Non classifié/Unclassified **NEA/NDC(2003)21**

Organisation de Coopération et de Développement Economiques
Organisation for Economic Co-operation and Development **02-Jul-2003**

Bil.

NEA/NDC(2003)21
Non classifié/Unclassified

AGENCE POUR L'ENERGIE NUCLEAIRE
NUCLEAR ENERGY AGENCY
COMITE CHARGE DES ETUDES TECHNIQUES ET ECONOMIQUES SUR LE DEVELOPPEMENT DE L'ENERGIE NUCLEAIRE ET LE CYCLE DU COMBUSTIBLE
COMMITTEE FOR TECHNICAL AND ECONOMIC STUDIES ON NUCLEAR ENERGY DEVELOPMENT AND FUEL CYCLE

NDC : Rapport des pays membres
NDC: Reports by member countries

48ème réunion du NDC, 11-13 juin 2003
48th NDC Session, 11-13 June 2003
Château de la Muette, Paris [France]

JT00146997

Document complet disponible sur OLIS dans son format d'origine
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Bil.

COMITÉ CHARGÉ DES ÉTUDES TECHNIQUES ET ÉCONOMIQUES
SUR LE DÉVELOPPEMENT DE L'ÉNERGIE NUCLÉAIRE ET LE CYCLE DU COMBUSTIBLE [NDC]

48ÈME RÉUNION
11-13 JUIN 2003

COMMITTEE FOR TECHNICAL AND ECONOMIC STUDIES
ON NUCLEAR ENERGY DEVELOPMENT AND THE FUEL CYCLE [NDC]

48TH SESSION
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RAPPORT DES PAYS MEMBRES
REPORTS BY MEMBER COUNTRIES

AUSTRALIA

Uranium Production and Exports

Production

Australian uranium production in 2002 decreased 11 per cent to 8083 tonnes (t) of U_3O_8 as a result of a serious fire in October 2001 in the solvent extraction plant at the Olympic Dam copper/uranium project in South Australia operated by WMC Resources Ltd. Uranium production at Olympic Dam decreased nearly 34% to 2867 t of U_3O_8 in 2002.

Australia's other two uranium production centres, Ranger in the Northern Territory and Beverley in South Australia, both increased production in 2002. Ranger, operated by Energy Resources of Australia Ltd (ERA), increased production by 6% to 4470 t of U_3O_8. Beverley, operated by Heathgate Resources Pty Ltd, increased production by 36.6% to 746 t of U_3O_8.

Exports

All Australian uranium production continues to be exported. Exports in 2002 decreased 17% per cent to 7636 t of U_3O_8, reflecting the lower production level.

Uranium Mine Developments - Existing Projects

Ranger
The higher production from Ranger in 2002 follows ERA commissioning the second mill circuit in the October – December quarter in order to meet higher sales commitments. This is expected to result in a further increase in production in 2003.

ERA continued to operate with no detrimental impact on the surrounding environment according to supervising authorities.

An independent technical review commissioned by the Northern Territory Government into the environmental regulation of the Ranger and Jabiluka (also owned by ERA) projects was completed in September 2002. The review found that existing authorisations, monitoring and reporting systems for these projects were adequate to ensure the protection of the environment and health of workers and the public.

Olympic Dam
On 21 October 2001 a fire destroyed Olympic Dam's solvent extraction plant and there have been delays in rebuilding the plant. The replacement plant is now expected to be operational by end June 2003 and result in production increasing to about 3600 t of U_3O_8 in 2003. Production in 2004 should further increase to the project's production capability of approximately 4600 tpa of U_3O_8.

WMC is continuing studies into long-term expansion options for Olympic Dam to produce between 350,000 and 600,000 tpa of refined copper and a commensurate increase in associated uranium production. In the meantime, an optimisation program to increase nominal copper production capacity from 200,000 to 235,000 tpa should be completed by the end of 2003. WMC has not indicated whether this expansion will have any significant impact on uranium production levels.

Beverley
Beverley is Australia's first in-situ leach (ISL) uranium mine. The higher production attained in 2002 reflects the company's objective to ramp up production closer to the project's nominal capacity of 1000 tpa of U_3O_8.

Uranium Mine Developments - New Projects

Jabiluka

As with Ranger, Jabiluka is surrounded by, but is not part of, Kakadu National Park (KNP).

In view of World Heritage concerns about the impact of Jabiluka's development on KNP, ERA has previously agreed that Jabiluka and the nearby Ranger operation would not be in full operation simultaneously

At its 2003 Annual General Meeting ERA announced that there will be no further development at Jabiluka without the support of Aboriginal people, and subject to feasibility studies and market conditions.

The project site remains on long-term environmental care, and supervising authorities have stated that there has been no detrimental impact on the surrounding environment. To make the site as benign as possible, evaluations and discussions are continuing regarding the options that might be included in these longer-term arrangements. The company has held recent consultations with the traditional Aboriginal owners and supervising authorities on ways of achieving this.

Honeymoon

In late 2001 Southern Cross Resources Australia Pty Ltd received Commonwealth and State environmental clearances to develop the Honeymoon ISL uranium project in South Australia to produce up to 1000 tpa of U_3O_8. However, development is currently on hold pending an improvement in market conditions.

Senate Inquiry

In June 2002 the Australian Senate agreed to a Senate Committee inquiry into environmental regulation of uranium mining. The Committee is scheduled to submit its report to the Senate on 24 June 2003.

Radioactive Waste

National Radioactive Waste Repository for Low Level and Short-lived Intermediate Level Waste

On 9 May 2003, following the environmental approval under the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* of two sites in central-north South Australia for the national repository for disposal of Australia's low level and short-lived intermediate level radioactive waste, a site was announced for the facility. The Minister for Science announced that the national repository would be constructed at Site 40a, which is located 20 km to the east of Woomera (about 420 km north-west of Adelaide) on stony desert which is currently covered by a pastoral lease. The area is characterised by stable geology and deep, saline ground water.

Site 40a was selected by the Minister for Science as the site for the national repository because it has a number of advantages over the other site including: better security; a less environmentally sensitive access route; and more saline water which has no pastoral use. In addition, no proposed commercial space activities at Woomera would affect Site 40a.

The environmental approval and selection of the site follows more than 10 years of scientific assessment and community consultation which commenced in 1992.

Before the national repository can commence operations, licences must be obtained from the Commonwealth's regulator, the Australia Radiation Protection and Nuclear Safety Agency (ARPANSA), and the site must be acquired by the Federal Government using the Federal *Lands Acquisition Act 1989.*

The national repository may be operating in 2004 subject to the satisfactory completion of these processes.

Following the construction of the repository, around 3700 cubic metres of low level and short-lived intermediate level waste currently stored at hundreds of sites around Australia will be disposed of in the purpose-built facility. After the first disposal campaign, the subsequent disposal campaigns are likely to take place every 2-5 years.

Uranium Industry Section

BELGIQUE

Service public fédéral Économie, P.M.E.
Classes moyennes et Énergie
Direction générale Énergie

DIVISION DES APPLICATIONS NUCLÉAIRES

PRODUCTION ET CONSOMMATION D'ÉLECTRICITÉ EN 2002

1.1 Production nette d'électricité

La production totale nette d'électricité pour l'année 2002 s'est élevée à 78.052 GWh, ce qui est une augmentation de 2,6 % par rapport à l'année 2001. Cette production totale nette est répartie comme suit :

Source	Production en GWh_e	Part	Différence en valeur absolue 2002-2001
Combustible nucléaire	44.737 GWh_e	57,3 %	+ 1,7 %
Combustibles solides	11.291 GWhe	14,5 %	+ 17,8 %
Combustibles liquides	795 GWhe	1,0 %	- 31,9 %
Combustible gazeux (a)	18.414 GWhe	23,6 %	+0,3 %
Energie hydraulique	1.467 GWhe	1,8 %	- 10,3 %
Energie éolienne	496 GWhe	0,1 %	+ 44,1 %
Autres (b)	1.299 GWhe	1,7 %	- 0,4 %

(a) Y compris le biogaz.
(b) Déchets industriels, ménagers et agricoles et vapeur de récupération.

En 2002, la part de l'énergie nucléaire dans la production totale nette d'électricité a légèrement diminué de 0,5 % par rapport à l'année 2001, pour arriver à 57,3 %.

1.2.Consommation d'électricité

La consommation totale de l'énergie électrique en 2002 était égale à 84.171 GWh_e. Ceci représente une légère augmentation de 600 GWh_e, soit 0,7 %.

La relation entre la production totale nette et la consommation peut être établie comme suit :

Production nette	78.052 GWh_e
Importations	16.751 GWh_e
Exportations	- 9.094 GWh_e
Energie de pompage	- 1.538 GWh_e
Energie appelée	84.171 GWhe

On constate que les importations ont encore légèrement augmenté. Les exportations ont considérablement augmenté de plus de 35 %.

1.3. Les événements les plus importants dans les centrales nucléaires belges en 2001

Le taux d'utilisation moyen de toutes les centrales nucléaires belges a atteint 89,8 % en 2002. Ce pourcentage est légèrement plus élevé que celui atteint en 2001. Il est à noter qu'au cours de l'année 2002, seule l'unité Tihange 3 n'a pas été arrêtée pour révision et rechargement en combustible.

En 2002, l'unité Doel 2 a battu le record d'exploitation sans arrêt d'urgence durant 4 ans (1.461 jours).

1.4 Situation de l'entreposage du combustible irradié

1.4.1 Entreposage à sec à Doel

Durant l'année 2002, quatre conteneurs, pour un total de 117 assemblages de combustible irradié, ont été transférés dans le bâtiment d'entreposage.

Au total, fin 2002, le bâtiment contenait 41 conteneurs pour 1.155 assemblages.

1.4.2. Entreposage sous eau à Tihange

Aucun transfert de combustible irradié n'a été effectué durant l'année 2002. Au total, fin 2002, les piscines du bâtiment d'entreposage contenaient 995 assemblages.

MESURES POLITIQUES EN MATIÈRE DE PRODUCTION D'ÉLECTRICITÉ

2.1 Libéralisation du marché de l'électricité

Le gestionnaire du réseau a été désigné et un nouveau règlement technique pour la gestion du réseau de transport et son accès a été promulgué. Au niveau fédéral, tout consommateur au-delà de 10 GWh/an est autorisé à choisir librement son fournisseur. Dans la région flamande, à partir du 1er juillet 2003, tout consommateur pourra choisir librement son fournisseur.

2.2 Loi sur la sortie progressive de l'énergie nucléaire à des fins de production industrielle d'électricité

Le 31 janvier 2003, la loi sur la sortie progressive de l'énergie nucléaire à des fins de production industrielle d'électricité a été promulguée. Cette loi contient entre autres les dispositions suivantes :

- Les centrales nucléaires destinées à la production industrielle d'électricité doivent être désactivées 40 ans après la date de leur mise en service industrielle.
- Aucune nouvelle centrale nucléaire destinée à la production industrielle d'électricité ne peut être construite et/ou mise en exploitation.

Par la loi, le régulateur du marché d'électricité reçoit la mission de veiller à la sécurité d'approvisionnement en matière d'électricité et de formuler des recommandations si celle-ci risque d'être en danger. De plus, elle stipule qu'en cas de menace pour la sécurité d'approvisionnement, les mesures nécessaires doivent être prises, sans toutefois mettre en question la sortie du nucléaire, sauf en cas de force majeure.

2.3 Loi sur les provisions constituées pour le démantèlement des centrales nucléaires et pour la gestion des matières fissiles irradiées dans ces centrales

Afin de garantir la suffisance des provisions pour le démantèlement des centrales nucléaires et pour la gestion du combustible irradié et leur disponibilité effective au moment voulu, l'Etat veut exercer un contrôle plus strict sur ces provisions. Afin de réaliser ceci, le Gouvernement a approuvé la loi sur les provisions constituées pour le démantèlement des centrales nucléaires et pour la gestion des matières fissiles irradiées dans ces centrales. Cette loi a déjà été votée au Parlement. Avant qu'elle puisse effectivement entrer en vigueur, une série d'arrêtés royaux d'exécution doivent encore être prise.

Selon la loi, la totalité des provisions sera centralisée dans un fonds auprès de la société Synatom, dont l'Etat possède un « golden share », lui permettant de s'opposer à toute décision du conseil d'administration de la firme qui est contraire aux lignes directrices de la politique énergétique du pays. 75 % des montants disponibles dans le fonds peuvent être prêtés aux exploitants des centrales nucléaires tant que leur solvabilité est suffisante. Afin de mesurer cette solvabilité, on se basera sur des indicateurs financiers, notamment : un ratio d'endettement ou un « credit rating » international. Dès qu'un des indicateurs est atteint, le pourcentage de 75 % doit être adapté, selon une échelle graduée, en concertation avec les exploitants nucléaires.

Les 25 % restants des montants disponibles dans le fonds peuvent être placés dans des actifs extérieurs aux exploitants nucléaires.

Le projet de loi prévoit un mécanisme pour assurer la suffisance des moyens dans le fonds. Il prévoit également la création d'un comité de suivi composé d'experts financiers et économiques. Ce comité aura les missions suivantes :

- Le contrôle de la méthodologie de constitution et de détermination des provisions.
- Le contrôle de l'utilisation des moyens disponibles dans le fonds ou des montants prêtés du fonds.
- Le contrôle des décisions relatives à la politique d'investissement et de gestion des montants dans le fonds non prêté aux exploitants des centrales nucléaires.
- La prise de décisions relative à la restitution des montants prêtés aux exploitants des centrales nucléaires.

CYCLE DU COMBUSTIBLE ET GESTION DES DÉCHETS

3.1 Transport des déchets vitrifiés depuis la France vers la Belgique

Conformément aux engagements contractuels entre les parties concernées et aux autorisations octroyées, les quatrième et cinquième transports depuis la France vers la Belgique de déchets vitrifiés hautement radioactifs, issus du retraitement en France de combustibles belges irradiés, ont eu lieu en 2002.

Toutes les dispositions ont été prises afin que les deux assemblages de transport, chargés chacun de 28 conteneurs de déchets vitrifiés soient arrivés respectivement le 28 février et 25 septembre 2002, en gare de Mol. Comme pour les transports déjà effectués en 2000 et 2001, les emballages de transport ont été déchargés des wagons et placés sur un véhicule routier à l'aide d'un portique mobile, installé en gare de Mol pour la durée des opérations, pour rejoindre le bâtiment d'entreposage sur le site de Belgoprocess à Dessel.

Avec ces cinq retours de déchets vitrifiés, il s'agit du tiers de la totalité des déchets vitrifiés issus des contrats de retraitement conclu, en accord avec les directives successives des autorités belges, entre Synatom et Cogéma.

3.2 Programme d'études en matière d'évacuation des déchets de faible activité

Le programme établi, dans le cadre de la décision gouvernementale d'opter pour une solution définitive ou à vocation définitive pour les déchets de faible activité et de courte durée de vie, est poursuivi à un rythme plus ou moins normal. Des partenariats locaux ont été créés dans les communes de Mol, Dessel et Fleurus-Farciennes. Ces partenariats, qui permettent une concertation active avec la population locale, préparent des projets intégrés, dans lesquels le projet d'évacuation est incorporé dans un développement plus global (du point de vue économique, social,…) de la région. Il est attendu que les partenariats déposeront leur rapport au Gouvernement dans le courant des années 2004/2005, après quoi le gouvernement devra prendre une décision définitive sur l'évacuation des déchets de faible activité.

3.3 Programme d'études et de R&D en matière d'évacuation géologique

Au début de l'année 2002, l'ONDRAF (Organisme national des Déchets radioactifs et des Matières fissiles enrichies) a publié son rapport de sûreté et de faisabilité intermédiaire, appelé SAFIR 2. Ce rapport résume la connaissance technique et scientifique qui a été acquise par l'ONDRAF pendant sa seconde phase (1990-2000) de son programme de recherche méthodologique et de développement en matière d'évacuation géologique des déchets de moyenne et haute activité et de longue durée de vie.

Le rapport SAFIR 2 conclu que, jusqu'à maintenant, des problèmes prohibitifs n'ont pas été rencontrés pour l'évacuation géologique dans l'argile de Boom (la formation hôte qui est examinée le plus en Belgique), ce qui augmente la confiance dans la solution étudiée. Ceci confirme que l'évacuation dans l'argile reste une option à considérer. Il y a toutefois un nombre de question sur lesquelles les travaux doivent être poursuivis.

Le rapport SAFIR 2 a été soumis à un « peer review » international, organisé par l'Agence pour l'Energie nucléaire (AEN). Le « peer review » confirme les conclusions mentionnées ci-dessus du rapport SAFIR 2. Il formule une série d'observations et de recommandations, dont les plus importantes sont :

- La haute qualité du travail effectué par l'ONDRAF est reconnue. Il s'accorde avec ce qui est fait dans d'autres programmes nationaux. Il a été possible de développer quelques méthodes et outils nouveaux et innovateurs. Le travail effectué jusqu'à présent forme une bonne base pour la suite du programme.
- Le « review team » confirme les bonnes qualités de l'argile de Boom pour la sûreté et la faisabilité d'une installation d'évacuation. Toutefois, la continuation de la recherche est nécessaire pour compléter la connaissance manquante et pour renforcer la confiance dans la solution étudiée.
- Le rapport SAFIR 2 forme une bonne base pour la concertation avec les autorités de sûreté et les décideurs afin d'appliquer et même de compléter le cadre légal (en particulier en ce qui concerne un nombre de questions comme par exemple la réversibilité, la protection des ressources d'eau, l'intrusion humaine,…).

CANADA

1. Nuclear Power Program

Table 1. Nuclear Power Data, 2002

	Canada	Ontario	New Brunswick	Quebec
Total Electricity Generation (Growth %)	2.0	0.6	-10.0	3.6
Nuclear Share of Electricity Generation (%)	12.3	41.0	21.0	2.5
Reactors in Service	14	12	1	1
Installed Capacity (MW)	15,795	14,440	680	675

Source: Statistics Canada.

1.1 Overview

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, 14 reactors are currently in full commercial operation, and they generate on average around 12.5% 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%.

1.2 Ontario - Current Situation

Re-start of laid up units

The two nuclear operators in Ontario, Ontario Power Generation (OPG) and Bruce Power Inc., are still pursuing their respective recovery plan to restart six of the eight laid-up units at Pickering A and Bruce A stations.

Of the 20 reactor units in the province of Ontario, eight are presently laid-up, four of which are at the Pickering A nuclear generation station and four at the Bruce A station. Three of the six units are slated to be returned to service by mid-2003, whereas, the remaining three units are expected to be brought back to service over the next few years.

Plans for the restart of Bruce A units 3 and 4 are well underway. Refuelling of unit 3 began last month and is expected to be completed within 45 days. Approximately, 90 per cent of the required work on unit 4 is completed. Bruce Power announced that unit 3 should be operating at full capacity by the end of May 2003, whereas the second reactor should be fully operational by the end of June 2003. The return to service of those two units will add 1,500 MW of capacity to the Ontario grid. With respect to the other two units at Bruce A, Bruce Power indicated that these units will be restarted if a proper business case can be made for resurrecting them.

OPG is also in the process of refurbishing four laid-up units at the Pickering A station. While OPG is continuing to make significant progress in its program to restart the Pickering A unit, the restart initiative has faced major challenges which resulted in some delays. OPG is confident that the first unit will be in-service by the summer 2003. In fact, in early May 2003, the Canadian Nuclear Safety Commission (CNSC) authorised OPG to proceed with some commissioning work related to the re-start of the first unit. OPG has also undertaken the planning for the return to service of the other three units and OPG indicated that they should be in service over the next few years.

Bruce Power - Change of ownership

A significant ownership restructuring of Bruce Power Inc., took place at the end of 2002. Bruce Power was initially a joint venture of: British Energy plc (80%), Cameco Corporation (15%), the Power Workers' Union (4%) and The Society of Energy Professionals (1%). As a result of the ownership restructuring that occurred in December 2002, British Energy sold off all of its interests in Bruce Power to a Canadian consortium. Cameco acquired an additional 16.6% ownership stake in Bruce Power for a combined 31.6% ownership. TransCanada PipeLines and the Ontario Municipal Employees Retirement System each own 31.6%, while two unions own the remainder.

1.3 New Brunswick - Current Situation

Refurbishment of Point Lepreau

The Point Lepreau nuclear station is approaching the point where a decision needs to be made as to whether it should be refurbished or begin to prepare for decommissioning.

During 2002, the New Brunswick Public Utilities Board (NB PUB) completed a public review of the project. It recommended to New Brunswick Power's (NB Power) Board of Directors that the project, as presented, should not proceed as there was no significant economic advantage. However, NB Power has recognized that factors outside the scope of the NB PUB's economic review are important inputs towards a final decision on refurbishment. These include the significant environmental benefits from continued operation of the station along with the uncertainty in the pricing and supply of natural gas, a potential replacement source of generation.

NB Power and Atomic Energy of Canada Limited have also begun a two-year refurbishment assessment program to define the technical scope for refurbishment. Following the assessment, the costs and benefits of refurbishment will be compared with other development opportunities to determine the most viable option for NB Power.

Consequently, a final decision on the project has not yet been made and, concurrently, the New Brunswick Government is exploring the potential for private sector involvement in the project. If the refurbishment program goes ahead, the reactor's life will be extended in 2008 for an additional 25 years. The plant rehabilitation would need to receive the approval of the Canadian Nuclear Safety Commission before it can go ahead.

During 2001-2002, Point Lepreau operated with a capacity factor of 82.5%, its second highest performance in six years. Since 1983, the station's in-service capacity factor has averaged 82%.

1.4 Quebec - Current Situation

Refurbishment of Gentilly 2

The Gentilly 2 nuclear station is also approaching the point in time where a decision needs to be made as to whether it should be refurbished or begin to prepare for decommissioning, as it went into operation at about the same time as the Point Lepreau station. Hydro-Quebec is currently conducting some studies, as well as some public consultations. No decision has been made but it seems that some preliminary studies show that the refurbishment of Gentilly 2 look quite promising. A decision by the Board of Directors of Hydro-Quebec is expected in 2005. The plant rehabilitation would also need to receive the approval of the Canadian Nuclear Safety Commission before it can go ahead. If approved, the refurbishment of Gentilly 2 is expected to take place in 2009 and 2010.

The lifetime average performance of the Gentilly 2 station has been as good as the Point Lepreau Station.

1.5 Amendment to the NSCA

The *Nuclear Safety and Control Act*, replacing the existing *Atomic Energy Control Act* of 1946, received Royal Assent in March 1997. The new Act created the CNSC to replace the Atomic Energy Control Board. It came into force on May 31, 2000 with new regulations.

In February 2003, subsection 46(3) of the Act was amended (Bill C-4) to clarify a point concerning site remediation obligations that had the consequence of discouraging private sector lending to companies that own and operate nuclear facilities.

2. Nuclear R&D

2.1 Whiteshell Laboratories

At AECL's Whiteshell Laboratories, work continues to shut down the site nuclear facilities and prepare them for decommissioning. In December 2002, the CNSC approved AECL's application to begin the first phase of decommissioning at the Whiteshell site. AECL's new licence for the site authorises the first planned phase of site decommissioning as well as the continuation of limited research programs at Whiteshell Laboratories. Subsequent phases of decommissioning will be the subject of future licensing hearings and decisions of the Commission prior to the expiry of the licence.

2.2 Chalk River Issues

Following public hearings held on January 15 and April 9, 2003, the CNSC announced, in May 2003, its decision to renew the operating licences for three Atomic Energy of Canada Limited (AECL) facilities including: the Chalk River Laboratories (CRL), the MAPLE reactors, and the New Processing Facility (NPF). These facilities are all located in Chalk River, Ontario. The licence for the Chalk River Laboratories is valid until July 31, 2006. The licences for the MAPLE reactors and the NPF are valid to May 31, 2005. The Commission requires that the matter of the financial guarantees for the decommissioning of all of the facilities within the CRL boundaries (including CRL, MAPLE and NPF) come before the Commission for decision at a public hearing. AECL is required, by condition of the renewed licences, to submit a proposal for this purpose on or before December 31, 2003.

2.3 Nuclear Research Facility

AECL is planning to continue to extend the operation of the Nuclear Reactor Universal (NRU), an important component of Canada's nuclear R&D infrastructure, somewhat longer than previously planned. AECL has informed the CNSC that it would like to continue operating the NRU beyond 2005.

3. Status of the International Nuclear Program

Currently, there are 6 CANDU reactors of the CANDU-6 design in operation or under construction outside of Canada. There are four CANDU reactors in operation in South Korea and one reactor in each of the following countries: Argentina, Romania and China. Two CANDU reactors are under construction: one in China and one in Romania.

The first CANDU 6 unit in Qinshan, China reached full commercial operation in December 2002. The completion of the first unit was ahead of schedule and on budget which is a remarkable accomplishment and a tribute to the entire Qinshan Project Team. The second unit, another CANDU 6, is also on schedule and is expected to be completed in the fall of 2003.

The construction to complete the second CANDU reactor in Romania has resumed in early 2003, and it is expected to be completed in 2006. The Government of Canada agreed to guarantee a portion of the financing for the completion of the second CANDU reactor in Romania. The first unit in Romania was completed in 1996 and is producing about 10% of the country's electricity.

4. Uranium Industry Highlights

4.1 Canadian Uranium Industry Highlights

Canada retained its position as world leader in uranium production in 2002 with output totalling 11 607 tU (tonnes of uranium metal), down slightly from the 2001 total mainly due to reduced Rabbit Lake output. As of January 1, 2003, Canada's recoverable uranium resources amounted to 439 000 tU, down slightly from the 2002 total of 452 000 tU due to extraction and ongoing deposit appraisal. With over 85% of the resource base categorised as "low-cost", Canada is well positioned to continue its leadership in uranium production.

Canadian uranium production is expected to decline somewhat in 2003, however, since production at the Cluff Lake mine and mill ended in December 2002 and the McArthur River mine could be shut down for as much as 6 months to repair damage caused by flooding that occurred in April 2003. Cigar Lake, currently a care and maintenance, could begin production as early as 2006, with favourable market conditions and regulatory approvals.

Table 2. Canadian Uranium Data.

	2002	2001	2000	1999	1998
Known Uranium Resources Recoverable from Mineable Ore (1 000 tU as of January 1)[1]	452	437	417	433	419
Total Primary Production (tU)	11 607	12 522	10 683	8 214	10 922
Total Producer Shipments (tU)	13 042[2]	12 921	9 921	10 157	9 984
Value of Shipments ($C millions)	6002	600	485	500	500
Average Price for Deliveries under Export Contracts ($C/kgU) / ($US/lb U_3O_8)	NA	46.60/ 11.60	47.70/ 12.40	49.10/ 12.70	51.10/ 13.30
Exports of Uranium of Canadian Origin (tU)	NA	10 029	10 966	7 146	8 274
Uranium Exploration Expenditures ($C millions)	402	25	46	49	60

1 Resources at prices of $100/kgU or less. 2 Preliminary figures. NA Not available at this time.

Commencing in 2002, Natural Resources Canada has decided to suspend the publication of the Average Price of Deliveries under Export Contracts for uranium for a period of three to five years, pending a policy review and assessment of market conditions. The Price was designed to reflect the international selling price for Canadian uranium. However, the international trend in recent years toward “open-origin” uranium sales contracts has made it increasingly difficult to isolate a figure applicable only to Canadian uranium. Natural Resources Canada may resume publication of pricing information in the future, if changed market conditions allow it to calculate an average price that is clearly applicable to Canadian uranium.

4.2 Recent Uranium Developments

Mining ended at Cluff Lake in May 2002 and all stockpiled ore was milled by the end of December 2002, bringing to a close a long and successful chapter in Canadian uranium mining. In its 22 years of operation, the Cluff Lake mine produced over 24 000 tU and set high standards for uranium production and workplace safety. Once an environmental assessment of the closure and remediation plan is completed and all regulatory approvals have been obtained, CRI will begin the decommissioning process.

The sharp decline in Rabbit Lake mine and mill production in 2001 and 2002 is the result of a decision by the mine owner, Cameco Corp., to temporarily suspend mining and milling due to market conditions. Following the development of a revised mining plan, the Rabbit Lake Eagle Point mine was re-opened in July 2002 and the mill in August 2002. However, poor ground conditions encountered since the re-opening have reduced output below expected levels.

The Federal Court of Canada issued an order on September 23, 2002, quashing a 1999 McClean Lake operating licence on the grounds that an environmental assessment (EA) under the *Canadian Environmental Assessment Act* (*CEAA*) had not been conducted prior to issuing the licence. An appeal court subsequently ordered the decision stayed pending the disposition of the appeal, which has not yet been heard. The Court decision is not about the environmental performance of the facility, but the transitional provision of the *CEAA*. The entire McClean Lake operation was reviewed by an environmental review panel pursuant to regulatory requirements that preceded the *CEAA*.

Environmental management systems at the McArthur River mine and the Key Lake mill were certified under the ISO 14001 standard in 2002. The McClean Lake mine and mill, as well as the Blind River refinery and Port Hope conversion plant, have already achieved this internationally recognised standard that outlines the key requirements that companies should comply with in order to operate in an environmentally responsible manner. Thus, the front end of the nuclear fuel cycle meets rigorous international standards in Canada.

5. Radioactive Waste Management

5.1 Policy Framework for Radioactive Waste

In July 1996, the Government of Canada announced its Policy Framework for Radioactive Waste. The Framework sets the stage for the further development of institutional and financial arrangements to implement disposal of radioactive waste in a safe, environmentally sound, comprehensive, cost-effective and integrated manner. The Policy Framework specifies that the federal government has the responsibility to develop policy, to regulate, and to oversee radioactive waste producers and owners in order that they meet their operational and funding responsibilities in accordance with approved disposal plans. The Framework recognises that there will be variations in approach in arrangements for the different waste types in Canada, i.e., nuclear fuel waste, low-level radioactive waste and uranium mine and mill tailings.

5.2 Nuclear Fuel Waste

The *Nuclear Fuel Waste (NFW) Act* came into force on November 15, 2002. The *Act* requires nuclear utilities to form a waste management organisation. Under the Act, the organisation's mandate is to propose to the Government of Canada approaches for the long-term management of nuclear fuel waste, and to implement the approach that is selected by the Government. The *NFW Act* also requires the utilities and AECL to establish trust funds to finance the implementation of the selected long-term nuclear fuel waste management approach.

The Nuclear Waste Management Organisation (NWMO) was established by the nuclear utilities in the fall of 2002. Its president, Ms. Elizabeth Dowdeswell, has held a number of senior posts within government and non-government organisation, and had been active in environment-related programs.

The *NFW Act* requires that by November 15, 2005, the NWMO submit to the Government a study setting out its proposed approaches for the long-term management of nuclear fuel waste, and its recommendation on which proposed approach should be adopted. The *NFW Act* requires the NWMO to include in the study approaches based on both storage (on-site or centralised) and disposal. In carrying out this study, the NWMO must consult with the general public on each of the proposed approaches.

The Government of Canada will select one of the approaches for the long-term management of nuclear fuel waste from among those set out in the study, and the NWMO will then be required to implement the selected approach. This implementation will be funded through monies deposited in trust funds set up by the utilities and AECL in accordance with requirements in the *NFW Act.*

5.3 Low-Level Radioactive Waste

The major nuclear utility in Canada, OPG, produces about 70% of the annual volume of low-level radioactive waste in Canada. To date there has been no pressing need in OPG for early disposal; volumes are small and the waste is being safely stored on an interim basis. However, in its 1992 plan for these wastes the utility fully recognised that, in the longer term, disposal is a necessary step in responsible waste management, so that future generations are not burdened with managing this waste. OPG is currently assessing possible options for the long-term management of low and intermediate level radioactive wastes. The year 2015 is considered an achievable target date for bringing a long-term management facility into service.

The other major ongoing producer of low-level radioactive waste, AECL, had discussions with the CNSC to license a prototype below-ground concrete vault known as IRUS (Intrusion-Resistant Underground Structure) for relatively short-lived waste. The future application of IRUS technology is currently being reassessed by AECL. Until this, or another disposal facility is available, AECL will continue to store its on-going LLW in-ground and above-ground structures.

5.4 Port Hope Area Wastes

The bulk of Canada's historic low-level radioactive waste is located in the southern Ontario communities of Port Hope and Clarington. These wastes, amounting to roughly one million cubic metres, relate to the historic operations of a radium and uranium refinery in the Municipality of Port Hope. In March 2001, the Government of Canada and the local municipalities where the wastes are located entered into an agreement for the long-term management of these wastes. The Project will involve the cleanup of the wastes and long-term management in newly constructed above-ground mounds in the local communities. The $260 million project will take roughly ten years to complete. The first phase of the Project is an environmental assessment and regulatory review that is expected to last five years. Cleanup, waste facility construction, and waste emplacement would take place in the following five years.

5.5 Uranium Mine and Mill Tailings

In Canada, about 200 million tonnes of uranium mine and mill tailings have been generated since the mid-1950s. These comprise about two percent of all mine and mill tailings in the country. Most of the existing uranium tailings are located in the provinces of Ontario and Saskatchewan. Of the total of twenty-four tailings sites in Canada, only three in Saskatchewan continue to receive waste material.

Uranium tailings are decommissioned on-site. Uranium producers, in co-operation with provincial and federal governments, are involved in on-going research on the decommissioning of uranium tailings, specifically tackling the problem of acid mine drainage and increasing the stability of engineered barriers. Successful decommissioning has been achieved at sites in Saskatchewan and Ontario.

With regard to financial responsibility for decommissioning and long-term maintenance of the tailings, the CNSC requires that present-day operators provide financial assurances that decommissioning of uranium facilities will take place in a responsible and orderly manner in the short- and long-term. Where a producer or owner cannot be identified, cannot be located, or is unable to pay, responsibility for decommissioning would rest with the Canadian federal and provincial governments. In January 1996, a Memorandum of Agreement (MOA) on cost-sharing for management of abandoned uranium mine tailings was signed between the federal and Ontario governments. The MOA recognises that present and past producers of uranium are responsible for all financial aspects of the decommissioning and long-term maintenance of uranium mine sites, including the tailings. In the case of abandoned sites, the MOA outlines how governments will share the long-term management responsibilities and associated costs.

5.6 Decommissioning

The CNSC requires that all nuclear facilities be decommissioned in accordance with regulatory requirements. Nuclear facilities include CANDU power reactors, prototype/demonstration power reactors, research reactors, nuclear research establishments, and facilities involved in processing and fabricating uranium into fuel for power reactors or in conducting nuclear/uranium R&D activities. Planning for decommissioning activities should be initiated at the earliest stages in the design of facilities and refined during their operating life. Under the *Nuclear Safety and Control Act*, the CNSC can require financial assurances from facility operators to demonstrate that sufficient funds will be available for decommissioning activities.

CZECH REPUBLIC

Nuclear energy is a significant energy resource having an increasing share of total electricity production in the Czech Republic. At the end of 2002 the share of nuclear power in total electricity generation was 25% and, when the two units of Temelin will have reached full power, this share will increase to 40%.

The Dukovany nuclear power plant has been in operation for 18 years and has demonstrated very good technical, safety and reliability performance. In March 2002, its total cumulated electricity output exceeded 200 million GWh. The annual production was 13.3 TWh in 2002. An investment programme for the refurbishment and safety upgrade of the plant is going on and should be completed in 2010. A dry spent fuel storage facility with a capacity of 600 tHM is operated at the plant site. The construction of the second dry spent fuel storage facility with a capacity of 1 340 tHM shall start in 2003 and shall be finished in 2005. The shallow underground radioactive waste repository at the plant site is in operation for final disposal of operational radioactive waste from both nuclear power plants Dukovany and Temelin.

The unit 1 of the Temelin nuclear power plant reached full power in the first quarter of 2002 and since June 2002 test operation is going on; its shut down for first partial refuelling is scheduled in the first quarter of 2003. The commercial operation of unit 1 is expected in the last quarter of 2003. The fuel loading of unit 2 was completed in March 2002 and it was connected to the grid for the first time on 29 December 2002 (Unit 1 was connected to the grid for the first time on 21 December 2000. Test operation of unit 2 started on 18 April 2003 and its commercial operation is expected in the last Quarter of 2004. In 2002, both units generated 4.3 TWh. The construction of a dry spent fuel storage facility at the plant site with a capacity of 1 370 tHM is under preparation.

Austria and the Czech Republic reached an agreement on 29 November 2001 over their dispute on the start-up of Temelin, after an international expert review and under mediation by the European Commission. The problems could be resolved within the framework of the “Melk Protocol” whereby Austria and the Czech Republic agreed to a safety review process before commercial operation of the plant and a regular exchange of information.

The evaluation of geological, geographical and environmental conditions for the siting of deep geological repository is being carried out and the Czech Republic is involved also in research and development activities on transmutation technologies.

FRANCE

1. Production et consommation d'électricité

1.1 Production nette et consommation intérieure d'électricité en 2002

La production totale nette d'électricité a été en 2002 de 532,9 TWh, en augmentation de 1,9 % par rapport à 2001. Cette production se répartit comme suit :

	Quantité (TWh)	Ecart par rapport à 2001	Part en %
Production totale	532,9	+1,9 %	100
Dont : Nucléaire	415,5	+4,0 %	78,0
Thermique non nucléaire	52,9	+15,3 %	9,9
Hydraulique	64,5	-16,6 %	12,1
Bilan Import-Export	- 76,8	+12,3 %	14,4
Pompage	7,4	+29,1 %	1,4
Consommation intérieure	448,7	0,0 %	84,2

(source : RTE)

Le maximum de consommation d'électricité en puissance instantanée a été enregistré le 10 décembre et s'élève à 76,6 GWe, inférieur de 0,5 GWe au record de 2001. Par ailleurs les volumes d'énergie couverts par des contrats d'importation et d'exportation sont en hausse importante par rapport à l'année 2001. Cela traduit la mise en œuvre de nouvelles règles du marché de l'électricité, achats des clients éligibles à l'étranger, vente à l'étranger par des producteurs implantés en France, transits transfrontaliers, achats d'énergie à l'étranger pour la couverture d'une partie des pertes sur le réseau RTE, etc.

2. Installations nucléaires

2.1 REP

Parc

Le parc électronucléaire français comprend 34 réacteurs de 900 MWe, 20 réacteurs de 1 300 MWe, et 4 réacteurs N4 de 1 450 MWe. L'ensemble représente une puissance installée de 63 GWe. Le palier N4 a fait l'objet d'améliorations, notamment dans le domaine de la sûreté et du contrôle commande. Pour ce programme, une nouvelle turbine « Arabelle » a été développée, plus performante et plus légère.

Le facteur de disponibilité s'est amélioré en 2002 pour atteindre 82 % (81,1 % en 2001), et ce bien que les centrales françaises fonctionnent en suivi de charge.

MOx

La France ayant choisi la voie du retraitement des combustibles irradiés, le plutonium séparé est brûlé sous forme de MOx. Actuellement 20 réacteurs de 900 MWe sont autorisés a être chargés en MOx à hauteur de 30 % du cœur.

Les usines de fabrication de combustible MOx de Cadarache et Marcoule (Mélox) ont fonctionné en 2002 à pleine capacité produisant respectivement 36,8 et 96,5 tonnes de métal lourd. Suite à une enquête publique, le gouvernement a donné son autorisation pour l'augmentation de capacité de l'usine Mélox, qui passera de 100 à 145 tonnes par an afin de compenser la fermeture de l'usine de Cadarache prévue le 31 décembre 2003.

Sûreté

Malgré une stabilité du nombre d'événements significatifs pour la sûreté, on note une baisse de la proportion d'événements marquants précurseurs d'incidents plus graves. Cela traduit une diminution de l'impact sur la sûreté des événements constatés et met en évidence les efforts faits pour améliorer la détection des écarts minimes et la transparence, facteurs importants de la culture de sûreté.

Un seul événement INES de niveau 2 a été constaté en 2002 contre deux les deux années précédentes.

Onze événements déclarés en 2002 ont présenté un caractère générique (7 en 2001) dont 6 ont été classés au niveau 1 de l'échelle INES.

Radioprotection

Pour ce qui concerne la radioprotection, les résultats traduisent une amélioration tant au niveau de la dose individuelle qu'au niveau de la dose collective :

- Aucun intervenant n'a dépassé la dose annuelle de 20 mSv (future norme réglementaire) pendant l'année 2002 pour la deuxième année consécutive et le nombre d'intervenants ayant reçu une dose comprise entre 15 et 20 mSv est en forte baisse (142 en 2002 contre 199 en 2001).
- La dose collective continue de décroître pour atteindre en 2002 0,97 homme-sievert par tranche moyennée sur 54 réacteurs.

2.2 RNR

Creys-Malville

Plus des trois quarts des assemblages de combustible étaient déchargés à la fin du premier trimestre 2002 lorsque le déchargement a dû être interrompu en raison d'avaries sur les installations impliquées. Ces dernières ont été remises en fonctionnement au cours du quatrième trimestre.

Parallèlement les opérations de mise hors service définitive des systèmes non requis pour la sûreté et l'exploitation se sont poursuivies. La démolition des cheminées extérieures du bâtiment réacteur a été réalisées entre août et décembre 2002 au moyen d'une grue de 90m de hauteur

Phénix

Les travaux de rénovation, portant notamment sur le contrôle des structures internes ainsi que la remise à niveau sismique des bâtiments étant achevés, l'autorité de sûreté nucléaire a autorisé en 2003 la remontée en puissance du réacteur. Celui-ci va dès lors pouvoir être utilisé pour la réalisation de programmes de recherche de transmutation prévus dans le premier axe de la loi du 30 décembre 1991 concernant la gestion des actinides mineurs et les déchets à vie longue.

2.3 Exportation

Framatome ANP, filiale d'AREVA et de Siemens a remis fin mars 2003 son offre à Teollisuuden Voima Oy (TVO) pour la construction du cinquième réacteur nucléaire finlandais. Framatome a proposé deux types de réacteur : l'EPR, un réacteur à eau pressurisée, et le SWR 1000, un réacteur à eau bouillante.

2.4 Évolution future

Parmi les activités qui concernent l'avenir du parc électronucléaire, on peut citer la préparation du programme de démantèlement des centrales mises à l'arrêt. Celui-ci nécessitant l'amélioration des connaissances sur ce type de travaux, l'expérience sera acquise sur le réacteur de Brennilis dont les travaux de démantèlement au niveau 2 se sont poursuivis.

En 2000, EDF a décidé d'accélérer le démantèlement des centrales nucléaires de première génération (initialement prévue 40 ans après l'arrêt du réacteur) pour l'achever en 2025. Le montant de cette opération s'élève à environ 3 milliards d'euros.

Un nouveau cadre réglementaire a été mis en place au premier semestre 2003 par l'autorité de sûreté nucléaire (ASN) afin de grouper sous un même texte réglementaire l'ensemble des opérations de démantèlement de la mise à l'arrêt définitif à la dernière étape du démantèlement. En contrepartie, l'exploitant doit fournir un dossier justifiant ses choix de démantèlement (calendrier, technologies…). Cette mesure est de nature, sans le rendre obligatoire, à amener les exploitants à démanteler les installations en fin de vie dans des délais beaucoup plus courts que ce qui était prévu jusqu'à présent

3. Réacteurs de recherche

Les études de définition du réacteur Jules Horowitz sont en cours. Ce réacteur devrait être implanté sur le site de Cadarache, au centre d'une infrastructure de recherche sur la technologie de fission. D'une puissance thermique de l'ordre de 100 MW, il doit, dans le cadre d'une coopération internationale, servir aux études sur les matériaux et les combustibles, tant pour les réacteurs existants que pour orienter les choix sur les systèmes futurs.

4. Cycle du combustible

Dans le domaine du cycle du combustible, la France dispose d'une industrie qui recouvre l'ensemble des différentes étapes qui vont de l'extraction du minerai d'uranium à la vitrification des déchets de haute activité à vie longue. La dernière mine d'uranium en activité sur le territoire national a cessé sa production en juillet 2001.

En août 2001, EDF et Cogéma ont signé un protocole portant sur le retraitement de combustible irradié et la fabrication de combustible MOX pour une nouvelle période de 15 ans.

4.1 Retraitement

Les usines UP2 et UP3 de La Hague ont fonctionné de façon très satisfaisante en 2002 : 550 tonnes de combustible ont été retraitées dans UP2 et 510 t dans UP3. La quantité cumulée de combustible usé retraité à La Hague depuis 1976 a dépassé 18 300 t.

4.2 Enrichissement

Un programme de maintenance/extension de durée de vie engagé il y a plusieurs années sur l'usine Georges Besse du Tricastin s'est terminée en 2002, renforçant ainsi l'excellente condition de l'usine et sa durabilité pour les 10 ans à venir. L'usine a été exploitée aux ¾ de sa capacité, Eurodif ayant approvisionné en 2002 plus du 1/5 des besoins mondiaux d'enrichissement.

5. Gestion des déchets

5.1 Laboratoire souterrain

Suite à la parution du décret du 3 août 1999 relatif à la gestion des déchets de haute activité et à vie longue, l'ANDRA a engagé les travaux concernant le laboratoire de recherche souterrain de Meuse/Haute Marne sur la commune de Bure. Le laboratoire doit permettre d'étudier, à 500 m de profondeur, si des roches stables depuis des millions d'années pourraient protéger les déchets et isoler de l'environnement la radioactivité qu'ils contiennent.

Après un arrêt prolongé du chantier dû à un accident mortel, le creusement des puits a repris le 26 mai 2003. Ce délai malheureux a conduit l'ANDRA (Agence nationale pour la gestion des déchets radioactifs) à réviser son programme de façon à être en mesure d'en tirer priorités et éléments clefs pour son rapport final au gouvernement maintenant attendu pour 2005.

5.2 Un nouveau centre pour les déchets radioactifs

Un nouveau centre destiné aux déchets très faiblement radioactifs, issus principalement du démantèlement des installations nucléaires, sera opérationnel prochainement. Ce centre de stockage, situé à Morvilliers, près de Troyes (Aube), recevra quelque 650.000 m^3 de déchets, soit 700 à 900.000 tonnes avec un flux estimé à 25.000 tonnes par an. Ce nouveau centre complétera celui concernant les déchets faiblement ou moyennement radioactifs à vie courte qui fonctionne dans la commune voisine de Soulaines.

6. Réforme de la sûreté

Le 22 février 2002 est paru le décret de création de la Direction Générale de la Sûreté Nucléaire et de la Radioprotection (DGSNR). Placée sous l'autorité conjointe du ministère chargé de l'environnement, du ministère chargé de l'industrie et du ministère chargé de la santé, elle est responsable de la définition et de la mise en œuvre de la politique de contrôle en matière de sûreté nucléaire et de radioprotection.

La loi du 10 mai 2001 a prévu la création de l'Institut de Radioprotection et de Sûreté Nucléaire (IRSN) par fusion de l'actuel IPSN (Institut de Protection et de Sûreté Nucléaire) et de l'OPRI (Office de Protection contre les Rayonnements Ionisants). Le décret de création de l'IRSN est paru le 22 février 2002. L'IRSN est chargé de la sûreté nucléaire, la sûreté des transports de matières radioactives et fissiles, la protection de l'homme et de l'environnement contre les rayonnements ionisants, la protection des installations nucléaires et des transports de matières radioactives et fissiles contre les actes de malveillance. L'IRSN est placé sous la tutelle conjointe des ministres chargés de la défense, de l'environnement, de l'industrie, de la recherche et de la santé.

7. Rapport sur la durée de vie des réacteurs

En mai 2003, l'Office Parlementaire d'Evaluation des Choix Scientifiques et Technologiques (OPECST) a publié un rapport portant sur « la durée de vie des centrales et les nouveaux types de réacteurs », qui formule notamment les recommandations suivantes :

- En ce qui concerne la durée de vie des centrales, une extension envisageable jusqu'à 40 ans et la possibilité de « fixer la durée des autorisations de fonctionnement à 20 ans (et non 10 ans comme c'est le cas aujourd'hui).
- En ce qui concerne le renouvellement du parc à horizon 2010-2015, la nécessité d'engager dès que possible la construction d'un démonstrateur - tête de série EPR afin de disposer, au moment de l'arrêt des premiers REP 900, d'un réacteur testé et prêt à être construit en série.
- En ce qui concerne le futur à plus long terme – au-delà de 2030 – l'intérêt pour la France de participer aux partenariats internationaux de R&D qui permettront de mettre au point « une éventuelle quatrième génération de réacteurs pour 2035 ». Cette complémentarité se conçoit dans le temps : la première moitié du 21ème°siècle pourrait voir le développement industriel de REP de 3ème°génération, plus sûrs et plus économes que les REP actuels de 2nde° génération, et d'une durée de vie d'au moins 60 ans. Les réacteurs de 4ème°génération, qui nécessitent que soient levés un certain nombre de verrous technologiques, ne pourront être déployés à l'échelle industrielle qu'à l'horizon 2030 et au-delà. Cette complémentarité se conçoit aussi dans l'espace : les besoins sont différents en Chine, en Inde, aux USA, en Europe, et il y a place pour le déploiement de réacteurs de conception et de puissance différentes dans ces différentes zones.

8. Forum Génération IV

La France a participé à la sélection de six concepts de systèmes nucléaires du futur dans le cadre du Forum Génération IV. Parmi ces concepts, la France portera particulièrement ses efforts de R&D sur le VHTR (réacteur de très haute température, permettant de produire également de l'hydrogène), le GFR (réacteur à neutrons rapides refroidi au gaz) et le cycle du combustible, et maintiendra son expertise dans le domaine des réacteurs rapides refroidis au sodium (SFR). Il faut souligner que parmi les concepts sélectionnés par le GIF, cinq sont à cycle fermé afin de mieux satisfaire aux exigences de développement durable (utilisation optimale des ressources, minimisation des déchets ultimes) et quatre sont à neutrons rapides. [Pour plus d'informations sur GIF, voir annexe de la France]

9. Fusion contrôlée

La France a déposé officiellement la candidature du site de Cadarache pour la construction du futur réacteur expérimental international ITER destiné à l'étude de la fusion contrôlée. L'Espagne étant aussi candidate avec le site de Vandellos, l'Union européenne prendra position prochainement sur une candidature unique européenne pour accueillir ce réacteur.

10. Programmation pluriannuelle des investissements

La loi du 10 février 2000 relative à la modernisation et au développement du service public de l'électricité prévoit une programmation pluriannuelle des investissements (PPI) qui constituera la traduction concrète de la politique énergétique dans le domaine de l'électricité. Trois documents distincts sont prévus : un rapport sur la PPI présenté au parlement dans l'année qui suit la promulgation de la loi, une décision ministérielle qui constitue la programmation pluriannuelle proprement dite et une loi d'orientation sur l'énergie.

Le rapport au Parlement a été déposé le 29 janvier 2002. Dans le contexte d'un parc de production suffisant pour satisfaire les besoins en base et en semi-base, ce sont les objectifs et engagements de la France en matière de développement des énergies renouvelables et de réduction de gaz à effet de serre, ainsi que les récentes directives sur la limitation des émissions de polluants atmosphériques qui vont orienter le développement du parc de production.

À l'horizon 2010 les énergies renouvelables devront couvrir 21 % de l'électricité consommée en France (contre 15% actuellement). Ce taux sera atteint principalement grâce à l'éolien. L'hydroélectricité ainsi que la biomasse pourraient aussi apporter leur contribution. Par ailleurs des actions de maîtrise de la demande d'électricité devront être entreprises tant pour la diminution de la demande totale que pour l'écrêtement des pointes de consommation. À partir de 2008, la nécessité de déclasser des moyens thermiques classiques imposera de trouver de nouvelles solutions pour satisfaire les besoins de pointe.

11. Débat national sur l'énergie

À l'initiative du ministère de l'économie, des finances et de l'industrie s'est déroulé de mars à juin 2003 dans cinq villes de France un vaste « Débat national sur les énergies » visant à informer et à faire participer les Français aux grandes orientations énergétiques qui vont dessiner le mix énergétique français pour les 30 ans à venir. Ce débat, qui a donné lieu à de nombreuses « initiatives partenaires » (débats locaux organisés de façon pluraliste par des associations), constitue une expérience pilote dans le domaine de la gouvernance. Il est destiné à préparer la loi d'orientation qui sera soumise à l'automne au Parlement, et qui portera notamment sur les grands équipements énergétiques. Est également prévu le vote d'une loi sur la transparence dans le domaine nucléaire.

Annex to the French country report
French participation in the Generation IV International Forum a new generation of nuclear systems

The Generation IV International Forum

Setting objectives for the systems of the future and the choice of the key technologies required to achieve them, are the focus of a major drive towards co-operation on an international level, notably in the context of the Generation IV International Forum.

The genesis of the Forum

Once it became aware of the risks of shortages and medium-term energy dependence, the US government, through the Department of Energy (DOE), has committed itself to boosting its means of producing electricity. In the field of nuclear energy, this has taken the form of two complementary initiatives:

- The first, specific to the US, aims to facilitate the construction of new reactors in the USA, on a short-term time scale (by 2010); it is called the nuclear power programme 2010 (NP 2010). An ad hoc group, the Near Team Deployment Group (NTDG), has evaluated the reactors that are likely to be built between now and 2010, identifying the possible problems that may need to be resolved, both of a technical nature and those arising in relation to regulations and administrative complexities. The end result is a series of actions designed to facilitate the short-term deployment of these third-generation nuclear reactors;
- The second is the Generation IV International Forum. Its founding principle is recognition, by the ten member countries, of the advantages of nuclear energy in response to the world's growing energy requirements, in a process that leads towards sustainable development and prevention of the risks

caused by climate change. This principle is stated in the Forum's charter and is translated in practical terms by the establishment of an International R&D organisation whose job it is to define, develop and enable the deployment of 4th generation nuclear systems by the year 2030. The member countries of the Generation IV International Forum are Argentina, Brazil, Canada, France, Japan, the Republic of Korea, the Republic of South Africa, Switzerland, the United Kingdom and the USA. Other countries or international authorities could eventually join in this research effort.

Methodology of the choice of technological orientations

Three steps have already been taken:

- Evaluation, according to a highly codified methodology, of the concepts proposed by the participating countries (this step was taken between April 2001 and April 2002),
- Selection of a small number of technology concepts that were judged to be particularly promising during the evaluation phase (this step was taken in May 2002),
- Compilation of a development plan for these technologies, published in October 2002, preparing the ground for a subsequent phase of international co-operation (main goal of the Forum from 2003 onwards).

It was evident from the outset that there was a high degree of convergence as to the main goals of the Generation IV programme and concerning the means of achieving these goals. Four main aims or "goal areas" were defined to characterise the systems of the future. They must be all of the following:

- Sustainable: in the sense of using natural resources sparingly and respecting the environment (by minimising the production of long-term radiotoxic waste, and by ensuring optimal use of natural fuel resources).
- Economical: in terms of the investment cost per kWe installed, the cost of the fuel, the cost of operating the plant and, consequently, the production cost per kWh, which needs to be competitive in comparison to the costs of other energy sources.
- Safe and reliable: with research into the ways of improving upon the current reactors, and by eliminating as far as possible the need to evacuate the population surrounding the site, whatever the cause and the seriousness of the accident occurring within the power station.
- Resistant in terms of the risks of proliferation and in terms of being easy to protect against external threats.

Around one hundred engineers and researchers participated in the initial phase of the work of the Forum, which resulted in the publication, in October 2002, of a development plan for the technologies that were judged to be the most promising, which was to serve as a basis for international co-operation between the member countries of the Forum.

Technical groups were allotted the task, for each of the sectors under consideration (water, gas and liquid metal reactors, etc.), of evaluating the different concepts proposed according to the chosen goals and criteria, and drafting R&D plans for the concepts that were finally selected. The evaluation methodology was drawn up and finalised by a specific working group, and the four major progress goals explained above were incorporated into about thirty basic criteria.

Crosscutting technical groups identified the developments required in terms of fuels, cycle processes, equipment, safety and the energy products for the different systems examined by the Forum. A co-ordination group provided direction for all the activities of the technical groups and integrated the results in the phase-specific documents and in the final synthesis. This synthesis (entitled the Technology Roadmap) is available for consultation on the US Energy Department website: http://gen-iv.ne.doe.gov/

The choices made by the Forum

The selection of the most promising concepts for the systems of the future was finalised in 2002.

Six nuclear systems have been selected, which will allow major advances to be made in terms of the development of sustainable energy, economic competitiveness, safety and reliability, as well as resistance to proliferation and to external threats. It will also be possible to use these systems for procedures other than the production of electricity, such as the production of hydrogen or the desalination of seawater.

The diversity of the needs to be dealt with and the international contexts explains why it is impossible to come up with a single Generation IV system, but rather a set of the most promising system concepts, upon which the R&D efforts of the member countries of the Forum are now concentrating.

The chosen six systems include two high temperature gas-cooled reactors, two liquid metal-cooled reactors (sodium and lead alloys), one supercritical water-cooled reactor, and one molten salt reactor. Four of the six systems use fast neutrons and five rely on a closed fuel cycle, with integral recycling of all the actinides.

The second stage in the work of the Forum is the international co-operation phase, which aims to consolidate the feasibility of the systems by removing the technological barriers and then validating their performances. This stage is currently being implemented and France is playing a very active part in the process. Once the feasibility of the systems is confirmed a phase of validation of their technical and economic performances will ensue. This work will be completed between 2015 and 2025, according to the degree of innovation of the systems, and will result in a situation of sufficient development and technical maturity, with a view to major industrial deployment by the year 2030.

The six selected systems:

- VHTR (Very high temperature reactor system) – A very high temperature reactor system (1000°C/1200°C), cooled by helium and designed for the production of hydrogen or for the co-generation of hydrogen/electricity.
- GFR (Gas-cooled fast reactor system) – A helium-cooled fast reactor.
- SFR (Sodium-cooled fast reactor system) – A sodium-cooled fast reactor.
- LFR (Lead-cooled fast reactor system) – A fast reactor cooled by a lead alloy.
- SCWR (Supercritical water-cooled reactor system) – A water-cooled supercritical reactor.
- MSR (Molten salt reactor system) – Molten salt reactor.

In the framework of the Generation IV International Forum, France has expressed a particular interest for prioritising advanced, very high temperature gas-cooled systems (VHTR) and systems using fast neutrons with integral recycling of the actinides (GFR). France will also contribute to the developments on the fast neutron and sodium-cooled reactor system (SFR). The impressive results obtained by the gas reactors in the final evaluation, and therefore the recognition of the usefulness of this concept by the Generation IV International Forum, confirms the pertinence of the decision taken by the CEA in the year 2000 to concentrate its research projects on creating a range of systems with the capacity to evolve based on this technology. The work of the CEA into the development of the SFR system is proof of the desire to make the most of this major area of expertise acquired in terms of sodium-cooled reactors.

Gas-cooled reactors: a privileged axis of development

The use of helium produces larger amounts of energy, which benefits the technologies of gas turbines, which have made considerable progress.

The CEA has gained much experience from its work on gas-cooled reactors:

- Firstly in terms of NUGG (natural uranium graphite gas) technology in the nineteen-sixties.
- Secondly in terms of HTR technology (High Temperature Reactor cooled by helium) in the nineteen-seventies and eighties.

The experience gained from past research into NUGG has since been used to develop a new sector, which is that of High Temperature Reactors. An important programme of collaboration was launched between the CEA and General Atomics. This helped the CEA to gain valuable experience in HTR technology, particularly in terms of fuels, systems and materials, and the physics of the reactors.

Today the CEA can use this accrued experience of both NUGGs and HTRs in the framework of its research into gas-cooled reactors.

This technology has a number of interesting characteristics:

- *Primarily in terms of safety and security*: the conductive, refractive and highly confining attributes of the fuel ensure a very solid level of resistance in case of accidents,

- *In terms of economic competitiveness*: its potential is linked to the increased amount of energy that is produced, the simplicity of the circuits, the short time period in which it can be built and a reduced investment requirement, with the possibility of creating modular reactors with a power of a few hundred megawatts.
  The member countries of the Generation IV International Forum validated the pertinence of this choice as the major axis for research and development. They chose two of the systems proposed by the CEA (the VHTR and the GFR), out of the most promising concepts for progress in the coming decades, with the following time scale perspectives:

- *By 2015-2020, development of a 300 megawatt (MWe) modular high temperature helium-cooled reactor*. The industrial development of this type of reactor could result in the creation of an industrial prototype by the year 2015 or thereabouts. The power range (300 MWe) is particularly advantageous for regions where the electricity network is relatively badly interconnected, and it is particularly suited for the development of the first nuclear production units in industrialising countries or developing countries. The sector of very high temperatures (in excess of 950°C for VHTR) paves the way for a scope of applications reaching far beyond that of simply producing electricity, and offers interesting perspectives in terms of increased competitiveness through co-generation. It is for this reason that the CEA is actively conducting research into processes of hydrogen production (thermo-chemical decomposition of water or high temperature electrolysis). Equally, technical and economic evaluations of the processes of desalinating seawater that could viably be coupled with high temperature reactors are currently underway, particularly in the context of a European project called Eurodesal and also through cooperation with Tunisia and Morocco under the aegis of the International Atomic Energy Agency (IAEA).

- Continuing on from high temperature reactors, the development of the gas-cooled system, with fast neutrons and integral recycling of the fuel (GFR system) has begun with a view to creating, by the year 2030, a technology that makes it possible to use the energy-producing potential of nuclear fuel with optimal efficiency, and to minimise the production of long lived radioactive waste. The aim of such systems is to produce waste that is much less potentially harmful, returning within a few centuries to the level of the initial uranium mineral that was used.

Sodium-cooled reactors: a degree of expertise that is highly sought after in the current climate

The objective of preserving and making the most of expertise is particularly relevant in the case of sodium-cooled fast reactors, an area in which France has made major technological progress in terms of R&D, experimentation and industrial development. In relation to this technology, the CEA can make the most of the knowledge obtained from the development phase and the industrial feedback pertaining to the fast neutron reactor network (Phénix, Superphénix, EFR, etc.) and the comeback of the Phénix in 2003.

The CEA controls all aspects of the sodium-cooled fast reactor network:

- Creation of installations from the experimental Rapsodie reactor (40 MWth) to the industrial prototypes Phénix 250 MWe (563 MWth) and Superphénix 1 200 MWe (3 000 MWth).
- Industrial control of the main stages of the fuel cycle:
  - manufacture of the uranium and plutonium-based fuels.
  - reprocessing of the used fuel with a demonstration, in 1981, of the capacity of Phénix to use the plutonium that it had itself produced in a previous cycle.
- Experience of good behaviour of a wide range of structural materials (mainly steels).

This experience is being fully exploited through international co-operation, mainly with Japan and the USA, within the Generation IV International Forum, but also with Russia.

GERMANY

In 2002, Germany started to phase out nuclear energy production. The underlying legal decision had been triggered both by a vanishing public acceptance of nuclear energy and by the fact that the residual risk of electricity production cannot be tolerated any longer.

The foundations of nuclear phase-out were laid by an agreement reached between the federal government and the utilities. This agreement was signed on 11 June 2001 and initialed on 14 June 2000. Giving their signature, the utilities did not consent generally to phasing out nuclear energy production. However, the partners agreed to define residual amounts of electricity for each German nuclear power plant. After generation of these amounts, the power plants will be shut down. The agreement of 14 June 2001 was put into effect when the amended Atomic Energy Act entered into force on 26 April 2002.

There are 19 nuclear power plants on the grid today in Germany. In 2002, the gross electricity production of these plants amounted to 164.6 TWh corresponding to about 28% of the total electricity production. In accordance with the agreement of 14 June 2001, the first nuclear power plant, Stade, will be shut down in 2004. Obrigheim will follow in late 2005.

Germany plans to store radioactive waste in deep geological formations. The official plan approval for low and medium-level waste was issued in June 2002 but was not enforced immediately, according to the agreement of 14 June 2001. So far, four legal proceedings have been started over the plan approval. They postpone, until decided, the ultimate enforcement of the latter.

Until September 2000, the Gorleben salt mine was explored in particular for high-level waste repository storage. The agreement of 14 June 2001 has been subjecting exploration of the mine to a moratorium which shall last three years at least, but not longer than 10 years. During that time, one intends to solve the safety issues and conceptual problems raised by the federal government, e.g.

- Development of gases and their impacts.
- Period of safe isolation of the waste from the biosphere.
- Risks of criticality in the direct repository storage of fuel elements.
- Retrievability of the waste after disposal in the repository.
- Comparison of existing host rock formations (salt, clay, granite) that are suited for repository storage.

After completion of the work of the “Arbeitskreis Auswahlverfahren Endlager” (repository selection procedure working group), the federal government will submit to the parliament a proposal specifying the selection criteria and selection procedure for a repository storage site in accordance with the coalition agreement of 1998.

HUNGARY

Introduction

The Hungarian economy attained a stable growth of 4-6% in the last couple of years. Inflation has declined steadily, the year-end inflation in 2002 was 4.8% offering a stable and predictable economic environment for investors. Despite the weak performance and slowdown of the world economy the country was able to sustain the 3.8% GDP growth in 2001 and 3.3% in 2002 as well as a double-digit increase of exports in euro-term. The rate of unemployment stabilised under 6% in the last two years. The dynamic growth of income has given an impetus to private consumption in 2002 which showed an increase of about 9%.

As Hungary is expected to join the EU in 2004 the Hungarian government strives for a foreseeable, transparent regulation as well as gradual liberalisation in the market areas controlled by centrally set prices such as the electric power and gas markets.

Energy policy

The new government elected in April 2002 formed by the Hungarian Socialist Party and the Alliance of Free Democrats has kept the continuity in the reforms initiated earlier. The energy policy of Hungary continues to be determined by "Hungarian Energy Policy Principles and Business Model of the Energy Sector" a key document adopted by the previous government (Decision 2199/1999 VIII.6) whose main objectives are to:

- Develop diverse energy supplies and eliminate dependency on imports from the former Soviet Union.
- Improve environmental protection.
- Increase energy efficiency through modernisation of the supply infrastructure and better management of electricity consumption.
- Attract foreign capital for investment in capital intensive projects.

To reach these goals the previous government took a number of measures to liberalise the energy sector and improve regulations. A similar direction is being pursued by the new government that came into power in May 2002. A number of these measures are also driven by the requirements of the forthcoming accession to EU planned for 2004. The Energy Chapter of the EU accession is closed meaning that Hungary is now fully in - or in the process of being fully in - conformity with EU requirements.

Electricity industry

In 2002 the electricity consumption of Hungary was 39.62 TWh, a slightly higher than in 2001. Of this amount 4, 243 TWh was imported. The total domestic production was of 35.377 TWh, its nuclear share amounted to 39.4%, oil and gas to 32.3%, coal to 26.2% and others to 2.1%.

There is a surplus generating capacity until about 2004-2005 with a reserve margin currently reaching 25-30%. Temporarily before accession to EU there will be a larger reserve margin since more generation has been contracted and coal fired stations were not closed as planned. Problems may arise at 2005.

The new administration is now in the process of discussing details of the secondary legislation of the Electricity Act passed in December 2001. This legislation concerns the implementation of the Act from January 2003. The liberalisation of the electricity market began in January 2003, to allow for gradual implementation by the time Hungary is admitted to the EU. The first step is to open 35% of the retail market to competition. A gradual opening of the market until all customers are free to choose their suppliers is planned to be achieved by 2010. The new law recognises the existing three categories of the market players (power producers, distributors and grid operator) and defines a new group, the power traders operating from 2003 onwards.

Hungarian electricity consumers spend about 3,8% of GDP on electric energy that is far more than consumers spend in most other developed countries. In the absence of competition efficient price regulation plays important microeconomic and macroeconomic roles. The revised system of price regulation began on 1 January 2001 and will end on 31 December 2004. During these four years regulation will continue to be based on price formula whose main elements continue to be monthly consumer price indices (excluding energy products) inflation adjustment and fuel price indices. Household prices in Hungary have reached cost levels and they are at similar levels found in the rest of Europe.

Operation of the Paks NPP

Both the technical and the economic experience with the Paks plant have been satisfactory in 2002. The plant runs in base load and sells electricity to MVM under a long-term contract. The power generation of the four V-213/440 Type WWER units of the Paks NPP was 13 953 GWh representing 39.4% of the total electricity production in 2002. The average annual cumulative load factor of the plant reached 85.82%.

In April 2003 a serious incident (INES-3) occurred at the Paks NPP. During the outage of unit 2 the cleaning of fuel assemblies in a dedicated tank was carried out in the fuel transport pool in the reactor hall. After finishing the cleaning process, some hours later the radiation monitoring system indicated the presence of radioactive gases. It turned out that the fuel assemblies in the cleaning tank suffered serious damage due to incomplete cooling. The details of the event can be found in a report on the HAEA’s web site (www.haea.gov.hu).

Radioactive Waste Management

As part of an ongoing project for the disposal of low and intermediate-level waste generated at the Paks NPP a long-term research project was elaborated for the site characterisation and confirmation of the selected site in Bátaapáti (Üveghuta). Based on a geological exploration plan, approved by the competent authority, on-site investigations have taken place using boreholes, trenches and wells. Preparations started for the elaboration of an environmental impact study and an integrated safety assessment. On this basis the research project would end in 2004 with the first steps of the licensing procedure.

ITALY

1. The Italian Electricity Market

1.1 Electricity production and demand

Italian energy situation for the year 2002 – as far as electricity production and demand - is synthesised in the following Table 1, along with the per cent variations of the various items with respect to the year 2001.

Gross electricity production, reaching 283.7 TWh, increased in 2002 by 1.7%, i.e. analogous to the increase of the electric network demand (+1.8%). Also a considerable increase of net electricity import (+5.3%) was observed.

Table 1. Electricity Production and Demand in 2002*

	2002		Change 2002/2001
	TWh	%	%
Thermoelectric Energy	229.8	81	+4.8
Primary Electricity	53.9	19	-9.6
– Hydro	48.1	17	-10.9
– Geo + Renewable	5.8	2	+1.6
– Nuclear	–	–	–
Total Gross Production	283.7	100	+1.7
Net Electricity Import	51.5		+5.3
Total Availability	335.2		+2.2
Network Demand	310.4		+1.8

* Provisional data
Source: “Rapporto sulle attività del Gestore della Rete di Trasmissione Nazionale; April 2002 – March 2003”

1.2 Liberalisation of the electric market [1]

The Italian Government has continued to pursue its new energy policy, already begun in the early 1990s, and based on market liberalisation, decentralisation to the Regions of the main administrative functions, diversification of energy sources, and development of renewable energy sources.

The Italian liberalisation and privatisation process is an integral part of the unique European energy market creation process. The decisions taken at national level are also a consequence of the community directives; furthermore, their effects are largely influenced by the development of the European policy and from the degree and modalities of assumption of the European directives by the other member States.

The EU Directives for Electricity and Gas market liberalisation have been transported into national legislation and the correspondent legislative decrees represent the most important events during the last period. Large state-owned energy companies, including ENI – the oil and gas conglomerate – and ENEL – the major electricity company - have started to be privatised. The Government share in ENI is currently 30.33%, while in ENEL it has been reduced to 67.58%.

Decree 79/1999 entitled “Implementing the European Directive 96/92/EC with common rules for the single market of electricity”, is a framework law to introduce regulation governing different activities in the electricity sector. This decree liberalises the activities of production, importation export, purchase and sale of electric energy.

1 Source: International Energy Agency: *2002 In Depth Review – Italy*, 25 September 2002

The main consequences of this decree have been:

- The separation of ENEL's production, transmission, distribution and sale of electricity activities. It retains only the ownership of the transmission network, but the activity is managed by a public Transmission System Operator (*GRTN – Gestore della Rete di Trasmissione Nazionale*), which must guarantee the safety, the reliability and the efficiency of the network.
- The Transmission System Operator must give non-discriminatory access to all producers and eligible customers, provide that the technical conditions are complied with. The tariff for the use of the network is the same regardless of the distance between the generator and the eligible customer.
- For captive customers, the same electricity tariffs are applied throughout the entire Italian territory. In order to guarantee their supply, the transmission network operator has established a specific company, the Single Buyer (*Acquirente Unico*), which is responsible for the supply to captive customers.
- From 2003 onwards, no company can have more than 50% of the electricity produced in or imported to Italy. ENEL is transferring at least 15,000 MWe of its own capacity. Due to this provision, ENEL has constituted the three listed Companies below named GENCOs (Generation Companies) sold by 1 January 2003:
  – Elettrogen (5,438 MW).
  – Eurogen (7,008 MW).
  – Interpower (2,611 MW).

  On 23 July 2001 Elettrogen was sold to a consortium formed by Endesa, Banco Santander Central Hispanico and ASM Brescia and, on 18th, march 2002, Eurogen was sold to Edipower (a company owned by Edison, AEM Milano, AEM Torino, ATEL, Unicredito Italiano, Interbanca, MRSB Capital Partners).
- The decree foresees the creation of the figure of the "market manager" to organise the market and assume the management of the offer of acquisition and supply of electricity and complementary services. It must also provide for an office of bilateral contracts. A company acting as market manager (*Gestore del Mercato*) was set by the transmission network operator in June 2002.
- A full liberalisation of the activities of electricity production, with a unique administrative authorisation for plant construction and management.
- The distributing companies must guarantee grid connection to all subjects that apply for it.
- Priority is given to renewables and CHP (Cogeneration) in despatching and there is the obligation for any producer or importer handling more than 100 GWh/yr to feed the system with at least 2% of renewables produced by plants that enter into production after 1st April 1999.

The Decree 164/2000 was issued to implement the European Directive 98/3/EC on natural gas. It liberalizes the activities of storage, transport, distribution, and supply of natural gas.

Both decrees point out the role of the Regulatory Authority for Electricity and Gas (*Autorità per l'Energia Elettrica e il Gas, AEEG*), already established in 1995 as an independent agency created to regulate both the electricity and gas sectors.

The two new decrees in the electricity and gas sectors enhance energy efficiency by obliging electricity and gas distributors to promote end-use energy saving and by stipulating that quantitative national targets for this activity must be set.

As far as decentralisation, the regions and local bodies administrative assignments in the energy sector, with particular respect to the organisation of services in the territory and to renewable energy sources.

As for diversification of energy sources, this is not only a political strategy, but also a national need, related to the lack of domestic energy resources which leads to a strong historical dependence on the primary energy source import. In the diversification process the renewable energy sources play an important role, one that is fundamentally important to be able to meet the conditions of the Kyoto protocol.

The energy diversification target will also be reached by meaningfully increasing coal use, taking advantage of new available technologies.

Finally, as far as research and technologies, public funding for energy R&D was about € 263 million in 2000 and € 283 million in 2001. In 2002, the R&D budget was about € 287 millions with an increase for renewables equal to 18%.

Specific resources (about 100 M€) have been dedicated to the promotion of photovoltaic technology by the Ministry of the environment and regions. 100 M€ were attributed in 2001 by the Parliament to ENEA for the development of solar thermal power generation during a three year programme.

2. Nuclear Related Activities

Nuclear activities are performed mainly by two organisations i.e. SOGIN – the Nuclear Plant Management Company – and ENEA – the Italian National Agency for New Technology, Energy and the Environment.

2.1 Decommissioning of NPPs and waste management

In 1999, all the ENEL's liabilities and assets connected to nuclear power have been assigned to a newly established company, named SOGIN (*Società Gestione Impianti Nucleari*). The mission of SOGIN covers:

- The decommissioning of the NPPs in Italy.
- The management of the back end of the fuel cycle.
- The valorisation of the asset such as sites, components and resources.
- Providing engineering and consultancy services in the nuclear and environmental field within the domestic and the international market.

Strategic guidelines for the management of the past national nuclear activities and in particular for the radioactive waste management and decommissioning of the nuclear installations, are provided in recent document issued in 1999 by the Ministry of Industry, now Ministry for Productive Activities.

Institutional framework

In the framework of the Nuclear Activities management in Italy, the competent national bodies are the following:

Ministry for Productive Activities	The Ministry for Productive Activities is the authority that issues the operating licenses for all nuclear and radioactive installations, after the positive technical advice of APAT. For installations related to radioactive waste storage and disposal, the concerted agreement of the Ministries of Environment, Internal Affairs, Welfare and Health is also required.
APAT (Agency for Environmental Protection and Technical Services)	APAT (created in October 2002 from the formerly ANPA) is responsible for the regulation and supervision (by inspection) of nuclear installations in matters of nuclear safety and radiation protection. Any license granted by the Ministry for Productive Activities incorporates the corresponding preceptive and legally binding report of APAT. It is a public body governed by law with administrative and financial autonomy, under the supervision of the Ministry of the Environment. In the siege of the APAT operates also the Technical Commission for Nuclear Safety and Health Protection from Ionising Radiations, composed of experts designed by ENEA, APAT and various Ministries, which gives technical advice concerning the granting of licenses for nuclear installations.

Environment Ministry	This is the Ministry in charge of the VIA procedure (environmental impact assessment). This procedure has been extended to nuclear installations decommissioning in application of a European directive, although the directive has not yet been incorporated in the national legislation.
The Regions	With the devolution of power enacted in the Country, the importance of the Regions has strongly increased. Actually they provide binding advices to all licensing procedures.

Decommissioning policy

By the end of 1999, the Ministry for Productive Activities issued a document providing strategic guidelines for the management of liabilities resulting from past national nuclear activities.

Highlights of this new policy were:

- Treatment and conditioning of all radioactive waste stored on the sites.
- The start up of a concerted procedure, by means of a specific agreement between the Government and the Regions, for the selection of a near surface national site for the final disposal of low and intermediate level waste and for the interim storage of the spent fuel and the high level waste.
- The adoption of strategy for a prompt decommissioning ("DECON") of all national shutdown nuclear power plants, thus abandoning the previous "SAFESTORE" option.
- The establishing of a new national company, SOGIN, in charge of all shutdown nuclear power plants, with a mandate to perform their prompt decommissioning.
- The creation of a National Agency for the Management and Disposal of Radioactive Waste, whose main mandate would be to realise and operate the national radwaste disposal site.
- The allocation of special funds for all these activities by means of a specific levy on the electric energy consumption.

According to these directives, all the old nuclear installations should be completely decommissioned by the year 2020.

The new policy was followed by a Ministerial Decree of January 26, 2001. The Decree establishes plans and procedures for funding the decommissioning of the nuclear facilities, NPPs and fuel cycle facilities, from dismantling to waste conditioning and disposal.

The strategy identified in the Decree of January 26, 2001, was further detailed by a Ministerial Decree of May 7, 2001, which provided operative directives to SOGIN for implementing a prompt decommissioning of the four national power stations up to an unconditional release of the respective sites within twenty years. Such a Decree provided also directives to SOGIN for the safe management of radioactive waste and spent fuel associated to the power stations, together with funding provision with an additional fee on the consumed KWh.

On this basis, SOGIN has modified its decision on the decommissioning strategy to be implemented, moving from SAFESTORE to accelerated dismantling (DECON). This change implied that the applications for the decommissioning licenses had to be reviewed, and in particular that a large part of the submitted documents were no longer applicable. During the time needed to update the documents, SOGIN asked for authorisation to perform at least some preliminary decommissioning activities, consistent with both strategies. It must be underlined that the most important obstacle to the fast decommissioning comes from the lack of a low-level waste repository: the viability of the new strategy was ensured by the commitment of the Government to take all the actions needed for speeding up the process of site selection. The envisaged date for repository availability is 2010.

In this new context, a comprehensive plan for a prompt decommissioning has been presented by SOGIN to the Ministry for Productive Activities for Garigliano, Caorso, Trino and Latina NPPs, and is currently under review by APAT.

Furthermore, the Ministerial Decrees of 2001 established that the decommissioning of the ENEA fuel cycle facilities can be funded by an additional fee on the consumed KWh if the activities are carried out by ENEA in Consortium with SOGIN. This provision brought to the creation of a Consortium, called SICN, among ENEA, FN and SOGIN, with the main objectives of managing the activities related to decommissioning of the facilities of the nuclear fuel cycle owned by ENEA and FN, in order to prepare the transfer to SOGIN of the facilities themselves, foreseen by the end of 2003. Main activities of SICN are to contribute to the planning of the waste management and dismantling and to control the activities in progress.

At this moment SOGIN is performing the following preliminary activities:

- Dismantling management
  SOGIN has improved some waste characterisation systems and, in order to obtain the totally traceability of each part of the plant, has implemented a 3D system with a complete CAD 3D power plant model.
- Spent fuel treatment
  The spent fuel assemblies of Garigliano, Latina and partially Trino NPPs have been sent to Sellafield (UK) for reprocessing. For the Caorso spent fuel assemblies an option is to build a temporary repository for the dry storage casks. As an alternative the reprocessing strategy is being considered.
- Documents for the Safety Authority
  For each NPP, SOGIN has delivered to the Italian Authority a general authorisation document named "Istanza" and is preparing a VIA (Evaluation of Environmental Impact).

Waste management policy

In order to solve the serious problem of the radioactive wastes – which to date are still stored in the sites where they were produced - the Italian Government has included, as a strategic goal, in the Document for Economic and Financial Planning 2002-2006, the realisation of a national disposal for radioactive waste.

The Government itself – following agreements with the Regions regarding the need to give legislative substance to the plan for the dismantling of nuclear power plants and installations in Italy – in the ambit of the bill on energy submitted to the Parliament at the end of 2002, has included a section (article 27) which delegates the Government to issue one or more legislative decrees aimed at regulating both a safe storage of radioactive waste, of irradiated fuel elements and of nuclear materials (including the search of an available site and the realisation of a national repository of low radioactive wastes), and the decommissioning of nuclear plants of the fuel cycle and fuel production structures. In the same section is also identified the company (SOGIN) which, on behalf of the Government, will manage all these operations.

2.2 Nuclear R&D

Nuclear fission research

The R&D activities performed or coordinated by ENEA in the field of nuclear fission research are aimed to innovative solutions in a wide spectrum of industrial applications of nuclear fission physics and technologies.

The international frame of development in this field is characterized by the centrality of the growing energy demand, and by the even more compelling demand of sustainability and safety in energy production. Innovative concepts of nuclear fission plants have an important potential for increased production of electricity and other energy vectors, like hydrogen, avoiding problems that in the past slowed down the industrial exploitation of the nuclear energy.

The R&D is focused on new solutions, optimized on the whole life cycle of the process of energy production, avoiding or substantially reducing external costs (environmental impact, long lived waste), risks to the public safety, forthcoming generations legacy, and nuclear weapons proliferation risks.

In this context the R&D program is focused on the nuclear waste management and elimination by transmutation: this is the goal of the ADS (Accelerator Driven System) program, and the leading idea for the other sub programs on safety and innovative systems development.

The objective of the ENEA activities for ADS is to demonstrate the feasibility of transmuting high-level long lived nuclear residues of nuclear power plants in a subcritical plant. In the national program, priority is given to technological development of an ADS plant cooled by heavy metal (led or lead bismuth eutectic, LBE) and to the demonstration of coupling of a proton accelerator to a subcritical system. Methods for nuclear safety are developed within an international context. They concern system and safety analysis, risk assessment, transient and accidents studies, thermal-hydraulics studies, core degradation analysis, reactor pressure vessel integrity, ex-vessel molten corium coolability studies, containment behaviour analysis, source term evaluation, plant safety analysis in severe accident, passive systems performance analysis, nuclear data and neutronic studies, new fuel studies.

The main activity lines are:

- Design activities for ADS.
- Method development for ADS.
- Technological development for ADS.
- TRIGA Accelerator-Driven Experiment (TRADE).
- Method development for nuclear safety and technology.

Design activities for ADS

ENEA activities have been performed in co-operation with INFN and Ansaldo in the frame of the European PDS-XADS Project of the 5th Framework Programme. PDS-XADS is focused on basic design studies for an eXperimental ADS. Two 80 MW basic design options are studied in detail; a XADS with a lead/bismuth eutectic (LBE)-cooled core and one with a gas (Helium)-cooled core.

ENEA is involved mainly in the nuclear design LBE-cooled XADS.

The configuration of the primary system is pool-type, similar to the design solution adopted for most sodium-cooled reactors. This concept permits to contain all the primary coolant within the Reactor Vessel, thus eliminating all problems related to out-of-vessel primary coolant.

The pool design has important beneficial features. These include a simple boundary containing all primary coolant with its large thermal capacity.

The primary coolant of the XADS circulates in natural circulation enhanced to full flowrate by gas injection into the riser. The natural drought ensures the flowrate required to keep the core cooled at shutdown with no gas injection. This natural circulation capability has been made possible by the low-pressure-drop design of core and IHX. While the natural circulation alone can provide decay heat removal for unlimited time with the reactor at shutdown, in case of loss of gas injection with reactor at power, an increase of hot collector temperatures is expected, but is acceptable for a limited time.

The in-vessel Fuel Handling System is integrated with the Primary System in order to allow introduction and withdrawal of fuel assemblies inside and outside the Reactor Vessel, without the need of opening the primary containment. No internal storage of fuel assemblies is provided in the reactor vessel, allowing a smaller diameter. The in-vessel Transfer Machine, carried by the rotating plug, can reach all core positions, as well as the Load -Unload Station in the Reactor.

The Decay Heat Removal (DHR) function is performed by the Secondary System. In the unlikely event of its unavailability, DHR would take place via the Reactor Vessel Air Cooling System (RVACS). In normal operation the RVACS keeps the Reactor Cavity wall cooled; it mainly consists of air cooled U-pipes, arranged vertically in the annulus between Reactor Cavity wall and Safety Vessel, of two concentric headers and of four stacks that constitute redundant inlet and outlet air paths.

In the year 2002 the main results of R&D applied to this configuration of XADS are:

- Performed neutronic evaluations allow to propose an operational K_{eff}=0.97 at beginning of cycle and full power which guarantees adequate subcriticality margin under any operational and accident conditions without need of shutoff or control rods. Compensation of fuel burnup would be achieved by increasing the 600 MeV proton beam current up to 6 mA max at the end of the cycle.
- In spite of the large mass of Pb-Bi of the primary system, main and safety vessel can accommodate seismic loads if the reactor assembly rests on horizontal anti-seismic supports.
- The adoption of a windowless target unit eliminates the need of qualifying materials to be immersed in Pb-Bi that have to be simultaneously tolerant to neutron and proton irradiation. This allows the target unit replacement during reactor refuelling.
- Activation of reactor roof can be limited in order to allow unrestricted personnel access at reactor shut down.
- The low LBE temperature and velocity allow the use of proven stainless or martensitic steels for the primary system, even if some confirmations are still necessary.

TRIGA Accelerator-Driven Experiment (TRADE)

It has been recognised world-wide the need to proceed towards an experimental demonstration of the ADS concept and a proof of principles for transmutation, at the horizon 2010, by realising an Experimental ADS of approximately 100 MW.

In order to comply with that requirement a large R&D program has been launched in Europe, USA and Japan since a few years, with the objective to validate the basic features of ADS. A pioneering experiment was performed at CERN (FEAT) and, among others, experiments are performed in France (MUSE) and are under preparation at PSI-Switzerland (MEGAPIE), in the frame of large international collaborations.

However, the case for the licensing of an Experimental ADS of 100 MW can present some difficulty in absence of a preliminary coupling experiment at power. A way out is simply to realise an experiment where an “existing” (low power) reactor, with well-known safety features, is made sub-critical and coupled with an accelerator which should provide the needed protons to induce spallation reactions on a target hosted inside the core.

The domain of interest of such experiment will be to show a reliable operation of the system, from start-up to nominal power level, up to shutdown, in presence of thermal reactor feedback effects. The presence of control rods in the system will allow to verify different modes of operation during fuel irradiation and the determination and monitoring of reactivity levels with “ad-hoc” techniques. The possibility to run the experiment at different levels of sub-criticality will allow to explore experimentally the transition from an “external” source-dominated regime, to a core thermal feedback dominated regime. The joint cooling of the target and of the sub-critical core will be demonstrated, together with the solution of some practical engineering problems of generic interest for an ADS, such as the configuration of the beam ingress into the core.

It was suggested that this pilot experiment, which would be the first example of ADS components coupling “at real size”, could be carried out on the TRIGA reactor at the ENEA Casaccia Centre, an existing pool reactor of 1 MW thermal power, cooled by natural convection of water in the reactor pool. An external 140 MeV-1 mA proton cyclotron may be coupled - through a beam transport line - with a solid spallation target installed in the central channel of the TRIGA reactor scrammed to sub-criticality.

The TRADE experiment, to be performed in the TRIGA reactor at the ENEA Casaccia Centre, can represent a major demonstration step of the ADS concept, in relatively short time frame and at a cost which is more than an order of magnitude lower with respect to, e.g., the XADS demonstration plant discussed in the “European Roadmap for Developing ADS for Nuclear Waste Transmutation”. Therefore, TRADE opens a new perspective in the roadmap towards the demonstration of ADS for waste transmutation. This pilot experiment will not provide a demonstration of actinide fuel transmutation, and in that respect, the

XADT dedicated experimental demonstration, also discussed in the European Roadmap, will still stay essential, at a time horizon of 2010. The XADT could benefit from the early demonstration of the ADS concept (by ~ 2007), which will provide the essential elements in order to assume that decision. The TRADE experiment will be a logical and significant further step with respect to the MUSE and MEGAPIE experiments, and could be run in parallel with the development of transmutation dedicated fuels and high intensity proton accelerators.

The technical feasibility of the TRADE experiment has been demonstrated: no showstoppers have been found in the way to its realisation.

A Final Feasibility Report was prepared by the Working Group on March 2002. The results of these new studies confirm the general conclusions of the 2001 report as far as feasibility, and provide further credibility to a realistic implementation of the experiment in the time horizon of 2006-2008.

Starting from mid-2002, the TRADE experiment is now greatly benefiting from an enlargement to other international partners which will share cost, manpower and responsibilities in the frame of a joint project. Indeed, the following 13 organisations have expressed their willingness to participate in the experiment: AAA (France), AIMA (France), ANSALDO (Italy), CEA (France), CIEMAT (Spain), CNRS (France), DOE (USA), ENEA (Italy), FZK (Germany), IBA (Belgium), JRC (EU), PSI (Switzerland), SCK•CEN (Belgium).

According to the preliminary discussion with the Italian Safety Authority (APAT) and to the DISP technical guide n. 2, the Working Group has prepared the technical documentation – recently submitted to the Minister of Productive Activities and to APAT - for obtaining a preliminary authorisation of feasibility of the plant modification, along with the definition of the second stage of the licensing process of the plant modification itself.

The R&D work performed for TRADE in 2002 have concerned:

- Neutronic analysis: by means of 3-D Monte Carlo simulations codes a number of neutronic features of the proposed TRADE experiment have been analysed.
- Target system: different solutions for the target, which operate a minimum impact on the existing geometries of the TRIGA reactor core, have been envisaged.
- Preliminary design of the beam transport line: a preliminary design of the Beam Transport Line has been performed. The BTL transports the beam from the cyclotron to the TRIGA reactor.
- Preliminary measurements: some preliminary measurements have been carried out in TRIGA, mainly concerning the efficiency of the neutron detectors and the calibration of the control rods.

Nuclear fusion research

Most of the fusion R&D activities in Italy are performed in the framework of the European coordinated programme partially financed by EURATOM through a system of Associations with the national research organisations (22 Associations of which the German, French and Italian are the most relevant, covering 80% of the activities).

Other activities in Italy are financed on the basis of national funds, the most relevant being those related to the IGNITOR project.

The activities are performed by ENEA, mainly in the Labs of Frascati and Brasimone, by Consorzio RFX in the Lab of Padua, by CNR in the Lab of Milan, by Politecnico of Turin, by Consorzio CREATE (Universities of Naples, Cassino and Reggio Calabria).

The main international issue in the magnetic confinement program deals at present with the R&D and preparatory work for ITER (International Thermonuclear Experimental Reactor) a 4.7 billion Euro device having the aim of demonstrating the technical and physical feasibility of a fusion reactor. The negotiations on the possible construction of the device are in progress between the partners (UE, Japan, Russian Federation, USA, China) and a conclusion is foreseen within about one year from now. Matter of the discussion are the organisation of the international ITER legal entity, the share of the costs between the partners and the choice of the site where the machine should be located. In case of success of the negotiations ITER will be constructed. The construction period is foreseen to take ten years and the following scientific experimentation period twenty years, polarising the interest of an entire generation of fusion scientists.

In the magnetic confinement field the Italian activities in the EURATOM frame during 2002 have been concentrated on research in preparation of physical scenarios of ITER and on technological issues for ITER.

Regarding the first argument, in particular, there have been performed on the Tokamak FTU (Frascati Tokamak Upgrade), a world class Tokamak operating at the ENEA Center of Frascati, experiments aiming at the study of particular plasma regimes with low heat transport (transport barriers) that, if demonstrated feasible and tested in the future at the ITER level, can bring to a fusion reactor of smaller size than that foreseen with the actual established data base and consequently to a lower cost of the electrical energy produced by the commercial fusion reactor.

Other experimental research done on FTU deals with the study of the heating of the plasma by means of radiofrequency waves at different frequencies. The importance of these studies is related with the possibility of modifying locally the plasma and current density characteristics (an important factor in the generation of the transport barriers) due to the localised absorption of the RF power and with the generation of current inside the plasma due to the transfer of momentum from the RF waves to the electrons. The last research argument is important in allowing a continuous operation of a Tokamak commercial fusion reactor. Indeed actually the plasma current is inductively generated, a method intrinsically pulsed, whereas the drive of the current by means of RF has not this limit, relaxing the fatigue on the machine structure.

In the magnetic confinement physics the activity of reconstruction (with improvements) of the RFX (Reversed Field Experiment) device in Padua, damaged in a fire in 2000, can be mentioned. It is foreseen that the experimental exploitation will be resumed in the early 2004 with the aim of testing active systems to control the magnetohydrodinamic activity of the plasma.

Finally there have to be mentioned the ITER relevant activities in the field of plasma theory and diagnostic development as well as the important Italian participation in the experimental exploitation of the JET (Joint European Torus) machine (Culham, UK).

In the field of the inertial confinement, beside the theoretical activity, experiments have been performed using the ABC device in Frascati (Nd, two beams each of 100 J, 3 ns at λ = 1.054 μm or 40 J at λ 0.527 μm) irradiating low density targets; moreover a technological activity has been pursued to develop diode pumped high power lasers.

In the technology field the Italian Association with EURATOM is engaged in several arguments going from the development of the ITER “divertor” (a critical component where it is concentrated a considerable fraction of the energy released by the plasma) to the development of new structural materials (composite SiC/SiC) to withstand the high heat flux and with low activation by energetic neutrons, to the construction and test of various remote handling tools and remote metrology devices, to the experimental validation of the codes calculating the cross sections of interest for fusion making use of the FNG (Frascati Neutron Generator) device of Frascati.

Other technological developments deal with the thermo-hydraulic experimental tests, performed in the ENEA Brasimone Center, of the modules of the ITER blanket. This is a component of the reactor to be tested in ITER in which the neutrons emitted in the fusion reactions lose their energy to be extracted and converted in electrical power and where the tritium is produced to fuel the reactor by means of nuclear reactions between the neutrons and lithium (the reactor fuel is a mixture of deuterium and tritium). An additional task of the blanket is to shield from the neutrons the superconducting magnet coils that produce the magnetic field confining the plasma.

The superconductivity is another important technological field in which the Italian fusion research is strongly committed.

In 2002 samples of ITER NbTi superconductor has been produced and tested as well as tests of ITER full size conductors and coils have been performed.

Outside of the frame of the EURATOM programme Italy is developing the design and performing the R&D of IGNITOR, a Tokamak machine proposed by Prof. B. Coppi of MIT with the aim of studying the physics of the “burning plasma”, i.e. a plasma in which the energy released in the plasma itself by the energetic alpha particles produced by the nuclear reactions is of the same order of the energy content of the plasma. The study of a burning plasma, never done up to now, is of fundamental importance in the path to the fusion reactor, being possible the appearance of new unforeseen physical phenomena.

Only three devices have been proposed to study the burning plasma: ITER, FIRE and IGNITOR (FIRE is a 1.2 billion dollars device that will be possibly constructed in USA in the case of failure of the negotiations for the construction of ITER).

IGNITOR is a device of relatively low cost (less than 10% of ITER) with a cryogenic magnet in copper (instead of the superconducting magnets of ITER) designed to perform some crucial physics experiments (the mission of ITER is more extended, embracing important reactor technology tests and long duration plasma scenarios).

The design of IGNITOR is completed for the non conventional part of the apparatus (the so called load assembly), prototypes of the main components have been produced and tested, the fabrication procedures have been established.

During 2002 a design review of the project has been started to take into account new operative scenarios extending the possible plasma characteristics, to take also into account the most recent issues produced by the international research. The design review includes also the conventional parts of the plant, taking into account some possible sites.

JAPAN

1. Outline of the Japanese Nuclear Energy Policies

Japan has consistently developed and utilized nuclear energy to achieve a stable energy supply for the future and to minimize environmental effects.

To confirm this position, the Cabinet issued a policy statement on “Policies to Promote the Nuclear Fuel Cycle” in February 1997. And the Japanese government has made efforts to promote construction of the Rokkasho reprocessing plant, plutonium utilization in Light Water Reactors (LWRs), spent fuel management, backend measures and research and development program of Fast Breeder Reactors (FBRs).

The Atomic Energy Commission (AEC) issued the current Long-Term Program for Research, Development and Utilization of Nuclear Energy (Long-Term Program) in Japan in November 2000. The Long-Term Program has been revised approximately in every five years, since 1956. These programs have played an important role in the systematic implementation of research, development and utilization of nuclear energy in Japan.

Inspection and test scandals of nuclear power plants occurred last year, which have affected public trust in nuclear power and fuel cycle. Furthermore, a recent High Court ruling on nullity of FBR Monju construction permit presents a new roadblock, and the government has appealed the ruling to the Supreme Court.

Since last November, to recover the public trust, AEC has continued to discuss what a nuclear fuel cycle should be with various circles including local governors who hold nuclear facility in their region, press people and consumers. AEC intends to show the comprehensive vision of nuclear fuel cycle as the result of discussions.

2. Current Status of Nuclear Power Generation

As of the end of FY2002, 52 commercial nuclear power plants are operated in Japan (see Table 1). The total capacity of these plants is 45,742 MW. Four power plants (including Fast Breeder Reactor “MONJU”) are under construction and eight plants are being planned as of the end of March 2003. Nuclear power generation represented 34.5% of total electricity generated in FY2001. Electricity generated by the nuclear power plants, which constitutes the core of base load, amounted to about 320 TWh in FY2001.

Table 1. Current Status of Nuclear Power Reactors

Reactor type	Operation	Capacity [MW]	Construction	Capacity [MW]	Planned	Capacity [MW]
BWR	27	23,664	1	1,100	1	825
ABWR	2	2,712	2	2,738	4	5,502
PWR	23	19,366		0	1	912
APWR				0	2	3,076
Subtotal	52	45,742	3	3,838	8	7,239
FBR	□	0	1	280	□	0
Total	52	45,742	4	4,118	8	10,385

The Electric Power Companies submitted the electricity supply plan to METI in March 2003. According to this plan, 15 nuclear power plants are to start operation by 2012. It would add 19,695 MW and reduce 375 MW. Total electricity generation capacity would be 6,508 MW in 2011.

The Japanese government regularly makes public a report called “Long-Term Outlook of Japanese Energy Demand and Supply”. In June 2001, Advisory Committee for Natural Resources and Energy submitted new report to METI. It is comprehensive review of Japanese energy policy. This report recommends that Japan should raise the share of nuclear energy in primary energy supply from 13% in 1999 to 15% in 2010, and in electricity generation supply from 34.5% in 1999 to 42% in 2010.

3. Nuclear Fuel Cycle

The primary objective of Japanese nuclear policy is establishing a domestic nuclear fuel cycle system to make efficient use of nuclear materials. According to The Long-Term Program since the mid of 1950s, Japan has pursued to utilise plutonium as Mixed Oxide (MOX) fuel both in a Fast Breeder Reactor and also in a Light Water Reactor.

Mining and milling

Power Reactor and Nuclear Fuel Development Corporation (PNC), predecessor of Japan Nuclear Cycle Development Institute (JNC), made contribution on exploration activities in thirteen countries (Canada, Australia, the U.S., China, Zimbabwe, Mali, Niger, Guinea, Gabon, Central Africa, Zambia, Indonesia and Colombia). However, it was decided, in the context of the overall reorganization of PNC in 1998, that newly established JNC would withdraw from exploration activities by September 2002. In June 2002, JNC completed the transfer of all rights and interests acquired by PNC to private companies in Japan as well as to overseas company.

Enrichment

JNC’s Uranium Enrichment Demonstration Plant at Ningyo-toge terminated its operation in March 2001. Expertise acquired by JNC through the operation of the uranium enrichment plant was transferred to Japan Nuclear Fuel Ltd. (JNFL). JNFL has been operating a commercial enrichment plant with a capacity of 1,050 tons SWU/year at Rokkasho-mura in Aomori prefecture since 1992. The capacity of this commercial plant is to be expanded by 1,500 tons SWU/year.

Reprocessing

In Japan, plutonium retrieved by reprocessing of the spent fuel of LWR will be utilized for Plutonium and Uranium Mixed Oxide (MOX) fuel.

Tokai Reprocessing Plant of JNC has been operated since 1977, and its cumulative amount of reprocessed fuels reached about 1,009tU as of the end of 2002.

The Rokkasho Reprocessing Plant (designed for dealing with 800 tU/y) of JNFL is now under construction and more than 90% of total construction has been completed as of the end of March 2003. The operation is planned to start from July 2005. The spent fuel will be reprocessed at the rate of 800 tU per year. Pre-operational test of the plant used with chemical reagent started in November 2003. The construction of a spent fuel storage facility was completed as an accompanying facility of this plant. Spent fuel from electric utility companies has been transferred to the storage facility since December 2000.

Plutonium utilisation

Domestic power companies have a program to start loading of MOX fuel in sixteen to eighteen commercial LWRs by the year 2010. MOX fuel, however, has not been loaded in any LWRs yet, except for a few cases of irradiation test, because of the objection of the local community in the vicinity of LWRs. Therefore, Electric utility companies and Government have made efforts to get much more public understanding of this program in order to start the MOX utilization.

JNC has developed MOX fuel fabrication technology and total amount of the MOX fuel fabricated in JNC had reached about 170 tons of MOX at the end of FY2002.

JNFL has a plan to build MOX fuel fabrication facility with a production capacity of 130 tons-HM per year at Rokkasho. JNFL is consulting to build the facility with, Aomori prefecture and Rokkasho village, since August 2001.

Spent fuel storage and management

“Policy to promote the Nuclear Fuel Cycle” was approved by Japanese Cabinet in February 1997 including the management of spent fuel. For the appropriate storage and management of spent fuel, it is necessary to start interim storage outside of nuclear power stations by 2010 to accommodate the increasing spent fuel. The Law for Regulations of Nuclear Source Material, Nuclear Fuel Material and Reactors was amended in June 1999, to establish a legal basis for private organizations to be licensed to construct and operate interim spent fuel storage facilities outside of nuclear power station. Tokyo Electric Power Company is investigating the potential site for interim spent fuel storage facilities in Mutsu, Aomori prefecture.

Waste management

The number of vitrified wastes corresponding to the amount of spent fuel at the end of 2000, is estimated at almost 16,600. In June 2002, the Specified Radioactive Waste Final Disposal Act was passed at Diet and this act enables to institutionalize the final geological disposal system of high-level radioactive waste in Japan. This legislation includes a funding system for final geological disposal, site selection procedure, and the establishment of an entity to implement final geological disposal and the designation of an entity to manage the fund. Based on this act, Nuclear Waste Management Organization of Japan (NUMO) was established in October 2000. NUMO is responsible for a selection of final geological disposal site of high-level radioactive waste, construction, operation and maintenance of the site, closure of the facility and institutional control after closure. In the case of deposing 40,000 vitrified packages, which corresponds to the nuclear power generation by 2020, the cost is estimated at almost 3 trillion yen. Concerning site selection, a three-step procedure will be adopted, and survey methods and selection criteria will be clarified through legal procedure. The final disposal site should start the operation around 2035.

As the first milestone of siting process, NUMO announced to the public a document entitled “Overall procedure for selection of preliminary investigation areas” on October 29, 2001. NUMO started solicitation of volunteer municipalities for preliminary investigation areas (PIAs) for potential candidate site with publishing four documents as an information package in December 2002.

- Low-level waste (LLW) is managed appropriately according to the radioactivity.
- LLW from Nuclear power plants (NPPs) are classified into three levels.
  - As for very low-level waste, such as concrete or metal, will be disposed in the slot excavated on the ground (trench pit disposal). At present, the Japan Atomic Energy Research Institute is performing the practical test, disposing concrete from dismantled research reactor.
  - As for relatively low-level waste, such as the solidified wears or groves, will be disposed to the concrete–pit, and Japan Nuclear Fuel Ltd is already carrying out disposal in Aomori Prefecture by
  - As for relatively high-level waste, such as control rod or structures inside the reactor, will be disposed in underground of 50 to 100 meters depth. Japan Nuclear Fuel Ltd. is performing detailed investigation at the Rokkasho-mura, Aomori Prefecture.

The uranium waste or radioactive waste including the Transuranium (TRU) radionuclide generated form the fuel cycle facilities, is also managed according to the radioactivity. The safety regulation of its disposal is under consideration in the Nuclear Safety Committee.

Public relations

AEC conducts Round-Table Conference for Public Participation to find a measure of establishing public trust in nuclear policy. The conference has a purpose to increase opportunities of public participation in the process of making nuclear policy by itself.

To cooperate and to take much closer communication among utilities in order to realize the MOX fuel utilization, “Inter-Ministry Council on MOX fuel utilization in thermal reactors” was set up and it released an interim report in August 2001. It points out the need to make clearer explanation of the importance of nuclear fuel cycle policy, it suggests some new key concepts for the public information activities, and government is to make the action plans based on these key concepts.

4. Promotion of a Variety of Advanced Nuclear Technology

AEC’s special meeting of innovative reactor and related fuel cycle technology

In view of domestic and overseas circumstances, the necessity of innovative nuclear systems and social expectations for such systems, AEC conducted investigations and discussions by establishing the Subcommittee on the Innovative Reactor and related Fuel Cycle Technology under the Advisory Committee on R&D.

The subcommittee deliberated from January 2001 to November of the same year, and drew up the report “Ways to Promote the R&D of Innovative Nuclear Systems in the Future.”

As a first step to tackle the R&D of innovative nuclear systems, the report grasps the current status of the R&D in Japan and summarizes the concepts about the necessity of such systems and development strategies.

Scheme for development of innovative nuclear

MEXT and METI are carrying out the budgetary aid programs from deferent point of view, to promote the competitive research and development of nuclear energy technology.

MEXT is carrying out a new scheme that calls for research and development activities on innovative nuclear technologies by creating an environment circles under competitive conditions brought forth by public invitation of relevant projects. With the competitive environment thus prepared, the scheme aims to strengthen cooperation among the three sectors in conducting fundamental studies on nuclear energy, develop related technologies and examine the innovative nuclear technologies that are expected to broaden the range to nuclear technologies.

METI seeks the innovative and viable nuclear power technology development projects, which is to accelerate the industrialization of nuclear power generation and fuel cycle technology, and therefore, to improve the safety and economically.

GEN-IV

Japan signed the Charter for the Generation-IV International Forum (GIF) in July 2001 and has been taking part in the GIF activities. Japanese technical experts are also contributing to the preparation of the research and development roadmap through the participation in several working groups.

Feasibility study on commercialised fast reactor cycle systems

In July 1999, JNC started the “Feasibility Study on Commercialized FR Cycle Systems” in co-operation with electric power companies and other related institutes, to propose the FBR system, which has the advantages of effective use of resources, reduction of environmental burden, proliferation resistance and economic competitiveness with the LWR system. Phase-I in which phase the highly feasible candidate concepts for FR Cycle System had been identified, was completed and subsequently the activities have been shifted to the Phase-II stage (approximately five years). During Phase-II, well-balanced consistency of the entire FR cycle will be pursued, based on engineering experiments, and candidate concepts screened in Phase-I will be narrowed down.

HTTR project

JAERI has promoted the HTGR development study as the high temperature engineering test reactor (HTTR) project to establish and upgrade the HTGR technologies. The HTTR, which is the first HTGR in Japan, reached first criticality in 1998 and accomplished a full power operation of 30 MW and gas temperature of 850°C in December 2001. In the HTTR Project, a hydrogen production system is planned to be connected to the HTTR. This plan will be useful to apply nuclear energy not only to power generation but also to heat utilization.

5. Other Nuclear Topics

Decommission

The Japan Power Demonstration Reactor (JPDR) of the Japan Atomic Energy Research Institute was the first case of decommissioning in Japan, which started in 1986. In this case, dismantling of reactor had started immediately, without posing safety-storing term. It took about 10 years for its whole process.

Tokai Power Station (166 MWe) of the Japan Atomic Power Company is the first commercial nuclear power plant in Japan, which started operation in July 1966, using natural uranium and cooled by carbon dioxide gas. The commercial operation was terminated in March 1998, for preparing the decommissioning, and taking out of all the spent fuel in reactor had been completed by June 2001. The nuclear reactor decommissioning was started in December after getting the review of the regulator. All facilities including its nuclear reactor will be dismantled and removed by the end of March 2018.

In order to establish decommissioning technologies, the government has contracted decommissioning technology development for commercial power plants as a national R&D project to the Nuclear Power Engineering Corporation (NUPEC).

A Ministry of Economy, Trade and Industry stipulates that the licensee may reserve a certain amounts to a decommissioning fund during its plant operation prior to the start of decommissioning. The regulatory authorities annually approve the estimated amount for decommissioning cost and ensure the adequacy of the reserved amount by financial audit and review of accounting report submitted by the licensee.

FBR and ATR

Japan Nuclear Cycle Development Institute (JNC) had been developing two types of reactors, one of which is Fast Breeder Reactor (FBR) and the other is Advanced Thermal Reactor (ATR).

The prototype FBR “MONJU” with the capacity of 280 MW, which was constructed based on the expertise obtained through the operation of experimental reactor “JOYO”, reached criticality in 1994 and, however, has suspended its operation since the sodium leakage accident in 1995. Until now, the investigation into the cause for the leakage has been conducted thoroughly and the measures to prevent similar accidents have been identified. In December 2001, the license for the plant modification of MONJU to install the countermeasures against sodium leakage was granted by the Nuclear and Industrial Safety Agency (NISA), nuclear regulatory authority. The plant modification will be started subject to the understanding of the local community.

ATR “FUGEN” with a capacity of 165 MW, is the heavy water moderated, boiling water-cooled reactor using MOX as fuel and a pressure pipe in the reactor core. Development of ATR “FUGEN” has been furthered domestically as a nuclear reactor with the advantage of effectively utilizing reprocessed uranium and plutonium. “FUGEN” reached criticality in March 1973 and has continued its operation since then. In 1995, a plan to construct a demonstration plant was abandoned by AEC mainly due to its lack of economic competitiveness. “FUGEN” terminated its operation in the end of March 2003 and subsequently entered into the phase in which the preparatory work for the decommissioning is being conducted. During this phase which takes about ten years, spent nuclear fuel will be transported to the Tokai Reprocessing Plant, heavy water will be taken out of the reactor and the R&D necessary for the decommissioning will be carried out.

Unification of two institutes for nuclear development

A cabinet decision of the Re-formation and Streamlining Plan for Special Public Corporations was made in December 2001. In this cabinet decision, Japan Atomic Energy Research Institute (JAERI) and Japan Nuclear Cycle Development Institute (JNC) will be unified, and new independent administrative agency, which is in charge of the integrated research and development of atomic energy, will be established. The AEC presented Basic Policies toward the unification of JAERI and JNC in advance to an examination by the related administrative organ. In the MEXT, the Preparation Meeting for Unification of the Two Nuclear Corporations is held for the purpose of examining the role and the function of the new corporation, taking into consideration priorities and efficiency of its operation, and the basic report was summarized in August 2002.

REPUBLIC OF KOREA

Nuclear policy

Mr. Moo Hyun Roh of the New Millennium Democratic Party was elected as the new president of Korea in Dec. 2002. However, it is expected that there would be no change in nuclear energy policy, because President Roh agreed with the need of nuclear energy in Korea, in the viewpoint of energy security, during his presidential campaign

Nuclear power program

Younggwang 5 and 6, which are the 3rd and 4th units of Korean Standard Nuclear Power Plant, started their commercial operations in 2002. They are 1000 MWe class PWRs and located in the same site as Younggwang 3 and 4 which are already in operation. It took more than 6 years for construction and Younggwang 5 started its commercial operation on 21 May 2002, while Younggwang 6 on 23 December 2002. 18 units of nuclear power, including Younggwang 5 and 6, are currently operating in Korea and the plants are located spreading over in four sites such as Kori, Younggwang, Wolsung, and Ulchin. Total installed capacity of nuclear power plants reached 15.7GWe.

According to the long-term plan, 12 new nuclear power units will be constructed by 2015. The share of nuclear power capacity and that of nuclear power generation will increase to 33% and 44.5% by 2015 respectively.

Nuclear R&D

ITER

Korea will join the international nuclear fusion energy project, International Thermonuclear Experimental Reactor(ITER). Minister of Science and Technology of Korea, during a round visit to Europe in April, already won the positive response from the European Union’s Science and Technology Minister regarding Korea’s admittance. In coming August the minister will visit the United States to draw the support. The government garnered approval for its plan to earn a membership to ITER, from the National Science and Technology Council of Korea on May 26.

National activities related to Gen IV development

Korea actively participates in an international collaboration on Gen IV development as a chartered member of GIF (Gen IV International Forum). Since October 2002, Korea has made a national plan for an effective collaboration on Gen IV development with GIF member states as well as participations in MATF (Multi-lateral Agreement Task Force) and GIF R&D planning. About 40 technical experts have involved in the national planning.

In the preliminary result of the planning, two main directions to Gen IV development are proposed. One is to develop Gen IV reactor and its fuel cycle technologies for electricity generation, and the other for hydrogen energy production. R&D budget for an international collaboration on Gen IV development in fiscal year 2004 is under request to the Government.

Selection of candidate radioactive waste disposal sites

Four locations in the southern part of Korea have been selected as candidate sites for low level radioactive waste disposal facilities in February 2003. They are Younggwang and Gochang in Jeolla Province and Ulchin and Yeongdeok in Gyeongsang Province.

Now that those candidates have been identified, the government plans to let KHNP conduct detailed inspections to see if they are suitable for the facilities geologically and environmentally. At the same time, the government will hold consultations with residents and local governments about the project.

However, if any place other than the above-mentioned four locations expresses willingness to host a disposal facility, the government would give it preferential consideration. Based on the outcomes of the inspections and consultations, the government will finally select the location.

THE NETHERLANDS

Nuclear electricity generation

A couple of years ago the Government took the decision that the nuclear power plant, Borssele (PWR, 450 MWe), had to close down at the end of the year 2003 and consequently a validity date until then was written into the license. The legal grounds of this action turned out to be insufficient and the Dutch State Council judged that the Government took a wrong way to put its decision into effect.

In addition a lawsuit was undertaken by a previous Government to force the operator of Borssele to close down the plant at the end of 2003. The judgement turned out to be favourable for Borssele. Besides a new centrum/right-wing Government took the decision that Borssele should continue its operation after 2003 as long as it is safe

Uranium enrichment

Uranium enrichment is the most important part of the fuel cycle for the Netherlands and it is very successful. Urenco Nederland BV has a licence for a capacity of 2 500 tSW/y. The total uranium enrichment market share of Urenco in the Western world is about 15% and is still growing. Urenco has concluded contracts with 15 countries, including many European Union countries, Switzerland, Brazil, South Africa, the United States, as well as in the Far East Korea and Japan.

The success of Urenco is based on its advanced gas ultra centrifuge technology. Improvements are still made in this technology as a result of an extensive R&D programme. Ultra-Centrifuge's availability was better than 99.9% in 2002. Construction of a new plant – SP5, fifth plant – was started in 1999. In its first hall the first ultra centrifuges ran smoothly in 2002. Construction of a second hall was completed end 2002 and it is being filled with ultra centrifuges at the moment. A license for a third hall has been issued. The construction of a new Urenco enrichment plant in the USA is being pursued.

Radio-isotope production

Dutch Government sent a study to Parliament on the future of radio-isotope production. A large part of the production takers place in the High Flux Reactor at the Petten site. The outcome of the study was that a long-term shutdown of this reactor will cause serious problems all over Europe, because it leads to shortages of Molybdenum-99. That is the radio-isotope which is been used most for medical diagnostic applications. Because of this conclusion Dutch Government took the policy to make a case with the European Union for building a replacement reactor in Europe for the production of medical isotopes. Preferably in a site where other production facilities already are in place.

RD&D and nuclear technology

The merge of nuclear departments of ECN (Energy Research Foundation) and KEMA (Dutch electric power research institute) into the new entity NRG (Nuclear Research and consultancy Group) is still successful. NRG is performing most nuclear R&D in the Netherlands, is committed to international projects in and outside European Union and performs a number of commercial activities. Its commercial services have been divided into six product groups, viz. Materials, Monitoring and Inspection; Fuels, Actinides and Isotopes; Risk Management and Decision Analysis; Radiation and Environment; Irradiation Services; Plant Performance and Technology.

Nuclear policy

National elections took place in January 2003. A change in nuclear policy is not expected as another centrum/right-wing Government took over.

SPAIN

1. Electrical generation

In Spain there are 9 nuclear units in operation, in 7 sites, with an installed power of 7,875.8 MWe, which represents 12,7% of the whole installed power.

The total nuclear origin gross energy during 2002 has been 63,027 GWh, which represents 27% of the total electrical output of Spain. The average Load Factor of the Spanish nuclear park has been 92.0%.

The power of the nuclear park has increased in 60,12 MWe, as consequence of the increase of thermal power in Cofrentes NPP.

In September 2002, the Spanish Government approved the document "Gas and Electric Plan, Development of Transport Grids 2002-2011". On it is foreseen to increase the electricity consumption in an average figure of 3.75% per year, increasing the use of gas and maintaining the nuclear capacity.

In accordance with the liberalisation scheme, established by the Electricity Industry Act in 1997, this Plan is not compulsory, only contains indicative basis.

In October 2002 the renewal of the operation licence was given to José Cabrera NPP which limits the life of the plant till April 30, 2006, when the operation of the plant will cease definitively and its dismantling will follow. This plant, a one loop Westinghouse PWR, is the smallest (160 MWe) and the oldest (commissioned in 1968) of the Spanish park. The decrease of capacity due to the definitive shut-down of this Plant, is foreseen to be balanced by increasing the output of other NPP through optimisation of the thermal performance of equipments and/or increasing the thermal energy produced by the fuel. Taking into account these premises, it is foreseen that the nuclear power capacity will be maintained in the period 2002-2011.

2. Front-end of the fuel cycle

In 2002 the production of Planta Quercus, of ENUSA Industrias Avanzadas, was 44 tU_3O_8, treating mine water, because the Uranium mining activities in the same site were finalised at the end of 2000. At the end of 2002 the production activities were definitely finalised.

The Juzbado Fabrication Plant, that the same company has at Juzbado (Salamanca), has fabricated 788 nuclear fuel bundles with 240 tU.

3. Back-end of the fuel-cycle

El Cabril Centre is, in accordance with the 5th General Radioactive Waste Plan, the fundamental basis for the management of low and intermediate level waste (L/ILW) in Spain. This facility provides an integrated management system that includes waste collection, transport, treatment and conditioning and accurate information on the waste inventory, radiological characterisation and quality assurance, all of which are compatible with the type of disposal applied.

The El Cabril disposal facility is in operation since 1992. As of December 2002 some 19.747 m^3 of conditioned waste had been disposed of, and some 4.664 m^3 of conditioned waste were placed in the existing storage facilities at the installation.

The facility has operated at the expected rate of reception, conditioning and disposal of the L/ILW generated at Radioactive and Nuclear Installations, up to October when some of the activities had to stop due to protests and demonstrations, outside the facility. The demonstrators were requesting for a hospital in a town close to El Cabril.

Regarding the radioactive waste arising from the dismantling works at Vandellós I NPP, some 383 m^3 have been transported to El Cabril in 2002 in 220 litres drums and metallic containers of 1.32 m^3 of capacity.

Following the Protocol for managing radioactive material coming from metallic scrap, signed in 1999 between the Ministry of Economy, the Nuclear Safety Council, ENRESA, the Association of Iron and Steel Companies and the Association of Scrapping Companies, the wastes coming from two melting furnace incidents in 1998 and 2001, are stored and will be managed at El Cabril. In 2002, 323 m^3 of those wastes, with very low activity concentration, have been shipped to the facility.

ENRESA has started actions to accomplish Resolutions of a Congress (Lower chamber of the Parliament) Commission, which state the necessity of having a facility for the disposal of Very Low Level Wastes. This facility is to be building at El Cabril.

The approach adopted in the 5th Plan with regard spent fuel and HLW, makes a distinction between the temporary and definitive technological solutions, and considers a period of analysis prior to establish in detail the required strategies and actions.

Concerning a temporary solution, the strategy is:

- On the one hand, to have available by the year 2002 a temporary dry storage facility for the Trillo NPP spent fuel, due to lack of capacity in its pool.
  By the end of the year a storage building was commissioned. In it, dual purpose metal casks, designed by ENRESA together a consulting company and fabricated in Spain, are to be stored at a rate of 2 casks (21 fuel bundles each) per year. The two first casks were loaded during 2002.
- On the other hand, to have available a centralised temporary storage facility by the year 2010, in order to solve the problem of storage of vitrified wastes and of the spent fuel from the other power plants and of the wastes coming from Vandellós 1 fuel reprocessing and others types of wastes.
  The new situation created with the limited licence renewal of José Cabrera NPP (See § 1) may render necessary to have at this power plant another facility similar to the Trillo's one.

4. Decommissioning and dismantling of nuclear installations

The dismantling works of the conventional and active parts at Vandellós 1 NPP were in progress having reached 98% of all the works expected for Level 2 decommissioning. It is worth mentioning that the metallic box that surround the reactor building was installed. This box limits the effects of the inclemencies of the weather and reduce visual impact. In mid 2003 all activities will be finished at the site.

With regard to José Cabrera NPP, ENRESA has started to study the strategies for dismantling and for the spent fuel management. Level 3 dismantling is expected to last 6 years starting in 2009.

Some facilities whose decommissioning is close to start belong to CIEMAT research centre. This nuclear research centre was built from 1952 and onwards. Till now, engineering and licensing works have been undertaken, among others EIA, Radiological Characterisation, Emergency Planning, etc. The main buildings to be decommissioned are a M.T. Reactor, metallurgy buildings, hot cells, an old Pilot Reprocessing Plant and some installations for waste treatment. Decommissioning will start soon when all licenses are granted.

The dismantlement of the research reactor ARGOS, of the Polytechnical University of Catalonia, was finished. These works were authorized in 1998. This reactor was operative between1963 and 1977 and its fuel was withdrawn from the site in 1992.

The restoration and closure works in the mining facility of Saelices el Chico (Salamanca), operated by ENUSA are following the project programme and should finished by 2008.

SWEDEN

Spring 2003

The Government presented 13th of March 2003 a Bill about the Electricity Market and Barsebäck 2 to the Parliament. The Bill was mainly based on reports from two Consultants, which also have been referred to different authorities, the industry and organisations for consideration. Almost all parties concerned declared that the aforementioned conditions for the closure of Barsebäck 2 are not fulfilled. A closure of Barsebäck 2 during the year 2003 will instead have serious impact on the environment and supply of electricity. The Government proposed that it would be investigated if it is possible to include Barsebäck 2 in the negotiations between the Government and the Nuclear Power Industry about an agreement about the future utilisation of the nuclear power. The Parliament discusses the Bill during April and the Parliaments view will be presented in the end of April or first half of May.

Electricity generation and consumption

The total production of electricity in Sweden in year 2002 was 143 TWh and consumption 148,3 TWh. The net **import** of electricity was 5,3 TWh compared with an export of 7,4 TWh year 2001.

Ten nuclear power reactors generated 65,6 TWh in 2002. During year 2001 the nuclear production, eleven reactors, was 69,2 TWh. In December 2001 Oskarshamn 1 (440 MW) was shut down for about 12 months' final modernisation of the unit. The modernisation includes exchange of the control and supervision equipment and also the turbine. Oskarshamn 1 was in operation again in January 2003.

The summer 2002 has been the warmest for more than hundred years with extremely small amounts of precipitation resulting in lower levels than usual in the water reservoirs. Consequently the hydro electricity production was at extremely low level in the second half of year 2002. The hydropower production for the whole year of 2002 ended up to 66,0 TWh, slightly higher than a normal year. In the end of year 2002 the level of the hydropower water reservoirs was extremely low.

Low hydropower production usually leads to higher electricity prices in the wintertime. In the last weeks of year 2002 the price on Nord Pool increased to an extremely high level. A high price level has maintained during the first quarter of year 2003. The melting of snow and following run-off in rivers started earlier than normal but still the Nordic hydropower reservoirs are filled to less than 40%, significantly lower than average.

Nuclear fuel cycle developments

The siting process of a deep geological repository for spent nuclear fuel took a major step forward in 2002 when SKB, the Swedish Nuclear Fuel and Waste Management Co., began site investigations in two municipalities. These include more comprehensive geo-scientific investigations with the aid, among other things, of measurements from the ground surface and in drill holes.

SKB had originally selected three sites for site investigations, but in April 2002, the municipal board of Tierp voted against any further investigations in the municipality. The municipal boards of Oskarshamn and Östhammar, however, said yes to investigations with strong majorities.

This also heralds the start of the Environmental Impact Assessment (EIA) process for a potential deep repository in either Oskarshamn or Östhammar. This process will eventually result in an Environmental Impact Statement (EIS), which will be submitted by SKB along with an application for an encapsulation plant and a deep repository in one of the municipalities.

Following a comprehensive hearing, the Government decided in December 2002 that SKB's 2001 RD&D-Programme fulfils the requirements expressed in the Nuclear Activities Act. According to this act, SKB has to report to the Government every third year.

SWITZERLAND

1. Energy sources and production in 2001/2002

1.1 General survey

Switzerland depends on imported energy for 80% of its primary energy supplies (2001), having no oil or gas resources of its own. Total final energy consumption rose by 2% in 2001 after falling 0.8% in 2000. The increase in 2001 was due to colder weather and lower oil prices. Electricity's share of total final energy consumption in 2001 was 22%, and much of this was local production. Hydropower's share of total electricity production was 60.2%, nuclear power contributed 38.5%.

Renewables' share of final energy consumption was 16.8%. This share was composed of 12.6% electricity from renewable resources, wood contributed 2.4%, waste 0.6% and other renewables 1.2%. The Swiss government promotes the use of new renewable energy sources.

In 2002, the implementation of the CO_2 law showed the first results with the conclusion of a voluntary agreement to reduce greenhouse gas emissions between the association of car importers (AutoSuisse) and the Swiss government. The objective of this agreement is to reduce the consumption of cars from 8.4l/100km (in 2000) to 6.4 l/100km in 2008. Other voluntary agreements negotiated during the year were due for signing at the beginning of 2003.

The first annual report on the new SwissEnergy programme was published in September 2002. The results are good in general though not all of the goals were reached. The transition from the earlier programme (Energy 2000) to SwissEnergy – for example the promotion of energy efficiency in vehicles and appliances with the help of a new label – was accomplished successfully. The internal control system was standardised and reinforced, and collaboration with private sector agencies and with the cantonal authorities has been stepped up.

Parliament's law for liberalisation of the electricity market was rejected in a referendum on 22 September 2002. As a result of this vote, the Swiss Federal Office of Energy has begun to study ways to reorganise the electricity sector, taking the greater European context into account.

1.2 Primary energy supplies

	1998		1999		2000		2001	
	TJ	%	TJ	%	TJ	%	TJ	%
Coal	3,810	0.3	3,980	0.4	5,850	0.5	6,170	0.5
Oil	547,860	49.0	547,200	48.5	532,370	47.0	548,610	47.0
Gas	98,880	8.8	102,450	9.1	101,880	9.0	106,040	9.1
Nuclear	265,'830	23.8	256,610	22.7	272,170	24.0	275,920	23.6
Hydro	154,330	13.8	182,770	16.2	170,330	15.0	190,180	16.3
Other	69,610	6.2	71,880	6.4	75,200	6.5	79,050	6.6
Total*	1,140,320	101.9	1,164,890	103.3	1,157,800	102.2	1,205,970	103.2
El. trades	-21,430	-1.9	-36,820	-3.3	-25,450	-2.2	-37,600	-3.2

*Includes electricity trades Source: Swiss Energy Statistics (Swiss Federal Office of Energy)

General comments

On an annualised basis Switzerland is still a net exporter of electricity. The year 2002 saw an export surplus of 4.5 TWh, i.e. 6.9 % of the electricity produced. Total imports were 47.1 TWh and total exports 51.6 TWh. In the winter of 2001/2002, imports exceeded exports by 1.9 TWh after an export surplus of 2.3 TWh in the winter of 2000/2001.

In order to guarantee security of supplies in the coming decades Swiss electricity companies signed contracts with foreign suppliers. Long-term contracts with the French electricity company (EDF), covering the years 1977 to 2040, give access to a maximum output capacity of 2,455 GWe.

Electricity generation

	1999		2000		2001		2002	
	TWh	%	TWh	%	TWh	%	TWh	%
Hydro	40.6	60.9	37.9	57.9	42.3	60.2	36.5	56.2
Nuclear	23.5	35.3	24.9	38.2	25.3	36.1	25.7	39.5
Fossil	2.6	3.8	2.5	3.9	2.6	3.7	2.8	4.3
Total	66.7	100.0	65.3	100.0	70.2	100.0	65.0	100.0

(iii) Electricity demand

	1998		1999		2000		2001	
	TWh	%	TWh	%	TWh	%	TWh	%
Household	15.1	30.5	15.6	30.4	15.7	30.0	16.1	29.9
Agriculture	0.9	1.9	0.9	1.9	1.0	1.9	1.0	1.9
Trade & Industry	16.7	33.5	17.0	33.2	18.1	34.5	18.3	34.1
Services	12.9	26.1	13.6	26.6	13.4	25.6	14.0	26.1
Transportation	4.0	8.0	4.1	7.9	4.2	8.0	4.3	8.0
- Railways	(2.5)	(5.0)	(2.5)	(5.0)	(2.6)	(5.0)	(2.7)	(5.0)
Total	49.6	100.0	51.2	100.0	52.4	100.0	53.7	100.0

New capacity and plans for the future

Appropriate sites for profitable new hydroelectric power plants have become scarce in Switzerland. The upgrading of existing plant is more common than the construction of new installations. Hydroelectric output capacity is thus set to rise by just 0.01 GW and electricity production by 17 GWh in the next few years, of which 5 GWh will be in winter and 12 GWh in the summer.

2. Nuclear power

2.1 Nuclear power plants

Nuclear power statistics

Power Plant	Type	Net Power MWe	Commissioned	Production in 2002 (TWh)	Availability in 2002 (%)
Beznau 1	PWR	365	1969	2.88	90.7
Beznau 2	PWR	365	1972	3.00	93.9
Mühleberg	BWR	355	1972	2.84	91.3
Gösgen	PWR	970	1979	7.80	92.5
Leibstadt	BWR	1165	1984	9.17	90.9
Total		3220		25.69	91.7

The Beznau and Gösgen plants also produced 1,080 TJ of process and district heat in 2002.

Reactor performance and plans for the future

The performance of the Swiss NPPs has been good in 2002. Their load factors attained values between 90.7% and 94.3%. Three unplanned scrams had no consequences, either for the installations, the staff or the environment. Ten events subject to notification were classified at INES level 0.

Once more, efficient radiation protection led to low values of collective occupational exposure accumulated by persons at the Swiss reactors in 2002. The values of collective doses, in person-Sievert at each plant in 2002 were as follows: 0.44 (Beznau Unit 1 – KKB-1), 0.16 (Beznau Unit 2 – KKB-2), 0.95 (Mühleberg – KKM), 0.93 (Gösgen – KKG) and 0.45 (Leibstadt – KKL).

2.2 Fuel cycle

General survey

The owners and operators of NPPs are responsible for the fuel cycle planning and decision-making. They make contracts in accordance with national legislation and international agreements.

The activities of the government and the relevant authorities are of a subsidiary nature, e.g. accounting and controlling nuclear materials as required by the Non Proliferation Treaty, import/export controls in accordance with bilateral agreements, and checking conformity with the guidelines of the Nuclear Suppliers Group (NSG), as well as negotiating bilateral agreements.

Uranium supply, enrichment and reprocessing

Natural uranium is currently procured from three sources: partnership or joint-venture production, long-term contracts and spot market contracts.

Enrichment is provided by the U.S., Russia and the European Community (France, Germany, United Kingdom, the Netherlands). The fuel elements are manufactured in the U.S., the European Community (Belgium, Germany, United Kingdom, Spain, Sweden) and Russia.

Reprocessing contracts with COGEMA and the BNFL cover about one third of the total nuclear fuel to be irradiated. MOX elements with recycled plutonium have been used in the Beznau I power plant since 1978. Today, the use of MOX is a standard operational procedure in both Beznau plants. Gösgen has used MOX elements since June 1997.

Waste management and storage

Swiss law requires that domestic radioactive waste be disposed of in Switzerland, although the government may allow exceptions. The government considers the feasibility of the safe final storage of radioactive waste in Switzerland to have been proven for low and intermediate level waste (L/ILW). For high-level waste (HLW), the safety of disposal in deep geological formations is considered to be proven in general.

Centralised interim storage of radioactive wastes

Interim storage of HLW and spent fuel in the utility-owned ZWILAG facilities has been fully operational since 2001. Three CASTOR-type containers with vitrified HLW and seven with spent fuel are currently in storage. Construction of the storage facilities for LLW was finalised in 2002 and these can be made ready whenever necessary. Certain ancillary facilities were commissioned in February 2003. Final testing of the plasma incinerator is underway; an active test phase is scheduled to take place within the next few months.

Planning for an additional interim wet storage facility at Gösgen commenced in 2002.

Programme for Disposal of L/ILW

The project for a repository at Wellenberg was defeated at a referendum in 1995. An attempt to salvage it through a lengthy process which involved several working groups (see previous reports) resulted in the submission of an application for a concession for the exploratory drift in 2001. The government of canton Nidwald granted the concession in September 2001, but this was subject to ratification at the polls, and the population of the canton once again rejected the scheme in the referendum of 22 September 2002 (the host community Wolfenschiessen was again in the minority of those voting in favour). The plans for an L/ILW repository at Wellenberg have now been abandoned. A painstaking analysis of the situation and of the next possible steps is currently under way.

Programme for disposal of spent fuel, HLW and long-lived ILW

The Disposal Feasibility project (*Entsorgungsnachweis*) was submitted to the government on 20 December 2002 for its consideration. This project is an important milestone in the HLW programme, the aim being to demonstrate convincingly that a safe repository is possible and that a suitable opalinus clay site exists near Benken, deep below the Zurich wine growing district. The project also serves as a platform for discussion of the HLW programme and its future. Although the Swiss National Co-operative for the Disposal of Radioactive Waste (Nagra) wants the government to focus HLW research on the opalinus clay option, disposal within the framework of a multinational project has been retained as a possible alternative. As a next step the Swiss Federal Nuclear Safety Inspectorate (HSK) will examine the technical aspects of this project. It will also be reviewed by an International Review Team under the auspices of the OECD/NEA. The Swiss government’s decision is expected in 2006. In the meantime widespread consultations will be held.

3. Energy policy developments and public acceptance of nuclear power

Nuclear energy is a very controversial issue in Switzerland. One of the tactics of its opponents is to try to amend the constitution by means of a referendum, either at the federal or the cantonal level. At the federal level there have been five popular initiatives of this type to date. In 1990, the Swiss voters accepted an initiative banning the construction of new nuclear plant for 10 years. In 1999, opponents organised two new initiatives. The first one aims at an extension of the moratorium on new plant until 2010. The other calls for the decommissioning of all five Swiss reactors after a service life of 30 years.

On 28 February 2001, the government sent its message on these initiatives to parliament together with the draft of its new nuclear energy law, intended as a counter-proposal. Parliament adopted the new nuclear energy law on 21 March 2003, after more than two years of intensive discussions, with a number of changes of major political significance. As it now stands the new law allows the possibility of building new reactors, with the possibility of a referendum against their construction; no artificial time limit is imposed on the life of existing nuclear power plant; the general license is maintained. It introduces a 10-year-moratorium on the export of nuclear fuel for reprocessing from 2006 to 2016. It also includes provisions for decommissioning, a concept of monitored long-term geological disposal of radioactive waste that combines elements of final disposal and reversibility, and a system for funding the costs of decommissioning and of radioactive waste management. It simplifies licensing procedures and allows the general right of appeal. Among points the parliament rejected was the government’s original proposal to *ban* the reprocessing of spent fuel. Also defeated was the right of veto by any canton designated to host a geological deep storage facility.

The referendum on these two initiatives takes place on 18 May 2003. There is also the possibility of a referendum on the new nuclear energy law being called at a later stage.

In November 2000 Nordostschweizerische Kraftwerke (NOK), the operator of Beznau Unit 2, applied for removal of the limit on its operating license until the end of 2004. Its application is being examined by the Swiss Federal Nuclear Safety Inspectorate (HSK).

The cost of decommissioning the nuclear power plants has been estimated at CHF1,500 million. A decommissioning fund was established for this purpose in 1984. The operators make annual contributions to this public fund. By the end of 2001 the fund contained CHF940 million (2002 provisionally CHF845m). The amount necessary for decommissioning must be available by the 40th year of operation. The strategy for investing this money tries to achieve an optimal balance between risk and performance. Investments in companies controlled by the owners of the nuclear power plants are not allowed.

The total cost of radioactive waste management has been estimated at CHF13,100 million. This must be met from reserves set aside by the owners. These amounted to CHF7,900 million at the end of 2000. The new ordinance on the radioactive waste management fund requires the plant owners to transfer the reserves into the fund within a period of years, and to continue making yearly payments into the fund. The total cost must be covered by the 40th year of plant operation. Costs incurred while the plant is still in operation are to be paid directly by the owners. By the end of 2001 the fund amounted to CHF1 440 million (2002 provisionally 1,432 m).

4. RD&D policy in (other) energy fields

The current public Swiss energy RD&D (research, development and demonstration) policy is outlined in the ***“Federal Energy Research Master Plan of 2000-2003”***. The ***Master Plan*** is intended both as a guideline for decision-makers in the energy research field within the federal and cantonal administrations, and as an invitation to researchers to apply for projects. The aim of energy RD&D is to help implement the government’s energy policy, ensuring energy supplies that are safe, sufficient, environmentally sound and economically feasible in the long-term, including at the levels of production and distribution, and to promote rational and efficient use of energy. The long-term goal is to achieve a significant reduction in the carbon dioxide emissions, while moving towards the so-called “2000 Watt Society”.

The RD&D strategy in the present ***“Master Plan 2000-2003”*** is thus:

- To step up RD&D activities in the area of energy conservation (energy efficiency), particularly by promoting pilot and demonstration (P+D) projects, with an increase in funding from the current 32% to 34% of the total RD&D budget in 2003.
- To continue efforts in the field of renewable energy sources (including sizeable support for P+D projects), increasing the funding from 30% to 34%.
- To reduce the nuclear energy research funding from 30% to 23%.

Coordinating and monitoring public energy RD&D programmes are among the tasks of the Swiss Federal Office of Energy (SFOE), in consultation with the Federal Energy Research Commission. The SFOE’s duties include keeping the Swiss energy RD&D concept up to date, ensuring optimum utilisation of research findings, liasing with private sector RD&D activities and also with international research projects.

In 2000 [and 2001] public energy RD&D was funded with 166.8 [172.8] MCHF (million Swiss francs), of which 26.6 [29.8] MCHF was spent on P+D projects. The total amount is equivalent to 120.8 [125.1] MUSD (million US dollars at 2003 conversion rate: 1 USD = 1.38081 CHF). From this figure 38.2 [36.9] MUSD (i.e. 31.6% [29.5%]) was invested in nuclear energy research, 37.7 [37.9] MUSD (i.e. 31.3% [30.3%]) in research on renewable energy sources, 36.0 [39.6] MUSD (i.e. 29.8% [31.7%]) in research on rational use of energy (conservation) and 8.8 [10.6] MUSD (i.e. 7.4% [8.5%]) in research on energy policies and economics. The figures for the year 2002 are *expected* to be in the same range. The final figures will be published in fall 2004 together with the figures for the year 2003.

Swiss government energy RD&D expenses
in MCHF (million Swiss francs) nominal
and in MUSD (million US dollars at 2003 conversion rate)

Total energy RD&D	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
MCHF (nominal)	187.2	199.0	220.6	223.3	220.8	215.1	206.7	196.9	182.6	179.9	166.8	172.8	180*
MUSD (2003)	135.6	144.1	159.8	161.7	134.9	155.8	149.7	142.6	132.2	130.3	120.8	125.1	130*

* Provisional

5. Paul Scherrer Institute (PSI)

The Paul Scherrer Institute (PSI) is a multi-disciplinary research centre for natural sciences and technology. The PSI is active in solid state physics and materials sciences, elementary particle physics and astrophysics, life sciences, nuclear and non-nuclear energy research, and energy-related ecology. The PSI collaborates with various universities at the national and international levels as well as with other research institutes and industry.

The Institute concentrates on those subjects which are at the leading edge of scientific knowledge, which contribute to the education of the next generation, and which pave the way to a sustainable, environmentally friendly society. Most of the PSI R&D projects would be beyond the possibilities of a single university department. The PSI develops and operates complex research facilities requiring especially high standards of know-how, experience and professionalism. As one of the leading “user labs” for the national and international scientific community, the PSI seeks industrial applications for new knowledge acquired through research.

The mission of PSI is as follows:

- To conceive, design, build and operate large, complex research facilities for the scientific community (user-lab mission for universities, other research institutes and industry).
- To carry out basic and applied research in
  - Solid state physics and materials sciences (investigation of the atomic structure of solid matter and liquids by means of particle beams and radiation; use of this method for micro- and nano-technology)
  - Particle physics (study of fundamental interactions of matter; search for rare decaying elementary particles) and astrophysics (study of stellar atmosphere, dark matter, solar spectroscopy; development of X-ray detectors)
  - Life sciences (cancer therapy and medical diagnosis using particle beams and radiotracers, effects of radiation on living organisms, structural biology)
  - Nuclear and non-nuclear energy and energy related environmental research (reactor safety research and scientific services, studies for the safe disposal of radioactive wastes; new methods for energy production, storage and conversion, energy systems analysis)

In August 2001 a new large research facility, the Swiss Synchrotron Light Source SLS, started its operation with four beam lines. Start of construction of the facility was in the middle of 1998; the costs amount to CHF 159 million plus about 450 PY of manpower from the institute. Three additional beam lines are under construction, the number of users continues to rise and for the next 7-10 years about 2 new beam lines per year will be added to the facility.

The Spallation Neutron Source SINQ has now been in operation for more than six years and is producing a continuous neutron flux of about 10E14 n s^{-1} cm^{-2} with a proton beam current of about 1.8 mA on a solid target.

The SINQ and the SLS resulted in a major shift in the focus of PSI research towards the study of the structure of matter and materials. It also strengthened the PSI’s international appeal as a user lab for universities, other research institutions and industrial laboratories. About 70 percent of the annual PSI budget is dedicated to the user-lab mission.

The PSI continued to expand its proton therapy facilities in 2002 (PROSCAN project). This long-term programme for advanced proton radiation therapy, which is based on experiences with the PSI compact spot-scanning gantry, aims to optimise the irradiation and treatment technique and to prepare the compact gantry system for transformation into a marketable product for hospital applications. As a first step, the existing spot-scanning gantry will be connected through a new beam transport system to a dedicated 250 MeV compact superconducting proton cyclotron, ordered in May 2001. A new gantry with an advanced scanning system is under development.

The PSI budget for the year 2003 is about CHF250 million, including external funding (18%) and social and infrastructure costs. It has a staff of about 1200 employees, including 250 scientists and technicians paid out of the external funds. About 240 students are working on their doctoral theses at the PSI.

Energy Research

About 25% of the PSI annual government funding of CHF218 million in 2003 is earmarked for energy and energy-related environmental research. The PSI government-funded nuclear energy research activities have been reduced by more than 30% in the past decade. To a large extent, this reduction was compensated by external funding (mainly from nuclear power plant operators and from the nuclear safety authorities). The resources thus obtained have been used for new research projects and in particular for construction of the SINQ and SLS facilities. Cuts in personnel resources are stabilising and, with a current staffing quota of about 165 person-years per year, and about 7 MCHF for O&M and investment costs, a position of equilibrium has now been reached. One third of the overall cost of nuclear energy research is externally funded by the Swiss utilities, NAGRA, the Swiss Federal Nuclear Safety Inspectorate (HSK) and other agencies. Most of this support is for long-term research contracts. Several projects are being conducted under EU Framework Programmes.

Nuclear energy research at the PSI concentrates on reactor safety and in particular on safety-related operational problems at Swiss reactors, as well as on nuclear waste disposal. The safety features of advanced reactor concepts relying on inherent safety mechanisms and on passive system layouts (to a greater extent than today's plants) will continue to be investigated to a limited extent. In this respect, the PSI participates as an active partner in the Generation IV International Forum (GIF).

The main objectives of nuclear energy research carried out at the PSI are as follows:

- To ensure that the utilisation of nuclear energy remains safe in the future by maintaining and further developing scientific know-how to the highest international standards.
- To train the next generation of scientists and technicians in a valid research environment and with the closest possible co-operation with the universities.
- To provide scientific expertise in specific areas and above all to provide scientific/technical services to ensure that Swiss reactors continue to operate with the greatest possible safety.
- To actively follow the development of safety requirements and the characteristics of the nuclear power plants and fuel cycles of the future, and the way in which this reflects the sustainability potential of nuclear power.

The *light water reactor (LWR) safety research program* is centred on the transient analysis of Swiss reactors and on their life extension (ageing and other problems). Safety-related operational questions in relation to existing plant (e.g. power transient analysis, PIE) are also studied. Reactor physics experiments for heterogeneous LWR core lattices (PROTEUS facility) are part of program. The PSI also participates in research into severe accidents in the framework of international co-operation (PHEBUS, France).

The *waste management research program* mainly focuses on assessing the performance and safety of waste repositories (characterisation of waste forms, near-field and far-field studies) with emphasis on the development of models of mechanisms for nuclide transport in the geosphere and their validation by experiments, as well as on data acquisition for safety analysis. The work is done in close co-operation with Nagra.

The *ARTIST project,* started in 2001, studies aerosol retention in a pressurised water reactor (PWR) steam generator containing broken tubes on a design basis and severe accident prototype conditions. More than 10 national and international institutions signed contracts with PSI and contribute to the program. First tests showed higher aerosol retention than expected.

Backfitting of the *hot laboratory* has been completed in 2002 at costs of about 14 MCHF. The nuclear power plant operators have agreed to contribute to the operational costs of the hot lab with 3 MCHF per year.

Launched in 1999, *MEGAPIE (MEGAwatt PIlot Experiment)* is an attempt to design, build, operate and test an exploratory liquid lead-bismuth spallation target for 1 MW of beam power, taking advantage of the existing spallation neutron source, SINQ, at the PSI. The target material is a lead bismuth alloy (Pb-Bi) liquefying at 125.5 deg C. A critical aspect of MEGAPIE is the beam window, through which the intensive proton beam penetrates the lead bismuth in order to generate neutrons. The project will make an important contribution to the development of accelerated driven system (ADS) concepts to transmute long-lived fission products and minor actinides in shorter lived isotopes. The 5-year programme costs about CHF10 million and involves collaboration with partners from France (CEA/CNRS, SUBATECH), Germany (FZK), Italy (ENEA), Belgium (SCK-CEN), the USA (DoE), Japan and other countries. The conceptual design was completed, and the licensing process started.

With regard to education and training in nuclear energy technology, in view of the necessity to maintain a continuous education program at university level, the Swiss utilities have conditionally agreed to fund an ETH professor chair in Nuclear (Systems) Engineering. The appointee will become a central part of the new Masters program in Nuclear Engineering, which should become an integral part of the emerging European Network on Nuclear Energy (ENEN).

6. International co-operation

The Swiss authorities have long cultivated bilateral relations in the area of nuclear technology with their counterparts in France and Germany.

The inspections of nuclear installations undertaken by the French and Swiss regulatory authorities are similar. Differences exist mainly with regard to the form of the inspections, the duration of the inspection programmes and the training of inspectors. Joint inspections will continue in the years ahead.

Switzerland will continue to follow the development of international nuclear projects with great interest.

UNITED KINGDOM

Government policy on nuclear energy production and waste management

Following the report published by the Cabinet Office Performance and Innovation Unit (PIU) on the longer term, strategic issues surrounding energy policy for the UK, in May 2002 the government launched a public consultation aimed at developing a new energy strategy. A government statement with the consultation stressed the need to move toward a low-carbon economy and greater energy efficiency to respond to climate change targets with sustainable energy being the key. Over six thousand responses were submitted which were analysed. A White Paper was issued in February 2003.

The Government's Energy White Paper set out four goals for the UK's energy policy to 2050. These are to reduce CO_2 emissions by 60% by 2050 (with significant progress by 2020), to maintain the security of energy supplies, to promote competitive markets in the UK and beyond and to ensure every home is adequately and affordably heated. The Government's priority is to strengthen the contribution that energy efficiency and renewable energy sources make to meeting its carbon commitment but the Government does not believe it is equipped to set targets for the composition of the fuel mix.

Whilst the Government recognises that nuclear power is an important source of carbon free electricity, the current economics of nuclear power make it an unattractive option for new generating capacity and there are also important issues for nuclear waste to be resolved. Although there are no proposals for building new nuclear power stations in the White Paper, the Government recognises that at some point in the future new nuclear build may be necessary in order to meet its carbon targets. The White Paper makes it clear that before any decision to proceed with the building of new nuclear power stations there would need to be the fullest public consultation and the publication of a White Paper setting out the Government's proposals.

In July 2002, the Energy Minister announced the publication of the White Paper: *Managing the Nuclear Legacy: A Strategy for Action*. The White Paper sets out detailed plans for radical changes to the current arrangements for cleaning up the legacy created during the early years of Britain's civil nuclear programme. The changes include the creation of a new national body- the Nuclear Decommissioning Authority (NDA). The NDA will be responsible to Government with a specific remit to ensure that the nuclear legacy is cleaned up safely, securely, cost effectively and in ways which protect the environment for the benefit of the current and future generations. The setting up of the NDA will require primary legislation. The draft Bill is due to be published in June 2003 and will enter Parliament at the earliest available opportunity. The Bill will also include provisions enabling the transfer of BNFL and UKAEA assets and liabilities to the NDA.

In April 2003, the Government announced that the NDA will be funded by a statutory segregated account rather than a segregated fund, the other option that was put to consultation. In considering the two options and after public consultation, it was decided that it would not be an efficient use of public money to set aside at the outset the many years of funding that a segregated fund would require. Funding the NDA through a statutory segregated account will ensure that the funding process operates within the normal principles of the Supply process. It will also inspire public confidence in the work of the NDA by ensuring openness and transparency in the funding process. The Government is now exploring ways in which an account can provide the necessary rolling commitment to finance the NDA beyond the normal public spending planning cycle.

The UK Government will reconsider the scope for introducing a Public Private Partnership (PPP) into BNFL in 2004/5 in the light of BNFL's overall performance across its businesses and advice from the NDA which by then will have gained real experience in the best means of discharging liabilities.

Following a public consultation exercise, *Managing radioactive waste safely***,** in 2001-2, the Government and the devolved administrations for Scotland, Wales and Northern Ireland announced in July 2002 that they would set up an independent body to oversee a review of options for dealing with radioactive waste in the long term. This should make recommendations by around 2006 so that Ministers can announce the UK's long term strategy.

Nuclear electricity generation and consumption

The UK's nuclear power stations supplied 81.08 TWh in 2002, compared with 82.99 TWh in 2001. This represented 22 % of total electricity supplied in 2002 (compared with 23% in 2001).

Industry structure: recent developments

In September 2002, British Energy (BE) approached the UK Government seeking immediate financial support and discussions about longer term restructuring. The Government 's overriding priorities are to ensure the safety of nuclear power and security of electricity supplies. In accordance with these priorities, the Government provided a short-term loan to the company in order to give sufficient time to clarify the company's full financial position and to come to a clear view on the options for restructuring the company. The European Commission approved the loan as "rescue aid" on 27 November. On 28 November, British Energy announced a restructuring plan intended to achieve its long-term viability. On the same day, the Government set out the limits of what it was willing to do to support a solvent restructuring by taking financial responsibility for British Energy's historic spent fuel liabilities; underwriting, to ensure safety and environmental protection, new and enhanced arrangements by the company to fund decommissioning and other nuclear liabilities; and continuing to fund the company's operations while the plan is agreed and implemented.

BE continues to make progress on the solvent restructuring plan it announced on 28 November 2002. On 14 February 2003, BE announced it had reached agreement in principle with its financial creditors on its restructuring plan. The Government welcomed the progress the company had made in implementing its plan, and, on the basis of the company's announcement, made a state aids submission to the European Commission on 7 March. The Government announced on 7 March that BE had repaid all outstanding amounts under the credit facility (made available to BE by the Government last September) following the sale of BE's stake in Bruce Power. On a contingency basis, the credit facility continues at a reduced level of £200 million and has been extended to the earlier of 30 September 2004 or the date on which the restructuring plan becomes effective. The Electricity (Miscellaneous Provisions) Bill which allows the Government to support the solvent restructuring of BE, or ease processes in the event of the company going into administration, was given Royal Assent in May 2003.

Industry activities: recent developments

In the Anti-Dumping and Countervailing duty investigations initiated by USEC for imports of low enriched uranium from the Netherlands, Germany and the United Kingdom, the US International Trade Commission found that these imports had caused, or threaten to cause injury to USEC and imposed a definitive duty of 2.23%. Urenco has appealed the ITC decision.

On 6 October, Urenco and Areva signed a Memorandum of Understanding with the aim to establish a joint venture in the field of centrifuge technology for uranium enrichment. On 19 July, Urenco signed a Memorandum of Agreement (MOA) together with Cameco Corporation, Westinghouse Electric Company, Fluor Daniel and the affiliates of three US energy companies, Exelon, Entergy and Duke, as an initial step towards restructuring the LES Partnership. The MOA marks the first step towards a formal partnership to design, construct and operate a new uranium enrichment facility in the United States based on the Urenco centrifuge technology.

In April, BNFL announced that it would not be extending the lives of its two largest Magnox reactors, Wylfa and Oldbury. BNFL had intended to extend the life of Wylfa to at least 2016 and of Oldbury to 2013. The reactors will now close in 2010 and 2013 respectively. This is to allow BNFL and the UK to meet obligations under OSPAR to curtail discharges to the Irish Sea, through the closure of the Sellafield Magnox reprocessing plant by 2012. In June 2002, BNFL announced that Chapelcross would close in March 2005 and not 2008. In addition, Calder Hall closed in March 2003 and not 2006 as previously envisaged. These accelerated closures were in response to a fall in electricity prices.

The White Paper *Managing the Nuclear Legacy: A Strategy for Action* started that any new proposals for new reprocessing contracts would require approval by the Secretary of State. In the event of such a proposal the Government has indicated that it would look at a range of issues which would be involved in increasing the current volume of fuel to be reprocessed through Thorp. These issues would include consistency with clean-up plans for Sellafield and with the UK's environmental objectives and international obligations. The same principles will be applied in the interim period leading up to the establishment of the NDA.

A report published in January 2002 by the Health and Safety Executive (HSE) and the Scottish Environment Protection Agency (SEPA) closed out the safety audit on Dounreay which had commenced in 1998. Eighty-nine recommendations have been met by UKAEA and those that remain are mostly of a long term or strategic nature. More than 200 firms are known to be interested in being involved with the £4 billion cleanup project of the Dounreay complex over the next 50-60 years. Up to 20 new processing and waste treatment plants will be required on site within the next 10-15 years to enable large quantities of radioactive waste to be properly managed.

The report of the 'Nuclear Skills Group', published by DTI on 5 December 2002, concluded that although the UK nuclear industry was not facing an immediate skills problem, unless action was taken soon problems could arise over the next 10-15 years. Following the report, DTI has been exploring the possibility of establishing a Sector Skills Council (SSC) to cover the nuclear industry. Good progress is being made in discussions with an existing SSC to expand its coverage to include the nuclear industry. If all goes well, the new enlarged SSC could be up and running early next year.

USA

1. Nuclear electricity generation

Nuclear energy produces about 20% of US electricity generation or approximately 100 GW. There are 103 operating nuclear power plants in the United States (U.S.) as of January 2003. The decision by the Tennessee Valley Authority to invest in the restart of Browns Ferry Unit 1 may increase the number to 104 by 2007. The average capacity factor for these plants in 2002 was 91.5%. Although final performance figures are not yet available, preliminary estimates for 2002 show US nuclear plants increasing their output 1-2 percent to about 778 billion kilowatt-hours (kWh), setting an electricity production record for the fourth straight year.

A steady stream of applications to the Nuclear Regulatory Commission (NRC) for operating license extensions and for increases in the licensed power capacity of operating plants continues. From March 2000 to date, the operating license extensions of 14 plants have been approved and issued. The NRC has 16 more under review, with the expectation that 18 additional applications will be submitted by the end of 2004. Eventually, it is expected that license extension applications will also be filed for all existing units. Also, the NRC reviewed and approved 72 power uprate applications, resulting in about 3 250 MWe of additional nuclear capacity. An additional 34 uprating applications over the next five years that could add an additional 1160 MWe to U.S. capacity are expected. The highest uprate application to date was 20%, for the Clinton nuclear plant.

- *Safety and public acceptance issues*

On February 16, 2002, the **Davis-Besse** Nuclear Power Station in Oak Harbor, Ohio, began a refueling outage that included inspecting the nozzles entering the head of the reactor pressure vessel (RPV), the specially designed container that houses the reactor core and the control rods that regulate the power output of the reactor. Of these vessel head penetration (VHP) nozzles, the licensee’s inspections focused on the nozzles associated with the control rod drive mechanism (CRDM). In conducting its inspections, the First Energy Nuclear Operating Company (FENOC) found that three CRDM nozzles had indications of axial cracking, which had resulted in leakage of the reactor’s pressure boundary. After some follow up inspections, on March 7, 2002, FENOC conducted a visual examination, which identified a large cavity in the RPV head on the CRDM nozzle 3. The wastage area was found to extend approximately 5 inches and was approximately 4 to 5 inches at its widest part. The minimum remaining thickness of the RPV head was found to be approximately 3/8 inch. This is the thickness of the stainless steel cladding on the inside surface of the RPV head. The investigation of the causes at Davis-Besse is continuing. FENOC has announced restart of the reactor will be the first half of the summer.

Public acceptance

According to a public opinion poll released December 2002 by the Nuclear Energy Institute, 73% of college graduate voters and 65% of all adults favor the use of nuclear energy as one of the ways to provide electricity in the U.S. Of those polled, 31% are opposed to the use of nuclear energy and 4% answered did not know. 62% of college graduate voters and 55% of all adults answered that it would be acceptable to add a nuclear plant next to the nearest power plant that is already operating. According to the study results, 34% of college graduate voters and 40% of all adults said it was not acceptable. In answer to the question “We should definitely build more nuclear energy plants in the future” 59% strongly agree or somewhat agreed, while 26% agree strongly. Residents of the Midwest and South are more accepting of a new plant (by margins of 70/% and 66%) than those of the West and the Northeast (57% and 50% respectively).

2. U.S. uranium and enrichment industry

The U.S. uranium industry production in 2002 was about 2.34 million pounds, the sixth straight year of decline. Employment has also declined from 1,120 person-years in 1998 to 423 person-years, a sixty-two percent reduction. Today, only two In-Situ leaching mines operate in the United States, Smith Ranch/Highland WY and Crowe Butte, NE. In addition, U.S. mining production is only equal to about 4.3 percent of total U.S. annual demand (54 million pounds). The United States ranks eighth in the top ten uranium producing countries in the world.

The greatest source of competition to the uranium industry are government inventories and deliveries under the U.S./Russia HEU Agreement. This historic U.S.-Russian non-proliferation agreement, dilute highly enriched uranium (HEU) taken from dismantled Russian nuclear warheads into low-enriched uranium fuel. Only 54 percent of demand was met by new uranium production in 2002. The continued supply of inventories from utilities, suppliers and previously Government-owned stockpiles discourages exploration for new uranium resources.

One favourable note – uranium market prices have now increased to the level of $11 per pound. The current price is nearly 55 percent above the market price in December 2000.

Uranium enrichment demand in the U.S. is approximately 11 million SWU per year. USEC Inc., which was privatised in 1998, is the only domestic primary supplier of enriched uranium fuel for commercial nuclear plants. USEC, leases from the Department of Energy and operates the only uranium enrichment facility in the United States: a gaseous diffusion plant in Paducah, Kentucky.

USEC is also the U.S. government's executive agent under the Megatons to Megawatts program, sells low-enriched uranium fuel from the U.S.-Russian HEU agreement to its customers to generate electricity. This Agreement supplies 5.5 million SWU per year to USEC in partial fulfilment of its enrichment contracts.

Recently, Portsmouth, Ohio was named as USEC's Lead Cascade demonstration project site for the American Centrifuge uranium enrichment technology. USEC plans to deploy a commercial centrifuge plant by the end of the decade.

In addition, Louisiana Energy Services, a consortium of Urenco, Westinghouse, and three domestic utilities is planning to seek an NRC license to deploy a centrifuge enrichment plant in the United States by the end of the decade.

3. Market developments

The trend toward deregulation of electricity markets in many states has slowed after the electricity crisis in California. However, utilities continue to be keen on reducing nuclear production costs and optimising plant performance in anticipation of future competition. According to the industry trade association (NEI) the annual cost per kilowatt-hour of nuclear generated electricity has decreased to 1.68 cents/kWh (in 2001 $), improving the industry's competitiveness with coal and gas.

DOE is continuing its *Nuclear Power 2010* Program in FY 2004 to demonstrate, in cost-shared co-operation with industry, key regulatory processes associated with licensing new nuclear plants in the U.S. In FY 2002, the Department initiated projects with three nuclear utilities to demonstrate the new regulatory process for siting new nuclear power plants and we anticipate that applications for Early Site Permits (ESP) will be submitted to the NRC by the end of FY 2003. In FY 2004, the Department will continue to support these regulatory demonstration projects to achieve successful NRC staff review and approval of the siting application.

It is anticipated that joint venture project teams comprised of reactor vendors and power generation companies will cost-share with DOE. In the regulatory demonstration phase the project teams will demonstrate both the previously untested ESP and the combined COL regulatory processes to reduce licensing uncertainties. DOE will also encourage utilities to join in promotion of the most promising nuclear plant technologies by supporting work to finalise and certify selected designs.

4. Political developments

Congress has a number of bills under consideration with implications for the future of nuclear technology. In addition to the annual appropriations bills for DOE spending in FY 04, the House has passed an Energy bill and the Senate is currently debating a similar piece of legislation. In the Senate's version the Nuclear Energy Title includes the following provisions:

- Permanently re-wauthorises Price-Anderson which indemnifies both nuclear reactor operators and DOE contractors from liability in case of an accident;
- Authorises funds for the Advanced Fuel Cycle Initiative to develop ways to reduce the volume and toxicity of spent nuclear fuel;
- Authorises the Secretary of Energy, subject to appropriations to provide loan guarantees to assist in the construction of up to 8,400 Megawatts of new, nuclear power if the Secretary determines the plants are necessary for energy diversity, security, or clean air attainment; and
- Directs that an advanced reactor be built in Idaho to demonstrate a GEN-IV technology and to produce hydrogen.

Some of these provisions are unique to the Senate version of the energy bill and will require a House/Senate conference committee to agree on a compromise bill before it can become law.

DOE has proposed for FY 2004, a $388 million budget for nuclear research and development a 6 percent increase over the current year appropriation. The bill proposes new priorities -- a new *Nuclear Hydrogen Initiative* that will use high temperature nuclear energy systems for clean hydrogen production as part of President Bush's Hydrogen Fuel Initiative.

In April, DOE announced the Idaho National Laboratory would be the center for all the department's advanced nuclear energy R&D. The new Laboratory will result from the merger of Argonne-West Laboratory and the Idaho Energy and Engineering Laboratory. DOE's objective is to create a premier applied research and nuclear engineering institution to develop GEN-IV nuclear systems, nuclear hydrogen production technology, advanced fuel cycle technologies, as well as assisting NASA in the development and testing of space power systems.

5. DOE's Nuclear Energy R&D

Nuclear Energy Research Initiative

The objectives of the Nuclear Energy Research Initiative (NERI) and the International NERI (I-NERI) Program are to:

- Develop advanced concepts nuclear fission reactor technology to address and overcome the principal technical obstacles to the expanded use of nuclear energy for power generation.
- Advance the state of nuclear technology in the U.S. to maintain a competitive position in the marketplace.
- Promote and maintain a nuclear science and engineering infrastructure to meet future technical manpower needs.

Generation IV Nuclear Energy Systems

Two years ago, the US launched the *Generation IV* program to develop advanced reactor technologies for deployment after 2010 but before 2030. Development of these reactors is being pursued by the *Generation IV International Forum*, a group of ten leading nuclear nations (Argentina, Brazil, Canada, France, Japan, Republic of Korea, Republic of South Africa, Switzerland, the United Kingdom and the United States), which last year selected six technologies for further research, development, and demonstration. The six innovative concepts include two gas-cooled reactors, one water-cooled reactor, two liquid-metal-cooled reactors, and a molten salt-based reactor concept. Key research objectives for these technologies will include such activities as demonstrating advanced fuels and materials. The goal of the initiative is to resolve the fundamental research and development issues necessary to establish the viability of these concepts. By successfully addressing the fundamental research and development issues, the concepts are highly likely to attract future private sector sponsorship and ultimate commercialization.

Advanced Fuel Cycle Initiative

Of the issues affecting future expansion of nuclear energy in the U.S. and worldwide, none is more important or more difficult than dealing effectively with spent nuclear fuel. After a long and difficult process, the country is moving forward with a geologic repository (see next section), and DOE intends to submit a license application to the Nuclear Regulatory Commission by the end of 2004.

With these successes, DOE intends to pursue research that can optimise the use of the first repository and possibly reduce the need for future repositories. The FY 2004 DOE Budget proposes an aggressive research and demonstration program, the *Advanced Fuel Cycle Initiative*, with an investment of $63 million in FY 2004 to continue exploring advanced, proliferation-resistant nuclear fuel treatment and transmutation technologies that can reduce volume and toxicity of spent nuclear fuel for a geologic repository.

6. High Level Radioactive Waste Management

The Nuclear Waste Policy Act of 1982 affirmed the Federal government's responsibility for the disposal of high-level radioactive waste and established the scientific, regulatory, and funding framework supporting the development of a geologic repository. In 1987, Congress amended the Nuclear Waste Policy Act to direct the DOE to focus site characterisation activities exclusively on Yucca Mountain, Nevada.

The DOE conducted more than 20 years of site characterisation activities at Yucca Mountain, encompassing extensive surface and subsurface testing, laboratory testing, analytical studies, modelling, and engineering work. Concurrent with site characterisation, the regulatory framework for geologic disposal was developed. The United States Environmental Protection Agency set radiation protection standards for Yucca Mountain; the United States Nuclear Regulatory Commission (NRC) established criteria for licensing a repository; and DOE promulgated its guidelines for determining the suitability of the site.

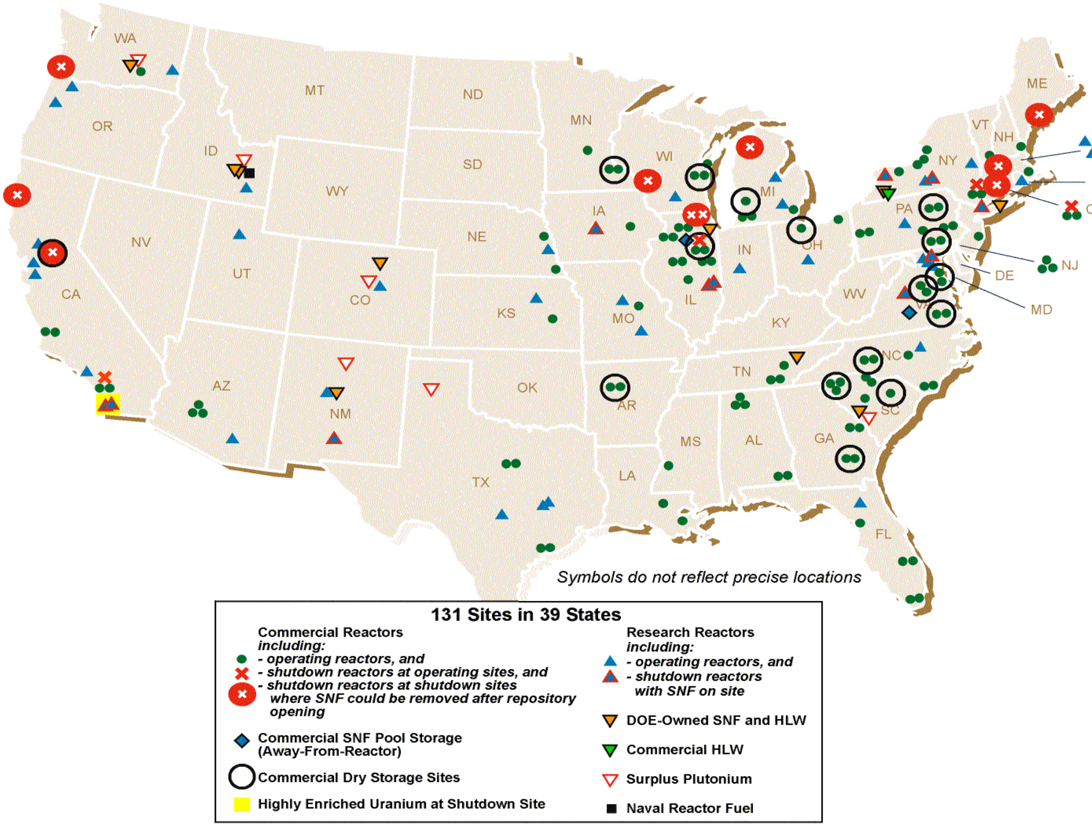
The information and analyses developed during 20 years of site characterisation provided the foundation for President Bush to sign the Joint Resolution of Congress on July 23, 2002 designating Yucca Mountain as the site for a proposed geologic repository. This action permits DOE to move forward to prepare and submit a license application to the NRC by December 2004, and if approved, to begin emplacing waste in the repository by 2010. The licensing process is designed to lead to construction authorisation in December 2007, and a license to receive and possess spent nuclear fuel and high-level waste by June 2010.

Yucca Mountain is located about 160 kilometers northwest of Las Vegas, Nevada, on unpopulated desert land owned by the Federal Government. Geological information indicates that the regional climate has changed little over the past million years, and the long-term average precipitation has been about 30 centimeters per year. Yucca Mountain itself is a ridge composed of a sequence of tilted layers of variably welded and fractured tuffs (Figure 1). The host rock proposed for the potential repository is a welded tuff unit located about 300 meters below the surface and 300 meters above the water.

Figure 1: Yucca Mountain

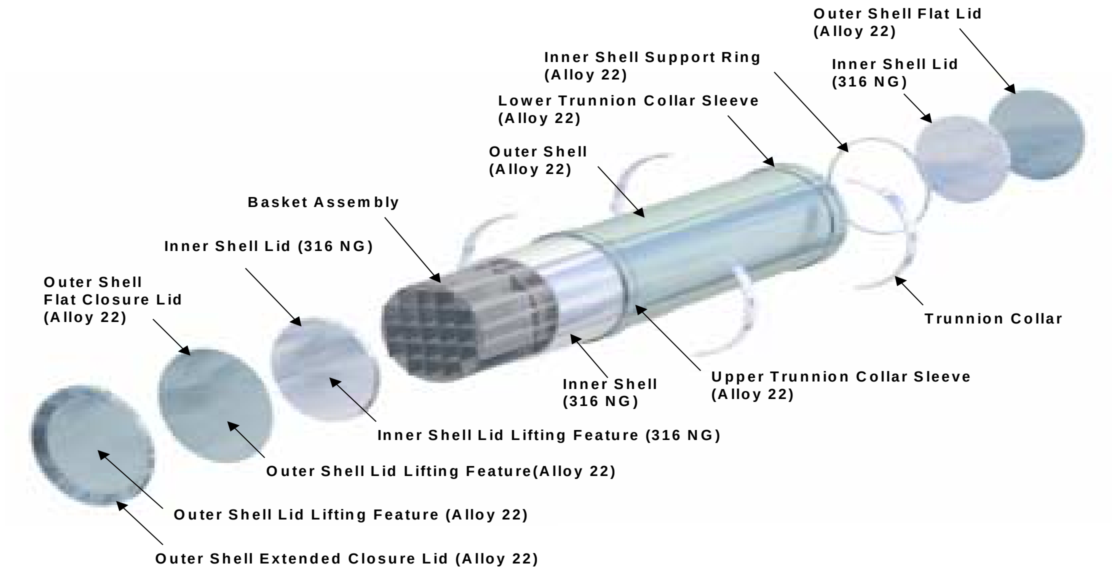
The repository will be legislatively limited to a capacity of 70,000 metric tons heavy metal (MTHM) until such time as a second repository is in operation. Materials that may be disposed at Yucca Mountain are currently located at 131 sites (Figure 2) and include about 63,000 MTHM of commercial spent fuel; about 2,333 MTHM of DOE spent fuel: and about 4, 6667 MTHM of USDOE high-level radioactive waste. The DOE will submit a report to the President and the U.S. Congress between 2007 and 2010 on the need for a second repository.

Figure 2. Current Locations of SNF and HLW



DOE will commence in 2010 to dispose of 400 MTHM SNF. The repository will receive 600 MTHM in 2011, 1200 in 2012, 2000 in 2013 and 3000 per year from 2014 through 2034 with completion of loading to the total of 70,00 MTHM in 2035. At this point, the repository will be closed for further receipts and monitored for waste isolation. However, the construction will allow the waste packages to be accessed for their removal or repositioning for up to 300 years. This flexibility will enable repository operations to meet future societal needs. Approximately 10,000 waste packages will be emplaced in the repository (Figure 3)

Figure 3: PWR SNF Waste Package



7. Weapons Plutonium Utilisation

In July 1998 the U.S. and the Russian Federation signed a Scientific and Technical Co-operation Agreement to work on key technologies required for plutonium disposition. In September 2000 an agreement was signed between the two countries to dispose of 68 metric tons (MT) of weapon-grade plutonium declared excess to defense needs, 34 MT in each country.

Both the U.S. and Russia plan to dispose of their surplus plutonium by converting it to mixed oxide (MOX) fuel and irradiating it in nuclear reactors. As part of the U.S. plutonium disposition program, two facilities will be built at the Savannah River Site in South Carolina: a Pit Disassembly and Conversion Facility, where nuclear weapons pits would be disassembled and the resulting plutonium metal would be converted to an unclassified plutonium oxide form suitable for disposition, and a MOX Fuel Fabrication Facility, where plutonium oxide would be mixed with uranium oxide to form MOX fuel pellets that are then made into MOX fuel assemblies for subsequent irradiation in nuclear reactors. Construction is currently scheduled to begin on the MOX facility in Fiscal Year 2004 and on the Pit Disassembly and Conversion Facility in Fiscal Year 2006. Following irradiation, the resulting spent fuel will ultimately be disposed of in a high level waste repository.