PART F
Other World Markets

9 Other World Markets

This chapter details the structure, characteristics, sources of information and contact points in the main global nuclear decommissioning markets that offer potential opportunities for the UK.

9.1 USA Nuclear Decommissioning Market Summary

9.1.1 Introduction and Current Status

The nuclear power industry grew to its present size following construction programmes initiated during the 1960s and 1970s when nuclear power was anticipated to be a low cost source of electricity. Increases in nuclear generating capacity during 1969-1996 made nuclear power the second largest source of electricity generation in the U.S., following coal. Better utilization of generating capacity has permitted nuclear power to maintain this position despite the end of new plant construction during the 1990s and extended shutdowns of several reactors for maintenance and refitting during the 1990s. Several nuclear reactors were permanently closed during the 1990s though many were small or prototype units. The last units were closed during 1998.

Annual nuclear electricity generation has more than tripled since 1980 to 780 billion kW·h in 2002. Nuclear power now accounts for over 20 percent of total electricity generation in the United States. The positive nuclear power record has been influenced by growth in reactor productivity as measured by an increase in capacity factors from 56% in 1980 to 66% in 1990 and over 90% in 2002. Many individual units have achieved 95% or higher capacity factors. There are 104 licensed nuclear reactors in the U.S currently. One of the licensed reactors, Browns Ferry 1, has not “operated” since 1985 though the plant’s owner/operator, the Tennessee Valley Authority, intends to restart the reactor by 2007. Reactors are located at 65 sites (plants) throughout the United States with most located in the eastern half of the country. Table 1.1 below shows the current status of nuclear power plants in the US.

Over 40 years of operational experience and steadily improving licensee performance have changed the way that the U.S. regulates nuclear power. This has taken the form of a more risk-informed and performance-based approach. To encourage a sustained high level of safety performance of U.S. nuclear plants, important oversight processes have incorporated risk insights from quantitative risk analysis. Efforts also continue to revise regulations to focus requirements on plant programmes and activities that are most risk significant.

9.1.1.1 Fuel Cycle and Waste Management

All activities of the commercial nuclear fuel cycle are conducted in the United States, with the exception of spent fuel reprocessing which U.S. fuel cycle policy prohibits. A re-examination of reprocessing is included in the National Energy Policy of 2001 though, no commitment has been made. Each fuel cycle stage is subject to competition and supply from international sources which in many cases dominate the stage. At present the U.S. nuclear fuel supply is highly dependent on imports for mined uranium concentrates (80%), uranium conversion (48%), and enrichment (86%). Virtually all fuel fabrication requirements are met by domestic sources. The Energy Information Administration publishes data on www.eia.doe.gov/cneaf/nuclear/page/uran_enrich_fuel/uransum.html

9.1.2 Fuel Fabrication

Three companies (Framatome ANP, Global Nuclear Fuels, and Westinghouse) fabricate uranium fuel in the United States for light-water reactor fuel. Plants are located in Columbia, South Carolina; Wilmington, North Carolina; Richland, Washington; and Lynchburg, Virginia. Some product is exported to Japan.

9.1.3 Nuclear Waste Management

Commercial nuclear power reactors currently store most of their spent fuel on-site at the nuclear plant, although a small amount has been shipped to off-site facilities.

During 2002 Congress and the President approved plans to dispose of high-level waste (HLW) in a geological repository (www.ocrwm.doe.gov/ymp/index.shtml) in Nevada. The US Department of Energy (DOE) submitted a licence application for construction authorization for this repository to the NRC in late 2004.

The Office of Civilian Radioactive Waste Management (OCRWM) manages nuclear wastes for the U.S. Department of Energy. OCRWM programmes include:

- Programme management activities are administered from Washington, DC. Responsibilities include oversight of quality assurance, programme planning and administration, programme management and integration, external interactions, human resources, and the OCRWM budget.

- The Yucca Mountain site is located in Nye County, Nevada, approximately 100 miles northwest of Las Vegas. For two decades, the OCRWM conducted scientific and engineering investigations at Yucca Mountain to determine its suitability as a nuclear waste repository.

- Development of waste acceptance, storage and transportation systems. Activities also include interactions with other waste owners, generators and international waste management programmes.

9.1.4 Research and Development

Both private industry and the Federal Government conduct research and development (R&D) for the nuclear industry. Private companies actively investigate reactor technology, enrichment technology, and nuclear fuel design. One of the main institutions for private research funding is through the Electric Power Research Institute (www.my.epri.com). EPRI, through membership fees, conducts R&D in many nuclear-related areas as well as other areas of the electric power industry.

The Federal Government supports R&D through specific budget allocations for the Nuclear Regulatory Commission (www.nrc.gov) and through national bodies (e.g. www.energy.gov) operated by private agencies licensed by the U.S. DOE. DOE includes 26 laboratories and institutes, many of which are involved with the nuclear fuel cycle.

9.1.5 Human Resources Development

The United States shares the global trend of declining enrolments in nuclear engineering schools. The work force in the nuclear power industry is ageing and it is feared that many professional skills might vanish as the staff at nuclear power and research facilities retire. Without any active programme of construction in the nuclear power industry, it is not clear what level of trained personnel will be required by the industry in the future. The long term trend toward a decline in the number of university programmes offering nuclear engineering degrees ended in 2002 when two departments added new programmes.

The U. S. DOE's Office of Nuclear Energy, Science and Technology has an active programme to encourage the development of academic programmes related to nuclear power (www.nuclear.gov). The American Nuclear Society, a professional organisation, also promotes the improvement of academic work related to nuclear power at higher education institutions (www.ana.org).

9.1.6 Current Status of decommissioning in the USA

The majority of U.S. decommissioning activities occurs in two sectors: the commercial nuclear energy industry and the Federal Government. In addition, there are thousands of commercial facilities licensed to handle radioactive materials that are or may be required to undergo decommissioning.

The U.S. nuclear energy industry has considerable experience in decommissioning nuclear reactors. Since 1960, more than 70 test, demonstration and power reactors have been retired, most of them relatively small. The first commercial nuclear plant decommissioned was Shippingport, PA, in 1989; and 14 nuclear plants greater than 100 MW have been shutdown or decommissioned since then. Currently, 19 power reactors and 16 test/research reactors are permanently shutdown and undergoing decommissioning.

Approximately 300 materials licenses are terminated each year. Most of these license terminations are routine and the sites require little, if any, remediation to meet the NRC unrestricted release criteria. However, some present technical and policy challenges that require large expenditures of NRC staff resources, including a few complex materials sites have requested license termination under the restricted-use provisions of NRC regulations.

Additionally, during the course of nuclear weapons production and research and development (R&D) activities, the Federal Government built and used more than 20,000 facilities, including production reactors, research reactors, chemical processing facilities, uranium production facilities, plutonium production facilities, gaseous diffusion plants, and others.

Currently, the thrust of the Federal Government's environmental mission is to clean up the legacy left by nuclear weapons production and R&D. More than 10,000 facilities are now surplus as the result of changes to the United States Department of Energy (DOE) mission and/or facility obsolescence. Over 3,000 of these facilities are now slated for decommissioning, and there are significantly more that will be transitioned from operating status to cleanup status beginning in FY 2002. This inventory of facilities includes some of the largest, most complex facilities in the world. Many are contaminated with radioactive and hazardous substances and were built with materials such as asbestos and polychlorinated biphenyls, which are now tightly regulated. To date, more than 500 facilities have been decommissioned by the Department of Energy.

The status of all of the nuclear power plants in the USA is provided in the following tables:-

Table 1.1. Status of US Nuclear Power Plants

Station	Type	Net Capacity	Operator	Status	Reactor Supplier	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
ARKANSAS ONE-1	PWR	846	ENTERGY	Operational	B&W	01-Oct-68	06-Aug-74	17-Aug-74	19-Dec-74	
ARKANSAS-ONE-2	PWR	984	ENTERGY	Operational	CE	01-Jul-71	05-Dec-78	26-Dec-78	26-Mar-80	
BEAVER VALLEY-1	PWR	810	FIRSTENERGY	Operational	WEST	01-Jun-70	10-May-76	14-Jun-76	01-Oct-76	
BEAVER VALLEY-2	PWR	831	FIRSTENERGY	Operational	WEST	01-May-74	04-Aug-87	17-Aug-87	17-Nov-87	
BRAIDWOOD-1	PWR	1185	EXELON	Operational	WEST	01-Aug-75	29-May-87	12-Jul-87	29-Jul-88	
BRAIDWOOD-2	PWR	1177	EXELON	Operational	WEST	01-Aug-75	08-Mar-88	25-May-88	17-Oct-88	
BROWNS FERRY-1	BWR	1065	TVA	Operational	GE	01-May-67	17-Aug-73	15-Oct-73	01-Aug-74	
BROWNS FERRY-2	BWR	1113	TVA	Operational	GE	01-May-67	20-Jul-74	28-Aug-74	01-Mar-75	
BROWNS FERRY-3	BWR	1113	TVA	Operational	GE	01-Jul-68	08-Aug-76	12-Sept-76	01-Mar-77	
BRUNSWICK-1	BWR	820	PROGRESS	Operational	GE	01-Sept-69	08-Oct-76	04-Dec-76	18-Mar-77	
BRUNSWICK-2	BWR	811	PROGRESS	Operational	GE	01-Sept-69	20-Mar-75	29-Apr-75	03-Nov-75	
BYRON-1	PWR	1194	EXELON	Operational	WEST	01-Apr-75	02-Feb-85	01-Mar-85	16-Sept-85	
BYRON-2	PWR	1162	EXELON	Operational	WEST	01-Apr-75	09-Jan-87	06-Feb-87	21-Aug-87	
CALLAWAY-1	PWR	1143	AMERUE	Operational	WEST	01-Sept-75	02-Oct-84	24-Oct-84	19-Dec-84	
CALVERT CLIFFS-1	PWR	845	CONSTELL	Operational	CE	01-Jun-68	07-Oct-74	03-Jan-75	08-May-75	
CALVERT CLIFFS-2	PWR	840	CONSTELL	Operational	CE	01-Jun-68	30-Nov-76	07-Dec-76	01-Apr-77	
CATAWBA-1	PWR	1129	DUKE	Operational	WEST	01-May-74	07-Jan-85	22-Jan-85	29-Jun-85	
CATAWBA-2	PWR	1129	DUKE	Operational	WEST	01-May-74	08-May-86	18-May-86	19-Aug-86	
CLINTON-1	BWR	1017	AMERGEN	Operational	GE	01-Oct-75	27-Feb-87	24-Apr-87	24-Nov-87	
COLUMBIA-2	BWR	1108	EMERGYNW	Operational	GE	01-Aug-72	19-Jan-84	27-May-84	13-Dec-84	
COMANCHE PEAK-1	PWR	1084	TXU	Operational	WEST	01-Oct-74	03-Apr-90	24-Apr-90	13-Aug-90	
COMANCHE PEAK-2	PWR	1124	TXU	Operational	WEST	01-Oct-74	24-Mar-93	09-Apr-93	03-Aug-93	
COOPER	BWR	758	NPPD	Operational	GE	01-Jun-68	21-Feb-74	10-May-74	01-Jul-74	
CRYSTAL RIVER-3	PWR	842	PROGRESS	Operational	B&W	01-Jun-67	14-Jan-77	30-Jan-77	13-Mar-77	
DAVIS BESSE-1	PWR	873	FIRSTENERGY	Operational	B&W	01-Sept-70	12-Aug-77	28-Aug-77	31-Jul-78	
DIABLO CANYON-1	PWR	1087	PGEC	Operational	WEST	01-Aug-68	29-Apr-84	11-Nov-84	07-May-85	
DIABLO CANYON-2	PWR	1087	PGEC	Operational	WEST	01-Dec-70	19-Aug-85	20-Oct-85	13-Mar-86	
DONALD COOK-1	PWR	1000	IMPCO	Operational	WEST	01-Mar-69	18-Jan-75	10-Feb-75	27-Aug-75	
DONALD COOK-2	PWR	1060	IMPCO	Operational	WEST	01-Mar-69	10-Mar-78	22-Mar-78	01-Jul-78	
DRESDEN-2	BWR	850	EXELON	Operational	GE	01-Jan-66	07-Jan-70	13-Apr-70	09-Jun-70	
DRESDEN-3	BWR	850	EXELON	Operational	GE	01-Oct-66	31-Jan-71	22-Jul-71	16-Nov-71	

Table 1.1. Status of US Nuclear Power Plants continued

Station	Type	Net Capacity	Operator	Status	Reactor Supplier	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
DUANE ARNOLD-1	BWR	566	NUCMAN	Operational	GE	01-Jun-70	23-Mar-74	19-May-74	01-Feb-75	
ENRICO FERMI-2	BWR	1111	DETED	Operational	GE	01-May-69	21-Jun-85	21-Sept-86	23-Jan-88	
PEACH BOTTOM-2	BWR	1093	EXELON	Operational	GE	01-Jan-68	16-Sept-73	18-Feb-74	05-Jul-74	
PEACH BOTTOM-3	BWR	1093	EXELON	Operational	GE	01-Jan-68	07-Aug-74	01-Sept-74	23-Dec-74	
PERRY-1	BWR	1238	FIRSTENERGY	Operational	GE	01-Oct-74	06-Jun-86	19-Dec-86	18-Nov-87	
PILGRIM-1	BWR	667	ENTERGY	Operational	GE	01-Aug-68	16-Jun-72	19-Jul-72	01-Dec-72	
POINT BEACH-1	PWR	505	NUCMAN	Operational	WEST	01-Jul-67	02-Nov-70	06-Nov-70	21-Dec-70	
POINT BEACH-2	PWR	507	NUCMAN	Operational	WEST	01-Jul-68	30-May-72	02-Aug-72	01-Oct-72	
PRAIRIE ISLAND-1	PWR	525	NUCMAN	Operational	WEST	01-May-68	01-Dec-73	04-Dec-73	16-Dec-73	
PRAIRIE ISLAND-2	PWR	524	NUCMAN	Operational	WEST	01-May-69	17-Dec-74	21-Dec-74	21-Dec-74	
QUAD CITIES-1	BWR	762	EXELON	Operational	GE	01-Feb-67	18-Oct-71	12-Apr-72	18-Feb-73	
QUAD CITIES-2	BWR	855	EXELON	Operational	GE	01-Feb-67	26-Apr-72	23-May-72	10-Mar-73	
R.E. GINNA	PWR	498	RGE	Operational	WEST	01-Apr-66	08-Nov-69	02-Dec-69	01-Jul-70	
RIVER BEND-1	BWR	980	ENTERGY	Operational	GE	01-Mar-77	31-Oct-85	03-Dec-85	16-Jun-86	
SALEM-1	PWR	1111	PSEG	Operational	WEST	01-Jan-68	11-Dec-76	25-Dec-76	30-Jun-77	
SALEM-2	PWR	1110	PSEG	Operational	WEST	01-Jan-68	08-Aug-80	03-Jun-81	13-Oct-81	
SAN ONOFRE-2	PWR	1070	SCE	Operational	CE	01-Mar-74	26-Jul-82	20-Sept-82	08-Aug-83	
SAN ONOFRE-3	PWR	1080	SCE	Operational	CE	01-Mar-74	29-Aug-83	25-Sept-83	01-Apr-84	
SEABROOK-1	PWR	1161	FPL	Operational	WEST	01-Jul-76	13-Jun-89	29-May-90	19-Aug-90	
SEQUOYAH-1	PWR	1126	TVA	Operational	WEST	01-May-70	05-Jul-80	22-Jul-80	01-Jul-81	
SEQUOYAH-2	PWR	1125	TVA	Operational	WEST	01-May-70	05-Nov-81	23-Dec-81	01-Jun-82	
SHEARON HARRIS-1	PWR	900	PROGRESS	Operational	WEST	01-Jan-74	03-Jan-87	19-Jan-87	02-May-87	
SOUTH TEXAS-1	PWR	1264	STP	Operational	WEST	01-Sept-75	08-Mar-88	30-Mar-88	25-Aug-88	
SOUTH TEXAS-2	PWR	1265	STP	Operational	WEST	01-Sept-75	12-Mar-89	11-Apr-89	19-Jun-89	
ST LUCIE-1	PWR	839	FPL	Operational	CE	01-Jul-70	22-Apr-76	07-May-76	21-Dec-76	
ST LUCIE-2	PWR	839	FPL	Operational	CE	01-Jun-76	02-Jun-83	13-Jun-83	08-Aug-83	
SURRY-1	PWR	810	DOMINION	Operational	WEST	01-Jun-68	01-Jul-72	04-Jul-72	22-Dec-72	
SURRY-2	PWR	815	DOMINION	Operational	WEST	01-Jun-68	07-Mar-73	10-Mar-73	01-May-73	
SUSQUEHANNA-1	BWR	1105	PP&L	Operational	GE	01-Nov-73	10-Sept-82	16-Nov-82	08-Jun-83	
SUSQUEHANNA-2	BWR	1111	PP&L	Operational	GE	01-Nov-73	08-May-84	03-Jul-84	12-Feb-85	
THREE MILE ISLAND-1	PWR	816	AMERGEN	Operational	B&W	01-May-68	05-Jun-74	19-Jun-74	02-Sept-74	
TURKEYPOINT 3	PWR	693	FPL	Operational	WEST	1-Apr-67	20-Oct-72	2-Nov-72	14-Dec-72	
TURKEY POINT 4	PWR	693	FPL	Operational	WEST	1-Apr-67	11-Jun-73	21-Jun-73	7-Sep-73	
VERMONT YANKEE	BWR	506	ENTERGY	Operational	GE	1-Dec-67	24-Mar-72	20-Sep-72	30-Nov-72	

Table 1.1. Status of US Nuclear Power Plants continued

Station	Type	Net Capacity	Operator	Status	Reactor Supplier	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
VIRGIL C SUMMER 1	PWR	986	SCEG	Operational	WEST	1-Mar-73	22 Oct 82	16-Nov-82	1-Jan-84	
VOGTLE 1	PWR	1148	SOUTH	Operational	WEST	1-Aug-76	9-Mar-87	27-Mar-87	1-Jun-87	
VOGTLE 2	PWR	1149	SOUTH	Operational	WEST	1-Aug-76	28-Mar-89	10-Apr-89	20-May-89	
WATERFORD 3	PWR	1091	ENTERGY	Operational	CE	1-Nov-74	4-Mar-85	18-Mar-85	24-Sep-85	
WATTS BAR 1	PWR	1138	TVA	Operational	WEST	1-Dec-72	1-Jan-96	6-Feb-96	5-May-96	
WOLF CREEK	PWR	1170	WOLF	Operational	WEST	1-Jan-77	22-May-85	12-Jun-85	3-Sep-85	
MAIN YANKEE	PWR	860	MYAPC	Shut down	CE	1-Oct-68	23 Oct 72	8-Nov-72	28-Dec-72	Aug-97
MILLSTONE 1	BWR	641	DOMINION	Shut down	GE	1-May-66	26-Oct-70	29-Nov-70	1-Mar-71	Jul-98
HADDAM NECK	PWR	560	CYAPC	Shut down	WEST	1-May-64	24-Jul-67	7-Aug-67	1-Jan-68	4-Dec-96
BIG ROCK POINT	BWR	67	CPC	Shut down	GE	1-May-60	27-Sep-62	8-Dec-62	29-Mar-63	Aug-97
ZION 1	PWR	1040	EXELON	Shut down	WEST	1-Dec-68	19-Jun-73	28-Jun-73	31-Dec-73	Jan-98
ZION 2	PWR	1040	EXELON	Shut down	WEST	1-Dec-68	24-Dec-73	26-Dec-73	17-Sep-74	Jan-98
BONUS	BWR	17	DOE/PRWR	Shut down	GNEPRWRA	1-Jan-60	1-Jan-64	14-Aug-64		1-Jun-68
CVTR	PHWR	17	CVPA	Shut down	WEST	1-Jan-60	1-Mar-63	18-Dec-63		1-Jan-67
DRESDEN 1	BWR	197	EXELON	Shut down	GE	1-May-56	15-Oct-59	15-Apr-60	4-Jul-60	31-Oct-78
ELK RIVER	BWR	22	RCPA	Shut down	AC	1-Jan-59	1-Nov-62	24-Aug-63	1-Jul-64	1-Feb-68
ENRICO FERMI 1	FBR	65	DETED	Shut down	UEC	1-Aug-56	23-Aug-63	5-Aug-66		29-Nov-72
FORT ST VRAIN	HTGR	330	PSCC	Shut down	GA	1-Sep-68	31-Jan-74	11-Dec-76	1-Jul-79	29-Aug-89
HUMBOLDT BAY	BWR	63	PGEC	Shut down	GE	1-Nov-60	16-Feb-63	18-Apr-63	1-Aug-63	2-Jul-76
INDIAN POINT 1	PWR	257	CONED	Shut down	B&W	1-May-56	2-Aug-62	16-Sep-62	1-Oct-62	31-Oct-74
LACROSSE	BWR	48	DPC	Shut down	AC	1-Mar-63	11-Jul-67	26-Apr-68	7-Nov-69	30-Apr-87
PATHFINDER	BWR	59	NSP	Shut down	AC	1-Jan-59	1-Jan-64	25-Jul-66		1-Oct-67
PEACH BOTTOM 1	HTGR	40	EXELON	Shut down	GA	1-Feb-62	3-Mar-66	27-Jan-67	1-Jun-67	1-Nov-74
RANCHO SECO 1	PWR	873	SMUD	Shut down	B&W	1-Apr-69	16-Sep-74	13-Oct-74	17-Apr-75	7-Jun-89
SAN ONOFRE 1	PWR	436	SCE	Shut down	WEST	1-May-64	14-Jun-67	16-Jul-67	1-Jan-68	30-Nov-92
THREE MILE ISLAND 2	PWR	880	GPU	Shut down	B&W	1-Nov-69	27-Mar-78	21-Apr-78	30-Dec-78	28-Mar-79
TROJAN	PWR	1095	PORTGE	Shut down	WEST	1-Feb-70	15-Dec-75	23-Dec-75	20-May-76	9-Nov-92
YANKEE NPS	PWR	167	YAEC	Shut down	WEST	1-Nov-57	19-Aug-60	10-Nov-60	1-Jul-61	1-Oct-91

9.1.7. Location of US Licensed Nuclear Sites

The following DOE and NRC websites provide maps of:

- Power reactor sites
- Research and test reactor sites
- Major US fuel cycle facilities
- DOE sites and facilities

Listings of power reactor units, research and test reactors and other fuel cycle facilities together with a wealth of information about the status are available on these websites:

www.lm.doe.gov/land/sites/doe_sites.htm

www.nrc.gov/reactors/operating/map-powe-reactors.html

www.nrc.gov/what-we-do/regulatory/decommissioning/complex-sites.html

9.1.8. USA Nuclear Sector Customers and Stakeholders

9.1.8.1 Government

Federal Government policies concerning commercial nuclear power are carried out through the US Department of Energy (DOE). Active DOE programmes involve new reactor technologies, initiation of power plant construction and radioactive waste management.

Various Federal agencies and commercial entities are responsible for decommissioning activities, regulations, and oversight, including the Department of Energy (DOE), the commercial nuclear energy industry, the Army Corps of Engineers (ACE), the Nuclear Regulatory Commission (NRC), the Environmental Protection Agency (EPA), the Defence Nuclear Facilities Safety Board (DNFSB) and the U.S. states.

The **DOE** has lead Federal agency responsibility for conducting the decommissioning of former nuclear weapons production and R&D facilities. In other words, the DOE is responsible for project planning, budgeting and executing decommissioning for these facilities, in coordination with regulators and stakeholders. Some of the DOE cleanup projects in the Formerly Utilized Sites Remedial Action Program (FUSRAP) are now implemented by ACE. The DOE and commercial nuclear energy industry must also co-ordinate with state regulators. Specific states are involved in oversight of DOE cleanups in conjunction with the EPA through the CERCLA

and RCRA processes. Certain states, called Agreement States, have entered into agreements with the NRC that give them the authority to license and inspect by-product, source, or special nuclear materials (in quantities not to exceed critical mass) used or possessed within their borders.

NRC licensed facilities and commercial nuclear power plants consist of public utilities that own and operate nuclear power plants and privately owned commercial facilities. The owners are responsible for the decommissioning planning, funding, and implementation for these plants and facilities.

The **NRC** regulates the planning, funding, and execution of decommissioning activities at nuclear power plants and facilities that hold NRC licenses.

When decommissioning or decontaminating a facility, the DOE's lead agency responsibility must be coordinated with **EPA** oversight and remedy selection authority. The EPA focuses on key documents and decision points in the decommissioning process. EPA also has oversight over commercial nuclear energy and other industry decommissioning activities on a limited basis. The **DNFSB** is responsible for independent, external oversight of all activities in DOE's nuclear weapons complex affecting nuclear health and safety.

Web sites for all organisations involved are included in section 6 of this annexe.

9.1.8.2 Regulators

The Nuclear Regulatory Commission (NRC) is the primary agency involved in nuclear safety regulation. This regulatory responsibility includes safety evaluations and rules related to waste management. The actual management of nuclear waste is the responsibility of the U.S. Department of Energy which handles waste through its Office of Civilian Radioactive Waste Management (OCRWM). The primary intended ultimate destination for long-lived, high level civilian radioactive waste will be the Yucca Mountain Project in Nevada. A smaller high level waste (HLW) facility already exists in Carlsbad, New Mexico. The selection of the Yucca Mountain Project site remains a controversial issue with state and local authorities in Nevada taking the lead role in judicial and legislative challenges to the site's selection.

9.1.8.3 Main Site Operators/ Owners & Licensees

As stated above, the actual management of nuclear waste is the responsibility of the U.S. Department of Energy which handles waste through its Office of Civilian Radioactive Waste Management (OCRWM). Information on all its sites can be found at:-
www.lm.doe.gov/land/sites/doe_sites

The US DOE Office of Civilian Radioactive Waste Management operates a programme assigned to develop and manage a federal system for disposing of spent nuclear fuel from commercial reactors and high level radioactive waste from national defence activities. Much useful information is available on its web site at:-
www.ocrwm.doe.gov

The US DOE Office of Legacy Management is responsible for long term care of legacy liabilities of former nuclear weapons production sites after completion of the environmental cleanup effort. Useful information is available at:- www.lm.doe.gov

Table 3.1 Nuclear Power Plant Operators

Code	Operator Name
AMERUE	AMEREN (UNION ELECTRIC)
AMERGEN	AMERGEN ENERGY CO.
ANPP	ARIZONA NUCLEAR POWER PROJECT
CONED	CONSOLIDATED EDISON CO.
CONSTELL	CONSTELLATION NUCLEAR GROUP
CPC	CONSUMERS POWER CO.
CVPA	CAROLINAS-VIRGINIA NUCLEAR POWER ASSOC
CYAPC	CONNECTICUT YANKEE ATOMIC POWER CO.
DETED	DETROIT EDISON CO.
DOE/PRWR	DOE & PUERTO RICO WATER RESOURCES
DOMINION	DOMINION GENERATION
DPC	DAIRYLAND POWER COOPERATIVE
DUKE	DUKE POWER CO.
ENERGYNW	ENERGY NORTHWEST
ETERGY	ENTERGY NUCLEAR
EXELON	EXELON GENERATION LLC
FIRSTENERGY	
FPL	FLORIDA POWER & LIGHT CO.
GPU	GENERAL PUBLIC UTILITIES
IMPCO	INDIANA MICHIGAN POWER CO.
MYAPC	MAINE YANKEE ATOMIC POWER CO.
NAES	NORTH ATLANTIC ENERGY SERVICE CORP.
NPPD	NEBRASKA PUBLIC POWER DISTRICT
NUCMAN	NUCLEAR MANAGEMENT CO.
NSP	NORTHERN STATES POWER

Code	Operator Name
OPPD	OMAHA PUBLIC POWER DISTRICT
PGEC	PACIFIC GAS & ELECTRIC CO.
PORTGE	PORTLAND GENERAL ELECTRIC CO.
PP&L	PENNSYLVANIA POWER & LIGHT CO.
PROGRESS	PROGRESS ENERGY
PSCC	PUBLIC SERVICE CO. OF COLORADO
PSEG	PUBLIC SERVICE ELECTRIC & GAS CO.
RCPA	RURAL COOPERATIVE POWER ASSOC.
RGE	ROCHESTER GAS & ELECTRIC CORP.
SCE	SOUTHERN CALIFORNIA EDISON
SCEG	SOUTH CAROLINA ELECTRIC & GAS CO.
SMUD	SACRAMENTO MUNICIPAL UTILITY DISTRICT
SOUTH	SOUTHERN NUCLEAR OPERATING CO.
STP	STP NUCLEAR OPERATING CO.
TXU	TXU ELECTRIC GENERATION CO.
TVA	TENNESSEE VALLEY AUTHORITY
VYNPC	ERMONT YANKEE NUCLEAR POWER CORP.
WOLF	WOLF CREEK NUCLEAR OPERATION CORP.
YAEC	YANKEE ATOMIC ELECTRIC CO.

Note: Web site details for most of the above operators are available in section 9.1.4.3.

9.1.8.4 Funding Arrangements

9.1.8.4.1 The Commercial Sector

NRC licensed facilities and commercial nuclear power plants are responsible for funding their decommissioning activities through rates charged to utility customers. NRC funding requirements are specifically related to that portion of a nuclear plant that has been contaminated by radioactive material. The NRC does not require companies to include funds for dismantling buildings and facilities (such as office buildings and switchyards) that do not pose a radiation hazard to workers or the public.

In October 2003 the NRC published a new regulation that changed the requirements for decommissioning funding for materials facilities.

The changes are in four areas:

1. large sealed source licensees (large irradiators) are no longer able to use the certification amount in NRC regulations as a basis for financial assurance, and would have to base their financial assurance on a site-specific decommissioning cost estimate;
2. all waste broker licensees must provide financial assurance and would not be permitted to use the certification amounts;
3. the certification amount for all licensees is increased by 50 percent; and
4. licensees using a decommissioning cost estimate must update it at least every 3 years.

The NRC requires that companies establish a decommissioning fund for each reactor. The company must annually review the amount of money required for decommissioning and the adequacy of the fund being used to accumulate it. The size of the fund is adjusted periodically to account for changes in the cost of labour, energy and low-level waste disposal, and to take into account technological advancements.

The NRC requires companies to have at least $164 million available to decommission a full-size pressurized water reactor and $211 million to decommission a full-size boiling water reactor. The NRC provides guidance on how to calculate the minimum amount required.

In light of the changing nature of the electric power industry – moving from a regulated, monopoly structure to a more competitive business – the NRC amended its decommissioning trust fund requirements to ensure they are appropriate in the new business environment. The NRC approved the new rule in 1998 "to reflect conditions expected from rate deregulation of the electric power industry." In short, the rule:

- Identifies which licensees may use an external sinking fund to generate adequate money for decommissioning.

- Describes other acceptable decommissioning financial assurance mechanisms.

- Requires nuclear plant licensees to report the status of their decommissioning funds to the NRC every two years (annually during a plant's last five years of planned operation).

9.1.8.4.2 Funding for DOE

Congress appropriates funds for the DOE's Environmental Management (EM) Programme. The EM programme is structured to accomplish cleanup of DOE sites throughout the country.

Decommissioning activities are included with other site cleanup activities and generally are funded as separate projects. However, some small decommissioning projects on contaminated areas can be included as a component of a remedial action project to cleanup those areas.

Funding for the facilities used to enrich uranium for use in the Federal Government and the commercial nuclear energy industry is provided for separately. The nation's three gaseous diffusion plants are located at Portsmouth, Ohio; Paducah, Kentucky; and the East Tennessee Technology Park (ETTP) (formerly K-25) in Oak Ridge, Tennessee. The funding for decommissioning enrichment facilities is shared between DOE and the commercial sector and is provided by each entity in proportion to facility usage of enrichment services.

Cleanup responsibilities include decontamination and decommissioning, remedial actions, waste management, landlord requirements and surveillance and maintenance activities associated with pre-existing conditions at the plants.

The overall DOE Environmental Management programme budget is approximately $6 billion per year. Deactivation and Decommissioning activities are currently less than ten percent of the annual funding. As site cleanup progress continues and additional facilities are transferred into the cleanup programme the proportion of funds for deactivation and decommissioning will increase.

9.1.9. US Nuclear Sites, Decommissioning Status & Programmes

For full details of the status of the whole US decommissioning programme, including power reactors, research and test reactors undergoing decommissioning, see the 2004 Annual Report of the US NRC "Status of the Decommissioning Programme" available at :- www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1814/sr1814.pdf.

9.1.9.1 Decommissioning Status for Shut Down Power Reactors

A table providing the decommissioning status for shutdown power reactors (as of Jan 2004) is available at:
www. rc.gov/reading-rm/doc-collections/fact-sheets/decommissioning.html#table1.

9.1.9.2 Map of Decommissioning Sites

A map of the USA showing all sites undergoing decommissioning is available at:
www.nrc.gov/@info-finder/decommissioning.html

Click on link to map of decommissioning sites.

9.1.9.3 Main Nuclear Site Operators

The web sites below of all the main site operators and owners of the nuclear power plants in the US and provide information on the plant status and information for suppliers. The sites they operate can be found by reference to table 1 of this report or through their web site:-

Ameren UE	www.ameren.com
American Electric Power (AEP)	www.aep.com/
Constellation	www.constellation.com
Detroit Edison	www.detroitedison.com
Dominion Nuclear	www.dom.com/about/stations/nuclear/index.jsp
Duke Power	www.duke-energy.com
Energy Northwest	www.energy-northwest.com
Entergy Nuclear	www.entergy-nuclear.com
Exelon	/www.exeloncorp.com
First Energy	www.firstenergycorp.com
FPL Nuclear	www.fpl.com
Nebraska Public Power District	www.nppd.com
Nuclear Management Co.	www.nmcco.com
Omaha Public Power District	www.oppd.com

Pacific Gas & Electric	www.pge.com
Pennsylvania Power & Light	www.pplweb.com
Pinnacle West	www.pinnaclewest.com
Progress Energy	www.progressenergy.com
PSE&G	www.pseg.com
Scana	www.scana.com
South Texas Nuclear Operating Company	www.stpnoc.com
Southern Californian Edison	www.sce.com
Southern Nuclear Operations	www.southerncompany.com
Tennessee Valley Authority (TVA)	www.tva.gov
TXU	www.txu.com/us
Wolf Creek Nuclear Operating Corporation	www.wcnoc.com

9.1.9.4. USA Companies in the Nuclear Sector

9.1.9.4.1. Main DOE Contractors

A full list of DOE contractor organisations together with links to their websites can be found at the web site below including Bechtel, CH2MHill, Fluor Corporation, Westinghouse etc:-
www.lm.doc.gov

9.1.9.4.2. Some Hardware Manufactures/Vendors and Service providers servicing the US nuclear industry include:-

Canberra (US based company)	www.canberra.com
GE Reuter-Stokes (General Electric)	www.ge.com
NFS Radiation Protection Systems (NFS-RPS)	www.nfsrps.com
Framatome Technologies Group (FTG)	www.framatech.com
World Nuclear Fuel Market (WNFM) Consultants/Engineering	www.wnfm.com

9.1.9.4.3. Consultancy and Engineering Companies

Electric Power Services Inc.	www.epsint.com
Engineering Information Inc. (commercial Internet Portal)	www.ei.org
General Atomics	www.gat.com
NAC International	www.nacintl.com
New York Nuclear and Washington Nuclear	www.nynco.com
The Uranium Exchange Company	www.uxc.com
Westinghouse BNFL	www.westinghouse.com
BNFL Inc. (U.S. subsidiary of British Nuclear Fuels plc)	www.bnfl.com
Compagnie Générale des Matières Nucléaires COGEMA)	www.cogema-inc.com
NUKEM Nuclear Technologies	www.nukem.com
Welding Services Inc.	www.weldingservices.com

9.1.9.4.4. Notes on Equipment and Service Suppliers

A large number of companies in the U.S. provide equipment and services to the nuclear power industry. These services cover the entire nuclear fuel cycle spectrum, from suppliers of main components to providers of routine equipment and services found in most power plants. Reprocessing is not available in the U.S. Steam generators for PWRs and some high quality steel castings are no longer made in the United States for nuclear reactors. Domestic suppliers in the U.S. must often compete with imports. This has resulted in the slow growth of nuclear plant construction and the internationalisation of the nuclear energy business. The American Nuclear Society's annual Buyer's Guide, published in their journal Nuclear News (www.ans.org) provides a partial list of equipment and service providers to the nuclear industry.

To help assure high quality products, the American Society of Mechanical Engineers (ASME) certifies nuclear equipment suppliers. To obtain a nuclear certificate of authorisation, a company must comply with quality assurance requirements set forth by the ASME. This programme is open to foreign companies. Presently over 200 foreign and U.S. companies hold ASME nuclear certificates of authorisation.

Table 5.1 Nuclear Steam Supply System Suppliers

CODE	NSSS SUPPLIER NAME
AC	ALLIS CHALMERS
B&W	BABCOCK & WILCOX CO.
CE	COMBUSTION ENGINEERING CO.
GA	GENERAL ATOMIC CORP.
GE	GENERAL ELECTRIC COMPANY (US)
GNEPRWRA	GENERAL NUCLEAR ENGINEERING & PUERTO RICO WATER RESOURCES
UEC	UNITED ENGINEERS AND CONTRACTORS
WEST	WESTINGHOUSE ELECTRIC CORPORATION

9.1.9.5. Other Information

9.1.9.5.1. Sources of Information

Department of Energy
Freedom of Information Act Reading Room
Room 1E-190, Forrestal Building
Washington, DC 20585
Telephone: (202) 586 3142
Fax: (202) 586 0575

Home Pages:

Department of Energy
www.energy.gov

Office of Environmental Management (EM)
www.em.doe.gov

EM Decommissioning
www.em.doe.gov/dd

EM Deactivation
www.em.doe.gov/em60/deactivation

Deactivation and Decommissioning Focus Area (technology)
www.netl.doe.gov/dd/

Office of Environment, Safety and Health
http://tis-nt.eh.doe.gov/dd/

Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460
Telephone: (202) 260-2090

Home Pages:

Environmental Protection Agency
www.epa.gov/radiation

RCRA, Superfund & EPCRA Hotline
www.epa.gov/epaoswer/hotline/index

Nuclear Regulatory Commission
Public Document Room
11555 Rockville Pike
Rockville, Maryland 20852
Telephone: (800) 397 4209
Fax: (301) 415 3548

Home Page: www.nrc.gov

Defence Nuclear Facilities Safety Board
Post Office Box 7887
Washington, D. C. 20044-7887
Telephone: 800 788 4016

Home Page: www.dnfsb.gov/

Nuclear Energy Institute
(The Nuclear Energy Institute is the commercial nuclear energy industry's Washington-based policy organisation)
Suite 400, 1776 I Street N.W.
Washington, DC 20006-3708
Telephone: (202) 739 8000

Home Page: www.nei.org/

Nuclear Research Institutes
Argonne National Laboratory www.anl.gov
Armed Forces Radiobiology Research Institute (AFRRI)
www.afrri.usuhs.mil/

Brookhaven National Laboratory	www.bnl.gov/
Electric Power Research Institute	www.epri.com/
Idaho National Engineering Laboratory	www.inel.gov/
Lawrence Berkeley Laboratory	www.lbl.gov/
Lawrence Livermore National Laboratory	www.llnl.gov/
Los Alamos National Laboratory	www.lanl.gov/worldview/
Los Alamos Neutron Science Centre (LANSCE)	www.lansce.lanl.gov/index_ext
Oak Ridge National Laboratory	www.ornl.gov/ornlhome/home
Sandia National Laboratory	www.sandia.gov/
Savannah River Site	www.srs.gov/

Professional Organisations

American Nuclear Society (ANS)	www.ans.org/
Federation of American Scientists (FAS)	www.fas.org/
Nuclear Energy Institute	www.nei.org

9.2 French Nuclear Decommissioning Market Summary

9.2.1 Introduction & Current Status

The majority of French decommissioning activities are taking place in two sectors, civil nuclear facilities and those nuclear facilities dedicated to defence. In France there are four major civilian operators:

- EDF (Electricité de France)
- COGEMA (Compagnie Générales des Matières Nucléaires)
- CEA (Commissariat à l'Energie Atomique)
- ANDRA (Agence Nationale pour les Déchets Radioactifs)

Nuclear energy provides France with nearly 80% of its electricity. Presently there are 58 operating nuclear power plants (PWR's) operated by EDF and all of the gas cooled graphite nuclear power plants (6 units) have been shutdown, including Superphenix, a fast breeder reactor. The fuel cycle industry is run by COGEMA which operates chemical reprocessing facilities, uranium production facilities, gaseous diffusion plants, and others. In France, most of the nuclear R & D installations are run by the CEA. Many installations have already been dismantled, are presently being dismantled or are on a waiting list (research reactors, laboratories, pilot plants). Since 1991 ANDRA has been responsible for research and operation of the waste disposal centres (LLW, MLW, HLW and VLLW). The first repository for waste containing short lived radio nuclides (CM Centre de la Manche) was closed in 1994 after 25 years of operation with about 530 000 m^3 of waste having been disposed of. The Aube centre (CA) came into operation in 1991 and has a capacity of 1 000 000 m^3, ANDRA has opened a disposal site for VLLW, close to the Aube centre, in 2003.

The share of nuclear power in the French electricity supply has reached its technical and economic maximum, amounting to about 63,000 MWe. It consists of fifty-nine units, fifty-eight being pressurized water reactors (thirty four 900 MWe, twenty 1300 MWe, and four 1450's), all constructed by the French manufacturer Framatome, and the 230 MWe fast breeder reactor, Phenix.

The nuclear plants accounted for 401 TWh in 2001 (over 75% of total electricity production), making France the world's second largest nuclear power producer. Table 1 lists the status of the power plants. Nuclear power generation represents about one third of total primary energy supply, and over 80% of the domestic energy production in France, making EDF by far the largest nuclear operator and electricity producer in the world.

Table 1. Status of Nuclear Power Plants

Station	Type	Net Capacity	Operator	Status	Reactor Supplier	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
BELLEVILLE-1	PWR	1310	EDF	Operational	FRAM	01-May-80	09-Sep-87	14-Oct-87	01-Jun-88	
BELLEVILLE-2	PWR	1310	EDF	Operational	FRAM	01-Aug-80	25-May-88	06-Jul-88	01-Jan-89	
BLAYAIS-1	PWR	910	EDF	Operational	FRAM	01-Jan-77	20-May-81	12-Jun-81	01-Dec-81	
BLAYAIS-2	PWR	910	EDF	Operational	FRAM	01-Jan-77	28-Jun-82	17-Jul-82	01-Feb-83	
BLAYAIS-3	PWR	910	EDF	Operational	FRAM	01-Apr-78	29-Jul-83	17-Aug-83	14-Nov-83	
BLAYAIS-4	PWR	910	EDF	Operational	FRAM	01-Apr-78	01-May-83	16-May-83	01-Oct-83	
BUGEY-2	PWR	910	EDF	Operational	FRAM	01-Nov-72	20-Apr-78	10-May-78	01-Mar-79	
BUGEY-3	PWR	880	EDF	Operational	FRAM	01-Sep-73	31-Aug-78	21-Sep-78	01-Mar-79	
BUGEY-4	PWR	880	EDF	Operational	FRAM	01-Jun-74	17-Feb-79	08-Mar-79	01-Jul-79	
BUGEY-5	PWR	900	EDF	Operational	FRAM	01-Jul-74	15-Jul-79	31-Jul-79	03-Jan-80	
CATTENOM-1	PWR	1300	EDF	Operational	FRAM	29-Oct-79	24-Oct-86	13-Nov-86	01-Apr-87	
CATTENOM-2	PWR	1300	EDF	Operational	FRAM	28-Jul-80	07-Aug-87	17-Sep-87	01-Feb-88	
CATTENOM-3	PWR	1300	EDF	Operational	FRAM	15-Jun-82	16-Feb-90	06-Jul-90	01-Feb-91	
CATTENOM-4	PWR	1300	EDF	Operational	FRAM	28-Sep-83	04-May-91	27-May-91	01-Jan-92	
CHINON-B-1	PWR	920	EDF	Operational	FRAM	01-Mar-77	28-Oct-82	30-Nov-82	01-Feb-84	
CHINON-B-2	PWR	920	EDF	Operational	FRAM	01-Mar-77	23-Sep-83	29-Nov-83	01-Aug-84	
CHINON-B-3	PWR	920	EDF	Operational	FRAM	01-Oct-80	18-Sep-86	20-Oct-86	04-Mar-87	
CHINON-B-4	PWR	920	EDF	Operational	FRAM	01-Feb-81	13-Oct-87	14-Nov-87	01-Apr-88	
CHOOZ-B-1	PWR	1455	EDF	Operational	FRAM	01-Jan-84	25-Jul-96	30-Aug-96	15-May-00	
CHOOZ-B-2	PWR	1455	EDF	Operational	FRAM	31-Dec-85	10-Mar-97	09-Apr-97	29-Sep-00	
CIVAUX-1	PWR	1450	EDF	Operational	FRAM	15-Oct-88	29-Nov-97	24-Dec-97	28-Jan-02	
CIVAUX-2	PWR	1450	EDF	Operational	FRAM	01-Apr-91	27-Nov-99	24-Dec-99	23-Apr-02	
CRUAS-1	PWR	915	EDF	Operational	FRAM	01-Aug-78	02-Apr-83	29-Apr-83	2-Apr-84	
CRUAS-2	PWR	915	EDF	Operational	FRAM	15-Nov-78	01-Aug-84	06-Sep-84	01-Apr-85	
CRUAS-3	PWR	915	EDF	Operational	FRAM	15-Apr-79	09-Apr-84	14-May-84	10-Sep-84	
CRUAS-4	PWR	915	EDF	Operational	FRAM	01-Oct-79	01-Oct-84	27-Oct-84	11-Feb-85	
DAMPIERRE-1	PWR	890	EDF	Operational	FRAM	01-Feb-75	15-Mar-80	23-Mar-80	10-Sep-80	
DAMPIERRE-2	PWR	890	EDF	Operational	FRAM	01-Apr-75	05-Dec-80	10-Dec-80	16-Feb-81	
DAMPIERRE-3	PWR	890	EDF	Operational	FRAM	01-Sep-75	25-Jan-81	30-Jan-81	27-May-81	
DAMPIERRE-4	PWR	890	EDF	Operational	FRAM	01-Dec-75	05-Aug-81	18-Aug-81	20-Nov-81	
FESSENHEIM-1	PWR	880	EDF	Operational	FRAM	01-Sep-71	07-Mar-77	06-Apr-77	30-Dec-77	
FESSENHEIM-2	PWR	880	EDF	Operational	FRAM	01-Feb-72	27-Jun-77	07-Oct-77	18-Mar-78	
FLAMANVILLE-1	PWR	1330	EDF	Operational	FRAM	01-Dec-79	29-Sep-85	04-Dec-85	01-Dec-86	
FLAMANVILLE-2	PWR	1330	EDF	Operational	FRAM	01-May-80	12-Jun-86	18-Jul-86	09-Mar-87	
GOLFECH-1	PWR	1310	EDF	Operational	FRAM	17-Nov-82	24-Apr-90	07-Jun-90	01-Feb-91	

Station	Type	Net Capacity	Operator	Status	Reactor Supplier	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
GOLFECH-2	PWR	1310	EDF	Operational	FRAM	01-Oct-84	21-May-93	18-Jun-93	01-Jan-94	
GRAVELINES-1	PWR	915	EDF	Operational	FRAM	01-Feb-75	21-Feb-80	13-Mar-80	01-Dec-80	
GRAVELINES-2	PWR	915	EDF	Operational	FRAM	01-Mar-75	02-Aug-80	26-Aug-80	01-Dec-80	
GRAVELINES-3	PWR	915	EDF	Operational	FRAM	01-Dec-75	30-Nov-80	12-Dec-80	01-Jun-81	
GRAVELINES-4	PWR	915	EDF	Operational	FRAM	01-Apr-76	31-May-81	14-Jun-81	01-Oct-81	
GRAVELINES-5	PWR	915	EDF	Operational	FRAM	01-Oct-79	05-Aug-84	28-Aug-84	15-Jan-85	
GRAVELINES-6	PWR	915	EDF	Operational	FRAM	01-Oct-79	21-Jul-85	01-Aug-85	25-Oct-85	
NOGENT-1	PWR	1310	EDF	Operational	FRAM	26-May-81	12-Sep-87	21-Oct-87	24-Feb-88	
NOGENT-2	PWR	1310	EDF	Operational	FRAM	01-Jan-82	04-Oct-88	14-Dec-88	01-May-89	
PALUEL-1	PWR	1330	EDF	Operational	FRAM	15-Aug-77	13-May-84	22-Jun-84	01-Dec-85	
PALUEL-2	PWR	1330	EDF	Operational	FRAM	01-Jan-78	11-Aug-84	14-Sep-84	01-Dec-85	
PALUEL-3	PWR	1330	EDF	Operational	FRAM	01-Feb-79	07-Aug-85	30-Sep-85	01-Feb-86	
PALUEL-4	PWR	1330	EDF	Operational	FRAM	01-Feb-80	29-Mar-86	11-Apr-86	01-Jun-86	
PENLY-1	PWR	1330	EDF	Operational	FRAM	01-Sep-82	01-Apr-90	04-May-90	01-Dec-90	
PENLY-2	PWR	1330	EDF	Operational	FRAM	01-Aug-84	10-Jan-92	01-Feb-92	01-Nov-92	
PHENIX	FBR	233	CEA/EDF	Operational	CNCLNEY	01-Nov-68	31-Aug-73	13-Dec-73	14-Jul-74	
ST. ALBAN-1	PWR	1335	EDF	Operational	FRAM	29-Jan-79	04-Aug-85	30-Aug-85	01-May-86	
ST. ALBAN-2	PWR	1335	EDF	Operational	FRAM	31-Jul-79	07-Jun-86	03-Jul-86	01-Mar-87	
ST. LAURENT-B-1	PWR	890	EDF	Operational	FRAM	01-May-76	04-Jan-81	21-Jan-81	01-Aug-83	
ST. LAURENT-B-2	PWR	890	EDF	Operational	FRAM	01-Jul-76	12-May-81	01-Jun-81	01-Aug-83	
TRICASTIN-1	PWR	880	EDF	Operational	FRAM	01-Nov-74	21-Feb-80	31-May-80	01-Dec-80	
TRICASTIN-2	PWR	880	EDF	Operational	FRAM	01-Dec-74	22-Jul-80	07-Aug-80	01-Dec-80	
TRICASTIN-3	PWR	880	EDF	Operational	FRAM	01-Apr-75	29-Nov-80	10-Feb-81	11-May-81	
TRICASTIN-4	PWR	880	EDF	Operational	FRAM	01-May-75	31-May-81	12-Jun-81	01-Nov-81	
BUGEY-1	GCR	540	EDF	Shut Down	VARIOUS	01-Dec-65	21-Mar-72	15-Apr-72	01-Jul-72	27-May-94
CHINON-A1	GCR	70	EDF	Shut Down	LEVIVIER	01-Feb-57	16-Sep-62	14-Jun-63	01-Feb-64	16-Apr-73
CHINON-A2	GCR	210	EDF	Shut Down	LEVIVIER	01-Aug-59	17-Aug-64	24-Feb-65	24-Feb-65	14-Jun-85
CHINON-A3	GCR	480	EDF	Shut Down	GTM	01-Mar-61	01-Mar-66	04-Aug-66	04-Aug-66	15-Jun-90
CHOOZ-A (ARDENNES)	PWR	310	SENA	Shut Down	A/F/W	01-Jan-62	18-Oct-66	03-Apr-67	15-Apr-67	30-Oct-91
CREYS-MALVILLE	FBR	1200	NERSA	Shut Down	ASPALDO	13-Dec-76	07-Sep-85	14-Jan-86	31-Dec-98	
EL-4 (MONTS D'ARREE)	HWGCR	70	EDF	Shut Down	GAAA	01-Jul-62	23-Dec-66	09-Jul-67	01-Jun-68	31-Jul-85
G-2 (MARCOULE)	GCR	38	COGEMA	Shut Down	SACM	01-Mar-55	21-Jul-58	22-Apr-59	22-Apr-59	02-Feb-80
G-3 (MARCOULE)	GCR	38	COGEMA	Shut Down	SACM	01-Mar-56	11-Jun-59	04-Apr-60	04-Apr-60	20-Jun-84
ST. LAURENT-A1	GCR	480	EDF	Shut Down	VARIOUS	01-Oct-63	07-Jan-69	14-Mar-69	01-Jun-69	18-Apr-90
ST. LAURENT-A2	GCR	515	EDF	Shut Down	VARIOUS	01-Jan-66	04-Jul-71	09-Aug-71	01-Nov-71	27-May-92

9.2.2. Location of French Nuclear Licensed Sites

For details of the location of French nuclear sites see the map under item 1 of chapter 12 of the Regulators Annual Report for 2004 at:
www.asn.gouv.fr/

See drop down box in Documents Available in English on right hand side.

9.2.3. Nuclear Sector, Customers and Stakeholders

Government

DGEMP (General Directorate for Energy and Raw Materials), Ministry of Industry.

DGSNR (General Directorate for Nuclear Safety and Radioprotection), Ministries of Industry, Health and Ecology and Sustainable Development.

DRIRE (Regional Directorates for Industry, Research and Environment)

Full details of the roles of the relative organisations above are provided on their web sites included in section 6 of this report, "Information Sources".

Regulators

The DGSNR (General Directorate for Nuclear Safety and Radioprotection) was created in 2002 and relies on the State's decentralised departments. The DGSNR together with the State's decentralised departments, for which it organises and supervises the activities in its area of competence, is referred to as the "Nuclear Safety Authority" (ASN). In addition to nuclear safety and licensing procedures, DGSNR retains responsibility for radiological protection research and co-ordinating public information on nuclear safety. At the local level, DGSNR's actions are implemented through the nuclear divisions of the Regional Directorates for Industry, Research and Environment (DRIRE). These Directorates survey the nuclear installations and monitor reactor shut downs and pressurised components. DGSNR is assisted in its decision making by the Institute de Radio-Protection and Nuclear Safety Nucleaire (IRSN). The IRSN can also undertake studies or research on protection and nuclear safety problems.

For details of the structure of the Nuclear Safety Authority and technical support organisations and the supervision of nuclear safety and radiation protection in France, please refer to the Annual Report for 2004, chapters 2-5 at:
www.asn.gouv.fr/

See drop down box in documents available in English on right hand side.

Other Institutions

IRSN (Radioprotection and Nuclear Safety Institute) – research and development

CEA (Atomic Energy Commission)

Main Site Operators/Licensees

Nuclear power plants operator:
EDF (Electricité de France)

Nuclear plants construction:
Framatome-ANP, Jeumont, Alstom

Fuel cycle industry, including engineering and services: AREVA group
Mining: Cogema
Conversion: Comurhex
Enrichment: Eurodif
Fuel fabrication: Framatome, (UO), Cogema (MOX)
Reprocessing and packaging: Cogema
Used fuel storage: ANDRA

Funding Arrangements

The owners of French nuclear facilities calculate liabilities (all cleanup responsibilities including decontamination, remedial actions, waste management, landlord requirements and surveillance and maintenance activities) each year and set aside provisions in the company's accounts. Each year, the accumulated provisions to date are revalued to cover inflation and a real rate of return and the provision adjusted. The cost of revaluation is taken out of the companies' profits and added to the provisions account. For CEA, a state owned company, a dedicated fund, based on AREVA's capital assets, has recently been set up, to allow CEA to manage their decommissioning plan.

9.2.4. French Nuclear Sites – Decommissioning Status & Programmes

The current decommissioning status of all the French nuclear sites is recorded on the WNA web site at:
www.world-nuclear.org/wgs/decom/database/database.htm
carry out a search on Country (all types of facility) for France.

Also, refer to chapter 15 of the Annual Report of 2004 at: www.asn.gouv.fr/ for two tables providing lists of basic nuclear installations finally declassified and shutdown as at 31 12 2004.

For EDF (Electricité de France) access their web site at www.edf.fr/
Click on "EDF Group", "our energy sources", "EDF's presence in France" to find the locations of their generating sites and useful addresses.
It also allows commercial contacts for companies by use of an interactive map. Fill in the box details.

Cogema's web site can be accessed at www.cogema.fr/
This is a useful web site – click "profile" for French and international locations and "organisation" for environmental, health, safety and quality standards. There is also other information about Cogema.

CEA (Atomic Energy Commission) – A French Government funded research organisation
www.cea.fr/
Click on "find out more" on the English version of their homepage for contact information and location of their headquarters and research centres for civil nuclear and military applications.

ANDRA – French Nuclear Agency for Radioactive Waste Management
www.andra.fr. A useful web site showing the locations of the waste disposal facilities and contact data.

9.2.5. French Contracting Companies in the Nuclear Sector

The Foratom web site has a list of 86 French companies working in the French nuclear industry, many with links to their company web sites providing details of their products/services together with contact information. See:-
www.foratom.org
Click on "links" on the homepage, then "companies" and scroll down to France.

AREVA and its subsidiaries cover the whole of the nuclear power cycle and also electricity transmission and distribution including enrichment, fuel fabrication, reactors and reactor services. Click on "Group" on their home page to find a simplified organisational chart which comprises Framatome-ANP (66% AREVA, 34% Siemens), Cogema, Areva T&D and FCI. Click this interactive chart to take you to the web sites of the various companies in the AREVA Group. A search will produce details of their operations, sites and contacts. The web site is :-
www.areva.com

SOCODEI is a company owned jointly by Cogema and EDF that provides solutions for managing low and intermediate level radioactive waste.
Details of its operations and contact data are provided on its web site at:-

www.socodei.fr/
Eurodif web site is at:- www.wise-uranium.org/oceud.html

Links to all of the main French companies and organisations can be found on:-
www.uxc.com/index.html

Click on "industry links" in the box in the top RH corner which leads to a table of regions and company types. Select whichever option is required for information.

9.2.6. Other Information

9.2.6.1 Sources of Information

Reports published via the Internet

The Decommissioning and Dismantling of Nuclear Facilities Status, Approaches, Challenges Nuclear Energy Agency, 2002
www.nea.fr/html/rwm/reports/2002/3714-decommissioning.pdf

Decommissioning of Nuclear Power Facilities Nuclear Energy Agency, 2004
www.nea.fr/html/rwm/reports/2004/nea5728-decom.pdf
The above report provides references to further relevant publications on decommissioning and related websites.

IAEA-TECDOC-1043 – Technologies for gas cooled reactor decommissioning, fuel storage and waste disposal. Proceedings of a Technical Committee meeting held in Julich, Germany, 1997
www.iaea.or.at/inis/aws/htgr/fulltext/29059898.pdf

Decommissioning of Nuclear Power Plants Nuclear Energy Institute
www.nei.org/doc.asp?catnum=3&catid=278

Decommissioning Nuclear Facilities Report by the Australian Uranium Information Centre
www.uic.com.au/nip13.htm

Conferences & Events

National and international events are published on the French Atomic Forum web site at:- The French Atomic Forum (SFEN) – Societe Francaise de l'Energie Nucleaire
www.sfen.org/

French Government websites

DGEMP (Ministry of Industry)
www.industrie.gouv.fr/
(French only)

CEA (Atomic Energy Commission) – A French Government funded research organisation
www.cea.fr/

DGSNR under Ministries for Industry, Health and Ecology and Sustainable Development
www.asn.gouv.fr

IRSN Nuclear Safety & Radioprotection Institute
www.irsn.fr/

ANDRA – French Nuclear Agency for Radioactive Waste Management
www.andra.fr A useful web site showing the locations of the waste disposal facilities and contact data.

EU websites

The following are two directly relevant pages from the official European Commission's website: General
www.europa.eu.int/comm/energy/nuclear/decommissioning/index_en.htm
Re. candidates for EU membership
www.europa.eu.int/comm/energy/nuclear/decommissioning/candidate_en.htm

The French Atomic Forum (SFEN) – Societe Francaise de l'Energie Nucleaire
www.sfen.org/

International bodies

Foratom (European Atomic Forum)
www.foratom.org

The International Atomic Energy Agency
www.iaea.org

Nuclear Energy Agency – also known as the Agence pour l'energie nucleaire (AEN) funded by the OECD
www.nea.fr

World Association of Nuclear Operators
www.wano.org.uk/

The World Nuclear Association
www.world-nuclear.org/
See Chapter 10 on international opportunities for a description of the WNA's decommissioning database.

The World Nuclear Transport Institute
www.wnti.co.uk/

Radwaste.org. Primary purpose of this site is to provide a reference source for radioactive waste management professionals.
www.radwaste.org/decom.htm

World Energy Council
www.worldenergy.org/wec-geis/default.htm

Other national sources of information

The Nuclear Energy Institute (USA)
www.nei.org/

Australian Uranium Information Centre
www.uic.com.au/

Miscellaneous sources

The Virtual Tourist
www.nucleartourist.com/

International Nuclear Safety Centre
www.insc.anl.gov/

9.3 The German Nuclear Decommissioning Market Summary

9.3.1. Introduction & Current Status

Coal and nuclear power plants are the pillars of Germany's power generation. Coal is the most important energy source, accounting for 50.6% of the country's gross electricity production, according to government statistics. Nuclear power is the second most important energy source, providing 28.4% of total gross electricity production. Natural gas accounts for 9.3%, down slightly year-on-year. The biggest increase in generation comes from wind, which jumped 60% year-on-year, but only provides 2.9% of the total gross electricity generated.

As of January 2002, Germany had an installed electric generating capacity of 115 gigawatts (GW). Thermal sources (coal, natural gas, and oil) accounted for 67% of the country's installed capacity, followed by nuclear with 22.4%, other renewables (mainly wind) with 9.4%, and hydro with 4%. With nuclear power scheduled to be completely phased out in Germany 2021, electricity generated from natural gas, coal and renewables, particularly wind, are expected to increase.

As of December 2002, Germany ranked fourth worldwide in installed nuclear capacity, behind the United States, France, and Japan. Operators E.On, RWE, HEW, and EnBW own nuclear generation capacity, with E.On holding stakes in 12 of Germany's 19 nuclear power plants.

After much controversy, the German government formally signed an agreement with utility companies in June 2001 to gradually phase out nuclear power, and in April 2002, an amended Atomic Energy Act entered into force, formally legalising the phase-out. All of Germany's nuclear power plants are expected to be closed by 2021, but production from some plants could be extended. On November 14, 2003, E.On Energie closed its Stade nuclear power plant, marking the first plant to be decommissioned. Germany's oldest nuclear power plant, Obrigheim, was closed in 2005. There has been opposition, however, to the government's nuclear phase-out programme and if the current ruling coalition (Social Democrats and environmentalist Green Party) loses power, the phase-out could be overturned.

Table 1.1: Status of Nuclear Power Plants

Station	Type	Net Capacity	Status	Operator	Reactor Supplier	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
BIBLIS-A (KWB A)	PWR	1167	Operational	RWE	KWU	01-Jan-70	16-Jul-74	25-Aug-74	26-Feb-75	
BIBLIS-B (KWB B)	PWR	1240	Operational	RWE	KWU	01-Feb-72	25-Mar-76	25-Apr-76	31-Jan-77	
BROKDORF (KBR)	PWR	1370	Operational	E.ON	KWU	1-Jan-76	08-Oct-86	14-Oct-86	22-Dec-86	
BRUNSBUETTEL (KKB)	BWR	771	Operational	KKB	KWU	15-Apr-70	23-Jun-76	13-Jul-76	09-Feb-77	
EMSLAND (KKE)	PWR	1329	Operational	KLE	SIEM, KWU	10-Aug-82	14-Apr-88	19-Apr-88	20-Jun-88	
GRAFENRHEINFELD (KKG)	PWR	1275	Operational	E.ON	KWU	01-Jan-75	09-Dec-81	30-Dec-81	17-Jun-82	
GROHNDE (KWG)	PWR	1360	Operational	KWG	KWU	01-Jun-76	01-Sep-84	04-Sep-84	01-Feb-85	
GUNDREMMINGEN-B (KRB B)	BWR	1284	Operational	KGB	KWU	20-Jul-76	09-Mar-84	16-Mar-84	19-Jul-84	
GUNDREMMINGEN-C (KRB C)	BWR	1288	Operational	KGB	KWU	20-Jul-76	26-Oct-84	02-Nov-84	8-Jan-85	
ISAR-1 (KKI 1)	BWR	878	Operational	E.ON	KWU	01-May-72	20-Nov-77	03-Dec-77	21-Mar-79	
ISAR-2 (KKI 2)	PWR	1400	Operational	E.ON	KWU	15-Sep-82	15-Jan-88	22-Jan-88	09-Apr-88	
KRUEMMEL (KKK)	BWR	1260	Operational	KKK	KWU	05-Apr-74	14-Sep-83	28-Sep-83	28-Mar-84	
NECKARWESTHEIM-1 (GKN 1)	PWR	785	Operational	GKN	KWU	01-Feb-72	26-May-76	03-Jun-76	01-Dec-76	
NECKARWESTHEIM-2 (GKN 2)	PWR	1269	Operational	GKN	SIEM, KWU	09-Nov-82	29-Dec-88	03-Jan-89	15-Apr-89	
OBRIGHEIM (KWO	PWR	340	Operational	KWO	SIEM, KWU	15-Mar-65	22-Sep-68	29-Oct-68	01-Apr-69	
PHILIPPSBURG-1 (KKP 1)	BWR	890	Operational	EnBW	KWU	01-Oct-70	09-Mar-79	05-May-79	26-Mar-80	
PHILIPPSBURG-2 (KKP 2)	PWR	1392	Operational	EnBW	KWU	07-Jul-77	13-Dec-84	17-Dec-84	18-Apr-85	
STADE (KKS)	PWR	640	Operational	E.ON	KWU	01-Dec-67	08-Jan-72	29-Jan-72	19-May-72	
UNTERWESER (KKU)	PWR	1345	Operational	E.ON	KWU	01-Jul-72	16-Sep-78	29-Sep-78	06-Sep-79	
AVR JUELICH (AVR)	HTGR	13	Shut Down	AVR	BBK	01-Aug-61	16-Aug-66	17-Dec-67	19-May-69	31-Dec-88
GREIFSWALD-1(KGR 1)	WWER	408	Shut Down	EWN	AEE, KAB	01-Mar-70	03-Dec-73	17-Dec-73	12-Jul-74	18-Dec-90
GREIFSWALD-2 (KGR 2)	WWER	408	Shut Down	EWN	AEE, KAB	01-Mar-70	03-Dec-74	23-Dec-74	16-Apr-75	14-Feb-90
GREIFSWALD-3 (KGR 3)	WWER	408	Shut Down	EWN	AEE, KAB	01-Apr-72	06-Oct-77	24-Oct-77	01-May-78	28-Feb-90
GREIFSWALD-4 (KGR 4)	WWER	408	Shut Down	EWN	AEE, KAB	01-Apr-72	22-Jul-79	03-Sep-79	01-Nov-79	02-Jun-90
GREIFSWALD-5 (KGR 5)	WWER	408	Shut Down	EWN	AEE, KAB	01-Dec-76	26-Mar-89	24-Apr-89		30-Nov-89
GUNDREMMINGEN-A (KRB A)	BWR	237	Shut Down	KGB	AEG, GE	12-Dec-62	14-Aug-66	01-Dec-66	12-Apr-67	13-Jan-77
HDR GROSSWELZHEIM	BWR	23	Shut Down	FZK	AEG, KWU	01-Jan-65	14-Oct-69	14-Oct-69	02-Aug-70	20-Apr-71
KNK II	FBR	17	Shut Down	FZK	IA	01-Sep-74	10-Oct-77	09-Apr-78	03-Mar-79	23-Aug-91
LINGEN (KWL)	BWR	240	Shut Down	KWL	AEG	01-Oct-64	31-Jan-68	01-Jul-68	01-Oct-68	05-Jan-77
MUELHEIM-KAERLICH (KMK)	PWR	1219	Shut Down	RWE	BBR	15-Jan-75	01-Mar-86	14-Mar-86	01-Oct-87	09-Sep-88
MZFR	PHWR	52	Shut Down	FZK	SIEMENS	01-Dec-61	29-Sep-65	09-Mar-66	19-Dec-66	03-May-84
NIEDERAICHBACH (KKN)	HWGCR	100	Shut Down	FZK	SIEM, KWU	01-Jun-66	17-Dec-72	01-Jan-73	1-Jan-73	31-Jul-74
RHEINSBERG (KKR)	PWR	62	Shut Down	EWN	AEE, KAB	01-Jan-60	11-Mar-66	06-May-66	11-Oct-66	01-Jun-90
THTR-300	HTGR	296	Shut Down	HKG	HRB	01-May-71	13-Sep-83	16-Nov-85	01-Jun-87	29-Apr-88
VAK KAHL	BWR	15	Shut Down	VAK	GE, AEG	01-Jul-58	13-Nov-60	17-Jun-61	01-Feb-62	25-Nov-85
WUERGASSEN (KWW)	BWR	640	Shut Down	E.ON	AEG, KWU	26-Jan-68	20-Oct-71	18-Dec-71	11-Nov-75	26-Aug-94

9.3.1.1 Fuel Cycle and Waste Management

All facilities necessary to close the nuclear fuel cycle have been retained in Germany. Today, only a few of them are in operation, several are shut down and being decommissioned or have not received a license to operate. In accordance with the new energy policy and the respective amendment of the Atomic Energy Act, the waste management of nuclear power plants comprises:-

- transport of spent fuel for reprocessing until June 30, 2005 at the latest.

From July 1, 2005, use of the local interim storage facilities for spent fuel until a final repository is commissioned.

- interim storage of spent fuel at central (external) interim storage facilities and, as soon as possible, at local interim storage facilities
- conditioning and interim storage of radioactive waste from operation and decommissioning of the nuclear power plants until a final repository is commissioned.

At Gronau, the enrichment plant of URENCO expanded from a capacity of originally 400 SWU/year to 1 400 SWU/year within the last few years and it is intended to increase the capacity further to 4 500 SWU/year.

At Lingen, the fuel fabrication facility, ANF is in operation and produces uranium fuel elements for LWRs. In 2002, an increase of the throughput capacity up to 500 t Uranium per year was licensed.

Three central interim storage facilities for spent fuel are in operation: The transport flask store Ahaus (TBLA) for irradiated fuel, the transport flask store Gorleben (TBLG) for both irradiated fuel and vitrified reprocessing products, and the interim storage facility Zwischenlager Nord (ZLN) exclusively for spent fuel from decommissioning of the NPPs in Greifswald and Rheinsberg.

In line with the new German energy policy, additional local interim storage facilities for spent fuel are to be built on the NPP sites. License applications have been introduced for 13 sites.

The waste conditioning facility PKA at the Gorleben site is now completed, but only a limited operation license to repair damaged containers was granted by the regulator in 2000.

Concerning the final repository, the Federal Government has a target that a future facility for all types of radioactive waste will be available around 2030. A working group on the site selection for a possible repository, set up by BMU, has produced a report on a comprehensive and suitable site selection procedure.

9.3.2. Location of Nuclear Licensed Sites

A map showing the location of nuclear licensed sites in Germany is available in section 2.3 of the IAEA country profile for Germany at www.pub.IAEA.org/MTCD/publications/PDF/cnpp2003/CNPP_Webpage/countryprofiles/Germany/Germany2003.html

9.3.3. Nuclear Sector, Status & Customers

9.3.3.1 Government

The following organisations on the federal level provide public information:

The Federal Ministry of Economics and Labour, Berlin Bundesministerium Fur Wirtschaft und Arbeit (BMWA)

Federal Ministry for the Environment, Nature Conservation & Nuclear safety, Berlin Bundesministerium Fur Umwelt, Naturschutz und Reaktorsicherheit (BMU)

Federal Ministry of Education and Research, Bonn & Berlin
Bundesministerium fur Bildung und Forschung (BMBF)

Federal Office for Radiation Protection
Bundesamt fur Strahlenschutz (BfS)

A number of other Government organisations and institutions involved in nuclear power related activities are included in section 9.3.6 under Sources of Information.

9.3.3.2 Research and Development Activities

Basic nuclear research is supported by the BMBF (Federal Ministry of Education and Research), the applied nuclear research – especially nuclear reactor safety and repository research – by the BMWA (Federal Ministry of Economics and Labour), and regulatory nuclear investigations by BMU (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety). The national development activities on disposal are refinanced by the utilities. Research in nuclear matters at universities and research centres is decreasing. Nothing more is being done on future nuclear reactors because of the political decision to phase out nuclear energy for commercial electricity production.

9.3.3.3 Regulators

For participants in the nuclear licensing and supervisory process, refer to IAEA country profile for Germany at the website provided under item 2.

In relation to regulation concerning the safety of nuclear power plants, the Federal Environmental Ministry (BMU) has the federal competence, whereas the execution of federal laws lies within the responsibility of the federal states, the Länder. So the licensing of nuclear installations is carried out by the Länder, where different ministries are responsible for licensing of construction, operation, essential modification and decommissioning of nuclear power plants. For technical matters in the licensing procedure and the supervision of nuclear facilities, the regulatory authorities of the Länder are supported by independent technical support organizations, in general the nuclear departments of the Technical Inspection Agencies (TÜV).

To preserve the legal uniformity for the entire territory of the Federal Republic of Germany, the BMU supervises the licensing and supervisory activities of the Länder authorities (so-called "federal executive administration"). Supervision by BMU includes the right to issue binding directives.

In performing its federal supervision, the BMU is supported by the Federal Office for Radiation Protection (BfS) in all matters concerning nuclear safety and radiation protection. The BfS is responsible – inter alia – for the construction and operation of nuclear waste repositories, subcontracting for this task with the Deutsche Gesellschaft zum Bau und Betrieb von Endlagern für Abfallstoffe mbH (DBE). Further advisory support for the BMU comes from the RSK, the SSK and the GRS, a central technical support organisation.

As in licensing, the prime objective of the regulatory supervision of nuclear installations is to protect the general public and workers against the hazards connected with the operation of the installation. Officials of the supervisory authorities as well as the authorised experts working on behalf of the supervisory authority have access to the nuclear installation at all times and are authorised to perform the necessary examinations and to request any pertinent information. Nuclear installations are subject to continuous regulatory supervision. However, the Länder perform this supervisory procedure on behalf of the Federal Government.

9.3.4 Main Power Utilities

EnBW Energie Baden – Wurttemberg AG
E.ON Energie AG
Hamburgische Electricitatswerke AG (HEW)

RWE Energie AG

Web site details and access to more specific project information is provided in section 9.3.4.

9.3.3.5 Other Stakeholders

Nuclear Research Institutes

Forschungszentrum Jülich	Jülich	www.kfa-juelich.de
Forschungszentrum Karlsruhe	Karlsruhe	www.fzk.de
Hahn-Meitner-Institut Berlin (HMI)	Berlin	www.hmi.de
Max-Planck-Institut für Kernphysik	Heidelberg	www.mpi-hd.mpg.de
Gesellschaft für Schwerionenforschung (GSI)	Darmstadt	www.gsi.de
Deutsches Elektronen-Synchrotron (DESY)	Hamburg	www.desy.de
German Atomic Forum (DatF) – Deutsches Atomforum e. V. – DatF		www.datf.de

9.3.4. German Nuclear Sites – Decommissioning Status & Programmes

In Germany, 18 nuclear power plants (NPPs) and prototype reactors are permanently shut down (see Table 4.1.1. below). Two of them (KKN in Niederaichbach and HDR in Grosswelzheim) have been completely dismantled. The sites were restored to "green-field status" and released from nuclear regulatory control. Two of the NPPs (KWL in Lingen and THTR-300 in Hamm-Uentrop) are in safe enclosure. For the other 14 NPPs dismantling is in progress with "green-field status" being the planning target. The 672 MW Stade NPP was shut down in November 2003 and is earmarked for immediate dismantling.

Additionally, 32 research reactors are permanently shut down. This figure includes the FRM in Munich, Germany's oldest research reactor. Up to now 21 research reactors are completely dismantled. Three of the research reactors are in safe enclosure. Dismantling the other 8 research reactors is either in progress or in preparation. Finally, 10 nuclear fuel cycle facilities (mostly fuel fabrication and fuel reprocessing facilities) are permanently shut down and 5 of them have been completely dismantled. Dismantling is in progress at the other 5 facilities.

9.3.4.1 Decommissioning of Nuclear Power Plants and Prototype Reactors

Table 4.1.1: Power & Prototype Reactors Under Decommissioning in Germany (NPP Reactors)

Up to now two reactors have been dismantled completely ("green field") in Germany:

Completely dismantled nuclear power plants	Start of operation	Shut-down	"Green field"
Niederaichbach (KKN)	1973	1974	1995
Großwelzheim hot-steam reactor (HDR)	1970	1971	1998

Two reactors are in safe enclosure:

Nuclear power plants in safe enclosure	Start of operation	Shut-down	Safe enclosure
Lingen (KWL)	1968	1977	1988
Thorium high-temperature reactor (THTR) in Hamm-Uentrop	1987	1988	1997

Decommissioning work is currently being carried out at 13 reactors:

Nuclear power plants with decommissioning work	Start of operation	Shut-down	Decommissioning since
AVR test-reactor Jülich (AVR)	1969	1988	1994
Gundremmingen (KRB-A)	1967	1977	1983
Compact sodium-cooled nuclear power plant (KNK-II) in Karlsruhe	1979	1991	1993
Multi-purpose research reactor (MZFR) in Karlsruhe	1966	1984	1987
Würgassen (KWW)	1975	1994	1997
Kahl test-reactor (VAK)	1962	1985	1988
Greifswald, units 1-5 (KGR)*	1974	1990	1995
Rheinsberg (KKR)	1966	1990	1995
Mülheim-Kärlich (KMK)	1987	1988	2004

* Unit 6 of the Greifswald nuclear power plant (KGR) was not in nuclear operation but it was included in the decommissioning license.

Applications for the decommissioning of two reactors were submitted to the respective regulatory bodies.

Start of operation	Final shut-down	Nuclear power plants with decommissioning applied for	Anticipated start of decommissioning
1972	14.11.2003	Stade (KKS)	2005
1969	11.05.2005	Obrigheim (KWO)	2007

The first decommissioning licence for the nuclear power plant in Stade (KKS) is expected in 2005.

The amended Atomic Energy Act (AtG) which came into force on 27 April 2002 requires the controlled termination of commercial nuclear power generation. Annex 3 of the AtG provides a limit on the residual power generation of the existing Nuclear Power Plants which is based on a reactor operating time of 32 years.

Reference values for the remaining operating time of the nuclear power plants can be projected from the residual power generation. It has to be taken into account however, that the operating time may change, e. g. when transferring residual power generation (production rights) from one nuclear power plant to another when unplanned shut-downs occur or when the availability declines. Final binding shut down dates for when a nuclear power plant will actually be shut down are thus not possible.

9.3.4.2 The Main German Power Utilities

EnBW Energie Baden-Württemberg AG	Karlsruhe	www.enbw.com
E.ON Energie AG	München	www.eon-energie.com
Hamburgische Electricitätswerke AG (HEW)	Hamburg	www.hew.de (not English)
RWE Energie AG	Essen	www.rwe.com

More detailed information on selected decommissioning projects in Germany is available on the following websites. Some provide full details of power plants, location, decommissioning status and communication information:-

- Kernkraftwerk Würgassen & Kernkraftwerk Stade www.eon-kernkraft.com
- Kernkraftwerk Mülheim-Kärlich www.rwepower.com
- Versuchsatomkraftwerk Kahl GmbH www.vak.rweenergie.de
- Energiewerke Nord GmbH www.ewn-gmbh.de
- Forschungszentrum Karlsruhe GmbH www-pbs.fzk.de/projekte.htm
- Wiederaufarbeitungsanlage Karlsruhe www.wak-karlsruhe.de

A complete listing of the status of Germany's nuclear facilities is located on the following web site:-
www.bfs.de/kerntechnik/stilllegung/Stilllegungsliste_August_2004_engl.pdf

It includes :-
Power reactors in operation
Power and prototype reactors being decommissioned
Research reactors under construction
Research reactors being decommissioned

Research reactors decommissioning completed
Nuclear fuel cycle facilities in operation
Nuclear fuel cycle facilities and radioisotope production facilities being decommissioned or decommissioning completed.

9.3.5. German Companies in the Nuclear Sector

The Foratom web site has a list of 56 German companies working in the German nuclear industry, many with links to their company web sites providing details of their products/services together with contact information. See:- www.foratom.org
Click on "links" on the homepage, then "companies"in LH menu and scroll down to Germany.

Links to all of the main German companies and organisations can be found on:- www.uxc.com/index.html
Click on "industry links" in the box in the top RH corner which leads to a table of regions and company types. Select whichever option is required for information.

Manufacturers, Services and other Nuclear Organisations

Organisation	Location	Website
Babcock Noell Nuclear	Würzburg	www.bb-powersystems.de
Brennelementlager Gorleben (BLG)	29475 Gorleben	Lüchower Str. 8
Brennelement-Zwischenlager Ahaus (BZA)	48683 Ahaus	Ammeln 59
Brenk-Systemplanung	Aachen	www.brenk.com
Bundesanstalt für Geowissenschaften und Rohstoffe (BGR)	Hannover	www.bgr.de
Deutsche Gesellschaft zum Bau und Betrieb von Endlagern für Abfallstoffe (DBE)	Peine	www.dbe.de
Deutsche Kernreaktor-Versicherungsgemeinschaft (DVKG)	50950 Köln	Postfach 52 01 29
Deutsches Atomforum (DAtF) Kerntechnische Gesellschaft (KTG) Informationskreis Kernenergie (IK) INFORUM Verlag	Bonn	www.kernenergie.de
Fachverband für Strahlenschutz	Berlin	www.fs.fzk.de
Fichtner	Stuttgart	www.fichtner.de
Framatome-ANP (Germany)	Erlangen	www.de.framatome-anp.com/anp/d/foa/anp/index.htm
Gesellschaft für Anlagen- und Reaktorsicherheit (GRS)	Köln	www.grs.de
Gesellschaft für Nuklear-Behälter (GNB)	Essen	www.gnb-nuklearbehaelter.de

Organisation	Location	Website
Gesellschaft für Nuklear-Service (GNS)	Essen	www.gns.de
Internationale Länderkommission Kerntechnik (ILK)		www.ilk-online.org
Kerntechnischer Ausschuß (KTA)	Salzgitter	www.kta-gs.de
Kerntechnischer Hilfsdienst	Eggenstein-Leopoldshafen	www.khgmbh.de
Kraftanlagen Nukleartechnik	Heidelberg	www.nukleartechnik.de
Kraftwerksschule	Essen	www.kraftwerksschule.de
KSB Pumpen + Armaturen		www.ksb.de
Physikalisch-Technische Bundesanstalt (PTB)	Braunschweig	www.ptb.de
Reaktor-Sicherheitskommission (RSK)	Bonn	www.rskonline.de
RWE NUKEM Group		www.nukem.de
Siempelkamp Nukleartechnik (SNT)	Krefeld	www.siempelkamp.de
STEAG Energie- und Kerntechnik	Essen	www.steag.de
Strahlenschutzkommission (SSK)	Bonn	www.ssk.de
Studsvik SINA Industrieservice	Pforzheim	www.sina.de
TÜV Nord Gruppe	Hamburg	www.tuev-nord.de
TÜV Süddeutschland	München	www.tuev-sued.de
Urenco Deutschland	Jülich	www.urenco.com
Verband der Elektrizitätswirtsschaft (VDEW)	Frankfurt/Main	www.strom.de
Vereinigung der Großkraftwerksbetreiber (VGB)	Essen	www.vgb.org
Westinghouse Electric Company		www.westinghouse.com
Wismut	Chemnitz	www.wismut.de

9.3.6. Other Information

9.3.6.1 Sources of Information

German Government Websites:-
Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU)

Referat Öffentlichkeitsarbeit
D-11055 Berlin
Tel.: +49-1888-305-3355
E-Mail: service@bmu.de
Internet: www.bmu.de

A comprehensive brochure entitled: Decommissioning of Nuclear Facilities (September 2001) is available upon request from the BMU in English and German.

Bundesministerium für Bildung und Forschung (BMBF)
Heinemannstr. 2
D-53175 Bonn
or:
Hannoversche Str. 30
D-10115 Berlin
Tel.: +49-1888-57-0
Information about decommissioning projects in Germany can be found in the BMBF
booklet:
Stilllegung und Rückbau kerntechnischer Anlagen
2. neu bearbeitete Auflage
Mai 2000

Bundesamt für Strahlenschutz (BfS)
Willy-Brandt-Str.5
D-38226 Salzgitter-Lebenstedt
Tel.: +49-1888-333-1130
E-Mail: info@bfs.de
Internet: www.bfs.de/kerntechnik/stilllegung

Information on selected decommissioning projects in Germany is available from the following addresses:

Kernkraftwerk Würgassen
An der Kreisstraße 338
D-37688 Beverungen
Tel.: +49-5273-38-0
E-Mail: info-kernkraft@eon-energie.com
Internet: www.eon-kernkraft.com

Kernkraftwerk Stade
Bassenflether Chaussee
D-21713 Stade
Tel.: +49-4141-77-2390
E-Mail: detlef.hubert@eon-energie.com
Internet: www.eon-kernkraft.com

Kernkraftwerk Mülheim-Kärlich
Postfach 1432
D-56210 Mülheim-Kärlich
Tel: +49-2637-644 456
E-Mail: werner.herig@kkw.rwe.com
Internet: www.rwepower.com

Versuchsatomkraftwerk Kahl GmbH
Postfach 6
D-63791 Karlstein
Tel.: +49-6188-499-125
E-Mail: vak@energie.rwe.de
Internet: www.vak.rweenergie.de

Energiewerke Nord GmbH
Energiewerke Nord GmbH
Postfach 1125
Abteilung Öffentlichkeitsarbeit
D-17507 Lubmin
Tel.: +49-38354-48030
E-Mail: info@ewn-gmbh.de
Internet: www.ewn-gmbh.de

Forschungszentrum Karlsruhe GmbH
Hermann-von-Helmholtz-Platz 1
D-76344 Eggenstein-Leopoldshafen
Tel: +49-7247-82-0
E-Mail: info@fzk.de
Internet: www-pbs.fzk.de/projekte.htm

Wiederaufarbeitungsanlage Karlsruhe
Betriebsgesellschaft mbH
Postfach 1263
D-76339 Eggenstein-Leopoldshafen
Tel.: +49-7247-88-0
E-Mail: kontakt@wak.fzk.de
Internet: www.wak-karlsruhe.de

Nuclear Research Institutes

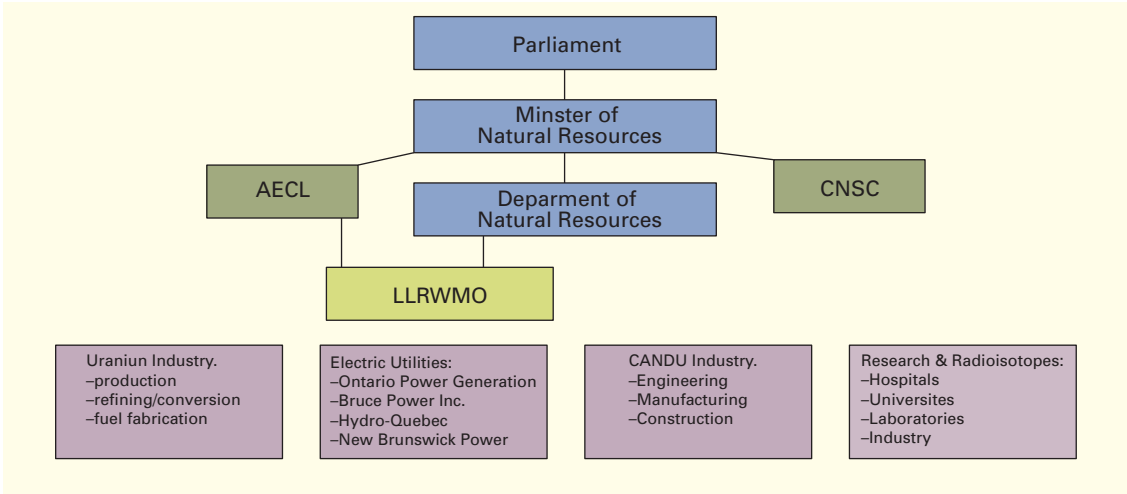
Forschungszentrum Jülich	Jülich	www.kfa-juelich.de
Forschungszentrum Karlsruhe	Karlsruhe	www.fzk.de
Hahn-Meitner-Institut Berlin (HMI)	Berlin	www.hmi.de
Max-Planck-Institut für Kernphysik	Heidelberg	www.mpi-hd.mpg.de
Gesellschaft für Schwerionenforschung (GSI)	Darmstadt	www.gsi.de
Deutsches Elektronen-Synchrotron (DESY)	Hamburg	www.desy.de

German Atomic Forum (DatF) – Deutsches Atomforum e. V. – DatF www.datf.de

9.4 Canadian Nuclear Decommissioning Market Summary

9.4.1. Introduction & Current Status

Fig 1. Structure of the Canadian Nuclear Industry



CNSC	Canadian Nuclear Safety Commission
AECL	Atomic Energy of Canada Limited
LLRWMO	Low Level Radioactive Waste Management Office

The provincial electric power utilities are responsible for electricity supply and make decisions about the type of technology to be used for electricity generation; they are also responsible for building, operating and maintaining provincial power facilities, including nuclear facilities. Utilities with nuclear plants in operation in Canada are: OPG and Bruce Power, a private consortium whose principal shareholders are:

- Cameco Corporation (31.6%)
- TransCanada PipeLines (31.6%)
- The BPC Generation Infrastructure Trust of Toronto (31.6%)
- The remaining 5.5% is owned by two unions, New Brunswick Power and Hydro-Québec.

Apart from Bruce Power, which is a newcomer in the electric power scene, the three provincial utilities, particularly OPG, have had critical roles to play in the development of Canada's nuclear programme. They have worked closely with AECL in the design and construction of the power reactors in their respective provinces.

In 2002, Canada's nuclear capacity ranked 6th in the world, and represented close to 13 % of its electricity supply.

There are currently 22 nuclear power reactors in Canada which are operated by public utilities and private companies in Ontario (20), Quebec (1) and New Brunswick (1). Of the 22 reactors installed, 16 reactors are currently in full commercial operation, and they generate around 13% of Canada's electricity, over 40% in Ontario. Moreover, nine CANDU reactors are currently in operation or under construction outside of Canada. Last year, CANDU reactors in operation in Canada and abroad performed very well. Their performance averaged 85%, slightly higher than the lifetime average performance of 83%. Table 1 gives an overview of the main nuclear power data in Canada and its provinces.

Table 1. Canadian Nuclear Power Data

	Canada	Ontario	New Brunswick	Québec
Total Eectricity Generation (Growth %)	2.0	0.6	-10.0	3.6
Nuclear Share of Electricity Generation (%)	12.8	41.0	21.0	2.5
Reactors In Service	16	14	1	1
Installed Capacity (MW)	15,795	14,440	680	675

Sources: Natural Resources Canada; and Statistics Canada.

The two nuclear operators in Ontario, OPG and Bruce Power, are still pursuing their respective recovery plans to restart the laid-up units at Pickering A and Bruce A stations. Two of the eight laid-up units were brought back to service (Pickering A Unit 4 and Bruce A Units 3 & 4) in 2003/04.

Table 2. Status of Nuclear Power Plants

Station	Type	Net Capacity	Operator	Status	Reactor Supplier	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
BRUCE – 5	PHWR	785	Bruce Power	Operational	OPG/AECL	1-Jun-78	15-Nov-84	2-Dec-84	1-Mar-85	
BRUCE - 6	PHWR	785	Bruce Power	Operational	OPG/AECL	1-Jan-78	29-May-84	26-Jun-84	14-Sep-84	
BRUCE - 7	PHWR	785	Bruce Power	Operational	OPG/AECL	1-May-79	7-Jan-86	22-Feb-86	10-Apr-86	
BRUCE - 8	PHWR	785	Bruce Power	Operational	OPG/AECL	1-Aug-79	15-Feb-87	9-Mar-87	22-May-87	
DARLINGTON - 1	PHWR	881	OPG	Operational	OPG/AECL	1-Apr-82	29-Oct-90	19-Dec-90	14-Nov-92	
DARLINGTON - 2	PHWR	881	OPG	Operational	OPG/AECL	1-Sep-81	5-Nov-89	15-Jan-90	9-Oct-90	
DARLINGTON - 3	PHWR	881	OPG	Operational	OPG/AECL	1-Sep-84	9-Nov-92	7-Dec-92	14-Feb-93	
DARLINGTON - 4	PHWR	881	OPG	Operational	OPG/AECL	1-Jul-85	13-Mar-93	17-Apr-93	14-Jun-93	
GENTILLY - 2	PHWR	635	HQ	Operational	BBC	1-Apr-74	11-Sep-82	4-Dec-82	1-Oct-83	
PICKERING - 5	PHWR	516	OPG	Operational	NEI.P	1-Nov-74	23-Oct-82	19-Dec-82	10-May-83	
PICKERING - 6	PHWR	516	OPG	Operational	OPG/AECL	1-Oct-75	15-Oct-83	8-Nov-83	1-Feb-84	
PICKERING - 7	PHWR	516	OPG	Operational	OPG/AECL	1-Mar-76	22-Oct-84	17-Nov-84	1-Jan-85	
PICKERING - 8	PHWR	516	OPG	Operational	OPG/AECL	1-Sep-76	17-Dec-85	21-Jan-86	28-Feb-86	
POINT LEPREAU	PHWR	635	NB Power	Operational	AECL	1-May-75	25-Jul-82	11-Sep-82	1-Feb-83	
BRUCE - 1	PHWR	769	Bruce Power	Laid up	OPG/AECL	1-Jun-71	17-Dec-76	14-Jan-77	1-Sep-77	16-Oct-97
BRUCE - 2	PHWR	769	Bruce Power	Laid up	OPG/AECL	1-Dec-70	27-Jul-76	4-Sep-76	1-Sep-77	8-Oct-95
BRUCE - 3	PHWR	769	Bruce Power	Laid up	NEI.P	1-Jul-72	28-Nov-77	12-Dec-77	1-Feb-78	9-Apr-98[3]
BRUCE - 4	PHWR	769	Bruce Power	Operational	NEI.P	1-Sep-72	10-Dec-78	21-Dec-78	18-Jan-79	16-Mar-98[1]
PICKERING - 1	PHWR	515	OPG	Laid up	OPG/AECL	1-Jun-66	25-Feb-71	4-Apr-71	29-Jul-71	31-Dec-97
PICKERING - 2	PHWR	515	OPG	Laid up	OPG/AECL	1-Sep-66	15-Sep-71	6-Oct-71	30-Dec-71	31-Dec-97
PICKERING - 3	PHWR	515	OPG	Laid up	OPG/AECL	1-Dec-67	24-Apr-72	3-May-72	1-Jun-72	31-Dec-97
PICKERING - 4	PHWR	515	OPG	Operational	OPG/AECL	1-May-68	16-May-73	21-May-73	17-Jun-73	31-Dec-97[2]
DOUGLAS POINT	PHWR	206	OPG	Shut down	AECL	1-Feb-60	15-Nov-66	7-Jan-67	26-Sep-68	4-May-84
GENTILLY - 1	HWLWR	250	HQ	Shut down	AECL	1-Sep-66	12-Nov-70	5-Apr-71	1-May-72	1-Jun-77
NPD	PHWR	22	OH	Shut down	CGE	1-Jan-58	11-Apr-62	4-Jun-62	11-Oct-62	1-Aug-87

[1] – The Bruce A unit 4 was returned to service on October 7, 2003.
[2] – The Pickering A unit 4 was returned to service on September 25, 2003
[3] – The Bruce A unit 3 was returned to service early in 2004.

OPG has also undertaken the planning for the return to service of the three remaining units at Pickering and it indicated that they should be brought back to service over the next few years. With respect to the other two units at Bruce A, Bruce Power has indicated that these units will be restarted if a proper business case can be made for returning them to service.

No commercial nuclear power reactors are undergoing active decommissioning in Canada. Three prototype power reactors (NPD, Douglas Point and Gentilly-1) have been partially decommissioned and put into storage with surveillance mode pending final decommissioning at an undetermined future date. These three sites are all owned and operated by Atomic Energy of Canada Limited (AECL), under licences from the regulatory body, the Canadian Nuclear Safety Commission (CNSC) (see section entitled "Competent Bodies and Roles" for more information on the CNSC).

An environmental assessment was completed for the decommissioning of the Bruce Heavy Water Plant at the Bruce Nuclear Site in October 2003 with a decision by the Federal Minister of the Environment to allow the project to proceed through the licensing process. Following a public hearing in February 2004, the applicant was granted a licence on 1 April 2004, for a period of ten years, to carry out decommissioning of the facility.

Some decommissioning of research and mining facilities is taking place and is outlined in section 9.4.4 of this study report.

9.4.2. Location of Nuclear Licensed Sites

For location of nuclear licensed sites please refer to the maps provided by each of the nuclear operators at the following web sites:

Ontario Power Generation (OPG):- www.opg.com/ops/map.asp
Click on "here" at top of map for a detailed printable version showing the OPG nuclear site locations

Bruce Power www.brucepower.com/
Click on "about us", "where" then "map"

Hydro- Quebec www.hydro-quebec.com/en/

New Brunswick Power Corporation www.nbpower.com/en/default.aspx
Click on "nuclear" under "our company" for address details

9.4.3. Nuclear Sector, Customers & Stakeholders

9.4.3.1 Government

Federal government departments and agencies

Nuclear Energy Division
Department of Natural Resources
580 Booth Street
Ottawa, Ontario K1A 0E4

Tel: (+1-613) 995-2870
Fax: (+1-613) 995-0087
www.nrcan.gc.ca/

Uranium and Radioactive Waste Division
Department of Natural Resources
580 Booth Street
Ottawa, Ontario, KIA 0E4
Tel: (+1-613) 996-2395
Fax: (+1-613) 947-4205
www.nrcan.gc.ca/

Atomic Energy of Canada Limited
Kent Street, 5th Floor
Ottawa, Ontario K1A 0S4
Tel: (+1-613) 782-2021112
Fax: (+1-613) 782-2061
www.aecl.ca/

2251 Speakman Drive
Mississauga, Ontario L5K 1B2
Tel: (+1-905) 823 9040
Fax: (+1-905) 403 7301

Canadian Nuclear Safety Commission
280 Slater Street, 4th Floor Reception 8828
P.O. Box 1046, Station B
Ottawa, Ontario K1P 5S9
Tel: (+1-613) 995-5894 or 992
Fax: (+1-613) 995-5086
www.cnsc.gc.ca/

Nuclear waste Management Organisation
www.nwmo.ca

Low level Radioactive Waste Management Office
www.llrwmo.org

Canadian Environmental Assessment Agency
www.ceaa.gc.ca

Nuclear Fuel Waste Bureau
www.nfwbureau.gc.ca

9.4.3.2 Main Site Operators/Licensees

Relevant power utilities

Ontario Power Generation
700 University Avenue
Toronto, Ontario M5G 1X6
Tel: (+1-416) 592-3453
www.opg.com/default2.asp

Bruce Power
P.O. Box 1540
Tiverton, Ontario, NOG 2T0
Tel. 519-361-3550
Fax: 519-361-3325
www.brucepower.com/

Hydro-Québec
75, boul. René Lévesque ouest
Montréal, Québec H2Z 1A4
Tel: (+1-514) 289-3811
Fax: (+1-514) 289-3342
www.hydro-quebec.com/en/

SaskPower Corporation
2025 Victoria Avenue
Regina, Saskatchewan S4P 0S1
Tel: (+1-306) 566-2121
Fax: (+1-306) 566-3523
www.saskpower.com/

New Brunswick Power Corporation
515 King Street
P.O. Box 2000
Fredericton, New Brunswick E3B 4X1
www.nbpower.com/en/index.html

Tel: (+1-506) 458-4342
Fax: (+1-506) 458-4390

9.4.3.3 Regulators

The Canadian Nuclear Safety Commission

On 31 May 2000, the Canadian Nuclear Safety Commission (CNSC) was created as the successor to the Atomic Energy Control Board (AECB), which had served as the regulator of Canada's nuclear industry for more than 50 years. The Commission's creation followed the coming into force of the Nuclear Safety and Control (NSC) Act and its regulations. The NSC Act represented the first major overhaul of legislation governing Canada's nuclear regulatory regime since the AECB was established in 1946. It established a seven-member tribunal (the Commission) to regulate the nuclear industry, and authorised the Commission to hire technical and support staff. The Commission reports to Parliament through the Minister of Natural Resources. The CNSC's mission is to regulate the use of nuclear energy and materials to protect health, safety, security and the environment and to respect Canada's international commitments on the peaceful use of nuclear energy. Under the NSC Act, the CNSC's mandate involves four major areas:

- Regulation of the development, production and use of nuclear energy in Canada;
- Regulation of the production, possession and use of nuclear substances, prescribed equipment and prescribed information;
- Implementation of measures respecting international control of the use of nuclear energy and substances, including measures respecting the non-proliferation of nuclear weapons; and
- Dissemination of scientific, technical and regulatory information concerning the activities of the CNSC and the effects on health and safety and the environment arising from the development and use of nuclear energy and nuclear substances.

The Canadian regulatory system is designed to protect people and the environment from the risks associated with the development and use of nuclear energy and nuclear substances. Companies, medical or academic institutions wishing to operate nuclear facilities or use nuclear substances for industrial, medical or academic purposes must first obtain a licence from the CNSC. It is a fundamental tenet of Canada's regulatory regime that licensees are primarily responsible for safety.

The CNSC's role is to ensure that the applicants live up to their responsibility. The onus is therefore on the applicant or the holder of the license to justify the selection of a site, design, method of construction, and mode of operation of a facility, etc. When issuing a licence, the CNSC must be satisfied that the companies have taken adequate measures to protect health and safety, the environment, security and to respect international commitments, and that the companies are qualified to carry out the licensed activities. Licensing matters for major facilities are carried out in public hearings by the seven-member tribunal. This is one of the most visible functions of the CNSC in the regulation of the nuclear industry.

The CNSC controls the import and export of nuclear materials, nuclear technology and equipment that might be used to develop nuclear weapons (including so-called "dual use items"). CNSC staff play an important role in international activities aimed at the non-proliferation of nuclear weapons. CNSC participates in IAEA activities and ensures compliance with Canada's Nuclear Non-Proliferation policy and the Treaty on the Non-Proliferation of Nuclear Weapons.

CNSC staff inspect licensed activities, enforce compliance with regulations, and develop safety standards. Standards for radiological protection have been developed over the years at both national and international levels. The basis for the Canadian regulatory radiation dose limits originates from the recommendations of the International Commission on Radiological Protection (ICRP).

9.4.3.4 Other Stakeholders

Relevant associations

Uranium Saskatchewan Association Inc.
600 Spadina Crescent East
Saskatoon, Saskatchewan S7K 3G9
Tel: (+1-306) 242-8222
Fax: (+1-306) 244-4441

Canadian Nuclear Association
130 Albert Street, Suite 1610
Ottawa, Ontario K1P 5G4
Tel: (+1-613) 237-9082
Fax: (+1-613) 237-0989

Canadian Electrical Association
60 Slater Street, Suite 1210
Ottawa, Ontario K1P 5H1
Tel: (+1-613) 230-9263
Fax: (+1-613) 230-9326
www.canelect.ca

Electrical and Electronic
Manufacturers Association
10 Carlson Court, Suite 210
Rexdale, Ontario M9W 6L2
Tel: (+1-416) 674-7410
Fax: (+1-416) 674-7412

9.4.3.5 Funding Arrangements

The responsibility for paying for the costs of construction, operation and decommissioning of any nuclear facility rests with the licensee (owner/operator). In order to ensure that the costs of decommissioning will be funded, the CNSC has the power to require financial guarantees of its licensees. The CNSC exercises this power for any licensed activities where the expected cost of decommissioning is considered high enough to warrant requiring a guarantee. A prerequisite to agreeing a financial guarantee is establishment of the amount of that guarantee, which in turn is based on an estimate of decommissioning costs. This estimate is part of the preliminary decommissioning plan required in support of a licence application for any nuclear facility. As these plans are received, they are reviewed and cost estimates agreed upon. Subsequently, the licensee is requested to propose financial guarantee arrangements to cover the full amount of the accepted decommissioning cost estimates. Once these arrangements are acceptable to the Commission, they are referenced in the construction or operating licence.

9.4.4. Canadian Nuclear Sites – Decommissioning Status & Programmes

Current Status Nuclear Power Reactor Sites

No commercial nuclear power reactors are undergoing active decommissioning in Canada. Three prototype power reactors (NPD, Douglas Point and Gentilly-1) have been partially decommissioned and put into storage with surveillance mode pending final decommissioning at an undetermined future date. These three sites are all owned and operated by Atomic Energy of Canada Limited (AECL), under licences from the regulatory body, the Canadian Nuclear Safety Commission (CNSC) (see section entitled "Competent Bodies and Roles" for more information on the CNSC).

An environmental assessment was completed for the decommissioning the Bruce Heavy Water Plant at the Bruce Nuclear Site in October 2003 with a decision by the Federal Minister of the Environment to allow the project to proceed through the licensing process. Following a public hearing in February 2004, the applicant was granted a licence on 1 April 2004, for a period of ten years, to carry out decommissioning the facility.

Atomic Energy of Canada Limited Research Facilities

AECL, which is 100% owned by the Government of Canada, received the Government's concurrence in 1998 to begin the process to decommission its Whiteshell Laboratories facility. The decommissioning of the Whiteshell

Laboratories facility will encompass all of the site facilities, buildings, infrastructure and land affected by nuclear development and operations, including the partially decommissioned WR-1 research reactor. The decommissioning of the facility is planned to take place over a time period that optimizes the advantages of natural radioactive decay against the removal of buildings and structures as they come to the end of their economic and structural life. At this time, a neutron generator and a Van de Graaff accelerator have already been decommissioned.

An environmental assessment under the Canadian Environmental Assessment Act (CEAA) for this facility was completed in March 2002. Following public hearings in September and November 2002, the CNSC issued a decision in December 2002 approving a decommissioning licence for a six-year term for the Whiteshell Laboratories facility. This is intended to cover the first phase of decommissioning and will be part of the larger decommissioning programme for this project.

Other decommissioning projects are continuing at AECL's Chalk River Laboratories facility. Some shutdown buildings have been decommissioned and dismantled, whereas other buildings have been decontaminated and made available for other uses. Other shutdown buildings are in various stages of decommissioning. In particular, the former NRX research reactor at Chalk River is partially decommissioned and in a safe storage mode. AECL is currently seeking approval to carry out decommissioning work on the former fuel bays associated with the NRX reactor, a heavy water upgrading plant, some facilities formerly associated with plutonium extraction, waste water processing plant and a small research reactor.

AECL is also currently preparing a site-wide preliminary decommissioning plan for the Chalk River site and has submitted a proposal for a financial guarantee of decommissioning costs for the nuclear facility. A public hearing was held in September 2004 to assess AECL's progress regarding decommissioning planning with a decision by the Commission expected shortly.

Uranium Mining Facilities

Ontario

Decommissioning the uranium mining facilities in the Elliot Lake area has been completed. Denison Energy Inc. (Stanrock, Denison) and Rio Algom Limited (Quirke, Panel, Stanleigh, plus five smaller sites) continue to manage the sites under licences from the CNSC. In the Bancroft area, Madawaska Mines Limited continues to be licensed for its decommissioned uranium mining facility.

In 2001, the CNSC initiated the Contaminated Lands Evaluation and Assessment Network (CLEAN) programme, whose purpose is to identify and regulate the remediation of radiologically contaminated sites that were associated with the nuclear fuel cycle at various locations in Canada. Several mining sites have been identified, including three in Ontario.

Saskatchewan
This province contains the only currently operating uranium mining facilities. These are all under CNSC licence. In addition, the decommissioned Beaverlodge uranium mining facility continues to be licensed and two former uranium mining facilities, Lorado and Gunnar, are included in the CLEAN programme.

Northwest Territories
Indian and Northern Affairs Canada, under CNSC licence, is managing the Rayrock former mine site in the Northwest Territories. The Port Radium and Contact Lake former uranium mining facilities are included in the CLEAN programme.

Other Facilities
A former research laboratory at Tunney's Pasture in Ottawa has been decommissioned and its site has been released for unrestricted use.
The University of Toronto has completed decommissioning of its subcritical assembly and the facility is no longer licensed. In addition, the University's SLOWPOKE II research reactor has been decommissioned, and the building that housed the reactor has been decontaminated to levels permitting unrestricted use.

9.4.5. Canadian Companies in the Nuclear Sector

All of the major contractors in the Canadian nuclear supply chain are members of the Canadian Nuclear Association (CNA) and links to all of these company web sites can be found on the CNA web site home page at
www.cna.ca/
Click on "English", "Our members".

Links to all of the main Canadian companies and organisations can be found on:-
www.uxc.com/index.html
Click on "industry links" in the box in the top RH corner which leads to a table of regions and company types. Select whichever option is required for information.

Firms involved in the front end of the fuel cycle

Cameco Corporation
2121 – 11th Street West
Saskatoon, Saskatchewan S7M 1J3
Tel: (+1-306) 956-6200
Fax: (+1-306) 956-6302
www.cameco.com/index.html

Uranerz Exploration and Mining Limited
410 – 22nd Street E., Suite 1300
Saskatoon, Saskatchewan S7K 5T6
Tel: (+1-306) 668-1711
Fax: (+1-306) 652-3731

Cogema Resources Inc.
817 – 825, 45th Street West, Box 9204
Saskatoon, Saskatchewan S7K 3X5
Tel: (+1-306) 343-4502
Fax: (+1-306) 653-3883
www.cogema.ca/

Rio Algom Limited
120 Adelaide Street West, Suite 2600
Toronto, Ontario M5H 1W5
Tel: (+1-416) 367-4000
Fax: (+1-416) 365-6870

Denison Mines Limited
Atrium on Bay – Suite 320
40 Dundas Street West
Toronto, Ontario M5G 2C2
Tel: (+1-416) 979-1991
Fax: (+1-416) 979-5893

Candu industry

Monenco Agra Inc.
Monenco Agra Building
2010 Winston Park Drive, Suite 100
Oakville, Ontario L6H 6A3
Tel: (+1-905) 829-5399
Fax: (+1-905) 829-5401

Babcock & Wilcox Canada
P.O. Box 310
581 Coronation Boulevard
Cambridge, Ontario N1R 5V3
Tel: (+1-519) 621-2130
Fax: (+1-519) 621-8550
www.badcock.com

Canatom Inc.
2020 University, Suite 2200
Montréal, Québec H3A 2A5
Tel: (+1-514) 288-1990
Fax: (+1-514) 289-9300
www.canatomnpm.ca

CAE Electronics Ltd.
C.P. 1800
Saint-Laurent, Québec H4L 4X4
Tel: (+1-514) 341-6780
Fax: (+1-514) 341-7699

Dominion Bridge
500 Notre-Dame Street
Lachine, Québec H8S 2B2
Tel: (+1-514) 634-355l
Fax: (+1-514) 631-2668

GE Canada Inc.
Nuclear Products
107 Park Street North
Peterborough, Ontario K9J 7B5
Tel: (+1-705) 748-7509
Fax: (+1-705) 748-7338
www.ge.com

9.4.6. Other Information

9.4.6.1 Sources of Information

Ontario Power Generation
700 University Avenue
Toronto, Ontario M5G 1X6
Tel: (+1-416) 592-3453
www.opg.com/ops/map.asp
Click on "here" at top of map for a detailed printable version showing the OPG nuclear site locations

Bruce Power
P.O. Box 1540
Tiverton, Ontario, NOG 2T0
Tel. 519-361-3550
Fax: 519-361-3325
www.brucepower.com/
Click on "about us", "where" then "map"

Hydro-Québec
75, boul. René Lévesque ouest
Montréal, Québec H2Z 1A4
Tel: (+1-514) 289-3811
Fax: (+1-514) 289-3342
www.hydro-quebec.com/en/

New Brunswick Power Corporation
515 King Street
P.O. Box 2000
Fredericton, New Brunswick E3B 4X1
Tel: (+1-506) 458-4342
Fax: (+1-506) 458-4390
www.nbpower.com/en/default.aspx

Government Departments/Organisations

Federal government departments and agencies

Nuclear Energy Division
Department of Natural Resources
580 Booth Street
Ottawa, Ontario K1A 0E4
Tel: (+1-613) 995-2870
Fax: (+1-613) 995-0087
www.nrcan.gc.ca/

Uranium and Radioactive Waste Div.
Department of Natural Resources
580 Booth Street
Ottawa, Ontario, KIA 0E4
Tel: (+1-613) 996-2395
Fax: (+1-613) 947-4205
www.nrcan.gc.ca/

Atomic Energy of Canada Limited 112 Kent Street, 5th Floor Ottawa, Ontario K1A 0S4	Tel: (+1-613) 782-2021 Fax: (+1-613) 782-2061 www.aecl.ca/
2251 Speakman Drive Mississauga, Ontario L5K 1B2	Tel: (+1-905) 823 9040 Fax: (+1-905) 403 7301
Canadian Nuclear Safety Commission 280 Slater Street, 4th Floor Reception 8828 P.O. Box 1046, Station B Ottawa, Ontario K1P 5S9	 Tel: (+1-613) 995-5894 or 992 Fax: (+1-613) 995-5086 www.cnsc.gc.ca/
Nuclear waste Management Organisation	www.nwmo.ca
Low level Radioactive Waste Management Office	www.llrwmo.org
Canadian Environmental Assessment Agency	www.ceaa.gc.ca
Nuclear Fuel Waste Bureau	www.nfwbureau.gc.ca

Relevant power utilities

Ontario Power Generation 700 University Avenue Toronto, Ontario M5G 1X6	 Tel: (+1-416) 592-3453 www.opg.com/default2.asp
Bruce Power P.O. Box 1540 Tiverton, Ontario, NOG 2T0	Tel. 519-361-3550 Fax: 519-361-3325 www.brucepower.com/
Hydro-Québec 75, boul. René Lévesque ouest Montréal, Québec H2Z 1A4	Tel: (+1-514) 289-3811 Fax: (+1-514) 289-3342 www.hydro-quebec.com/en/
SaskPower Corporation 2025 Victoria Avenue Regina, Saskatchewan S4P 0S1	Tel: (+1-306) 566-2121 Fax: (+1-306) 566-3523 www.saskpower.com/
New Brunswick Power Corporation 515 King Street P.O. Box 2000 Fredericton, New Brunswick E3B 4X1	 Tel: (+1-506) 458-4342 Fax: (+1-506) 458-4390 www.nbpower.com/en/index.html

High energy research institutes

Canadian Institute for Synchrotron Radiation (CISR)	www.uwo.ca/cisr/index.html

TRIUMF (Canada)	www.triumf.ca/
Centre canadien de fusion magnétique (CCFM)	www.ccfm.ireq.ca/
INRS – Energie et Matériaux	www.inrs-ener.uquebec.ca/
Plasma Physics Laboratory at the University of Saskatchewan	www.physics.usask.ca/research/plasma.htm

Universities

University of Saskatchewan	www.usask.ca/
University of Western Ontario	www.uwo.ca/

Other organizations

Canadian Centre for Occupational Health and Safety (CCOHS)	www.ccohs.ca/
Canadian Coalition for Nuclear Responsibility (CCNR)	www.ccnr.org/
Friends of the Earth (Canada)	www.foecanada.org/
War, Peace and Security WWW Server (Department of National Defence, Canada)	www.cfcsc.dnd.ca/
Energy Council of Canada (ECC)	www.energy.ca/
Canadian Nuclear Association	www.cna.ca/
Canadian Nuclear Society (CNS)	www.cns-snc.ca/
Atlantic Nuclear Services Ltd. (ANSL)	www.ansl.ca/
Can Nuke Technologies Ltd	www.cannuke.com/
International Energy Foundation (IEF)	www.cableregina.com/nonprofits/ief/Index.htm

9.5 Japanese Nuclear Decommissioning Market Summary

9.5.1. Introduction & Current Status

Japan ranks third worldwide for installed nuclear capacity, behind the United States and France. Japan currently has 53 reactors with an installed capacity of 45 GW. By 2010, 20 of these will be over 30 years old. The Japanese Government plans to maximise the use of existing facilities until around 2030 and they will gradually be replaced (and decommissioned) with new reactors. Japan's government has indicated that it is still committed to increasing nuclear power's share of generating capacity in the future, but many independent analysts think that the target of a 41% nuclear share of electric power generation by 2011 is unlikely to be achieved. Public opposition to Japan's nuclear power programme has increased in reaction to a series of incidents/accidents at Japanese nuclear plants.

In August 1998, the Atomic Energy Commission approved the construction of a new light-water reactor, which will be built in Higashidori in Aomori prefecture in northern Japan. Also, in March 1999, the Japanese Nuclear Safety Commission approved plans for Hokuriku Electric Power Company to build a new nuclear power plant in the central town of Shika, which will be operational by 2006. The status of other nuclear facilities includes:-

- **Reprocessing Plant:** Japan's first commercial reprocessing plant in Rokassho, Aomori Prefecture is currently undergoing uranium commissioning. Japan Nuclear Fuel Limited (JNFL), the operator of the plant, plans to commence active commissioning using spent fuel in December 2005 and commercial operation in May 2007.
  In the meantime, Japan is negotiating with the French firm COGEMA for the reprocessing of spent nuclear fuel in France. COGEMA may continue to reprocess some spent fuel even after the Rokkasho plant is operational. The estimated lifetime of the plant is about 40 years.
- **MOX Fuel Fabrication Plant:** JNFL, the operator of the plant, signed an agreement with the local government of Aomori Prefecture in April 2005 for the construction of the MOX fabrication plant. JNFL is planning to commence operation of the plant from around April 2012 for about 40 years.
- **Interim Storage of the Spent Fuel:** Tokyo Electric Power Company and Japan Atomic Power Company who are owners/operators of the storage facility are requesting Aomori Prefecture government for approval to begin construction. They are planning to use the facility from around 2010 for about 50 years.

- **Storage of Returned LLW:** The construction of the storage for LLW that will be returned from France and UK is currently planned from 2009. It should, however, be noted that the government is currently discussing a possibility of substituting multiple returns of LLW with a single shipment of an HLW as proposed by BNFL. The construction of the storage is contingent upon the outcome of the government policy discussions.
- **Uranium Enrichment Plant:** A Uranium enrichment plant has been in operation since 1992. It is anticipated the plant will operate until 2047.

Status of Nuclear Power Plants in Japan

A table showing the status of nuclear power plants in Japan can be found in table 6 of the IAEA country profile for Japan at: www-pub.iaea.org/MTCD/publications/PDF/CMPP2003/CMPP-Webpage/countryprofiles/Japan/Japan2003.htm

9.5.2. Location of Nuclear Licensed Sites

A map showing the location of nuclear power plants in Japan can be found in section 2.1 of the IEAE country profile at the same website provided above.

9.5.3. Nuclear Sector, Customers & Stakeholders

Current Organisation Chart for Nuclear Power in Japan

A chart showing the organisation for nuclear power in Japan in the IAEA country profile for Japan can be found at the website address provided above.

The Japanese government carried out administrative reforms in January 2001 and now the Atomic Energy Commission and Nuclear Safety Commission (NSC) of the Cabinet Office gives high-level independent direction to other ministries and agencies.

The Ministry of Education, Culture, Sports, Science and Technology (MEXT) was created through a merger between the former Ministry of Education, Science, Sports and Culture and the Science and Technology Agency (STA). In MEXT, three Bureaus and four Divisions are in charge of nuclear energy. MEXT is responsible for the administration of nuclear energy for science and technology. Its key roles are:

- nuclear research and development including nuclear fuel cycle
- FBR, quantum research, fusion, and accelerators

- utilisation of radiation and radioisotopes, nuclear liability, safety regulation and disaster prevention for nuclear reactors for testing and research
- use of nuclear fuel material, and regulation for ensuring peaceful use and safeguards.

It is also responsible for supervision of the National Institute of Radiological Science, the Japan Atomic Energy Research Institute and the Japan Nuclear Cycle Development Institute.

The Ministry of Economy, Trade and Industry (METI) is in charge not only of those areas that it had been involved in previously, as the Ministry of International Trade and Industry (MITI), or aspects taken over from STA related to the nuclear fuel cycle business (refining, enrichment, fabrication, reprocessing and waste disposal), but also regulation of nuclear reactors including Monju and Fugen, that are in the research and development stage for use in generating electricity. Nuclear power-related issues will continue to be the responsibility of the Agency of Natural Resources and Energy. In addition, the Nuclear and Industrial Safety Agency (NISA), with its ten sections related to nuclear energy, has been added as a special institution, to play a central role in safety regulations for industrialised nuclear power. NISA is responsible for regulating nuclear safety. The drafting of safety regulations and the licensing of milling and refining, nuclear fuel fabrication, spent nuclear fuel reprocessing and storage, disposal of radioactive waste and decommissioning of nuclear power plants, are now carried out by NISA. A double check system of safety review of nuclear facilities by NSC and NISA or MEXT is continuously adopted.

The Ministry of Foreign Affairs (MoFA) is responsible for the international aspects of nuclear energy utilization, including the implementation of the related international treaties and conventions.

9.5.3.1 Government & Regulation

National Atomic Energy Authority
Atomic Energy Commission (AEC)
c/o Cabinet Office
Central Government Building No. 4, 7F
3-1-1 Kasumigaseki, Chiyoda-ku
Tokyo, Japan

Tel.: +81-3 3581 6690
Fax: +81-3 3581 9827
www.aec.jst.go.jp/

Nuclear Safety Commission of Japan (NSC)
3-1-1, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8970 Japan

Tel: +81-3-3581-9919
Website: www.nsc.jst.go.jp/

Government Organisations

Ministry of Education, Culture, Sports,
Science and Technology (MEXT)
2-2-1 Kasumigaseki, Chiyoda-ku
Tokyo, Japan
Tel.: +81-3 5253 4160
Fax: +81-3 5253 4162
www.mext.go.jp/

Ministry of Economy, Trade
and Industry (METI)
1-3-1 Kasumigaseki, Chiyoda-ku
Tokyo, Japan
Tel.: +81-3 3501 1991
Fax: +81-3 3508 8447
www.meti.go.jp/

Ministry of Foreign Affairs (MoFA)
2-11-1 Shibakouen, Minato-ku
Tokyo, Japan
Tel.: +81-3 6402 2598
Fax: +81-3 6402 2593
www.mofa.go.jp/index.html

9.5.3.2 Other Stakeholders

Japan Atomic Energy Research Institute (JAERI)
Office of Planning
14-1, Suehiro-cho, Kashiwa-shi,
Chiba Prefecture
Tel: +81-4-7142-2400
Fax: +81-4-7142-2419
www.jaeri.go.jp/

Japan Nuclear Cycle Development Institute (JNC)
Executive Office for Policy Planning and Administration
4-49, Muramatsu
Tokai-Mura
Naka-Gun, Ibaraki Prefecture
Tel: +81-29-282-1122
Fax: +81-29-282-4917
www.jnc.go.jp/

Nuclear Power Engineering Corporation (NUPEC)
Safety Information Research Centre
1-8, Toranomon 4-Chome
Minato-ku, Tokyo
Tel: +81-3-4512-2500
Fax: +81-3-4512-2600
www.nupec.or.jp/

Japan Atomic Industrial Forum Inc. (JAIF)
Department of Information & Research
2-13, Shiba-daimon 1-Chome
Minato-ku, Tokyo
Tel: +81-3-5777-0750
Fax: +81-3-5777-0760
www.jaif.or.jp/

Japan Nuclear Energy Safety Organization (JNES)
Fujita Kanko Toranomon Bldg., 3-17-1
Toranomon, Minato-ku, Tokyo
Tel: +81-3-4501-1111
www.jnes.go.jp

9.5.3.3 Main Site Operators/Licensees

The Federation of Electric Power Companies (FEPCO)
Nuclear Power Department
9-4, Otemachi 1-Chome
Chiyoda-ku, Tokyo
Tel: +81-3-3279-2187
Fax: +81-3-3241-1780
www.fepc.or.jp/

Hokkaido Electric Power Co., Inc. (HEPCO)
Higashi 1-Chome, Ohdori
Chuoku, Sapporo
Tel: +81-11-251-1111
www.hepco.co.jp/

Tohoku Electric Power Co., Inc. (TOHOKU)
7-1, Ichibancho 3-Chome
Aoba-ku, Sendai
Tel: +81-22-225-2111
www.tohoku-epco.co.jp/

Tokyo Electric Power Co., Inc. (TEPCO)
1-3, Uchisaiwai-cho
1-Chome, Chiyoda-ku, Tokyo
Tel: +81-3-3501-8111
www.tepco.co.jp/

Chubu Electric Power Co., Inc. (CHUBU)
Ichibanchi Toshin-Cho,
Higashi-ku, Nagoya
Tel: +81-52-951-8211
www.chuden.co.jp/

Hokuriku Electric Power Co., Inc. (HOKURIKU)
15-1, Ushijima, Toyama
Tel: +81-76-441-2511
www.rikuden.co.jp/

Kansai Electric Power Co., Inc. (KEPCO)
3-22, Nakanoshima 3-chome
Kita-ku, Osaka
Tel: +81-66-441-8821
www.kepco.co.jp/

Chugoku Electric Power Co., Inc. (CHUGOKU)
4-33, Komachi
Naka-ku, Hiroshima
Tel: +81-82-241-0211
www.energia.co.jp/

Shikoku Electric Power Co., Inc. (SHIKOKU)
2-5, Marunouchi,
Takamatsu
Tel: +81-87-821-5061
www.yonden.co.jp/

Kyushu Electric Power Co., Inc. (KYUSHU)
2-1-82, Watanabe-Dori,
Chuo-ku, Fukuoka
Tel: +81-92-761-3031
www.kyuden.co.jp

Japan Atomic Power Co., Inc. (JAPCO)
6-1, 1-Chome, Otemachi,
Chiyoda-ku, Tokyo
Tel: +81-3-3201-6631
www.japc.co.jp/

Central Research Institute of
Electric Power Industry (CRIEPI)
www.criepi.denken.or.jp/

Fuel cycle

Japan Nuclear Cycle Development Institute (JNC)
4-49, Muramatsu, Tokai-Mura, Naka-Gun, Ibaraki Prefecture
Tel: +81-29-282-1122
www.jnc.go.jp/

9.5.3.4 Funding Arrangements

A METI ordinance stipulates that a licensee must reserve a certain amount of money to a decommissioning fund during its plant operation prior to start of decommissioning. The total cost for the decommissioning of a nuclear power plant (BWR or PWR of 1,100MWe) was estimated at approximately 30 billion JPY in 1984 and the cost of the radioactive waste treatment and disposal was estimated approximately 18 billion JPY in 1999.

9.5.4 Japanese Nuclear Sites, Decommissioning Status & Programmes

9.5.4.1 Current Status

There are 52 nuclear power plants and 10 research reactors operating in Japan. Several experimental nuclear facilities have been decommissioned or are in a planning stage of final shutdown for decommissioning in research organisations. Thus far, the Nuclear ship "Mutsu" and the Japan Power Demonstration Reactor (JPDR) have been decommissioned in the Japan Atomic Energy Research Institute (JAERI).

The JAERI reprocessing test facility (JRTF) and the Japan Research Reactor No.2 (JRR-2) decommissioning projects are the current major activities related to decommissioning in JAERI. In terms of nuclear power plants, the Tokai Power Station (Gas Cooled Reactor), which is the first commercial nuclear power plant of the Japan Atomic Power Company (JAPC), completed its commercial use in March 1998. This is the first case of decommissioning a commercial nuclear power plant in Japan. The decommissioning programme started at the end of 2001 after submitting the decommissioning programme to the competent authority. The programme is divided into three phases; none or low radioactive components such as the turbine and the steam generators will be dismantled in the first and second phases. The reactor components will be dismantled in the third phase after about 10 year's safe storage. In addition, the Fugen Nuclear Power Plant, which is the prototype advanced thermal reactor operated by the Japan Nuclear Cycle Development Institute (JNC), was shut down permanently in March 2003, and the defuelling from the core was also finished in August. Preparatory studies on decommissioning the Fugen are now on going in JNC.

9.5.5. Japanese Companies in the Nuclear Sector

- The only company that has had some decommissioning experience in Japan thus far is JAPCO and they are seeking to position decommissioning in their future business line up. Other companies listed below are major players in the nuclear reactor construction/maintenance business and could be potential players in decommissioning services. At this stage, however, they are simply gauging potential business opportunities and how the market will evolve. They have all showed some level of interest in NDA decommissioning opportunities in the UK.
- The Japan Atomic Power Company Co Ltd (JAPCO): JAPCO is the owner and operator of Japan's first commercial nuclear power plant, Tokai Power Station. In 2001, JAPCO launched the first (and so far only) decommissioning of a commercial nuclear power plant in Japan with the Tokai Power Station. So far, they have completed one-third of the overall decommissioning process which is due to take 17 years. They aim to commence demolition of the reactor in 2011. The overall process will cost around £465m. It was recently reported in a news bulletin that JAPCO is planning to accumulate decommissioning knowledge and expertise with this experience and seek new business opportunities as many Japanese reactors will be facing the need to decommission around 2010. JAPCO's decommissioning information can be found at:- www.japc.co.jp/english/decommi/decommi-index-e.htm
- Toshiba – Nuclear Energy System and Services Division: Constructed its first nuclear power plant in the late 1920s. Involved in construction of the world's first ABWR for Tokyo Electric Power Company. Involved in nuclear business comprehensively as a designer, supplier and architectural engineer.
  www.toshiba.co.jp/product/abwr/english/index.htm
- Hitachi: Have been in the nuclear business for over 40 years and were also involved in the construction of the world's first ABWR for Tokyo Electric Power Company. It owns Hitachi Babcock KK
  www.bhk.co.jp/english/index.html
  which produces nuclear related equipment as their subsidiary. (Hitachi has no English site on nuclear but here is a link to the Japanese site www.pi.hitachi.co.jp/Div/power/index.html)
- Mitsubishi Heavy Industries Ltd. – Nuclear Organisation: Mitsubishi has been engaged in nuclear business for more than three decades. Since commencing research into and development of nuclear power generation in the 1950s, Mitsubishi has taken part in the design,

manufacture and construction of a large number of very successful PWR power plants. Mitsubishi is the only organisation to produce such a large range of supplies for nuclear power generation, including Architectural Engineering, Nuclear Steam Supply System, Turbine Generator Systems, Electrical Systems, I & C Systems, and Nuclear Fuel and also the Balance of Plant. Mitsubishi is enthusiastically developing a new generation of nuclear power plants such as the APWR, the fast breeder reactor, the high temperature gas cooled reactor and the nuclear fusion reactor. As a comprehensive nuclear plant manufacturer, they are also engaged in the supply of fuel cycle-related equipment and the implementation of R & D programmes.
www.mhi.co.jp/atom/hq/atome_e/index.html

- Ishikawajima Harima Heavy Industries Co., Ltd (IHI): IHI has started its nuclear business with power reactors and nuclear ship development. They have been in the business for more than 40 years.

Links to all of the main Japanese companies and organisations can be found on:-
www.uxc.com/index.html
Click on "industry links" in the box in the top RH corner which leads to a table of regions and company types. Select whichever option is required for information. A number of the power companies listed have web sites in English and advertise procurement opportunities and provide invitations to new suppliers together with their procedures for doing so.

Also use the web site information for the main operators given in section 9.5.3.3. above for procurement opportunities.

9.5.6 Other Information

9.5.6.1 Sources of Information

A Japanese Government related organisation that promotes trade and investment web site:-
www.jetro.go.jp/
This is a good place to start for any company considering Japan as an export market

The Nuclear & Industrial Safety Agency (NISA) has links on its web site to a number of Regional Bureaus of Economy, Trade and Industry in Japan in English which are a good source of information.
www.nisa.meti.go.jp/english/
Click on LINK in the LH menu.

9.6 Swedish Nuclear Decommissioning Market Summary

9.6.1. Introduction & Current Status

Most of Sweden's electricity is produced by hydropower or nuclear power, with conventional thermal power production accounting for only about 5 %. Oil-fired cold condensing power plants and gas turbines are used today primarily as reserve capacity during years with low precipitation and resulting low hydropower production. Restructuring of the electricity market has resulted in several reserve power stations being taken out of use for economic reasons. There are also about 500 wind power plants in the country (as of August 2000). As yet, however, their contribution to the country's electricity balance is still very small, amounting to 0.2 % during 1999.

Sweden has eleven nuclear units representing a total capacity of 9.4 GW(e). In 2001, the electricity generated by the nuclear power plants amounted to 69.2 TWh and supplied some 43.8 % of the total electricity production of the country. Nuclear power generation in Sweden during 2001 was 69.2 TWh; about the same as during 1998 and 1999. Table 1 shows the status of the Swedish Nuclear Power Plants.

A Central Interim Storage Facility for Spent Nuclear Fuel; CLAB, has been in use since 1986 and a Final Repository for Reactor Waste, SFR, has been in operation since 1988. SFR is being used for medium- and low-activity waste. Both these storage facilities can house with minor extensions all the spent fuel and reactor waste produced in Swedish reactors up to the year 2010 and beyond. CLAB is situated in the neighbourhood of the Oskarshamn nuclear power plant and SFR is close to Forsmark nuclear power plant. The Äspö Rock Laboratory for waste disposal experiments in the bedrock at 500 metres depth was completed in 1995 and is situated close to the Oskarshamn nuclear power plant.

Table 1. Status of Sweden's Nuclear Power Plant

Station	Type	Capacity	Operator	Status	Reactor Supplier	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
BARSEBÄCK-2	BWR	600	BKAB	Operational	ASEAATOM	1-Jan-73	20-Feb-77	21-Mar-77	01-Jul-77	
FORSMARK-1	BWR	968	FKA	Operational	ASEAATOM	01-Jun-73	23-Apr-80	06-Jun-80	10-Dec-80	
FORSMARK-2	BWR	964	FKA	Operational	ASEAATOM	01-Jan-75	16-Nov-80	26-Jan-81	07-Jul-81	
FORSMARK-3	BWR	1155	FKA	Operationa	IASEAATOM	01-Jan-79	28-Oct-84	05-Mar-85	18-Aug-85	
SKARSHAMN-1	BWR	485	OKG	Operational	ASEAATOM	01-Aug-66	12-Dec-70	19-Aug-71	06-Feb-72	
OSKARSHAMN-2	BWR	605	OKG	Operational	ASEA	01-Sep-69	06-Mar-74	02-Oct-74	01-Jan-75	
OSKARSHAMN-3	BWR	1160	OKG	Operational	ASEAATOM	01-May-80	29-Dec-84	03-Mar-85	15-Aug-85	
RINGHALS-1	BWR	830	VAB	Operational	ASEAATOM	01-Feb-69	20-Aug-73	14-Oct-74	01-Jan-76	
RINGHALS-2	PWR	875	VAB	Operational	WEST	01-Oct-70	19-Jun-74	17-Aug-74	01-May-75	
RINGHALS-3	PWR	915	VAB	Operational	WEST	01-Sep-72	29-Jul-80	07-Sept-80	09-Sep-81	
RINGHALS-4	PWR	915	VAB	Operational	WEST	01-Nov-73	19-May-82	23-Jun-82	21-Nov-83	
BARSEBÄCK-1	BWR	600	BKAB	Shut Down	ASEAATOM	01-Feb-71	18-Jan-75	15-May-75	01-Jul-75	30-Nov-99
AGESTA	PHWR	10	VAB	Shut Down	ASEA	001-Dec-57	17-Jul-63	01-May-64	01-May-64	02-Jun-74
Marviken	HWLWR	130	VAB	Never started	ASEA					

9.6.2. Location of Swedish Nuclear Licensed Sites

A map showing the Swedish nuclear facilities can be accessed by clicking on the English version of the homepage at:
www.ski.se/

At the top of the page click on nuclear activities and select facilities from the dropdown box.

9.6.3. Nuclear Sector, Customers and Stakeholders

The operators and some of the owners of Swedish nuclear power plants are shown on the following website. Some additional information about the power utilities is given in Table 1 above. It should be mentioned that all the operators are relatively independent of their mother organisations when it comes to technical capability.

The structure of the nuclear power sector in Sweden is provided in the IAEA country profile at:

www-pub.iaea.org/MPCD/publications/PDF/cnpp2003/CNPP-Webpage/countryprofiles/Sweden/Sweden2003.htm

9.6.3.1 Government & Regulators

National Atomic Energy Authority

Ministry of the Environment
S-103-33 Stockholm
Sweden
Tel: +46 8 405 10 00
Fax: +46 8 24 16 29
Telex: 15499 MINENS

Swedish Nuclear Power Inspectorate
Statens Kärnkraftinspektion (SKI)
S-106 58 Stockholm
Sweden
Tel: +46 8 698 84 00
Fax: +46 8 661 90 86
Telex: 11961 SWEDATOM S
www.ski.se

Swedish Radiation Protection Institute
Statens Strålskyddsinstitut (SSI)
S-171 16 Stockholm
Sweden
Tel: +46 8 729 71 00
Fax: +46 8 729 71 08
Telex: 11771 SAFERAD S
www.ssi.se

Board of the Swedish Nuclear Waste Fund
C/o Kammarkollegiet, Box 2218
S-103 15 Stockholm, Sweden
Tel: +46 8 700 08 00
Fax: +46 8 20 38 81

9.6.3.2 Other Nuclear Organisations

Swedish National Council for Nuclear Waste (KASAM)
c/o Ministry of the Environment
SE-103 33 Stockholm, Sweden
Tel: +46-8 405 17 92
Fax: +46- 8 20 10 66

9.6.3.3 Main Site Owners/Operators/Licensees

The following are all nuclear site licensees:-

Nuclear Power Plant Licensees
Barseback Kraft AB
Forsmark Kraftgrupp AB
OKG Aktiebolag
Ringhals AB

Fuel Fabrication Plant
Westinghouse Electric Sweden AB

Research reactors licensee & waste handling operator
Studsvik Holding AB

Waste handling operators (Licensees)
AB SVAFO
The Swedish Nuclear Fuel & Waste Management Company (SKB)
Ranstad Mineral AB

Others

Vattenfall AB (Company controlled by the government and shareholder with interests in the power plants at Ringhals, Forsmark & Barseback). Vattenfall AB is also licensee of the Agesta (PHWR) reactor under decommissioning.

9.6.3.3.1 Main Power Utilities

Vattenfall AB
S-162 87 Stockholm
Sweden
www.vattenfall.com
Tel: +46 8 739 50 00
Fax: +46 8 37 01 70
www.vattenfall.se or

Sydkraft AB
S-205 09 MALMÖ,
Sweden
Tel: +46 40 25 50 00
Fax: +46 40 97 60 69
www.sydkraft.se

Birka Energi AB
S-115 77 Stockholm
Sweden
Tel: +46 8 671 70 00
Fax: +46 8 671 70 60
www.BirkaEnergi.se

9.6.3.3.2 Nuclear Plant Operators and Subsidiaries

Ringhals AB
S-430 22 Väröbacka,
Sweden
(operator of Ringhals NPP and owner of both Ringhals NPP and Barsebäck NPP)
Tel: +46 340 66 70 00
Fax: +46 340 66 51 84
www.ringhals.se

Barsebäck Kraft AB
Box 524
S-246 25 Löddeköpinge, Sweden
(operator of Barsebäck NPP)
Tel: +46 46 72 40 00
Fax: +46 46 77 57 93
www.sydkraft.se/bkab

OKG AB
S-573 83 Oskarshamn
Sweden
(operator of Oskarshamn NPP)
Tel: +46 491 860 00
Fax: +46 491 869 20
www.okg.se

Forsmark Kraftgrupp AB
S-742 03 Östhammar
Sweden
(operator of Forsmark NPP)

Tel: +46 173 810 00
Fax: +46 173 551 16
www.forsmark.se
www.forsmark.com (valid from Dec. 01)

Svensk Kärnbränslehantering AB (SKB)
Box 5864
S-102 40 Stockholm, Sweden

Tel: +46 8 665 28 00
Fax: +46 8 661 57 19
www.skb.se

Kärnkraftsäkerhet och Utbildning AB (KSU)
Box 1039
S-611 29 Nyköping, Sweden

Tel: + 46 155 26 35 00
Fax: +46 155 26 30 74
www.ksu.se

9.6.3.4 Funding Arrangements

The Act on the Financing of Future Expenses for spent Nuclear Fuel regulates requirements for funding future costs for final disposal of spent fuel and for the decommissioning of nuclear facilities (including the NPP's). The Act on the Financing the Management of Certain Radioactive Waste regulates fees and reimbursements for the decommissioning of some research reactors and some older nuclear installations. Future costs are covered by a funding system met by the owners of the nuclear power plants. If the fund does not cover the costs there is an additional system, a system of securities, to cover the unforeseen costs. The SKI is responsible for an annual review of the nuclear power industry's cost estimates for waste management and for proposing the size of the fees and guarantees to the government, which then establishes the fee. The Board of the Nuclear Waste Fund manages the fund.

9.6.4. Swedish Nuclear Sites, Decommissioning Status & Programmes

Sweden has currently only decommissioned and dismantled a number of small research reactors and laboratories, in Studsvik and in Stockholm. The research reactors were zero power reactors, or in one case a reactor with a capacity of less than 1 MW(Th). The spent fuel is in interim storage pending decision on final management, and dismantled radioactive material is either in a final repository or kept in interim storage. Regarding power reactors, the Ågesta reactor, PHWR, 65 MW(th) and 12 MW(e) was shut down 1974 and is partially decommissioned and the Barsebäck 1 reactor, BWR, 650 MW (e) was shut down in November 1999 and is now de-fuelled. Barseback 2 reactor was closed on 31st May 2005 as a consequence of a political decision.

9.6.4.1 Fuel Cycle and Waste Management

Swedish utilities import all their need of uranium and enrichment services. Westinghouse (previously ABB Atom) manufactures reactor fuel both for BWRs and PWRs. Half of the deliveries are to utilities abroad. The Swedish utilities buy part of their fuel elements from abroad. The spent fuel from all the Swedish nuclear power plants is transported by boat to the central interim storage CLAB. The facility started operation in 1985 and is situated close to the Oskarshamn nuclear power plant. It has been substantially expanded during the last few years.

Some low level waste is finally disposed of at local dumps and some of it is incinerated at Studsvik. All other waste from reactor operation is transported to SFR, the final repository for radioactive operational waste, in operation since 1988. SFR is located close to the Forsmark nuclear power plant. Most of the waste from decommissioning of the reactors will be disposed at SFR.

Svensk Kärnbränslehantering AB, SKB (Swedish Nuclear Fuel and Waste management Company) has built and owns the CLAB, SFR and the Äspö Hard Rock Laboratory. SKB acts on behalf of the nuclear utilities in conducting the extensive research and development and demonstration work with regard to the remaining facilities for final disposal of long-lived spent nuclear fuel. SKB is also responsible for co-ordination and investigations regarding the costs for nuclear waste and future decommissioning. SFR and CLAB are operated by Forsmark Kraftgrupp and OKG respectively on behalf on SKB. SKB is jointly owned by the Swedish utilities (Vattenfall 36%, Forsmark Kraftgrupp 30%, OKG 22% and Barsebäck Kraft 12%).

The SKB on behalf of the power plant operators is planning a final repository for spent fuel and nuclear waste. This is being carried out under a research and development programme. Full information is available on the following web site:-
www.skb.se/

9.6.5. Swedish Companies in the Nuclear Sector

The Foratom web site has a list of Swedish companies working in their nuclear industry, most with links to their company web sites providing details of their products/services together with contact information. See:-
www.foratom.org
Click on “links” on the homepage, then “companies” in LH menu and scroll down to Sweden.

Links to a number of the main Swedish companies and organisations can be found on:-
www.uxc.com/index.html
Click on “industry links” in the box in the top RH corner which leads to a table of regions and company types. Select whichever option is required for information. A number of the power companies listed have web sites in English and advertise procurement opportunities and provide invitations to new suppliers together with their procedures for doing so.

Maintenance services are supplied by Westinghouse Electric Sweden AB (previously ABB Atom) Westinghouse Electric Sweden AB – Tekniska Röntgencentralen, Alstom Power (previously ABB Stal) and several other Swedish companies. Major maintenance service companies in Germany, France and UK are often engaged at the Swedish nuclear power plants.

Suppliers of NPP's, Components and Services

Westinghouse Electric Sweden AB S-721 63 Västerås, Sweden	Tel: +46 34 70 00 Fax: +46 21 18 71
www.westinghousenuclear.com/B2b7.asp	
Tekniska Roentgencentralen AB Box 121 SE-183 22 Täby, Sweden	Tel: +46 8 630 81 00 Fax: +46 8 630 82 01
Alstom Power Sweden AB S-612 72 Finspång Sweden	Tel: +46 122 810 00 Fax: +46 122 197 000 www.se.alstom.com
Sandvik AB S- 811 81 Sandviken Sweden Studsvik AB S-611 82 Nyköping Sweden	Tel: +46 26 26 00 00 Fax: +46 26 26 13 50 www.sandvik.se/ Tel: +46 155 22 10 00 Fax: +46 155 26 30 00 www.studsvik.se/
SQC Kvalificeringscentrum AB Box 519 SE-183 25 Täby, Sweden	Tel: +46-8 638 71 10 Fax: +46-8 638 71 20
Det Norske Veritas Nuclear Technology AB Box 49306	Tel: +46-8 587 940 00 Fax: +46-8 651 70 43

SE-100 29 Stockholm, Sweden	www.dnv.com
ES-konsult Gustavslundsvägen 151 G SE-167 51 Bromma, Sweden	Tel: +46 8 634 22 40 Fax: +46 8 634 22 55 www.eskonsult.se

9.6.6 Other Information

9.6.6.1 Sources of Information

Stockholm International Peace Research Institute (SIPRI)	www.sipri.se
Natural Science Research Council (NFR)	www.nfr.se

9.7 Russian Nuclear Decommissioning Market summary

9.7.1. Introduction & Current Status

Thermal power (oil, natural gas, and coal-fired) accounts for roughly 63% of Russia's electricity generation, followed by hydropower (21%) and nuclear (16%). The Russian government has stated that it intends to expand the role of nuclear and hydropower generation in the future to allow for greater export of fossil fuels. Russia has an installed nuclear capacity of 22.2 GW, distributed across 31 operational nuclear reactors at 10 locations. However, Russia's nuclear power facilities are aging (albeit at approximately the same rate as other countries), and the nuclear power industry has been hard hit by Russia's transition to a market economy. Surprisingly, 50% of the country's 31 nuclear reactors use the RBMK design employed in Ukraine's ill-fated Chernobyl plant. The working life of a reactor is considered to be 30 years; nine of Russia's plants are between 26 and 30 years old, and six are between 21 and 25 years old. By 2010, Russia plans to construct five new units at existing facilities throughout the country.

The structure of the Russian electricity sector is undergoing change. However it is intended to introduce reforms beginning in 2006. The current structure of the Russian electricity sector can be found at: www.rao-ees.ru/en/reforming/reason/show.cgi?background.htm.

9.7.1.1 Russian Joint Stock Company, Unified Energy System of Russia, – RAO UES of Russia

The company, Unified Energy Systems of Russia dominates the industry as the state-controlled entity implementing Government policy. It has total ownership of the Federal Grid Company, System Dispatch, and runs the Federal Wholesale Electricity Market (FOREM) system which allocates generation capacity and is a forerunner of the coming live generation market. The governments own shareholding is more than 52%, giving it a majority on the Board.

RAO UES in turn holds stakes, many of them controlling stakes, in most of the thermal and hydro generation companies, and in the Energos who also have power and heat generation stations.

Only three Energos, Irkutskenergo in Siberia, Tatenergo in Tatarstan, and Bashkirenergo are independent of RAO UES and are majority owned by their regional governments.

RAO UES therefore manages the integrated electricity system and is primarily responsible for the overall generation, transmission and distribution of electricity and heat. It is accountable for providing a comprehensive and balanced development of the integrated electricity system, including demand forecasting, as well as the design, investment-raising, and construction of our projects.

With its responsibility for implementing the government's programme for electricity reform, in the longer term it will even plan its own demise, when it sells its assets to private investors.
Web site:- www.rao-ees.ru/en/

9.7.1.2 Operating Utility – Rosenergoatom

Separate from ROU OES but with its power supplies co-ordinated through the Federal Wholesale Electricity Market system, the nuclear industry is owned by the Government, through the company Rosenergoatom. Following elimination of the Ministry of Atomic Energy in President Putin's 2004 Government, this stake is now administered through the Ministry of Industry and Energy.

Now the unified generating company concern Rosenergoatom consists of 10 Russian NPP's with 31 reactors having a total installed capacity of 22 2 GWe.

Web site:- www.eng.rosatom.ru/?razdel=0

ROSENERGOATOM performs the functions of the NPP operating utility and bears complete responsibility for maintaining nuclear and radiological safety at all the stages of NPP operation including measures for elimination of nuclear accident consequences, operational support and nuclear power development and decommissioning programmes.

9.7.1.3 Fuel Cycle and Waste Management

The Russian Federation has capabilities in all sections of the nuclear fuel cycle. Where their capacities are exceeded, goods and services are offered to foreign utilities on a commercial basis. Some of the Nuclear Fuel Cycle Facilities are State owned; the other part being managed by joint stock companies (TVEL, Rosenergoatom, Atomstroi, etc.) in which controlling interests are retained by the State. They do not offer current decommissioning opportunities but will do so for the future.

Uranium mining and milling

The Priargunsky Industrial Mining and Chemical Union has a capacity of 3500 t U/a using open pit, underground and ISL extraction methods. This facility is operated by JSC TVEL.

Uranium conversion

Minatom operates Angarsk and Tomsk conversion plants (conversion to UF6), which have a total capacity of 30 000 t U/a. The excess capacities are offered to foreign utilities on a commercial basis.

Enrichment process

The first civil uranium enrichment plant in the Russian Federation started operation in 1964 at Ekaterenburg. Three more plants came into operation later at Tomsk, Angarsk and Krasnoyarsk. At present, Minatom operates all four plants, which have a total capacity of 15 000 t SWU/a. The excess capacities are offered to foreign utilities on a commercial basis.

Fuel fabrication

Nuclear fuel fabrication is carried out by JSL TVEL at two plants: Electrostal and Novosibirsk. Electrostal produces fuel elements, assemblies, powder and pellets for WWER 440, WWER 100, BN 600, RBMK and PWR reactors. The Novosibirsk plant manufactures fuel elements and assemblies for WWER 1000 reactors. In the production of fuel assemblies for RBMK and WWER 1000 reactors, a quantity of fuel pellets is supplied from the Ust Kamenogorsk plant (Kazahstan). However, new lines for powder and pellet production at the Novosibirsk plant started operation in 2000-2002. Zirconium production for nuclear fuel fabrication capacity (fuel assemblies for different reactor types) of JSC TVEL is about 2600n HM/a. The excess capacities are offered to foreign utilities on a commercial basis.

Reprocessing

The reprocessing option is the one followed for dealing with spent reactor fuel, with the exeption of that originating from RBMKs, the spent fuel of which should be disposed of. Minatom operates the RT-1 Plant in Chelyabinsk for reprocessing fuel from WWER plant's capacity for WWER 440 fuel is 400 t HM/a. The construction of a second reprocessing plant (RT-2) at Krasnoyarsk, which has a first line design capacity of 800 t HM/a has been postponed indefinitely. Reprocessed uranium is used for RBMK fuel production. Plutonium obtained at RT-1 is temporarily stored on-site in dioxide form. Minatom operates several wet AFR fuel storage facilities at RT-1 and RT-2, and at several nuclear power plants, which have a total capacity of about 16 000 t.

9.7.1.4 The G8 Global Partnership

At the 2002 G8 summit at Kananaskis in Canada, leaders pledged to provide up to $20 billion over ten years for a new Global Partnership against the spread of weapons and materials of mass destruction. The Prime Minister announced that the UK would make available up to $750 million to fund projects in pursuit of the Partnership's aims. This funding will allow the UK to significantly expand its work to address the nuclear, chemical and biological legacies of the Former Soviet Union (FSU).

The Department of Trade and Industry is responsible for establishing and directing the UK Government's involvement in this programme. The Ministry of Defence (www.dti.gov.uk/energy/nuclear/fsu/mod) is responsible for a similar programme of UK Assistance to Russia, to help manage the destruction
of chemical weapons stocks. The Foreign and Commonwealth Office (www.fco.gov.uk) have a particular interest in two specific programmes – Disposition of Surplus Plutonium and Closed Nuclear Cities.

The Department of Trade and Industry (DTI), website is the focal point for information on UK assistance towards managing the FSU nuclear legacy:- www.dti.gov.uk/energy/nuclear/fsu. Those interested in keeping up to date on the latest developments in each project and programme should visit the web site. This provides full information on projects associated with the Nuclear Safety Programme, N W Russia, Aktau Decommissioning, Closed Nuclear Cities and Social Consequences of NPP Closure.

Table 1. Status of Nuclear Power Plants

Station	Type	Net Capacity	Operator	Status	Reactor Supplier	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
KOVO-1	WWER	950	REA	Operational	MNE	01-Dec-80	12-Dec-85	28-Dec-85	23-May-86	
BALAKOVO-2	WWER	950	REA	Operational	MNE	01-Aug-81	02-Oct-87	08-Oct-87	18-Jan-88	
BALAKOVO-3	WWER	950	REA	Operational	MNE	01-Nov-82	16-Dec-88	25-Dec-88	08-Apr-89	
BALAKOVO-4	WWER	950	REA	Operational	MNE	01-Apr-84	03-Apr-93	11-Apr-93	22-Dec-93	
BELOYARSKY-3	FBR	560	REA	Operational	MNE	01-Jan-69	26-Feb-80	08-Apr-80	01-Nov-81	
BILIBINO UNIT A	LWGR	11	REA	Operational	MNE	01-Jan-70	11-Dec-73	12-Jan-74	01-Apr-74	
BILIBINO UNIT B	LWGR	11	REA	Operational	MNE	01-Jan-70	07-Dec-74	30-Dec-74	01-Feb-75	
BILIBINO UNIT C	LWGR	11	REA	Operational	MNE	01-Jan-70	06-Dec-75	22-Dec-75	01-Feb-76	
BILIBINO UNIT D	LWGR	11	REA	Operational	MNE	01-Jan-70	2-Dec-76	27-Dec-76	01-Jan-77	
KALININ-1	WWER	950	REA	Operational	MNE	01-Feb-77	10-Apr-84	09-May-84	12-Jun-85	
KALININ-2	WWER	950	REA	Operational	MNE	01-Feb-82	25-Nov-86	03-Dec-86	03-Mar-87	
KOLA-1	WWER	411	REA	Operational	MNE	01-May-70	26-Jun-73	29-Jun-73	28-Dec-73	
KOLA-2	WWER	411	REA	Operational	MNE	01-Jan-73	30-Nov-74	09-Dec-74	21-Feb-75	
KOLA-3	WWER	411	REA	Operational	MNE	01-Apr-77	07-Feb-81	24-Mar-81	03-Dec-82	
KOLA-4	WWER	411	REA	Operational	MNE	01-Aug-76	07-Oct-84	11-Oct-84	06-Dec-84	
KURSK-1	LWGR	925	REA	Operational	MNE	01-Jun-72	25-Oct-76	19-Dec-76	12-Oct-77	
KURSK-2	LWGR	925	REA	Operational	MNE	01-Jan-73	16-Dec-78	28-Jan-79	17-Aug-79	
KURSK-3	LWGR	925	REA	Operational	MNE	01-Apr-78	09-Aug-83	17-Oct-83	30-Mar-84	
KURSK-4	LWGR	925	REA	Operational	MNE	01-May-81	31-Oct-85	02-Dec-85	05-Feb-86	
LENINGRAD-1	LWGR	925	REA	Operational	MNE	01-Mar-70	12-Sep-73	21-Dec-73	01-Nov-74	
LENINGRAD-2	LWGR	925	REA	Operational	MNE	01-Jun-70	06-May-75	11-Jul-75	11-Feb-76	
LENINGRAD-3	LWGR	925	REA	Operational	MNE	01-Dec-73	17-Sep-79	07-Dec-79	29-Jun-80	
LENINGRAD-4	LWGR	925	REA	Operational	MNE	01-Feb-75	29-Dec-80	09-Feb-81	29-Aug-81	
NOVOVORONEZH-3	WWER	385	REA	Operational	MNE	01-Jul-67	22-Dec-71	27-Dec-71	29-Jun-72	
NOVOVORONEZH-4	WWER	385	REA	Operational	MNE	01-Jul-67	25-Dec-72	28-Dec-72	24-Mar-73	
NOVOVORONEZH-5	WWER	950	REA	Operational	MNE	01-Mar-74	30-Apr-80	31-May-80	20-Feb-81	
SMOLENSK-1	LWGR	925	REA	Operational	MNE	01-Oct-75	10-Sep-82	09-Dec-82	30-Sep-83	
SMOLENSK-2	LWGR	925	REA	Operational	MNE	01-Jun-76	09-Apr-85	31-May-85	02-Jul-85	
SMOLENSK-3	LWGR	925	REA	Operational	MNE	01-May-84	01-Dec-89	17-Jan-90	30-Jan-90	
ROSTOV-1	WWER	950	REA	Operational	MNE	01-Sep-81	17-Feb-01		30-Mar-01	
KALININ-3	WWER	950	REA	Under Constr.	MNE	01-Oct-85				
KURSK-5	LWGR	925	REA	Under Constr.	MNE	01-Dec-85				

Station	Type	Net Capacity	Operator	Status	Reactor Supplier	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
SOUTHURALS 1										
SOUTHURALS										
BILIBINO E										
BILIBINO F	LWGR	31	REA	Planned						
BILIBINO G	LWGR	31	REA	Planned						
BN-1600	FBR	1500	REA	Planned						
SOUTH URALS 3	FBR	750	REA	Planned						
BELOYARSKY-1	LWGR	102	REA	Shut Down		01-Jun-58	01-Sep-63	26-Apr-64	26-Apr-64	01-Jan-83
BELOYARSKY-2	LWGR	146	REA	Shut Down		01-Jan-62	10-Oct-67	29-Dec-67	01-Dec-69	01-Jan-90
NOVOVORONEZH-1	WWER	197	REA	Shut Down		01-Jul-57	17-Dec-63	30-Sep-64	31-Dec-64	16-Feb-88
NOVOVORONEZH-2	WWER	336	REA	Shut Down		01-Jul-64	23-Dec-69	27-Dec-69	14-Apr-70	29-Aug-90

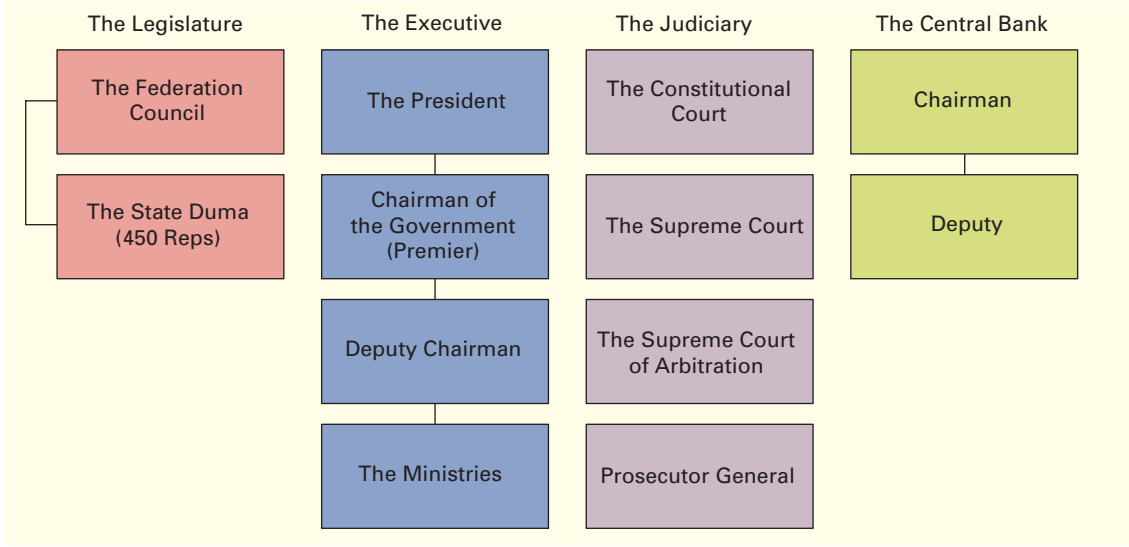
9.7.2. Location of Nuclear Licensed Sites

A map showing the location of Russian nuclear power plants with links to their websites can be found at: www.eng.rosatom.ru/?razdel=12

9.7.3. Nuclear Sector, Customers & Stakeholders

9.7.3.1 Government

Fig 3.1: Branches of Power



Government Ministries

President: Vladimir Vladimirovich Putin (President since May 7, 2000)
Prime Minister: Mikhail Fradkov (since March, 2004)
Minister of Economic Development and Trade: German Oskarovich Gref
Minister of Finance: Aleksey Leonidovich Kudrin
Minister of Industry and Energy: Viktor Borisovich Khristenko
Minister of Natural Resources: Yuriy Trutnev

The newly formed Ministry of Industry and Energy of the Russian Federation www.mpe.gov.ru (in Russian only) comprises the Federal Atomic Energy Agency www.minatom.ru/ (in Russian) as well as the Federal Atomic Supervisory Service (Gosatomnadzor, which had previously been under the office of the prime minister) www.gan.ru/ (in Russian). In accordance with the presidential decree, the Atomic Energy Agency's functions include legislation implementation issues and state and government property management services, (which were also Minatom's responsibility). The decree also places the agency under the Defence Ministry in matters related to the nuclear defence complex.

The reorganisation of Minatom and creation of the Atomic Energy Agency are part of a major reorganisation of the structure of the Russian government that took place in the run-up to the country's 14th March 2004 presidential election.

9.7.3.2 Regulators

The Russian Federal Supervision of Nuclear and Radiological Safety (Gosatomnadzor) is the Nuclear Regulatory Body of the Russian Federation with the headquarters in Moscow and seven regional offices throughout the country. Within the last year President Putin has announced that the country's three main regulatory bodies, in the fields of nuclear, environment and technology, were being united in one organisation: the Federal Environmental, Technological and Atomic Supervisory Service.

Web site (in Russian only): www.gan.ru

9.7.3.3 Main Site Operators/Licensees

The unified generating company Rosenergoatom comprises 10 Russian Nuclear Power Plants with 31 operational reactors and a total installed capacity of 22.2 GW (electrical).

Details of all 10 Nuclear Plants together with recent operational history can be found on their web site at www.eng.rosatom.ru/?razdel=0

Some links to nuclear plant's web sites (Some in English) are given below

These provide details of staff structure, contacts etc and will provide a valuable source of information

Balakovo NPP:	www.balaes.ru
Volgodonsk NPP:	www.rosnpp.org.ru
Kalinin NPP:	www.knpp.ru
Kola NPP:	www.kolanpp.ru/english/index.html
Kursk NPP:	www.kunpp.ru
Leningrad NPP:	www.laes.sbor.ru
Novovoronezh NPP:	www.nvnpp.vrn.ru

9.7.3.4 Funding Arrangements

A number of countries have pledged funding for the Global Partnership, details of which can be found in the G8 Global Partnership Report on progress during 2004, available on the DTI web site: www.dti.gov.uk/energy/nuclear/fsu.

9.7.4. Russian Nuclear Sites, Decommissioning Status & Programmes

The Commonwealth of Independent States (CIS) and other countries that made up the former Soviet Union have inherited a significant legacy of nuclear facilities. These facilities were constructed during the period 1950-70 within a programme for the production of both electrical power and nuclear weapons material that paralleled similar programmes in Western Europe and North America. Russia, as the country with the majority of nuclear facilities, now has some 15 VVER (pressurised water) Nuclear Power Plants (NPPs), 17 RBMK or similar (watergraphite) reactors, 13 further graphite moderated industrial reactors used for the production of plutonium, 1 fast reactor and, according to a 1993 report by Gosatomnadsor, there were at the last count, 45 research reactors, 52 critical assemblies and 18 subcritical assemblies. The shut down of all these reactors and their associated supporting facilities, such as reprocessing and waste treatment facilities, leaves a major nuclear decommissioning legacy. Since the break-up of the Soviet Union and its communist economy, the funds that have been available for this decommissioning have been, at best, limited or non-existent.

A report entitled " Review of Existing & Future Requirements for Decommissioning Nuclear Facilities in the CIS" prepared in 1999 provides the results of a study funded by the Directorate General XI of the European Commission (EC) on a review of existing and future requirements for decommissioning nuclear facilities in the CIS including Russia. The report provides an overview of the current state in CIS countries concerning

decommissioning requirements for a number of nuclear facilities with the power reactors being the largest decommissioning liability. The objective was to establish the technical conditions and requirements for decommissioning nuclear facilities in the CIS-countries. The study is part of the European Union co-operation with individual CIS Member States. Although it was produced in 1999 the information in it about nuclear sites is largely relevant today and it contains information on the site owners and operators and also funding for decommissioning. It can be accessed at:- www.europa.eu.int/comm/energy/nuclear/publications/doc/eur18945.pdf

Decommissioning
Five civil reactors are currently being decommissioned: an experimental LWGR type at Obis which started up in 1954, and four larger units, two AMB 100/200 units at Bezoars and two prototype VVER-440 units at Novovoronezh, a V-210 and V-365 type, which wait dismantling.

Fuel Cycle Facilities
Many of Russia's fuel cycle facilities were originally developed for military use and hence are located in former closed cities in the country. Their locations are shown in fig 2 above.

Nuclear Legacy of the Former Soviet Union
Web site: www.dti.gov.uk/energy/nuclear/fsu

The DTI web site provides information on the programmes set up to manage the FSU nuclear legacy including:-

- The nuclear safety programme
- Closed nuclear cities
- North West Russia
- Aktau Decommissioning
- Social consequences of plant closure

Details of countries covered, Government policies, programmes, project profiles, business opportunities etc; are all included together with useful links.

9.7.5. Russian Companies/Organisations in the Nuclear Sector

Links to a number of the main Russian companies and organisations can be found on:-
www.uxc.com/index.html
Click on "industry links" in the box in the top RH corner which leads to a table of regions and company types. Select whichever option is required for information. A number of the power companies listed have web sites

in English and advertise procurement opportunities and provide invitations to new suppliers together with their procedures for doing so.

Nuclear Research Facilities and Waste Repositories

Institutes

The Nuclear Safety Institute (IBRAE)

Web site:- www.ibrae.ac.ru/english/menu_eng.html

The main feature of the Institute activity is a safety analysis of nuclear power facilities and fuel/power complex (FPC) using complex computer codes integrating the bases of prediction, theoretical, experimental and operating knowledge.

The Russian Research Centre _ Kurchatov Institute

Web site:- www.kiae.ru/

Dollezhal Research and Development Institute of Power Engineering (NIKIET)

The Research and Development Institute of Power Engineering (NIKIET) is one of Russia's largest centres for nuclear engineering and technology, with sites in Moscow and in the Urals.

Web site:- www.nikiet.ru/eng/index.html

Joint Stock Company JSC TVEL

Web site:- www.tvel.ru/jsctvel.htm

JSC TVEL is a manufacturer and supplier of Russian nuclear fuel. It is a company within the nuclear complex of the Ministry of the Russian Federation for Atomic Energy. It is a state-owned holding monopoly, which manufactures and supplies fresh nuclear fuel to atomic, research, propulsion and commercial reactors in Russia, as well as to power and research reactors worldwide.

TENEX

Web site:- www.tenex.ru/sitemap_en.html

Foreign economic JSC "Techsnabexport" carries out export of goods and services, produced by enterprises of the Russian Federation Federal Agency for Atomic Energy as well as import of state-of-the-art technological, medical and other types of equipment.

The unique feature of JSC "Techsnabexport" includes delivery of an entire range of nuclear fuel cycle products and services.

Export and import operations are performed by the specialised incorporated companies:

- Directorate for Uranium Products
- Department of isotope products
- Department of non-nuclear materials
- Department of spent nuclear fuel

General Director: Vladimir A Smirnov

Others include:-

The State Scientific and Research Institute for Energy Policy (SSRIEP)

Russian Scientific Research Centre (RSC) Kurchatov Institute
Web site:- www.kiae.ru

State Scientific Centre (SSC NIIAR) – "Nuclear Reactor Research Institute"
Web site:- www.niiar.simbirsk.su/eng/riarsb.htm

State Departments under the previous Ministry for Atomic Energy:

- TVEL (fuel fabrication);
- Progress (construction and industrial holding company);
- Atomstroi (construction company);
- Spetsatommontazh (industrial company);
- Spetsstroimaterialy (construction materials for nuclear industry);
- Tekhsnabexport (export company);
- Eleron (security technology company).

Some Companies in Supply of Nuclear Power Plants

These companies have web sites but if not provided they are in Russian.

Architect engineers:
- All-Russia Scientific Research and Design Institute of Power Technology (VNIPIET), St. Petersburg;
- Institute "Atomenergoproekt" (AEP), and its branches in Moscow, St. Petersburg, Nizhny
Novgorod;
- State Institute of Construction and Design (GSPI), Moscow.

NSS main suppliers:
- "Atommash", an open-end joint stock company – NSS WWER-1000, BN and AST, Volgodonsk;

- “Izhorskie zavody”, an open-end joint stock company – NSS WWER-1000 and WWER-440, St.
Petersburg;
www.omz.ru/eng/overview/profile/

Main component suppliers:
- “Leningradskiy metallicheskiy zavod”, an open-end joint stock company – turbines for NPP’s, St. Petersburg;
www.english.power-m.ru/themes/english
- “Podolskiy mashinostroitelniy zavod”, an open-end joint stock company – steam generators, separators, piping, etc.

9.7.6 Other Information

9.7.6.1 Sources of Information

Procurement Web sites
Procurement web sites include:-

European Funding
www.europa.eu.int/comm/europeaid/tender/index_en.htm
Click on tender and calls for proposals notices
Click on tenders and grants
The display provides advice on how to obtain details of EU external aid projects including:-
PHARE/ISPA/SAPARD
TACIS
CARDS/OBNOVA
And also project global forecasts.

EUROPA Grants and Loans
The Grants & Loans website is the starting point on Europa for anyone looking for information on funding available from the European Union.

Concise information is provided in the form of fact sheets on each funding programme managed by the European Commission. Among other data are the programme’s objectives, the type of funding, the conditions and procedure for participation and important deadlines. For more detailed information, links are provided to the other relevant websites.

Although the information on this site is constantly checked and updated by the Commission departments, the Commission accepts no liability for it. Only the official legal texts are authentic.

Grants and loans web site:- www.europa.eu.int/grants/info/about_en.htm

European Bank EBRD
www.ebrd.org/index.htm
The homepage provides links to information about EBRD. Check on "Countries and Sectors" Check out Russia for projects, opportunities and how to apply for financing.

UK Trade & Investment

www.uktradeinvest.gov.uk

Provides information on country profiles, doing business, opportunities, events, websites and contacts.

Nuclear Legacy of the Former Soviet Union
Web site: www.dti.gov.uk/energy/nuclear/fsu

The DTI web site provides information on the programmes set up to manage the FSU nuclear legacy including:-

- The nuclear safety programme
- Closed nuclear cities
- North West Russia
- Aktau Decommissioning
- Social consequences of plant closure

Details of countries covered, Government policies, programmes, project profiles, business opportunities etc; are all included together with useful links.

Topical briefs on the programme and presentation material from a DTI Contractors Seminar on the Nuclear Safety Programme at Warrington on 8th June 2004 have been provided to NNC separately.

Institute of Direct Investments
Investment opportunities in Russia
www.ivr.ru/english/indexen.shtml
Provides information on investment projects, business opportunities, investment monitoring, investment news, analysis, regional investments and regional regulations.

Investment projects in Russia
www.investproject.ru/eng/
A completely open information source dedicated to direct investments in Russia. Self filling data bases on investors, investment projects and consultants.

Russian Joint Stock Company, Unified Energy System of Russia, – RAO UES of Russia

Web site:- www.rao-ees.ru/en/

RAO UES
In 2002 RAO UES launched e procurement to improve visibility and transparency of its $3 billion annual purchases. The system is comprehensive and open to internal suppliers but is only available in the Russian language. It offers substantial information on projects, programmes, documentation etc, major market players and even on line trading. The system can be accessed at :-www.b2b-energo.ru

Trade Agreements

The EU's relations with Russia is described on the following web site:-

www.eur.ru/en/index.htm

This provides information on:

- The EU and Russia
- Co-operation programmes with Russia
- Tenders and grants

The EU-Russia Technology Centre
www.technologycentre.org/
The EU-Russia Technology Centre is a platform for enhancing industrial co-operation in the energy sector between Russia and the European Union.

The Technology Centre was created with the aim of promoting new and advanced energy technologies and facilitating the attraction of investment financing for priority projects in the energy sector in Russia.

An area of activity of the Centre is the project facilitation service. The project facilitation service supports the development of the most promising new energy technology projects to a level that will attract interest from financing organisations and potential private investors.

The Technology Centre includes an important **Energy Information Point**, which provides up-to-date information on EU and Russian energy policies and technologies to public visitors. The Centre is equipped with latest information technologies such as an Internet corner and a video conferencing facility.

Department for International Development

Web Site:- www.britemb.msk.ru/development/info.html
Conduct a quick search by inserting "DFID"
The British Government has been providing assistance to Russia through its share of multilateral assistance and bilaterally, since 1991. The Department for International Development (DFID) is the British Government Department responsible for this assistance. DFID contributes to multilateral agencies working in Russia including the World Bank, EBRD,UN Agencies and the EU TACIS Programme.

The British Embassy in the Russian Federation web site itself is also worth a look:-
www.britemb.msk.ru/

9.8 Spanish Nuclear Decommissioning Market Summary

9.8.1. Introduction & Current Status

Spain has a total of eleven nuclear facilities, including seven nuclear power plants which contain a total of nine operational nuclear reactors. These are:

- Almaraz I & II, Ascó I & II
- Cofrentes, José Cabrera
- Santa María de Garoña
- Trillo 1 and Vandellós 1 and Vandellós 2

The country also has a nuclear fuel factory, Juzbado and a low and medium-level radioactive waste repository, El Cabril. The Jose Cabrera plant is to be closed in 2006. Nuclear power generates a significant proportion of Spain's power supply, but the Spanish Prime Minister has announced that Spain will gradually replace nuclear power with energy from renewable resources.

Table 1.1: Status of Nuclear Power Plants

Station	Type	Gross Capacity	Operator	Status	Reactor Supplier	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
ALMARAZ-1	PWR	973.5	CNA	Operaional	WEST	02-Jul-73	05-Apr-81	01-May-81	01-Sep-83	
ALMARAZ-2	PWR	982.6	CNA	Operational	WEST	02-Jul-73	19-Sept-83	08-Oct-83	01-Jul-84	
ASCO-1	PWR	1028	ANA	Operaional	WEST	16-May-74	16-Jun-83	13-Aug-83	10-Dec-84	
ASCO-2	PWR	1015	ANA	Operational	WEST	07-Mar-75	11-Sept-85	23-Oct-85	31-Mar-86	
COFRENTES	BWR	1025	ID	Operational	GE	09-Sept-75	23-Aug-84	14-Oct-84	11-Mar-85	
JOSE CABRERA (ZORITA)	PWR	160	UF	Operational	WEST	24-Jun-64	30-Jun-68	14-Jul-68	13-Aug-69	30-Apr-06
SANTA MARIA DE GARONA	BWR	466	NUCLENOR	Operational	GE	02-May-66	05-Nov-70	02-Mar-71	11-May-71	
TRILLO-1	PWR	1066	CNT	Operational	KWU	17-Sept-79	14-May-88	23-May-88	06-Aug-88	
VANDELLOS-2	PWR	1087	ANV	Operational	WEST	29-Dec-80	14-Nov-87	12-Dec-87	08-Mar-88	
VANDELLOS-1	PWR	508	HIFRENSA	Shut down	CEA	21-Jun-68	11-Feb-72	06-May-72	01-Aug-72	31-Jul-90

9.8.2. Location of Nuclear Licensed Sites

A map showing the location of nuclear licensed sites in Spain can be found in section 2.2.1 of the IAEA country profile for Spain at:

www-pub.iaea.org/MTTCD/publications/PDF/cnpp2003/CNPP-Webpage/countryprofiles/Spain/Spain2003.htm

9.8.3. Nuclear Sector, Customers & Stakeholders

9.8.3.1 Competent Bodies and Roles

ENRESA was constituted in 1984 as the company responsible for the management of radioactive wastes in Spain and its responsibilities include the decommissioning of nuclear installations. ENRESA is a state company whose shareholders are the CIEMAT (Centre for Energy-Related, Environmental and Technological Research) and SEPI (State Industrial Holding Company). ENRESA operates as a management company, its role being to develop radioactive waste management programmes in accordance with the policy and strategy approved by the Spanish Government.

The Ministry of Industry, Tourism and Trade is responsible for ensuring compliance with the nuclear legislation and for the awarding of operating licenses, subject to a binding assessment report by the CSN. The CSN was created in 1980 as the sole competent organisation in the field of nuclear safety and radiological protection, and in general is responsible for regulating and supervising nuclear installations. This organisation, governed by a legal statute, is independent from the Administration and reports directly to Parliament.

The Ministry of the Environment participates in the licensing process, in collaboration with the CSN, for approval of the environmental impact report, a process which also includes the participation of the regional and local authorities in areas falling within their respective areas of competence.

9.8.3.2 Government

Ministry of Industry, Tourism and Trade
www2.mityc.es/en-us/index.htm
Click on “welcome” at top RH corner for English version, then “energy” in top RH menu. Select “nuclear & radioactive facilities”.

9.8.3.3 Regulators

Consejo de Sequridad Nuclear (CSN)
Nuclear Safety Council
www.csn.es (not in English)

9.8.3.3 Main Site Owners/Licensees

In Spain, there are four large electricity producers: Endesa, Iberdrola, Unión Eléctrica and Hidroeléctrica del Cantábrico. The largest are the first two mentioned companies.

Endesa was totally privatised in 1998. Since then Endesa has bought a number of other smaller electricity companies. Iberdrola was created in 1991.
www.endesa.es (English)
www.iberdrola.com/ (English)

The Union Fenosa Group (UEF), an electric power generation and distribution company, owns all or part of four of the plants, Jose Cabrera,Almaraz 1 &2 and Trillo.
www.uef.es/ (in English)

Centrales Nucleares Almarez Trillo, AEI (CNAT) is a joint facilities management company operating Almarez and Trillo NPP's.
www.cntrillo.es/ (Spanish only)

Links to the web sites of all the Spanish NPP's can be found on the Spanish Nuclear Industry Forum web site at:-
www.foronuclear.org/ (English)

Table 3.1: Spain's Nuclear Power Plant Owners

Station	Owner	Output (Mw)	Type	In Service
José Cabrera	Unión Fenosa Generación, S.A.	160.0	P.W.R.	1968
Sta. Mª Garoña	Nuclenor, Iberdrola Generación, S.A.(50%) y Endesa Generación, S.A. (50%)	466.5	B.W.R.	1971
Almaraz I	Iberdrola Generación, S.A. (52,7%), Endesa Generación, S.A. (30.6%) Unión Fenosa Generación (11,3%)	973.5	P.W.R.	1981
Ascó I	Endesa Generación, S.A.(100%)	1032.5	P.W.R.	1983
Almaraz II	Iberdrola Generación, S.A. (52,7%), Endesa Generación, S.A.(36%) Unión Fenosa Generación (11,3%)	982.6	P.W.R.	1983
Cofrentes	Iberdrola Generación, S.A.	1092.0	B.W.R.	1984
Ascó II	Endesa Generación, S.A.(85%), Iberdrola Generación, S.A. (15%)	1027.2	P.W.R.	1985
Vandellós II	Endesa Generación, S.A.(72%), Iberdrola Generación, S.A. (28%)	1087.1	P.W.R.	1987
Trillo	Iberdrola Generación, S.A. (48%), Nuclenor (2%). UFenosa G. (34,5%) Hidroeléctrica Cantábrico (15,5%),	1067.0	P.W.R.	1988

9.8.3.4 Other Stakeholders

CIEMAT is a public technological research and development agency in the service of the Ministry of Science and Technology. Its main objectives are:

- to forward solutions to enhance the use of energy generation resources and systems
- develop alternative energy sources; solve the problems of Spanish firms in the energy field, as well as its repercussion on the environment.

www.ciemat.es/index.html (English). The site includes some decommissioning information of its research facilities. See "safety & decommissioning" on the home page for the present decommissioning status of their facilities.

ENUSA is a supplier of enriched uranium for Spanish plants www.gui.uva.es/~polyfemo/enusa/nusa.html (Spanish only)

ENRESA is a waste management company www.enresa.es (in English). Click on "public service" at the top of the home page then "activities" for nuclear and mining decommissioning status. Includes decommissioning reports and tenders.

9.8.3.5 Funding Arrangements

In Spain the costs of radioactive waste management and the decommissioning of nuclear installations are financed by the producers of the wastes. The financing of these responsibilities is by way of a fund set up for this purpose. The system established for transfers to this fund makes a distinction between two types of producers, the nuclear power sector and other radioactive waste producers.

9.8.4. Spanish Nuclear Sites, Decommissioning Status & Programmes

9.8.4.1 Current Status

Spanish experience of the decommissioning of nuclear installations includes the decommissioning of the Vandellós I Nuclear Power Plant, remedial actions for decommissioning the Andújar Uranium Mill, the restoration of nineteen disused uranium mines and some research facilities.

Vandellós I Nuclear Power Plant, with its 500 MWe graphite-gas reactor, is the first one to be dismantled in Spain. Taking into account the specific characteristics of the Vandellós I plant, ENRESA carried out studies to define the most feasible strategy from the technical and economic points of view.

In 1997, licensing for decommissioning occurred with a favourable report from the CSN, along with the "Environmental Impact Statement" from the Ministry of the Environment. In 1998, the Ministry of Industry and Energy (MINER) issued its authorisation to allow the Vandellós I Stage 2 Decommissioning and Dismantling Project to proceed and for the transfer of site responsibility to ENRESA. The main decommissioning activities of Vandellós I started following post operational clean out, the conditioning of spent fuel and the treatment of operational wastes including the graphite components from fuel elements. These activities continued to June 2004. Following the Level 2 stage of decommissioning, the facility was prepared for the period of dormancy and a large part of the site was released. Following the stage 2 dismantling, the dormancy period, currently under way and estimated at some 30 years, will be followed by the total dismantling of the remaining parts of the plant (stage 3). This will leave the site completely free for subsequent unrestricted use.

The Andújar Uranium Mill was an installation at which ore was treated to obtain uranium concentrates from 1959 to 1981. As a result of the process, 1,200,000 tons of tailings were left, containing low concentrations of certain natural radionuclides from the original ore. At the end of 1986, ENRESA took the responsibility for the development of the "Site Decommissioning and Dismantling Plan". Eventually, documentation relating to the Environmental Assessment of the project was prepared and the different aspects of the engineering project were completed. In 1992, work began on remodelling of the tailing piles, demolition of the buildings and installations, reshaping slopes to improve stability, construction of an engineered cover and incorporation of the resulting material into the aforementioned piles. The work, which was finished in 1994, resulted in the safe, long-term stabilisation of the tailing dykes and the environmental restoration of the surroundings.

From 1999 to 2001, ENRESA developed a restoration plan for "Disused uranium mines", the objective of which was to recover the land altered by these facilities. The project included the protection of surface and groundwater, the sealing and closure of shafts and chimneys, and the re-vegetation of the areas to reduce the impact on the environment and the landscape.

Other facilities related to the front end of the fuel cycle, such as the Saelices el Chico uranium mine and mill closed down in 2001. Restoration activities are going on at present and are scheduled for completion by the year 2008.

Regarding research facilities, three small research reactors are currently in a safe shutdown situation, with their fuel elements removed, pending the initiation of decommissioning work. In particular the decommissioning of the

CIEMAT Research Centre includes the dismantling of obsolete and shut-down facilities such as the research reactor JEN-I, a pilot reprocessing plant, a fuel fabrication facility, a conditioning plant for liquid waste and a liquid waste storage facility. Most of these facilities were shutdown in the early eighties and the objective of the decommissioning plan is to release the site for conventional use. The dismantling works were planned to start in 2005 and will last for about four years.

The definite shutdown of José Cabrera Nuclear Power Plant is planned for mid 2006 and planning studies for dismantling activities were started in 2003. Actual decommissioning work will not begin before 2009, after the fuel is removed from the ponds.

9.8.5. Spanish Companies in the Nuclear Sector

The Foratom web site has a list of 21 Spanish companies working in the Spanish nuclear industry, many with links to their company web sites providing details of their products/services together with contact information. See:-
www.foratom.org
Click on “links” on the homepage, then “companies” in the LH menu and scroll down to Spain.
Links to 14 of the main Spanish companies and organisations can be found on:-
www.uxc.com/index.html
Click on “industry links” in the box in the top RH corner which leads to a table of regions and company types. Select whichever option is required for information.

The Spanish Nuclear Industry Forum web site has a link to its member’s web sites on its home page. Click on “members” in the LH menu to access this:-
www.foronuclear.org/

9.8.6 Other Information

9.8.6.1 Sources of Information

Government
Ministry of Industry, Tourism and Trade
www2.mityc.es/en-us/index.htm

Regulatory
Nuclear Safety Council (CSN)
www.csn.es (not in English)

NPP Owners/Operators
The Union Fenosa Group (UEF), an electric power generation and distribution company, owns all or part of four of the plants, Jose Cabrera, Almaraz 1 &2 and Trillo.
www.uef.es/ (in English)

Endesa was totally privatised in 1998. Since then Endesa has bought a number of other smaller electricity companies. Iberdrola was created in 1991.
www.endesa.es (English)
www.iberdrola.com/ (English)

Centrales Nucleares Almarez Trillo, AEI (CNAT) is a joint facilities management company operating Almarez and Trillo NPP's.
www.cntrillo.es/ (Spanish only)

Nuclear Related Organisations

CIEMAT is a public technological research and development agency in the service of the Ministry of Science and Technology. Its main objectives are to forward solutions to enhance the use of energy generation resources and systems; develop alternative energy sources; solve the problems of Spanish firms in the energy field, as well as its repercussion on the environment.
www.ciemat.es/index.html (English)

ENUSA is a supplier of enriched uranium for Spanish plants
www.gui.uva.es/~polyfemo/enusa/nusa.html (Spanish only)

ENRESA is a waste management company
www.enresa.es (in English). Click on "public service" at the top of the home page then "activities" for nuclear and mining decommissioning status. Includes decommissioning reports and tenders.

Trade Organisations

The Spanish Nuclear Industry Forum
Links to the web sites of all the Spanish NPP's can be found on the Spanish Nuclear Industry Forum web site at:-
www.foronuclear.org/ (English).

Also includes a list of Spanish member companies in the Spanish nuclear industry under "members".
The Foratom web site has a list of 21 Spanish companies working in the Spanish nuclear industry, many with links to their company web sites providing details of their products/services together with contact information.
See:-
www.foratom.org
Click on "links" on the homepage, then "companies" in the LH menu and scroll down to Spain.

Links to 14 of the main Spanish companies and organisations can be found on:-
www.uxc.com/index.html
Click on "industry links" in the box in the top RH corner which leads to a table of regions and company types. Select whichever option is required for information.

9.9 Ukraine Nuclear Decommissioning Market Summary

9.9.1. Introduction & Current Status

At present, the Nuclear Energy Industry of the Ukraine includes the Nuclear Power Plants, uranium ore mining, processing and enrichment facilities, facilities for producing metallic zirconium and hafnium, R&D Institutes, maintenance and repair enterprises and the enterprises for Nuclear Power Plant construction.

The nuclear power sector represents one of the most important components of the energy industry of Ukraine. The production of electricity by the nuclear power sector remains stable providing the national economy with electricity for at least 40% of the overall needs. The Ukraine currently has 15 operational reactors with a total capacity of 12095 MWe. It also has four units that are shutdown or decommissioned.

The Ukraine is planning to create all of the facilities necessary for a complete national nuclear fuel cycle which it forecasts will be available by 2010.

The table on the next page indicates the status of the Ukrainian nuclear power plants.

Table 1.1 Status of Nuclear Power Plants

Station	Type	Net Capacity	Operator	Status	Reactor Supplier	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
KHMELNITSKI-1	WWER	950	NNEGC	Operational	PAIP	01-Nov-81	10-Dec-87	31-Dec-87	13-Aug-88	
ROVNO-1	WWER	381	NNEGC	Operational	PAIP	01-Aug-73	17-Dec-80	31-Dec-80	21-Sep-81	
ROVNO-2	WWER	376	NNEGC	Operational	PAIP	01-Oct-73	19-Dec-81	30-Dec-81	30-Jul-82	
ROVNO-3	WWER	950	NNEGC	Operational	PAIP	01-Feb-80	11-Nov-86	21-Dec-86	16-May-87	
SOUTH UKRAINE-1	WWER	950	NNEGC	Operational	PAA	01-Mar-77	09-Dec-82	31-Dec-82	18-Oct-83	
SOUTH UKRAINE-2	WWER	950	NNEGC	Operational	PAA	01-Oct-79	30-Dec-84	06-Jan-85	06-Apr-85	
SOUTH UKRAINE-3	WWER	950	NNEGC	Operational	PAA	01-Feb-85	01-Sep-89	20-Sep-89	29-Dec-89	
SOUTH UKRAINE-4	WWER	950	NNEGC	Under construction						
ZAPOROZHE-1	WWER	950	NNEGC	Operational	PAIP	01-Apr-80	07-Dec-84	10-Dec-84	25-Dec-85	
ZAPOROZHE-2	WWER	950	NNEGC	Operational	PAIP	01-Jan-81	28-Jun-85	22-Jul-85	15-Feb-86	
ZAPOROZHE-3	WWER	950	NNEGC	Operational	PAIP	01-Apr-82	04-Dec-86	10-Dec-86	05-Mar-87	
ZAPOROZHE-4	WWER	950	NNEGC	Operational	PAIP	01-Apr-83	15-Dec-87	18-Dec-87	14-Apr-88	
ZAPOROZHE-5	WWER	950	NNEGC	Operational	PAIP	01-Nov-85	20-Jul-89	14-Aug-89	27-Oct-89	
ZAPOROZHE-6	WWER	950	NNEGC	Operational	PAIP	01-Jun-86	06-Oct-95	19-Oct-95	16-Sep-96	
KHMELNITSKI-2	WWER	950	NNEGC	Operational		01-Feb-85				
KHMELNITSKI-3	WWER	950	NNEGC	Under Construction		01-Mar-86				
KHMELNITSKI-4	WWER	950	NNEGC	Under Construction		01-Feb-87				
ROVNO-4	WWER	950	NNEGC	Operational		01-Aug-86				
CHERNOBYL-1	LWGR	725	SPE ChNPP	Shut Down	MNE	01-Mar-70	02-Aug-77	26-Sept-77	27-May-78	30-Nov-96
CHERNOBYL-2	LWGR	925	SPE ChNPP	Shut Down	MNE	01-Feb-73	17-Nov-78	21-Dec-78	28-May-79	30-Nov-91
CHERNOBYL-3	LWGR	925	SPE ChNPP	Shut Down	MNE	01-Mar-76	02-Jun-81	03-Dec-81	08-Jun-82	15-Dec-00
CHERNOBYL-4	LWGR	925	SPE ChNPP	Shut Down	MNE	01-Apr-79	26-Nov-83	22-Dec-83	26-Mar-84	26-Apr-86

Research Reactors

Ukraine has two research reactors: in Kiev and in Sebastopol (www.insc.gov.ua).

Research reactor WWR-M is located at the Scientific Centre Institute of Nuclear Research in Kiev. Research reactor IR-100 is located at the Sebastopol Institute of Nuclear Energy and Industry. Nominal capacity is 200 KW which at the moment is shut down.

9.9.2. Location of Nuclear Licensed Sites

A map of the location of nuclear power plants in the Ukraine can be found at: www.insc.gov.ua/maps.html.

9.9.3. Nuclear Sector, Customers & Stakeholders

9.9.3.1 Government

The structure of the ministries involved in the nuclear industry in the Ukraine can be found in the IAEA country profile at: www-pub.iaea.org.

Additional websites:

Ministry of Fuel and Power Industry:- www/mpe.energy.gov.ua (In English)

Ministry of Environment & Natural Resources of Ukraine:- www.menr.gov.ua (English)

9.9.3.2 Regulators

State Nuclear Regulatory Committee of the Ukraine (SNRCU).

The organisational structure and its website can be found at www.kmu.gov.ua/control

Click on authorities, then central executive authorities, then state committees and other central authorities and scroll down to state nuclear regulation committee.

9.9.3.3 Main Site Operators/Licensees

9.9.3.3.1 Energoatom

The National Nuclear Energy Generating Company “Energoatom” (NNEGC “Energoatom”) was set up in accordance with a Government decree in 1996 integrating all of the five nuclear power plants into one single enterprise with the aim of improving the electricity supply for the good of the national economy and the population. A new separate subdivision “Atomcomplekt” has become part of the NNEGC structure. The goal of the subdivision is to purchase the materials and equipment which are needed for the nuclear power industry activity. The new structure implements full commercial NNEGC activity, including nuclear fuel, materials and equipment purchasing.

Web site:- www.energoatom.kiev.ua

Contact data and information for all its licensed sites can be accessed at this web site.

NNEGC ENERGOATOM is included into the list of enterprises that are strategically significant for the economy and security of the country.

This holds the SNRCU licences to:-

- Operate SU NPP
- Operate Kh NPP
- Operate R NPP
- Operate Z NPP

9.9.3.3.2 Structure of Energoatom

The structure of Energoatom can be found in the IAEA country profile for Ukraine at: www-pub.iaea.org.

9.9.3.3.3 Chernobyl NPP

A further State Specialised Enterprise, "Chernobyl NPP" was created in 2001 for the following tasks:-

- Decommissioning of units 1,2,3 of the Chernobyl NPP and other nuclear power plants
- The Chernobyl shelter conversion into an ecologically safe system
- Management of radioactive waste accumulated at the Chernobyl NPP and that generated in the process of plant decommissioning and the Shelter conversion project into an ecologically safe system
- Management of the spent nuclear fuel of the Chernobyl NPP
- Construction and operation of infrastructure facilities required for Chernobyl NPP decommissioning and conversion of the shelter into an ecologically safe system.

Chernobyl NPP holds the SNRCU licenses to:-

- Decommission units 1,2 & 3
- Operate the shelter
- Construct the spent nuclear fuel storage facility – SFSF -2.
- Train personnel, transport radioactive materials & utilise radiation sources

The official site web of Chernobyl NPP:-
www.new.chnpp.gov.ua/eng/index.php?lng=en

This provides full details and information on the status of decommissioning at the shelter and NPP's including:-

- Contacts
- Procurement
- Announcements
- News
- Links

9.9.4. Nuclear Sites, Decommissioning Status and Programmes in Ukraine

The Ukraine has been pursuing the following strategy for spent nuclear fuel management:-

- Construction of on-site and centralised SNF storage facilities
- Scientific development and exploration for selecting a site for disposal of radioactive waste in geological repositories
- Development of scientific-technical and design engineering support to SNF management

The spent nuclear fuel storage facility at the Zaporizhzhya NPP is currently in operation and a storage facility at Chernobyl NPP site is currently under construction.

Energoatom are going to construct a centralised dry storage facility for spent nuclear fuel from the Ukrainian reactors and is at the design stage of the storage facility.

The Chernobyl units are closed down and the spent nuclear fuel is held in the reactors and cooling ponds.

There is nearly a four year delay in the Chernobyl NPP decommissioning due to significant errors in the design of the Spent Nuclear Storage Facility (SFSF-2).

Number 4 unit at Chernobyl which was destroyed by a severe accident in 1986 was subsequently transformed into a shelter facility which remains a significant nuclear hazard. The shelter conversion into an ecologically safe system requires significant financial and material resources and innovative scientific and engineering solutions. Ukraine is unable to solve this problem on its own and is relying on assistance from the IAEA, international organisations and individual states.

The following work is underway within the framework of the shelter implementation plan:-

- Preparation is in progress for construction and installation work needed to stabilise the most hazardous structures in view of their potential collapse
- Implementation of the conceptual design of the safe confinement is in progress
- Implementation of the integrated automated monitoring system design is in progress
- Trial commercial operation of the modernised dust suppression system is in progress.

See section 3 above for the Chernobyl NPP web site which has full details of the decommissioning projects.

9.9.5. Companies in the Nuclear Sector in Ukraine

A list of main suppliers of equipment and services for the Ukraine nuclear power industry is as follows:

Conduct a web search using the Company name where no web details are provided. Few will be available in English.

- The scientific management of NPP development is the "Kurchatov Institute" (Russia)
- www.kiae.ru/
- NPP designers "Kievenergoproject" "Kharkovenergoproject"
- Energy equipment development NIKIET, OKB "Hydropres", NPO, "CKTI" (Russia)
- Equipment production and supply:
  - "Atommash" (Russia)
  - "Izhorsky Plant"(Russia)
  - LMZ PEO "Electrosila"(Russia)
  - Podolsky machine manufacturing plant (Russia)
  - PO "Turboatom" (Ukraine)
  - PO "Zaporozhtransformator" (Ukraine)
  - Khartron-Enkos (Ukraine)
  - Westron (Ukraine)
  - Pump and power equipment machinery plant of Sumy "Nasosenergomash" (Ukraine)

- ABB “Monolit” (Ukraine)
- “ARMA” (Ukraine)
- Ivano-Frankovsk hardware plant (Ukraine)
- Zuev energymechanical plant (Ukraine)
- “Impuls” (Ukraine)
- Kharkov Machinery building plant (Ukraine)

Others include:

- Energorisk:- /www.energorisk.com.ua/
- TVEL:- www.tvel.com.ua/eng/

9.9.6 Other Information

9.9.6.1 Sources of Information

International Nuclear Safety Centre (INSC):- www.insc.gov.ua/

Provides much information on the nuclear industry in the Ukraine and companies in it. Click on “partners” in the LH menu.

Ukrainian Nuclear Society (UKrNS):- www.ukrns.odessa.net

State Scientific and Technical Centre on Nuclear and Radiation Safety (SSTC) www.sstc.kiev.ua/.