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**International
Nuclear Fuel Cycle
Fact Book**

K.M. Harmon
L.T. Lakey
I.W. Leigh
A.G. Jeffs

Issued November 1980
Latest Revision January 1985

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Pacific Northwest Laboratory
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INTERNATIONAL NUCLEAR
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PREFACE

As the US Department of Energy (DOE) and DOE contractors have become more and more involved in cooperative activities with other nations in nuclear fuel cycle and waste management activities, a need has developed for a ready source of information concerning foreign fuel cycle programs, facilities, and personnel. This Fact Book was compiled to meet that need.

The information contained herein has been obtained from many unclassified sources: nuclear trade journals and newsletters; reports of foreign visits and visitors; CEC, IAEA, and OECD/NEA activities reports; proceedings of conferences and workshops; etc.

The information in the Fact Book is subject to frequent change. If you have suggestions which would improve the usefulness of the book or uncover more current information, please let us know so that these changes can be included in periodic updates.

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TABLE OF CONTENTS

	<u>Page</u>
Introduction and Overview.	Intro-1
National Summaries	
Argentina.	AR-1
Australia.	AS-1
Austria.	AU-1
Belgium.	BE-1
Brazil.	BR-1
Canada.	CA-1
China (People's Republic of China).	CH-1
Denmark.	DA-1
Finland.	FI-1
France.	FR-1
Germany (Federal Republic).	GE-1
India.	IN-1
Italy.	IT-1
Japan.	JA-1
Korea (Republic of Korea).	KS-1
Mexico.	MX-1
Netherlands.	NL-1
Pakistan.	PK-1
South Africa.	SF-1
Spain.	SP-1
Sweden.	SW-1
Switzerland.	SZ-1
Taiwan (Republic of China).	TW-1
United Kingdom.	UK-1
United States.	US-1
USSR (Union of Soviet Socialist Republics).	UR-1
International Agencies	
CMEA (Council for Mutual Economic Assistance).	Intl-1
EC (European Communities).	Intl-2
IAEA (International Atomic Energy Agency).	Intl-5
ICRP (International Commission on Radiological Protection).	Intl-7
OECD Nuclear Energy Agency (NEA).	Intl-8
Energy Supply and Demand.	Energy-1
Fuel Cycle.	Fuel-1
Travel Aids	
International Dialing Instructions.	Aids-1
International Standard Time Chart.	Aids-2
Passport and Visa Requirements.	Aids-3
Currency Exchange Rates.	Aids-4
Distribution List.	Distr-1

ACRONYMS

ORGANIZATIONS AND FACILITIES

AAEC	Australian Atomic Energy Commission
AEB	Atomic Energy Bureau (Korea)
AEC	Atomic Energy Commission (Korea)
AEC	Atomic Energy Council (Taiwan)
AECB	Atomic Energy Control Board (Canada)
AECL	Atomic Energy of Canada, Limited
AERB	Atomic Energy Regulation Board (India)
ANDRA	Agence Nationale pour la Gestion des Déchets Radioactifs (France)
AWRE	Atomic Weapons Research Establishment (UK)
BARC	Bhabha Atomic Energy Centre (India)
BGR	Bundesanstalt für Geowissenschaften und Rohstoffe (FRG)
BMFT	Bundesministerium für Forschung und Technologie (FRG)
BMI	Bundesministerium des Innern (FRG)
BNFL	British Nuclear Fuels Limited
BRE	Building Research Establishment (UK)
BRGM	Bureau de Recherches Géologiques et Minières (France)
CANMET	Canada Centre for Metals and Energy Technology
CDTN	Centro de Desenvolvimento de Tecnologia Nuclear de Nuclebrás (Brazil)
CEA	Commissariat à l'Énergie Atomique (France)
CEC	Commission of the European Communities
CEGB	Central Electricity Generating Board (UK)
CEN/SCK	Centre d'Études de l'Énergie Nucleaire/ Studiecentrum voor Kernenergie (Belgium)
CEN-CA	Centre d'Études Nucléaires de Cadarache
CEN-FaR	Centre d'Études Nucléaires de Fontenay-aux-Roses (France)
CEN-G	Centre d'Études Nucléaires de Grenoble (France)
CEN-S	Centre d'Études Nucléaires de Saclay
CFC	COGEMA Framatone Combustible (France)
CMEA	Council for Mutual Economic Assistance
CNEA	Comisión Nacional de Energía Atómica (Argentina)

CNEN	Commissao Nacional de Energia Nuclear (Brazil)
CNSNS	Comisión Nacional de Seguridad Nuclear y Salvaguardias (Mexico)
COGEMA	Compagnie Générale des Matières Nucléaires (France)
CPE	Countries with Centrally Planned Economies
CRIEPI	Central Research Institute of Electric Power Industry (Japan)
CRPPH	Committee on Radiation Protection and Public Health (NEA)
CSN	Consejo de Seguridad Nuclear (Spain)
DAM	Direction Des Applications Militaires
DBE	Deutsche Gesellschaft zum Bau und Betrieb von Endlagern für Abfallstoffe mbH (FRG)
DHI	Deutsches Hydrographisches Institut (FRG)
DOE	Department of the Environment (UK)
DWK	Deutsche Gesellschaft für Wiederaufar- beitung von Kernbrennstoffen mbH (FRG)
EC	European Communities
ECN	Energy Centrum Nederland
EIR	Eidgenössisches Institut für Reaktor Forschung (Switzerland)
EMR	Energy, Mines and Resources (Canada)
ENEA	Energia Nucleare e Delle Energie Alternativa (Italy)
ENEL	Ente Nazionale per l'Energia Elettrica (Italy)
ENI	Ente Nazionale Idrocarburi (Italy)
ENUSA	Empresa Nacional del Uranio S.A. (Spain)
EPB	Electric Power Bureau (Korea)
ESCOM	Electricity Supply Commission (South Africa)
FBFC	Société Franco-Belge de Fabrication de Combustibles (France)
GIRIO	Government Industrial Research Institute- Osaka (Japan)
GSF/IFT	Gesellschaft für Strahlen-und- Umweltforschung mbH/Institut für Tief Lagerung (FRG)
HMI	Hahn-Meitner Institut (FRG)
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IGS	Institute of Geological Sciences (UK)

INER	Institute of Nuclear Energy Research (Taiwan)
ININ	Instituto Nacional de Investigaciones Nucleares (Mexico)
IPEN	Instituto de Pesquisas Energéticas e Nucleares (Brazil)
IPSN	Institut de Protection et de Sûreté Nucléaire(France)
IRDI	Institut de Recherche Technologie et de Developpement Industriel
JAERI	Japan Atomic Energy Research Institute
JEN	Junta de Energía Nuclear (Spain)
JRC	Joint Research Center (CEC)
KAERI	Korea Advanced Energy Research Institute
KBS	Kärnkraftavfallets Behandling och Slutförvaring(Sweden)
KEMA	N.V. Tot Keuring van Electrotechnische Materialen Arnhem (Netherlands)
KEPKO	Korea Electric Power Corporation
KEWA	Kernbrennstoff-Wiederaufarbeitungs-GmbH (FRG)
KFA	Kernforschungsanlage Jülich GmbH (FRG)
KfK	Kernforschungszentrum Karlsruhe GmbH (FRG)
KOPEL	Korea Power Engineering Company
KTM	Royal Institute of Technology
KWU	Kraftwerk Union AG (FRG)
LDC	Less Developed Country
MAFF	Ministry of Agriculture, Fisheries and Food (UK)
MITI	Ministry of International Trade and Industry
NAGRA/CEDRA	Nationalen Genossenschaft für de Lagerung Radioaktiver Abfälle (Switzerland)
NAK	Naemden foer Hantering av Atvaenr Kernsbrensl (Sweden)
NEA	Nuclear Energy Agency (OECD)
NII	Nuclear Installations Inspectorate (UK)
NIREX	Nuclear Industry Radioactive Waste Executive (UK)
NPT	Non-Proliferation Treaty
NRPB	National Radiological Protection Board (UK)
NSC	Nuclear Safety Commission (Japan)
NTL	Nuclear Transport Limited (UK, France and FRG)

OECD	Organization for Economic Cooperation and Development
ÖFZS	Österreichisches Forschungszentrum Seibersdorf GmbH (Austria)
ONDRAF	Organisme National de Déchets Radioactifs et des Matières Fissiles (Belgium)
PNC	Power Reactor and Nuclear Fuel Development Corporation (Japan)
PTB	Physikalisch-Technische Bundesanstalt (FRG)
RWC	Radioactive Waste Management Center (Japan)
RWMAC	Radioactive Waste Management Advisory Committee (UK)
RWMC	Radioactive Waste Management Committee (NEA)
SGN	Société Générale pour des Techniques Nouvelles (France)
SKI	Statens Kärnkraftinspektion (Sweden)
SRD	Safety and Reliability Directorate (UK)
STA	Science and Technology Agency (Japan)
TN	Transnucleaire (France)
UKAEA	United Kingdom Atomic Energy Authority
UKOR/UCOR	Uranium Enrichment Corporation (South Africa)
UNIREP or URG	United Reprocessors GmbH (FRG, France, UK consortium)
URAMEX	Uranio Mexicano
URENCO	British-German-Dutch uranium enrichment consortium
WAK	Wiederaufarbeitungsanlage Karlsruhe Betriebsgesellschaft mbH (FRG)
WOCA	World Outside Centrally Planned Economies Areas

TECHNICAL

AFR	Away-from-reactor spent fuel storage facility
AGR	Advanced gas-cooled reactor, UO ₂ fuel (UK)
ALONA	FRG acid digestion plant to be built at Mol, Belgium
ATR	Advanced thermal reactor

AVB	AVM-type HLW vitrification plant to be built at Eurochemic (Belgium)
AVH	AVM-type waste vitrification plant to be built at La Hague (France)
AVM	Atelier de vitrification de Marcoule (France)
BLWR	Boiling light water reactor
BWR	Boiling water reactor
CANDU	Canada deuterium uranium reactor
D&D	Decontamination and decommissioning
ESTER	Multistage pot calcination-vitrification process for HLW (Italy)
FBR	Fast breeder reactor
FBTR	Fast breeder test reactor
FIPS	Fission product solidification process (FRG/KFA)
FRP	Fuel reprocessing plant
GCHWR	Gas-cooled, heavy water moderated reactor
GCR	Gas-cooled, graphite moderated reactor
GWd	Gigawatt days
GWe	10 ⁹ watts of electricity (1000 MWe)
HAO	Oxide head-end
HARVEST	British waste vitrification process
HLLW	High-level liquid waste
HLW	High-level waste
HTGR	High-temperature, gas-cooled reactor
HTR	High-temperature reactor
HWLWR	Heavy water moderated, light water cooled (same as LWCHW)
HWR	Heavy water reactor
IFTF	Immobilized Fuel Test Facility (Canada)
ILW	Intermediate-level waste
KghM	Kilograms heavy metal
KgU	Kilograms uranium
LGR	Light water cooled, graphite moderated reactor
LHGW	Low heat generating waste
LLW	Low-level waste
LLLW	Low-level liquid waste
LMFBR	Liquid metal fast breeder reactor
LWCHW	Light water cooled, heavy water moderated (same as HWLWR)
LWR	Light water reactor
MLW	Medium-level waste (same as intermediate-level)
MOX	Mixed (plutonium/uranium) oxide

Mtce	Million metric tons of coal equivalent
Mtoe	Million metric tons of oil equivalent
MTR	Materials test reactor
MW	Megawatts
MWd/t	Megawatt days per tonne
MWe	Megawatts electric
MWt	Megawatts thermal
NPT	Non-Proliferation Treaty
PAMELA	West German vitrification pilot plant (Mol, Belgium)
PFR	Prototype Fast Reactor (UK)
PHWR	Pressurized heavy water reactor
PLWR	Pressurized light water reactor
PURR	Prototype d'usine de retraitement des rapids (France)
PWR	Pressurized water reactor
QUAD	10 ¹⁵ Btu
t/a	Tons per annum
tHM	Tons heavy metal
tSWU/a	Tons of separative work (uranium enrichment) per annum
tU	Tons uranium per annum
TEKO	Nonradioactive semi-works facility (FRG)
THORP	Thermal Oxide Reprocessing Plant (UK)
THTR	Thorium high-temperature reactor
Th/U	Thorium/Uranium
TRU	Transuranic
TWh	Terawatt hour (million megawatt hours)
URL	Underground Research Laboratory
WIP	Waste Immobilization Plant (India)

INTRODUCTION AND OVERVIEW

INTRODUCTION

The International Fuel Cycle Fact Book has been compiled in an effort to provide 1) an overview of worldwide nuclear power and fuel cycle programs and 2) current data concerning fuel cycle and waste management facilities, R&D programs and key personnel. Additional information on each country's program is available in the International Source Book: Nuclear Fuel Cycle Research and Development, PNL-2478, Rev. 2.

The Fact Book is organized as follows:

- Overview section--summary tables which indicate national involvement in nuclear reactor, fuel cycle, and waste management development activities.
- National summaries--a section for each country which summarizes nuclear policy, describes organizational relationships and provides addresses, names of key personnel, and facilities information.
- International agencies--a section for each of the international agencies which has significant fuel cycle involvement.
- Energy supply and demand--summary tables, including nuclear power projections.
- Fuel cycle--summary tables.
- Travel aids--international dialing instructions, international standard time chart, passport and visa requirements, and currency exchange rates.

TABLE 1. Reactor Mix

Country	No. of Reactors Online, Ordered, or Under Construction (06-30-84)				Advanced Reactor Development
	LWR	HWR	GCR	Other	
Argentina	--	3	--	--	--
Belgium	7	--	--	--	--
Brazil	3	--	--	--	--
Bulgaria	4	--	--	--	--
Canada	--	22	--	--	--
China (PR)	3	--	--	--	--
Czechoslovakia	10	--	--	--	--
Egypt	2	--	--	--	--
Finland	4	--	--	--	--
France	52	1	7	2 FBR	FBR
Germany (FRG)	26	--	--	1 FBR, 1 HTR	FBR, HTR
Germany (GDR)	7	--	--	--	--
Hungary	4	--	--	--	--
India	2	8	--	--	FBR
Italy	4	1	1	--	HWR
Japan	39	1	1	1 FBR	HWR, FBR
Korea (South)	8	1	--	--	--
Mexico	2	--	--	--	--
Netherlands	2	--	--	--	--
Pakistan	--	1	--	--	--
Philippines	1	--	--	--	--
Poland	6	--	--	--	--
Rumania	4	2	--	--	--
South Africa	2	--	--	--	--
Spain	17	--	1	--	--
Sweden	12	--	--	--	--
Switzerland	7	--	--	--	--
Taiwan	6	--	--	--	--
USSR	34	--	--	2 FBR, 23 LGR	--
UK	--	1	40	1 FBR	FBR
USA	134	--	--	1 HTR, 1 LGR,	HTR, FBR
Yugoslavia	1	--	--	--	--

TABLE 2. Fuel Production Program^(a)

Country	Mining ^(b) & Milling	Conver- sion	Enrich- ment	Fuel Fabrication	
				UO ₂	MOX
Argentina	X	X	R&D	X	R&D
Australia	X	--	R&D	--	--
Belgium	--	X	(c)	X	X
Brazil	X	X	X	X	--
Canada	X	X	--	X	--
France	X	X	X	X	X
Germany (FRG)	X	X	X	X	X
India	X	X	--	X	X
Italy	X	X	(c)	X	X
Japan	X	X	X	X	X
Korea (South)	R&D	R&D	--	R&D	--
Mexico	X	X	--	X	--
Netherlands	--	--	X	--	--
South Africa	X	X	X	--	--
Spain	X	--	--	X	--
Sweden	--	--	(c)	X	--
USSR	X	X	X	X	X
UK	--	X	X	X	X
USA	X	X	X	X	X
Yugoslavia	X	--	--	--	--

(a) Legend: X - industrial plant in operation or on order
R&D - R&D stages only

(b) Commercial mining and milling operations are also conducted in the following countries: Central African Republic, Gabon, German Democratic Republic, Namibia, Niger, Philippines and Portugal.

(c) Partnership in Eurodif enrichment plant in France.

TABLE 3. Spent Fuel Management and Waste Treatment Programs

Country	Spent Fuel Transport	Fuel Reprocessing	Waste Conditioning	
			HLW	Non-HLW
Argentina	--	R&D	R&D	X
Australia	--	--	R&D	--
Austria	--	--	R&D	R&D
Belgium	--	X	X	X
Brazil	--	R&D	R&D	R&D
Canada	--	R&D	R&D	X
Denmark	--	--	--	R&D
Finland	--	--	--	X
France	X	X	X	X
Germany (FRG)	X	X	X	X
India	--	X	X	X
Italy	--	X	R&D	X
Japan	X	X	X	X
Mexico	--	--	--	X
Netherlands	--	--	--	X
Spain	--	--	--	X
Sweden	X	--	R&D	X
Switzerland	--	--	--	X
USSR	X	X	R&D	X
UK	X	X	X	X
USA	X	X	X	X

Legend: X - commercial facility planned or operating
R&D - R&D stages only

TABLE 4. Spent Fuel and Waste Disposal R&D Programs

<u>Country</u>	<u>Spent Fuel Disposal</u>	<u>HLW Disposal</u>	<u>LLW/ILW Disposal</u>	<u>Spent Fuel Storage</u>
Argentina	--	X	X	X
Austria	--	X	--	--
Belgium	--	X	X	--
Brazil	--	--	X	--
Canada	X	X	X	X
Denmark	X	X	--	--
Finland	X	X	X	X
France	--	X	X	X
Germany (FRG)	X	X	X	--
Germany (DGR)	--	--	X	--
India	--	X	X	--
Italy	--	X	X	X
Japan	--	X	X	X
Mexico	--	--	X	X
Netherlands	--	X	X	X
South Africa	X	X	X	X
Spain	X	X	X	X
Sweden	X	X	X	X
Switzerland	X	X	X	X
USSR	--	X	X	X
UK	--	X	X	X
USA	--	X	X	X

NATIONAL SUMMARIES

ARGENTINA

MAJOR ARGENTINE HOLIDAYS (1985)

January 1	New Year
January 6	Epiphany
February 18-19	Carnival
April 4	Holy Thursday
April 5	Good Friday
May 1	Labor Day
May 25	Anniv. of 1810 Revolution
June 9	Corpus Christi
June 20	Flag Day
July 9	Independence Day
August 15	Assumption
August 17	Death of Gen. San Martín
October 12	Columbus Day
November 1	All Saints
November 6	Bank Holiday
December 8	Immaculate Conception
December 25	Christmas

ARGENTINA

ENERGY

Population	1984	30 million
Energy Demand	1979	40 Mtoe
Electric Power Plant Capacity	1980	12 GWe
Electric Power Production	1982	27.1 TWh-- 50% oil/coal 40% hydro/geoth 10% nuclear

NUCLEAR POWER

National Policy: High priority on self-sufficient CANDU-based nuclear power industry; government ownership and operation of all nuclear power plants; develop nuclear plant and services export capability.

Nuclear Power Plant Capacity	1984	0.9 GWe
	1985	0.9 GWe
	1990	1.6 GWe
	2000	3.0 GWe
Reactor Mix	1984	HWR: 2 (1974-83); 1 (1988)

INDUSTRIAL FUEL CYCLE

Policy: Develop domestic capability for D₂O production and all phases of the CANDU-type PHWR fuel cycle; may export Pu to breeder nations.

Waste Management Strategy: Build repository in granite formation, use it for interim (dry) storage of spent fuels until ready to dispose of HLW. (Characterization is under way of a potential repository site in Chubut Province in southern Argentina. Conceptual design for the repository places the gallery at a depth of about 500 m. The HLW package, with lead overpack, is designed for a thousand-year life.)

Argentina

Cumulative Spent Fuel 1980 416 tU
Arising (HWR) 1985 940 tU
1990 1,900 tU
2000 5,800 tU

Demonstration/Production Activities

- D₂O production: 1984--200 t/a D₂O enrichment plant, supplied by a Swiss firm; develop domestic technology.
- Uranium mining and milling (t/a): 1981--260; 1985--680.
- Conversion of yellowcake to UO₂.
- Uranium enrichment: 500 kg/a of 20% enriched U--1985.
- UO₂ fuel fabrication.

INTERNATIONAL RELATIONSHIPS

Member of IAEA but opposed to Non-Proliferation Treaty; signed but not ratified Tlatelcilo Treaty. Nuclear plants and technology purchased from Canada, FRG, and Switzerland. Technical cooperation with Latin America countries, primarily Brazil and Peru.

ORGANIZATION

- CNEA (Comision Nacional de Energía Atomica)--National Atomic Energy Commission, owns and operates all facilities.

CNEA (National Atomic Energy Commission)

Comision Nacional de Energía Atomica (CNEA)
Avenida del Libertador 8250
1429 Buenos Aires
Argentina

Tel: (54) 1 70 7711
Telex: 121 388

President

Alberto Constantini

EZEIZA ATOMIC CENTRE

Location: 10 miles northwest of Buenos Aires, near airport.

Facilities

- Conversion of yellowcake to UO_2 (150 tU/a).
- Fuel production: the first of three planned fabrication lines started up in 1982; capacity, 1-1/2 PHWR assembly per day; MOX fuel R&D.
- Fuel reprocessing: Ezeiza pilot plant, planned capacity of 20 kgU/day feed, 10-15 kgPu/a product; cold runs--1987. Potential--expansion of pilot plant to commercial facility by early 1990s.

AUSTRALIA

MAJOR AUSTRALIAN HOLIDAYS (1985)

January 1	New Year
January 29	Australia Day
April 5	Good Friday
April 8	Easter Monday
April 25	ANZAC Day
December 25-26	Christmas

AUSTRALIA

ENERGY

Population 1984 15.5 million

Energy Resources: production exceeds consumption by about 20%, but Australia imports 38% of its oil

Electric Power Production 1982 105.5 TWh--
69% coal
14% hydro/geoth
11% gas
6% oil

NUCLEAR POWER

National Policy: No nuclear power installed; none planned. Large uranium reserves; uranium currently produced for export, but labor government opposes opening new mines and has severely restricted mining activities. Government sponsors nuclear R&D, including development of: uranium enrichment technology, HTGR and LMFBF systems, and SYNROC process for immobilizing HLW.

ORGANIZATION

- Ministry of State for Resources and Energy.
- Australian Atomic Energy Commission.
- AAEC Research Establishment at Lucas Heights.

AAEC

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Director, Research	Dr. D. G. Walker
Deputy Director, Research	Dr. P. M. Kelly
Materials	Dr. K. U. Snowden
Environmental Science	Dr. D. R. Davy
Nuclear Technology	G. W. K. Ford

Fuel Cycle R&D: Uranium enrichment, HLW immobilization (SYNROC process development and waste form properties), mill tailings treatment (actinide transport, surface hydrology, and radionuclide release).

Facilities

- **Nonradioactive SYNROC Fabrication Plant**
Mission: Engineering-scale tests of SYNROC process.
Design Basis: 10 kg/hr SYNROC; no operations incompatible with remote operation; highly instrumented and partly automated.
Milestone: Commissioning, 1985/6.
- **SYNROC Glove Box Line**
Mission: Produce SYNROC containing actinides and ⁹⁹Tc.
Process Scale: Hundreds of grams.
History: Startup, 1984.
- Hot-Cell Processing Line for SYNROC**
History: Startup, 1984.

Australia

AUSTRALIAN NATIONAL UNIVERSITY

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Australia

Director, Research School of Prof. A. E. Ringwood
Earth Sciences

Waste Management R&D: HLW immobilization (SYNROC
process).

AUSTRIA

MAJOR AUSTRIAN HOLIDAYS (1985)

January 1	New Year
January 6	Epiphany
April 5	Good Friday
April 7-8	Easter
May 1	Labor Day
May 16	Ascension
May 26-27	Pentecost
June 9	Corpus Christi
August 15	Assumption
October 26	National Day
November 1	All Saints
December 8	Immaculate Conception
December 25-26	Christmas

AUSTRIA

ENERGY

Population	1983	7.6 million
Energy Demand	1979	27 Mtoe (50-60% imported)
Oil Demand	1980	12.7 Mtoe (88% imported)
Electric Power Plant Capacity	1980	13 GWe
Electric Power Production	1984	42.9 TWh-- 72% hydro/geoth. 10% oil 10% gas 8% coal

NUCLEAR POWER

National Policy: Government sponsors R&D on reactor safety, waste treatment and waste isolation. 0.7 GWe nuclear plant at Zwentendorf completed but not approved for operation. Exercise of nuclear option requires change in Austrian law; current government committed to startup.

INDUSTRIAL FUEL CYCLE

Policy: Initial--depend on foreign suppliers. Currently negotiating with China on long-term storage and disposal of spent fuel.

ORGANIZATION

- ÖFZS--Responsible for Austrian Research Center Seibersdorf LTD waste treatment and disposal R&D. Headquartered in Vienna with a laboratory at Seibersdorf.

GEOLOGICAL SURVEY

Geological Survey of Austria
Rasumofskygasse 23
A-1031 Wien
Austria

ÖFZS (Austrian Research Center Seibersdorf)

Österreichisches Forschungszentrum
Seibersdorf GmbH

Lenaugasse 10

A-1082 Vienna

Austria

Tel: (43) 222 42-7511

Telex: 07-5400

A-2444 Seibersdorf

Austria

Tel: (43) 2254 80-0

Telex: 014-353

Waste Management

Dr. Peter Krejsa

(43) 2254 80 2541

Incineration Material

Dr. Peter Patek

Test, Cementation

(43) 2254 80 2568

Bituminization

Dr. Karl Knotik

(43) 2254 80 2405

Owners: National government, industry, and electric utilities.

Waste Management R&D: HLW immobilization, LLW and ILW treatment, waste isolation in granite formations (geology, hydrology, heat transfer, corrosion, barrier materials, and risk analysis).

BELGIUM

MAJOR BELGIAN HOLIDAYS (1985)

January 1	New Year
April 7-8	Easter
May 1	Labor Day
May 16	Ascension
May 26-27	Pentecost
July 21	National Day
August 15	Assumption
November 1	All Saints
November 11	Armistice Day
December 25	Christmas

BELGIUM

ENERGY

Population	1983	9.9 million
Energy Demand	1982	41.6 Mtoe (84% imported)
Oil Demand	1982	19.8 Mtoe (100% imported)
Electric Power Plant Capacity	1982	15 GWe-- 23% nuclear
Electric Power Production	1982	50.7 TWh-- 38% coal 31% nuclear 24% oil 4% gas 2% hydro/geoth.
	1985	>60% nuclear

NUCLEAR POWER

National Policy: Complete the LWRs currently under construction; evaluate addition of an eighth (1300 MWe) unit.

Nuclear Power Plant Capacity	1984	3.5 GWe
	1985	5.4 GWe
	1995	6.7 GWe
	2000	8.0 GWe
Reactor Mix	1984	PWR: 5 (1975-83) 2 (1985)

INDUSTRIAL FUEL CYCLE

Policy: Well-rounded capability--uranium enrichment (share in Eurodif); MOX and UO₂ fuel fabrication; purchase of foreign reprocessing services; decision on resuming operation of former Eurochemic plant pending.

Belgium

Waste Management Strategy (responsibility of ONDRAF):
Vitrify HLW and store (50 years) in geologic formation
(investigation of HLW disposal in clay formation under
way); treat and immobilize other wastes; sea-dumping of
LLW halted (pending LDC approval); shallow-ground disposal
under investigation.

Cumulative Spent Fuel	1980	196 tU
Arisings (LWR)	1985	560 tU
	1990	1,290 tU
	2000	3,000 tU

Major Milestones

- Industrial repository (ILW, TRU) Late 1990s
- Startup of German HLW vitrification 1986
pilot plant (PAMELA) at Mol
- Vitrification plant (AVM Process) Proposed
- Decision on startup of renovated Late 1985
Eurochemic Reprocessing Plant
- Startup of Eurochemic Plant 1992

INTERNATIONAL RELATIONSHIPS

Member of EC, IAEA, and OECD-NEA. Partnership in
Belgian-Dutch-German FBR project, and in Eurodif enrich-
ment plant. Cooperative waste management agreement with
USDOE. Home of the Eurochemic Company and facilities.

ORGANIZATION

AE

Administration of Energy
Rue de Mot, 30
B-1040 Brussels
Belgium

Tel: (32) 2 233-6636
Telex: 23509 ENERGI B

BELGONUCLEAIRE

Belgonucleaire S.A.
Rue du Champ de Mars 25
B-1050 Brussels
Belgium

Tel: (32) 2 513-9700
Telex: 22187 nucbru b.

Nuclear Waste Projects L. M. Mergan

Mission: Provide engineering services for nuclear power plants, nuclear fuel cycle facilities, and waste treatment plants; fabricate MOX fuels.

Sponsors: CEN/SCK (50%), utilities and holdings (50%).

Facilities

Belgonucléaire MOX Plant (at Dessel, near Mol)
Mission: Produce MOX fuels for FBRs and LWRs.
Design Capacity: 38 t/a LWR fuel, 7 t/a FBR fuel.
History: Startup, 1973.

CEN/SCK (NUCLEAR ENERGY RESEARCH CENTER)

Centre d'Etude de l'Energie Nucleaire/
Studiecentrum voor Kernenergie

Laboratory of the C.E.N./S.C.K.
Boeretang 200
B-2400 Mol
Belgium

Tel: (32) 14 31-1801
Telex: Atomol 31922

General Manager	S. Amelinckx
Fuel Cycle	P. Dejonghe
Chemistry	L. H. Baetsle
Waste	N. L. C. Van de Voorde
Geological Disposal	A. A. Bonne

CEN/SCK (contd)

Sponsor: Federal government--Ministry of Economic Affairs and Industry.

Waste Management R&D: FBR fuel reprocessing (head-end and offgas treatment), incineration of TRU wastes, immobilization of cladding hulls, LLW treatment, geologic waste isolation in clay formations.

Facilities

- **HERMES Pilot Plant (Head-End Research facility on Mockup Engineering Scale)**
Mission: Develop head-end treatment technology for LWR fuels.
Design Basis: Chop-leach; silver zeolite and cryogenic treatment of offgas.
Process Components: Double-pin chopper, critically safe dissolver, centrifugal filtration for solution clarification, fuel residue dissolver, "super dissolver" for cleanup of hulls, offgas scrubbers, treatment of hulls by high-pressure compaction, encapsulation of compacted hulls.
Throughput: 10 kg irradiated fuel (20-30% PuO₂ in UO₂) per batch.
History: Hot operation, depending on authorization and budget allocation.
- **FLK Slagging Incinerator (radioactive)**
Mission: Volume reduction of combustible, and of selected noncombustible, low-activity TRU wastes.
Design Basis: High-temperature combustion (1200-1500°C); capacity, 50-100 kg/hr; product, insoluble granular slag.
History: First tests with Pu-bearing wastes (tens of grams Pu in several tons of waste), 1983.
- **CEN/SCK Bituminization Plant**
Mission: Immobilize Belgian LLW.
Design Basis: Stirred evaporator, batch process; capacity, 60-80 l/hr liquid LLW or 15-20 l/hr dried sludge.
History: Startup, 1964.

CEN/SCK (contd)

• **Underground Research Laboratory**

Mission: In-situ investigation in a deep clay formation to develop technology for disposal of ILW, TRU waste, and HLW.

Description: Access shaft to -230 m level, 2.65 m useful dia; laboratory gallery, 3.5 m useful dia by 30 m length; cast iron liner.

Test Program: Geomechanical behavior of clay around underground structures, water-flow measurements, in-situ heater tests, clay stability studies, liner stresses, borehole atmospheres, corrosion; test emplacement of HLW and TRU incinerator residues.

History: Laboratory operational, early 1984.

BELGO PROCESSING (Formerly Eurochemic)

Eurochemic

B-2400 Mol

Belgium

Tel: (32) 14 312 861-70

Telex: EUROCHEM ML 31 924

[Brussels National Airport (Zaventem); then by rental car, Eurochemic driver (1-1/2 hours), or train to Mol.]

Managing Director

Dr. E. J. Detilleux

Deputy Director

H. Eschrich

Industrial Development

J. Van Geel

Laboratories

Activities: Ceramic melter development (technical support to FRG PAMELA pilot plant being built at Mol), glass marble encapsulation in lead matrices, and non-HL waste conditioning.

Facilities

• **Eurowetcomb** (hot pilot plant-acid digestion)

Mission: Wet combustion of combustible TRU wastes and Pu recovery (ALONA acid digestion).

Design Basis: Acid digestion with $H_2SO_4-HNO_3$.

History: Startup, 1980.

EUROCHEMIC (contd)

- **Eurobitum** (bituminization plant)
Mission: Immobilize ILW.
Design Basis: Batch chemical pretreatment; screw extruder-evaporator (continuous); capacity, 650 m³/a ILW.
History: Startup, 1978; on-stream time, 87% through June 1983. Plant now operated batchwise.

- **Eurowatt** (hot pilot plant-solvent treatment)
Mission: Treat Purex (TBP-kerosene) solvent.
Design Basis: Extract TBP with concentrated H₃PO₄, pyrolyze H₃PO₄ fraction; capacity, 1 m³/day.
History: Startup, 1982. Now in standby position.

- **Eurochemic Fuel Reprocessing Plant**
Original Mission: Reprocess low- and high-enriched metal and oxide fuels from test reactors for Eurochemic partners.
Original Design Basis: Chemical decladding; PUREX flowsheet; contact maintenance. Capacity, 350 kgU/day for natural and low-enriched uranium fuels, 250 kgU/day for 1.6-5% ²³⁵U fuels, 5-10 kgU-Al/day for HEU fuels.
Operating History: Operated from 1966-1974, treating 180 tU in low-enriched fuels, including 100 tU in LWR/oxides, to yield 67 m³ HLW; 30 t high-enriched fuels, to yield 806 m³ HLW. The plant has been decontaminated and is now under Belgium ownership. Renovation and recommissioning is currently under study by a SYNATOM. Contacts with potential foreign partners being pursued.
Renovation Design Basis: 600 kgU/day; chop-leach head-end for LWR fuels.

- **ALONA Acid Digestion Plant** (see FRG/KfK).

- **PAMELA HLW Vitrification Pilot Plant** (see FRG/KEWA).

MINISTRY OF PUBLIC HEALTH AND ENVIRONMENT

Ministère de la Santé Publique
Service de Protection des Radiations Ionisantes
Quatier Vésale
B-1010 Brussels
Belgium

Tel: (32) 2 564-1755
Telex: 21034 IHEBRU

ONDRAF/NIRAS (NATIONAL INSTITUTE FOR RADIOACTIVE
WASTES AND FISSILE MATERIALS)

Organisme National des Déchets Radioactifs
et des Matières Fissiles (ONDRAF/NIRAS)
Boulevard du Regent 54
B-1000 Brussels
Belgium

Tel: (32) 2 513 7460
Telex: 65784 Nirond

Chairman, Board of Directors	M. Frerotte
Chairman, Perm. Tech. Committee	F. Deconinck
General Manager	E. Detilleux
Tech. Manager/Deputy General	F. Decamps
Manager, Exploitation	G. Claes

Sponsor: Government.

Mission: Provide for transportation of radioactive materials; waste conditioning and interim storage; spent fuel AFR storage; waste disposal; Pu storage; definition of waste management R&D requirements. Operate Eurochemic waste treatment facilities.

Organization: ONDRAF/NIRAS is governed by a Board of Directors composed of a president, vice-president, and board members representing various national ministries and local government executives. The Board is advised by a permanent Technical Committee.

SYNATOM

SYNATOM S.A.
Avenue Marnix, 13
B-1050, Brussels
Belgium

Tel: (32) 2 518-6666
Telex: 24152 SYNAT B

Chairman, Board of Directors
Managing Director
General Manager
Fuel Reprocessing Service

R. De Cort
R. Cayron
Pierre A. Erkes
Jean Danguy

Mission: Provide commercial fuel cycle and waste management services for the Belgian nuclear utilities.

Sponsors: SNI (50%), INTERCOM (20%), EBES (20%), UNERG (10%).

US EMBASSY - BRUSSELS

US Embassy
40 Boulevard du Regent, 83
B-1000 Brussels
Belgium

Tel: (32) 2 513-3830
Telex: 846-21336

USDOE Representative,
Energy and Resources Office

Dana M. Marshall

BRAZIL

MAJOR BRAZILIAN HOLIDAYS (1985)

January 1	New Year
February 18-19	Carnival
April 5	Good Friday
April 21	Tiradentes Day
May 1	Labor Day
June 9	Corpus Christi
September 7	Independence Day
November 2	All Souls
November 15	Proclamation of the Republic
December 25	Christmas

BRAZIL

ENERGY

Population 1984 130 million

Energy Demand 1980 ~95 Mtoe

Indigenous Energy Sources: limited crude oil, shale oil, natural gas, and coal. Oil imports - 80%.

Electric Power Plant Capacity 1982 ~30 GWe

Electric Power Production 1980 125 TWh
88% hydro
8% nuclear
4% thermal

NUCLEAR POWER

National Policy: Ambitious program to develop complete government-owned nuclear industry, based upon technology transfer from FRG and other countries.

Nuclear Power Plant Capacity 1984 0.6 GWe
1990 1.9 GWe
2000 4.4 GWe

Reactor Mix 1984 PWR: 1 (1984);
2 (1987-89)

Reactor Development FBR

INDUSTRIAL FUEL CYCLE

Policy: Full commercial capability through a government-owned corporation--conversion of U_3O_8 to UF_6 ; enrichment; UO_2 fuel fabrication; fuel reprocessing.

Waste Management Strategy: Not yet defined.

Brazil

Cumulative Spent Fuel	1985	32 tU
Arising (LWR)	1990	180 tU
	1995	510 tU
	2000	1,000 tU

Demonstration/Production Activities

- Uranium mining and milling: 500 tU/a--in operation.
- UF₆ production: 2000 tUF₆/a (1984).
- Uranium enrichment (Becker nozzle process):
First Cascade, 24 stages (1984)
200-300 tSWU/a demo plant (1988).
- Fuel fabrication: 80 t/a (1982); design capacity--
400 tU/a.
- Spent fuel reprocessing: 10 kg/d pilot plant (1986).

INTERNATIONAL RELATIONSHIPS

Member of IAEA--but has not signed NPT. Heavy dependence on nuclear technology transfer (mainly from FRG). Joint US-Brazil R&D program to study radionuclide transport from a thorium deposit. Current interest in receiving US waste management technology.

ORGANIZATION

Federal Ministry of Mines and Energy: planning, execution and control of nuclear power program.

- CNEN (Nuclear Energy Commission)--regulatory and R&D.
- Nuclebrás--plant engineering, construction and operation; operates through partly-owned subsidiaries--Nucon (construction), Nuclen (design), Nuclep (heavy components), Nuclam (mining), Nuclei and Nustep (enrichment), and Nuclemen (thorium production).

CDTN (Center for the Development of Nuclear Technology)

Centro de Desenvolvimento de
Tecnologia Nuclear de Nuclebrás (CDTN)
Rua Gonçalves Dias No. 1054
Belo Horizonte, MG
Brazil
Tel: (55) 31 226-6988

Mission: Applied research and industrial development of
uses of atomic energy.

CNEN (Nuclear Energy Commission)

CNEN (Comissao Nacional de Energia Nuclear)
Rua General Severiano 90
Botafogo ZC-82
20000 Rio de Janeiro, RJ
Brazil
Tel: (55) 21 246-1747
Telex: 2121280

President
Hervásio G. de Carvalho

Fuel Cycle and Waste Management R&D: Uranium enrichment;
migration of radionuclides from a thorium deposit, a joint
Brazil-US study; spent fuel reprocessing. The government
is building a 10 kg HM/day pilot reprocessing facility in
the Rio de Janeiro area.

IPEN (Energy and Nuclear Research Institute)

Instituto de Pesquisas Energéticas e Nucleares
Cidade Universitária
Caixa Postal 11.049
Pinheiros - CEP 01000
São Paulo, Brazil
Tel: (55) 11 211 6011
Telex: (011) 23592-IPEN

Superintendent
Durvaldo Goncalves

IPEN (contd)

Areas of Activity: Physics; nuclear physics; high energy physics. Life Sciences; nuclear medicine; radiobiology; radiation health and safety. Engineering and reactor technology; instrumentation. Chemistry; materials in the nuclear industry. Isotope and radiation applications and production. Nuclear waste disposal. Nuclear metallurgy. Radiochemistry.

NUCLEBRÁS

Nuclebrás

Avenida Presidente Wilson 231

CEP 20030, Rio de Janeiro

Brazil

Tel: (55) 21 292-1144

Telex: 23128, 23830

President

Dario Gomes

Director

John Forman

Mission: Establish a nuclear fuel cycle industry, promote nuclear technology, transfer to private industry, design and build nuclear power plants, pursue R&D programs.

Owner: Government.

CANADA

MAJOR CANADIAN HOLIDAYS (1985)

January 1	New Year
April 5	Good Friday
April 7-8	Easter
May 20	Victoria Day
July 1	Canada Day
September 2	Labor Day
October 14	Thanksgiving Day
December 25-26	Christmas

CANADA

ENERGY

Population	1984	24.8 million
Energy Demand	1979	281.3 Mtoe
Oil Demand	1979	90.4 Mtoe (9% imported)
Electric Power Plant Capacity	1980	79 GWe
Electric Power Production	1982	390.2 TWh-- 68% hydro/geoth 18% coal 9% nuclear 3% oil 2% gas

NUCLEAR POWER

National Policy: Strong support of the domestic use and the export of the CANDU reactor system, with possible conversion to a thorium/uranium-233 fuel cycle.

Nuclear Power Plant Capacity	1984	8.8 GWe
	1985	10.1 GWe
	1990	13.4 GWe
	2000	14.9 GWe

Reactor Mix	1984	HWR: 13 (1968-84) 9 (1984-92)
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INDUSTRIAL FUEL CYCLE

Policy: Retrievable storage of spent fuels, pending decision between reprocessing and disposal of spent fuel; continue small reprocessing R&D activity.

Waste Management Strategy: Geologic disposal of "nuclear fuel waste," either spent CANDU fuel or immobilized HLW, in a crystalline rock repository; disposal of reactor wastes in engineered surface facilities.

Canada

Cumulative Spent Fuel	1980	3,650 tU
Arisings (HWR)	1985	8,800 tU
	1990	17,700 tU
	2000	38,000 tU

Major Milestones

- Start of shaft excavation for the Underground Research Laboratory (URL) 1984
- URL operational 1986
- Spent fuel immobilization pilot plant Mid-1980s
- Complete concept verification for a geologic repository 1990

INTERNATIONAL RELATIONSHIPS

Member of IAEA and OECD/NEA. Cooperative agreements with FRG/BMFT, SKBF/KBS, USDOE, UKAEA and Eurotom.

ORGANIZATION

- AECB (Atomic Energy Control Board)--regulatory.
- AECL (Atomic Energy of Canada Limited)--a Crown Corporation owned by the federal government. Nuclear R&D; design, engineering and sale of CANDU reactors; operation of heavy-water plants. Waste management R&D at Whiteshell and Chalk River.
- Ontario Hydro--provincial public utility, owns and operates most of Canada's nuclear power plants--those located in Ontario Province. Waste management R&D.

FIGURE CA-1. Government Responsibilities--Fuel Cycle and Waste Management

CA-3

FIGURE CA-2. Partial Organization Chart for Energy,
Mines and Resources Canada

CA-4

Canada

Canada

AECS

Atomic Energy Control Board
P.O. Box 1046
270 Albert Street
Ottawa, Ontario K1P 5S9
Canada

Tel: (613) 995-5894
Telex: 533771

President
Fuel Cycle/Materials
Regulation
Waste Management

Fuel and Heavy Water Plant
Regulatory Research
Safety and Safeguards

J. H. Jennekens
W. D. Smythe

L. C. Henry
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J. P. Didyk
J. W. Bears
J. R. Coady
(613) 995-7651

AECL

Atomic Energy of Canada Limited
275 Slater Street
Ottawa, Ontario K1A 0S4
Canada

Tel: (613) 237-3270
Telex: 053 31 26

Chairman
President
President, AECL Research
Vice President, R&D

Robert Despres
James Donnelly
Robert Hart
Dr. A. J. Mooradian

AECL-CRNL

AECL-Chalk River Nuclear
Laboratories
Chalk River, Ontario K0J 1J0
Canada

Tel: (613) 687-5581
Telex: 053-34555

Chalk River Environmental
Authority
Director, Applied R&D

Dr. D. H. Charlesworth
(613) 687-2441
Dr. H. K. Rae
(613) 687-2624
Dr. G. F. Taylor
(613) 687-2771

AECL-CRNL (contd)

Facilities

Waste Treatment Center (WTC)

Mission: Develop reactor waste treatment processes.

AECL-WNRE

AECL-Whiteshell Nuclear Research
Establishment

Pinawa, Manitoba R0E 1L0
Canada

Tel: (204) 753-2311
Telex: 0757553

Vice President/General Manager	R. E. Green
Chemistry and Materials Science	M. Tomlinson
Applied Science	W. T. Hancox
Fuel Recycle	D. R. McLean
Eng. Design/Operations	S. A. Mayman
Waste Management	R. B. Lyon
	(204) 753-8432
Fuel Waste Technology	K. Nuttall
Geochem./Applied Chemistry	F. P. Sargent
Applied Geoscience	K. W. Dormuth
Environmtl./Safety Assessment	E. L. J. Rosinger

Facilities

- **WIPE (cold pilot plant-vitrification)**
Mission: Develop HLW conditioning process for the CANDU-Thorium fuel cycle.
Design Basis: 10 kg/hr glass--rotospray calciner/ceramic melter.
History: Startup, 1983.
- **Hot Pilot Plant-Reprocessing**
Mission: Develop CANDU-Thorium fuel cycle technology; provide HLW for waste studies.
Design Basis: Thorex process, mixer-settlers; capacity, 0.3 kg/day.
History: Hot operation, 1980.

AECL-WNRE (contd)

- **URL (Underground Research Laboratory)**
Mission: Provide a research facility in a virgin granite pluton characteristic of the Canadian granite formations which may be selected for waste repository construction.
Design Basis: Location about 20 km from the White-shell reservation, on the Lac du Bonnet Batholith; horizontal tunnel with adjoining rooms located 300 ± 200 m below the surface, with vertical shaft or ramp access. Licensed radioactive sources and selected tracers may be used in the facility, but no radioactive wastes are to be emplaced there.
Milestones: Start site evaluation, Fall 1980; start URL construction, 1984; start underground operation, 1986.
- **Immobilized Fuel Test Facility (IFTF)**
Mission: Experimental studies of the behavior of spent fuels and HLW forms in a radiation field.
Test Beds: Concrete canisters, 2 m dia x 2 m high, which hold heated pressure vessels containing individual experiments.
History: Licensing and commissioning were under way in May 1983.

EMR

Energy, Mines and Resources Canada
Science and Technology
580 Booth Street
Ottawa, Ontario K1A 0E4
Canada

Tel: (613) 995-3065
Telex: 053 3117

Director, Nuc. Fuel Waste Disposal Dr. J. S. Scott

Canada

EMR-CANMET

EMR-Canada Centre for Mineral and Energy Technology
555 Booth Street
Ottawa, Ontario K1A 0G1
Canada

Tel: (613) 995-4029

Director General	W. G. Jeffery (613) 995-4179
Deputy Director General	V. A. Haw
Rock Mechanics	G. E. Larocque
Waste Management (Elliot Lake)	Gordon Ritze

Facilities

- Mineral Sciences Laboratories (Ottawa)
- Rock Mechanics Laboratory (Ottawa)
- Elliot Lake Laboratory
Mining Research Laboratories
Elliot Lake, Ontario P5A 2K2
Canada

EMR-EPB

EMR-Earth Physics Branch
1 Observatory Crescent
Ottawa, Ontario K1A 0Y3
Canada

Director	Dr. K. Whitham
----------	----------------

EMR-GSC

EMR-Geological Survey of Canada
601 Booth Street
Ottawa, Ontario K1A 0E8
Canada

Tel: (613) 995-4938
Telex: 053-3117

Director	Dr. D. G. McLaren
----------	-------------------

ONTARIO HYDRO

Ontario Hydro
700 University Avenue
Toronto, Ontario M5G 1X6
Canada

Tel: (416) 592-5111
Telex: 06 217662

Nuclear Design and Development	D. A. Meneley (416) 592-5210
Nuclear Materials Management	H. N. Isaac (416) 592-5539
Reactor Waste Management	T. J. Carter (416) 592-6024
Irradiated Fuel Management	R. C. Oberth (416) 592-2856

Mission: Design, construction, and operation of CANDU power stations.

Facilities

- **RMVRF** (Radioactive Waste Volume Reduction Facility)
Location: Bruce Nuclear Complex, Tiverton, Ontario.
Components: Pyrolysis incinerator (2-chamber), solid waste compactor.
History: Startup, 1977.
- **Intermediate-Level Waste Storage**
Location: Bruce Nuclear Power Development Waste Management Site, Tiverton, Ontario.
Components: In-ground concrete tile holes or trenches, above-ground concrete "Quadricell."

WASTEWATER TECHNOLOGY CENTER

Wastewater Technology Center
Environmental Protection Service
Department of Fisheries and the Environment
P.O. Box 5050
Burlington, Ontario L7R 4A6
Canada

CHINA
(People's Republic of China)

MAJOR CHINESE HOLIDAYS (1985)

Late January/ early February	Lunar New Year
May 1	Labor Day
Aug 1	Army Day
Oct 1-2	National Liberation Days

CHINA (PEOPLE'S REPUBLIC)

ENERGY

Population	1984	1 billion
Energy Demand	1980	637.2 Mtce
Electric Power Plant Capacity	1980	55-60 GWe
Electric Power Production	1980	300.6 TWh-- 69% coal 24% oil 4% hydro/geoth. 3% gas

NUCLEAR POWER

National Policy: Develop nuclear power as one of three major sources of energy, in response to imperative need to solve problems caused by uneven distribution of resources; be self-sufficient, but introduce foreign advanced technology.

Nuclear Power Plant Capacity	1990	2 GWe
	2000	10 GWe
Reactor Mix	1984	PWR: 3 (1988-90)
Reactor Development		BWR, HTR, FBR

INDUSTRIAL-SCALE FUEL CYCLE ACTIVITIES

Uranium mining, milling and enrichment; fuel fabrication, reprocessing of defense fuels.

ORGANIZATION

- Ministry of the Nuclear Industry--fuel cycle development
- Ministry of Power and Water Resources--nuclear power/construction and operation

China

- Atomic and Nuclear Energy Research Institute of the Academy of Sciences (Peking Area and Southwest China)--nuclear R&D.

INSTITUTE OF ATOMIC ENERGY

Institute of Atomic Energy
Academia Sinica
Beijing
People's Republic of China

Director

Dai Cuanzheng

INSTITUTE OF NUCLEAR ENERGY TECHNOLOGY

Institute of Nuclear Energy Technology
Qinghua University
P.O. Box 1021
Beijing
People's Republic of China

Director

Prof. Lu Yingzhong

Dep. Director, Radiochem. Tech. Div. Prof. Zhu Yong-jun

MINISTRY OF THE NUCLEAR INDUSTRY

Ministry of the Nuclear Industry
Beijing
People's Republic of China

Minister

Jiang Xingxiong

Science/Technical Committee

Chairman

Jiang Sheng-Jie

Vice Chairman

Wang Ganchang

DENMARK

MAJOR DANISH HOLIDAYS (1985)

January 1	New Year
April 4	Holy Thursday
April 5	Good Friday
April 7-8	Easter
May 3	Prayer Day (4th Friday after Easter)
May 16	Ascension Day
May 26-27	Pentecost
June 5	Constitution Day
December 25-26	Christmas
December 31	New Year's Eve

DENMARK

ENERGY

Population	1984	5.12 million
Energy Demand	1980	19.7 Mtoe (97% imported)
Oil Demand	1980	13.5 Mtoe (98% imported)
Electric Power Plant Capacity	1980	7 GWe
Electric Power Production	1982	23.4 TWh-- 93% coal 7% oil

NUCLEAR POWER

National Policy: National energy plan calls for nuclear power, but public opposition has prevented implementation; power companies continue to plan for reactor plant construction and for management of wastes.

INDUSTRIAL FUEL CYCLE

Policy: Not defined; power companies are conducting design, feasibility, and site characterization studies for a Danish salt-dome repository.

ORGANIZATION

- Danish Atomic Energy Commission--overall responsibility for nuclear energy matters
- Risø Research Establishment--nuclear R&D
- Elkraft and Elsam (power companies)--waste disposal studies.

ATOMIC ENERGY COMMISSION

Atomenergikommisionen
Strandgade 29
DK-1401 Copenhagen
Denmark

ELKRAFT

ELKRAFT
Power Company Ltd., Copenhagen
Lautruphøj 5
P.O. Box 230
DK-2750 Ballerup
Denmark
Tel: (45) 2 66-0022
Waste Repository Project Finn Hasted

ELSAM

Elsam
DK-7000 Fredericia
Denmark
Tel: (45) 5 56-2500
Telex: 51151
Waste Repository Project Dr. A. V. Joshi

GEOLOGICAL SURVEY

Geological Survey of Denmark
Thoravej 31
DK-2400 Copenhagen NV
Denmark
Waste Management Dr. J. L. Andersen

Denmark

RISØ NATIONAL LABORATORY

Risø National Laboratory

P.O. Box 49

DK-4000 Roskilde

Denmark

Tel: (45) 2 37-1212

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Chairman, Chem. Department

Bror Skytte Jensen

(Ext. 5300)

Section Leader

Knud Brodersen

(Ext. 5340)

Project Leader

Lars Carlsen

(Ext. 5352)

Mission: Scientific and technological research on atomic energy.

Owner: Government.

FINLAND

MAJOR FINNISH HOLIDAYS (1985)

January 1	New Year
January 6	Epiphany
April 5	Good Friday
April 7-8	Easter Monday
May 1	May Day
May 16	Ascension Day
May 26-27	Pentecost
June 26	Midsummer
November 1	All Saints
December 6	Independence Day
December 25-26	Christmas

FINLAND

ENERGY

Population	1984	4.7 million
Energy Demand	1981	25.3 Mtoe (73% imported)
Oil Demand	1981	10.6 Mtoe (100% imported)
Electric Power Plant Capacity	1982	11.9 GWe
Electric Power Production	1982	41.2 TWh-- 41% nuclear 31% hydro/geoth. 21% coal 5% oil 2% gas

NUCLEAR POWER

Nuclear Power Plant Capacity	1984	2.2 GWe
	1995	3.2 GWe
	2000	3.2 GWe
Reactor Mix	1984	PWR: 2 (1977/81) BWR: 2 (1979/82)

INDUSTRIAL FUEL CYCLE

Policy: Purchase fuel and fuel cycle services from other countries (spent fuel from Russian-built reactors is returned to USSR).

Waste Management Strategy: Not fully defined; spent fuel or HLW from non-Russian fuels will be stored for 40 years, then placed in a granite repository; reactor wastes are bituminized and will be stored underground.

Finland

Cumulative Spent Fuel	1980	48 tU
Arising (LWR)	1985	350 tU
	1990	650 tU
	2000	1,400 tU

Major Milestones

- Complete site characterization, geologic repository 1992
- Complete site selection 2000
- Complete repository 2020

ORGANIZATION

- IVO and TVO: state-owned power companies; IVO operates two Russian-built reactors, while TVO operates two Swedish-built plants.
- Nuclear Waste Commission of Finnish Power Companies--established by IVO and TVO to do joint analysis and planning for managing their nuclear wastes.
- VTT (Technical Research Center)--nuclear research, including waste management R&D.

ATOMIC ENERGY COMMISSION

Atomic Energy Commission
Ministry of Trade and Industry
Pohjois Makasiinikatu 6
SF-00130 Helsinki 13
Finland

Telex: 125452 EDEPT SF

Chairman

Prof. Pekka Jauho
(358) 0 456-4100

Telex: 122972

Secretary-General

Prof. Jorma Routti
(358) 0 451-2450
Telex: 125161

GEOLOGICAL SURVEY OF FINLAND

Geological Survey of Finland
Kivimiehentie 1
SF-02150 Espoo 15
Finland

Tel: (358) 15 46931
Telex: 123185 geolo SF

Director
Research Director
Nuclear Waste Disposal

Prof. L. K. Kauranne
Prof. K. Korpela
M. Salmi
(358) 0 803-7988

INSTITUTE OF RADIATION PROTECTION

Institute of Radiation Protection
P.O. Box 268
SF-00101 Helsinki 10
Finland

Tel: (358) 0 61671
Telex: 122691 STL-SF

Chief Inspector, Reactor Safety
Inspectors

S. Väisänen
E. Ruokola
I. Aro

VTT

Tech. Research Center of Finland
Nuclear Engineering Laboratory
P.O. Box 169
SF-00181 Helsinki 18
Finland

Tel: (358) 0 4561
Telex: 125175

Director, Nuclear Waste
Nuclear Waste Management

Dr. Esko Peltonen
Dr. Seppo Vuori

Reactor Laboratory
Otakaari 3A
SF-02150 Espoo 15
Finland

Tel: (358) 15 4561
Telex: 125175

Nuclear Waste Management

Dr. Pekka Hiismäki

FRANCE

MAJOR FRENCH HOLIDAYS (1985)

January 1	New Year
April 7-8	Easter Monday
May 1	Labor Day
May 16	Ascension
May 26-27	Pentecost
July 14	Bastille Day
August 15	Assumption
November 1	All Saints
November 11	Remembrance Day
December 25	Christmas

FRANCE

ENERGY

Population	1984	54.61 million
Energy Demand	1980	198 Mtoe (74% imported)
Oil Demand	1980	115 Mtoe (98% imported)
Electric Power Plant Capacity	1980	66 GWe
Electric Power Production	1982	278.6 TWh-- 39% nuclear 26% hydro/geoth. 24% coal 9% oil 2% gas
	1983	48% nuclear

NUCLEAR POWER

National Policy: Aggressive nuclear power program, scaled down recently to construction of one or two new reactors per year; commercialization of the breeder reactor; export of nuclear plants and services.

Nuclear Power Plant Capacity	1984	31.5 GWe
	1985	35.6 GWe
	1990	51.0 GWe
	2000	61.2 GWe
Reactor Mix	1984	GCR: 8 (1959-72)
		PWR: 34 (1967-84)
		19 (1985-90)
		LMFBR: 2 (1973/85)
Reactor Development		LMFBR commercialization; Super Phenix--1985; follow-on work still under debate.

INDUSTRIAL FUEL CYCLE

Policy: Maintain full domestic fuel cycle capability; aggressive export of fuel cycle plants, equipment and services (including uranium enrichment and spent fuel reprocessing).

Waste Management Strategy: HLW--vitrify and store in engineered storage facility for indefinite period, then emplace in geologic repository (granite, salt, clay or seabed). LLW--immobilize in bitumen, concrete or resin and store in surface facility.

	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>2000</u>
Cumulative Spent Fuel Arisings, tU	248	2,700	7,700	22,000

	<u>1983</u>	<u>1990</u>	<u>2000</u>
Cumulative Waste Arisings, m ³			
• vitrified HLW	400	750	3,000
• packaged TRU waste	10,000	15,000	45,000
• packaged LLW/ILW	210,000	410,000	800,000

Industrial-Scale Activities

- Uranium mining and milling (tU): 1981--2,000; 1985--3,900.
- Uranium enrichment (tSWU/a)
 - Pierrelatte, gaseous diffusion: 400-600
 - Eurodif, gaseous diffusion: 1982--10,800.
- Fuel fabrication (tHM/a)
 - UO₂: current capacity--400; 1983--600; 1986--1,100
 - MOX: for FBR fuels--5; for LWR fuels--15.
- Spent fuel reprocessing
 - Marcoule: 3 tU/day, U metal fuels
 - La Hague: 3 tU/day, U metal fuels; 1.3 tU/day, UO₂ fuels (to be expanded to 5 tHM/day).

Major Milestones

- TOR demonstration reprocessing plant for FBR fuels (Marcoule) 1985
- UP3 reprocessing plant (La Hague) 1988-9
- UP2-800 reprocessing plant (La Hague) 1990
- AVH waste vitrification plants (La Hague) 1987-9
- New LLW disposal site 1986-7
- Underground Research Laboratory 1989

INTERNATIONAL RELATIONSHIPS

Membership in EC, IAEA and OECD/NEA. Major role in international uranium enrichment companies, Eurodif and Coredif. Partnership with German and British companies in United Reprocessors GmbH and in Nuclear Transport, Ltd. Leadership of international consortium involved in Super Phenix project. Participation of EdF in SERENA, international FBR technology marketing organization.

ORGANIZATION

- EdF (Electricité de France, 100% government)--public power generation; owns and operates all nuclear plants except Phenix (50% EdF, 50% CEA) and Super Phenix (NERSA: 51% EdF, 33% ENEL, 16% RWE)
- CEA (Atomic Energy Commission)--controls all nuclear R&D and industrial fuel cycle activities:
R&D: Nuclear research centers at Cadarache, Fontenay-aux-Roses, Grenoble, Marcoule, Saclay;
Institute for Nuclear Protection and Safety
Commercial fuel cycle: COGEMA (mining, uranium conversion, enrichment, reprocessing); SGN, a COGEMA subsidiary (design, construction and marketing of fuel cycle facilities)
Commercial waste disposal: ANDRA.

FIGURE FR-1. CEA-COGEMA-ANDRA Activities

FIGURE FR-2. COGEMA and CEA Research Centers

FR-5

France

DERDCA - Division of Reprocessing Waste and Applied Chemistry

FIGURE FR-3. Nuclear Fuel Cycle Responsibilities

FIGURE FR-4. COGEMA and CEA Research Centers

ANDRA (National Agency for Radioactive Waste Management)

Agence Nationale pour la Gestion des Déchets
Radioactifs
Commissariat à l'Énergie Atomique
B.P. 510
69 Quai de Grenelle
F-75015 Paris
France

Tel: (33) 1 273-6000
Telex: 200 671 Energat Paris

Director	M. Chatou
Deputy Director	Alain Barthoux
Projects Division	Y. Marque
Site Division	R. André Jehan
Centre de la Manche	G. Cornec

Mission: Manage long-term waste storage centers; provide for new storage and disposal sites; coordinate French R&D programs related to long-term waste disposal.

Waste Disposal Facilities

- **Centre de la Stockage de la Manche (CSM)**
B.P. 71
F-50440 Beaumont-Hague

Mission: Store immobilized ILW and LLW; capacity: 400,000 m³ (1984: 220,000 m³ in place).

BRGM (Bureau of Geological and Mineral Research)

Bureau de Recherches Géologiques
et Minières
B.P. 6009
F-45060 Orleans
France

Tel: (33) 38 63-8001
Telex: 780258 F

Managing Director	H. Astie
Waste Storage	P. F. R. Peaudecerf
Hydrogeology	J. J. Collin
Geotechnology	Ph. Masure

CEA (Atomic Energy Commission)

Commissariat à l'Énergie Atomique (CEA)
 Centre d'Études Nucléaires (CEN)
 29-33, Rue de la Fédération
 F-75752 Paris
 France

Tel: (33) 1 273-6000
 Telex: 200671 Energat

Administrator General	Gerard Renon
High Commissioner for Safety	Jean Teillac
Director, Nuc. Safety (FaR)	Pierre Tanguy
Director, Nuc. Waste Mgmt. (FaR)	Jean Lefevre
	(33) 1 654-7471
Ass. Director, Internatl.	Pierre Jourde
Ass. Director, R&D	Annie Sugier
Director, Safety	Jacques Bellot
Director, Applied R&D	Michel Rapin

CEA-IRDI (Institute for Applied Research and Development)

Institut de Recherche Technologique
 et de Développement Industriel (IRDI)

President	Michel Rapin
Division, Reprocessing Waste and Applied Chemistry	J. Megy
Department, Technology and Know-How Transfers	M. Courouble
Department, Reprocessing R&D Pilot Plants	J. Sauteron
Department, Analysis-Corrosion, Applied Chemistry	M. Leveque
Department, R&D Waste (FaR)	Guy Baudin
	(33) 1 654-8222
Characterization (Cadache)	Paul Pottier
LL/ILW (Cadache)	D. Alexandre
HLW (Marcoule)	M. Bonniaud
Engineered Barriers, Modelling (FaR)	M. Jorda
	(33) 1 654-8129

CEA-IPSN (Institute of Protection and Nuclear Safety)

Institut de Protection et de Sûreté
Nucléaires (ISPN)
B.P. 6
F-92260 Fontenay-aux-Roses
France

Tel: (33) 1 654-7080
Telex: 204841 Energat
Fnayr

President Pierre Tanguy
Safety Analysis D. Queniat
Technical Protection J. Pradel
Waste Protection Research A. M. Chapuis
Studies and Research in Safety M. Bailly
(Cadarache)

CEN-CA (CADARACHE NUCLEAR RESEARCH CENTER)

Centre d'Études Nucléaires de Cadarache
B.P. 1
F-13115 Saint-Paul-lez Durance
France

Tel: (33) 42 25-7000
Telex: CEACA 440678 F

(Marseille-Marignane Airport; 65 km to Cadarache by car
provided by Center, or rental car.)

Bureau for Evaluation and Control Paul Pottier
of Waste Confinement (BECC/CIDN) (33) 42 25-7364
Information Center for Nuclear Y. Francois
Waste (33) 42 25-7882
Studies of LLW/ILW D. Alexandre
(33) 42 25-7123

Waste Management R&D: Treatment of TRU waste, LLW, and
ILW; properties of non-HLW waste forms; MOX fuel fabrica-
tion; and waste isolation (radionuclide migration).

CEN-CA (contd)

Facilities

- **Solid Waste Treatment Pilot Plant**
Mission: Develop methods to handle solid wastes (cryogenic crushing and ultrasonic washing).
Design Capacity: Eight 200-lb drums/hr.
History: Startup, 1984.
- **Bituminization Plant**
Design Basis: Immobilize reactor wastes; twin-screw extruder; capacity, 260 m³/a.
History: Startup, 1977.
- **MOX Fuel Fabrication**
- **LLW Incinerator**
- **Solvent Incinerator**

CEN-FaR (FONTENAY-AUX-ROSES NUCLEAR RESEARCH CENTER)

Centre d'Études Nucléaires
de Fontenay-aux-Roses

B.P. 6

F-92260 Fontenay-aux-Roses
France

Tel: (33) 1 654-8000
Telex: FaR 20481

(See CEA-IRDI, Institute for Applied R&D)

Waste Management R&D: Safety-related research; airborne waste treatment; solvent extraction processes for waste partitioning; OKLO studies.

CEN-G (GRENOBLE NUCLEAR RESEARCH CENTER)

Centre d'Études Nucléaires
de Grenoble

Avenue des Martyrs 85X
F-38041 Grenoble
France

Tel: (33) 76 97-4111
Telex: 320323 Energat
Greno

Director

Michel Suscillon

Waste Management R&D: Treatment of reactor wastes and removal of tritium from heavy water used as a reactor moderator.

CEN-M (Marcoule Nuclear Research Center)

Centre d'Études Nucléaires de la Vallée du Rhône
B.P. 171

F-30203 Bagnols-sur-Cèze
Marcoule, France

Tel: (33) 66 89-5390
Telex: 480232F

Manager, High-Level Waste
Deputy Manager

M. Bonniaud
Claude G. Sombret
(Ext. 2767)

Laboratory Studies
Confinement Processing

N. Jacquet-Francillon
A. Jouan
(Ext. 2768)

Hot Technology

F. Laude

Facilities

- TOR (reprocessing head-end pilot plant)
Mission: Develop technology for LWR, FBR and MOX fuels.
Design Basis: PUREX flowsheet, mixer-settlers and pulsed columns; 5 tHM/a.

CEN-M (contd)

- **PIVER** (hot pilot plant-vitrification)
Mission: Test batch vitrification processes (1969-1973); produce samples for characterization (1978-), and advanced (high-temperature) waste forms (198 -).
Design Basis: Pot calciner/melter; capacity, 90 kg glass/batch or 25-30 m³ HLLW/a; product, borosilicate glass blocks, 25 cm dia by 2.5 m high.
History: Produced 12 tons glass, 1969-1973. Now used for special process studies.
- **ATLAS** (hot pilot plant-vitrification)
Mission: Conduct off-gas treatment studies for AVM process.
Design Basis: AVM: rotary calciner, metallic melter; capacity, 1/2 AVM scale; product, borosilicate glass blocks.
History: Startup, 1978.

CEN-S (Saclay Nuclear Research Center)

Centre d'Études Nucléaires
de Saclay

F-91191 Gif-sur-Yvette
France

Tel: (33) 6 908 6000
Telex: 690641 F Energat
Saclay

Director
Nuclear Wastes

Paul Mirat
Henri Vialettes

Facilities

- **Bituminization Plant** (radioactive)

COGEMA (Compagnie Générale des Matières Nucléaires)

COGEMA, Inc.
Direction Générale
B.P. 4
F-78141 Velizy Villacoublay Cedex Tel: (33) 3 946-9641
France Telex: COGEM 697833

President Francois de Wissocq
Manager, Reprocessing Plants Claude Aycoberry
Director, Repros. Plants Maurice Delange
UP₃ Reprocessing Plant Francois Chenevier

COGEMA-LA HAGUE CENTER

COGEMA, Centre de La Hague
B.P. 270
F-50107 Cherbourg Tel: (33) 33 03 6000
France Telex: 170030 Energat
Hag

Director Jean Parmentier
Reprocessing Department Jean-Louis Ricaud
Waste Management Mr. Laurent

Fuel Cycle Program: Spent fuel reprocessing and HLW vitrification. The La Hague plant was originally designed to handle magnesium-clad U metal fuels from gas/graphite power reactors. Current plans are to transfer all reprocessing of gas/graphite fuels to Marcoule UP-1 and devote La Hague to treating LWR fuels with occasional FBR fuel campaigns through UP-2.

COGEMA-LA HAGUE CENTER (contd)

Facilities

- UP2 (fuel reprocessing plant)
Mission: Reprocess magnesium-clad, natural uranium metal fuels from gas/graphite reactors and oxide fuels from LWRs and Phenix FBR. (Phenix fuel is diluted with natural uranium fuel for criticality control.)
Design Basis: *Metal fuels:* mechanical decladding; PUREX flowsheet; capacity, 800 t/a and 1.6 tPu/a; contact maintenance. *FBR and LWR oxide fuels:* shear-leach HAO head-end; remote maintenance; capacity, 1.3 t/day of LWR fuels. HAO expansion to 800 t/a of LWR fuels started in late 1980, to be completed in early 1990s.
History: Startup: UP-2, 1967; HAO, 1976. During 1967-1977, annual throughputs of gas/graphite reactor fuels reportedly averaged 220-270 tHM. From startup through 6/84 total HAO throughput was 920 t fuel from LWRs and some from Phenix.
- UP3 (fuel reprocessing plant)
Mission: Reprocess French and foreign LWR fuels.
Design Basis: Chop-leach head-end; PUREX flowsheet; capacity, 4 t/day each for UP3 and UP2 800.
Milestones: Startup, UP2 800--1990/91.
- AT-1 (hot pilot plant-reprocessing)
Mission: Test technology, reprocess FBR fuels.
Design Basis: Chop-leach head-end and mixer-settlers; capacity, 1 kg HM/day.
History: Hot startup, 1972. Shutdown, 1979.
- AVH (vitrification plant)
Mission: Vitrify La Hague HLW.
Design Basis: AVM process: rotary calciner, metallic or ceramic melter; capacity, 600 m³/a HLLW (three lines @ 50 t/hr HLLW, 25 kg/hr glass). Canister dimensions: 42 cm dia x 1.3 m high (400 kg glass).
Milestone: Startup, mid-1986.

COGEMA-MARCOULE CENTER

COGEMA

Centre de Marcoule

B.P. 170

F-30200 Bagnols-sur-Cèze

Marcoule, France

Tel: (33) 66 89-5390

Telex: 480232F MARCOGEMA

(Marseille-Marignane Airport; by train to Avignon; car provided by Center.)

Director

Reprocessing Plant

Maurice Allès

Maurice Chotin

Facilities

- **UP1** (reprocessing plant)
Mission: Reprocess magnesium-clad natural uranium metal fuels from military or gas/graphite power reactors.
Design Basis: Mechanical declad; PUREX flowsheet; contact maintenance; capacity, 4.5-6 tHM/day. Expansion is under way to allow treatment of 400-450 tHM/a of gas/graphite reactor fuel, in addition to military fuel load.
History: Startup, 1958; 280 tHM of gas/graphite fuel processed in 1959, in addition to military fuels. Reportedly, total 1958-1981 throughput was about 12,000 tHM.
- **AVM** (ateliers de vitrification de Marcoule)
Mission: Demonstrate AVM process: vitrify Marcoule UP-1 wastes.
Design Basis: Rotary calciner feeding an induction-heated metallic melter; capacity, 30 t/hr HLLW feed and 360 kg/day (1 canister) borosilicate glass product; waste form, glass blocks 0.5 m dia x 1.0 m high.
History: Hot startup, 6/78; as of 7/1/82, 546 m³ of HLLW from reprocessing 9657 tonnes of fuel had been vitrified to yield 251 tonnes of glass (734 canisters). 1,000 canisters had been produced as of 5/84.
- **Incinerator**
- **Bituminization Facility**

DAM (Directorate of Military Applications)

Direction des Applications Militaires
Commissariat à l'Energie Atomique
31-33 Rue de la Fédération
F-75752 Paris, Cedex 15
France

FBFC (Franco-Belge Company for Fuel Fabrication)

Société Franco-Belge de Fabrication de
Combustibles
Avenue Bertie Albrecht
F-75008 Paris
France

Tel: (33) 1 766-5200
Telex: 290503

Facilities

- **Fuel Fabrication Plant** (Romans, France)
Mission: Fabricate UO_2 fuels for power reactors.
Design Capacity: 400 t/a (to be increased to 600 t/a).
- **Fuel Fabrication Plant** (Dessel, Belgium)
Mission: Fabricate UO_2 fuels.
Design Capacity: 400 t/a.

PARIS SCHOOL OF MINES

Ecole Nationale Supérieure des Mines de Paris
Centre d'Informatique Géologique
35 Rue Saint-Honoré
F-77305 Fontainebleau
France

Tel: (33) 6 422-4821
Telex: 600736 MINEFON

Director, Math. Geol. Center Dr. Ghislain de Marsily
Deputy Director Dr. G. E. Ledoux
Research Engineers Dr. Patrick Goblet
 Dr. Michel Poulin
 Dr. Anne Ribstein

PARIS SCHOOL OF MINES (contd)

Waste Management R&D: Geologic waste isolation (fluid flow, heat transport and mass transport studies--theoretical, laboratory and field tests).

SGM

Société Générale pour les
Techniques Nouvelles

1 Rue des Hérons,
Montigny le Bretonneux
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President
Managing Director
Technical Director
Operations Vice President
International Projects
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Pierre B. de la Combe
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TN

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Tel: (33) 1 723-7850
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General Manager
Technical Manager

Bernard Savornin
Paul Blum

US EMBASSY - PARIS

US Embassy
2 Avenue Gabriel
75382 Paris
France

Tel: (33) 1 296-1202
(261-8075)
Telex: 650221

Science Counselor

J. Boright

GERMANY
(Federal Republic of Germany)

MAJOR WEST GERMAN HOLIDAYS (1985)

January 1	New Year
April 5	Good Friday
April 7-8	Easter
May 1	Labor Day
May 16	Ascension
May 26-27	Pentecost
June 17	Day of Unity
December 25-26	Christmas

GERMANY (FRG)

ENERGY

Population	1983	61.4 million
Energy Demand	1980	272 Mtoe (55% imported)
	1982	257 Mtoe
Oil Demand	1980	133 Mtoe (96% imported)
Electric Power Plant Capacity	1980	86 GWe
Electric Power Production	1982	366.9 TWh-- 17% nuclear 63% coal 5% oil 10% gas 5% hydro/other
	1985	25% nuclear
	1990	30% nuclear

NUCLEAR POWER

National Policy: strong support for private-enterprise nuclear industry; federal funding of nuclear research; joint financing (federal/industry) of demonstration projects.

Nuclear Power Plant Capacity	1984	12.3 GWe
	1985	16.4 GWe
	1990	22.9 GWe
	2000	29.3 GWe
Reactor Mix	1984	PWR: 7 (1972-84);
		7 (1985-92)
		BWR: 6 (1972-84);
		1 (1985)
		FBR: 1 (1987)
		HTR: 1 (1985)

INDUSTRIAL FUEL CYCLE

Policy: Full commercial capability (private companies)--enrichment; fuel fabrication; domestic reprocessing of standard LWR fuels; plutonium recycle to FBRs and LWRs. Immediate reprocessing load is to be handled by foreign plants. The federal government provides and operates waste disposal facilities; the power producers pay for the service.

Waste Management Strategy: Vitrification of HLW and interim storage of HLW glass for 20-30 years; disposal of reprocessing wastes in salt-dome repository; disposal of reactor and decommissioning wastes in salt repository or abandoned iron mine.

Cumulative Spent Fuel	1980	960 tU
Arisings (LWR)	1985	2,250 tU
	1990	4,550 tU
	2000	11,000 tU
Cumulative Waste Arisings	2000	250-500,000 drums LLW; 70-100,000 drums ILW; 4,600 blocks HLW glass

Industrial-Scale Activities

- Uranium mining and milling (tU/a): 100.
- Uranium enrichment (tSWU/a): 1986--400.
- Conversion of UO_2 to UF_6 (tU/a): 1000.
- Fuel fabrication
 - UO_2 fuels: 950 tU/a
 - MOX fuel: 40 tHM/a for LWR fuels, 10 tHM/a for FBR fuel elements (ALKEM).
- AFR spent fuel storage
 - 1,500 t, dry storage (Ahaus; demonstration license obtained)
 - 1,500 t, dry storage (Gorleben; startup, 1983).
- Fuel reprocessing plant (350 t/a--constructed in Bavaria or Lower Saxony).

Major Milestones

- Complete site characterization at Gorleben 1985
- Spent fuel AFR at Gorleben 1983
- First fuel reprocessing plant 1990
- PAMELA HLW vitrification pilot plant 1985
- HOVA HLW vitrification plant for the WAK pilot plant 1992-3
- Konrad iron mine repository 1988
- Gorleben repository 1995

INTERNATIONAL RELATIONSHIPS

Member state of OECD/NEA, IAEA and EC. Bilateral agreement (BMFT/DOE) for waste management cooperation.

Commercial ties with other countries:

- URENCO** (UK-Netherlands-FRG uranium enrichment consortium)
- UNIREP** (UK-France-FRG reprocessing consortium)
- NTL** (UK-France-FRG Nuclear Transport)
- SNR-300** (Partnership with Belgium and The Netherlands)
- Super Phenix** in France (5% interest)
- SERENA** (FRG-France marketing agency - 35% interest)
- Cooperation** with General Atomic in HTGR development
- Nuclear technology transfer** to various countries
- Licensing arrangements** with US reactor vendors.

ORGANIZATION

- Federal Government
 - Coordinates FRG nuclear program
 - Sponsors R&D
 - Builds and operates radioactive waste disposal facilities
 - Sets licensing rules.
- Privately-owned Utilities
 - Provide spent fuel storage, reprocessing and waste treatment
 - Pay for waste disposal.
- States (Länder)
 - License nuclear plants.

FIGURE GM-1. Government Responsibilities--Nuclear
Fuel Cycle and Waste Management

GE-4

Germany (FRG)

FIGURE GM-2. Industrial and University Responsibilities--
Nuclear Fuel Cycle and Waste Management
Activities

Germany (FRG)

ALKEM

ALKEM GmbH
Postfach 110069
D-6450 Hanau 11 (Wolfgang) Tel: (49) 6181 58-0
Federal Republic of Germany Telex: 04 184 124 rbu d

Company Directors	Horst Roepenack (49) 6181 58-4600 Dr. Wolfgang Stoll (49) 6181 58-4666
Plutonium Waste Treatment	Dr. Volker Schneider (49) 6181 58-4590 Dr. F.-W. Ledebink (49) 6181 58-4155

Facilities

- **MOX Fuel Fabrication Plant**
Capacity: 40 t/a, LWR fuel; 10 t/a, FBR fuel.

BAM (Federal Institute for Material Testing)

Bundesanstalt für Material Prüfung (BAM)
Unter den Eichen 87
D-1000 Berlin 45 Tel: (49) 30 8104-1
Federal Republic of Germany Telex: 183261 BAMB D

**BGR (Federal Institute for Geosciences
and Natural Resources)**

Bundesanstalt für Geowissenschaften und
Rohstoffe
Stilleweg 2
D-3000 Hannover 51 Tel: (49) 511 6468-1
Federal Republic of Germany Telex: 923730 bfb

BGR (contd)

Director, Division 2, General and Technical Geology	Prof. Helmut Venzlaff
Director, Subdivision, Engineering Geology	Prof. M. Langer
Rock Mechanics	Prof. A. Pahl
Soil Mechanics	Dr. R. Lüdeling
Salt Mechanics	Dr. H. Albrecht
Rock Mechanics in Mining and Technical Research	Dr. D. Meister
Disposal of Rad. Waste	Dr. W. Jaritz
Underground Storage	Dr. H. Reum
Hydrogeology	Dr. H. Vierhuff
Groundwater Geophysics	Dr. W. Giesel

BMFT (Federal Ministry for Science and Technology)

Bundesministerium für Forschung und Technologie
Heinemannstrasse 2
Postfach 200706
D-5300 Bonn 2
Federal Republic of Germany

Tel: (49) 228 591-3300
Telex: 885674 BMFT
Telefax: 593105

Minister, Science/Technology	Dr. Heinz Riesenhuber
Director General, Energy/ Environment/Raw Materials	Dr. Günter Lehr
Director, Energy Sci. Tech. Reprocessing/Recycling	Dr. Manfred Popp Dr. Rolf-Peter Randl (49) 228 59-3275
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Spent Fuel	Helmut H. Geipel
Waste Treatment	Dr. Karlheinz Hübenthal
Safety Assessment	Dr. Bernd Reuse
Repository Programs	Reinhard Ollig

Germany (FRG)

BMI (Federal Ministry of the Interior)

Bundesministerium des Innern
Graurheindorfer Strasse 198
D-5300 Bonn 1
Federal Republic of Germany

Tel: (49) 228-6811
Telex: 886-664 bmid
886-896

Chairman, Advisory Committee
on Reactor Safeguards (RSK) D. Smidt
Chairman, Advisory Committee
on Radiological Protection
(SSK) A. Kaul

**DBE (German Company for Construction and Operation
of Waste Disposal Facilities)**

Deutsche Gesellschaft zum Bau und Betrieb
von Endlagern für Abfallstoffe mbH (DBE)
Woltorfer Strasse 74
D-3150 Peine 1
Federal Republic of Germany

Tel: (49) 5171 43-100
Telex: 092646 dbd d

Managing Director, Surface Fac., Arno Jacobi
Purchase and Stores, Nuclear (49) 5171 43-200
Handling and Protection
Managing Director, Underground Wolfgang Pitz
Facilities, Licensing,
Project-Related R&D
Director, Mining G. Grübler
Director, Licensing G. Holtz
Director, Project-Related R&D Dr. H. Jezierski

DHI (German Hydrographic Institute)

Deutsches Hydrographisches Institut
Isotopenlaboratorium
Bernhard-Nacht-Str. 78
P.O. Box 220
D-2000 Hamburg 4
Federal Republic of Germany

Tel: (49) 40 3190-1
Telex: 0211 138 bmvhh d

President Prof. Gerhard Zickwolff

Germany (FRG)

DWK (German Fuel Reprocessing Company)

Deutsche Gesellschaft für Wiederaufarbeitung
von Kernbrennstoffen mbH
Hamburger Allee 4, Postfach 1407
D-3000 Hannover 1 Tel: (49) 511 3390-0
Federal Republic of Germany Telex: 9220202 dwk

Board Member for Eng./Technical	Joachim Mischke
Director	
Manager, Waste Management	Dr. Klaus Einfeld
Manager, Fuel Element	Dr. Klaus Janberg
Handling	
Manager, Reprocessing	Dr. W. Weinländer
Project Direction	Dr. Hess
Board Member for Research	Dr. Carsten Salander

GSF/IFT (Institute for Underground Storage, Company
for Radiation and Environmental Research)

Gesellschaft für Strahlen- und
Umweltforschung mbH München
Institut für Tieflagerung (GSF/IFT)
Theodor-Heuss-Strasse 4
D-3300 Braunschweig Tel: (49) 531 8012-1
Federal Republic of Germany Telex: 0952865 iftt: d

Schachtanlage Asse
D-3345 Remlingen
Kreis Wolfenbüttel
Federal Republic of Germany Tel: (49) 5336-191

Director, Disposal Tech. Dr. Klaus Kühn
(49) 531 8012-231

Eng. Techniques Vacant
Geotechnology M. W. Schmidt
Test Fields Tilman Rothfuchs
Geophysics D. Flach
Director, Safety Tech. Werner Hild
Safety Analysis Storck
Geology T. Brasser
Geochemics H. Gies
Director, Proj. Mgmt. Dr. Wernt Brewitz
MLW/HLW Projects R. Stippler
Gorleben Site Kunze
Licensing Opp

GSF/IFT (contd)

Director, Asse	Klaus Dürr
Mine Manager	Kurt Thieleman
Tech. Planning	H. Kolditz
Rad. Protection	Müller-Lyda
Konrad Mine, Mgr.	M. Kubetzy

Facilities

- **Asse II Salt Mine** (10 km S.E. of Wolfenbüttel)
Mission: In situ testing and disposal technology development for a salt dome repository; through 1978, disposal of LLW and ILW.
History: Startup, 1967.
- **Konrad Iron Mine** (10 km S.W. of Braunschweig)
Mission: Disposal of reactor and decommissioning wastes; R&D on hard-rock disposal.
Milestone: Startup as disposal site, 1988.
- **Chemical and Hydrology Laboratories** (Braunschweig)
- **Rock Mechanics Laboratory** (Braunschweig)

HMI (Hahn-Meitner Institute)

Hahn-Meitner Institut für Kernforschung, GmbH
Postfach 390128
Glienicker Strasse 100
D-1000 Berlin 39
Federal Republic of Germany

Tel: (49) 30 8009-1
Telex: 185763

Scientific Technical Director	Prof.-Dr. H. Lindenberger
Managing Director	Dr. M. Nettesheim
Reactor Chemistry	Dr. Werner Lutze
Section (HMI Waste Program)	

KEWA

Kernbrennstoff-Wiederaufarbeitungs-GmbH
Hamburger Allee 4, Postfach 3245 Tel: (49) 511 33900
D-3000 Hannover 1 Telex: 9 222 202 dwk
Federal Republic of Germany (für kewa)

Directors	Joachim Mischke
	Dr. H.-J. Mylord
Process Engineering	Mr. W. A. Issel
Engineering and Technology	Dr. Knoch

KEWA is a subsidiary of DWK.

Facilities

- **AFR Spent Fuel Storage Facilities** (Gorleben and Ahaus sites)
Design Basis: Dry storage in CASTOR casks - 400 casks in a building which has dimensions of 600 ft x 125 ft x 62 ft high; capacity, 1500 t.
History: Startup of Gorleben AFR, 1983.
- **Fuel Reprocessing Plant** (Bavaria or Lower Saxony)
Mission: Demonstrate operability and safety of small commercial plant; reprocess spent LWR fuels commercially.
Design Basis: Shear-leach head-end; PUREX process; capacity, 350 t/a.
Milestone: Startup, 1990.
- **PAMELA Pilot Plant** (Mol, Belgium)
Mission: Demonstrate ceramic melter and VITROMET production with stored Eurochemic LEWC.
Design Basis: Denitration; liquid-fed ceramic melter, 0.72 m² surface area; capacity, 36-2/hr feed, 25 kg/hr glass (3 canisters/day @ 150 kg glass/canister); product, either borosilicate glass blocks or VITROMET, 0.3 m dia by 1.2 m high.
Milestone: Hot operation, 1985.

KFA (Jülich Nuclear Research Center)

Kernforschungsanlage Jülich GmbH
Postfach 1913
D-5170 Jülich
Federal Republic of Germany

Tel: (49) 2461-610
Telex: 833556

Director, Institute of Chemical Technology	Prof. Erich Merz
Reproc./Final Storage	Prof. Erich Zimmer
HTGR Fuel Cycle Project/ JUPITER Project	G. Kaiser
Director, Decon. Inst.	Dr. Manfred Laser
Director, Reactor Mtls. Inst.	Prof. H. Nickel

Facilities

- **Jupiter Pilot Plant** (radioactive)
Mission: Develop HTGR fuel reprocessing technology.
Design Basis: Grind-burn-leach head-end; Thorex solvent extraction. Capacity, 2 kg/day.
Milestone: Startup, 1985.
- **FIPS II** (radioactive)
Mission: Develop vitrification technology for HTGR fuel cycle HLW.
Design Basis: Denitration to form sludge, drum dryer, in-can melter. Capacity, 1 kg/hr glass; product, phosphate or borosilicate glass.
Milestone: Hot operation, TBD.

KfK (Karlsruhe Nuclear Research Center)

Kernforschungszentrum Karlsruhe GmbH
Postfach 3640
D-7500 Karlsruhe 1
Federal Republic of Germany

Tel: (49) 7247-821
Telex: 7826484

(Most convenient way from US is to fly to Frankfurt and go by train or car to Karlsruhe.)

KfK (contd)

Manager, Fuel Reproc./Waste Mgmt. Project (PWA)	Dr. Reinhard Kroebe1 (49) 7247 82-2032
Director, Waste Treatmt. (HDB)	Dr. Gunter Höhle1n
Director, Institute for Hot Chemistry	Prof. Klaus Ebert
Deputy Director	Dr. Gunter Koch
Director, Institute for Nuc. Waste Tech. (INE)	Dr. Helmut Krause (49) 7247 82-2230
Final Disposal	Dr. R. Köster (49) 7247 82-2302
Chemistry (WMRD)	Dr. Pentinghaus
Process Engineering	Dr. S. Weisenburger
Director, Institute for Radiochemistry (IRCh)	Prof. Ache
Director, Ctrl. Eng. Dept. (IT)	W. P. Schmidt
Remote Handling	G. Böhme
Director, Lab. for Aerosol Phys./Filter Tech. (LAF II)	J. Wilhelm

Facilities

- **MILLI Hot Cell Facility** (fuel reprocessing)
Mission: LWR and FBR fuel reprocessing R&D.
- **Ceramic Melter** (nonradioactive)
Mission: Test remote operation of a ceramic melter facility which is a prototype of the PAMELA hot cell.
Design Capacity: 30 t/hr HLLW.
History: Startup, Fall 1981. As of 5/83, had produced 5 + glass beads and 30 + blocks, and had demonstrated 90% availability.
- **PUTE Hot Facility** (fuel reprocessing)
Mission: U/Pu Separation.
Design Basis: Pulsed Columns, Electr. Chem. Reduction.
History: Startup 1982.

KfK (contd)

- **PUSTA Facility** (fuel reprocessing)
Mission: Development of Pulsed Plate Columns Design Data, Correlation Equations.
Design Basis: Columns of 100 mm, 210 mm, and 350 mm diameter.
History: Startup 1984.
- **KRETA**
Mission: Develop ^{85}Kr recovery technology.
Design Basis: Cryogenic distillation; capacity, 50 m³/hr.
- **PASSAT Facility**
Mission: Development and testing of DOG filters.
Design Basis: Packed fiber mist eliminators, HEPA-filter, iodine-filter.
History: Startup 1978.
- **BEATE Facility**
Mission: Aerosol source term destination and VOG-behavior.
Design Basis: Stirring and transport of liquids by air and steam.
History: Startup 1983.
- **Ceramic Melter** (nonradioactive)
Mission: HLW vitrification process development with ceramic melter for the PAMELA pilot plant and for the WA-350.
Design Basis: Liquid-fed joule heated melter; PAMELA capacity: 30 t/hr HLLW or 30 kg/hr glass; WA-350 capacity: 80 t/hr HAWC evaporation.
History: Startup 1981; WA-350 melter 1984.
- **ALONA** (radioactive acid digestion pilot plant built and operated by KfK at Mol, Belgium)
Mission: Demonstrate acid digestion of combustible TRU wastes.
Design Basis: Treatment with H₂SO₄-HNO₃ in thermal loop system. Capacity, 1000 m³/a.
History: Startup, 1982.

KfK (contd)

- **Waste Concreting Plant** (radioactive)
Mission: Immobilize KfK ILW.
Design Capacity: 2.5 t/day waste.
History: Startup, 1977.

NUKEM

NUKEM GmbH
 Postfach 110080
 D-6450 Hanau 11
 Federal Republic of Germany

Tel: (49) 6181 58-0
 Telex: 4184113 nuk d

Managing Directors M. Stephany
 P. Jelinek-Fink
 Dr. K. G. Hackstein

Division Managers, H. Pirk
 Process Engineering H. Dyroff
 Department Manager, R&D Dr. H. Huschka

PTB (Federal Science and Engineering Laboratory)

Physikalisch-Technische Bundesanstalt
 Bundesallee 100
 D-3300 Braunschweig
 Federal Republic of Germany

Tel: (49) 531 5921
 Telex: 952822 ptb d

Director, Division Storage/
 Disposal of Radioactive
 Wastes Prof. H. Röthemeyer
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Subdivision Science/Technology
 (Waste Disposal)

Waste Product Dr. Ernst Warnecke
 Repository Technical Mine Dr. P. Oesterle
 Safety (49) 531 592-7635

Radiation Safety Dr. Ehrlich
 R&D, Accident Analysis Dr. Illi
 Explorations, Construction G. Wosnick
 of Mines

Director, Subd. Fuel Matls. Dr. W. Collin
 Transport Licensing M. Blechschmidt
 (acting)

Interim Stor. Fac. Licensing M. Blechschmidt

PTB (contd)

Facilities

• **Gorleben Disposal Site**

Mission: Dispose of high-level and TRU wastes.

Repository Concept: 65-m deep boreholes in tunnel floors at depths of 800-1000 m in the Gorleben salt dome.

Milestone: Startup, 1995.

TRANSNUKLEAR

Transnuklear GmbH

Postfach 110030

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Federal Republic of Germany

Tel: **(49) 6181 580**

Telex: 4184123 tnf d

Company Executives

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Dr. Horst Keese

TUM (Technical University Munich)

Technische Universität München

Walther-Meissner-Strasse

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Director, Institute for
Radiochemistry

Prof. Franz Baumgärtner

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Nuc./Electrochem. Division

Nuclear Division

Process. Engineering Dept.

Dr. Bernd Strasser

Karl-Heinz Knickel

Dr. Wolfgang Strewe

WAK (Fuel Reprocessing Company)

Wiederaufarbeitungsanlage Karlsruhe
Betriebsgesellschaft mbH
Postfach 220
D-7514 Eggenstein-Leopoldshafen 2 Tel: (49) 7247 4755
Federal Republic of Germany Telex: 7826893 gwk d

(WAK and the WAK plant are located next to Karlsruhe
Nuclear Research Center. WAK is a subsidiary of DWK.)

Chief Executive	Dr. Walter Schüller
Operations	Dr. Wilhelm Heinz
HLW Solidifictn./Tech. Proj.	Dr. Karl-Dieter Kuhn

Facilities

- **WAK Reprocessing Plant** (owned by KfK)
Mission: Reprocess UO₂ fuels; recover plutonium for recycle; test advanced technology.
Design Basis: Chop-leach head-end; PUREX process; capacity, 175 kg HM/day.
History: On-line from 9/71 to early 1980, when it was shutdown for dissolver replacement. Total throughput to 1980, 115 tHM (43 tHM from LWR fuel). Operation resumed, October 1982.
- **TEKO Hall** (cold semi-works, owned by KfK)
Mission: Test fuel cycle components and unit operations; currently being equipped for fuel reprocessing studies.
Design Basis: Shear, dissolver, centrifuge, solvent extraction battery; head-end capacity, 4 tHM/day.

WAK (contd)

- **AZUR**
Mission: Demonstrate dissolver off-gas treatment.
Design Basis: Varied; includes cryogenic recovery of ⁸⁵Kr.
History: Startup, late 1970s.
- **HOVA**
Mission: Vitrify WAK plant HLW.
Design Basis: French AVM process; product, borosilicate glass blocks, 0.3 m x 1.3 m high; capacity, 30 μ /hr HLW feed or 15 kg/hr glass.
Milestone: Startup, 1990.

US EMBASSY - BONN

American Embassy
Delchmannsaue
5300 Bonn 2
Federal Republic of Germany

Tel: (49) 228 339-3390
Telex: 885452

INDIA

MAJOR INDIAN HOLIDAYS

January 1	New Year	August 15	Independence Day
January	Id-ul-Fitr	August	Janmashtami
January 26	Republic Day	September	Anant Choudas
February	Vasanta	October	Dusehra
February	Maha Sivarati	October	Diwali
March	Holi	October 2	Gandhi's Birthday
March	Dulhendi	October	Bhaiya Dooj
April	Durga Ashtmi	November	Guru Nanak's Birthday
April	Muharram	December	Singh's Birthday
April	Mahavir Jayanti	December 31	Bank Holiday
April 13	Baisakhi		
August	Raksha Bandhan

INDIA

ENERGY

Population	1984	731 million
Energy Demand	1979	94 Mtoe
Oil Demand	1980	28 Mtoe (65% imported)
Electric Power Plant Capacity	1982 1985	35 GWe-- 50 GWe
Electric Power Production	1982	107 TWh-- 50% coal 42% hydro 6% oil 2.7% nuclear

NUCLEAR POWER

National Policy: Heavy dependence on nuclear power to augment the nation's electric power generating capacity. A three-phase program--first phase, reactors fueled with natural uranium; second phase, FBRs fueled with Pu produced by first-phase reactors; third phase, self-sustaining thorium-uranium cycle reactors.

Nuclear Power Plant Capacity	1984 1985 1990 2000	1.0 GWe 1.2 GWe 1.9 GWe 4.4 GWe
Reactor Mix	1984	BWR: 2 (1969) HWR: 3 (1973-81); 3 (1985-89);
Reactor Development	1985 1990	FBR 12-15 MWe test unit FBR 500 MWe commercial

INDUSTRIAL FUEL CYCLE

Policy: Achieve self-sufficiency in CANDU-type fuel cycle--uranium milling, conversion to UO_2 , fuel fabrication, reprocessing (in small plants adjacent to power stations); if enriched UF_6 supply for India's BWRs is cut off, they may fuel with UO_2 - PuO_2 .

Waste Management Strategy: Vitrification of HLW, interim storage for at least 20 years and disposal in a granite or gneiss formation.

Cumulative Spent Fuel	1980	370 tU
Arisings (LWR and HWR)	1985	780 tU
	1990	1,580 tU
	2000	5,000 tU
Cumulative Waste Arisings	1982	2000
Primary solid wastes	1,700 m ³	107,000 m ³
LLW concentrates	2,500 m ³	77,000 m ³
ILW	650 m ³	20,000 m ³
HLW	350 m ³	8,000 m ³

Industrial-Scale Activities

- Heavy-water production (t/a): 1981--300; additional capacity is planned, sufficient to yield a 13,000 t inventory by the year 2000.
- Uranium mining and milling (t/a): 200.
- UO_2 fuel fabrication (t/a): 1981--100; 1984--210.
- Fuel reprocessing: Trombay pilot plant, 30 t/a (1962--); Tarapur plant, 100 t/a (1982--); Kalpakkam plant, 100 t/a.
- HLW vitrification: Tarapur (1982--).

ORGANIZATION

India

AEC

Government of India
Department of Atomic Energy
Atomic Energy Commission
Chhatrapati Shivaji Maharaj Marg
Bombay 400 039
India

Tel: 242823

Chairman

Dr. Raja Ramanna

AERB (ATOMIC ENERGY REGULATION BOARD)

Chairman

A. K. De
(Indian Institute
of Technology)

Mission: Regulation and Licensing of Nuclear Facilities.

BARC

Bhabha Atomic Research Centre
Trombay, Bombay 400 085
India

Tel: 523321
Telex: 112817

Director, Nuclear Safety Group	V. N. Meckoni
Waste Management Division	N. S. Sunder Rajan
Central. WM Facil., Kalpakkam	R. V. Amalraj
Radiol. Protection Division	K. G. Vohra
Director, Chem. Engineering Group	B. K. Garg
Fuel Reproc. Div. PreFre	A. N. Prasad

Activities: BARC has five test reactors; radiochemistry and isotope laboratories; an isotope production and processing unit; pilot plants for production of heavy water, zirconium, titanium, etc.; a thorium plant; a uranium metal plant; a fuel reprocessing plant; the Fuel Irradiation and Processing Laboratory; and supporting facilities. Fuel cycle R&D includes fuel reprocessing, HLW solidification, treatment of alpha-emitting wastes (incineration, wet oxidation, decontamination, and immobilization of cladding hulls), D&D, and waste isolation in geologic formations.

Facilities

- **Trombay Fuel Reprocessing Plant**
Mission: Reprocess natural uranium metal fuels.
Design Basis: Chemical declad, PUREX flowsheet; contact maintenance; capacity, 0.1-0.15 tHM/day.
History: On-line, 1965-1974; modified and being readied to operate again.
- **HLW Vitrification Plant**
History: Construction start, 1981.

KOLAR WASTE DISPOSAL RESEARCH STATION

Location: In the Kolar gold mine area at the Karnataka State.

Mission: Assess the suitability of peninsular gneisses for location of a repository (in situ studies).

Description: Tunnel extended from abandoned section of one of the Kolar gold mines into a neighboring gneissic formation.

History: Startup, late 1979.

MADRAS ATOMIC POWER PROJECT

Madras Atomic Power Project
Kalpakkam
India

Mission: Nuclear power production, FBR development, fuel reprocessing and waste treatment, plutonium fuel fabrication for FBRs.

Fuel Cycle R&D: FBR technology, reprocessing of FBR fuels.

Facilities

- **Kalpakkam Fuel Reprocessing Plant**

Mission: Reprocess spent fuel from the Kalpakkam reactors and from the 15-MW FBTR due for commissioning in mid-1981.

Design Basis: Purex process, with a separate line for FBTR mixed-carbide fuels; capacity, 0.5 tHM/day for PHWR fuels.

- **Kalpakkam Fuel Reprocessing Laboratory**

Mission: Develop and test equipment and unit operations for FBR fuel reprocessing.

- **Kalpakkam HLW Vitrification Plant**

History: Construction start, 1983.

TARAPUR ATOMIC POWER STATION

Tarapur Atomic Power Station
Tarapur, Maharashtra
India

Mission: Provide electric power for India, reprocess spent fuel from Tarapur reactors and immobilize the associated wastes.

Facilities

- **Tarapur Fuel Reprocessing Plant (PreFre)**
Mission: Reprocess natural and low-enriched UO_2 fuels (zircaloy clad).
Design Basis: Chop-leach head-end; PUREX flowsheet; contact maintenance; capacity, 0.5 tHM/day.
History: Construction completed, 1975; hot operation, 12/82.
- **WIP (Waste Immobilization Plant)**
Mission: Vitrify Tarapur HLW.
Design Basis: Two-step calcination and melting in drainable pot; capacity, 25 t/hr HLLW, 125 kg glass/canister, 1 canister/day; product, borosilicate glass blocks.
History: Construction completed 1981.
- **Solid Storage Surveillance Facility**
Mission: Provide air-cooled storage for WIP products.
Design Basis: Stack-induced natural-draft air cooling; capacity for 20 years' storage of Tarapur and Trombay WIPs.
- **ILW Bituminization Plant**
- **Polymerization Facility**

ITALY

MAJOR ITALIAN HOLIDAYS (1985)

January 1	New Year
April 5	Good Friday
April 7-8	Easter
April 25	Liberation Day
May 1	Labor Day
May 26-27	Pentecost
August 15	Assumption
November 1	All Saints
December 8	Immaculate Conception
December 25-26	Christmas

ITALY

ENERGY

Population	1984	58 million
Energy Demand	1980	142.1 Mtoe (80% imported)
Oil Demand	1980	95 Mtoe (97% imported)
Electric Power Plant Capacity	1981	47.4 GWe
Electric Power Production	1982	184.4 TWh-- 57% oil/gas 25% hydro/geoth. 13% coal 4% nuclear

NUCLEAR POWER

National Policy: National government supports nuclear power growth, but is hampered by financial and siting problems.

Nuclear Power Plant Capacity	1984	1.3 GWe
	1990	1.3 GWe
	1995	4.8 GWe
	2000	6.7 GWe
Reactor Mix	1984	GCR: 1 (1964)
		PWR: 1 (1965)
		BWR: 1 (1981)
		2 (1988)
		HWR: 1 (1986)
Reactor Development	HWR, FBR; membership in Super Phenix consortium	

Italy

INDUSTRIAL FUEL CYCLE

Policy: Reprocess spent fuel and recycle Pu to breeders; develop indigenous fuel cycle and waste treatment capability.

Waste Management Strategy: HLW--vitrify and store in engineered surface facility for 50-60 years; emplace canisters in geologic repository (clay).

Cumulative Spent Fuel	1980	160 tU
Arisings (LWR)	1985	330 tU
	1990	520 tU
	2000	2,000 tU

INTERNATIONAL RELATIONSHIPS

Membership in EC, IAEA, and OECD/NEA. A CEC Joint Research Center laboratory is located in Northern Italy at Ispra. Participation in Eurodif and Super Phenix projects.

ORGANIZATION

- Ministry of Industry--overall nuclear responsibility.
- ENEA--safety and regulatory; nuclear R&D (principally at Casaccia, Saluggia and Trisaia).
- ENI--government-owned oil and energy holding company (of AGIP), which provides fuel cycle services.
- Nucleco--manages institutional and reactor LLW/ILW.
- CIPE (Interministerial Council for Economic Planning)--designates regions where nuclear plants are to be located.
- ENEL--state-owned power utility.

**ENEA (National Commission for Research and Development
of Nuclear Energy and Alternative Forms of Energy)**

ENEA
Regina Margherita 125
I-00198 Rome
Italy

Tel: (39) 6 85281
Telex: 61183

President
Director General

Prof. Umberto Colombo
Dr. Fabio Pistella

Mission: Supervise pure and applied nuclear research,
maintain technical control over nuclear power plants,
cooperate in international program.

Owner: Government.

ENEA-CASACCIA

ENEA-Casaccia Center
S. Maria di Galeria
S.T. Anguillarese km 1+300
I-00060 Rome
Italy

Tel: (39) 6 6948-1
Telex: 613296

For Correspondence:
Casella Postale 2400
I-00100 Rome
Italy

Fuel Cycle
Waste Management
HLW Vitrification Project
Reprocessing

Dr. Paolo Venditti
Dr. B. Dello Vicario
Dr. Piero Risoluti
Dr. G. Rolandi

Mission: Applied research--advanced technology, fast
breeder development; fuel cycle and alternative energies
R&D.

Waste Management R&D: MOX fuel reprocessing, HLW solidi-
fication, actinide transmutation, treatment of LLW and
characterization of waste forms, waste isolation in clay
formations (site characterization and thermal properties).

ENEA-SALUGGIA

ENEA-Impianto Eurex
I-13040 Saluggia (Vercelli) Tel: (39) 161 48415
Italy Telex: 380058 EURI

(Located about 35 km from Torino and 120 km from Milano.)

Director, Eurex Pilot Plant Dr. Franco Pozzi
Deputy Director, Eurex Dr. Arnolfo Hall

Mission: Applied nuclear research (EUREX fuel reprocessing pilot plant is located here).

Facilities

- EUREX (fuel reprocessing pilot plant-radioactive)
Mission: Reprocess MTR and low-enriched uranium (including UO₂) fuels.
Design Basis: EUREX process for MTR fuel has capacity of 30 kg U-Al/day. Plant will be modified for LWR fuel.
History: Built and operated under a CNEN-Euratom convention 1964-1983. Startup, 1970. CANDU fuels from Canada processed in 1983. A unit will be added for MOX fuel reprocessing.
- IVEX (HLW vitrification plant-radioactive) - Planned
Mission: Immobilize EUREX HLW.
- IFEC (fuel element fabrication)

ENEA-TRISAIA

ENEA-Trisaia Center
S.S. 106 Jonica, Km. 419+500
I-75025 Rotondella (Matera) Tel: (39) 835 972241
Italy Telex: 760085 ENEATR I

(Located about 5 km from the coast of the Ionian Sea in the Gulf of Taranto.)

ENEA-TRISAIA (contd)

Energy Research	Dr. G. Lapolla
ITREC Plant	Dr. T. Candelieri
Technology Development for the Backend of the Fuel Cycle	Dr. A. Canonico
Vitrification Plant Operations	Dr. E. Scoditti

Mission: Applied nuclear research (ITREC fuel reprocessing pilot plant is located here).

Waste Management R&D: Fuel reprocessing; centrifugal contactor development; cladding hulls compaction; HLW vitrification; D&D; waste isolation (clay repositories); operation of inactive vitrification pilot plant; remote technology development for HLW and reprocessing, optimization of glass composition.

Facilities

- ITREC (fuel reprocessing pilot plant-radioactive)
Mission: Special fuel reprocessing R&D; reprocess thorium and MOX (FBR) fuels.
Design Basis: Chop-leach headend; maintenance by remote removal of modules; capacity, 15 kg HM/day (ThO_2 and UO_2).
History: Startup, 1975.
- IVET-1 (vitrification pilot plant-nonradioactive)
Owner: ENEA and AGIP.
Mission: Develop full-scale HLW vitrification process.
Design Basis: IVET-1 pot vitrification (rising-level process); capacity, 20 μ /hr feed; product, borosilicate glass cylinders, 0.25 m dia x 1 m.
History: Operation from July 1980.

ENEA-TRISAIA (contd)

- **IVET-2** (HLW vitrification pilot plant-radioactive) -
Planned
Owner: ENEA.
Mission: Process development; solidify HLW from
EUREX fuel reprocessing pilot plant.
Design Basis: Pot vitrification (rising-level pro-
cess); capacity, 15 t/hr feed (2 canisters/wk) or
10 m³ HLLW/a; product, borosilicate glass cylinders,
0.25 m dia x 1 m.
History: Startup, late 1980s.

ENEL (National Electric Energy Agency)

Ente Nazionale per L'Energia Elettrica
Casella Postale 386
Via Giovan Battista Martini 3
I-00198 Rome Tel: (39) 6 85091
Italy Telex: 610518

Vice President Dr. L. Magno
Director General Dr. M. Moretti

Mission: Responsible for electric power produced by all
sources.

Owner: Government.

ENI

Ente Nazionale Idrocarburi SPA
Piazza Enrico Mattei
I-00198 Rome
Italy

President Dr. Franco Reviglio

Mission: Provide nuclear fuel cycle services. Oil and
energy holding company of AGIP (owned by the government).

NUCLECO

Nucleco
Casella Postale 2400
I-00100 Rome
Italy

Mission: Treat and dispose of low- and intermediate-level wastes from hospitals, laboratories, industrial establishments, and nuclear plants. Eventual plans include decommissioning work on nuclear installations.

Owner: Italian government (ENEA--40%; AGIP--60%).

SNIA TECHINT

Snia Techint
Tecnologie Energetiche Avanzate SpA
Via A. Brgoni 34
I-00153 Rome
Italy

Tel: (39) 6 5894041
Telex: 614354 SNITEC

General Manager

Dr. Marino Fiorelli

Mission: Provide architect-engineering services for reprocessing, fuel handling and HLW conditioning facilities.

JAPAN

MAJOR JAPANESE HOLIDAYS (1985)

January 1	New Year
January 15	Adult's Day
February 11	National Foundation Day
March 20 or 21	Vernal Equinox
April 29	Emperor's Birthday
May 3	Constitution Day
May 5	Children's Day
September 15	Respect for the Aged Day
September 23 or 24	Autumnal Equinox
October 10	Physical Culture Day
November 3	Culture Day
November 23	Labor Thanksgiving Day

JAPAN

ENERGY

Population	1983	119.5 million
Energy Demand	1983	357 Mtoe (83% imported)
	1990	398 Mtoe (78% imported)
Oil Demand	1983	221.4 Mtoe (99% imported)
	1990	209 Mtoe (99% imported)
Electric Power Plant Capacity	1982	137 GWe-- 13% nuclear
	1985	170 GWe
Electric Power Production	1982	581.1 TWh-- 43% oil 18% nuclear 14% gas 14% hydro/geoth. 11% coal
	1990	685 TWh-- 28% nuclear

NUCLEAR POWER

National Policy: Strong nuclear power program, to lessen dependence on foreign energy sources--install LWRs for near-term needs; develop an advanced HWR; aim for commercial FBR operation approximately 2010. Supply domestic needs and build export business.

Nuclear Power Plant Capacity	1984	19.0 GWe
	1985	21.2 GWe
	1990	31.3 GWe
	2000	49.8 GWe

Japan

Reactor Mix	1984	GCR:	1 (1966)
		BWR:	14 (1970-1984)
			6 (1985-1990)
		PWR:	12 (1970-1984)
			6 (1985-1990)
		HWR:	1 (1979)
		FBR:	1 (1991)

Reactor Development	HWR (ATR), LMFBR, HTGR
---------------------	---------------------------

INDUSTRIAL FUEL CYCLE

Policy: Obtain ownership of foreign uranium resources; develop complete fuel cycle capability (enrichment, reprocessing and waste treatment, buying foreign reprocessing services as long as necessary); recycle Pu to FBRs, HWRs, and LWRs.

Waste Management Strategy: HLW--vitrify with borosilicate glass, store to cool for 30-50 years and dispose in geological formations. Dispose off both on-land and at-sea, depending on waste characteristics. Electric utilities have decided to build a complex of three nuclear fuel cycle facilities, for uranium enrichment, spent fuel reprocessing, and radioactive LLW storage (at Rokkashomura, Amori Prefecture).

Cumulative Spent Fuel	1980	1,450 tU
Arising (LWR)	1985	3,700 tU
	1990	7,800 tU
	2000	20,500 tU

Industrial-Scale Activities

- Power production (GWe): 1984--19.7; 1990--34.
- Uranium mining and conversion (tUF₆/a): 200.
- Uranium enrichment (tSWU/a): 1981--50; 1988--250; 2000--3000.

Japan

- Fuel fabrication
 - UO₂: 1984--1,275 tU/a.
 - MOX--FBR fuels: 1972--1 t/a; 1988--6 t/a; ATR fuels: 1972 10 t/a; 1991--50 t/a.
- Reprocessing (t/day): 1981--0.7; 2000--4.7.

Major Milestones

- Selection of candidate geological or seabed repository formations ~1985
- Pu waste treatment facility 1987
- Uranium enrichment demonstration plant ~1987
- HLW vitrification pilot plant (PNC) 1990
- Return of HLW from COGEMA and BNFL ~1990
- Selection of repository test site for in situ test with a simulated waste package ~1990
- MONJU LMFBR 1991
- Uranium enrichment commercial plant ~1991
- Completion of URL 1992
- HLW glass storage facility 1992
- Commercial reprocessing plant for LWR fuels ~1995
- Selection of demonstration site for in situ test with actual waste package ~1995
- FBR fuel reprocessing pilot plant ~1997
- HLW vitrification commercial plant ~1997
- Startup of disposal site After 2000
- Experimental sea-dumping of LLW TBD

INTERNATIONAL RELATIONSHIPS

Member of IAEA and OECD/NEA. LMFBR exchange agreement with DOE, and licensing agreements with GE and Westinghouse. Agreements for cooperation in the peaceful uses of atomic energy with Canada, Australia and UK, and for utilization of nuclear energy with France.

ORGANIZATION

Government funds nuclear R&D and is responsible for HLW disposal. Industry handles the commercial fuel cycle and LLW disposal, and pays for HLW disposal. See Figures JA-1, JA-2, JA-3 for organizational relationships and responsibilities.

FIGURE JA-2. Partial PNC Organization

JA-5

FIGURE JA-3. Partial JAERI Organization Chart

JA-6

AEC

Atomic Energy Commission
2-2-1 Kasumigaseki
Chiyoda-ku, Tokyo 100
Japan

Tel: (81) 3 581-2585

Chairman
Acting Chairman

R. Eiichi Takeuchi
M. Mukaibo

Mission: Formulate national policy on nuclear energy
research, development and utilization.

CRIEPI

Central Research Institute
of Electric Power Industry
1-6-1, Ohtemachi
Chiyoda-ku, Tokyo 100
Japan

President

Hiroshi Narita

Research Laboratory for Civil
Engineering and Biology
1646, Abiko, Abiko-Shi,
Chiba Pref. 270-11
Japan

Tel: (81) 471 82-1181

Energy and Environmental
Research Laboratory
for Energy and Electric Power
2-11-1, Iwato-kita
Komae-shi, Tokyo 201
Japan

Tel: (81) 3 480-2111

Telex: 2423098 CRIEPI J

Waste Management R&D: Standardization of a seismic assess-
ment method. Reliability proof of spent fuel transporta-
tion cask.

GIRIO

Government Industrial Research
Institute, Osaka
1-8-31 Midorigaoka, Ikeda-shi
Osaka 563, Japan Tel: (81) 727 51-8351

Director, 4th Department Dr. Ryozo Hayami
Nuclear Waste Program Dr. Ryohei Terai

Waste Management R&D: Alternatives for HLW solidification; waste form characterization.

HITACHI

Hitachi, Ltd.
6, Kanda-surugada, 4-chome
Chiyoda-ku, Tokyo 101 Tel: (81) 3 258-1111
Japan Telex: J26375 HITACHI

General Manager, Nuclear Power Yoshiaki Korei
Generation
Nuclear Power Development Tsunetaka Wajima

Waste Management R&D: Development on volume reduction systems of radioactive waste. Application of automation and robot technology. Development of advanced control technology through use of fiber optics.

Hitachi Engineering Co., Ltd.
1-1 Saiwai-cho, 3-chome
Hitachi-shi, Ibaraki-ken, 317 Tel: (81) 294 21-1111
Japan Telex: 03645511

Nuc. Power Plant Construction Kiyoshi Shimizu
Nuclear Fuel Project Yasuo Hirose
Nuclear Fuel Cycle Project Sadatoshi Inoue

Waste Management R&D: Develop technology to reprocess spent LWR fuel; fixation, storage, and disposal of HLW; spent fuel storage; Pu fuel production; and decommissioning.

IHI

Ishikawajima-Harima
Heavy Industries Co., Ltd.
Tokyo-chu Bldg.
6-2, Marunduchi 1-chome
Chiyoda-ku, Tokyo 100
Japan

Tel: (81) 3 286-2185

President Kousaku Inaba
Gen. Manager, Nuc. Power Div. Kugao Nojima

IHI Research Institute
Yokohama Branch
1, Shin-mokaharacho, Isogo-ku
Yokohama 235
Japan

Waste Management R&D: Development of nuclear waste management system.

JAERI

Japan Atomic Energy Research Institute
2-2, Uchisaiwai-cho, 2-chome
Chiyoda-ku, Tokyo 100
Japan

Tel: (81) 3 503 6111
Telex: J24596

President Tsuneo Fujinami
Vice President Hiroshi Ishikawa
Exec. Director, International Yoshio Kawashima

Location: JAERI headquarters and Radioisotope Center are in Tokyo. The Tokai and O-arai Research Establishments share government reservations at Tokai-mura and O-arai-machi with PNC. Tokai and O-arai are 120 and 100 km, respectively, northeast of Tokyo, near the ocean. These sites can be reached by train from Tokyo to the city of Mito, then by taxi.

Japan

JAERI: O-ARAI

O-Arai Research Establishment
O-Arai-machi, Higashi-Ibaraki-gun
Ibaraki-ken Pref. 311-13
Japan
Tel: (81) 2926 7-4111

JAERI: TOKAI

Tokai Research Establishment
Tokai Mura, Naka-gun
Ibaraki-ken Pref. 319-11
Japan
Tel: (81) 2928 2-5111
Telex: 3632340 J TOKAI J
3632339 JAERIF J

Vice President	Dr. Hiroshi Ishikawa
Executive Director	Tetsuo Aochi
Director, Environmental Safety Research (DERS)	Dr. H. Amano
Deputy Director, DERS	Dr. K. Araki

Facilities

- **WASTE** (glove box and hot cell facilities)
Mission: Safety evaluations for high level waste.
History: Startup, cold tests, 1981; hot tests, 1982.
- **STEM** (simulation test for environmental radionuclide migration)
Mission: Safety evaluation for land disposal of radioactive LLW.
History: Startup, 1983.

JGC

JGC Corporation
Nuclear Project Division
New Ohtemachi Bldg.
2-1 Ohtemachi 2-chome
Chiyoda-ku, Tokyo 100
Japan
Tel: (81) 3 279-5441
Telex: 02223096 JGCTOK J
General Manager
Takao Nakajima

JGC (contd)

Mission: Design and construction of fuel reprocessing and radwaste treatment facilities.

JGC Nuclear Research Center
2205 Narita-cho, Oharai-machi
Higashi-Ibaraki-gun
Ibaraki Pref. 311-13
Japan

Waste Management R&D: Wet oxidation process (decomposition of organic materials such as spent ion exchanger resin) incinerator; waste solidification process (cementing, bituminization, plastic solidification); regeneration waste recycle process.

JNFS

Japan Nuclear Fuel Service Company, Ltd.
2-2, 2-chome, Uchisaiwaicho
Chiyoda-ku, Tokyo 100
Japan Tel: (81) 3 580 6911

President	Kenzaburo Kobayashi
Exec., Mg. Dir. - Technology	Shigefumi Tamiya
Director - Plant Design	Kentaco Nakajima

Facilities

• **Commercial Fuel Reprocessing Plant**

Mission: Reprocess Japanese fuels.

Design Basis: 800 tHM/a; 3000 tU storage pool;
HLW vitrification and storage. Cost estimate -
700 billion yen.

Milestone: FRP startup, 1995; spent fuel storage,
1991.

Location: Shimokita area (along with commercial
enrichment and LLW storage).

Japan

KOBE STEEL

Kobe Steel, Ltd.
No. 3-18, 1-chome, Wakinohama-cho
Chuoh-ku, Kobe 651 Tel: **(81) 78** 251-1551
Japan Telex: 5622177 KOBESTEEL

General Manager, Mechanical Dr. Kazuo Ikeda
Eng. Research Lab. (MERL)
Nuc. Power R&D Planning (MERL) Tokuya Ishikawa

Kobe Steel, Ltd.
Tekko Building
No. 8-2, 1-chome, Marunouchi
Chiyoda-ku, Tokyo 100 Tel: **(81) 3** 218-7111
Japan Telex: 2223601 KOBESTEEL

Energy Equipment/Projects Norio Nakahashi
Technical Advisor Dr. Yasuji Nakamura

Waste Management R&D: Development of radioactive waste
treatment technology.

MEIDENSHA

Meidensha Electric
Manufacturing Co., Ltd.
New Ohtemachi Building
2-1, 2-chome, Ohtemachi
Chiyoda-ku, Tokyo 100 Tel: **(81) 3** 246-7086
Japan Telex: 02223507 Meiden

Sr. Managing Director H. Hamoda

Waste Management R&D: Remote maintenance systems for PNC
fuel cycle activities.

Japan

MITI

Ministry of International Trade and Industry
3-1, Kasumigaseki
Chiyoda-ku, Tokyo 100
Japan

Tel: (81) 3 501-1511

Director, Nuc. Energy Industry Kazuhiko Ohtsuka
Deputy Director Masaki Mishiho

MMC

Mitsubishi Metal Corporation
5-2 Ohtemachi 1-chome,
Chiyoda-ku, Tokyo 100
Japan

Tel: (81) 3 213-2111
Telex: 2226533 MMCTOKJ

General Manager, Nuc. Energy Dr. Yumi Akimoto
Manager, Tech. Planning Dr. Tamotsu Ishii
General Manager, Tech. Depart. Eiji Yagi
General Manager, Nuc. Resources Takaaki Kashiwagi
Development/Waste Mgmt.

Waste Management R&D: Design and research on facilities
for spent fuel storage and reprocessing, waste treatment
and geologic disposal.

MOFA

Ministry of Foreign Affairs
2-2-1 Kasumigaseki
Chiyoda-ku, Tokyo 100
Japan

Tel: (81) 3 580-3311

Director, Nuclear Energy Hiroshi Yamada

Japan

NIRS

National Institute of Radiological
Sciences

4-9-1, Anagawa
Chiba-shi, Chiba Pref. 260
Japan

Tel: (81) 472 51-2111

Director

Toshiyuki Kumatori

NSC

Nuclear Safety Commission

2-2-1, Kasumigaseki
Chiyoda-ku, Tokyo 100
Japan

Tel: (81) 3 581-5271

Chairman

Keisuke Misonou

PNC

Power Reactor and Nuclear Fuel
Development Corporation

Sankaido Building
1-9-13 Akasaka
Minato-ku, Tokyo 107
Japan

Tel: (81) 3 586-3311

Telex: J26462

President

Minoru Yoshida

Vice President

T. Ishiwatari

Exec. Director

Kunihiko Uematsu

Director, Nuclear Fuels

Shosuke Watanabe

Waste Mgmt.

T. Mishima

Director, Reprocessing

T. Koizumi

Director, Technology Mgmt.

M. Koizumi

Internatl. Cooperation

C. Kinoshita

PNC (contd)

DOE Representative at PNC	D. H. Jones (HEDL)
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	[Ext. 471 (Work)]
	9am-5pm Japan Time
	Tel: (81) 3 584-3612
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	5:30-9pm Japan Time
US Office:	
Power Reactor and Nuclear Fuel	
Development Corporation	
Suite 908	
2600 Virginia Avenue N.W.	
Washington, DC 20037	
	Tel: (202) 338-3770
	Telex: 892777
Manager	Masami Katsuragawa

PNC: O-ARAI

PNC O-Arai Engineering Center	
Oarai-machi, Higashi Ibaraki-gun	
Ibaraki Pref. 311-13	Tel: (81) 292 67-4141
Japan	Telex: J26482
Director	K. Inoue
Waste Management	K. Otsuka

PNC: TOKAI

PNC Tokai Works	
Muramatsu 3371,	
Tokai-mura, Naka-gun	
Ibaraki-ken 319-11	
Japan	Tel: (81) 292 82-1111

PNC: TOKAI (contd)

Director	S. Omachi
Deputy Directors	I. Tanaka, T. Ueno
Director, Reprocessing Plant	T. Yamanouchi
Director, Processing	K. Takeda
Director, Reprocess. Tech. Devel.	K. Matsumoto
Director, Fuel Cycle Tech. Devel.	M. Yamamoto
Director, Plutonium Fuel	J. Komatsu
Director, Conversion Tech.	N. Tsuji

Facilities

- **Fuel Reprocessing Plant**
Mission: Reprocess low-enriched UO_2 .
Design Basis: Oxide fuels: chop-leach head-end. Purex flowsheet; capacity, 0.7 tHM/day. Remote maintenance of chop-leach equipment; contact maintenance of other components.
History: Startup, September 1977; 170 tU spent fuel processed through 12/83.
- **Co-Conversion Facility**
Mission: Demonstrate PNC microwave process for co-conversion production of MOX.
Design Basis: 10 kg/day MOX (50% PuO_2 , 50% UO_2).
History: Start-up of hot operation, 10/83.
- **Plutonium Fuel Development Facility**
Mission: Fabricate FBR and ATR fuels.
Design Basis: FBR fuels--15 kg/d (30% PuO_2 in enriched UO_2); ATR fuels--10 t/a (2% PuO_2 in UO_2).
Throughput to Date: 52 t MOX; 440 kg Pu from Tokai-mura has gone into FUGEN ATR.
- **Plutonium Fuel Fabrication Plant**
Mission: Fabricate MOX fuel for demonstration ATR, LWRs, prototype FBR and demonstration FBR.
Design Basis: 40 t MOX/a.
- **Mockup Test Facilities**
Mission: Nonradioactive, full-scale and/or engineering mockup tests of processes and equipment for vitrification, FBR spent fuel reprocessing.
History: Startup, 3/82.

PNC: TOKAI (contd)

- **Engineering Test Facility**
Mission: Develop full-scale engineering test of vitrification and ceramic melter technology.
Design Basis: Joule-heated melter--45 kg/hr glass.
History: Facility startup, 2/80.
- **Chemical Processing Facility** (reprocessing and HLW treatment)
Mission: Radioactive studies of FBR spent fuel reprocessing and HLW solidification processes.
Design Basis: Five standard hot cells for breeder-fuel reprocessing R&D, five cells for waste conditioning R&D. Reprocessing--1 kg/batch; HLW solidification--10 g/Batch HLW.
History: Hot tests, 9/82.
- **⁸⁵Kr Recovery Pilot Plant**
Mission: Demonstrate ⁸⁵Kr recovery from Tokai-mura reprocessing plant offgas.
Design Basis: Cryogenic distillation and pressurized cylinder storage.
History: In operation.
- **Bitumization Facility**
Mission: Immobilize PNC's LLW.
Design Basis: 200 g/hr.
- **Incinerator (Tokai)**
Mission: Burn solid LLW.
Design Basis: 100 kg/hr.
- **Incinerator (O-Arai)**
Mission: Burn solid LLW.
Design Basis: Three chambers--pyrolysis, combustion, after-burning.
- **Acid Digestion Facility** (nonradioactive)
Mission: Confirm laboratory-scale results on acid digestion process for TRU wastes.
Design Basis: 200-g tantalum digester vessel and ancillary equipment, glass-lined steel where necessary; capacity, 4-8 kg/hr.
History: In operation.

PNC: TOKAI (contd)

- **Plutonium Waste Treatment Facility**
Mission: Prepare PNC TRU wastes for disposal.
Design Basis: Acid digestion of chloride-containing wastes; incineration of other combustibles; mechanical volume reduction.
Milestone: Operation startup, 1987.
- **HLW Vitrification Pilot Plant**
Mission: Vitrify and store HLW from the Tokai-mura fuel reprocessing plant; demonstrate technology.
Design Basis: Ceramic melter to produce a borosilicate glass (tentative); capacity, 0.79 m³ HLLW/day or 1 canister (76 l)/day of glass.
Milestone: Startup, 1990.
- **FBR Fuel Reprocessing Pilot Plant** (reprocessing and HLW treatment)
Mission: Demonstrate FBR fuel reprocessing and HLW solidification.
Design Basis: 120 kg MOX/day (12 t/a).
Milestone: Hot operation, 1997.

RMC

Radioactive Waste Management Center
No. 15, Mori Building
2-8-10, Toranomon
Minato-ku, Tokyo, 105
Japan

Tel: (81) 3 504-1081

President	Syunichi Suzuki
Managing Director	Syunichi Murakoshi

Sponsors: Japanese industry, MITI and STA.

Mission: Promote the study of safe and rational operation of low-level radioactive waste disposal.

Japan

STA

Science and Technology Agency
2-2-1 Kasumigaseki
Chiyoda-ku, Tokyo 100
Japan

Tel: (81) 3 581 5271
Telex: 2226720 STASGD

Minister of State for Science
and Technology

Reiichi Takeuchi

Deputy Minister

Ken Naitou

Admin. Vice Minister

Syozo Shimomura

Director-General, AEB

Moritaka Nakamura

Director, Nuclear Fuel

Kaname Ikeda

Dep. Director

Tsuyoshi Maruyama

Director-General, NBS

Eiichi Jsuji

Deputy Director-General

Kohji Fujisaka

US EMBASSY - TOKYO

American Embassy
10-5 Akasaka 1-chome
Minato-ku, Tokyo 107
Japan

Tel: (81) 3 583 4121
Telex: 2422118

USDOE Representative

Billy D. Hill

KOREA
(Republic of Korea)

MAJOR KOREAN HOLIDAYS (1985)

January 1-3	New Year
March 1	Sam Il Chul (Independence Movement)
April 5	Arbor Day
May 1	Children's Day
May	Buddha's Birthday
June 6	Memorial Day
July 17	Constitution Day
August 15	Liberation Day
September	Chusuk (Thanksgiving)
October 1	Armed Forces Day
October 3	National Foundation Day
October 9	Hangul
December 25	Christmas

KOREA (REPUBLIC OF KOREA)

ENERGY

Population	1983	40 million
Energy Demand	1980	44.1 Mtoe (73.6% imported)
	1985	58.1 Mtoe (78.2% imported)
Oil Demand	1980	26.6 Mtoe (100% imported)
Electric Power Plant Capacity	1983	13.1 GWe
Electric Power Production	1983	41.5 TWh-- 55% oil 15% nuclear 5% hydro

NUCLEAR POWER

National Policy: Continue expansion in electric power capacity; reduce dependence on foreign oil by strong nuclear program; develop indigenous manufacturing capacity; develop FBR capability.

Nuclear Power Plant Capacity	1984	1.8 GWe
	1985	2.7 GWe
	1990	7.4 GWe
	2000	11.2 GWe
Reactor Mix	1984	PWR: 2 (1978-84); 6 (1985-89) HWR: 1 (1983)
Reactor Development		FBR

INDUSTRIAL FUEL CYCLE

Policy: Develop long-term contracts for fuel supplies; holdings of foreign uranium resources; fabrication capability for PWP and CANDU fuels; "wait and see"--reprocessing and recycle of Pu to FBR, CANDU and LWRs.

Waste Management Strategy: Not yet defined.

Cumulative Spent Fuel	1980	17 tU
Arisings	1985	360 tU
	1990	1,450 tU
	2000	4,400 tU

Industrial-Scale Activities

- Uranium milling--3 t ore/day pilot plant.
- Uranium conversion, yellowcake to UO₂--100 tU/a.
- UO₂ fuel fabrication pilot plant--10 tU/a.
- UO₂ fuel fabrication--200 tU/a. Startup, 1989.

KS-3

Korea (ROK)

AEB

Atomic Energy Bureau
Ministry of Science and Technology
Gwacheon 171-11
Republic of Korea

Tel: (82) 2 591-9038
Telex: K24230

Director-General Shiyohl Park
Director, R&D Division Uk Jong Yoo
Director, Nuclear Policy Jae Choon Lim
Director, Nuclear Reactor Kyong Chul Jang
Director, Internl. Cooperation Tae Sik Min

AEC

Atomic Energy Commission
Ministry of Science and Technology
Gwacheon 171-11
Republic of Korea

Tel: (82) 2 591-7694
Telex: K24230

Commissioners Dr. Yong-Kyu Lim
Byoung Whie Lee

EPB

Electric Power Bureau
Ministry of Energy and Resources
Seoul
Republic of Korea

Tel: (82) 2 720-2369
Telex: K23472

Director, Nuclear Power Se-Jong Kim

Korea (ROK)

KAERI

Korea Advanced Energy Research Institute
Head Office (Daeduk Center)
P.O. Box 7, Daedukdanji
Choongnam 300-32
Republic of Korea

Tel: (82) 42 822-6821
Telex: K45553

President	Dr. Pilsoon Han (Ext. 231)
Nuclear Fuel	Dr. Changsaeng Rim
Nuclear Fuel Cycle	Dr. Insuk Suh
Nuclear Safety	Dr. Sunggee Chai
Nuclear Policy	Dr. Poong-Eil Juhn

Waste Management R&D: Fuel fabrication, uranium ore processing and conversion, radioactive waste management, and post-irradiation examination.

KAERI: SEOUL

Korea Advanced Energy Research Institute
Seoul Research Center
P.O. Box 7, Cheongryang
Seoul 131
Republic of Korea

Tel: (82) 2 972-2081
Telex: K24230

Vice President	Dr. Donghoon Kim
Nuclear Reactor Research	Dr. Changgun Lee
Nuc. Radiation Application	Dr. Yongkuk Kim

KOPEC

Korea Power Engineering Co., Inc.
P.O. Box 109
YE0EU1D0
Seoul 150
Republic of Korea

Tel: (82) 2 783-7606
Telex: KOPEN K22562

President	Dr. Kun-Mo Chung
-----------	------------------

Korea (ROK)

KEPCO

Korea Electric Power Corporation
87, Samseong-Dong
Gangnam-Ku
Seoul,
Republic of Korea

Tel: (82) 2 562-9926
Telex: Kelecco K24287,
K28350

President
Nuclear Fuel

Jung Ki Park
Chang Kook Yang

KNFC

Korea Nuclear Fuel Company, Ltd.
P.O. Box 7
Daedukdanji, Daejeon
Choongnam 300
Republic of Korea

Tel: (82) 42 822-6821/9
Telex: K5553

President
Director

Dr. Pilsoon Han
Ui-Kyum Lee

MEXICO

MAJOR MEXICAN HOLIDAYS (1985)

January 1	New Year
January 6	Epiphany
February 5	Promulgation of Constitution
March 21	Birthday of Benito Juárez
April 4	Holy Thursday
April 5	Good Friday
May 1	Labor Day
May 5	Victory of Gen. Zaragoza
September 16	Independence Day
October 12	Columbus Day
November 2	All Souls
November 20	Anniv. of the Revolution
December 8	Immaculate Conception
December 12	Our Lady of Guadalupe's Day
December 25	Christmas

MEXICO

ENERGY

Population	1984	80 million
Energy Demand	1979	77 Mtoe
Electric Power Plant Capacity	1983	18 GWe
Electric Power Production	1978	53 TWh-- 69% oil & gas 30% hydro 1% geothermal
	1980	64.2 TWh

NUCLEAR POWER

National Policy: Future is unclear; ambitious plans to use extensive uranium reserves in domestic nuclear power production have been thwarted by national economic problems, cost overruns with nuclear plant construction, etc.

Nuclear Power Plant Capacity	1986	0.7 GWe
	1990	1.3 GWe
	2000	1.3 GWe
Reactor Mix	1984	BWR: 2 (1986-89)

INDUSTRIAL FUEL CYCLE

Policy: Future is unclear; plans for pilot reprocessing and waste management facilities have been dropped, but uranium mining/milling and fuel fabrication work continues.

Waste Management Strategy: Not announced.

Cumulative Spent Fuel	1990	100 tU
Arising (LWR)	2000	500 tU

ORGANIZATION

All nuclear activities controlled by federal government through:

- CNEA (National Atomic Energy Commission)
- URAMEX--fuel cycle activities, including exploitation of uranium resources
- ININ (National Nuclear Research Institute)--R&D
- CNSNS (National Commission of Nuclear Security and Safeguards)--safety R&D and licensing of nuclear facilities.

CNSNS (National Commission of Nuclear Security and Safeguards)

Comisión Nacional de Seguridad
Nuclear y Salvaguardias
Av. Insurgentes Sur No. 1806
Colonia Florida
Delegación Alvaro Obregón
01030 Mexico, D.F.
Mexico City Tel: (52) 5 534 1401

ININ (National Nuclear Research Institute)

Instituto Nacional de Investigaciones
Nucleares
Benjamin Franklin No. 161
Colonia Condesa
Delegación Cuauhtémoc
06140 Mexico, D.F.
Mexico City Tel: (52) 5 271 0547

Director General	R. Bello
Manager, Rad. Safety	Jose Roberto Martinez Salinas

(ININ's Salazar Plant is located about 35 km from Mexico City. Mail should be addressed to the Mexico City headquarters.)

Mexico

URAMEX

Uranio Mexicano
Insurgentes Sur No. 1079
Colonia Noche Buena
Delegación Benito Juárez
03720 Mexico, D.F.
Mexico City

Tel: (52) 5 563 7752

Director General
Fuel Cycle

Dr. Alberto Escofet
Dr. Carlos Graef Fernandez

MX-3

NETHERLANDS

MAJOR DUTCH HOLIDAYS (1985)

January 1	New Year
April 5	Good Friday
April 7-8	Easter
April 30	Queen's Birthday
May 16	Ascension
May 26-27	Pentecost
December 25-26	Christmas

NETHERLANDS

ENERGY

Population	1984	14.6 million
Energy Demand	1980	65.5 Mtoe
Oil Demand	1979	40.1 Mtoe (>90% imported)
Electric Power Plant Capacity	1980	17 GWe
Electric Power Production	1982	60.3 TWh-- 44% gas 26% coal 23% oil 7% nuclear

NUCLEAR POWER

National Policy: Government favors expansion of nuclear power capacity, but faces public opposition; utilities want three more plants (1,000 MWe each).

Nuclear Power Plant Capacity	1984	0.5 GWe
	2000	0.5 GWe
Reactor Mix	1984	BWR: 1 (1969)
		PWR: 1 (1973)
Reactor Development	Participation in SNR-300 FBR	

INDUSTRIAL FUEL CYCLE

Policy: Use foreign services (fuel fabrication, reprocessing).

Netherlands

Waste Management Strategy: Ocean-dumping of LL and ILW has been halted. Waste is currently stored, pending definition of national waste disposal policy.

Cumulative Spent Fuel	1980	103 tU
Arising (LWR)	1985	190 tU
	1990	270 tU
	2000	420 tU

INTERNATIONAL RELATIONSHIPS

Member state of EC, OECD/NEA, IAEA. Partnership with FRG and Belgium in SNR-300 FBR, and with FRG and UK in Urenco (uranium enrichment consortium).

ORGANIZATION

- Government - Ministries of Economic Affairs, Public Health and Environmental Control, and Social Affairs exercise overall control of nuclear matters with parliamentary approval of their decisions.
- ILONA - Program integrating waste management R&D directed by a policy committee which includes representatives from the ministries and the Netherlands energy research center at Petten (ECN). Partly financed by the CEC Indirect Action Program. Supporting R&D studies are conducted at:
 - ECN (in situ experiments at the Asse Mine in Germany--borehole convergence at elevated temperatures)
 - Delft University, Department of Mining (stress cracking in gallery walls, repository design, borehole closure, safety assessment)
 - Utrecht University, Department of Earth Sciences (salt rheology under repository conditions).

Netherlands

ECN (Netherlands Energy Research Foundation)

Stichting Energieonderzoek
Centrum Nederland
Scheveningse Weg 112
P.O. Box 80404
2508 GK The Hague
The Netherlands

Tel: (31) 70 51-4581
Telex: 31459

Chairman, Governing Board	G. W. zen Stein Callensels
Chairman, ECN Scientific Advisory Center	Prof. J. van Loef
Chairman, Program Committee of the Energy Study Center	Prof. P. de Wolff

Mission: Organize and sponsor energy research and development.

Sponsor: Government.

ECN: PETTEN

Research Center
Netherlands Energy Research Foundation
P.O. Box 1
1755 ZG Petten
The Netherlands

Tel: (31) 2246 6262
Telex: 57211 Reacp NL

Managing Director, Research	Prof. J. A. Goedkoop
Nuclear Waste	Dr. B. Verkerk
Technical Services	J. Hamstra
Geol. Disposal in Salt	Dr. L. H. Vons
Rad. Migration	Dr. A. van Dalen
Rad. Waste Treatment	L. Smeets

Mission: Scientific and technical center for ECN, applied energy research, treat and dispose of all Dutch radioactive waste.

Sponsor: ECN.

Waste Management R&D: Geologic waste isolation--salt dome repositories (conceptual design, thermal studies, and radionuclide migration), seabed disposal, sea disposal of ⁸⁵Kr, decontamination of large components.

GEOLOGICAL SURVEY OF THE NETHERLANDS

Geological Survey of the Netherlands
Nieuwe Gracht 13
Postbus 157
2000 AD Haarlem
The Netherlands

Tel: (31) 23 31-9362
Telex: 71105 geold

Dr. H. M. van Montfrans

KEMA (Research and Testing Electrochemical
Materials Company)

N.V. Tot Keuring van Elektrotechnische
Materialen Arnhem
Utrechtseweg 310
P.O. Box 9035
6800 ET Arnhem
The Netherlands

Tel: (31) 85 45-7057
Telex: 45016 Kema nl

Deputy Director, Research	Dr. M. E. A. Hermans
Research Technology	Dr. J. Kuypers
Nuclear Waste Research	Dr. H. Boekschoten
Acid Digestion and Incineration	Dr. J. Matteman

Mission: Development and engineering for the Dutch
utilities.

Waste Management R&D: Volume reduction and storage of
reactor station wastes.

**MINISTRY OF HOUSING, PHYSICAL
PLANNING AND ENVIRONMENT**

Ministry of Housing, Physical Planning
and Environment
P.O. Box 5811
Koopmansstraat 1
2280 HV Rijswijk
The Netherlands

Tel: (31) 70 94-9505
Telex: 32691

Deputy Chief
Director, Radiation
Protection

Dr. J. Ch. Cornelis
Dr. J. L. Baas

PAKISTAN

MAJOR PAKISTANI HOLIDAYS (1985)

January	Mawlid An-Nabi (Birth of the Prophet)
March 23	Pakistan Day
April 5	Good Friday
April 7-8	Easter
May 1	May Day
August	Id ul Sitr (End of Ramadan)
August 14	Independence Day
September 6	Defense of Pakistan
September 11	Death of Quaid-i-Azam
October	Id ul Azba (Feast of the Sacrifice)
November	Muhurran (Ashura)
December 25	Birthday of Quaid-i-Azam; Christmas

PAKISTAN

ENERGY

Population	1984	86.4 million
Energy Demand	1980	12.4 Mtoe
Electric Power Plant Capacity	1981	4 GWe
Electric Power Production	1981	14.2 TWh-- 50% thermal 46% hydro 4% nuclear

NUCLEAR POWER

National Policy: Provide up to 50% of electrical power supply with nuclear.

Nuclear Power Plant Capacity	1982	0.1 GWe
	1995	1.1 GWe
Reactor Mix	1984	HWR: 1 (1972)

INDUSTRIAL FUEL CYCLE

Policy: Develop complete domestic fuel cycle: uranium mining and milling; enrichment; fuel fabrication; reprocessing.

Cumulative Spent Fuel Arisings	1980	49 tU
	1985	110 tU
	1990	170 tU
	2000	440 tU

Pakistan

ORGANIZATION

- Pakistan Atomic Energy Commission--control of nuclear matters.
- Pakistan Institute of Science and Technology (Rawalpindi)--fuel cycle R&D, including lab-scale reprocessing facility.

PAEC

Pakistan Atomic Energy Commission
P.O. Box 1114
Islamabad, Pakistan

Chairman

Dr. Munir Ahmad Khan

SOUTH AFRICA

MAJOR SOUTH AFRICAN HOLIDAYS (1985)

January 1	New Year
April	Founder's Day
April 5	Good Friday
April 7-8	Easter
May 16	Ascension
May 31	Republic Day
October 10	Kruger Day
December	Covenant Day
December 25-26	Christmas

SOUTH AFRICA

ENERGY

Population	1984	30.9 million
Energy Demand	1980	85.7 Mtoe
Oil Demand		100% imported
Electric Power Plant Capacity	1982 2000	20 GWe 70 GWe-- 5% nuclear
Electric Power Production	1980	95.8 TWh

NUCLEAR POWER

National Policy: Expand electric power production capacity chiefly through coal-burning plants, but develop small nuclear capability.

Nuclear Power Plant Capacity	1984 1990 2000	0.9 GWe 1.8 GWe 2.8 GWe
Reactor Mix	1984	PWR: 1 (1984) 1 (1985)

INDUSTRIAL FUEL CYCLE

Policy: Produce and export uranium (7,000-8,000 tU/a); develop enrichment capability (200-300 tSWU/a). No current plans for fuel fabrication or reprocessing.

Waste Management Strategy: Store reactor wastes at the reactor until a disposal site is operational (1994); build a repository for HLW or spent fuel in an area 800-900 miles west of Pretoria, south of the Kalahari Desert.

Cumulative Spent Fuel	1985	40 tU
Arisings (LWR)	1990 2000	310 tU 1,200 tU

South Africa

ORGANIZATION

The Atomic Energy Corporation of South Africa (government-owned) controls nuclear matters through:

- Atomic Energy Board--regulating and licensing
- NUCOR (Nuclear Development Corporation)--R&D, including waste disposal and repository work
- UKOR (Uranium Enrichment Corporation of South Africa, Pretoria).

ATOMIC ENERGY CORPORATION

Atomic Energy Corporation
of South Africa Ltd.

South African Atomic Energy Board

Private Bag X256

Pretoria 0001

South Africa

Tel: (27) 12 21-3311

Telex: 3-0253 SA

Chairman

J. W. de Villiers

ESCOM

Electricity Commission
of South Africa

P.O. Box 1091

Johannesburg 2000

South Africa

Tel: (27) 11 800-8111

Telex: 4-24 481 SA

Chairman

Jan H. Smith

Sr. General Manager

I. D. van der Walt

South Africa

NUCOR

Nuclear Development Corporation
of South Africa (Pty), Ltd.

Private Bag X256

Pretoria 0001

South Africa

Tel: (27) 12 21-3311

Telex: 3-0253 SA

Managing Director

Geology

Chemical Operations

Dr. J. P. Hugo

P. D. Toens

H. J. Van der Westhuizen

UKOR

Uranium Enrichment Corporation
of South Africa (Pty), Ltd.

P.O. Box 4587

Pretoria 0001

South Africa

Tel: (27) 12 296-9111

Telex: 30805 SA

Managing Director

W. L. Grant

SPAIN

MAJOR SPANISH HOLIDAYS (1985)

January 1	New Year
January 6	Epiphany
April 4	Holy Thursday
April 5	Good Friday
May 1	Labor Day
May 16	Ascension
June 9	Corpus Christi Day
July 25	St. James Day
August 15	Assumption
October 12	Columbus Day
November 1	All Saints
December 8	Immaculate Conception
December 25	Christmas

SPAIN

ENERGY

Population	1984	38.7 million
Energy Demand	1982	64.3 Mtoe
	1990	106.5 Mtoe
Oil Demand	1982	48.2 Mtoe
		(96% imported)
	1990	48.1 Mtoe
		(94.7% imported)
Electric Power Plant Capacity	1982	33.5 GWe
	1990	44.2 GWe
Electric Power Production	1982	114.8 TWh--
		41% coal
		25% oil
		24% hydro/geoth.
		7% nuclear
		3% gas

NUCLEAR POWER

Nuclear Power Plant Capacity	1984	3.7 GWe
	1985	5.5 GWe
	1990	7.5 GWe
	2000	10.2 GWe
Reactor Mix	1984	GCR: 1 (1972)
		PWR: 4 (1969-84)
		3 (1983-87)
		BWR: 2 (1971-84)
		2 (1987-88)

INDUSTRIAL FUEL CYCLE

Policy: No domestic reprocessing and no further contracts for foreign reprocessing.

Spain

Waste Management Strategy: Store spent fuels at the reactor sites for 10 years, then transfer to AFR engineered (dry) storage facility until geologic repository is ready to receive "high-level wastes" (spent fuels); locate AFR and fuel encapsulation facility at repository site (salt dome or granite formation). Shallow-land burial of LLW in trenches. Institutional radioactive wastes are currently placed in a worked-out uranium mine.

Cumulative Spent Fuel	1980	176 tU
Arisings (LWR)	1985	490 tU
	1990	1,300 tU
	2000	3,400 tU

Industrial-Scale Activities

- Uranium mining and milling: 200 tU/a.
- Uranium enrichment: 11.1% interest in Eurodif.
- Fuel fabrication: 200 tU/a.
- AFR spent fuel storage: 1500 tU.

CSN (Council of Nuclear Safety)

Consejo de Seguridad Nuclear
Paseo de la Castellana 135
Madrid 16, Spain

Tel: (34) 1 450-5062
Telex: 49051 CSNM E

President Francisco Pascual
Counselor Prof. L. Guitiérrez Jodra

Mission: Assess the safety of nuclear technology and environmental protection; perform plant inspections and issue licenses.

ENUSA (National Fuel Cycle Company)

Empresa Nacional del Uranio S.A.
Santiago Rusiñol 12 Tel: (34) 1 233-6207
Madrid 3, Spain Telex: 43402 URAN E

Director General Manuel Isla

Mission: Supply fuel cycle services except waste management and disposal (uranium mining and milling; nuclear fuel) to all Spanish nuclear power plants.

JEN (Nuclear Energy Commission)

Junta de Energía Nuclear
Avenida Complutense 22
Ciudad Universitaria Tel: (34) 1 224-1200
Madrid 3, Spain Telex: 23555 JUVIG E

President	Martín Gallego
General Director	Gonzalo Madrid
Director, Rad. Waste	Baldomero López-Pérez
Waste Treatment	V. González
Spent Fuel Storage	A. Uriarte
Waste Storage	A. Martínez Martínez

Mission: R&D--nuclear fuel cycle, nuclear reactor technology, waste treatment, and terminal storage.

JUAN VIGON NATIONAL NUCLEAR ENERGY CENTER

Centro Nacional de Energía
Nuclear Juan Vigon
Avenida Complutense 22
Madrid 3, Spain

MINISTRY OF INDUSTRY AND ENERGY

Minister	Carlos Solchaga
Director General of Energy	María del Carmen Mestre

SWEDEN

MAJOR SWEDISH HOLIDAYS (1985)

January 1	New Year
January 6	Epiphany
April 5	Good Friday
April 7-8	Easter
May 1	Labor Day
May	Ascension Day
May 26-27	Pentecost
June	Midsummer Eve
November 1	All Saints
December 25-26	Christmas

SWEDEN

ENERGY

Population	1983	8.3 million
Energy Demand	1983	47.1 Mtoe (42% imported)
Oil Demand	1983	16.5 Mtoe (100% imported)
Electric Power Plant Capacity	1983	31 GWe
Electric Power Production	1983	105.9 TWh-- 54% hydro/geoth. 34% nuclear 11% oil 1% coal

NUCLEAR POWER

National Policy: Complete a total of 12 power stations by 1985-86, to provide 45% of Sweden's electricity; phase out all nuclear plants at the latest by the year 2010. Change of this policy will require a new decision by Parliament.

Nuclear Power Plant Capacity	1984	7.3 GWe
	1985	8.4 GWe
	1990	9.4 GWe
	2000	9.4 GWe
Reactor Mix	1984	BWR: 7 (1972-81)
		2 (1985)
		PWR: 3 (1975,1983)

INDUSTRIAL FUEL CYCLE

Policy: Honor or sell present commitments (870 tU) to foreign reprocessors, but put the rest of the spent fuel (~6,600 t) into a repository. No Pu recycle is planned. Costs for waste management and for future decommissioning of nuclear power plants are paid by fees collected from the nuclear utilities. Present fee is 2.4 mills/kWh.

Waste Management Strategy: Store vitrified HLW (returned from reprocessors) and spent fuel for 30-40 years in an underground storage facility; encapsulate HLW glass in lead/titanium overpack, spent fuel in a copper canister; emplace in a deep geologic (crystalline rock) repository. New facilities: 3000 t AFR; interim storage plants for conditioned reprocessing wastes; HLW and spent fuel encapsulation plants; repositories for reactor wastes, HLW glass, spent fuel, and other long-lived wastes.

Cumulative Spent Fuel	1980	465 tU
Arisings (LWR)	1985	1,330 tU
	1990	2,360 tU
	2000	5,000 tU

Cumulative Waste	2020	Spent fuel	4,500 canisters
Arisings		HLW glass	730 canisters
(Conditioned and		TRU waste	4,000 m ³
encapsulated--		R. core comp.	15,000 m ³
ready for dis-		Reactor waste	100,000 m ³
posal)		Decomm. waste	100,000 m ³

Industrial-Scale Activities

LWR fuel fabrication: 400 tU/a.

Major Milestones

- CLAB AFR facility for spent fuels 1985
- Repository for reactor wastes, SFR 1988
- HLW repository site selection 2000
- HLW repository operational 2020
- Interim HLW dry storage facility 1990
- Encapsulated spent fuel repository 2020-2050

INTERNATIONAL RELATIONSHIPS

Membership in IAEA and OECD/NEA. Waste management cooperative agreement with US, Canada, Switzerland and France. Host country for Stripa project.

ORGANIZATION

- Waste Management
 - NAK (National Board for Spent Fuel)--administers waste management fund collected from the nuclear utilities; oversees back-end-of-the-fuel-cycle activities
 - SKB (Swedish Nuclear Fuel and Waste Management Company)--executes spent fuel and waste management program for the utilities; manage waste disposal R&D programs.
- Licensing Responsibilities
 - SKI (Swedish Nuclear Power Inspectorate)--erection and operation of nuclear facilities
 - SSI (Swedish National Institute of Radiation Protection)
 - National Swedish Franchise Board for Environment Protection
 - Municipality where the facility is to be located (right of veto).

ASEA-CERAMA

ASEA-CERAMA
High Pressure Laboratory
S-91040 Robertsfors
Sweden

Tel:
Telex:

President
High Pressure Laboratory
Waste Treatment

Lars Halle
H. T. Larker
Tore Waltersten

Waste Management R&D: Application of hot isostatic pressing in spent fuel and waste treatment operations; AFR spent fuel storage facility design.

CHALMERS UNIVERSITY OF TECHNOLOGY

Chalmers Tekniska Högskola
S-40220 Göteborg 5
Sweden

Tel:
Telex:

Nuclear Chemistry

Prof. Jan Rydberg
Dr. Bert Allard

Waste Management R&D: Radionuclide transport by
groundwater, sorption on natural clays and rock minerals.

KEMAKTA

Kemakta Konsult AB
Luntmakargatan 94
S-11351 Stockholm
Sweden

Tel: (46) 8 15-0380
Telex:

Bertil Grundfelt

Computer calculations on hydrology and nuclide migration.

KTH (Royal Institute of Technology)

KTH
S-10044 Stockholm
Sweden

Tel:
Telex:

Department of Chemical
Engineering

Prof. Ivars Neretnieks

Waste Management R&D: Near- and far-field migration
modeling, rock-matrix diffusion experiments.

NAK (National Board for Spent Nuclear Fuel)

Nämnden för Hantering
av Använt Kärnbränsle

Box 2045
S-10311 Stockholm
Sweden

Tel:
Telex:

Director
Chief Engineer

Gerhard Rundquist
Nils Rydell

Mission: Serve as the government's control agency to oversee back-end fuel cycle technology, financing and information.

NUCLEAR SAFETY BOARD

Rådet för Kärnkraftsäkerhet

Box 5864
S-10248 Stockholm
Sweden

Tel: (46) 8 67-9540
Telex: 13108

Director

Thomas Eckered

Mission: Promote coordination and cooperation among the Swedish utilities in their nuclear power plant safety work.

Sponsors: The four Swedish nuclear power station owners.

SGAB (Swedish Geological Company)

Sveriges Geologiska AB (SGAB)
Vretgränd 18

Box 670
S-75128 Uppsala
Sweden

Tel: (46) 18 15-5280
Telex: 76154 GEOSWED S

SGAB (contd)

Geology, Site Investigations	Kaj Ahlbom
Hydrogeology	Leif Carlsson
Geologic Waste Disposal	Otto Brotzen

Waste Management R&D: Evaluation of rock formations for use as waste disposal sites (permeability; groundwater behavior, age and chemistry).

SKB (Nuclear Fuel and Waste Management Company)

Svensk Kärnbränsle-Hantering	
Box 5864	
S-10248 Stockholm	Tel: (46) 8 67-9540
Sweden	Telex: 13108 SKB

President	Sten Bjurström
CLAB Project	Bo Gustafsson
KBS Project	Per-Eric Ahlström
MWS (Nuclear Waste Services)	Lars Bertil Nilsson
Chemistry	Fred Karlsson
Geology and Hydrology	Hans Carlsson/ Anders Heiner
Material Sciences	Lars Werme
Waste Forms	Hans Forström
Engineered Barriers	Anders Bergström
Safety Analysis	Tónis Papp
Stripa Test Station	Hans Carlsson/ Harald Ahagen
Foreign Activities and Documentation	Claes Thegerström
Repository for Reactor Waste	Tommy Hedman

Mission: Coordinate and arrange for nuclear fuel supply and reprocessing services for all Swedish nuclear power reactors; manage and fund R&D for the back end of the fuel cycle. Responsible for design, construction and operation of all necessary storage and disposal facilities. Demonstrate that spent nuclear fuel and fuel reprocessing wastes can be disposed of safely and permanently.

Sponsors: State Power Board and utilities (Sydkraft, Oskarshamn, Forsmark).

SKB (contd)

Facilities

- **CLAB** (Central Storage for Spent Fuel, located at Simpevarp)
Mission: AFR storage facility.
Design Capacity: Initially, 3000 t.
History: Start of construction, 5/80; start of operation 1985.

- **Stripa Mine**

Stripa Mine Service AB
S-717 00 Storå
Sweden

Tel: **(46) 581 4142-0**

Stripa Project Manager Hans Carlsson (SKB)
Mine Operations Gunnar Ramquist

Location: Near Kopparberg (Storå vicinity), 15 km north of Lindesberg and about 250 km west of Stockholm.

Mission: Research in realistic environment of matters connected to disposal in crystalline rock. Development of investigation methods and instruments.

Description: Granite body, about 350-400 m below surface, at the Stripa iron mine.

SKI (Nuclear Power Inspectorate)

Statens Kärnkraftinspektion
Box 27106
S-102 52 Stockholm
Sweden

Tel: **(46) 8 6355 60**
Telex: 11961 Sweatom S

Director
Waste Management

Olaf Hörmander
Alf Larsson

SSI

National Institute
of Radiation Protection
Box 60204
S-10401 Stockholm 60
Sweden

Tel: (46) 8 2440 80
Telex: 11771 SAFE RAD

Director
Rad Waste Group

Gunnar Bengtsson
Ragnar Boge

STUDSVIK

Studsvik Energiteknik AB
S-611 82 Nyköping
Sweden

Tel: (46) 155 8000-0
Telex: 64013 studs s

Deputy Managing Director
Nuclear Technology
Waste Management Department
Waste Management Section

Stig Bergström
Lennart Devell
Åke Hultgren

Mission: Nuclear energy R&D to support Swedish power programs.

Sponsor: Contract research and federal government.

Waste Management R&D: HLW waste form characterization, LLW and ILW treatment, D&D techniques, leaching of UO₂ from spent fuel, biosphere migration, dose-calculations.

SWEDISH STATE POWER BOARD

Statens Vattensfallswerk
S-162 87 Vällingby
Sweden

Tel: (46) 8 739-5000
Telex: 19653 Svte1vxs S

Thermal Engineering
Low- and Medium-Level Wastes

Hans Bartsch
Stig Pettersson

Mission: Own and operate the power distribution grid in Sweden, produce power.

Sponsor: Government (Ministry of Industry).

SWITZERLAND

MAJOR SWISS HOLIDAYS (1985)

January 1	New Year
April 5	Good Friday
April 7-8	Easter
May 16	Ascension
May 26-27	Pentecost
August 1	Day of Independence
December 25-26	Christmas

SWITZERLAND

ENERGY

Population	1984	6.41 million
Energy Demand	1980	25.4 Mtoe (57% imported)
Oil Demand	1980	13.1 Mtoe (100% imported)
Electric Power Plant Capacity	1980	15 GWe
Electric Power Production	1982	53.6 TWh-- 70% hydro/geoth. 28% nuclear 1% coal 1% oil
	1985	40% nuclear

NUCLEAR POWER

National Policy: Government is pro-nuclear, but has encountered much public opposition. Policy now requires that by the end of 1985 the nuclear utilities establish a project guaranteeing safe waste management or lose their operating licenses.

Nuclear Power Plant Capacity	1984	2.9 GWe
	1985	2.9 GWe
	2000	3.4 GWe
Reactor Mix	1984	BWR: 2 (1972-84) 1 (1993)
		PWR: 3 (1969-79)
Reactor Development	FBR R&D: reactor core thermohydraulics; physics; fuels	

INDUSTRIAL FUEL CYCLE

Policy: Foreign reprocessing of spent fuels and Pu recycle to either LWRs or FBRs.

Switzerland

Waste Management Strategy: Develop two waste repositories; a horizontally accessed rock cavern in a geologic host rock with considerable overburden for LLW/ILW, and a deep repository (crystalline rock) for HLW glass or unprocessed spent fuel elements. Sea-dumping of LLW discontinued 1982, but still considered as an option.

Cumulative Spent Fuel	1980	380 tU
Arisings (LWR)	1985	650 tU
	1990	1,090 tU
	2000	2,000 tU

Cumulative Waste Arisings: After 40 years' operation of the nuclear power system (total 6,000 MGe):

LLW/D&D Waste	100,000 m ³
LLW/ILW	70,000 m ³
HLW glass	1,000 m ³
	or
Spent fuel	15,000 m ³

Major Milestones

- Feasibility of safe and final disposal demonstrated 1985
- Initial receipt of HLW glass from COGEMA (France) 1992
- Intermediate-depth storage facility for ultimate repository for reactor wastes 1995
- Geologic repository for HLW or spent fuels After 2020

ORGANIZATION

- NAGRA--company formed by utilities and government to handle fuel cycle and waste management activities. Budget for 1980-1985 is ~US \$90 million
- EIR--Federal Institute for Reactor Research--nuclear R&D
- Federal Energy Office--sets criteria for waste management practices, including geologic disposal.

EIR (Federal Institute for Reactor Research)

Eidgenössisches Institut für
Reaktorforschung (EIR)

CH-5303 Würenlingen
Switzerland

Tel: (41) 56 99-2111
Telex: 53714 eir ch

Director
Deputy Director
Staff Assistant, Research
Materials Technology
Hot Laboratory
Metallurgy
Chemistry
Fuel Division
Radioactive Waste Project
Fuel Program

Prof.-Dr. H. Gränicher
M. Breu
Dr. U. Flückiger
D. H. P. Alder
Dr. W. Hausmann
G. Ullrich
Dr. P. Baertschi
H. Flury
Dr. G. Bart
R. W. Stratton

Sponsor: Federal government--Department of Interior.

Waste Management R&D: Incineration of TRU wastes, modeling of radionuclide migration through heterogeneous geologic media, chemical behavior of radionuclides during migration, transport of radionuclides through the biosphere, hydrological studies, sorption constants on different rocks, immobilization of LLW and ILW in cements, leaching rates on LLW and ILW waste forms, and long-term corrosion tests on waste package materials.

Facilities

- **ADA** (Acid Digestion Plant for TRU Wastes)
Design Basis: Carbonization/digestion in H_2SO_4/HNO_3 at 250°C; capacity, 1 kg/hr solid wastes.
History: Non-Pu runs, late 1981; Pu runs, 1982.

FEDERAL OFFICE OF ENERGY

Federal Office of Energy
Nuclear Safety Inspectorate
CH-5303 Würenlingen
Switzerland

Tel: (41) 56 98-2853
Telex: 59058

Waste Management Dr. U. Niederer

Mission: License and inspection of nuclear installations.

FEDERAL OFFICE OF PUBLIC HEALTH

Office Fédéral de la Santé Publique
Bollwerk 27
CH-3001 Berne
Switzerland

Tel: (41) 31 61-9620
Telex: 33880

Radioprotection Dr. H.-R. Stadelmann

NAGRA/CEDRA (NATIONAL COOPERATIVE
FOR THE STORAGE OF RADIOACTIVE WASTE)

Nationale Genossenschaft für die Lagerung
radioaktiver Abfälle (NAGRA)
or
Société Coopérative Nationale pour l'Entreposage de
Déchets Radioactifs (CEDRA)
Parkstrasse 23
CH-5401 Baden
Switzerland

Tel: (41) 56 20-5511
Telex: 57333

President Dr. Rudolph Rometsch
Managing Director Hans Issler
Geology Dr. Marc F. Thury
Nuclear Technology Dr. Charles McCombie
Facilities Andreas L. Nold

Mission: Provide for the safe disposal of radioactive
wastes produced by the Swiss nuclear industry.
Sponsors: Utilities and government.
Facilities: URL at Grimsel Pass--operational since 1984.

TAIWAN
(Republic of China)

MAJOR TAIWANESE HOLIDAYS (1985)

January 1-2	Founding Day
January	Lunar New Year
March 29	Youth Day
April	Tomb Sweeping Day
June	Dragon Boat Festival
September 28	Teachers' Day
October	Moon Festival
October 10	National Day
October 25	Retrocession Day
October 31	Chiang Kai-Shek's Birthday
November 12	Sun Yat-Sen's Birthday
December 25	Constitution Day

TAIWAN

ENERGY

Population	1984	19 million
Energy Demand	1980	79% imported
Oil Demand	1980	100% imported
Electric Power Plant Capacity	1981	10.16 GWe-- 21.4% nuclear
Electric Power Production	1982	40.9 TWh-- 48% oil 30% nuclear 12% hydro 10% coal
	1985	44.7 TWh-- 55% nuclear

NUCLEAR POWER

National Policy: Look to nuclear power to meet rapidly growing demand for electric energy.

Nuclear Power Plant Capacity	1984	3.1 GWe
	1985	4.0 GWe
	1990	4.9 GWe
	2000	8.7 GWe
Reactor Mix	1984	BWR: 4 (1978-83) PWR: 1 (1984) 1 (1985)

INDUSTRIAL FUEL CYCLE

Policy: Develop indigenous fuel production capability; fuel assembly (1986); fuel hardware; UO₂ pellets; UF₆ conversion. May choose to reprocess.

Waste Management Strategy: Policy not yet defined on domestic reprocessing, HLW/spent fuel disposal; reactor wastes are to go to new National Waste Storage Facility on nearby Orchid Island.

Taiwan

Cumulative Spent Fuel	1980	70 tU
Arisings (LWR)	1985	430 tU
	1990	1,140 tU
	2000	2,600 tU

ORGANIZATION

- Nuclear power plants are owned by the government, operated by Taiwan Power
- AEC (Atomic Energy Council)--regulatory functions; waste disposal
- INER (Institute of Nuclear Energy Research)--nuclear R&D.

AEC

Atomic Energy Council
67, Lane 144
Keelung Road, Section 4
Taipei, Taiwan
Republic of China

Tel: (86) 2 392-4180
Telex: 26554

Secretary General
Director, Radwaste Admin.
Director, Planning Division
Radwaste Protection
Nuclear Energy Research

Dr. Yu-Hao Lee
Dr. Chao-Ming Tsai
Chao-Chin Tung
Dr. Yi-Ching Yang
Kuang-Chi Liu

INER

Institute of Nuclear Energy Research
P.O. Box 3
Lung tan Taiwan
Republic of China

Tel: (86) 2 381-4014
Telex: 34154 CAEC

Deputy Director
Health Physics
Eng. Development/Implementation
Waste Mgmt./Decontamination

Dr. Jen-Chang Chou
(Ext. 2302)
W. L. Chen
Tise-Sheng Chou
(Ext. 2525)
S. L. Hwang

INER (contd)

Fuel Cycle R&D: Solvent extraction technology; yellowcake conversion to UO₂; production of Zr, TiO₂ and TiCl₄; cement and thermoplastic waste forms for reactor wastes; HLW conditioning processes; irradiation of sewage sludge with spent fuels; burial of LLW.

TAIPOWER

Taiwan Power Company
242 Roosevelt Rd., Sec. 3
Taipei, Taiwan 107
Republic of China

Tel: (86) 2 396-7777
Telex: 2564 TPCAPD

Deputy Directors, Atomic Power

Mr. Eng Lin
(Ext. 2521)
Mr. Ching-Tang Hsu
(Ext. 2522)

UNITED KINGDOM

MAJOR BRITISH HOLIDAYS (1985)

January 1	New Year
April 5	Good Friday
April 7-8	Easter
May 3	May Day
May 26-27	Pentecost
August 30	Summer Bank Holiday
December 25-26	Christmas

UNITED KINGDOM

ENERGY

Population	1984	56 million
Energy Demand	1980	201.5 Mtoe
Oil Demand	1980	81 Mtoe (1% imported)
Electric Power Plant Capacity	1980	82 GWe
Electric Power Production	1982	272.2 TWh-- 72% coal 16% nuclear 9% oil 2% hydro 1% gas
	1982	254 TWh-- 16.4% nuclear

NUCLEAR POWER

National Policy: Aggressive development of nuclear power, based to date on gas-cooled reactors but diversifying to PWRs and eventually to FBRs.

Nuclear Power Plant Capacity	1984	9.4 GWe
	1985	10.0 GWe
	2000	13.6 GWe
Reactor Mix	1984	GCR: 26 (1956-72)
		AGR: 10 (1976-84)
		4 (1987-88)
		FBR: 1 (1976)
		HWR: 1 (1968)
Reactor Development		Major LMFBR development program, including fuel cycle

INDUSTRIAL FUEL CYCLE

Policy: Reprocess and recycle Pu to FBR system; develop and maintain complete fuel cycle capability (enrichment, UO₂ and MOX fuel fabrication, spent fuel reprocessing); sell fuel cycle services to foreigners.

Waste Management Strategy: Reprocess spent fuels as rapidly as plant capacity permits; vitrify HLW (French technology); long-term interim storage of HLW glass, deferring decision on disposal; shallow-land burial or sea-dump of LLW and ILW.

Cumulative Spent Fuel	1980	250 tU
Arisings (LWR and AGR)	1985	830 tU
	1990	2,000 tU
	2000	5,330 tU

Industrial-Scale Activities

- Power production (GWe): 1981--9.8; 1990--14.8.
- Uranium conversion (Springfields)
 - UF₆ production--9500 t/a
 - UF₆-UO₂ conversion--700 t/a.
- Uranium enrichment (Capenhurst)
 - gas diffusion plant--400 tSWU/a
 - centrifuge plant--225 tSWU/a.
- Fuel fabrication
 - U metal (Magnox)--2500 t/a (Springfields); UO₂ fuels--500 t/a (Springfields)
 - MOX fuels for recycle to FBRs (BNFL/Sellafield): current--10 t/a; future new capacity--20 t/a, 1984 and 50 t/a, 1987.
- Fuel reprocessing
 - Magnox fuels (Sellafield)--5 to 7 t/a
 - UO₂ fuels (THORP)--6 t/day (1990)
 - FBR fuels (PFR reprocessing pilot plant, Dounreay)--50 kg HM/day
 - FBR fuels (CDFR reprocessing plant, 1993).

United Kingdom

- HLW vitrification. Design and construction of Windscale Vitrification Plant (1988).
- Waste disposal. Underground repository for conditioned ILW, 1987-88.

INTERNATIONAL RELATIONSHIPS

Member of EC, IAEA and OECD/NEA. LMFBR exchange agreement with USDOE. BNFL has partnership in URENCO (uranium enrichment), United Reprocessors GmbH (reprocessing), and Nuclear Transport Limited (spent fuel transport) and Pacific Nuclear Transport Limited.

ORGANIZATION

- UKAEA (United Kingdom Atomic Energy Authority)--nuclear research; laboratories at Harwell, Risley, Springfields, Dounreay
- DOE (Department of Environment)--develops waste management strategy and coordinates waste management R&D
- BNFL (British Nuclear Fuels Ltd.)--commercial fuel cycle for domestic and foreign customers
- NIREX (Nuclear Industry Radioactive Waste Executive)--disposal of LLW and ILW
- IGS and IOS (Institutes of Geological and Oceanographic Sciences)--supporting R&D for the waste management program
- NRPB (National Radiological Protection Board)--environmental R&D
- NII (Nuclear Installations Inspectorate)--licensing.

FIGURE UK-1. Nuclear Fuel Cycle Responsibilities

UK-4

FIGURE UK-2. Nuclear Fuel Cycle Responsibilities -
Department of Energy

United Kingdom

AWRE (ALDERMASTON)

Atomic Weapons Research
Establishment
Aldermaston, Reading RG7 4PR Tel: (44) 7356-4111
United Kingdom Telex: 848104/5

Waste Management E. Whitehead

BNFL

British Nuclear Fuels Ltd.
Risley, Warrington
Cheshire WA3 6AS Tel: (44) 9253-5953
United Kingdom Telex: 627581

[About 20 miles by official car or taxi from Manchester International Airport; or train from London to Warrington (approx. 3 hours), then 6 miles by official car or taxi to Risley.]

Chairman	Coningsby Allday
Asst. Managing Director	Jack Tatlock
Director, Fuel	Anthony Stephens
R&D Reprocessing Division	N. R. Geary
	L. P. Shortis
	Alan D. W. Corbet
	D. W. Clelland
Waste Management	Dr. K. R. Schneider

BNFL: SELLAFIELD

British Nuclear Fuels Ltd.
Sellafield, Seascale
Cumbria CA20 1PG Tel: (44) 9402-8333
United Kingdom Telex: 64237/8

Director, Reprocessing	William L. Wilkinson
Director, Engineering	Gordon Steele

[By train from London-Euston Station to Carlisle Station (4 hours); transport can be arranged by BNFL from Carlisle to site (approx. 1-1/2 hours). From Manchester International Airport to site by car is approx. 3 hours.]

BNFL: SELLAFIELD (contd)

Reprocessing Facilities

- **B204**
Mission: Reprocess military fuels.
Design Basis: BUTEX process; "no-maintenance" concept.
History: On-line, 1952-1964. Converted to oxide fuel head-end plant for B205, 1969.
- **B205**
Mission: Reprocess Magnox (magnesium-clad, U metal) fuels from UK GCRs. Oxide head-end added in 1969 to handle AGR and LWR fuels.
Design Basis: Magnox fuels: mechanical declad; PUREX flowsheet; "no-maintenance" concept; nominal capacity, 8 tHM/day. New oxide head-end: shear-leach and one BUTEX cycle in B204; solution transferred to B205 for further processing; remote maintenance; nominal capacity, 1.3 tHM/day. Liquid HLW storage: SS tanks, 70 m³ and 150 m³, in SS-lined concrete cells.
History: Magnox fuels: B205 startup, 1967; annual throughput of Magnox fuels, 1000-1200 tHM. Oxide head-end operation, 1969-1973; 90 t oxide fuel processed before the plant was shut down after a contamination release incident.
- **Reprocessing Test Unit (nonradioactive)**
Mission: Test the THORP first solvent extraction cycle.
Design Basis: Purex flowsheet; nominal capacity, 4 t/a LWR fuels.
History: Startup, 1979.
- **THORP (Thermal Oxide Reprocessing Plant)**
Mission: Reprocess AGR and domestic or foreign LWR fuels.
Design Basis: Purex flowsheet, pulsed columns and mixer-settlers. AVM process for HLW vitrification. Nominal capacity, 6 tU/day.
Milestone: Startup, 1990.

BNFL: SELLAFIELD (contd)

- **Reprocessing Pilot Plant (radioactive)**
Mission: Support THORP design and operation.
Design Basis: 1/5000 scale.

MOX Fuel Fabrication Facilities

- **MOX Fuel Fabrication Plant**
Design Capacity: 10 t/a FBR fuels.
- **MOX Fuel Fabrication Plant**
Design Basis: Gel precipitation; capacity, 0.5 kg/day.
History: Startup, 1981-82.
- **MOX Fuel Fabrication Production Plants**
Design Basis: Mechanical mixing or coprecipitation. 20 t/a (startup, 1984); 50 t/a (startup, 1987).

Waste Treatment Facilities

- **FSIF (cold demonstration plant-vitrification)**
Mission: Test prototype equipment and maintenance techniques.
Design Basis: French AVM process (rotating-tube calciner/metal melter); capacity, 11 kg/hr glass; product, borosilicate glass blocks.
History: Startup, 1982.
- **Vitrification Plant**
Mission: Solidify Windscale HLW.
Design Basis: AVM process; product, borosilicate glass blocks.
Milestone: Startup, 1987.
- **Incinerator Pilot Plant (radioactive pyrolysis-incineration process).**
- **Waste Treatment Complex**
Mission: Prepare non-HLW for ocean dumping; extract Pu from process residues.
Construction: Ten-year period, starting in 1981 (estimated cost: \$225 x 10⁶).

BNFL: SPRINGFIELDS

British Nuclear Fuels Ltd.
Springfields Works
Salwick, Preston,
Lancashire PR4 0XJ
United Kingdom

Tel: (44) 772 72-8262
Telex: 67526/7

Chief Tech. Manager

A. Naylor

BRE

Building Research Establishment
Department of the Environment
Building Research Station
Garston, Watford WD2 7JR
United Kingdom

Tel: (44) 9273 74040
Telex: 923220

Asst. Director, Geotechnics/
Structural Engineering
Geotechnics Division
Seabed Disposal
Continental Disposal

Dr. J. B. Menzies
J. B. Boden
T. Freeman
Ms. C. M. Cooling

Waste Management R&D: Emplacement engineering and related activities; rock mechanics.

CEGB

Central Electricity Generating Board
Sudbury House
15 Newgate Street
London, EC1A 7AU
United Kingdom

Tel: (44) 1 248-1202
Telex: 883141

Chairman
Director, Plant Engineering
Director, Research
Fuel and Core Division

Sir W. Marshall
P. M. Billam
Dr. J. K. Wright
Dr. B. C. Masters

DOE

Department of the Environment
 Nuclear Waste Management Division
 43 Marsham Street
 London SW1 3PY
 United Kingdom

Tel: (44) 1 212-6315
 Telex: 22221

Director, Radioactive Waste	Dr. Frank S. Feates
Professional Division	(44) 1 212-8804
RWP I Branch	Brian Hookway
	(49) 1 212-6937
RWP II Branch	Dr. Allan G. Duncan
	(49) 1 212-8673
RWP III Branch	Dr. Haydn Richards
	(49) 1 212-6937

Waste Management Responsibility: Administer UK waste management programs; fund and coordinate waste treatment and waste isolation R&D at Harwell, IGS, NRPB, etc.; regulate discharge of radioactive materials to the environment.

IGS

Institute of Geological Sciences (HQ)
 Nicker Hill, Keyworth
 Nottingham, NG12 5GG
 United Kingdom

Tel: (44) 6077 6111
 Telex: 378173 ISGKEY G

Director	Dr. G. M. Brown
Fluid Processes	Dr. John D. Mather

Institute of Geological Sciences
 Harwell Laboratory
 Building 151
 Harwell, Oxon OX11 0RA
 United Kingdom

Tel: (49) 235 24141
 Telex: 83135 ATOMHA G

Institute of Geological Sciences
 Exhibition Road
 London, SW7 2DE

Tel: (44) 1 589-3444
 Telex: 8812180 GEOSCI G

Asst. Director, Geophysics/ Hydrogeology	David A. Gray
---	---------------

IOS

Institute of Oceanographic Sciences
Brook Road
Wormley, Godalming
Surrey GU8 5UB
United Kingdom

Tel: (49) 42 879-4141
Telex: 858833

Director
Nuclear Waste

Dr. Anthony S. Laughton
Dr. T. J. G. Francis

MAFF

Ministry of Agriculture, Fisheries, and Food
Fisheries Radiobiological Laboratories
Pakefield Road
Lowestoft, Suffolk NR32 0HT
United Kingdom

Tel: (49) 502-4381
Telex: 97470

Director, Fisheries Research
Directorate
Aquatic Environment Protection

Alan Preston
Harry Hill
(49) 502 62244

NRPB

National Radiological Protection Board
Chilton Didcot
Oxfordshire OX11 0RQ
United Kingdom

Tel: (49) 235 83-1600
Telex: 837124

Director
Secretary
Asst. Director, Nuc. Assess.
Nuclear Assessments
Waste Management
Environmental Transfer

H. J. Dunster
Dr. R. H. Clarke
G. A. M. Webb
Ms. M. D. Hill
Dr. M. J. Clark
Dr. G. S. Linsley

NIREX

Nuclear Industry Radioactive Waste Executive

Harwell

Didcot, Oxon OX11 0RA

United Kingdom

Tel: (49) 235-24141

Managing Director

M. E. Ginniff

Repository Development

H. Beale

Sea-Disposal; International;

Dr. J. Grover

Packaging/Transport

Waste Inventory R&D;

D. George

Packaging/Transport

Mission: Locate, develop and operate facilities and sites for disposal of LLW and ILW.

Sponsors: UKAEA, BNFL, regional electricity generating boards.

NII

Nuclear Installations Inspectorate

Thames House North

Millbank, London SW1P 4QJ

United Kingdom

Tel: (44) 1 211-3000

Telex: 918777 ENERGY G

Nuclear Installations

R. Anthony

Overseas Liaison

J. S. MacLeod

SRD

Safety and Reliability Directorate

Wigshaw Lane, Culcheth

Warrington WA3 6AT

United Kingdom

Tel: (44) 925 31244

Telex: 629301 atomry-g

Mission: Advise the UKAEA on safety, coordinate reactor safety research, and provide advice and services on safety to government and industry.

UKAEA

UK Atomic Energy Authority	
11 Charles II Street	
London SW1 4QP	Tel: (44) 1 930-5454
United Kingdom	Telex: 22 565
Chairman	Sir John Hill

UKAEA: HARWELL

Atomic Energy Research Establishment	
AERE, Harwell	
Didcot, Oxon OX11 0RA	Tel: (44) 235 24141
United Kingdom	Telex: 83135
Director	Dr. L. E. J. Roberts
Director, Fuel Processing	Dr. R. H. Flowers (Ext. 2323)
Director, Underlying/Harwell Res.	Dr. J. Williams
Director, Nuc. Res./Chem. Tech.	Dr. R. L. Nelson
Radioactive Waste Mgmt.	M. J. Smyth
Fuel Cycle	Dr. J. R. Findlay
Reactor Chemistry	R. L. Faircloth
Industrial Chemistry	Dr. K. W. Carley- Macaulay
Liquid Processes Tech.	B. Partridge
Materials Processing	M. J. S. Smith

Facilities

- **HARVEST Pilot Plant** (nonradioactive)
Mission: Develop waste vitrification technology.
Design Basis: Rising-level pot calcination/
vitrification process; capacity, 240 kg glass/run;
product, borosilicate glass blocks.
History: Startup, 1975.

UKAEA: HARWELL (contd)

- **Harwell Ceramic Melter Test Unit** (nonradioactive)
Mission: Develop ceramic melter capability for UKAEA.
Design Basis: Liquid-fed ceramic melter; capacity, 700 kg/day glass; product, borosilicate glass.
History: Startup, 1981/1982.

UKAEA: RISLEY

Risley Nuclear Power Development Establishment
UKAEA (Northern Division)
Risley, Warrington
Cheshire WA3 6AT
United Kingdom
Tel: (44) 925 31244
Telex: 629301

Director, Process Technology	R. H. Allardice
and Safety	(Ext. 2181)
Waste Management (General)	H. Barton
	(Ext. 2451)
Decommissioning	D. F. Rawson
	(Ext. 2919)

UKAEA: DOUNREAY

Dounreay Nuclear Power Development
Establishment
UKAEA (Northern Division)
Thurso, Caithness KW14 7TZ
Scotland
United Kingdom
Tel: (44) 847 62121
Telex: 75297

[From London by air to Wick (via Aberdeen), then approx. 30 miles by car to Dounreay; or by train from London to Thurso (via Inverness), then approx. 10 miles by car to Dounreay.]

Director	Clifford W. Blumfield
Asst. Director, Fuels	O. Pugh

UKAEA: DOUNREAY (contd)

Facilities

- **PFR Reprocessing Plant**

Mission: Reprocess Dounreay Prototype Fast Reactor (MOX) fuels.

Design Basis: Shear single pins and leach; PUREX process; capacity 9-10 tHM/a of 180-day cooled PFR assemblies with 8-10% burnup.

History: Dounreay Fast Reactor fuels processed from 1961 to 1975; plant rebuilt to handle PFR oxide fuels, resumed operation in October 1980.

- **Solidification Plant**

Mission: Convert liquid wastes from Dounreay reprocessing operations into solid blocks by mixing the liquid with a selected formulation of cement powders within steel drums (for economical long-term storage).

Milestone: Construction--start 1985, completion 1987 (cost US \$884 million)

UKAEA: SPRINGFIELDS

UK Springfields Nuclear Power
Development Laboratories

Salwick, Preston
Lancashire PR4 0RR
United Kingdom

Tel: (44) 772 72-8262
Telex: 67545

Chem. Engineering Division
Chem. Plant Development
Process Eng. Technology
Head-End/Solid Waste Mgmt.

John V. Shennan
P. Laurie Allen
Cliff Etherington
Brian E. Meredith

UNITED STATES

MAJOR US HOLIDAYS (1985)

January 1	New Year
February 18	Presidents Day
May 27	Memorial Day
July 4	Independence
September 2	Labor Day
November 11	Veterans Day
November 28	Thanksgiving
December 25	Christmas

STATE ABBREVIATIONS

AL - Alabama	MT - Montana
AK - Alaska	NB - Nebraska
AZ - Arizona	NV - Nevada
AR - Arkansas	NH - New Hampshire
CA - California	NJ - New Jersey
CO - Colorado	NM - New Mexico
CT - Connecticut	NY - New York
DE - Delaware	NC - North Carolina
DC - District of Columbia	ND - North Dakota
FL - Florida	OH - Ohio
GA - Georgia	OK - Oklahoma
HI - Hawaii	OR - Oregon
ID - Idaho	PA - Pennsylvania
IL - Illinois	RI - Rhode Island
IN - Indiana	SC - South Carolina
IA - Iowa	SD - South Dakota
KS - Kansas	TN - Tennessee
KY - Kentucky	TX - Texas
LA - Louisiana	UT - Utah
ME - Maine	VT - Vermont
MD - Maryland	VA - Virginia
MA - Massachusetts	WA - Washington
MI - Michigan	WV - West Virginia
MN - Minnesota	WI - Wisconsin
MS - Mississippi	WY - Wyoming
MO - Missouri	

UNITED STATES

ENERGY

Population	1984	235 million
Electric Power Production	1982	1,419 TWh-- 53% coal 15% gas 13% hydro/geoth. 12% nuclear 7% oil

NUCLEAR POWER GENERATION

National Policy: Encourage construction and operation of nuclear power stations by private and public utilities under close regulatory control by NRC and State regulatory boards; continue R&D emphasizing LWR safety, liquid-metal breeder reactors, high-temperature graphite reactors, and small, modular concepts.

Nuclear Power Plant Capacity	1984	66.7 GWe
	1990	106.9 GWe
	2000	109.1 GWe
Reactor Mix	1984	PWR: 56 (1961-84) 28 (1985-2002) BWR: 30 (1960-84) 10 (1985-88) LGR: 1 (1966) HTR: 1 (1979)

NUCLEAR FUEL CYCLE

Policy: Current US industrial activities include all phases of the nuclear fuel cycle, except spent fuel reprocessing: uranium mining, milling, and enrichment; fabrication of UO₂ and MOX fuels; interim spent fuel and waste storage; transportation, conditioning, and disposal of radioactive waste. Mining, milling, fabrication of UO₂ fuel, and LLW disposal is done predominantly by private firms; enrichment and HLW disposal are the responsibilities of the federal government. While permitted by law, commercial reprocessing is not envisioned to come in the near future.

United States

Waste Management Strategy: Hold fuel in storage at reactor until it can be reprocessed, immobilize the reprocessing waste and place the HLW glass and TRU waste packages in a geologic repository. However, there is a strong possibility that commercial reprocessing will not happen at all in the US - in which case direct disposal of the irradiated fuel will be necessary. The Nuclear Waste Policy Act (NWPA) of 1982 mandates a geologic repository be available in 1998 to receive immobilized HLW and/or spent fuel. If the repository is not ready, the waste packages would be sent to a federal monitored retrievable storage (MRS) facility, which Congress has yet to authorize. Short-lived LLW/ILW is to be disposed of by shallow-land burial.

Cumulative Spent Fuel Arisings	1980	6,500 thm
	1985	12,500 thm
	1990	21,100 thm
	2000	42,800 thm

Major Milestones

- Approval of three sites for characterization (First repository) 1985
- Startup of Waste Isolation Pilot Plant 1989
- Approval of three sites for characterization (Second repository) 1989
- Recommendation of site for first repository to Congress 1990
- Recommendation of site for second repository to Congress 1995
- Startup of first repository for civilian waste 1998

International Relationships

Membership in OECD/NEA and IAEA. Bilateral Agreements for waste management cooperation with Belgium, Canada, CEC, Germany (FRG), France, Japan, Sweden and the United Kingdom.

United States

International cooperation and exchange of waste management technology is encouraged. Requests for approval of foreign visits or assignments to DOE sites require submittal of Form IA-473 to the US Department of Energy, Division of International Research and Development Cooperation, IE-121, Forrestal, Washington, DC 20585, at least six weeks prior to the planned visit, at least eight weeks prior to an assignment. Official travel to foreign countries requires submittal of Form DOE-F-1512.1 (and in some cases also DP-290), at least six weeks prior to the proposed departure.

ORGANIZATION

- **USDOE** (Department of Energy) - Responsible for planning and implementing of programs for the safe handling of radioactive waste generated by federal activities, and for disposal of all high-level and TRU waste. Responsible also for ensuring availability of adequate technology for safe and efficient management of nuclear waste from both civilian and federal activities.
 - **HQ** (Headquarters) - Responsibilities for the nuclear waste management and fuel cycle programs are divided among the offices of:
 - **NE** - Nuclear Energy - R&D technologies for treatment of civilian radioactive waste; remedial action to treat or stabilize radioactive waste; D&D of selected facilities.
 - **RW** - Civilian Radioactive Waste Management - Storage and disposal of spent nuclear fuel and HLW; development of monitored retrievable storage (MRS) facilities as an available option to geologic repositories.
 - **DP** - Defense Programs - Safe management, including disposal, of radioactive nuclear waste generated primarily by federal facilities.
 - **IE** - International Affairs and Energy Emergencies - Coordination of DOE's international activities.
 - **F.O.** (Field Offices) - Implement HQ policy and directives, issuing orders to specific sites. Direct efforts of DOE contractors.
 - **Contractors** - Operate DOE facilities in accordance with HQ and F.O. guidance and orders.

United States

- **USDOI** (Department of the Interior) -
 - **USGS** (US Geological Survey) - Conducts laboratory and field geologic investigations in support of DOE's waste disposal programs; acts as consultant to NRC.
 - **BLM** (Bureau of Land Management) - Reviews proposals to place waste disposal facilities on Federal Lands.
- **USDOT** (Department of Transportation) - Development, issuance and enforcement of safety standards, governing all aspects of waste transit.
- **EPA** (Environmental Protection Agency) - Establishment and enforcement of standards for the protection of the general environment.
- **USNRC** (Nuclear Regulatory Commission) - Issuance of regulations and licenses for commercial nuclear activities, in compliance with the general environmental standards issued by the EPA.

DOE (DEPARTMENT OF ENERGY)

Partial Organization Chart

NRC (NUCLEAR REGULATORY COMMISSION)

Partial Organization Chart

United States**DOE**

US Department of Energy
Forrestal
Washington, DC 20585

TEL: 202-252-5000
FTS: 252-5000
TWX: 710-822-0176
FAX: 252-8134
VERIF: 252-5100

US Department of Energy
Germantown
Washington, DC 20545

TEL: 202-252-5000
FTS: 252-5000
TWX: 710-828-0475
FAX: 233-4767
VERIF: 233-3486

Civilian Radioactive Waste Management

RW-1	Director	Ben C. Rusche	252-6850
RW-10	Admin. Mgmt.	Robert H. Bauer	252-6842
RW-20	Geo. Repositories	W. J. Purcell	353-4285
RW-30	Storage/Transportation	J. R. Hilley	252-6842
RW-40	Policy, Integration	Roger W. Gale	252-2280

International Affairs and Energy Emergencies

IE-1	Assist. Secretary	Jan W. Mares	252-5800
IE-12	Internatl. R&D Coop./ Nuc.Non-Prolif.Policy	Harold Jaffe	252-5918
IE-121	Internatl. R&D Coop.	John A. Dugger	252-6777

Nuclear Energy

NE-1	Assist. Secretary	William A. Vaughan	252-6450
NE-20	Term. Waste Disp./ Remedial Action	William R. Voight	353-5006
NE-24	Remedial Action	John E. Baublitz	353-5272
NE-25	Storage/Treatment	Joseph Coleman	353-4728

Defense Programs

DP-1	Assist. Secretary	William W. Hoover	252-2177
DP-10	Def. Waste/Byproducts	David B. Leclaire	353-3641
DP-122	Operations/Traffic	James E. Dieckhoner	353-3273
DP-123	R&D/Byproducts	John J. Jicha	353-3031

United States

DOE OPERATIONS OFFICES

ALBUQUERQUE OPERATIONS (AL)

US Department of Energy
Albuquerque Operations Office TEL: 505-846-3118
PO Box 5400 FTS 846-3118
Albuquerque, NM 87115 TELEX: 66-0424
FAX: 844-4197
VERIF: same

Manager R. G. Romatowski 844-7231
Waste Mgmt./Transp.Devel. J. M. McGough 846-2340
Waste Isolation Pilot Plant W. R. Cooper 505-887-0586
ext. 217
Seabed Programs W. D. Forster 846-2312
Uranium Mill Tailings J. A. Morley 844-3941

CHICAGO OPERATIONS (CH)

US Department of Energy
Chicago Operations Office (CH) TEL: 312-972-2000
9800 South Cass Avenue FTS: 972-2000
Argonne, IL 60439 TWX: 910-258-3285
FAX: 972-2343
VERIF: 972-2209

Manager Hilary J. Rauch -2110
Cryst.Rock Proj.Office (CRPO) Sally A. Mann -2257
Waste Operations-Materials
Integration Office (MIO) Joel C. Haugen -2093
Salt Rep. Proj. Office (SRPO) FTS 976-5916
Columbus, Ohio Jeff O. Neff ext. 28

United States

IDAHO OPERATIONS (ID)

US Department of Energy		
Idaho Operations Office	TEL:	208-526-0111
550 2nd Street	FTS:	583-0111
Idaho Falls, ID 83401	TWX:	910-977-5915
	FAX:	583-0524
	VERIF:	583-1503
Manager	Troy E. Wade II	-1322
Nuc. Fuel Cycle/Waste Mgmt.	J. Phillip Hamric	-1395
Productn./Waste Operations	John B. Whitsett	-1709
W.Valley Proj.Office,NY Site	William H. Hannum	716-942-3235
TMI Site Manager	Willis W. Bixby	590-1011

NEVADA OPERATIONS (NV)

US Department of Energy		
Nevada Operations Office	TEL:	702-295-1212
PO Box 14100	FTS:	575-1212
Las Vegas, NV 89114-4100	TWX:	910-397-6868
	FAX:	575-1370
	VERIF:	575-1369
Manager	Thomas R. Clark	-3211
Waste Management	Donald L. Vieth	-1092

OAK RIDGE OPERATIONS (OR)

US Department of Energy		
Oak Ridge Operations Office	TEL:	615-576-5454
PO Box E	FTS:	626-5454
Oak Ridge, TN 37831	TWX:	810-572-1076
	FAX:	626-1064
	VERIF:	626-1057
Manager	Joe LaGrone	-4444
Nuclear R&D	Peter J. Gross	-0710

United States

RICHLAND (HANFORD) OPERATIONS (RL)

US Department of Energy
Richland Operations Office
825 Jadwin Avenue
PO Box 550
Richland, WA 99352

TEL: 509-376-7411
FTS: 444-7411
TWX: 510-770-5108
FAX: 444-7280
VERIF: 444-7317

Manager	Michael J. Lawrence	-7395
Commercial Spent Fuel Mgmt.	Philip A. Craig	-6152
Basalt Waste Isol. (ONWI)	O. Lee Olson	-7334
Waste Management	Jerry D. White	-1366
Surplus Facilities Mgmt.	Clarence E. Miller	-7473
Shippingport Stn. Decommissioning		-7134
Shippingport, PA Site	John J. Schreiber	722-2639

SAN FRANCISCO OPERATIONS (SAN)

US Department of Energy
San Francisco Operations Office
1333 Broadway, Wells Fargo Building
Oakland, CA 94612

TEL: 415-273-7111
FTS: 536-7111
TWX: 910-366-7228
FAX: 536-6207
VERIF: 536-7956

Manager	Richard A. DuVal	-7111
Magnetic Fusion - Nuclear	L. Lanni	-6444

SAVANNAH RIVER OPERATIONS (SR)

US Department of Energy
Savannah River Operations Office
PO Box A
Aiken, SC 29801

TEL: 803-725-6211
FTS: 239-6211
TWX: 810-771-2670
FAX: 239-2130
VERIF: 239-3160

Manager	Robert L. Morgan	-2277
Def.Waste Process.Fac. (DWPF)	S. P. Kowain	-2566

DOE CONTRACTORSANL

Argonne National Laboratory
9700 S Cass Avenue
Argonne, IL 60439

TEL: 312-972-2000
FTS: 972-2000
TWX: 910-258-3285
FAX: 972-2343
VERIF: 972-2209

Director	Allan Schriesheim	-3872
Waste Management	J. Howard Kittel	-6677
Materials Review Board	Martin J. Steindler	-4383
Natl. Energy Software Center	M. K. Butler	-7250
ANL-West, Manager	R. J. Teunis	FTS 583-7106

Fuel Cycle and Waste Management Activities:

Remedial action for formerly-used MED/AEC sites (FUSRAP)
and for surplus facilities management program (SFMP) -
D&D of ANL-East contaminated facilities - Materials
review board and materials integration office - Proof
of breeding program for light water breeders - Salt
repository development - Crystalline rock repository
development - Low-level waste technology - TRU waste
technology - Manage national energy software center -
Pyrometallurgical and pyrochemical fuel reprocessing -
Sodium waste management.

Major Facilities:

ANL-West: Experimental Breeder Reactor No. 2 (EBR-II) -
Zero Power Plutonium Reactor (ZPPR) - Transient Reactor
Test Facility (TREAT) - Hot Fuel Examination Facility
(HFEF) - Radioactive Scrap and Waste Facility - Sodium
Process Demonstration (SPD) Facility - Radioactive
Liquid Waste Treatment Facility (RLWTF).
ANL-East and ANL-West: High-Level Hot-Cell Facilities.

United States

BPMD

Battelle Project Management Division
505 King Avenue
Columbus, OH 43201

TEL: 614-424-7365
FTS: 976-7365
TELEX: 24-5454
FAX: 976-4874
VERIF: 976-5600

General Manager	Neal E. Carter	-7359
Nuc. Waste Isolation (ONWI)	Wayne A. Carbiener	-4507
Cryst. Repos. Devel. (OCD)	William J. Madia	972-2434
	(at ANL Site)	

Fuel Cycle and Waste Management Activities:

Salt repository development - Crystalline repository development.

Major Facilities:

Hot and Cold Development Laboratories - Hot Cells for Development Programs.

BNL

Brookhaven National Laboratory
Associated Universities, Inc.
Upton, NY 11973

TEL: 516-282-2123
FTS: 666-2123
TELEX: 96-7703
FAX: 666-3000
VERIF: 666-2546

Director	N. P. Samios	-2772
Nuclear Waste Management	D. G. Schweitzer	-3510

Fuel Cycle and Waste Management Activities:

Low-level waste form evaluation - Radiation effects in repositories - Waste management criteria for NRC.

Major Facilities:

Hot and Cold Development Laboratories.

GAT

GA Technologies Inc.	TEL: 619-455-3000
PO Box 85608	FTS: same
10955 John Day Hopkins Drive	TELEX: 69-5065
San Diego, CA 92138	TWX: 910-335-1260
	FAX: 619-455-3621
	VERIF: 455-3457

President	Harold Agnew	-2080
HTGR Fuel Cycle	B. J. Baxter	-2613
Transportation Systems	D. W. Ketchen	-3609

Fuel Cycle and Waste Management Activities:

HTGR spent fuel treatment - Transportation technology for commercial and defense waste.

Major Facilities:

Pilot Plant for HTGR Fuel Cycle Studies - Fuel Production Facility.

INEL

EG&G Idaho, Inc.	TEL: 208-526-0111
Idaho National Engineering Laboratory	FTS: 583-0111
PO Box 1625	TWX: 910-977-5915
Idaho Falls, ID 83415	FAX: 583-1998
	VERIF: 583-1771

Manager	James O. Zane	-9671
Waste Management	Dale L. Uhl	-1014
National LLW Technology	Ed A. Jennrich	-9490
TMI-2 Program (TMI Site)	H. M. Burton	590-1010

Fuel Cycle and Waste Management Activities:

National LLW technology - D&D (EBR-II, MTR, OMRE, Spent Reactors) - TMI-2 R&D - Development of stored waste examination pilot plant (SWEPP) for TRU waste - Development of process experimental pilot plant (PREPP) for TRU waste - Major test area North/spent fuel storage area.

INEL (contd)

Major Facilities:

Radioactive Waste Management Complex (RWMC) - Processing
Experimental Pilot Plant (PREPP) - Waste Environmental
Reduction Facility (WERF) - Loss-of-Fluid Test (LOFT)
Facility - Stored Waste Examination Pilot Plant (SWEPP).

LLNL

Lawrence Livermore National Laboratory

University of California

PO Box 808

Livermore, CA 94550

TEL: 415-422-1100

FTS: 532-1100

TWX: 910-386-8339

FAX: 532-4660

VERIF: 532-4546

Director

Roger E. Batzel

-7401

Nuclear Waste Management

L. D. Ramspott

-4176

Fuel Cycle and Waste Management Activities:

Particulate filter development - Fundamental geoscience
studies - CLIMAX spent fuel test at NTS - Development
of waste package for Tuff repository - Waste package
design criteria - Monitoring techniques for geologic
repositories.

Major Facilities:

CLIMAX Spent Fuel Test Facility at NTS.

LANL

Los Alamos National Laboratory

University of California

PO Box 1663

Los Alamos, NM 87545

TEL: 505-667-5061

FTS: 843-5060

TWX: 910-988-1773

FAX: 843-6937

VERIF: 843-5113

Director

Donald M. Kerr, Jr.

-5101

Nuclear Waste Mgmt.

Donald T. Oakley

-1310

LANL (contd)

Fuel Cycle and Waste Management Activities:

Fundamental studies of waste materials (BES) - Migration from low-level waste sites (BES) - D&D of various site facilities - Tuff repository support (NNWSI).

Major Facilities:

Waste Disposal Field Experimental Facility - Controlled
Air Incinerator Demonstration Facility - Glove Box
Reduction Facility - TRU Waste Assay Systems.

MOUND

Monsanto Research Corporation

Mound Facility

PO Box 32

Miamisburg, OH 45342

TEL: 513-865-4020

FTS: 774-4020

TWX: 810-473-2974

FAX: 774-3742

VERIF: 774-3575

Director

Wylie Hogeman

-3222

Nuc. Waste Technology

Ralph R. Jaeger

-3275

Fuel Cycle and Waste Management Activities:

Solid waste volume reduction with glass melter - TRU
waste technology/record systems, form development - TRU
waste treatment/liquid waste, incineration - 3H recovery
from waste - D&D of Pu-238 facilities.

Major Facilities:

Glass Melter - Incinerator - Waste Treatment - Combined
Electrolysis catalytic Exchange System.

United States

ORNL

Oak Ridge National Laboratory
Martin Marietta Energy Systems, Inc. TEL: 615-576-5454
PO Box X FTS: 626-5454
Oak Ridge, TN 37831 TWX: 810-572-1076
FAX: 626-2912
VERIF: 624-6068

Director Herman Postma 6-2900
Nuclear & Chemical Waste Thomas H. Row 4-5974

Fuel Cycle and Waste Management Activities:

Consolidated fuel reprocessing - Operate waste management facilities, including disposal by hydrofracture - Development of TRU waste technology, including assay and package certification - Low-level waste technology development - Hazardous chemical defense waste management - Beneficial uses of byproduct radionuclides - Repository development in sedimentary rocks - Remedial action surveys and certification activities.

Major Facilities:

Consolidated Fuel Reprocessing Program (CFRP) Pilot Plant: Integrated Equipment Test Facility, Fuel Element Shearing and Decladding Facilities, Rotary Dissolver - Fluorocarbon Pilot Plant for Kr-85 Recovery - Shallow-Land Burial Site - TRU Waste Assay Facility - Solvent Extraction Test Facility (TRU) - Sol-Gel Microsphere (UO₂ and U/PuO₂) Preparation Facilities.

PNL

Pacific Northwest Laboratory
Battelle Pacific Northwest Laboratories TEL: 509-375-2271
Battelle Boulevard FTS: same
PO Box 999 TELEX: 15-2874
Richland, WA 99352 FAX: 509-375-2718
VERIF: 509-375-2580

Director William R. Wiley -2201
Nuclear Fuel Cycle Ronald C. Liikala -2205
Nuclear Waste Technology Jack L. McElroy -2532
Mtls. Characterization Ctr. John E. Mendel -2905

PNL (contd)**Fuel Cycle and Waste Management Activities:**

Commercial spent fuel management - Civilian nuclear waste treatment (HLW/TRU) - Monitored retrievable storage - Materials characterization center - International program support - NRC environmental studies on LLW and Uranium mill tailing sites - Salt repository (ONWI) - Basalt repository (BWIP) - Granite repository (CR) - Tuff repository (NNWSI) - HLW technology (SR, WV, BRET, Hanford) - TRU technology (TWSO, Hanford) - LLW technology (LLWMP, Hanford) - Airborne waste technology (CFRP) - remedial action planning and technology - Byproduct utilization - Transport technology (TTC).

Major Facilities:

Hot and Cold Development Laboratories - Hot Cells for Development Programs.

RHO

Rockwell Hanford Operations
Rockwell International Corporation
Energy Systems Group
PO Box 800
Richland, WA 99352

TEL: 509-376-7411
FTS: 444-7411
TWX: 510-770-5108
FAX: 444-6430
VERIF: 444-6793

General Manager	Paul G. Lorenzini	440-1277
Bas.Waste Isol.Proj. (BWIP)	Edward B. Ash	444-6848
Waste Management	Ronald D. Prosser	440-3001

Fuel Cycle and Waste Management Activities:

Fuel reprocessing (PUREX) - HLW tank storage - Cs/Sr recovery and encapsulation - HLW concentration and solidification - Low-level liquid waste treatment and fixation - D&D (hot semi works) - TMI support/waste packaging and disposal - TRU waste assay - Basalt waste isolation program (BWIP) - Hanford waste disposal.

Major Facilities:

PUREX Reprocessing Plant - Cs/Sr Encapsulation Plant - BWIP site and Near Surface Test Facility (NSTF).

United States

RFP

Rocky Flats Plant
Rockwell International Corporation
Energy Systems Group TEL: 303-497-7000
PO Box 464 FTS: 320-7000
Golden, CO 80402-0464 TELEX:
FAX: 303-430-2909
VERIF: 303-430-2856

General Manager	Jack E. Dorr	-4361
Waste Management	C. E. Wicklund	-4294
Transuranic Waste	K. V. Gilbert	-2747

Fuel Cycle and Waste Management Activities:
Defense TRU waste technology - TRU waste technology
development - Operate waste treatment facilities.

Major Facilities:
Solid Waste Reduction Facility - TRU Waste Incinerators - TRU Waste Assay - Liquid Waste Treatment and Fixation Facilities.

Rockwell International Corporation

Rockwell International Corporation
Energy Systems Group TEL: 818-700-8200
Atomics International Division FTS: 983-3000
8900 DeSoto Avenue TELEX: 18-1017
Canoga Park, CA 91304 FAX: 818-700-3862
VERIF: 818-700-4292

General Manager	G. Wayne Meyers	-4267
Waste Mgmt./Remote Systems	Don G. Mason	-4156

Fuel Cycle and Waste Management Activities:
Declassing of sodium-bonded fuels - Operate energy
technology and engineering center (ETEC) - Remote
handling development - Large component fabrication.

Major Facilities:
Large Inert Hot Cell - Energy Technology and
Engineering Center (ETEC).

United States

SNL

Sandia National Laboratories
PO Box 5800
Albuquerque, NM 87185

TEL: 505-844-5678
FTS: 844-5678
TWX: 910-989-1600
FAX: 844-1723
VERIF same

President	G. C. Dacey	-7261
Nuclear Fuel Cycle	A. W. Snyder	-8203
Nuc. Waste Mgmt./Transp.	Richard W. Lynch	-3763
Transp. Tech. Center	R. M. Jefferson	-4296
WIPP Scientific Support	Wendel D. Weart	-4855
Subseabed Disposal	D. R. Anderson	-6553

Fuel Cycle and Waste Management Activities:

Transportation of Pu and HLW - Subseabed disposal - Tuff repository support (NNWSI) - Operate transportation technology center - Salt repository scientific support (WIPP) - Safety assessment of facilities for NRC.

Major Facilities:

Transportation Technology Center.

SRL

Savannah River Laboratory
E. I. du Pont de Nemours & Co.
Aiken, SC 29808

TEL: 803-725-6211
FTS: 239-6211
TWX: 810-771-2670
FAX: 239-2130
VERIF: 239-3160

Director	John T. Lowe	-3422
Programs/Planning	J. K. Okeson	-1886
Defense Waste Processing	W. Ross Stevens III	-2410

SRL (contd)

Fuel Cycle and Waste Management Activities:

Fuel reprocessing R&D - HLW storage and solidification
R&D-HLW form development and characterization - HLW
packaging R&D - TRU technology development - LLW tech-
nology development - Defense HLW technology development.

Major Facilities:

TNX HLW Vitrification Pilot Plant - TNX HLW Tank
Mockup - HLW Caves for Process Development - TRU
Waste Incinerator.

SRP

Savannah River Plant

E. I. du Pont de Nemours & Co.
Aiken, SC 29808

TEL: 803-725-6211

FTS: 239-6211

TWX: 810-771-2670

FAX: 239-2130

VERIF: 239-3160

Manager

John T. Granaghan

-2701

Waste Management

R. Maher

-3575

Fuel Cycle and Waste Management Activities:

Operate fuel reprocessing facilities - Operate associ-
ated spent fuel storage, HLW tank storage and liquid
waste treatment facilities - Operate LLW incinerator -
Operate LLW shallow-land burial grounds - Build and
operate defense waste processing facility.

Major Facilities:

F&H Reprocessing Plants - Canyon Mockup Shop - LLW
Incinerator - HLW Tank Farm.

United States

UNC

UNC Nuclear Industries, Inc.

PO Box 490
Richland, WA 99352

TEL: 509-376-7411
FTS: 444-7411
TWX: 510-770-5108
FAX: 444-6000
VERIF: 444-2726

General Manager Larry L. Humphreys 440-1123
Decommissioning Robert F. Potter 444-0114

Fuel Cycle and Waste Management Activities:

Waste management operations for N-Reactor - D&D Hanford
reactors - DOE surplus facilities program.

Major Facilities:

N-Reactor - N-Reactor Fuel Fabrication Facilities.

WHC

Westinghouse Hanford Company

PO Box 1970
Richland, WA 99352

TEL: 509-376-7411
FTS: 444-7411
TWX: 510-770-5108
FAX:
VERIF: 444-5087

President John E. Nolan -3915
Breeder Reproc.Eng. (BRET) Carl A. Burgess -4612
Fuel Cycle Development Roy E. Dahl -3177

Fuel Cycle and Waste Management Activities:

Breeder fuel reprocessing (BRET) - Breeder fuel devel-
opment and fabrication - Spent fuel integrity in
storage.

Major Facilities:

Fast Flux Test Facility (FFTF) - Fuels and Materials
Examination Facility (FMET) - Fuel Development
Laboratories.

United States

Westinghouse Electric Corporation

Westinghouse Electric Corporation
Waste Technology Services Division TEL: 702-295-5844
Nevada Operations FTS: 575-5844
PO Box 708 TELEX: none
Mercury, NV 89023 FAX: 575-5923
VERIF: 575-5850

Manager Jim B. Wright -5844
E-MAD Operations A. P. Weber -5845
Engineering J. C. Dobbins -5846

Fuel Cycle and Waste Management Activities:

Fuel integrity testing for commercial spent fuel management - Code verification for monitored retrievable storage - Receipt, handling, packaging of spent nuclear fuel - Tuff repository support.

Major Facilities:

E-MAD Hot Bay - Dry Storage Casks-Air-Cooled Vault for Lag Storage.

WVNS

West Valley Nuclear Services, Inc.
Subsidiary of Westinghouse Electric
PO Box 191 TEL: 716-942-3235
West Valley, NY 14171-0191 FTS: same
TELEX: none
FAX: same ext.246
VERIF: same ext.267

President M. Bruce Boswell ext.324
Engineering John L. Knabenschuh ext.295

Fuel Cycle and Waste Management Activities:

Demonstration of HLW vitrification - D&D of West Valley reprocessing plant.

Major Facilities:

Reprocessing Plant - HLW Vitrification Component Test Stand.

WINCO

Westinghouse Idaho Nuclear Co., Inc.	TEL: 206-526-0111
Idaho Chemical Processing Plant	FTS: 583-0111
PO Box 4000	TELEX: none
Idaho Falls, ID 83401	FAX: 583-5436
	VERIF: 583-5233

President	Max T. Johnson	-0998
Production	Raymond Mairson	-3303
Technology	Bert R. Wheeler	-3373

Fuel Cycle and Waste Management Activities:

Operate associated spent fuel storage, HLW tank storage, and liquid waste treatment facilities.

Major Facilities:

Idaho Chemical Processing Plant (ICPP) - Waste Calcining Facility (WCF) and Remote Mockup - Wet Fuel Storage - Dry HTGR Fuel Storage - Kr-85 cryogenic recovery plant.

WIPP

Westinghouse Electric Corporation	TEL: 505-887-0586
Advanced Energy Systems Division	FTS: same
WIPP Project	TELEX: none
PO Box 2078	FAX: 505-887-1077
Carlsbad, NM 88221	VERIF: 505-887-0586
	ext. 238

Manager	P. A. Miskimin	ext. 187
---------	----------------	----------

Fuel Cycle and Waste Management Activities:

WIPP technical support, including design review, construction support, safety assurance, operational planning, quality assurance systems.

Major Facilities:

Waste Isolation Pilot Plant.

United States

EPA

US Environmental Protection Agency
401 M Street S.W.
Washington, DC 20460

TEL: 202-655-2090
FTS: 382-2090
TELEX: 892-758
FAX: 382-7883
VERIF: 382-2078

International Activities

W. Grieder -4887
Glen L. Sjoblom -4981

Waste Management Standards

Floyd L. Galpin 703-557-8610

Radiation Programs

Sheldon Meyers -9710
W. F. Holcomb -8977

United States

NRC

US Nuclear Regulatory Commission
Washington, DC 20555

TEL: 301-492-7000
FTS: 492-7000
TELEX: 908-142
FAX: 492-7617
VERIF: 492-7371

Nuclear Material Safety and Safeguards -NMSS-

Director	John G. Davis	427-4063
Waste Management	Robert E. Browning	427-4069
Safeguards	Robert F. Burnett	427-4033
Fuel Cycle/Materials Safety	Richard E. Cunningham	427-4485

Nuclear Regulatory Research -RES-

Director	Robert E. Minogue	427-4341
Health, Siting/Waste Mgmt	Karl R. Goller	427-4350

Nuclear Reactor Regulation -NRR-

Director	Harold R. Denton	492-7691
Licensing	Darrell G. Eisenhut	-7672
Three Mile Island (TMI) Program	Lake H. Barrett	427-4173

Inspection and Enforcement -IE-

Director	Richard C. DeYoung	492-7397
----------	--------------------	----------

International Programs

Director	James R. Shea	492-7886
----------	---------------	----------

Regional Offices

Philadelphia	- Region I	Thomas E. Murley	215-337-5299
Atlanta	- Region II	James P. O'Reilly	404-221-5500
Chicago	- Region III	James G. Keppler	312-790-5677
Dallas	- Region IV	Robert D. Martin	817-860-8100
San Francisco	- Region V	John B. Martin	415-943-3700

United States

USGS

US Geological Survey
410 National Center
12201 Sunrise Valley Drive
Reston, VA 22092

TEL: 202-860-7000
FTS: 860-7000
TELEX: 899-153
FAX: 928-7793
VERIF: 928-7209

Director
Hazardous Waste Hydrol.
High-Level Waste

Dallas L. Peck -7411
John B. Robertson -6976
George A. Dinwiddie -6976

WESTON

Weston
2301 Research Blvd.
Rockville, MD 20850

TEL: 301-963-6814
FTS: 202-963-6814
FAX: 840-1552
VERIF: 963-6800

CRWM Program
Internat'l. Programs

William M. Hewitt -6810
James F. Strahl -6821

USSR
(Union of Soviet Socialist Republics)

MAJOR SOVIET HOLIDAYS (1985)

January 1	New Year
March 8	Women's Day
May 1-2	May Day
May 9	Victory over Fascism
November 7-8	October Revolution
December 5	Constitution Day

USSR

ENERGY

Population	1984	275 million
Electric Power Plant Capacity	1982	281 GWe
1993		460 GWe
Electric Power Production	1982	1376 TWh--
		7% nuclear
1985		1510 TWh--
		14% nuclear

NUCLEAR POWER

National Policy: Major program to develop nuclear power, to avoid transport of fossil fuels from east of the Ural Mountains to European Russia.

Nuclear Power Plant Capacity	1982	17 GWe
1985		25 GWe
1992		90-100 GWe
Reactor Mix	1984	LGR: 19 (1958-84)
		4 (1984-86)
		PWR: 15 (1964-84)
		17 (1984-88)
		BWR: 1 (1966)
		FBR: 2 (1973/80)
Reactor Development		LMFBRs, 1,500-MWe PWRs

INDUSTRIAL FUEL CYCLE

Policy: Complete domestic fuel cycle capability, including enrichment, fuel fabrication (UO₂ and MOX); develop commercial reprocessing capability.

Waste Management Strategy: Vitrify HLW, provide terminal storage in geologic repository.

ORGANIZATION**Nuclear Program Control**

- USSR State Committee on Utilization of Atomic Energy
- Ministry of Energy and Electrification.

R&D

- Institute of Physical Chemistry, Moscow, a branch of the USSR Academy of Sciences (geologic waste disposal; waste form properties; personnel: V. I. Spitsyn,^(a) N. E. Brezneva, M. K. Pimenov)
- V. G. Khlopin Radium Institute, Leningrad (chemical separation; fuels reprocessing; geochemistry)
- All-Union Scientific Research Institute for Inorganic Materials, Moscow (properties of solid waste forms; personnel: A. S. Polyakov,^(a) V. V. Kulichenko,^(a) N. V. Krylova^(a))
- Chemical Plant Research Institute, Sverdlovsk (vitri-fication pilot plants).

**STATE COMMITTEE ON THE UTILIZATION
OF ATOMIC ENERGY**

State Committee on the Utilization
of Atomic Energy
Staromonetny Pereulok 26
Moscow 109180
USSR

Chairman	A. M. Petrosyants
Deputy Chairman	Prof. I.D. Morokhov

Waste Management R&D: Develop processes for treating spent fuel (cladding, thermal decladding, meltdown of hulls), improved partitioning of TRU wastes, handling off-gases, and storing ⁸⁵Kr.

(a) Also a member of the State Committee on the Utilization of Atomic Energy

Facilities^(a)

- **Reprocessing Pilot Plant (radioactive)**
Owner: Khlopin Radium Institute, Leningrad.
Mission: Develop LWR fuel reprocessing technology.
Design Basis: Chop-leach head-end; Purex flowsheet; capacity, 3 kg/day uranium.
History: Startup, 1973.

- **Cold Pilot Plant-Vitrification**
Mission: Develop waste vitrification technology.
Design Basis: Liquid-fed ceramic melter, two-chamber unit; 150 g/hr HLLW; 30 g/hr glass; product, phosphate glass blocks.
History: Startup, 1974.

- **KS-KT-100 (cold pilot plant-vitrification)**
Location: Chemical Plant Research Institute, Sverdlovsk.
Mission: Develop vitrification technology for high-Al, high-Na HLW.
Design Basis: Fluid bed calciner; in-crucible melter (two-stage process); capacity, 20 kg/hr glass; 160-180 kg glass/batch; product, phosphate glass blocks.
Personnel: V. I. Davydov; V. V. Dolgov.

KHLOPIN RADIUM INSTITUTE

Khlopin Radium Institute
 Ul. Rentgena 1
 Leningrad 22
 USSR

Chief of Laboratory

Yergeny Shashukov

(a) Because there is only limited information available, it is not always known at which nuclear agency a facility is located.

INTERNATIONAL AGENCIES

CMEA

Council for Mutual Economic Assistance
Prospekt Kalinina 56
Moscow
USSR

MEMBER STATES

Bulgaria	Mongolia
Cuba	Poland
Czechoslovakia	Rumania
German Democratic Republic	USSR
Hungary	Yugoslavia

MISSION

Promote economic and industrial cooperation among the countries with centrally-controlled economies.

ORGANIZATION

CMEA has a Standing Commission on the Use of Atomic Energy for Peaceful Purposes. The Commission holds meetings to review national waste management R&D programs and defines areas for additional cooperation.

EC (EUROPEAN COMMUNITIES)

MEMBER STATES

Belgium	Ireland
Denmark	Italy
France	Luxembourg
Germany (FRG)	Netherlands
Greece	United Kingdom

NUCLEAR MISSION

Promote growth in nuclear industries of member countries, operate joint research center sites, sponsor and fund R&D, exchange information, establish radioprotection and safety standards, and operate the Euratom safeguard system and the Euratom Agency for Fuel Supply.

EC (contd)

FUEL CYCLE PROGRAM ADMINISTRATION

- Financing--R&D programs supported by a tax on the member states.
- R&D programs
 - Direct action--fully funded by EC, conducted by Euratom Joint Research Centre establishments at Ispra (Italy) and Karlsruhe (FRG)
 - Indirect action--partly funded by EC under cost-sharing contracts, conducted by research centers in the member states.
- Cooperation with US DOE--waste management cooperative agreement runs from October 6, 1982 to October 6, 1987.

ORGANIZATION

- CEC (Commission of the European Communities)--executive body for the combined communities (Euratom, Coal and Steel, Common Market).

CEC

Commission of the European Communities

200 Rue de la Loi

8-1049 Brussels

Belgium

Tel: (32) 2 235-1111

Telex: 21877 COMEU B

Vice-President for Industrial
Affairs, Energy, Euratom
Supply Agency, Research and
Science, Joint Research
Centre

Viscount Etienne Davignon

Director, Nuclear R&D

Sergio Finzi

Fuel Cycle Systems

Serge Orłowski

Reactors/Technologies

Mario De Bacci

Nuclear Plant Safety

Willem Vinck

Director, Nuc. Energy Policy

Fabrizio Caccia Dominioni

Director General, CEC JRC

Jean-Albert Dinkespiler

CEC-JRC: ISPRA

CEC Joint Research Center
Ispra Establishment Tel: (39) 332 78-0131
I-21020 Ispra (Varese) (39) 332 78-0271
Italy Telex: 380042/38058 euratom

(Northern Italy; it may be reached by air-travel to Milan,
ground transport to Ispra, about 50 km.)

Director George Robert Bishop
WM Program Coordinator Francesco Girardi

Waste Management R&D: R&D in treatment and storage of
radioactive waste. TRU wastes--volume reduction and
actinide separation; waste disposal--risk analysis,
nuclide migration, and waste form properties.

CEC-JRC: KARLSRUHE

Karlsruhe Establishment
(European Institute for
Transuranium Elements)
Postfach 2266
D-7500 Karlsruhe Tel: (49) 7247 841
Federal Republic of Germany Telex: 7825483 Eu D

Director Roland Lindner

Mission: Basic research in the transuranium elements,
especially plutonium, reactor fuels development.

Fuel Cycle R&D: Plutonium conversion and plutonium fuels,
characterization of waste forms.

IAEA

International Atomic Energy Agency
P.O. Box 100
A-1400 Vienna
Austria

Tel: (43) 222 23600
Telex: 112645

MEMBER STATES

Over 100 nations (UN members), including USA.

MISSION

Develop the peaceful use of atomic energy: safeguards, nuclear safety and standards, information exchange, and technical assistance.

Waste Management Activities

- Development of mutually agreed upon safety standards and criteria for the management and disposal of radioactive waste arising from all stages of the nuclear fuel cycle.
- Promotion of information exchanges in the radioactive waste management area through international conferences and symposia, technical committees and advisory groups, and specialized training courses and seminars.
- Coordination of research programs in specific technical areas.
- Issuance of publications in the field of waste management, including the annual "Waste Management Research Abstracts."

Director General	Hans Blix
Deputy Director General	Boris Semenov
Director, Nuc. Fuel Cycle	Syed Fareeduddin
Waste Management	Joseph Hirling
U.S. Waste Mgmt. Staff	A. Hagan
	Don Saire

International

ICRP

International Commission on Radiological
Protection

Clifton Avenue

Sutton, Surrey SM2 5PU

United Kingdom

Tel: (44) 1 642-4680

Telex: 895 1244 ICRPG

Chairman, Main Commission

Dr. B. Lindell

Scientific Secretary

Dr. F. D. Sowby

Committee Chairmen:

Rad. Effects

Dr. A. C. Upton

Secondary Limits

Dr. J. Vennart

Protection in Medicine

Dr. C. B. Meinhold

Application of Commission's

Dr. H. P. Jammet

Recommendations

MISSION

Provide principles of radiation protection as a basis for each country to use to establish technical codes of practice.

OECD-NEA

OECD Nuclear Energy Agency

38 Boulevard Suchet

F-75016 Paris

France

Tel: (33) 1 524-8200

Telex: 630 668

MEMBER STATES

Australia

Finland

Japan

Sweden

Austria

Germany (FRG)

Luxembourg

Switzerland

Belgium

Greece

Netherlands

Turkey

Canada

Iceland

Norway

United Kingdom

Denmark

Ireland

Portugal

United States

France

Italy

Spain

(New Zealand and Yugoslavia cooperate in certain projects.)

OECD-NEA (contd)

MISSION

Promote orderly development of peaceful uses of nuclear energy through cooperation among Member States. Initiate, encourage, and coordinate cooperative work in the following areas: reactor research, nuclear fuel cycle studies, radiation protection and waste management, nuclear safety, regulatory matters, and nuclear data collection.

Activities

- Workshops, technical meetings, symposia, and publications.
- Maintenance of the Multilateral Consultation and Surveillance Mechanism for Sea Disposal, which monitors sea dumping of LLW/ILW in the Northeast Atlantic.
- Joint projects: International Stripa Mine Project (Sweden); International Sorption Information Retrieval System (ISIRS); Agesta International Decontamination Project (Sweden).

US Mission to OECD
Nuclear Energy Agency
38 Boulevard Suchet
F-75016 Paris
France

Tel: (33) 1 647-6327

DOE Representative

Andrew W. Reynolds
(Ext. 25)

US Mailing Address:

US Mission to OECD
c/o US Embassy, Paris
APO New York, NY 09777

FIGURE Int'l-1. NEA Organization

ENERGY SUPPLY AND DEMAND

ENERGY SUPPLY AND DEMAND

ENERGY RESERVES

The world's measured, recoverable, nonrenewable energy reserves (as of 1974) are shown in Figure E-1 and listed by resource in Table E-1. The numbers are relatively old estimates but they do provide an order-of-magnitude picture. (The North American numbers are approximately 1/3 of US-ERDA 1976 estimates for the US alone.)

ENERGY DEMAND

According to the reference for Figure E-1, in 1974 the world consumed 1 percent of its recoverable, nonrenewable energy resources with the US accounting for one-third of that consumption. In 1978, the world consumed about 250 quads of energy, and the rate of energy use is accelerating, particularly for the developing countries (see Table E-2). The supply form of this 250 quads varied

FIGURE E-1. World Recoverable, Nonrenewable Energy Reserves

Source: Energy Perspectives 2, June 1976,
U.S. Department of Interior

TABLE E-1. Measured World Recoverable Energy Reserves,
1974 (quads)^(a)

Area	Solid Fuels	Crude Oil	Natural Gas	Oil Shale and Tar Sands ^(b)	Uranium (nonbreeder) ^(c)	Total
Africa	361.7	526.6	201.7	81.4	198.1	1,359.5
Asia (less USSR)	2,608.7	2,204.4	432.6	870.2	3.1	6,126.0
Europe (less USSR)	2,581.5	57.1	153.6	117.0	46.4	2,955.6
North America	5,070.9	301.0	380.6	9,111.0	422.7	15,286.2
South America	49.8	311.5	60.6	23.7	11.9	457.5
Oceania	459.8	9.4	24.9	9.2	99.1	602.4
Total	11,132.4	3,407.6	1,254	10,212.5	>781.3	>26,803.2

(a) Source: World Energy Conference, Survey of Energy Resources, New York, 1974.

(b) According to the U.S. Department of the Interior, Bureau of Mines, North American tar sands and shale oil reserves may be severely overstated. Development of most of these reserves is not economic at present.

(c) Energy content using breeders 60-100 times as great. Thorium resources neglected.

enormously from country to country. Figure E-2 shows the supply pattern in the major WOCA countries. This figure illustrates the relatively high dependence on imported oil for Japan, West Germany, and France.

TABLE E-2. World Energy Usage (Quads)^(a)

	1980	2000
Industrialized Countries (including CPEs)	224.8	340.4/386.1 ^(b)
Developing Countries	69.8	173.1/215.7

(a) Source: IAEA Book: "Energy, Electricity, and Nuclear Power Estimates Up to 2000," April 1981.

(b) Low/high projections are given.

NUCLEAR POWER SUPPLY

Electricity generation by commercial nuclear power began in the early 1950s in a few highly industrialized countries. From that beginning it has grown to the point where 24 nations (19 WOCA countries) now operate commercial nuclear power plants, and at least a dozen others have active nuclear power programs. Installed electric grid and nuclear power capacities as of the end of 1981 are shown in Table E-3, while Table E-4 provides high/low growth projections into the twenty-first century. Table E-4 utilizes the numbers generated for the INFCE study (1978 estimates) and also lists the nuclear projections obtained in 1980 from NEA Member States in response to a NEA/IAEA questionnaire. The INFCE projections shown in this table are currently too high. For example, the US now estimates a 125 GWe level for the year 2000, as opposed to the 255-395 GWe projection shown in the table.

The relative nuclear power capacities of the countries with major nuclear programs, as of 1979 and as projected to the year 2000, are depicted in Figures E-3 and E-4, respectively. Table E-5 provides low/high estimates of total electrical and nuclear capacities for regions of the world, for 1980 and for the year 2000.

FIGURE E-2. Primary Energy Supply Patterns (1978)
Source: Japan and the Oil Problem,
February 1980

TABLE E-3. Installed Electrical Grid Capacities in
Countries with Nuclear Power Programs

Country	Populations (millions, 1980)	Total Electric Power Plant Capacity (GWe, 1980)	Primary Energy ^(a) Demand		
			Mtoe	Mtce	Year
Argentina	27	13	40	--	1979
Austria	7.1	13	27.0	--	1979
Belgium	9.8	13	49.5	--	1980
Brazil	119	31	95	--	1980
Canada	23.9	79	231.3	--	1980
China (PR)	972	60	--	766	1978
Egypt	42	4	--	18.3	1978
Finland	4.8	12	25.3	--	1981
France	53.5	73	193	--	1981
Germany (FRG)	61.5	86	257	--	1982
India	700	29	93	--	1979
Italy	56.7	47	142	--	1980
Japan	117	148	386	--	1980
Korea (ROK)	38	6	41.4	--	1981
Mexico	69	17	80	--	1979
Netherlands	14.1	17	75.7	--	1980
Pakistan	81.5	2	--	13	1978
Philippines	48	4.6	--	--	--
South Africa	28	19	40.1		1981
Spain	38.3	36	73.4		1979
Sweden	8.4	29	50.6		1979
Switzerland	6.3	15	25.4		1980
Taiwan	17.7	9	--	--	--
United Kingdom	56	82	201.5		1980
USA	--	623	1853		1980
USSR	265.5	270	--	--	--

(a) 1 Mtoe = 1.6-1.9 Mtce and is equivalent to 3.75 to
4.5 terawatt hrs electric (TWh).

TABLE E-4. Nuclear Power Growth Projections, GWe^(a)

Country	Nuclear Power Capacity					Reactor Mix
	1984	1985	1990	1995	2000	
Argentina	0.9	0.9	0.9	1.6	3.0	HWR
Belgium	3.5	4.4	5.4	6.7	8.0	PWR
Brazil	0.6	0.6	1.9	3.1	4.4	PWR
Bulgaria*	1.6	2.6	3.5	--	--	PWR
Canada	7.9	9.9	13.2	15.6	15.6	HWR
Cuba*	--	--	0.4	--	--	PWR
Czechoslovakia*	0.8	3.3	3.3	--	--	PWR
Egypt	--	--	--	1.8	2.7	LWR
Finland	2.2	2.2	2.2	3.2	3.2	BWR, PWR
France	31.5	35.8	52.3	57.6	61.6	PWR, GCR, FBR
Germany (DR)*	1.7	1.7	1.7	--	--	PWR
Germany (FR)	12.3	16.4	22.9	24.1	28.0	BWR, PWR, HTR, FBR
Hong Kong	--	--	--	1.8	1.8	
Hungary*	0.4	1.2	1.6	--	--	PWR
India	1.0	1.3	1.9	3.2	5.9	BWR, HWR
Italy	1.3	1.3	1.3	4.8	6.7	BWR, PWR, GCR
Japan	19.0	22.8	31.3	38.0	47.0	BWR, PWR, HWR, GCR
Korea (ROK)	1.8	2.7	7.4	9.3	11.2	PWR, HWR
Mexico	--	--	1.3	1.3	1.3	BWR
Netherlands	0.5	0.5	0.5	0.5	0.5	BWR, PWR
Pakistan	0.1	0.1	0.1	1.1	1.1	HWR, LWR
Philippines	--	0.6	0.6	0.6	1.2	PWR
Romania*	--	--	1.3	--	--	HWR
South Africa	0.9	1.8	1.8	2.8	3.8	PWR
Spain	3.7	5.5	7.5	8.4	10.2	BWR, PWR, GCR
Sweden	7.3	9.4	9.4	9.4	9.4	BWR, PWR
Switzerland	2.9	2.9	2.9	3.8	3.4	BWR, PWR
Taiwan	4.0	4.9	4.9	6.7	8.7	BWR, PWR
United Kingdom	6.4	10.0	12.2	10.8	13.6	GCR, PWR, FBR
USA	66.7	79.1	106.9	110.2	109.1	BWR, PWR, HTR
USSR*	--	25	90-100	--	--	PWR, FBR, LGR
Yugoslavia	0.6	0.6	0.6	0.6	2.6	PWR

(a) Capacity figures are taken from "NUKEM Special Report: The Nuclear Power Plant Capacity of the Western World," October 1984, unless marked with an asterisk; the latter are taken from Nuclear Engineering International, August 1983, p. 2.

FIGURE E-3. Proportionate World Nuclear Capacity
for Named Countries, As of 12/79
Source: Nuclear News, February 1980
Courtesy of HEDL

TABLE E-5. Estimates of Total and Nuclear Electrical
Generating Capacity^(a)

Country Group	1980		2000 ^(b)	
	Total Electrical GWe	Nuclear, %	Total Electrical GWe	Nuclear, %
(1) OECD North America	713	8.0	1213 1600	13.9 14.9
(2) OECD Europe	441	10.1	985 1213	29.6 29.3
(3) OECD Pacific	178	8.4	437 578	22.9 29.4
(4) Centrally-Planned Europe	368	4.3	1051 1344	9.2 15.7
(5) Asia	131	2.0	945 1132	4.7 7.1
(6) Latin America	101	0.3	304 386	7.6 11.2
(7) Africa and Middle East	63		232 311	8.0 8.8
World Total	1996	6.8	5167 6554	14.4 17.1
Industrialized Countries	1720	7.7	3716 4790	17.8 20.5
Developing Countries	276	1.1	1451 1774	5.7 8.1

(a) Source: IAEA Book "Energy, Electricity and Nuclear Power
Estimates for the Period up to 2000," April 1981.

(b) The top and bottom figures are low and high estimates,
respectively.

FAST BREEDER REACTOR STATUS

The relative status of FBR development worldwide is provided in Figures E-5 and E-6. The US clearly led the world in the initial stages of development. The Experimental Breeder Reactor, EBR-1, provided the first electricity ever generated by nuclear power. The US has maintained its lead in research and development in selected areas but three countries, France, the Soviet Union and the United Kingdom are now operating large prototype reactors. The US prototype, CRBR, was cancelled in late 1983. A near commercial plant, the 1200 MWe Super Phenix, is scheduled to be connected to the electrical grid in France in 1986.

CONVERSION FACTORS

Tables E-7 and E-8 provide heat content and energy conversion factors.

FIGURE E-5. International Fast Reactor Development

FIGURE E-6. International Fast Reactor Development

TABLE E-6. Heat Content Conversion Factors

To convert from million tonnes oil equivalent (Mtoe), multiply by the following conversion factors.

	Canada	U.S.	OECD Europe	Japan	Overall
Million tonnes coal equivalent ^(a)					
Hard Coal	0.69		0.70	0.73	
Lignite	0.34		0.20		
Terawatt hours ^(a) thermal (TWh[t])					12.5
Terawatt hours ^(a) electrical (TWh[e])	4.22	3.86	3.9-4.4	4.08	
Million therms ^(b)					425
TeraJoules ^(b)					44,800
Barrels of oil					7.76×10^6

1 Barrel = 42 gallons

1 Terawatt hour = 10^9 kilowatt hours

1 Kilowatt hour = 3415 Btu = 8.60×10^5 calories

1 Therm = 10^5 Btu

1 Quad = 10^{15} Btu

(a) World Energy Outlook, OECD, 1977.

(b) The World Energy Book, Nichols Publishing Co., 1980.

TABLE E-7. Energy Conversion

1 Mile of Supply Train	$\approx 10,000$ T coal $\approx 50,000$ bbl oil
Quads/Yr (input)	≈ 1.7 GWe capacity (32% thermal efficiency @ 0.63 capacity factor)
1 GWe power plant requires	$\approx 51,000$ T coal/week (at 32% thermal efficiency, 100 capacity)
U.S. coal-fired plants Actual coal consumption (1980)	$\approx 56,900$ miles of supply train or 569×10^6 T coal
U.S. oil-fired plants Actual oil consumption (1980)	$\approx 8,420$ miles of supply train or 421×10^6 bbl oil

FUEL CYCLE

TABLE F-1. Values of Selected Reactor Parameters^(a)

<u>Power Station</u>	<u>Core Power MWe(net)/MWt</u>	<u>Fuel Inventory (Mg HM)</u>	<u>Fuel Element Weight (Mg HM)</u>
Tricastin-2 (PWR-France)	925/2785	72.46	0.46
Novo Voronezh (PWR-USSR)	420/1375	42	0.12
Krümme1 KKK (BWR-FRG)	1260/3690	155.8	0.185
Bruce 4 (PHWR-Canada)	740/2515	115	0.018
Wylfa 1 (GCR-UK)	420/1650	595	0.012
Hinckley Point B1 (AGR-UK)	621/1494	113.7	0.046
Super Phenix (LMFBR-France)	1200/3000	32	0.089

(a) Information gathered from Nuclear Engineering International, July/August 1980 supplement; "World List of Nuclear Power Plants, Nuclear News, June 30, 1980; and Power Reactors in Member States, International Atomic Energy Agency, 1978.

TABLE F-2. Values of Selected Spent Fuel Parameters^(a)

Power Station	Fuel Material	Cladding	Discharge Burnup (MW _e d/Mg HM)	Discharge Rate (Mg HM/ GWe Yr)
Tricastin-2 (PWR-France)	Enriched UO ₂	Zr-4	33,000	33
Novo Voronezh (PWR-USSR)	Enriched UO ₂	Zr	28,000	43
KrÜmmel KKK (BWR-FRG)	Enriched UO ₂	Zr-2	27,500	39
Bruce 4 (PHWR-Canada)	Natural UO ₂	Zr-4	7,085	175
Wylfa 1 (GCR-UK)	Natural U	Magnox	3,500	409
Hinckley Point B1 (AGR-UK)	Enriched UO ₂	SS	18,000	49
Super Phenix (LMFBR-France)	19-27% PuO ₂ in UO ₂	SS	100,000	9

(a) Information gathered from Nuclear Engineering International, July/August 1980 supplement; World List of Nuclear Power Plants, Nuclear News, June 30, 1980; and Power Reactors in Member States, International Atomic Energy Agency, 1978.

TABLE F-3. Forecast of Spent Fuel Arisings^(a)

Country	Fuel Discharged (cumulative tU)			
	1980	1985	1990	2000
Argentina	416	940	1,900	5,800
Belgium	196	560	1,290	3,000
Brazil	--	32	180	1,000
Canada	3,650	8,800	17,700	38,000
Egypt	--	--	--	360
Finland	48	350	650	1,400
France	248	2,700	7,700	22,000
Germany (FR)	960	2,250	4,550	11,000
Hong Kong				250
India	370	780	1,580	5,000
Italy	160	330	520	2,000
Japan	1,450	3,700	7,800	20,500
Korea (ROK)	17	360	1,450	4,400
Mexico	--	--	100	500
Netherlands	103	190	270	420
Pakistan	49	110	170	440
Philippines	--	--	80	270
South Africa	--	40	310	1,200
Spain	176	490	1,300	3,400
Sweden	465	1,330	2,360	5,000
Switzerland	380	650	1,090	2,000
Taiwan	70	430	1,140	2,600
United Kingdom	250	830	2,000	5,330
USA	6,500	12,500	21,100	42,800
Yugoslavia	--	50	130	420

(a) Only UO₂ fuels from LWRs, British AGRs, HWRs and Russian oxide-fueled graphite-moderated reactors are included.

For all countries except the US, the spent fuel forecasts are estimated from data in NAC Reports C-8023, "Worldwide Spent Fuel Disposition Analysis," September 1980; and T-8106, "Light-Water Reactor Spent Fuel Storage and Reprocessing in Europe in the 1980s," December 1981; corrected to reflect current projections of nuclear power plant capacity.

US data is in tHM and taken from "Spent Fuel and Radioactive Waste Inventories, Projections and Characteristics," DOE/RW-003, September 1984.

TABLE F-4. Spent Fuel Reprocessing Activities
and HLW Inventories

Country (Site)	Operation Dates	Fuel Reprocessed	HLW Inventory
Eurochemic (Mol, Belgium)	1966-1974	1,360 kg HEU 181 t LEU	800 m ³ HEWC 67 m ³ LEWC
Canada	-1979	Lab studies	16 m ³
FRG (WAK)	1971-1980	100 t (43 t LWR)	65 m ³
France (UP-1) (AVM)	1958-1983 6/78-3/83	12,000 t (GCR)	286 t HLW glass (836 canisters)
France (UP-2, La Hague)	1966-1977 1976-1983	4,000 t (GCR) 731 t (LWR)	
India (Trombay) (Tarapur)	1965-1974 1982-		
Italy (Saluggia) (Trisaia)			100 m ³ 3 m ³
Japan (Tokai)	1977-1983	170 t	
United Kingdom	1979 1952-1980 1969-1973	20,000 t (GCR) 90 t (LWR)	1000 m ³
United States (Nuclear Fuel Services)	1966-1971	244 t oxides 375 t metal	2100 m ³

TRAVEL AIDS

INTERNATIONAL DIALING INSTRUCTIONS

Telephone numbers in the International Nuclear Fuel Cycle Fact Book show country code, city code and local number, however, direct dial is not available in all areas and operator assistance may be necessary. There is no direct dial to India.

or ask the overseas operator for:

- numbers
- country and city codes
- rates
- other assistance.

Points to remember:

- It may take up to 45 seconds for the overseas phone to ring
- Overseas ringing and busy signals may vary
- There are time differences
- Rate discounts may apply. Call the overseas operator for information.

INTERNATIONAL STANDARD TIME CHART

	Hours From Wash., DC	Daylight Saving Time Effective Period (first and last day)
Argentina	+2	--
Australia (New South Wales)	+15 1/2	10/28/84-03/02/85
Austria	+6	03/31-09/28/85
Belgium	+6	03/31-09/28/85
Brazil (East-including all coast)	+2	--
Canada (Atlantic)	+1	
(Eastern)	0	04/28-10/26/85
(Pacific)	-3	
China (People's Republic)	+13	10/14/84-03/09/85
Denmark	+6	03/31-09/28/85
Finland	+7	03/31-09/28/85
France	+6	03/31-09/28/85
Germany (FRG)	+6	03/31-09/28/85
India	+10 1/2	--
Italy	+6	03/31-09/28/85
Japan	+14	--
Korea (Republic of)	+14	--
Mexico (Baja Calif. Norte)	-3	04/28-10/26/85
Netherlands	+6	03/31-09/28/85
Pakistan	+10	--
South Africa	+7	--
Spain	+6	03/31-09/28/85
Sweden	+6	03/31-09/28/85
Switzerland	+6	03/31-09/28/85
Taiwan (Republic of China)	+13	--
United Kingdom	+5	03/31-10/26/85
United States (Central)	-1	
(Mountain)	-2	
(Pacific)	-3	04/28-10/26/85
(Alaska)	-4	
(Hawaii)	-5	
USSR (Moscow time)	+8	03/31-09/28/85

PASSPORTS AND VISA REQUIREMENTS

PASSPORTS

Passports are needed to depart and re-enter the United States. To obtain current information and passport application/renewal forms contact your county courthouse. Most travel agencies also provide current information and necessary forms.

VISAS

While many foreign countries no longer have visa requirements for U.S. citizens, some still do. Most travel agencies can provide up-to-date information on visa requirements as well as the necessary forms. It is necessary to obtain most visas prior to departure, and they should be obtained well in advance from the nearest consulate of the country to be visited.

Visas are currently required for visits to the following countries:

- Argentina
- Australia
- Brazil
- China (People's Republic)
- India
- Japan
- Korea (Republic of)
- Mexico
- Pakistan
- South Africa
- Taiwan (Republic of China)
- USSR

CURRENCY EXCHANGE RATES

The following table illustrates the US dollar equivalent on 1-2-85.^(a) As rates fluctuate daily, it is recommended that current rates be obtained from local banks or newspapers prior to departure.

<u>Country</u>	<u>Currency</u>	<u>US \$ Equivalent</u>
Argentina	Peso	0.0064
Australia	Dollar	0.8167
Austria	Shilling	0.0449
Belgium	Franc	0.0157
Brazil	Cruzeiro	0.0031
Canada	Dollar	0.7563
China (People's Republic)	Yuan	0.3586
Denmark	Krone	0.0882
Finland	Markka	0.1512
France	Franc	0.103
Germany (FRG)	Mark	0.3152
India	Rupee	0.0803
Italy	Lira	0.0005
Japan	Yen	0.0039
Korea (ROK)	Won	0.0012
Mexico	Peso	0.0044
Netherlands	Guilder	0.2794
Pakistan	Rupee	0.0655
South Africa	Rand	0.497
Spain	Peseta	0.0057
Sweden	Krona	0.1107
Switzerland	Franc	0.3820
Taiwan (Republic of China)	Dollar	0.053
United Kingdom	Pound	1.149

(a) Wall Street Journal, 1/3/85.