performance, full core reserve storage be maintained. By shuffling spent fuel between reactors, the presently planned at-reactor-storage could hold spent fuel discharged up to the year 2000. The CANDU reactor has a 10-year storage capacity.

3.KR.4 Spent Fuel Disposition Profile

Operating Reactor Disposition Profiles

Although neither KM 1 nor KM 2 have begun operations, the ROK is planning* to implement an at-reactor-storage (ARS) expansion program which, for KM 1, is projected to be completed in 1979. The present plans - as compared to prior ARS plans - is shown below:

Reactor	Core Size (MTU)	Original ARS Capacity (MTU)	Present Planned ARS Capacity (MTU)
KM 1	56	75	336
KM 2	56	75	150

In both cases it was indicated that additional ARS expansion is possible.

Reprocessing Arrangements

No LWR reprocessing arrangements have been made or contemplated as of October 1977.

Centralized AFR Storage

The ROK is not considering a national AFR storage alternative.

Projected Spent Fuel Disposition Profiles

In order to provide a quantitative framework for evaluating spent fuel disposition requirements, the following exhibits are included:

Table 3.KR-3 summarizes the reactor and at-reactor-storage characteristics associated with the currently defined Korean nuclear power program. Correspondingly, Table 3.KR-4 summarizes the spent fuel generation and

*Design was to have been completed by December 1977 and "go-ahead" was dependent on approval by MOST and KECO.

away-from-reactor (AFR) disposition requirements for the currently defined nuclear power program.

Table 3.KR-5 provides (a) the annual spent fuel generation profile and (b) the annual AFR disposition profile (based on a Full Core Reserve criteria) for both the currently defined reactor program (firm) and for anticipated future reactor additions (projected). Table 3.KR-6 provides cumulative information for the same categorization.

Table 3.KR-7, 3.KR-8 and 3.KR-9 provides similar information for an at-reactor-storage (ARS) criteria wherein five year or older spent fuel is shipped away from the reactor beginning in 1985 - unless prior period spent fuel to ARS exceed FCR criteria (in which case spent fuel would be shipped away from reactor as soon as FCR limits were reached).

Technical Factors

At present there is no design provisions for shipping spent fuel away from reactor; however both KM1 and 2 have road, rail and water (barge) access. It is probable that, for international shipment, spent fuel would be sent from the KM reactors overland to Pusan harbor (about 25 miles from the reactor station).

Table 3KR-3

REACTOR CHARACTERISTICS - REP.OF KOREA-FCR

FIRM REACTORS

				——MTU——		
REACTOR		MWE	START UP	CORE SIZE	ANNUAL DISCHARGE	EFFECTIVE ARS
KORI-1	P	595	1978	56	16	280
KORI-2	P	650	1984	56	16	93

PROJECTED REACTORS

	MWE	(MTU PER 1000 MWE)	
1985-1990	2600.	26.	130.
1990-2000	6000.	28.	130.

Table 3KR-4

FIRM REACTOR SPENT FUEL PROFILE — REP.OF KOREA-FCR

FACILITY		DIS START YEAR	ANN DIS	EFF ARS	BEG AFR YEAR	1985 DIS	1985 AFR	1990 DIS	1990 AFR	2000 DIS	2000 AFR	2030 DIS	2030 AFR
KORI-1	P	1979	16	280	1996	112.	0.	192.	0.	352.	72.	832.	552.
KORI-2	P	1985	16	93	1990	16.	0.	96.	3.	256.	163.	736.	643.

CUMULATIVE (MTU)

Table 3KR-5

ANNUAL SPENT FUEL PROFILE — REP.OF KOREA-FCR

YEAR	ANNUAL DISCHARGE (MTU) FIRM	PROJECTED	TOTAL	ANNUAL AFR REQMT. (MTU) FIRM	PROJECTED	TOTAL
1977	0.	0.	0.	0.	0.	0.
1978	0.	0.	0.	0.	0.	0.
1979	16.	0.	16.	0.	0.	0.
1980	16.	0.	16.	0.	0.	0.
1981	16.	0.	16.	0.	0.	0.
1982	16.	0.	16.	0.	0.	0.
1983	16.	0.	16.	0.	0.	0.
1984	16.	0.	16.	0.	0.	0.
1985	32.	0.	32.	0.	0.	0.
1986	32.	0.	32.	0.	0.	0.
1987	32.	14.	46.	0.	0.	0.
1988	32.	27.	59.	0.	0.	0.
1989	32.	41.	73.	0.	0.	0.
1990	32.	54.	86.	3.	0.	3.
1991	32.	68.	100.	16.	0.	16.
1992	32.	83.	115.	16.	14.	30.
1993	32.	99.	131.	16.	27.	43.
1994	32.	114.	146.	16.	41.	57.
1995	32.	130.	162.	16.	54.	70.
1996	32.	146.	178.	24.	68.	92.
1997	32.	161.	193.	32.	83.	115.
1998	32.	177.	209.	32.	99.	131.
1999	32.	192.	224.	32.	114.	146.
2000	32.	208.	240.	32.	130.	162.
2010	32.	224.	256.	32.	224.	256.
2020	32.	224.	256.	32.	224.	256.
2030	32.	224.	256.	32.	224.	256.

Table 3KR-6

CUMULATIVE SPENT FUEL PROFILE —REP.OF KOREA-FCR

YEAR	CUM DISCHARGE (1000 MTU) FIRM	PROJECTED	TOTAL	CUM AFR RQMT. (1000 MTU) FIRM	PROJECTED	TOTAL
1977	0.000	0.000	0.000	0.000	0.000	0.000
1978	0.000	0.000	0.000	0.000	0.000	0.000
1979	.016	0.000	.016	0.000	0.000	0.000
1980	.032	0.000	.032	0.000	0.000	0.000
1981	.048	0.000	.048	0.000	0.000	0.000
1982	.064	0.000	.064	0.000	0.000	0.000
1983	.080	0.000	.080	0.000	0.000	0.000
1984	.096	0.000	.096	0.000	0.000	0.000
1985	.128	0.000	.128	0.000	0.000	0.000
1986	.160	0.000	.160	0.000	0.000	0.000
1987	.192	.014	.206	0.000	0.000	0.000
1988	.224	.041	.265	0.000	0.000	0.000
1989	.256	.081	.337	0.000	0.000	0.000
1990	.288	.135	.423	.003	0.000	.003
1991	.320	.203	.523	.019	0.000	.019
1992	.352	.286	.638	.035	.014	.049
1993	.384	.385	.769	.051	.041	.092
1994	.416	.499	.915	.067	.081	.148
1995	.448	.629	1.077	.083	.135	.218
1996	.480	.775	1.255	.107	.203	.310
1997	.512	.936	1.448	.139	.286	.425
1998	.544	1.113	1.657	.171	.385	.556
1999	.576	1.305	1.881	.203	.499	.702
2000	.608	1.513	2.121	.235	.629	.864
2010	.928	3.749	4.677	.555	2.631	3.186
2020	1.248	5.985	7.233	.875	4.867	5.742
2030	1.568	8.221	9.789	1.195	7.103	8.298

Table 3KR-7

FIRM REACTOR SPENT FUEL PROFILE — REP.OF KOREA-5Y-1985

FACILITY		DIS START YEAR	ANN DIS	EFF ARS	BEG AFR YEAR	CUMULATIVE (MTU) 1985 DIS	1985 AFR	1990 DIS	1990 AFR	2000 DIS	2000 AFR	2030 DIS	2030 AFR
KORI-1	P	1979	16	96	1985	112.	16.	192.	96.	352.	256.	832.	736.
KORI-2	P	1985	16	80	1990	16.	0.	96.	16.	256.	176.	736.	656.

Table 3KR-8

ANNUAL SPENT FUEL PROFILE — REP.OF KOREA-5Y-1985

YEAR	ANNUAL DISCHARGE (MTU) FIRM	PROJECTED	TOTAL	ANNUAL AFR REQMT. (MTU) FIRM	PROJECTED	TOTAL
1977	0.	0.	0.	0.	0.	0.
1978	0.	0.	0.	0.	0.	0.
1979	16.	0.	16.	0.	0.	0.
1980	16.	0.	16.	0.	0.	0.
1981	16.	0.	16.	0.	0.	0.
1982	16.	0.	16.	0.	0.	0.
1983	16.	0.	16.	0.	0.	0.
1984	16.	0.	16.	0.	0.	0.
1985	32.	0.	32.	16.	0.	16.
1986	32.	0.	32.	16.	0.	16.
1987	32.	14.	46.	16.	0.	16.
1988	32.	27.	59.	16.	0.	16.
1989	32.	41.	73.	16.	0.	16.
1990	32.	54.	86.	32.	0.	32.
1991	32.	68.	100.	32.	0.	32.
1992	32.	83.	115.	32.	14.	46.
1993	32.	99.	131.	32.	27.	59.
1994	32.	114.	146.	32.	41.	73.
1995	32.	130.	162.	32.	54.	86.
1996	32.	146.	178.	32.	68.	100.
1997	32.	161.	193.	32.	83.	115.
1998	32.	177.	209.	32.	99.	131.
1999	32.	192.	224.	32.	114.	146.
2000	32.	208.	240.	32.	130.	162.
2010	32.	224.	256.	32.	224.	256.
2020	32.	224.	256.	32.	224.	256.
2030	32.	224.	256.	32.	224.	256.

Table 3KR-9

CUMULATIVE SPENT FUEL PROFILE —REP.OF KOREA-5Y-1985

YEAR	CUM DISCHARGE (1000 MTU) FIRM	PROJECTED	TOTAL	CUM AFR RQMT. (1000 MTU) FIRM	PROJECTED	TOTAL
1977	0.000	0.000	0.000	0.000	0.000	0.000
1978	0.000	0.000	0.000	0.000	0.000	0.000
1979	.016	0.000	.016	0.000	0.000	0.000
1980	.032	0.000	.032	0.000	0.000	0.000
1981	.048	0.000	.048	0.000	0.000	0.000
1982	.064	0.000	.064	0.000	0.000	0.000
1983	.080	0.000	.080	0.000	0.000	0.000
1984	.096	0.000	.096	0.000	0.000	0.000
1985	.128	0.000	.128	.016	0.000	.016
1986	.160	0.000	.160	.032	0.000	.032
1987	.192	.014	.206	.048	0.000	.048
1988	.224	.041	.265	.064	0.000	.064
1989	.256	.081	.337	.080	0.000	.080
1990	.288	.135	.423	.112	0.000	.112
1991	.320	.203	.523	.144	0.000	.144
1992	.352	.286	.638	.176	.014	.190
1993	.384	.385	.769	.208	.041	.249
1994	.416	.499	.915	.240	.081	.321
1995	.448	.629	1.077	.272	.135	.407
1996	.480	.775	1.255	.304	.203	.507
1997	.512	.936	1.448	.336	.286	.622
1998	.544	1.113	1.657	.368	.385	.753
1999	.576	1.305	1.881	.400	.499	.899
2000	.608	1.513	2.121	.432	.629	1.061
2010	.928	3.749	4.677	.752	2.631	3.383
2020	1.248	5.985	7.233	1.072	4.867	5.939
2030	1.568	8.221	9.789	1.392	7.103	8.495

3.KR.5 Legal and Regulatory Factors

A. Reactor requirements on spent fuel

1. Minimum holding period at reactors

No formal regulations establishing holding periods have been found.

2. Storage capacity at reactor

Regulations of the Republic of Korea (ROK) state only that equipment for storing spent fuel must be of "sufficient storage capacity" but no total capacity or margin is defined (Appendix K-11, Art. 15(4)). Also, storage facility details must appear in an application for a reactor license (Appendix K-12, Art. 3(1)(5)(b)).

B. Custody and licensing of spent fuel and its handling

1. Custody

In Korea, the basic law requires that a license be obtained from the Minister of Science and Technology (MOST) for any handling of spent fuel, and for each person involved in handling. The act of handling is defined broadly and includes acquisition, production, import, export, possession, purchase or sale, control or management, or other acts of handling spent fuel (Appendix K-13, Art. 18(1)). A separate Decree specifies contents of a license application, which must include applicant's name and address; purpose; proposed method of handling; type of fissionable material and quantity; time and place of handling; and location, structure, and equipment to be used (Appendix K-9, Art. 4(1)). The applicant must also demonstrate his technical and financial capability.

Persons who actually handle the spent fuel material require a separate license (Appendix K-13, Art. 28), and the minimum age is 18 years (id., Art. 26).

2. Transport including packaging

There is little law governing transport except the requirement that accidental criticality be avoided (Appendix K-11, Art. 32(1)(1)), that the container be suitable (id., Art. 32(1)), and that a license be obtained as described in Sec. B(1) above. The container regulations are written in some detail however. Containers must be tightly sealed, unbreakable, heat-resistant, and tagged to indicate composition and quantity of contents (Appendix K-11, Arts. 16, 32). No container testing is specified, and such as that required in the U.S. by e.g. dropping, puncturing, heating and immersion. Container radiation must be less than 200 mrem/hr. at the surface and 10 mrem/hr. 1 meter away (id., Art. 16(6)).

3. Storage license

a. At reactor

As explained in Sec. B(1) above, a license is required for handling spent fuel, which includes possessing it or storing it. A power reactor license would include necessary authority for storage at the reactor of spent fuel from the same reactor.

b. Away from reactor

The license described in Sec. B(1) above would be required. However, storage in the ROK of spent fuel from other Pacific Basin countries does not appear to be a possible option at this time.

4. Import requirements, including license

Again in this instance, the license described in Sec. B(1) is specifically required. However, as discussed in Sec. B(3)(b), storage in the ROK of spent fuel from other countries is not expected.

5. Export requirements, including license

For export of spent fuel, a license from MOST is required (Appendix K-13, Art. 18(1)). Application requires the information specified in Sec. B(1) above (Appendix K-9, Arts. 4(1), 5(1)(2)).

C. Supplemental legal requirements

1. Radiation health and safety

Health and safety is protected by the basic Atomic Energy Law (Appendix K-13), which requires fullest safeguards against hazards to humans during handling of spent fuel (id., Art. 23, repeated in K-12, Art. 17(3)). Persons handling spent fuel are required to have their own safety rules, which must be approved by MOST (Appendix K-12, Art. 20; K-9, Art. 20(2)). A licensed senior handler (see Sec. B(1) on custody) must be on hand to supervise operations (Appendix K-9, Art. 18(2)) and assure that no employee receives radiation doses in excess of prescribed limits (Appendix K-11, Art. 29(1)(1)). If an accident occurs in spent fuel handling, the party responsible for handling is required to notify MOST or the local police (Appendix K-12, Art. 26(1); K-9, Art. 21(1)). Special clothing is required for handlers (Appendix K-11, Art. 32(4)).

The person responsible for handling spent fuel must appoint as supervisor of operations, a person who holds a senior radiation handler's license or is a senior reactor operator. In addition, the responsible person is required to report this appointment to MOST (K-9, Art. 17(1)).

2. Safeguards and physical security

a. International agreements

The ROK has subscribed to a number of international safeguards agreements, supervised by the

International Atomic Energy Agency (IAEA), as follows:

- The Non-Proliferation Treaty (NPT)
- An agreement with IAEA to apply NPT safeguards (Appendix K-15), as amended
- Trilateral agreements with IAEA and supplier state, including the U.S. (Appendix K-2 amended by K-3) and France (Appendix K-1).

While the safeguards provisions of the U.S. agreements have been suspended during IAEA authority (Appendix K-2,3), no such arrangement exists with Canada, which seeks to apply safeguards more strict than IAEA (Appendix K-14). The National system of safeguards and International Cooperation Directorate was established in 1976 within MOST. The Directorate verifies proper application of safeguards including nuclear material accounting in the ROK as required by Art. 7 of the ROK-IAEA agreement (Appendix K-15).

3. Environmental requirements

There is a Pollution Prevention Law (Appendix K-16) and associated regulations which must be observed. They set standards for air and water pollution, and require a permit for a facility such as one used to store spent fuel.

4. Third-party liability

For transport of spent fuel, the law requires financial security to compensate third-parties injured in case of a possible nuclear incident. Territorial scope of these provisions is not stated, so it is believed to be the territorial limits of ROK, i.e., the land mass and territorial waters.

The term "nuclear service operator" (NSO) means one who has a permit to use fissionable material, including spent fuel (Appendix K-7, Art. 2(3)(3)). The person liable for any injury during transit is the NSO who is the consignor of the spent fuel, unless he and other persons, such as the carrier, contract otherwise (id., Art. 3). This liability regime applies only to third-parties injured, i.e., persons other than the NSO who is consignor and consignee. Excluded from required coverage are the NSO responsible for transport and his employees (id., Art. 2(2)).

An NSO cannot handle spent fuel without financial security (Appendix K-17, 5(1)), which usually takes the form of insurance plus an indemnity agreement with MOST (id., 5(2)). If he is operating a reactor, an NSO's financial security must be 3 billion Won, while if the NSO merely transports spent fuel to off-site areas, 100 million Won is sufficient (Appendix K-6, Arts. 3(1), 3(9)). Therefore, his insurance and indemnity agreement must each be in this amount, and they require his payment of appropriate premiums or fees.

An indemnity agreement for transport of spent fuel requires an application which states the route, mode of transport, dates, kind and quantity of fissionable materials, and information on insurance obtained (Appendix K-4, Art. 6(5)).

5. Reporting and inspection

MOST may require reports by the spent fuel handler on inventory of fissionable materials and status of management of radiation hazards (K-9, Art. 23); the agency may also inspect the handler's place of business and the fuel itself (id.).

6. Public participation

There is no provision for public participation in the licensing of spent fuel storage or transport. A citizen has the right to sue the government if it acts illegally, but this provision is seldom used.

7. Other relevant considerations

Equipment used to handle spent fuel is required to be of proper size, and to be designed to prevent criticality or damage to the fuel (Appendix K-11, Art. 16). Details are not available on what is "proper size."

The Government of ROK may expropriate spent fuel, but reasonable compensation is required to be paid (K-13, Art. 10(1)).

Injury to persons or other improper use of spent fuel is a criminal offense (Appendix K-13, Art. 33(1)).

3.KR.6 Views Regarding Alternative Spent Fuel Disposition Programs

(Pages 3KR-23 and 3KR-24 deleted)

3.CN Visit Findings - Canada

3.CN.1 Introduction

3.CN.1.1 Organizations Visited

The Canadian organizations visited were: Atomic Energy of Canada, Ltd. (AECL) and the Atomic Energy Control Board (AECB). Ontario Hydro, the electrical utility with the largest commitment to nuclear power in Canada was not visited, but will be at a later date.

3.CN.1.2 Spent Fuel Disposition Highlights

Background

Canadian spent fuel disposition policies and programs stand, in many respects, in marked contrast to those of other countries with substantial nuclear power programs. These differences are a consequence of Canada's development and adoption of the heavy water moderated, natural uranium fueled reactor (CANDU), whose fuel cycle characteristics strongly favor the use of a once-through fuel cycle. As a result, in contrast to the presumption of reprocessing and recycle which accompanied the adoption of the light water reactor system by most other nations, Canada envisaged from the outset of its nuclear power program the extended, if not indefinite, storage of spent fuel. This fact has led to the accumulation of a considerable body of experience and analysis on once-through fuel cycles and extended spent fuel storage, which, despite significant differences in CANDU and LWR fuel characteristics (Table 1), is of obvious interest and relevance to consideration of extended spent fuel storage for LWR's.

Current Policies, Plans and Programs

The attractiveness of once-through fuel cycles for the CANDU reactor system arises from several unique characteristics of the fuel cycle. These are:

- Due to the use of heavy water as a moderator, uranium utilization efficiency of the CANDU system is higher than for LWR's, and enrichment is unnecessary. The resultant lower fuel cycle costs reduce incentives for recovery of energy values from CANDU spent fuel in comparison with the LWR fuel cycle.

- Since CANDU fuel is unenriched and burn-up (and corresponding plutonium production) per cycle is low, the fissionable material concentration for CANDU spent fuel is much lower than for LWR fuel. This means that the margin for economic gain from spent fuel recovery (energy value of spent fuel less recovery cost) is much less than for LWR fuel. For a large range of realistic uranium and plutonium values and recovery costs, including present values for these factors, recovery of energy values is clearly uneconomical.

Despite these factors, there are considerations which, in the view of Canadian officials, could make energy recovery from CANDU fuel more attractive in the future. These considerations include:

- Although CANDU spent fuel is dilute in plutonium contents as a result of the low burn-up per cycle, total plutonium per unit of reactor capacity is nearly twice as high for the CANDU as for the LWR. Use of this plutonium in a recycle mode in CANDU reactors of current design would reduce natural uranium requirements by a factor of two, at the same time approximately doubling burn-up, with consequent reduction of fuel fabrication costs.

- While the amount of spent fuel generated by the CANDU reactor with a once-through fuel cycle is some four times higher than for the LWR, the cost of recovering energy values would probably not increase in direct proportion, since the fact that CANDU spent fuel is more dilute in both fission products and plutonium should be reflected in somewhat lower unit recovery costs.

- Use of plutonium to produce U-233 in the CANDU reactor, followed by initiation of a U-233/thorium cycle would permit further reductions in uranium requirements, or even a self-sustaining U-233/thorium cycle in CANDU reactors of present design.

The economic attractiveness of these alternate fuel cycles for the CANDU reactor is dependent on uranium prices, recovery costs, and plutonium fabrication penalties. As noted previously, at present values for these variables, energy recovery from CANDU fuel is uneconomical. This situation could be reversed in the future, particularly if uranium prices increase sufficiently.

The foregoing considerations have led Canada to adopt a spent fuel disposition policy designated by Canadian officials as "secure, retrievable storage" until recovery or other disposition is determined to be in the national interest. While economic factors, as indicated above, will play a role in this decision, there is clear recognition and appreciation of the non proliferation implications of reprocessing on the part of Canadian officials, which, on the basis of longstanding Canadian policy, can be expected to play a major role in any ultimate decision on spent fuel disposition. Despite the possibility of future recovery, analysis and development work on spent fuel storage is based on a storage period of 50 years, with recognition that longer periods from the approach taken by any other country so far to the poblem of spent fuel disposition.

While Canadian policy contemplates what is clearly extended and perhaps indefinite storage of spent fuel, Canadian officials do not regard either the current storage practices, or those under consideration, as an acceptable means of permanent waste disposal. Both current and contemplated storage techniques, while regarded secure for long periods, depend on institutional continuity for their ultimate long-term security. One official described as the ieal but so far unrealized approach that of "retrievable disposal," implying a system in which spent fuel was deposited in a manner in which no further surveillance was necessary, but from which retrieval was nevertheless possible.

Ownership of spent fuel and responsibility for its secure, retrievable storage is vested in the utility firms which generate the material. While these firms operate on a commercial basis, they are without exception provincial Crown corporations, a factor of some importance in the Canadian view that they possess the necessary assurance of continuity to assume a long-term responsibility for spent fuel storage. However, Canadian officials feel that there is an underlying Federal responsibility for assuring secure storage, which could be asserted in the unlikely event of a breakdown in utility or provincial government performance with respect to spent fuel storage.

There is a strong realization on the part of Canadian officials that the policy of secure, retrievable storage is one which is vulnerable to the criticism that it allows the continued generation of spent fuel without the demonstrated capacity to dispose permanently of the resultant nuclear waste. In their view, the policy is nevertheless an acceptable one provided there is continued progress at an adequate rate toward the development and demonstration of ultimate disposal methods, and they do not foresee a cut-off in Canadian nuclear power plant licensing, as has occurred in some other countries, as a result of public or governmental concern over the absence of a demonstrated permanent disposal capacity.

Current and Projected Storage Systems

In Canada, as elsewhere, interim spent fuel storage capacity has been provided at reactor sites. In the earliest design philosophy for CANDU, in recognition of the once-through fuel cycle, reactor site storage capacity corresponding to the full reactor lifetime discharge of spent fuel was contemplated, but this philosophy later shifted to one of several years storage at reactors, followed by transfer of spent fuel to a central storage facility. This modification in approach has taken place principally at the initiative of the utilities, which bear responsibility for fuel storage. The change is said to be based on economic and operational considerations, and Canadian regulatory officials indicate that they would still have no objection to full reactor lifetime storage capacity located at reactor sites, provided this storage is properly engineered. Nevertheless, there appears to be an intuitive preference for avoiding the accumulation of large amounts of spent fuel at widely dispersed locations, and for its concentration at one, or a small number, of acceptable locations. As indicated later, siting criteria would favor, but not require, suitability for permanent disposal, as well as for storage, at some locations.

Pending creation of a centralized storage facility, the spent fuel capacity provided at reactor sites has varied, but is typically in the range of 5-10 years. At Pickering, Ontario, the first site for full-scale CANDU reactors, five years storage was initially provided for the four units (Pickering "A") but this is now being supplemented by the construction of ten years additional capacity, sufficient to last until 1985, when the central storage site is scheduled to be completed. Provision of sufficient reactor storage to cover requirements until 1985 is expected to be the pattern in the future, although a minimum of five years interim storage at reactor sites will probably be maintained.

The characteristics of CANDU reactor fuel, including absence of any criticality hazard (criticality can be achieved only in heavy water) and low specific heat generation, make extremely dense storage feasible, and storage ponds have been designed to take advantage of these facts from the outset. Consequently, densification of spent fuel storage ponds, as is being done at a number of LWR's, is inapplicable to CANDU reactors, and on-site spent fuel storage capacity can be increased only by construction of new ponds, as is now being done at Pickering "A". This is not, however, regarded as a particularly difficult operation.

Alternative Storage Systems

Active development work is now in progress to establish the nature of the central spent fuel storage system which is noted earlier is scheduled for 1985 completion (Table II). Three approaches have survived the initial screening of a large number of possibilities. One of these, wet storage in ponds, is essentially an extension of existing reactor site storage technology to a central facility. It is regarded as an "active" system, since operations must be conducted to assure water circulation and quality. The remaining two approaches both involve dry storage with air cooling and are viewed as "passive" systems. One of these systems involves the stacking of fuel in vertical columns within large concrete chambers provided with an upper and lower manifold, so that convection can be established. The final approach involves placement of fuel within reinforced concrete canisters, each 5 meters high by 2.5 meters diameter and containing 4.4 metric tons of fuel colled for 5 years. These in turn are spaced outdoors on a gravel pad. The active fuel is in a steel can surrounded by lead to promote heat transfer to the concrete, and final cooling of the concrete is by natural air flow. Conductive heat transfer through the concrete, which is probably aided to some degree by steel reinforcing beams , is the limiting factor on the efficiency of this system.

The wet storage approach has the advantages of being based on well-understood existing practice, and a minimum surface area requirement of the two "passive" approaches, the canister method is further advanced, and apparently preferred. Three canisters, one electrically heated, and two fuel loaded have been built and are in use with three years experience having been accumulated with a loaded canister. Cost estimates indicate surprisingly little difference between three approaches, with each contributing approximately 0.10 mill/kwh to the cost of nuclear power. Of this, approximately half represents the cost of transportation of spent fuel to the storage site, on the assumption of a 600 mile average transport distance. Surface area requirements show the expected variation, with wet storage involving minimum area, the dry convection approach intermediate, and the canister approach the largest. However, even in the latter case, surface area requirements (including an exclusive area) are modest, ranging from 0.10 sq pu for pool storage to 1.4 sq pu for canisters for the storage of fuel from 125,000MWe of CANDU reactor capacity, the projected figure for the year 2000. (Table III) Under Canadian conditions of land value, this requirement is insignificant. In fact, as Canadian officials have noted, land requirements for spent fuel storage are so small as to involve no appreciable contribution to the cost of nuclear power, even when very high land values, such as those prevalent in industrialized zones of Japan, are assumed.

Of the three approaches outlined above, the wet storage and canister systems are regarded as being the most attractive, with the choice between them being difficult to forecast. Since economic differences are insignificant, the selection is likely to be based on other considerations. Intuitively, there appears to be a preference for the canister approach, which has the appearance of being more secure and less dependent on institutional performance, and is likely for these reasons to be more acceptable to the public.

The applicability of the canister system to LWR fuel is open to question, since the specific heat generation of LWR fuel is four times higher, and the geometry is much different. On the basis of the crude assumption that LWR fuel loading per canister would have to be reduced by a factor of four, the difference is specific heat generation, with a corresponding increase in storage cost per kwh of electricity generated, storage costs by this technique would represent a sizeable increase in LWR fuel cycle costs. Some of this difference could be overcome by longer wet storage before transfer of spent fuel to canister or other dry storage methods. Specific heat generation is reduced by about 50% between 5 and 10 years of storage, but declines much more slowly thereafter.

Siting Criteria

No site has been selected yet for the Canadian central storage facility, but there is a consensus that the facility should be located in Ontario, the province with by far the largest commitment to nuclear power. It is assumed that spent fuel from other provinces (at present besides Ontario, only Quebec and New Brunswick are operating or building nuclear power plants) will be shipped to the storage site in Ontario.

There is, as noted, a distinct preference for a site which will be suitable both for storage and ultimate disposal. There is an assumption that if reprocessing in some form intervenes between storage and disposal, it would be colocated with them, and that a site suitable for both of the former operations would also be suitable for the latter.

Canadian thinking has been in the direction of permanent disposal in "Plutons". These are extremely large, geologically very old, high integrity monolithic inclusions. These structures are numerous and widely distributed in the Canadian shield, including many areas remote from population centers, and Canadian officials foresee no difficulty in finding a suitable site. They concede, however, that public opposition will be a problem and has already blocked a proposed exploratory drilling program. The site is most likely to be in the sparsely populated northern region, perhaps in the vicinity of uranium mining where the population is already somewhat aware of the basic facts concerning radiation.

There is an awareness that site selection is the most sensitive step in the central storage program, and the one most likely to delay the proposed schedule.

Regulatory and Public Acceptance Considerations

Design and construction of safe central waste storage facilities is not viewed as a particularly difficult goal. There is a school of thought that such facilities should be underground, (as is being considered in Sweden), but no requirement to this effect is foreseen. Physical security - specifically, protection against sabotage - is viewed as an important consideration.

The Atomic Energy Control Board is in the process of preparing a number of "licensing guides" on various nuclear facilities, and one is being readied on engineered spent fuel storage. Initial publication is expected in about April 1978.

Licensing of nuclear installations, including fuel storage, in Canada is a Federal responsibility. However, in light of Canada's Federal System, extremely close consultations with provincial authorities is the rule, and licensing a facility as central spent fuel storage over provincial objections is not a practical possibility.

International Storage Potential

Canada has apparently given little or no consideration to the possible storage in Canada of spent fuel from CANDU reactors, much less other reactors located abroad. Canadian bilateral policy is to require Canadian approval of any reprocessing of CANDU fuel by its overseas customers, but there are no provisions requiring return of spent fuel, and the assumption has been that it will remain in the country of origin. There was no apparent concern on the part of the Canadian officials visited that the accumulation of CANDU spent fuel in other countries represented a proliferation hazard, so long as reprocessing is controlled by Canada.

For the present, CANDU reactors are being built only in Argentina and Korea. Reactors were built earlier in Pakistan and India, but took place under old arrangements, and these countries, as is well known, are no longer receiving Canadian nuclear assistance.

In addition to reactors, Canada is a major exporter of natural uranium for enrichment and use in LWR's. The principal end users at present are the U.S., the U.K., and Japan. Canada has a policy of acquiring reprocessing approval rights (or "consultation") with respect to such exported material, but no concern is felt over the storage of the resulting spent fuel.

(Deleted)

Table 1

Typical Spent Fuel Characteristics
(once-through cycles)

	CANDU	LWR
Fuel Discharged, tons/GW yr.	174	--
Initial Enrichment, % U-235	0.7	.3
Burn Up Per Cycle, MWD, T	7,500	28-30,000
Enrichment at Discharge, % &-235	0.22	--
Plutonium Content at Discharge, G/T fissile,	2,700	
Non-fissile,	1,100	
Total	3,800	
Per Production $\frac{N}{}$G/GW yr.	--	--
Heat Production (5 years cooling), watts/kg.	.38	--
(10 years cooling)	.22	

Table II

Proposed Schedule for Control
Spent Fuel Storage Facility

Activity	Year
Evaluation Concept	Underway
Public Participation	1969-1979
Design	1979-1981
Site Approval	1981
Construction License	1982
Operating License	1985

Table III

Comparison of Retrievable Storage Concepts

Type	Storage[1] Area, Km^2	Total[2] Site Area, Km^2	Capital[3] $/kg U	Operating $/kg U	Shipping,[4] $/kg	Total $/kg U	Total Mills/kwh
Pools (wet)	0.11	2.36	1.95	2.34	3.19	7.48	0.12
Canisters (dry)	1.4	5.76	0.78	2.95	3.19	6.92	0.11
Convection vaults (dry)	0.21	2.79	0.87	1.76	3.19	5.82	0.09

1. Based on installed capacity of 133,000 MWe in year 2000; 125,000 +U.
2. Includes 600 meter exclusion boundary.
3. All costs in 1975 Candian dollars.
4. Shipping assumes average 600 mile one-way shipping distance.

(Pages 3BE-1 thru 3BE-3 deleted)

Finland

Nuclear Power Profile

Finland is highly deficient in fossil fuels, importing both coal, principally from Poland, and oil, principally from the Soviet Union. Only peat is available in significant quantity and some peat is burned in thermal power plants. Hydro power contributes about 1/3 of the total electric generation, but significant expansion is impractical. Electric power generation capacity of 10,000 MWe in 1980 corresponds to 2.0 Kr per capita, making Finland among the most intensive consumer's of electricity of electric power in the world on a per capita basis. In addition to domestic generation, a substantial amount of power - 20% in 1975 - is imported from Sweden. Although the growth rate of 9% per year between 1960 and 1973 was stagnant in 1974-1975, renewed growth is now taking place.

Given this background, Finland has placed a high priority on nuclear power. Two Soviet built plants, rated at 420 MWe were the first to be pruchased, and the first unit is now in operation at 90% power or more. Two 660 MWe BWR's of Swedish manufacture are under construction, with the first scheduled for commercial operation by the end of 1978. Three additional plants, in the range of 800-1000 MWe, may be required during the period 1985-1990, and a decision in principal has been made to construct one of these plants. There is a possibility that the next nuclear plant may be used for both electrcity production and district heating in the Helsinki Metropolitan area.

Spent Fuel Disposition Policies, Plans, and Programs

No quantitative information is available on spent fuel storage capacity at either the Sovisa site (Soviet reactors) or the Olkiluoto site (Swedish reactors). However, normal Soviet policy of supplying fabricated fuel elements, and requiring the return of spent fuel to the Soviet Union is applicable to these units. (This Soviet policy is not applied to the export of enriched uranium to Western Europe, the arrangements for which place no restrictions on use, other than peaceful use under safeguards, as required by the NPT). Enrichment services for the two Swedish built units are to be supplied by the United States under the U.S.-Finnish Bilateral

Agreement of April 8, 1970, which makes any reprocessing subject to U.S. approval. Finland is a party to the NPT and has been a strong and consistent supporter of effective non proliferation measures. This background suggests that Finland could have a positive interest in international or multinational arrangements for the storage of spent fuel elements from the Okliluoto units.

Views Regarding Alternative Spent Fuel Disposition Programs

No information is available on Finnish views regarding spent fuel disposition alternatives.

Spent Fuel Discharge Information

Assuming that scheduled completion dates for Olkiluoto Units 1 and 2 of the 1978 and 1980, respectively, are met and that a 1000 MW unit is placed in commercial operation in 1986, the following approximate spent fuel discharge schedule may assumed.

Year	MTU
1979	14
1980	44
1981	44
1982	60
1983	60
1984	60
1985	60
1986	60
1987	60
1988	96
1989	96
1990 and beyond	96

INDIA

Nuclear Power Profile

The Tarapur Power Station - two 190 MWe BWR plants supplied by General Electric - went into operation in 1970. The U.S. is supplying fuel, and the plant is under IAEA safeguards.

The Rajasthan Power Station (RAPP-I) - is a 200 MWe CANDU reactor built in cooperation with Canada which went into operation in 1973. RAPP-II - a similar unit - is scheduled for operation in 1978, but the project is having difficulty because of a shortage of heavy water.

The Madras Power Station consists of two CANDU reactors, each 200 MWe. The start-up dates are uncertain, partly as a result of Canada's suspension of assistance to the project.

The Narora Power Station is planned for two units of 235 MWe each and an additional 500 MWe unit later. These are CANDU type plants and the start-up dates are uncertain.

The Tarapur Fuel Reprocessing Plant can handle both LWR oxide and natural uranium (CANDU) fuel, with a capacity of 100 tons per year. IAEA safeguards would apply with Tarapur fuel was being reprocessed. The U.S. agreement provides controls over India reprocessing U.S. fuel.

Spent Fuel Disposition Policies, Plans and Programs

The information available in Washington, D.C. covered only the U.S. supplied reactor, Tarapur.

The combined ARS for Tarapur has a current capacity of 624 fuel assemblies. The U.S. is suggesting that the ARS be expanded to 724 elements in 1978, 1012 elements in 1979 and 2052 elements in 1981. The U.S. liaison team believes this would hold Tarapur fuel through 1988. The Indians will make their expansion decisions (high density poison racks) in 1979.

Reprocessing at Tarapur would require U.S. agreement.

Spent Fuel Discharge Information

Tarapur Reactor (I and II combined) only:

Spent fuel in combined ARS - 571 assemblies

Spent fuel discharge to ARS

Year	Annual	Cumulative
pre-1978	571	571
1978	70	641
1979	150	791
1980 and thereafter	170	960
		etc.

Philippines

Nuclear Power Profile

With its nearly total dependence on imported oil as a source of commercial energy, the Philippines developed an early interest in application of nuclear power to meet a portion of its energy requirements. Philippine petroleum imports in 1976 reached $1 billion, a third of its total imports, and a major contributor to its balance of trade deficit. An overall energy growth of 10% per year during the period 1960-1973 is expected to continue virtually undiminished for the next decade, despite the drastic oil price increases of 1973-1974.

The Philippines' first nuclear power project, a 620 MW PWR being built by Westinghouse for the National Power Corporation now under construction at Bagac on Luzon, is scheduled for commercial operation in the third quarter of 1982. Construction of the project is four months ahead of schedule. Construction of a planned second unit at the same site was deferred due to the unavailability of Export-Import Bank financing, but excavation work for this unit was undertaken at the same time as for Unit 1. Unit 2 was originally scheduled for completion in 1986, but this schedule is now uncertain.

An ambitious schedule of nuclear power plant construction, involving 9 plants totalling 7700 MW by the end of the century, has been described, but the firmness of these projects is questionable.

Spent Fuel Disposition Policies, Plans and Programs

Uranium enrichment services for the Philippine nuclear power program are provided to the Philippines under a U.S.-Philippine Agreement for cooperation signed June 13, 1968, which provides for the long-term enrichment requirements for two projects totalling 1000 MW. The agreement contains a provision, Article IX which calls for reprocessing to take place, at U.S.

discretion, in either U.S. facilities or facilities acceptable to the United States. Spent fuel storage capacity at Unit 1, originally designed for 2 1/2 cores is already being updated to 4 1/3 cores through densification, corresponding to more than 12 years of reactor discharges. The storage capacity of the pool now being installed cannot be further increased.

The Philippines are a party to the NPT, and generally support non proliferation policies and programs, although they have taken an active role in criticizing the expense of IAEA safeguards and have advocated that nuclear weapons states bear all safeguard costs. While there is no authoritative statement of Philippine policy on spent nuclear fuel disposition, it is understood that Philippine preference had been to return spent fuel to the U.S. or elsewhere for reprocessing. However, the expansion of the pool storage capacity reflects a recognition of the changing circumstances relating to reprocessing, and removes the pressure for transfers of spent fuel from the reactor site from some time to come. No information is available on Philippine views regarding alternative spent fuel disposition approaches.

Spent Fuel Discharge Information

The Bagac reactors each will contain 215 elements with a uranium content of approximately 48 metric tons. Based on projected reactor completion schedules, of 1983 for unit No. 1 and 1986 for unit No. 2, spent fuel discharges for Philippine nuclear plants completed before 1990 are estimated as follows:

Year	Assemblies	Quantity Metric Tonnes
1985	70	16
1986	70	16
1987	70	16
1988	70	16
1989	140	32
1990	140	32
1991	140	32

Yugoslavia

Nuclear Power Profile

Yugoslavia is building a Westinghouse supplied PWR (632 MWe) - NE Krsko - with a base load operational date of mid-1980. Feasibility studies are underway to support the planning of a second nuclear power plant in the 900 MWe range with a start up date in 1983-83. There is general thinking that a third and possibly fourth large plant would be in operation or construction by the mid-1990's.

Spent Fuel Disposition Policies, Plans and Programs

NW Krsko presently has a one and one-third core ARS capacity. Under consideration is a plan to densify the ARS to increase the capacity to three and one-third core size.

The long-term approach is not firm. The Yugoslavs have indicated they would not require reprocessing until the mid-1990's, by which time they would have three to four nuclear plants operating.

An estimate of their future plans includes the possibility of an AFR adjacent to an existing nuclear power plant, although there are no published plans on an AFR program.

Views Regarding Alternative Spent Fuel Disposition Programs

It is understood that the Yugoslavs support the U.S. proliferation policy but disagree with the implementation mode. They are INFCE participants.

The study effort has no information on the Yugoslav posture regarding alternatives.

Spent Fuel Discharge Information

The inital loading of NE Krsko is 49.7 MTU. Considering an approximate one-third core discharge, 16.57 MTU would be dischaged annualy. With the present ARS - and assuming FCR -

the NE Krsko pool would lose FCR in 1981. Assuming the expansion of the ARS to three and one-third core, the NE Krsko pool would lose FCR in 1987.

Based on the arbitrary (for study purposes) assumptions of the second plant in operation in 1984, the third plant (at 900 MWe) in 1990, and a fourth plant (at 900 MWe) in 1995, the projections of spent fuel discharge are as follows:

YEAR	MTU
1981	16.5
1982	16.5
1983	16.5
1984	16.5
1985	39.5
1986	39.5
1987	39.5
1988	39.5
1989	39.5
1990	39.5
1991	62.5
1992	62.5
1993	62.5
1994	62.5
1995	62.5
1996	85.5
1997	85.5
1998	85.5
1999	85.5
2000	85.5

4.0 Objectives of U.S. Spent Fuel Policy

4.1 Introduction

In describing the flow of the analysis of the country findings, it is desirable to outline the process of both Chapters 4 and 5 at one time. Chapters 4 and 5 are designed to begin with the data developed through the trip findings and related research, and yield one or more high-probability-of-success strategies for further detailed analysis.

Visit Findings and Related Data → [Chapters 4 and 5] → Strategies for Detailed Analysis

In selecting a logical approach for Chapters 4 and 5, it is immediately recognized that there are both a large number of possible strategies but also a large number of constraints which render many of these strategies impossible to implement. The approach to the logical analysis is therefore to do considerable prescreening to arrive at a limited number of feasible strategies. Then, analyze the difficulties of these strategies and select a few (those having good chances of being successfuly implemented) for detailed analysis at a future time.

The overall logic flow is shown schematically in Exhibit 4-1, and described below:

> The analysis is divided into two major parts: Chapter 4, Objectives of U.S. Policy and Chapter 5, Evaluation and Strategy Formulation. Chapter 4 lays out a hierarchy of U.S. objectives. First developed is a set of Worldwide Objectives of U.S. International Spent Fuel Policy, which serves as a set of working assumptions, i.e., premises for the analysis to come later. The material represents an assumption for purposes of

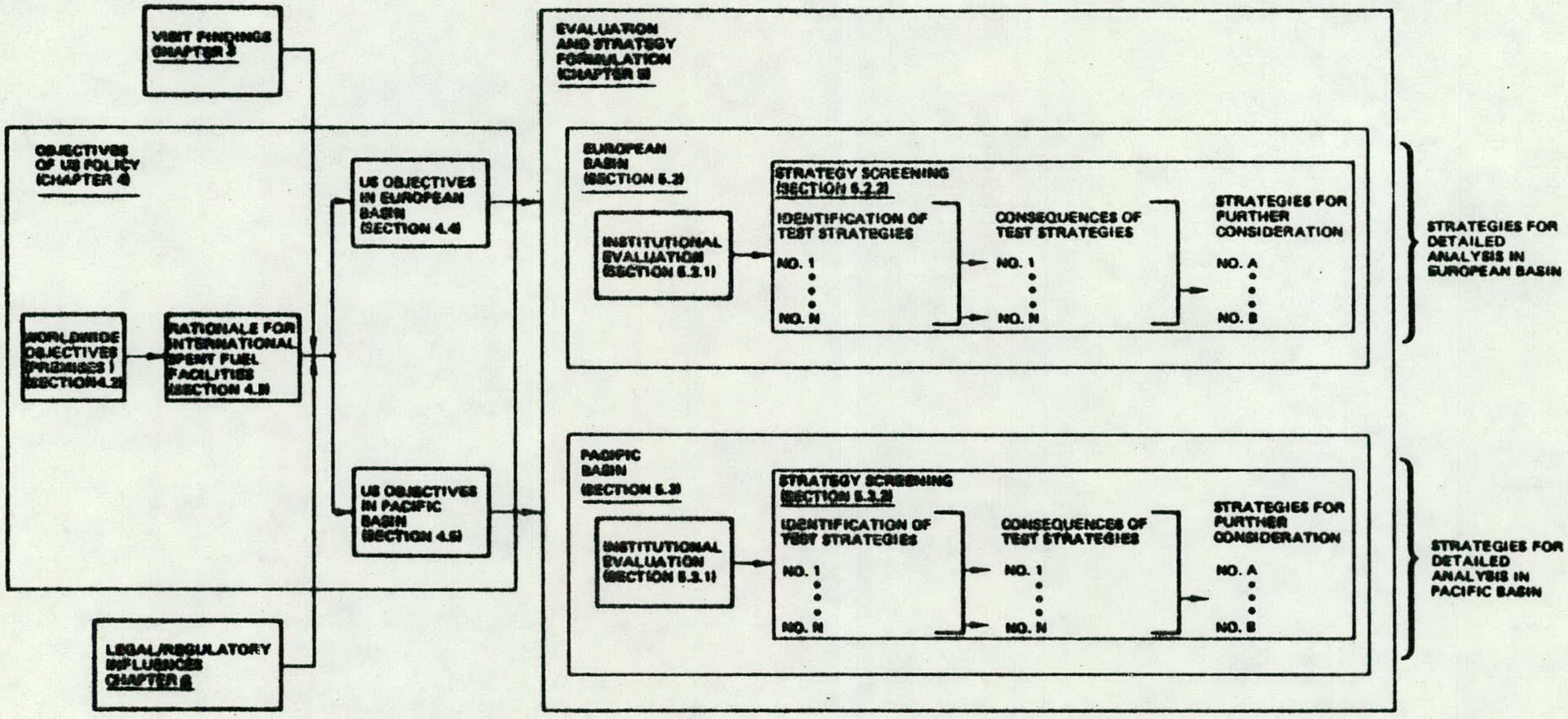


Figure 4.1: Logic Flow of Interim Report — Volume 2

this study, based on existing information.

The general objectives of U.S. worldwide policy, imply specific objectives in particular regions. These specific objectives are derived from the overall objective in light of general information about the particular region to which it applies. For purposes of this study, these objectives are focused as U.S. Objectives in Europe and U.S. Objectives in the Pacific and are formulated in the light of specific information about the individual nation's spent fuel disposition situations, capabilities, problems and priorities discussed in Chapter 2. These objectives are best viewed as working assumptions.

The evaluation and strategy development process of this study draws on imputed non-proliferation values of international or multi-national arrangements in dealing with spent fuel management. A discussion of the rationale of international or multi-national spent fuel facilities is included in Chapter 4 in support of the definition of specific U.S. objectives in particular regions.

Chapter 5, Evaluation and Strategy Formulation begins by extracting salient characteristics of each country from the visit findings, and using them to form a preliminary judgment as to national receptivities toward U.S. worldwide and regional objectives. These national salient characteristics and receptivities are then compared within each basin to search for commonalities which might form the basis for transnational arrangements.

On the basis of this preliminary evaluation, a strategy screening is conducted in three parts: First, formulation of "test strategies" in each basin. The test strategies are based on a judgement that there is a reasonable chance that a possible implementation arrangement may exist, and will serve U.S. objectives in the region. Second, each test strategy is screened for likely institutional (and to some extent technical) implications and potential feasibility. This is done principally by testing the strategy against the specific U.S. objective in each region. Finally, as a result of this testing, the most viable strategies are selected for more detailed, future analysis.

U.S. objectives for the region are used both to formulate test strategies and screen the strategies. The test strategies which are rated high for potentially successful implementation survive the procedure to receive more detailed treatment.

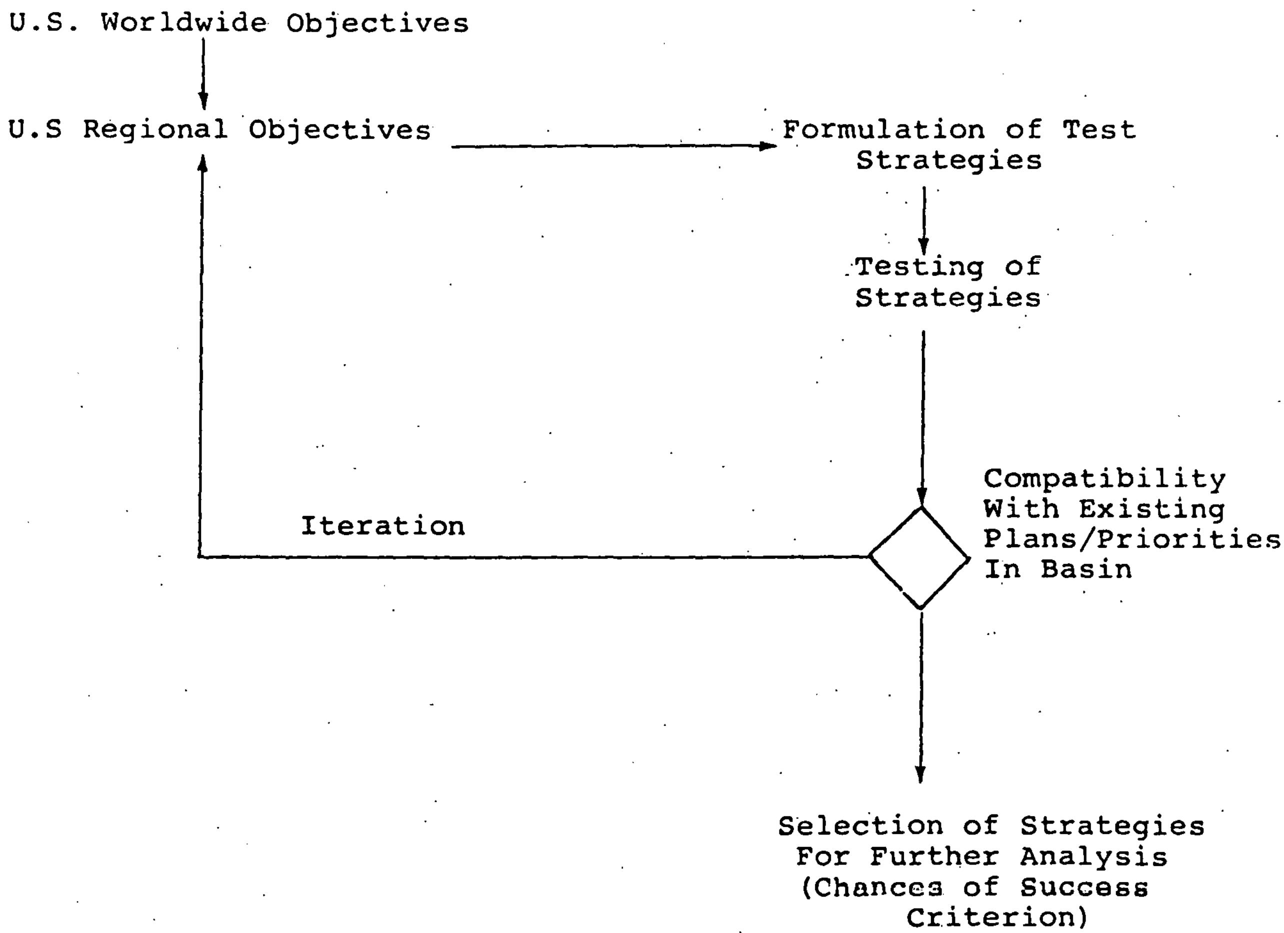
It should be noted that although this process is described in this report as more-or-less sequential, it is, in fact, highly iterative. The need for iteration can be conceptually visualized in Exhibit 4-2, showing important logical feedback loops in the overall relationship between objectives and strategies.

The results of strategy testing leads to revision of U.S. regional objectives (on the basis of new insights). The process then iterates in two directions: First, revised regional objectives leads to reformulation of test strategies. Second, revised regional objectives leads to revised testing of these new strategies.

The regional objectives test strategies and test strategy results presented in this report are the result of many such iterations, searching for viable strategies that would also closely support worldwide/regional U.S. objectives. As the analysis continues in more detail, such iteration will hopefully bring continued improvement in strategy development.

EXHIBIT 4-2

Conceptual Logic Showing Feedback Loops



4.2 Worldwide U.S. Spent Fuel Policy Objectives

United States policy with respect to the disposition of spent fuel is an integral part of its policy directed toward the deferral of reprocessing and the consequent accumulation and dispersion of weapons-useable plutonium; in short, the avoidance of the "Plutonium Economy." While spent nuclear fuel from present day light water or heavy water reactors is not a weapons-useable material in the form in which it is discharged from reactors, it represents a proliferation risk in two respects:

- The accumulation of spent fuel, especially in sensitive countries or regions, constitutes a source of plutonium if and when a country in which it is located decided upon and achieves a reprocessing capability, and the ready availability of spent fuel may even stimulate a decision to engage in reprocessing for military reasons.
- In some countries, the long-term storage of spent fuel is viewed as unacceptable, creating pressures for reprocessing as a means of alleviating the storage problem, with the consequent production of weapons-useable plutonium.

These two considerations could imply significantly different policy objectives on the part of the U.S., with correspondingly different solutions. To the extent that spent fuel is regarded as a proliferation hazard per se, the indicated objective would be to encourage or require the removal from national control of the maximum possible amount of spent fuel. To the extent that spent fuel is regarded with concern only when it provides the rationale or motivation to engage in reprocessing, the corresponding objective would be to offer concerned countries an alternative to the national accumulation and storage of spent fuel to the extent that such material would otherwise be reprocessed. A considerably less aggressive policy might satisfy this objective than that required to offer positive encouragement to the transfer of spent fuel inventories.

These two objectives are not, however, mutually exclusive. For example, the second objective may be regarded as the universal minimum, with the first objective a desirable collateral goal, especially with respect to countries deemed to represent especially serious proliferation risks. Policy-makers may, accordingly, view both of these objectives as desirable, attaching more or less weight to one than the other. On the other hand, policies designed to accomplish the second objective may be incompatible with, or fall short of, those needed to satisfy the first objective. This raises the question of whether implementing policies must necessarily be uniform, or whether differing arrangements for different countries and regions can be considered.

Consideration of U.S. policy actions to date, has led us to conclude that emphasis has been and continues to be given to the second of the above objectives in the formulation of U.S. policy toward foreign spent fuel disposition. For example, the Department of Energy spent nuclear fuel policy statement of October 18, 1977, after announcing the readiness of the Federal Government "to accept and take title to used or spent, nuclear reactor fuel from [domestic] utilities . . .," indicates the intention of the Government "to extend the offer to foreign <u>users on a limited basis</u>". [emphasis supplied] At the same time, the U.S. is encouraging other nations to expand their <u>own</u> [emphasis supplied] storage capacity . . ." These statements support the conlusion that the primary U.S. objective is to offer a viable storage scheme for those nations which protest that reprocessing will otherwise be necessary, rather than to draw as much fuel as possible from national control abroad. Another factor supportive of this conclusion is that substantial plutonium inventories are inevitably present in operating reactors, as well as in spent fuel not yet sufficiently cooled for transfer from a reactor site. In light of these inventories, even a very aggressive policy of spent fuel removal cannot deprive nations with even a small nuclear power program of significant stocks of unseparated plutonium should they choose to violate or abrogate international undertakings.

A policy of deferral of reprocessing is vulnerable to the criticism that it creates what, for a number of countries, is an unacceptable requirement for the long-term storage of spent fuel, unless a credible alternative means of disposing of spent fuel can be offered. This is especially true where the United States is able, through the exercise of its reprocessing approval rights, to forestall a reprocessing option. The viability of United States policy for deferral of reprocessing may, therefore, depend heavily on the ability of the United States to offer, or at least to be instrumental in the development of, acceptable spent fuel storage alternatives. The study group believes that providing this support to the policy of reprocessing deferral is the principal objective of U.S. policy toward foreign spent fuel disposition.

The exploration of possible multi-national or international options for spent fuel storage, especially under the circumstances of limited U.S. receptivity to spent fuel return to the United States, can be an important and perhaps the principal element in U.S. efforts to develop solutions for foreign spent fuel disposition. The emergence of one or more multi-national or international storage schemes, whether of regional or global applicability, could effectively overcome the contention that growing spent fuel accumulation demands a reprocessing solution. An additive benefit of such a development, which has been identified as at least a secondary U.S. policy objective, is to demonstrate the viability of multi-national fuel cycle solutions which could evolve into a broader role in the nuclear fuel cycle, either on the front-end or the back-end, in combination with acceptable technical modifications to the fuel cycle designed to avoid production of weapons-useable material. The performance of such activities under multi-national or international auspices could help overcome charges of discrimination which would inevitably accompany a regime under which performance of these activities was permitted in certain countries and denied to others. Spent fuel storage, due to the immediacy of its need and its relatively less demanding technology, may lean itself more readily to the creation of multi-national or international institutions than any other fuel cycle activity.

United States policy calls for indefinite deferral of reprocessing in its conventional mode - that is, any process which, as in the case of present day solvent extraction techniques, leads to the separation of weapons-useable plutonium. At the same time, the search for and evaluation of alternative processes which may allow recovery and utilitization of the energy values of spent fuel at acceptable proliferation risks, is also an integral and important part of U.S. policy. This search and evaluation is institutionalized in the International Nuclear Fuel Cycle evaluation - INFCE. This overall policy has provided the indispensable backdrop for the study described in this preliminary report, and has been given uppermost consideration in both the inquiry and evaluative activities undertaken under the study.

As suggested above, a close and perhaps necessary relationship, exists in United States policy between, on the one hand, deferral and indeed, avoidance of reprocessing in its conventional form, and, on the other hand, a comprehensive search for more attractive alternative fuel cycles. In a similar manner, an early indication of the inquiry phase of this study is that a close connection is made on the part of a number of foreign industrial and governmental officials between the arrangements for storage of spent fuel and the institutional and technical conditions under which final disposition of this spent fuel would take place. In short, the consideration of storage options cannot be entirely divorced from consideration of the arrangements by which storage would be terminated, either by permanent disposal or recovery of energy values. A recognition of this linkage, as viewed by many concerned foreign officials and an evaluation of its implications for the study objectives, is a necessary and important feature of this report.

4.3 Rationale of International or Multi-National Spent Fuel Facilities For Implementation U.S. Worldwide Objectives

The evaluation and strategy development process of this study draws on imputed nonproliferation values of international or multi-national arrangements in dealing with spent fuel management. The purpose of this section is to offer a general characterization of these values, both positive and negative.

The need for internationalization of the fuel cycle has generated much discussion, developing a range of views. These include advocating to:

1. put the entire fuel cycle in place at one time now (assuming reprocessing)
2. put in place now a system dedicated to the once-through cycle and leading to permanent storage of unreprocessed spent fuel
3. put in place now a fuel cycle system which can adjust to the technical and institutional nonproliferation solutions as they are developed and accepted by nations.

These views or approaches must, of course, make sense to participating nations and industries in order to be implemented, and it is possible that more than one of these approaches will become a reality.

The approach of this study centers on the third choice - to put in place now a fuel cycle system which can adjust to the technical and institutional nonproliferation solutions as they are developed and accepted by nations. The approach centers on the concept of centralized large scale spent fuel storage under international or multi-national auspices or control. The concept does not imply affirmative decision making for reprocessing, nor does it rule out reprocessing if agreement has been reached on the technical and institutional conditions required to make reprocessing an accepted activity from the nonproliferation standpoint. The concept is structured to relieve short-term fuel logistics pressures and provide a basis for accommodating longer-term decisions on fuel cycle management. For the purposes of this study, the assumed nonproliferation values (positive or negative) of the international or multi-national arrangements in such a concept are summarized as follow:

1. Relief of pressure for premature fuel movement into a reprocessing system

   The study country findings identify a significant amount of spent fuel positioned or potentially positioned for movement into domestic or foreign reprocessing systems. The absence of a workable spent fuel storage alternative providing a reprocessing deferral or cancellation scenario provides a continued pressure for solutions dependent upon reprocessing.

   It should be clear in an international storage scheme that reprocessing (or other recovery function) would not take place unless the nonproliferation concerns were resolved for such an operation and that it was agreed that reprocessing (or other recovery function) was desirable from the view of economics and resource conservation in certain countries. In addition to relieving the pressure for reprocessing decisions, the international storage, if under multi-national custody as well as IAEA safeguards, could, under appropriate siting and other conditions, provide greater storage security than national storage.

2. Reduction of incentives for national fuel cycle activities, including national reprocessing

   The centralized collection of spent fuel from a number of nations can be effected to favor international solutions in the disposition decisions following storage. International solutions in areas such as reprocessing, if technically appropriate reprocessing cycles are identified, provide an important intrinsic nonproliferation advantage over national reprocessing because of the possibilities of strengthened nonproliferation assurance obtainable from international arrangements.

Again in the case of reprocessing, the existence of a national facility in a particular region could be destabilizing to countries in the region which might believe they need a national facility to balance against proliferation uncertainties.

Obviously, a country with an identified national reprocessing facility has a significant advantage if it chooses to abrogate its safeguards and peaceful uses obligations.

3. <u>Reduction of risks associated with national fuel cycle activities</u>

In the case of reprocessing, should this ultimately be agreed upon, there are technical concerns on the limitations of measurements within the facility and the concomitant assurance that diversions of plutonium can be detected with a high degree of assurance by an international inspectorate. The concerns over measurement ability and accountancy safeguards expressed against international safeguards applied to a national project are significantly ameliorated in a properly internationalized facility.

4. <u>Unwanted technology transfer</u>

Technology transfer, either directly or inadvertantly, through multi-national fuel cycle facility operations can be detrimental to nonproliferation interests if the net result allows a participant nation (most likely a non-host nation) to subsequently proceed with a national program such as reprocessing, based on the technology transfer. Specific precautions would have to be implemented to assure that technology transfer was limited to countries already having the technology.

5. <u>Host country takeover problem</u>

It is possible for a host country, operating an international fuel cycle facility, to seize the facility through abrogation of the multi-national agreements and IAEA agreements associated with the facility. By such actions, the host country could have access to large amounts of fuel and to reprocessing facilities, if these were present. This means that care must be exercised in selecting sites and host countries and in developing organizational arrangements to protect against country takeover, even if reprocessing facilities are not associated with the storage facility as originally built.

6. <u>Possible deemphasis of proliferation concerns and safeguards</u>

There is the concern that multi-national solutions might provide an inducement to relax safeguards conditions and deemphasize proliferation objectives. Another version of this concern is to envisage the promotion of multi-national concepts as a sales device for reprocessing without genuine treatment of proliferation concerns.

7. <u>Host country cessation or slow down of fuel cycle functions</u>

There is the possibility that the host country of an international or multi-national fuel cycle operation would be unable to perform the operational functions, such as shipping, on a timely basis or at all due to intervention at the state and local government level, or due to a legal challenge at the Federal level. These impairments could come about even if the Federal executive and legislative branches were supportive of the agreement in force. This is the question of the "reliable supplier" and could influence potential participant countries' decisions to join and also increase the risk of countries departing from their non-proliferation undertakings based on host country non-performance.

8. Reduction in fixed facility safeguards cost

The costs of safeguarding a spent fuel storage facility are not proportional to the size of the facility, but generally decrease with increasing facility size. Multi-national facilities imply a larger scale. In addition, safeguards costs for co-located facilities are probably less than for dispersed facilities. Because of the spent fuel transportation cost, it may be advantageous to minimize fuel movement by co-locating spent fuel storage with subsequent fuel cycle steps.

9. Increased safeguards risk in transportation

At the same time that fixed facility safeguards are optimized in international programs, the attendant international shipping provides increased exposure which must be carefully treated.

Institutional Configuration

A range of institutional approaches which relate to the above non-proliferation values are considered in the evaluation and strategy development process associated with international or multi-national spent fuel storage and related fuel-cycle arrangements. The institutional considerations will continue to be developed throughout the definition of alternative concepts. The identified institutional characteristics, or in some cases assumptions, at this point in the study are as follow:

1. Siting

Siting is among the most important decisions in establishing an international spent fuel storage facility (with possibilities of serving other fuel cycle functions). Desirable siting characteristics of a non-technical nature are:

- The host country should be free from risk of terrorist, military or insurrectionist attack, or seizure by a foreign country.
- The host country non-proliferation credentials should be above suspicion. There should be no perception by other participants that the host country has an interest in acquiring nuclear weapons through the facility's existence. Accordingly, at a minimum, any non-nuclear weapons host country should be a party to the NPT, with all its fuel cycle activities under IAEA safeguards.
- Nuclear weapons countries would be the most secure sites because these countries have already demonstrated possession of weapons-usable material and should have little incentive to divert materials, except for use as a fuel.
- A non-nuclear weapons state which is a party to the NPT may be just as qualified from the perspective of lacking nuclear material diversion incentives.
- Countries which already possess reprocessing facilities should receive positive siting consideration because they would have little interest in diverting material from an international facility.
- A third world country could possibly be considered as a host country, providing the country demonstrated appropriate non-proliferation qualities, including a record of political stability and maturity and appropriate international controls were applied.

- Islands or other remote locations have a number of advantages, including the ability to limit the number of access points, such that diversion of material without detection might be difficult. There is an associated transportation risk.
- Extraterritorial areas, in which the extraterritorial zone and rights were carefully guaranteed in treaty provisions, would be a positive consideration for siting. There would not be the possible frustration of the objectives and functions of the system through actions of a host country exercising its sovereign powers - short of actual takeover - for instance, by harassing the facility staff or its inspectors. An example of this approach might be for a donor state to cede a small portion of its territory - or perhaps an island - to the consortium or to an established organization like the IAEA or the U.N., with the understanding that it could be utilized exclusively for the fuel cycle purposes intended.

2. <u>Organization Considerations</u>

There is general agreement that an international or multi-national regime for fuel cycle operation can provide important nonproliferation benefits, which are of two kinds:

- Multi-national or international staffing can improve the diversion detection capabilities beyond that obtainable through safeguards alone by, in effect, providing a "built-in" inspection capability.
- The existence of a properly constituted international or multi-national regime might not prevent, but could provide considerably greater assurances against, abrogation and seizure of materials and facilities by the host country, than those obtainable through safeguards and nonproliferation undertakings alone.

Despite these recognized nonproliferation advantages, international or multi-national fuel cycle facilities have been generally disfavored by governmental authorities and industrial officials, due in considerable measure to concern that international or multi-national organizations are ill-suited to the management and operation of complex fuel cycle activities which have proven difficult enough to undertake on a national basis. The experience of Eurochemic, a multi-national group of fourteen OCED nations, is viewed by the participants themselves as confirming rather than conflicting with this estimate. While Eurochemic was built and successfuly operated for several years, the difficulties were substantial, and in the final analysis the participants chose to proceed nationally rather than to adopt Eurochemic as the mechanism for future reprocessing undertakings.

The operational difficulties attendant on the multi-national conduct of spent fuel storage are clearly less serious than for other back-end fuel cycle operations, providing a basis for the view that spent fuel storage offers an attractive route for the establishment and demonstration of international or multi-national institutions with high nonproliferation effectiveness. At the same time, because of the possibility, explained elsewhere in this section, that these institutions may at an appropriate later date undertake other and more complex fuel cycle activities, there is a strong incentive to design the institutions initially with this flexibility in mind.

These considerations lead to the conclusion that an important criterion in the institutional design is the separation, insofar as possible, of the functions which relate to the safeguards and nonproliferation effectiveness of the regime from those which relate principally to its operational, economic, and commercial effectiveness, creating, in effect, a two-tier system. A similar conclusion has been reached and implemented by other organizations, a notable example being the tripartite (Dutch-German-British) consortium for centrifuge enrichment.

Under the treaty establishing the consortium, a number of responsibilities relating to nonproliferation, such as the export of materials and technology, are vested in a tri-national joint committee, while the financing, management, and conduct of all operations are vested in commercial organizations. The umbrella commercial organization, Urenco, Ltd., is itself tri-national at both the Board of Directors and staff levels. However, in a later development, the need for which itself reflects the degree of concern regarding the inefficiencies of multi-national operation, responsibility for actual plant design, construction, and operation has now been vested in two operating organizations, one (Urenco U.K.) being national, and the other (Urenco Netherlands) being bi-national (Dutch and German). Thus, the tripartite consortium is, in effect, now a three-tier institution.

While the tripartite consortium is a useful and interesting example, it cannot serve as a general model for multi-national institutions engaged in fuel cycle activities. The close political ties of the participants, which are bound together in other institutions of overwhelming economic and security importance -- that is, the European Community and NATO -- are an important element in the overall assurances which the institution provides its <u>own participants</u> as well as their partners in these institutions. While the tri-partite Joint Committee has important nonproliferation responsibilities in so far as export is concerned, it does not exercise direct materials control within the facilities, relying instead on the plant forces and the materials control system of Euratom, as supplemented recently by the

IAEA NPT safeguards responsibilities.

In the more general case, considerably greater attention to the structural details of the institution, particularly with respect to its nonproliferation effectiveness, would be required. An early, and perhaps first, consideration of the utmost importance is the national composition of the institution. The basic choices are international, more or less paralleling that of the U.N. or the IAEA; or multi-national, meaning a much smaller number of countries (such as in the centrifuge consortium example just cited), selected possibly but not necessarily on a regional basis. International organizations have the advantage in theory of providing safeguards and nonproliferation assurances which, because of the global membership, might have virtually universal acceptance. An important caveat on this consideration is the need for the organization to have the requisite operational and technical proficiency, a characteristic for which international organizations are not noted. The difficulties which the IAEA experiences in the application of its safeguards are an indication of the seriousness of this problem.

A multi-national organization of numerically much more limited membership may avoid some of these operational difficulties. However, its limited membership may make its assurances, however credible they may be to its own members, lacking in credibility to the world at large, or important sectors of the world community. The unacceptability to the Soviet Union and many other nations of Euratom safeguards as an appropriate nonproliferation assurance in the context of the NPT is an example of this difficulty.

This consideration has lead many to conclude that an important criterion for the composition of a multi-national group is the participation, at least at the "political" tier, of nations which have genuine and self-evident diversity of interest at least in respect to the important issue of nonproliferation. An organization of like-minded nations tied together in a close security relationship (as the Soviets claim to view Euratom) would not meet this test. The participation of at least one nuclear-weapons state in any multi-national institution created for nuclear fuel cycle purposes would seem to be a desirable, though perhaps not essential, criterion, given the strong commitment which nuclear-weapons states customarily accord nonproliferation.

A related consideration in evaluating the composition of a multi-national institution is the technical sophistication and competence of the member nations. Even if the organization is of a multi-tiered nature, with actual operating responsibilities delegated to a competent technical organization, it is unlikely that the "political" tier can effectively and credibly fulfill its oversight responsibility if it is composed wholly of members of limited technical sophistication. Thus, one or more members of such an organization -- including at least one which is not the host country -- should be of recognized technical competence. Inclusion of a nuclear-weapons state, or at least a nuclear supplier state, would seem to be indicated.

Assuming a consortium of appropriate composition can be assembled, the allocation of responsibilities to its two (or more) tiers is a matter of obvious importance. While the general criterion, as noted previously, is to assign nonproliferation responsibilities to the "political" tier, and operating responsibilities to the second tier, the detailed nature of these assignments is of significance. Consideration should be given to the establishment of a safeguards and physical security force, with multi-national staffing at every level, responsible directly to the political tier. The short-lived safeguards inspectorate of the ENEA, which had responsibility for the application of safeguards to ENEA projects such as Eurochemic, is a precedent for this approach.

At the same time, extension of the multi-national structure to the operating organization must also be considered. The basic purpose of separation of functions -- to ensure effective performance of both nonproliferation and operational tasks -- argues that the overriding criterion for staffing the operational tier at all levels should be merit. On this basis, purely national operating organization might be acceptable and, indeed, preferable. At the same time, multi-national staffing in activities which are significant from the safeguards and nonproliferation standpoint could provide important additive assurances and should be considered. There is a clear relationship between the safeguards and nonproliferation effectiveness, both real and perceived, which can be built into the political tier, and the need for extending the multi-national staffing pattern to the operational tier. The more effective the former, the less will be the need to compromise operational efficiency in staffing the second or lower tiers.

An additional organization consideration of great importance is the relationship between the host country and the international or multi-national institution. In the most extreme form of the concept, the international or multi-national institution might itself be the "host," having jurisdiction over an international enclave. As suggested earlier, there are advantages to this concept, and it may not be so lacking in achievability as to rule out any consideration.

In the more probable case, the facilities would be located on territory of a host country, with relationships between that country and the institution regulated by agreement, preferably of treaty rank -- as in the case of the centrifuge consortium. This agreement would have to prescribe a number of factors of nonproliferation importance, including

- National right or limitations on rights to interfere with the ingress and egress of nuclear material;
- The institution's right, if any, to apply physical security measures, and the relationship of its physical security and safeguards responsibilities to those of the host country;
- The rights or limitations on rights to termination of the agreement, and the disposition of material in the event of termination;
- Sanctions for violations by either party.

It is assumed, of course, that a fuel cycle activity would, under any circumstances, be subject to the safeguards of the IAEA. The relationship between the host country, the IAEA, and the institution (if other than the IAEA) would also have to be the subject of agreement.

3. <u>Release Criteria and Mechanism</u>

In establishing an international or multi-national spent fuel storage system, it would be necessary for the participants to agree in advance on the rules, procedures, and decision-making criteria (including which entities make decisions) for the release of spent fuel and nuclear material. The release mechanism has often been recognized as among the most critical of the issues in the construction of an international or multi-national regime for the conduct of fuel-cycle operations. It affects directly and perhaps conclusively both the acceptability of the regime to the intended participants and the effectiveness of the regime from the nonproliferation viewpoint. The release criteria is discussed from the view points of possible participants.

User nations participating in the system may be doing so for reasons relating to lack of storage capacity, economy, lack of environmentally acceptable national sites, reduction of international tensions, fuel supply conditions set by others, etc. These user nations should be willing to accept restrictions regarding release of fuel. The nations would be concerned if the restrictions seriously constrained their energy needs in the long term. As an example, a user nation might not preclude its long-term breeder reactor program decision making as a condition of joining, but it might be willing to defer its decision making. It is conceivable that an electric utility might differ from the government in evaluating release criteria. For example, the utility may have more direct interest in residual fuel values than the government, or the utility may have less interest in early reprocessing as a vital national interest while uranium prices are stable.

The original fuel supplier may have contract clauses which give the supplier the right to consent to reprocessing arrangements and the use of recovered plutonium. The rights must be considered in the multi-national agreements or be renegotiated.

The host nation may wish to exert control over spent fuel release under export control provisions from its own territory. The development of multi-national concepts should consider degrees of isolation from such host nation controls.

The IAEA, if it were the overseeing international institution, would presumably be required to apply the release criteria and mechanism which are specified in Article XII.A.5 of the IAEA statute. The development of this mechanism was among the most contentious issues of the negotion of the IAEA statute, and it remains today the only example of an internationally agreed formulation for this problem. (A similar concept, in somewhat different language, appeared in early U.S. bilateral agreements which provided for U.S. purchase of plutonium produced by other countries through the use of U.S. material.) As a consequence, the IAEA provision could have precedential implications for a release mechanism even when this is being developed for application by other than the IAEA. While Article XII.A.5 was apparently intended to apply to separated produced material, i.e., plutonium, the language of the provision is broad enough to apply to spent fuel as well.

The relevant portions of Article XII.A state that ". . . the Agency shall have the following rights and responsibilities to the extent relevant . . . : . . . (5) . . . to require deposit with the Agency of any excess of any special fissionable materials recovered or produced as a by-product over what is needed for the above-stated uses in order to prevent stockpiling of these materials, provided that thereafter at the request of the member or members concerned special fissionable materials so deposited with the Agency shall be returned promptly to the member or members concerned for use under the same provisions as stated above . . . ."

It will be seen that this provision specifies both a <u>criterion</u> for deposit and release -- that is, "any excess . . . over what is needed" must be deposited "in order to prevent stockpiling . . ." -- and a <u>mechanism</u> -- that is, "at the request of the member . . . materials so deposited . . . shall be returned promptly . . . ." Both the release criterion and the release mechanism present several problems from the viewpoint of effective nonproliferation policy. For example, it is difficult to escape the conclusion that "need" is intended to be sole criterion for judging whether deposit is required, or release is permissible. While the necessity to define the term "need" introduces some flexibility, it seems doubtful whether "need" can be construed broadly enough to include a balancing of safeguards and nonproliferation considerations against the importance of the intended use of the material. Thus, adoption of the IAEA criterion, whether applied by the Agency or not, could preclude the introduction of nonproliferation considerations (beyond the requirement for IAEA safeguards) as a factor in the release determination.

The mechanism for release called for by Article XII.A.5, i.e., "at the request of the member," also presents difficulties. While a member's request must, presumably, conform with the criterion of need, and the Agency, presumably but not explicitly, retains a right of judgment as to whether the criterion is met, it is at least clear that the determination is made in the first instance by the requesting country itself. The background and present composition of the Agency do not provide a high degree of assurance that the Agency could effectively challenge a determination by a member state that material is "needed".

Another consideration enters into the possible use of the IAEA for administering the release criterion and mechanism. Evidence of the past indicates a strong reluctance of countries to rely upon the IAEA to make judgements which can affect their access to important energy resources, believing, perhaps unjustifably, that the Agency's judgement could be colored by extraneous political considerations. This attitude could, if still prevalent, have a considerable influence on the acceptability of the IAEA as the sponsoring international institution for a spent fuel storage system. For similar reasons, it would affect the practicality of relying upon the IAEA as the administering agency for the release mechanism, in a system under other sponsorship.

The conditions for release - for example, return to user, send to permanent storage, release to host nation, send to reprocessing or recovery of some form, release of separated plutonium, release of MOX fuel - must be developed in the founding agreement.

The general character of this mechanism centers around the planning for permanent disposition of spent fuel beyond interim storage and would reflect upon the agreement in the state of the art in non-proliferation solutions. The user nations' view of economics, energy requirements and resource conservation would be critical factors. The attendant safeguards conditions surrounding released material would have to be defined.

The INFCE process would have some bearing on the ultimate conditions of release, but may not be considered as binding by any or all participants. It is possible to envisage a nation which would want no restrictions (other than business type penalties) on the ability to withdraw spent fuel from storage, particularly if no downstream fuel cycle decisions were made by the consortium in a particular time frame.

4. Spent fuel storage requirements versus complete fuel cycle requirements.

The concept of centralized interim spent fuel storage as the initial international or multinational activity is attractive in that the technology is simple and can be put in place easily from a technical point of view.

The transition of this activity from interim storage only to either reprocessing (recovery) or permanent storage requires more demanding technology and organizational implications. These factors could be developed while the interim storage is in place and operating.

In an optimized co-location scheme, the interim storage would serve as the receiving end of either reprocessing (recovery) or permanent storage.

5. <u>IAEA Role</u>

Possible roles for the IAEA include:

- There has been discussion of the possibility that the Agency could employ Article XII of its statute as a basis for IAEA control of the centralized spent fuel storage facility as well as any follow-on plutonium stockpile and fabricated MOX fuel.
- The IAEA could upgrade the quality of the consortium accountancy requirements, that is upgrade the quality beyond that of the host nation, through the IAEA safeguards agreement with the consortium without having to upgrade the entire host country system. Host country sensitivities to IAEA inspector presence and to containment and surveillance activities would be reduced where the results are not directed at host national activities.
- The IAEA could serve as a nonvoting observer on the governing body of the consortium.

The ability of IAEA to perform the functions already assigned and that would be assigned as a result of this and other international agreements depends on continued and expanded financial support. That capability would be seriously weakened by lack of financial support, particularly from the advanced nations, jeopardizing the viability of a spent fuel storage plan. Perhaps some financing mechanism that produced revenues by levying a charge against the countries utilizing its services and against the fuel storage itself may reduce that uncertainty.

6. <u>Ability of multi-national systems to perform functions user nations are incapable of accomplishing</u>

This ability is a siting criteria but is presented separately to identify the importance of the international or multinational consortium potentially providing vital and agreed upon functions which a user nation would require for its nuclear power program, such as permanent storage. In exchange for these functional availabilities the user nation might be more inclined to accept non-proliferation criteria.

4.4 Regional Objectives of U.S. Spent Fuel Policy in Europe

Based on the forgoing premise of worldwide U.S. policy, a spectrum of possible objectives can apply to Europe, none of which are necessarily mutually exclusive. Beginning with the least restrictive, these are:

Possible Regional Objective #1: Reprocessing Deferral

The possible U.S. objective could be to allow European countries to reprocess, but not at present. Within this general category there are several alternative approaches, including, in order of increasing restriction:

Objective #1.1	Postponement of reprocessing to a fixed date, say year 2000.
Objective #1.2	Postponement of reprocessing until identified criteria are met; i.e., it is acceptably demonstrated as cost-effective, proliferation concerns being resolved, or until it is needed for breeders.
Objective #1.3	Postponement of a decision on whether or not to reprocess until some future criteria are established.
Objective #1.4	Indefinite deferral; i.e., acceptance of reprocessing only when the U.S. decides it is appropriate.

Possible Regional Objective #2: Containing Reprocessing

The possible U.S. objective could be to confine reprocessing to countries with plans or existing facilities. The U.K. and France are firmly in this category. The F.R.G. planning is firm. Belgium planning (Mol) is firm, but includes also COGEMA services. Spain and Italy's plans are considered not firm.

Possible Regional Objective #3: Internationalization

The possible U.S. objective could be to assure that reprocessing occurs on an international rather than national basis. This objective could take two forms:

Objective #3.1: Internationalize* any reprocessing project still in the non-firm planning stage.

Objective #3.2: Internationalize* existing and firmly planned reprocessing facilities.

Possible Regional Objective #4: Combination of Deferring Reprocessing, Containing Reprocessing and Internationalization

The possible U.S. objective could be to assure that:

- national reprocessing decisions are delayed as long as possible, and/or
- if a reprocessing decision does occur, it is through internationalized facilities (or internationally supervised).

This approach represents a spectrum of possible alternatives. Specification on each is so complex as to be tantamount to setting objectives on a nation-by-nation basis.

These generalized regional objectives (based on the still more general U.S. worldwide objectives) form a basis for strategy screening. However, strategy formulation is likely to be more effective when considered in the context of U.S. spent fuel policy objectives in each country. As a preliminary to assessing the particular consequences of the general U.S. regional objectives in Europe, a mapping of European countries' general attitude toward such objectives is in order.

*or bring a national facility under some international auspices for safeguards purposes.

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4.5 Regional Objectives of U.S. Spent Fuel Policy in the Pacific

The purposes of this section is to suggest possible U.S. objectives in the Pacific Basin. As a preliminary, it is helpful to restate those U.S. worldwide objectives that will probably have important impacts on the Pacific Basin.

First, one considers the U.S.: The U.S. is believed to have two major objectives motivating its domestic spent fuel disposition policy. The first is to make provisions for spent fuel disposal which are satisfactory enough to allow continued operation of existing and near term planned nuclear power plants. The second is to defer making a decision to conduct or abandon LWR spent fuel reprocessing. The U.S. system has not yet firmly placed spent fuel in the category of "national asset", or "national liability", but is becoming reasonably firm in viewing spent fuel in the hands of non-weapon states as detrimental to world order. This last concept, combined with the desire of the U.S. to have the rest of the world defer commitment to reprocessing, provides the motivation for U.S. involvement in international spent fuel concepts.

The Japanese face a slightly different issue: having already come to the decision to reprocess LWR spent fuel, they are concerned with their ability to implement that decision in time to prevent a spent fuel disposition problem. The Japanese therefore can be expected to show little initiative in formulating any spent fuel disposition strategy other than reprocessing. Japanese involvement in an international strategy, other than reprocessing, is therefore likely to be motivated by favorable economics or as a means of placating U.S. pressure. There is an important further dimension to the Japanese position: their resolve to reprocess LWR fuel may be stimulated by a fear that deferral of LWR reprocessing may interfere with breeder deployment. If so then reprocessing of spent LWR fuel looms as a surrogate issue for the Japanese.

Other nations in the Pacific Basin - Korea, ROC and the Philippines - have no domestic spent fuel problem to speak of that cannot be solved on a national basis. The only motivation for being involved in any international spent fuel arrangement would be economic or to placate external diplomatic pressure.

With these motivations taken as premise, we can identify three obstacles which might impede any international spent fuel disposition scheme:

First, if institutions interested in reprocessing thought that such a scheme would preclude that option, they might be reluctant to enter into related discussions. This is a strong factor in dealing with Japan; probably of lesser consequence when dealing with Korea, ROC and the Philippines. It might be a problem within the U.S., since an attempt to create an institutional obstacle to domestic reprocessing might be expected to engender strong domestic opposition.

The second potential obstacle to any international option would be unfavorable economics. This is less a problem in the U.S. than elsewhere since the U.S., taking the initiative for foreign policy reasons, is presumed to be less determined to avoid financial loss. However, other Pacific Basin nations, resistant to the scheme in the first place, can be expected to be highly critical of unfavorable economics.

Finally, an international arrangement on spent fuel would be impeded if any national or significant subnational interest group perceived it as a give-away or placing out of reach of an important national resource - especially with heavily energy dependent countries.

Given these constraints and motivations, there are only a few objectives which are not likely to run into strong objections by some Pacific Basin nation. The one suggested here is:

- <u>to provide a means of storing LWR spent fuel so as to reduce the pressure to reprocess as a means of spent fuel disposition</u>.

As a note, interim spent fuel storage will not eliminate the pressure to reprocess - but rather only one, the most immediate, source of that pressure. Reprocessing pressure will still derive from the desire to recover the fuel value of spent fuel, to obtain security of supply, and the desire to develop a policy and technical precursor to breeder reprocessing.

5.0 Evaluation and Strategy Formulation

(Section 5.0 deleted)

6.0 LEGAL/REGULATORY EVALUATIONS

6.1 INTRODUCTION

The legal/regulatory evaluations presented herein are subdivided into two parts namely:

a) Synthesis of the critical legal/regulatory issues derived from the GSFLS visit findings (Section 6.2)

b) Analysis of the legal/regulatory considerations for the disposition of foreign spent fuel into a U. S. centralized spent fuel storage facility (Section 6.3)

6.2 CRITICAL GSFLS LEGAL/REGULATORY ISSUES

The critical issues vary from country to country, with most nations having one or more legal or regulatory difficulties that must be resolved. The principal critical issues include the following:

1. <u>The legal and regulatory difficulties associated with maintaining spent nuclear fuel at the reactor site.</u>

For example, in Germany, the regulatory requirements may well prevent enlargement of the spent fuel reactor pools at Biblis A and B because of the regulatory requirement that modification of the existing pools would require an open review of the entire plant.

2. <u>Legal and regulatory issues associated with establishing an interim storage facility for spent nuclear fuel away from the reactor.</u>

In almost every country, there is or is expected to be a requirement that such a facility be licensed by the appropriate governmental authority. Such a facility, which would principally involve possession of spent nuclear fuel only, would normally be expected to undergo a less extensive regulatory process. However, because of current concern about the back end of the fuel cycle, most government officials in the nations visited believe it will be necessary to use special procedures permitting a more far-ranging public inquiry than is normally necessary to license such a facility. This belief is especially prevalent in Germany.

3. Relationship of spent fuel handling to reactor program.

In several countries, such as Sweden and probably the Netherlands, it is necessary to demonstrate a solution to spent fuel handling prior to the initiation of plans to build new reactors. In Denmark, it appears that a solution to spent fuel handling must be demonstrated before the nuclear program will even begin. The same situation prevails in Austria where a fully completed plant may stand idle pending resolution of this issue.

4. Transportation issues.

In virtually every country, transportation is regulated by an appropriate governmental authority. This is a requirement, however, that does not appear to be an undue hindrance, given the widespread adherence to IAEA proposed regulatory requirements. Thus, it is expected that whatever transportation licenses are required would be routinely obtained.

5. Import and export issues.

As a general conclusion, there are few difficulties normally associated with the export of spent nuclear fuel. In fact, many countries would welcome having the opportunity to export this material. From a legal point of view, while there are normally export licenses to be secured, this is not usually a difficult or burdensome process.

With regard to imports, almost all countries require licenses prior to allowing the material to enter the country. The legal procedures are relatively well-defined and have posed no impediment to international nuclear commerce in the past. However, the political climate prevailing in most smaller nations would preclude them from receiving spent fuel irradiated in other countries in the quantities necessary to establish a centralized spent fuel facility. This is particularly true in central Europe.

6. Legal and regulatory restrictions imposed by safety and environmental requirements.

In every nation the authorities have promulgated regulatory standards to govern consideration of safety and environmental issues. While these provisions are often strict and/or costly, broad national adherence to the recommendations of international bodies such as the International Commission on Radiological Protection and the International Atomic Energy Agency ensure that the differences in legal regimes pertaining to radiological health and safety do not pose an undue obstacle to the development of interim spent fuel storage facilities.

While most national authorities have adopted the IAEA recommendations contained in INFCIRC 225/Revision 1, differences in legal systems do exist and the current worldwide uneasiness over the efficacy of existing safeguards and physical security could exacerbate the situation. Denmark will not even initiate its nuclear power program until this situation is clarified.

Environmental law primarily is a matter of national concern. In most countries the authority is diffused between national and local jurisdictions, and the possibility for conflict does exist. In Austria no locality will give a permit for exploratory geological drilling. In Switzerland an ongoing dispute involves the extension of the local authority over the siting of a facility. Additionally, the division of authority undoubtedly complicates the decision-making process. While this by itself is not a cause for alarm, most nations do not have a legal mechanism to resolve such conflicts, thereby adding to the uncertainty which would confront plans to establish a centralized spent fuel facility in those countries.

7. Third party liability.

The widespread adherence to the relevant international conventions makes the various legal regimes on the subject remarkably uniform. They do differ, however, on their territorial scope, and this could pose some difficulty to the establishment of a centralized facility. Additionally, the national provisions often discriminate against different legal systems. For example, many parties to the Paris and Brussels conventions have different provisions governing limitation of liability and scope of coverage.[a] In the United Kingdom certain non-U.K. licenses are subject to unlimited liability.

8. Public participation issues.

Nations visited had varying provisions governing public participation in the licensing process, less defined in some countries as opposed to others. These provisions not only differ in the nature of the interest which must be asserted prior to participating, but also in the extent of participation involved. In some countries, such as Germany, the licensing process is time-consuming and is becoming even longer. For instance, the time expected to review and reach a licensing decision for an interim storage facility at Ahaus is approximately one and one-half to two years. In addition, the courts in some countries are taking a stronger role, which adds a year or more of uncertainty to the review process.

It is somewhat difficult to quantify the amount of time that public participation can take, but it should be noted that it is not insignificant.

On the other hand, public participation is probably necessary to achieve widespread public acceptance of the project. To the extent that the failure to provide adequate means for public participation fosters distrust amongst the affected populace, the lack of such proceedings would be counterproductive.

9. Participation in multi-national or international arrangements associated with spent fuel.

There appears no insuperable legal barriers which would preclude participation by those countries visited in a multi-national or international program for spent nuclear fuel. Whether such participation occurs and in what form is a matter for governmental and political decisions, which then could be expected to be ratified by agreements or treaties. There are, however, precedents for the establishment of international undertakings in other parts of the nuclear fuel cycle.

10. Removal of spent fuel materials from storage facilities.

In anticipation that spent fuel collected and stored in a facility will ultimately be removed for final disposition, the legal issues of responsibility that disposal and credit for any value remaining will need to be resolved.

6.3 Generic Legal/Regulator Considerations Associated with Storing Foreign Spent Fuel in a U. S. Central Storage Facility

6.3.1 Introduction

A fundamental problem in analyzing the legal/regulatory framework affecting the establishment of a centralized spent fuel storage facility has been the lack, indeed, almost the total absence, of experience in licensing such entities. While the legal procedures in most nations are relatively well-defined and have posed no impediments in the past, the existing structures have been thoroughly tested in the highly controversial climate which currently affects nuclear activities in general. Where the plans involve territories which have not fashioned such structures, such conclusions obviously are tentative.

The growing politicization of nuclear power activities -- as evidenced by the growing number of nations where such decisions are made by the government as a whole -- threatens to render any apodictic statement in this regard useless. As a result, the following sections can be regarded as stating only the legal/regulatory framework as it currently exists and the manner in which it confidently can be expected to develop.

The disposition of spent fuel within the United States primarily is dependent on the legal/regulatory framework accompanying the establishment of such facilities, transportation, and export-import of the materials. In each case the situation is a state of flux. The NRC is currently re-evaluating its regulations governing spent fuel storage facilities and transportation activities by preparing generic environmental statements. The export-import area is also uncertain with Congress and the NRC actively considering legislation and new regulations to govern the subject. While the following analysis attempts to consider the likely impacts of such developments, it, of course, cannot fully take into account all of the ramifications of this fluid situation.

The following analysis does not discuss the increasing role of state and local regulation in this area. Until United States sites are chosen for the purposes of this study, such analysis would necessarily be too general to be of any substantial benefit.

6.3.2 - Transportation Issues

Being the link which ties the fuel cycle together, transportation must be both efficient and reliable if the nuclear option is to remain viable. Thus far only small amounts of commercial spent fuel have been transported given the lack of fuel reprocessing since the close of the West Valley plant or away from reactor storage facilities. However, spent fuel is piling up in both domestic and international reactor storage pools which have limited capacity. While an increased number of shipments will soon be needed, an array of developments threaten the previously well-defined legal/regulatory framework and could substantially impede the carriage of nuclear materials.

6.3.2.1 - Packaging

The Nuclear Regulatory Commission (NRC)[1] and the Department of Transportation (DOT)[2] share regulatory responsibilities in the transport of radioactive materials. The jurisdictions of the NRC and DOT overlap with respect to safety in the transportation of byproduct, source and special nuclear material on land in interstate and foreign commerce, on civil aircraft, and on water. For the purpose of developing and implementing consistent, comprehensive and effective regulations for the safe transport of radioactive material and to avoid duplication of effort, the DOT and the AEC entered into a Memorandum of Understanding in 1966[3] which has been superseded by a revised Memorandum of Understanding signed March 22, 1973.[4] Basically, under the revised memorandum, the AEC (now NRC) is to develop performance standards for package designs and review package designs for Type B, fissile and large quantity packages. The DOT will develop safety standards governing handling and storage of all radioactive material packages while they are in possession of a common, contract or private carrier and will require NRC approval prior to use of all Type B, fissile and large quantity package designs. DOT is the National Competent Authority with respect to foreign shipments under the International Atomic Energy Agency (IAEA) transport standards. IAEA Certificates of Competent Authority are issued by DOT with technical assistance provided by NRC as requested.

The implementing regulations of DOT and NRC[5] provide for the protection of transport workers and the public from external radiation in the transport of radioactive material under normal conditions by 1) specific limitations on the radiation levels on the outside surfaces of packages of radioactive materials and at 1 meter (3 feet) from the surfaces, 2) numerical controls on storage and segregation of packages in the vehicle, vessel or aircraft, 3) warning labels on packages in the vehicle, vessel or aircraft, and 4) placards on the outside of trucks and railcars (not on aircraft or ships) to inform of the presence of radioactive materials. The regulations also provide for a high degree of assurance that the packaging for significant quantities of radioactive materials is designed and constructed to maintain, under normal and accident conditions over its useful lifetime, the necessary design integrity, considering the type, form and quantity of radioactive contents.[6] The design objectives are 1) to prevent a significant increase in radiation levels from the package,

2) to provide for adequate controls over potential criticality and safety, and 3) to provide adequate heat removal. This is achieved through the design standards on packaging and implementations of quality assurance programs, including proof-testing and independent reviews.[7]

<u>Domestic-Interstate</u> - NRC regulations require approval of package designs for Type B, fissile and large quantity packages to be used by licensees. Thus, by virtue of DOT regulations (except for DOE) persons who are not NRC licensees nonetheless must obtain NRC approval for the same types of packages.[8] All package designs must be qualified by an applicant and approved by the NRC as meeting the regulatory standards in 10 C.F.R. Part 71 before they can be used for the shipment of radioactive material.[9]

To obtain NRC approval, persons are required to submit an application for approval of the package design with a detailed safety analysis. Compliance with the criteria contained in Part 71 may be shown through physical testing of a fabricated prototype, by compartative analysis with a similar container or components which have been physically tested, or by total analysis with computer techniques which have been experimentally verified.[10]

Within NRC, package design evaluations are conducted by the Transportation Branch, Office of Nuclear Material Safety and Standards. The Transportation Branch performs an in-depth technical review of the design and use of the package, primarily focusing upon structural, thermal, shielding, criticality and quality assurance matters. If the design is approved, the applicant will receive a Certificate of Compliance, enabling any person to use that design under a general license subject to registration with NRC and compliance with all terms and conditions of the certificate.[11]

DOE exempt contractors (which are not subject to NRC licensing) apply to DOE Operation Offices for approval.[12] DOE approvals are also issued in the format of a Certificate of Compliance and are currently recognized by DOT as satisfying its regulations with respect to package approval. DOE need not have NRC review prior to its use of the package.

Under an agreement previously made between Regulatory and the General Manager of the AEC,[13] NRC (formerly Regulatory) reviews and comments on DOE packages (formerly General Manager) as requested. The purpose of the agreement is to obtain regulatory review of DOE packages likely to be used by licensees. NRC licensees must have NRC approval to use DOE approved packages, by provisions of 10 C.F.R. Part 71.[14]

<u>Domestic Intrastate</u> - NRC regulations (10 C.F.R. Part 71) cover intrastate as well as interstate transportation.[15] 10 C.F.R. Part 71 incorporates by reference DOT regulations to cover situations where DOT regulations do not apply.[16] In addition, most States have adopted DOT regulations by reference, and DOT regulations require NRC review of package designs.

<u>Foreign</u> - The point of control for packages imported to the United States is with the Department of Transportation, which is the U.S. National Competent Authority under the IAEA transport regulations.[17] DOT has provisions in its regulations whereby Canadian shipments and packagings which conform to the regulations of the Canadian Transport Commission may be transported from point

of entry in the United States to their destination in the United States, or through the United States on route to a point in Canada without further packaging review and approval by the Unites States.[18] Canadian specification packagings are authorized under the DOT regulations for unrestricted use in the United States. These specification packages are the same as the specification packages published in the DOT regulations after NRC review. For other packages of foreign origin, DOT regulations require revalidation of the foreign country package certification.[19] NRC will provide, upon request by DOT, an independent package evaluation for use by the DOT in their revalidation procedures. Under working arrangement with the DOT, packages which originate in the UK or Canada (which do not require special controls in transport or features for which an independent review may be desired) are not forwarded to NRC for review. All other designs are forwarded to NRC for review prior to revalidation by DOT.[20]

Specification Packages - DOT, in regard to containers for hazardous materials, provides for use by shippers, shipping container specifications in its regulations. Included as specification packages are several designs that may be used for shipment of radioactive materials. The NRC reviews the detailed container specifications and authorizes contents prior to the container and contents being listed as a specification package.

6.3.2.2 - Safeguards and Security

Unlike DOT, the NRC also has the statutory responsibility to provide the the common defense and security[1] and has, therefore, promulgated other regulations applicable to transportation activities the objective of which is to protect the public against diversion or the use of radioactive materials for unlawful purposes.

In fulfilling these responsibilities, NRC has adopted a graduated safeguards approach which places special emphasis on those areas of the nuclear fuel cycle which are of greatest safeguards concern. In the LWR fuel cycle, for instance, materials safeguards does not become a critical item until the reprocessing stage. Therefore, the NRC physical protection requirement, 10 C.F.R. Part 73, does not apply to spent fuel shipments.

Where transportation involves Strategic Special Nuclear Material (SSNM),[2] Part 73 contains detailed requirements for the purpose of protection against theft or sabotage. Under this Part, each licensee who transports or who delivers to a carrier for transport SSNM must make arrangements to assure that guards monitor all transfers[3] and that the materials are shipped in containers using tamper indicating type seals.[4] Differing requirements are set forth for the various modes of transport.[5]

With the heightened concern over possible terrorist action against shipments of SSNM, the NRC during the past several years has been engaged in a series of actions to upgrade its safeguards requirements. In May, 1976 the NRC imposed license conditions[6] mandating increased escort guards, training and instruction of shipment guards and drivers, as well as installation of citizens band radios for shipment and escort vehicles.[7] In January, 1977, the Commission announced that its regulatory requirements would be upgraded through public rulemaking.[8] Subsequent to this announcement, the Commission has published a number of proposed rules.[9] Of these, the most significant - in that it probably will serve as the basis for the generic rulemaking - involves the establishment of general performance requirements for SSNM shipment.[10]

The NRC does not license DOE transports of SSNM. These shipments utilize specially designed government owned vehicles and Federal guards.

6.3.2.3 - Liability During Transportation

Transportation of nuclear materials is not specifically provided for under the Price-Anderson Act,[1] although carriers are generally covered either as ERDA contractors or under the omnibus aspects of licensee financial protection and identity. The Association of American Railroads has proposed that transportation be specifically covered because of gaps in the existing system for such situations as transportation of materials for a shipper or receiver not required to maintain financial protection. The 1975 amendments to the Act, however, did not deal with this matter, but in the Committee report, the Congress encouraged the Commission to review the situation to determine if procedural or legislative changes are in order.[2] After conducting this review the Commission determined no changes were necessary.[3]

Shipments between NRC - licensed facilities enjoy the full range of benefits accorded by the Price - Anderson Act so long as it remains within the terms of the agreement[4] between the facility operator and the insurance pools. This so-called "Facility Form" provides broad coverage for liability arising out of nuclear material in the course of transportation to and from the facility.[5] This, coupled with the licensee's indemnity agreement with the NRC, serves to provide a comprehensive legal regime governing the liability of all shipments of spent fuel or radioactive waste.[6] The carrier pays no premium under this coverage, but any liability of the carrier - except when the carrier is the United States Government or its contractors[7] is insured pursuant to the insurance and indemnity agreements. This coverage includes property damage caused by the carrier's own negligence. While the "Facility Form" does not protect the shipper from liability for damage to nuclear materials in transit, a carrier can purchase property insurance from the pools to protect itself against such an occurrence.

The amount of insurance and indemnity applying to a shipment from a NRC - licensed reactor or reprocessing facility[8] will always be the amount of the pool policy plus government indemnity, which is currently $560 million.[9] Most shipments to these facilities will have the same amount of coverage, though depending on where the shipment originated, the amount of insurance applicable could be less with indemnity applying to the loss in excess of the lesser amount of insurance. In both shipments to and from these facilities, the Price - Anderson Act provides that no one is liable for loss which exceeds the applicable insurance and indemnity.

Where the licensee is not required to arrange financial protection, the carrier may enter into a Suppliers & Transporters agreement with the insurance pools. This policy provides the carrier protection against loss which exceeds the insurance provided for the shipment under the licensee's policy.[10]

Shipments between NRC - licensed facilities and DOE or DOE contractors are covered under the "Facility Form" of the licensee. The rationale for this arrangement is that DOE may self-insure itself, and its contractors are not required to establish proof of financial protection.

Shipments between DOE facilities and/or those of its contractors also are covered by the Price - Anderson Act. Under the provisions of the Act DOE may execute indemnity agreements with its contractors who are engaged in activities which contain the risk of public liability for a substantial nuclear incident. These agreements not only protect the Department's prime contractors, but also the subcontractors, suppliers, carriers and others who may be at risk for public liability for a nuclear incident arising out of or in connection with a DOE contract activity. Although the Act authorizes DOE to require its contractors to furnish private financial protection,[11] DOE contracts place the burden of obtaining such insurance upon the Department. Additionally, a carrier may purchase a Suppliers & Transporters policy, as described above.

International Shipments generally are not covered by the Price - Anderson Act unless any nuclear incidents occur within the territorial limits of the United States. Exceptions are made for incidents involving the now retired nuclear ship Savannah, ocean shipments of new or spent fuel during ocean transit from one licensed nuclear ficility to another, shipments relating to licensed facilities located outside of territorial limits, and DOE contractual activities. In the last instance, the amount of indemnity provided by the Department may not exceed $100 million.

The Joint Committee on Atomic Energy and the AEC specifically considerd in 1962 extending the Price - Anderson Act to ocean carriers of nuclear materials at the behest of the American Merchant Marine Institute.[12] The request for such an amendment was denied for lack of sufficient information given the relative inexperience of American-flag vessels in transporting either spent or fresh fuel.[13]

Although the United States has not signed an international legal instrument relating to the transport of nuclear materials, it did participate in the 1971 International Legal Conference on the Maritime Carriage of Nuclear Substances. The conference was held under the auspices of the Inter-Governmental Maritime Consultative Organization (IMCO). The resulting Convention Relating to the Maritime Carriage of Nuclear Material ensures that the operator of a nuclear installation will be exclusively liable for damage caused by a nuclear incident occurring in the course of maritime carriage of nuclear fuel. The United States failure to sign this Convention is explained more by the document's creation of substantive legal regime to accomplish the objective than with the objective itself.[14]

United States maritime law currently is unclear as to the liability of the carrier for incidents involving nuclear materials which occur outside the territorial limits of the United States but which have an effect within them.[15] Traditionally, the prevailing rule of maritime law is that liability is based on fault[16] and limited to the value of the vessel and cargo after the cause of loss has taken place.[17] In the United States, however, recent judicial decisions have made inroads on both of these historical principles,[18] although the cases fall into no discernible pattern and it may be some time before a judicially-sanctioned rule of law emerges.

In the absence of a controlling convention or another form of international legal regime, the law governing the liability of transnational transportation will be determined by general principles of conflicts of laws. Although maritime law contains a large number of principles common to all nations and despite the essentially international character of shipping, this is one of those fields in which institutional cooperation between governments is least developed. International conferences on maritime matters tend to recommend rules for adoption by governments without embodying them in a convention. As a result maritime law remains national law,[19] and it is likely that the controlling law will be that of the nation which suffers the damage.

6.3.2.4 - Economic Regulation

The Interstate Commerce Commission (ICC)[1] and the Civil Aeronautics Board[2] exercise jurisdiction over the economic aspects of radioactive materials transport through the issuance of operating authorities to carriers and control of shipping costs. Given the vast superiority of railroad transportation and the need for an inter-connected, unified system of rail transportation if this mode of shipment is to be most effectively utilized, the nature of the ICC's authority is particularly important to the planning of effective arrangements for the disposition of spent fuel and waste.

Three recent proceedings before the ICC have involved attempts by railroads to restrict their carriage of radioactive materials. In Missouri - Kansas - Texas Railroad Company (M-K-T)[3] the railroad attempted to divest itself of its role as a common carrier in the transportation of radioactive materials, including spent fuel, waste materials, and containers which have been used in the transportation of radioactive materials. In the Special Trains[4] case the railroads have not attempted to renounce their common carrier status but have sought to require that all shipments of radioactive fuel and radioactive materials be shipped in special trains containing only radioactive materials and using special conditions such as a maximum 35 mile per hour restriction.[5] Finally, DOE and nuclear industry shippers have filed a complaint with the ICC against the eastern railroads claiming that the railroads' refusal to publish tariffs for spent nuclear fuel and radioactive waste and to otherwise fulfill their duties as common carriers of those materials violates the Interstate Commerce Act.[6] Common to all three proceedings have been railroad allegations that the course of action it has been following was necessary because of the potential safety hazards and type of insurance coverage available.

An initial decision by an administrative law judge has now been made in the first two proceedings. In each instance the hearing officer ruled that the Commission had jurisdiction to consider safety and insurance - indemnity issues insofar as these were interwoven with economic matters, despite the shippers' contentions otherwise. Nevertheless, both initial decisions failed to uphold the railroads' proposal. In the M-K-T case, it was held that -

> From the evidence presented, I am of the opinion, and so find, that respondent has not satisfied its burden of proof under section 15(8) of the act to demonstrate that its proposal is just and reasonable. Its argument in chief that common carriage of radioactive materials would subject it to unacceptable risks is not convincing. On the other hand, I do believe that respondent's refusal to publish and maintain reasonable and otherwise lawful tariff provisions covering the transportation of the involved commodities will seriously hamper attainment of the described energy goals for the nation and be damaging to both the urgent energy needs and the national defense.[6]

In the Special Trains case the judge concluded that the railroads' proposal would not increase safety, and even if it did, any small increment to the safety of the operation did not justify the additional cost. Moreover, the decision emphasized the need for nuclear power and the importance of eliminating undue interference with nuclear commerce.[7] Both cases have been before the ICC on appeal with the ICC affirming the decision in the M-K-T Case.[8] In that instance the Commission ruled that the ICC did not have unlimited authority to investigate safety issues, holding that the scope of its inquiry into the risks involved in transporting radioactive materials is limited to determining whether the shipment meet NRC and DOT requirements.

FOOTNOTES

6.3.2 Transportation Issues

6.3.2.1 Packaging

[1]Atomic Energy Act of 1954, as amended, 42 U.S.C. §2011 et seq. Under the Energy Reorganization of 1974, this authority was granted the NRC. 42 U.S.C. §5841(f).

[2]DOT jurisdiction has been granted under the Transportation of Explosives and Other Dangerous Materials Act (18 U.S.C. 831-835); The Transportation Safety Act of 1974 (P.L. 93-633, 88 Stat. 2156), and the Dangerous Cargo Act (46 U.S.C. 170).

[3]This agreement was actually between the AEC and the ICC. Subsequent legislation transferred this authority to DOT.

[4]38 Fed. Reg. 8466 (1973). This Memorandum is currently undergoing revision to bring it into conformity with the Energy Reorganization Act and the Hazardous Materials Transportation Act.

[5]See 10 C.F.R. Parts 20 and 71 (NRC - packaging and shipment); 10 C.F.R. Part 73 (NRC physical protection); 49 C.F.R. Parts 170-78, and 46 C.F.R. Part 146 (DOT). See also, 14 C.F.R. Part 103 (The Federal Aviation Administration has jurisdiction under the Federal Aviation Act of 1958, 49 U.S.C. 1421-1430, 1472(b), to proscribe labeling and conditions for shipment and carriage as well as certain packaging.)

[6]At present: certain small quantities and concentrations of radioactive material, small sources in manufactured goods and law specific activity materials are exempt from special packaging; limited quantities of radioactive material are permitted to be shipped in Type A Packages which must be designed to withstand normal conditions of transport; larger quantities (Type B and Large Quantities) and fissile material must be shipped in Type B Packages designed to withstand, in sequence, (1) a 30-foot free fall on an unyielding surface, (2) a 4-foot free fall on a 6-inch diameter plunger, (3) heat input from a 1475°F radiant source for 30 minutes, and (4) for fissile material, immersion in water; Fissile Material Packages must meet specified standards of nuclear criticality Safety. See 10 C.F.R. Subpart 31.

[7]On June 2, 1975 the NRC initiated a rulemaking proceeding concerning the air transport of radioactive materials, including packaging, with a view to the possible amendment of its regulations in 10 C.F.R. Parts 71 and 73. In connection with this

rulemaking the NRC instructed its staff to prepare a generic environmental statement on the air transport of such materials. This decision marked a departure from past AEC/NRC practice of not distinguishing between various modes of transportation. See 40 Fed. Reg. 23768 (1975).

The Commission's action was an outgrowth of several factors, including the so-called Conway report. See Rept. No. 1 of the Special Panel to Study Transportation of Nuclear Materials to the Joint Committee on Atomic Energy. (93 Cong. 2d Sess. Comm. Print). The action was followed by the Scheuer amendment to FY 1976 NRC authorization bill (P.L. 94-79) which banned the air transport of plutonium until the NRC has certified to the Congress that "a safe container has been developed and tested which will not rupture under crash and blast-testing equivalent to the crash and explosion of a high-flying aircraft."

The draft generic environmental impact statement (NUREG - 0034) was published in March, 1976. The preliminary conclusion in the draft statement is that the overall objectives of the regulations are being met. A determination whether a change in the regulations will be made after the publication of the final statement is necessary.

[8] See footnote 9.

[9] 10 C.F.R. §71.35.

[10] 10 C.F.R. §71.34.

[11] 10 C.F.R. §71.12.

[12] See 42 U.S.C. §2140 and §5842.

[13] See Agreement Between the General Manager and the Director of Regulation for Package Design Reviews, dated June 11, 1973.

[14] 10 C.F.R. §71.5.

[15] 10 C.F.R. Subpart A.

[16] 10 C.F.R. §71.5.

[17] See 38 Fed. Reg. 8466 (1973).

[18] 49 C.F.R. §173.8.

[19] 49 C.F.R. §171.12.

[20] See 38 Fed. Reg. 8466 (1973).

6.3.2.2 Safeguards and Security

[1]See, e.g., 42 U.S.C. 2077 (c).

[2]The term SSNM includes uranium-235 (contained in uranium enriched to 20 percent or more in the U-235 isotope), uranium-233, or plutonium alone or in any combination in a quantity of 5,000 grams or more computed by the formula, grams = (grams contained U-235) + 2.5 (grams U-233 + grams plutonium) 10 C.F.R. §73.30.

[3]10 C.F.R. §73.35.

[4]10 C.F.R. §73.30.

[5]10 C.F.R. §73.31 (road); §73.32 (air); §73.33 (rail); §73.34 (sea).

[6]The NRC has broad authority to impose license conditions. See 42 U.S.C. §16(b), (i); 10 C.F.R. §70.32(b).

[7]See generally, in the Matter of Nuclear Regulatory Commission (Licensees Authorized to Possess or Transport Strategic Quantities of Special Nuclear Materials), 5 NRC 16 (1977).

[8]Id.

[9]See, e.g., 42 Fed. Reg. 14880 (1977) (authority for access to or control over special nuclear material); 42 Fed. Reg. 8382 (1977) (guard force response to an alarm); 42 Fed. Reg. 34321 (1977) guard standard); 42 Fed. Reg. 25744 (1977) safeguards contingency plans).

[10]42 Fed. Reg. 34310 (1977).

Section 6.4.4.2.3 - Liability During Transportation

[1]42 U.S.C. §2210.

[2]S. Rept. No. 94-454, p.14 (1975).

[3]41 Fed. Reg. 40511 (1976).

[4]Article III of the "Facility Form" defines the termination of an "insured shipment" as that time when the material "is removed from a transporting conveyance for any purpose other than the continuation of its transportation." Thus, liability for a terrorist act which causes the dispersal of nuclear material while it is being shipped is covered. However, if the material is stolen from the shipment and subsequently utilized to cause

injury or damage, the "Facility Form" does not provide coverage for the subsequent injury or damage. See also discussion under the section relating to international shipments.

[5]An exception is where the shipment is from a ficility with a similar policy and indemnity agreement. In this case, coverage is provided under the shipper's policy and indemnity. The purpose for this is that only one policy and one indemnity agreement may apply to any given shipment.

[6]The omnibus provisions of this coverage includes any liabilities of the designer and manufacturer of the container.

[7]The United States Government is self-insurer in such instances.

[8]The only types of facilities of which NRC currently requires proof of financial protection. 10 CFR. §140 et seq.

[9]Under the 1975 amendments to the Act. This amount will increase over the years.

[10]Cask designers and manufacturers may also enter into S & T agreements.

[11]42 U.S.C. §2210(d).

[12]Letter from American Merchant Marine Institute to Hon. Chet Hollifield, Chairman, Joint Committee on Atomic Energy (August, 1962).

[13]See generally, AEC Staff Report on the Price-Anderson Act (1974).

[14]Id.

[15]See generally, Murphy, Issues of Financial Protection in Nuclear Merchant Ship Operations IV-3-8 (1975).

[16]See, e.g., E. Selvig, Towards Strict Shipowner Liability: Recent Trends in Norwegian Law on Maritime Torts, 2 J. MAR. L. COMM. 383 (1971).

[17]46 U.S.C. §183 (a) (1975).

[18]See, e.g., Askew v. American Waterway Operators, Inc. 411 U.S. 325 (1973) (State Regulation not precluded by Federal Water Quality Act); Union Oil Co. v. Oppen, 501 F. 2d 558 (9th Cir. 1974) (supplier not protected by limitation on liability).

[19]See Manual of Public International Law 634 (M. Sorensen, ed. 1968).

6.3.2.3 Economic Regulation

[1]Interstate Commerce Act, as amended, 49 U.S.C. § 1 et. seq.

[2]Civil Aeronautics Act of 1938, as amended, 49 U.S.C. §1301 et. seq.

[3]Docket No. 36307.

[4]Docket No. 36325.

[5]Docket No. 36312.

[6]Initial Decision, April 28, 1977.

[7]Initial Decision, August 24, 1977.

[8]Radioactive Materials, M-K-T R.R., ICC. No. 36307, November 8, 1977.

6.3.3 Spent Fuel Storage Issues

The changes in perception of the peaceful uses of nuclear energy and changes in laws, policies and practices governing those uses have resulted in a spent fuel storage situation very different from that anticipated in earlier years. Whereas such storage formerly was viewed as a prelude to reprocessing, recent events severely challenge this assumption. Currently, the uncertainties relating to plutonium recycle, waste management and nonproliferation all severely affect the ultimate disposition of spent fuel.

6.3.3.1 Nuclear Regulatory Commission

The Nuclear Regulatory Commission is responsible for licensing actions relating to spent fuel storage. [1] Given the historical view that such storage was merely a prelude to reprocessing and ultimate disposal, the Commission has not promulgated regulations governing either on-site storage pools or independent storage facilities. [2] As the NRC noted in 1975,

> Indeed, the Commission has not to date, found it necessary, in the discharge of its licensing and related regulatory functions, to develop any overall program of action to deal with the problem. [3]

Instead, the NRC has opted to address the issues involved on a case-by-case basis within the context of individual licensing proceedings.

Under its current procedures the NRC considers both safety and environmental factors in assessing applications involving spent fuel storage. Historically, of course, licensed spent fuel installations have been an integral part of either fuel reprocessing plants or nuclear reactors. As such, NRC consideration of spent fuel storage matters has begun with the construction permit stage of the reactor. Under the Commission's regulations[4] an applicant must submit the principal design criteria for the facility. The criteria must contain general considerations for spent fuel basin designed --

(1) with a capability to permit appropriate periodic inspection and testing of components important to safety,
(2) with suitable shielding for radiation protection,
(3) with appropriate containment, confinement, and filtering systems,
(4) with a residual heat removal capability having reliability and testability that reflects the importance to safety of decay heat and other residual heat removal, and
(5) to prevent significant reduction in fuel storage coolant inventory under accident conditions.[5]

The criteria also require a general discussion of the systems designed to prevent criticality in fuel storage.[6] At the operating license stage the applicant must supplement this information with a detailed discussion, analysis and evaluation of the spent fuel storage system. The NRC then will evaluate the proposal against the general criteria and conditions approved with the issuance of a construction permit and make its final determination on whether the facility would be inimical to the common defense and security or to the public health and safety.[7] At both stages the Commission considers the environmental impacts of the action, the alternatives to it, and the cost-benefit balance.[8]

Any increase in the storage capacity at reactor sites requires an amendment to the operating license. Modification of existing storage facilities involve health and safety as well as environmental considerations not dissimilar to those reviewed under the original application.[9] In a recent Licensing Board decision, the Board considered, inter alia, the following factors --

- Cooling capacity
- Demineralization system
- Seismicity
- Stored spent fuel rod integrity
- Strength of the racks
- Effect of accidents
- Heat removal
- Pool cleanup
- Additional occupational radiation exposure
- Environmental impact and alternatives[10]

The amendment will be approved only after its issuance is found to be not inimical to the common defense and security or the public health and safety.

One alternative to increased storage pool expansion is the shipment of the fuel to a second pool either at the same site or at another site. There are two difficulties with this approach. Current reactor licenses contain a condition that limits formation and possession of byproduct material to that produced by operation at the facility. Additionally, the "Facility Forms" issued by the insurance pools contain a similar condition. Therefore, absent amendments, these provisions preclude shipment of spent fuel from one reactor site for storage to another since spent fuel irradiated at another facility contains byproduct material not formed at the receiver facility.

Yet another alternative is the construction of a new storage pool either at an existing site or away from the reactor. The construction of a new pool would require a materials license from the NRC. These are several requirements for the approval of such licenses before construction of the facility commences:

- The material is to be used appropriately;
- The applicant is technically and financially qualified;
- The equipment and facilities are adequate to protect health and safety and minimize danger to life or property[11]
- An environmental impact statement has been prepared;[12] and
- The Director of NRC's Office of Nuclear Material Safety and Safeguards has concluded, after weighing the economic, environmental, technical, and other benefits against environmental costs and considering other available alternatives that the action called for is the issuance of the proposed license.[13]

If, after examining these matters, the Commission determines that the issuance of the license would not be inimical to the common defense and security or would not constitute an unreasonable risk to the health and safety of the public, it will issue the license. The Commission may incorporate in the license such conditions as it deems appropriate to protect the public health and safety, environment, or guard against the loss or diversion of special nuclear material.[14]

The case law governing materials licenses is sparse. Until 1976 the Commission had never held a hearing on such a license, although the Atomic Energy Act clearly requires some sort of hearing where an interested person requests one. In Pacific Gas and Electric[15] the Commission's licensing and appeal boards examined the safety of the Diablo Canyon fuel storage facility.

The case-by-case approach is not without its drawbacks. In the absence of well-defined regulations, the NRC licensing process could become stymied as intervenors require that basic issues be repeatedly litigated at each licensing hearing. Not only would this delay necessary regulatory actions and waste resources, but it also is not the optimum means for setting basic policy issues. A case-by-case approach does not lend itself to good forward planning, to rational consideration of major options and alternatives, or to a concern for the aggregate effect of individual decisions.

In recognition of this, the NRC will soon release a generic draft environmental impact statement on the subject. The Commission has stated that its preliminary conclusions will show that throughout most of the period in 1976-2000, most spent fuel could still be stored in reactor pools. Only if no reprocessing or disposal should occur by the last decade of this century should away-from-reactor storage amount to more than 20 percent of the total spent fuel storage. Thus, the draft environmental impact statement concludes that the incremental health and safety and environmental impacts of spent fuel storage are quite small. Indeed, no changes in the present Table S-3, "Summary of Environmental Considerations for Uranium Fuel Cycle," in 10 C.F.R. Parts 51.20 will be necessary.

The NRC believes that the cost of storage will increase the cost of nuclear power generation by about one-half of one percent, assuming no reprocessing or disposal of the fuel.[16]

6.3.3.2 Department of Energy Policy

On October 18, 1977, the Department of Energy announced that the Federal Government would accept and take title to spent fuel from utilities on payment of a one-time storage fee. Although only the outline of the policy has emerged, the intent of the Department of Energy in several areas is apparent. The Department currently envisions the policy as only an option which utilities may use if they so desire. Proposed acceptance criteria will be published sometime in the near future, and these criteria may include:

- Five-year advanced notice
- Exceptions of an emergency basis -- maintain discharge capability
- Availability of U.S. Government-approved storage sites
- Penalty for fuel cooled less than five years and leakers

DOE currently is preparing an environmental impact statement on the proposed action.

NRC's licensing authority over DOE spent fuel facilities is unclear. In general, DOE and its prime contractors are exempt from NRC regulatory authority except for (1) licensing of "facilities used primarily for the receipt or storage of high-level radioactive wastes resulting from licensed activities, and (2) licensing of Retrievable Surface Storage Facilities and other facilities authorized for the express purpose of subsequent long-term storage of high-level radioactive waste generated by the Administration which are not used for, or a part of, research and development activities."[17]

Dr. Clifford V. Smith, Jr., Director of the NRC Office of Nuclear Materials, Safety and Safeguards, has testified before the Congress that, "...with the exception of research and development activities, NRC must license ERDA operations for the long-term storage (or disposal) of high-level wastes generated by ERDA or its predecessor the AEC. The Commission has considered storage of longer than 20 years to be long-term."[18]

The definition and usage of the term 'high-level waste' illustrates some of the limitations and uncertainties of NRC's regulatory authority. When developed some years ago, the definition of high-level waste in the AEC's regulations contemplated reprocessing of spent fuel so that the fission products, along with small amounts of transuranic nuclides, would be separated from usable uranium and plutonium. NRC regulations defined high-level waste as those highly radioactive liquids resulting from the separation process. Further, NRC regulations required that such high-level liquid wastes be solidified and sent to a Federal repository. The rationale for sending the wastes to a Federal repository was that the intensely radioactive fission products (dangerous for a few hundred years) and the highly radio-toxic transuranic nuclides (potentially dangerous for thousands of years) require special care over long periods of time which can best be exercised by the Federal Government.

Irradiated fuel, if it is to be disposed of or stored for long periods, requires consideration and care over the same long periods of time as the high-level waste from reprocessing. In fact, irradiated fuel contains all of the fission products and transuranium elements in high-level waste plus the additional plutonium that is not extracted by reprocessing, and it would require long-term care similar to that required for high-level waste from reprocessing.

Thus, the proposed facility would not be subject to NRC licensing because of the current definition in NRC regulations of high-level waste. While NRC believes that it could redefine high-level waste to include spent fuel, its authority to do so remains unclear.

6.3.3.3 International Situation

Obviously, a shortage of domestic spent fuel storage capacity will limit the options the United States has to accomplish its nonproliferation objectives. The tie-in between the two subjects was noted by President Carter in his April 7, 1977, statement on nuclear power and nonproliferation issues:

> We will continue discussions with supplying and recipient countries alike, of a wide range of international approaches and frameworks that will permit all nations to achieve their energy objectives while reducing the spread of nuclear explosive capability. Among other things, we will explore the establishment of an international nuclear fuel cycle evaluation program aimed at developing alternative fuel cycles and a variety of international and U.S. measures to assure access to nuclear fuel supplies and <u>spent fuel storage</u> for nations sharing common non-proliferation objectives. [Emphasis added.]

The urgency with which this situation must be addressed is emphasized by DOE figures which indicate that by 1986 unless additional storage capacity or fuel disposition capability is available, the overwhelming majority of all currently operating foreign reactors would have inadequate storage for normal fuel discharges.

One possible solution to this problem which has received widespread attention in recent months is the storing of foreign spent fuel in the United States. Indeed, DOE's release of October 18, 1977, endorses this position to a limited extent:

> Although this spent fuel policy will have its primary impacts domestically, the U.S. Government also intends, in support of its non-proliferation goals, to extend the offer to foreign users on a limited basis. At the same time, the U.S. is encouraging other nations to expand their own storage capacity and is strongly supporting the study of regional or international storage sites.
>
> Under this policy, the U.S. would be prepared to store limited foreign spent fuel when this action would contribute to meeting non-proliferation goals. The U.S.'s ability to negotiate more effective non-proliferation measures with foreign countries and to prevent premature entry into the plutonium economy will be enhanced by this policy. It is expected that foreign spent fuel will be a small part of the total spent fuel stored in the U.S.
>
> Although specific details remain to be worked out, arrangements for storage of spent fuel from foreign users would probably be on the same terms as domestic spent fuel, subject to appropriate limitations established later.[19]

President Carter elaborated upon this statement at the opening session of the International Nuclear Fuel Cycle Evaluation Conference, saying,

> We are very eager also to help solve the problem of the disposal of spent nuclear fuel itself. We cannot provide storage for the major portion of the world's spent fuel, but we are willing to cooperate. And when a nation demonstrates to us your need for spent nuclear fuel storage, we hope to be prepared to accept that responsibility, working closely with you.[20]

While the outlines of the Administration's policy indicate that the U.S. will store foreign spent fuel only upon the request of the other nation, existing agreements for cooperation give the United States the right to designate the facilities in which fissionable material in excess of the recipient's peaceful needs is to be stored, with a United States option to purchase the excess fuel. As of this time, there has never been a return to the United States of low-enriched uranium in the form of spent fuel elements. However, high-enriched uranium originating in the U.S. has been returned in such a form from Japan, South Africa and Sweden.

The ability of the United States to store foreign spent fuel could have been hampered by the so-called McClure Amendment if it had become law. The amendment, an addition to the ERDA authorization bill as passed by Congress but vetoed by President. Carter would have precluded the Secretary of Energy from using funds made available under the Congressional budget process to repurchase, transport, or store any foreign-generated spent nuclear fuel. The amendment provided an exception if the President determines that (1) use of funds to repurchase, transport or store such fuel is required by an emergency situation, (2) it is in the interest of the common defense and security of the United States to take such action, and (3) he notifies the Congress of the determination and action, with a detailed explanation and justification thereof. If this amendment had become law, annual approval of foreign spent fuel handling by the United States would have been required, introducing uncertainties into the program.

FOOTNOTES

[1] Atomic Energy Act of 1954, as amended, 42 U.S.C. §2011 et seq.; Energy Reorganization Act of 1974, 42 U.S.C. §5801 et seq.

[2] NRC Policy Statement on Spent Fuel Storage, 40 Fed. Reg. 42801 (Sept. 16, 1975).

[3] Id.

[4] 10 C.F.R. 50.34(a).

[5] 10 C.F.R. Pt. 50, App. A, Criterion 61.

[6] 10 C.F.R. Pt. 50, App. A, Criterion 62.

[7] 10 C.F.R. 10.57 (a)(3)(1).

[8] 10 C.F.R. Pt. 51. The Commission recently has denied a petition by the Natural Resources Defense Council seeking to require the NRC to make a difinitive waste management finding prior to issuance of an operating license. NRC (1976). The matter is now on appeal before the Second Circuit (Docket No. 775147).

[9] 10 C.F.R. 50.91.

[10] Vermont Yankee Docket No. 50-271, O L No. DPR-28 Amdt. (Increase spent Fuel Storage) (Aug. 31, 1977).

[11] 10 C.F.R. 70.23(a).

[12] 10 C.F.R. Pt. 51.

[13] 10 C.F.R. 70.23(a)(7)

[14] 10 C.F.R. 70.

[15] See, e.g., ALAB-334, 3 NRC 809 (1976).

[16] Testimony of Lee V. Gossick, Esecutive Director, NRC, Congressional Testimony of August 1, 1977, before the House Committee on Interstate and Foreign Commerce.

[17] Energy Reorganization Act of 1974, 42 U.S.C. §5801 et seq.

[18] Testimony of Clifford V. Smith, Jr., NRC Director, Office of Nuclear Materials, Safety and Safeguards, May 16, 1977, before the House Committee on Interior and Insular Affairs.

[19] Department of Energy Press Release, "DOE Announces New Spent Nuclear Fuel Policy," October 18, 1977.

[20] Statement by President Carter, INFCE Meeting, October 19, 1977.

6.3.4 Export-Import

The Nuclear Regulatory Commission is responsible for licensing the export and import of utilization and production facilities as well as source, byproduct and special nuclear materials.[1] The exercise of this role, however, requires close coordination with the Executive Branch, and the Commission has developed intricate procedures over the past several years to enable it to do so.[2] Nevertheless, it would be mistaken to assume that export and import licensing exists independently of the broad framework of U.S. international nuclear cooperation, and this section shall attempt to view it in that broader perspective.

6.3.4.1 Exports

6.3.4.1.1 Agreements for Cooperation

A prerequisite to the export of nuclear facilities or materials is the existence of an agreement for cooperation between the United States and the recipient negotiated pursuant to conditions set forth in Section 123 of the Atomic Energy Act of 1954. This agreement establishes the basic terms, conditions and safeguards provisions which govern the recipient's use of U.S.-supplied material and equipment. While the Department of Energy has statutory responsibility for entering into an agreement,[3] a number of agencies also participate in its formulation and negotiation. In fact, its negotiation occurs under the approval and broad foreign policy direction of the Secretary of State.[4] In sensitive cases extensive interagency studies, sometimes requiring

Presidential approval, are undertaken within the framework of the National Security Council prior to the initiation of negotiations. As might be expected, the content of the final agreement reflects the United States perception of a wide number of factors, including the prospective cooperating nation's political stability, its overall relationship with the U.S. and its general policy toward the spread of nuclear weapons. After completion of the negotiations, the President must review the proposed agreement and determine in writing that it does not pose an unreasonable risk to the common defense and security of the United States. The President then submits the proposed agreement to the Congress for its examination. It becomes effective sixty days after submission unless the Congress disapproves by concurrent resolution.[5]

LIST OF AGREEMENT NATIONS

Country	Effective Date	Termination
	Research and Power Agreements	
Argentina	July 25, 1969	July 24, 1999
Australia	May 28, 1957	May 27, 1997
Austria	January 24, 1970	January 23, 2014
Brazil	September 20, 1972	September 19, 2002
Canada	July 21, 1955	July 13, 1980
China, Rep. of	June 22, 1972	June 21, 2014
Finland	July 7, 1970	July 6, 2000
Italy	April 15, 1958	April 14, 1978
Japan	July 10, 1968	July 9, 2003
Korea	March 19, 1973	March 18, 2014
Norway	June 8, 1967	June 7, 1997
Philippines	July 19, 1968	July 18, 1998
Portugal	June 26, 1974	June 25, 2014
South Africa	August 22, 1957	August 21, 2007
Spain	June 28, 1974	June 27, 2014
Sweden	September 15, 1966	September 14, 1996
Switzerland	August 8, 1966	August 7, 1996
Thailand	June 27, 1974	June 26, 2014
United Kingdom	July 21, 1955	July 20, 1976
Venezuela	February 9, 1960	February 8, 1980

LIST OF AGREEMENT NATIONS

Country	Effective Date	Termination
	Research Agreements	
Columbia	March 29, 1963	March 28, 1977
Greece*	August 4, 1955	August 3, 1974
Indonesia	September 21, 1960	September 20, 1980
Iran	April 27, 1957	April 26, 1979
Ireland	July 9, 1958	July 8, 1978
Israel	July 12, 1955	April 11, 1977
Turkey	June 10, 1955	June 9, 1981
Viet Nam, Rep.**	July 1, 1959	June 30, 1979
	Power Agreements	
India	October 25, 1959	December 31, 1985
United Kingdom	July 15, 1966	July 14, 1976
	International Cooperation	
EURATOM	February 18, 1959	December 31, 1985
EURATOM (Add'l)	July 25, 1960	December 31, 1995
IAEA	August 7, 1959	August 6, 2014

* Superseding, research and power agreement in abeyance; U.S. material by IAEA (NPT) safeguards and Greek "peaceful uses" guarantees.

** In abeyance.

6.3.4.1.2

Safeguards Under Existing Agreements for Cooperation

The earliest bilateral agreements under the Atomic Energy Act of 1954 set the tone for subsequent agreements. While the agreements required the recipient to submit detailed records and reports, they also allowed for on-site inspection by outside inspectors with "access to all places and data necessary" to ensure that the peaceful use guarantee was being observed. Furthermore, the United States required that the recipient agree to the U.S. right to designate the facilities in which produced fissionable material in excess of the recipient's peaceful needs was to be stored with a United States option to purchase the excess material. Additionally, under most existing agreements for cooperation, the U.S. has various rights of approval governing the reprocessing and storage of U.S.-supplied materials under effective safeguards, as well as the right to approve retransfers of plutonium produced therein. While these rights differ between agreements, the prevailing criterion for approval is that adequate safeguards must apply to the activities. Requests for reprocessing of U.S.-supplied power related fuel has involved only a few developed countries which have desired the produced plutonium for research and testing in reactor concepts. In future cases where special sensitive circumstances may convince the U.S. that reprocessing or plutonium storage in a particular country should be specifically precluded, the U.S. may require the inclusion of appropriate supplemental provisions in a proposed agreement for cooperation or in the interpretive notes that sometimes accompany the agreements. Thus, the proposed arrangements with Israel and Egypt include stipulations that any fuel reprocessing as well as the storage and fabrication into fuel elements of recovered plutonium would take place outside the recipient countries, at locations to be approved by the U.S. On the other hand, some countries, notably NPT parties in stable regions, contend that these particular kinds of restrictions are unacceptable in view of their commitments under the NPT to foreswear nuclear explosives and accept IAEA safeguards on their entire civil nuclear programs. While recognizing such concerns, the U.S. has been endeavoring to discourage the further spread of national reprocessing capabilities even in some NPT nations, by encouraging cooperating nations to look at alternatives.[6]

The United States has suspended the on-site inspection provisions in lieu of IAEA safeguards except for isolated instances. Not coincidentally, the provisions of Article XII of the Statute of the International Atomic Energy Agency which amplify the nature of those safeguards parallel those in the United States bilateral arrangements. The IAEA applies its safeguards either under a trilateral arrangement or as provided in the bilateral agreement concluded pursuant to Article II of the Nonproliferation Treaty.

If the applicable IAEA safeguards agreement should be terminated before expiration of the U.S. agreement and the parties fail to agree promptly on resumption of IAEA safeguards, either party may terminate the agreement. In the event of termination, and upon U.S. request, the recipient nation will return all special nuclear material received and still in its possession or in the possession of persons under its jurisdiction. In such a case the U.S. will compensate that nation for the returned material.[7]

Section 6.4.4.4.1.3. - Export Licensing

Although the agreement for cooperation establishes the framework for nuclear cooperation, nuclear facilities and materials cannot be exported until the NRC finds that the proposed export falls within the scope of that agreement and is not inimical to the common defense and security of the United States.[8] The former finding is relatively easy; it need not be dwelt upon here.[9] The common defense and security standard is not so easily determined.

In the first Tarapur[10] case the Commission commented upon the reason for this second common defense and security determination--

> The periods over which Agreements for Cooperation may be effective (up to 40 years) make it understandable why the initial common defense and security determination, made before entering into a particular Agreement, is not dispositive of whether an individual export, years or decades later, is inimical to the nation's common defense and security. In any event, by its terms, the Atomic Energy Act provides for periodic reexamination of these issues through the export licensing process.[11]

In this reexamination the Presidential finding "is entitled to great weight as an assessment of the circumstances at the time of the Agreement's execution."[12] Here, however, the Commission must make an independent determination, "giving due recognition to the weight to be accorded to Executive Branch views on such matters."[13]

The scope of the Commission's review is extremely broad. In the usual case the Commission asks the Executive Branch eight general questions to aid the NRC in its assessment. Of these, three relate to safeguards,[14] and three to foreign policy.[15] The Tarapur proceeding illustrates the range of issues the Commission must consider in making its common defense and security finding.[16] The Commission must take into account national non-proliferation policy as it relates to this case, the impact of various alternatives on relations with other countries and an assessment of the options realistically available. In its legislative hearing on Tarapur the Commission received information not only upon the adequacy of safeguards applicable to the material proposed for shipment but also on broader issues such as U.S. diplomatic efforts to gain Indian adherence to the NPT, the effect of the Indian nuclear program on Pakistani intentions to purchase a reprocessing facility, and the consequences for this nation's foreign policy of granting, denying or delaying the export license.[17]

6.3.4.1.3 Proposed Legislation

Recent developments increase the possibility that new legislation will substantially affect the export framework outlined above.[18] Although the ultimate form of the legislation is unknown at this time, it undoubtedly will elaborate upon the "common defense and security" standard, focusing upon the need to establish criteria for export licensing, negotiation of new agreements for cooperation and the renegotiation of existing agreements.

The legislation primarily will implement its policy objectives by adopting export licensing criteria. In all likelihood, it will adopt a two phase concept. Effective immediately upon enactment of the legislation, the NRC before issuing an export license will be required to find that the recipient has agreed to (1) NPT-type safeguards on all U.S.-supplied and derived materials and equipment, (2) forego nuclear explosives, (3) U.S. approval over retransfer and reprocessing for both U.S.-supplied and derived materials, (4) adequate physical security measures and (5) make any sensitive nuclear export technology exports subject to the same controls. (For some period of months the IAEA and Euratom will be exempted from complying with the third condition to allow time for the tricky Euratom negotiations.) After eighteen months, however, all recipients will be required to adopt full fuel cycle safeguards. Obviously, the adoption of these criteria will require the renegotiation of most, if not all, of the agreements for cooperation.

Other notable provisions of this legislation include:

* authority which would allow the President to review and/or override an NRC finding that it could not approve a proposed license where the Executive Branch had recommended approval of the license;
* new procedures for review of future agreements for cooperation, including a requirement that the Arms Control and Disarmament Agency submit an unclassified "Nuclear Proliferation Assessment Statement" to the President;
* allowing DOE to approve retransfers and reprocessing only after considering the size and scope of the activities involved, the nonproliferation policies of the country or countries involved, and whether the proposed action would give the United States timely warning of any diversion of the materials for explosive purposes; (the legislation likely will provide an exception for reprocessing at existing facilities provided that the United States "attempts to ensure" that the same standard will be applied);
* the President may exempt a nation from any of the requirements in a new or renegotiated agreement for cooperation if he determines that inclusion of any such requirement would be "seriously prejudicial to the achievement of United States' nonproliferation objectives or otherwise jeopardize the common defense and security;"

* the President may exempt a nation from any of the export licensing criteria under a similar test; and
* the Congress may overturn any of these exemptions if one House of Congress disapproves. (One should note that this remains a significant area of contention between the Administration and the Congress.)

6.3.4.1.4 Miscellaneous

Commitments to export. By signing an agreement of cooperation with another nation, the United States agrees to cooperate in the achievement of the uses of atomic energy for peaceful purposes. This commitment is qualified--

> subject to the provisions of this Agreement, the availability of personnel and material, and the applicable laws, regulations, and license requirements in force in their respective countries at the time of any cooperative activity.[19]

As a nuclear weapons state party to the Nonproliferation Treaty (NPT),[20] the United States incurred certain responsibilities. In the negotiation of the Treaty, many non-nuclear weapons states (NNWS) wanted to be assured that by becoming parties to the NPT they would not be deprived of the peaceful advantages of nuclear energy, if they were in turn prepared to relinquish their sovereign right to develop nuclear explosives and accept international safeguards on their entire civilian nuclear program. In particular, Article IV provides that parties to that Treaty shall cooperate in the fullest possible exchange of equipment, materials, and scientific and technological information for the peaceful uses of nuclear energy. It also provides that parties in a position to do so shall cooperate in contributing alone or with other states or international organizations to the further development of peaceful applications, especially in NNWS parties to the Treaty, with due consideration for the needs of the developing areas of the world. The formulation of this article was of great interest to the NNWS as a means of protecting and facilitating what they felt to be their "inalienable right" to pursue the peaceful uses of atomic energy, in conformity with Article II of the NPT (by which they agree not to acquire nuclear explosive devices), and to obtain assistance from nuclear-weapons states in this regard. In effect, the U.S., U.S.S.R., and U.K. were required to offer incentives such as Article IV as a quid pro quo for obtaining the agreement of NNWS not to acquire nuclear weapons or other nuclear explosive devices and to accept IAEA safeguards on their peaceful nuclear programs.

Export restrictions. United States nuclear trade has gradually grown more restrictive over the past few years. As evidenced by the material above, there has been a tightening of the conditions under which the United States will supply equipment and materials abroad during this time. This trend also has manifested itself by United States participation in several informal arrangements among supplier states in the nuclear area. In addition, the U.S. has refused to export certain sensitive items, such as enrichment and reprocessing facilities, as a matter of policy, and placed pressure on other suppliers to likewise refrain from such trade.

All major suppliers, with the exception of France, have agreed upon the so-called "Zangger List" meant to implement Article III of the NPT. The inclusion of an item on this list meant that its export would trigger IAEA safeguards designed to ensure that these items were not used in any way for the development of nuclear explosives and also to provide assurances that none of these items was re-exported without similar safeguards. The "trigger list" included complete reactors, reactor components and certain important materials such as heavy water and nuclear-grade graphite which are essential for the operation of certain types of reactors.[21]

The Zangger List consultations were, in a very real sense, a forerunner of the discussions which became known as the London Suppliers Conference. The initial concerns of the nuclear suppliers found their first formal expression in the final declaration of the NPT Review Conference held in Geneva in May 1975. This declaration, adopted by consensus, urged that common export requirements relating to safeguards be strengthened.

By January 1976 participants in the London Suppliers Conference had reached agreement on a broad number of fronts and exchanged letters which moved the level and comprehensiveness of some areas of the international legal regime substantially beyond that contained in the NPT. In these letters the major suppliers agreed to the application of IAEA safeguards on exports of material, equipment and technology and replicated technology to preclude their use in nuclear explosive devices, including those for peaceful purposes. They also agreed to apply restraint in the transfer of sensitive technologies and accept special conditions governing the use or retransfer of sensitive material, equipment, and technologies. Consistent with this, they pledged to encourage multinational regional facilities for reprocessing and enrichment. Finally, the suppliers agreed to require physical security measures on exported nuclear facilities and materials.[22]

As a result of these agreements, the United States formalized its policy of restraint in permitting "sensitive exports," including enrichment, reprocessing, and heavy water production.[23] Additionally, the United States launched an aggressive campaign to void the French sale of reprocessing plants to South Korea and Pakistan, and diplomatic pressure was used to improve the comprehensive sales package between West Germany and Brazil.

Concurrent with these developments, the passage of the International Security Assistance and Arms Export Control Act of 1976 prohibits the use of funds under either the Foreign Assistance Act or Arms Control Act for economic or military assistance to any country that delivers or receives "nuclear reprocessing or enrichment equipment, materials, or technology" unless--

1. The supplier and recipient countries have agreed to place all items "under multilateral auspices and management when available;" and

2. The recipient has agreed with the IAEA to place all its "nuclear fuel and facilities," as well as the transferred items, under the IAEA safeguards system.[24]

The President however may make an exception where he determines that termination of assistance would have a serious adverse effect on vital U.S. interests and he has reliable assurances that the country will neither acquire nor develop nuclear weapons, or assist other countries to do so. Any such Presidential determination would be subject to a Congressional veto by the passage of a joint resolution.

Liability. The Price-Anderson Act indemnity provisions do not apply to exports; they cover the material only before it leaves the territorial limits of the United States. By definition in the Atomic Energy Act "United States" includes "all Territories and possessions of the United States, the Canal Zone and Puerto Rico."[25]

Section 6.4.4.4.2. - Imports

Under the Atomic Energy Act of 1954 the NRC is authorized to issue licenses for the import of special nuclear material[1] where the Commission finds that issuance of the license would not be inimical to the common defense and security or would constitute an unreasonable risk to the health and safety of the public.[2] Unlike exports, imports need not occur pursuant to an agreement for cooperation, and the foreign affairs aspects of the transaction are de-emphasized. The Commission will forward the application to the Department of State only where it involves a subsequent re-export. In such cases the NRC will request the Executive Branch's preliminary views on whether it foresees any obstacles relating to the re-export that would affect the decision on issuance of the import license or whether there are other circumstances which should be considered in the Commission's licensing decision. No decision allowing import will prejudice the review for any subsequent re-export.[3]

Import licenses also involve health and safety considerations--and the possible requirement for an environmental impact statement under the National Environmental Policy Act[4]--which are absent from the export context. The NRC has never fully elaborated upon this determination,[5] and the proposed regulations governing imports do not provide further details.[6] Whether an environmental impact statement would be required depends on a NRC determination that its decision does or does not constitute "a major Federal action significantly affecting the environment." Materials licenses are specifically mentioned in the NRC regulations as not requiring such a statement,[7] but the Commission is given flexibility to do so if the occasion warrants.[8]

The health and safety and environmental concerns gain added significance with the Administration's recent announcement that it will accept a limited amount of foreign spent fuel for storage in the United States. While it is unclear whether this activity will be subject to NRC licensing,[9] the Administration's proposed generic environmental statement on the program will, in part, be devoted to the international effects of the proposal.[10]

Imports are covered by the Price-Anderson indemnity provisions only upon entering the territorial limits of the United States.

FOOTNOTES

6.3.4.1 Exports

[1]NRC jurisdiction over the export and import of nuclear facilities and material may be found in Sections 53, 103, 104 and 109 of the Atomic Energy Act of 1954, as amended, 42 U.S.C. §2011 et seq. The Energy Reorganization Act of 1973 transferred this authority to the Commission, 42 U.S.C. §5841(f).

While this section focuses on the NRC's authority, other agencies also have authority in this regard. DOE authorizes government-to-government transfers, nuclear-related technology and the so-called subsequent arrangements. The Department of Commerce's Office of Export Administration grants permits for nuclear industry exports not otherwise regulated. See also fn. 17.

[2]The Commission discussed these procedures in great detail in its ASCO II decision. Westinghouse Electric Corp., CLI-76-9, NRCI-76/6 739 (June 21, 1976) (hereinafter cited as ASCO II). These procedures would be codified in NRC proposed regulations. 42 Fed. Reg. 33317 (1977).

[3]42 U.S.C. §5814(c).

[4]Executive Order No. 10841 (Sept. 30, 1959).

[5]Prior to October 26, 1974 there was no Congressional veto; proposed agreement did have to lay before the Joint Committee on Atomic Energy for 30 days however.

[6]Address by President Carter before the Plenary Session of the International Nuclear Fuel Cycle Evaluation Conference, October 19, 1977.

[7]See, e.g., Atomic Energy: Cooperation for Civil Uses; Agreement between the United States of America and Austria, Art. XIII(c).

[8]The Commission has taken the view that the health and safety impact in foreign nations of exported nuclear materials is outside the jurisdiction of the Commission. Edlow International Co., CLI-76-6, NRCI-76/5 563, 582-84 (May 7, 1976) (hereinafter cited as Tarapur); ASCO II, supra note 2, at 754.

The Commission's position in interpreting the requirements of the National Environmental Policy Act is that only domestic environmental impacts need to be considered. Consequently an EIS is normally not required in the export licensing context. See Babcock and Wilcox, CLI 77 _, NRCI-77/6_, (June 22, 1977). These positions have been taken despite pressures to the contrary from the Council on Environmental Quality.

[9]See also ASCO II, supra note 2, at 743-44.

[10]This proceeding marked the first petition to intervene in an export matter ever received by the NRC. The Commission concluded that even though petitioners did not have standing it would hold a public hearing as a matter of discretion. This hearing was held on July 20 and 21, 1976.

[11]Tarapur, supra note 8, at 586.

[12]Id.

[13]Id.

[14]One of these questions related to the adequacy of the recipient state's physical security arrangements. Traditionally the adoption of physical security measures was considered the responsibility of the individual state. With the increased terrorist activity of the past several years, however, the U.S. has become increasingly sensitive to such matters and is encouraging the adoption of an international convention on the subject. The proposed legislation, discussed infra, almost certainly will require an NRC finding prior to issuance of a license that the physical security of the recipient is adequate. See also text accompanying footnote 23.

[15]See extended discussion in ASCO II, supra note 2, at 756-70 (dissent). The two other questions relate to the purpose of the proposed export and whether it is covered by an agreement for cooperation.

[16]Tarapur, supra note 8, at 585.

[17]There are also other steps in the nuclear export process. After the issuance of a license, DOE, in consultation with other agencies, has responsibility for entering into any "subsequent arrangements," such as approval for the re-export of nuclear materials and arrangements for the reprocessing of storage of irridiated nuclear fuel. Additionally, the process may include a DOE contractual commitment to supply enriched uranium and Export-Import Bank funding.

[18]H.R. 8638 passed the House of Representatives September 28, 1977. S. 897 was reported from the appropriate Senate committees on October 3, 1977.

[19]See, e.g., the Austrian Agreement for Cooperation, supra note 7, Article III.

[20]Treaty on the Nonproliferation of Nuclear Weapons, 21 U.S.T. 483, TIAS 6839.

[21]See generally Kratzer, Nuclear Cooperation and Non-Proliferation, 17 Atomic Energy L.J. 250, 282-83 (1976).

[22]Hearings on S. 1439 before the Senate Committee on Government Operations, 94th Cong., 2d Sess., at 792 (testimony of Secretary of State Henry A. Kissinger).

[23]Id.

[24]P.L. 94-329, §669.

[25]42 U.S.C. §2014(bb).

6.3.4.2 Imports

[1]42 U.S.C. §2073(a).

[2]42 U.S.C. §2077(c).

[3]See proposed §110.41(b), 42 Fed. Reg. 33317 (1977). This regulation would formalize existing practice.

[4]See Appendix A.

[5]The Commission has never issued a decision in the import licensing context, although it has issued import licenses.

[6]42 Fed. Reg. 33317 (1977).

[7]10 C.F.R. §51(d)(4).

[8]10 C.F.R. §51(d).

[9]NRC's authority over DOE's facilities is discussed in Appendix C. See also the discussion in Chapter IV, Parts B and C.

[10]See Department of Energy Statement, R-77-017 (October 18, 1977).

6.3.5 Closing

The increased need for spent fuel facilities under the Carter Administration's no-reprocessing policy will necessitate a world-wide effort to alleviate the problem. Since such efforts historically has involved strict national supervision, the above section on the legal/regulatory framework has dealt with these matters which would be of primary importance to any potential operator of a centralized spent fuel storage facility. As this framework changes, new matters may come to the fore. Additionally, some restraints in the current legal/regulatory framework may be circumvented through the establishment of a multi-national effort -- a proposal which, obviously, would create new concerns of its own. As a result, the conclusions reached should be re-evaluated periodically to take into account such additional considerations.