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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 of Member Countries

53ème réunion du NDC
53rd NDC Meeting

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As in previous years, the country report for Belgium has been drafted in French and has not been translated into English.

For the country report for the United States, please refer to NEA/NDC(2007)13/ADD1.

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Comité chargé des études techniques et économiques
sur le développement de l'énergie nucléaire et le cycle du combustible
—
Committee for Technical and Economic Studies
on Nuclear Energy Development and the Fuel Cycle

53ème réunion du NDC
53rd NDC Meeting

Rapports des pays membres
Reports of member countries

Belgique*

Production et consommation d'électricité en 2006

➲ Production nette d'électricité

La production totale nette d'électricité pour l'année 2006 s'est élevée à 81 420 GWhe, ce qui représente une légère diminution par rapport à l'année 2004. Cette production totale nette est répartie comme suit :

Source	Production en GWhe	Part en %	Différence 2003-2002
Combustible nucléaire[a]	44 314	54.4 %	- 0.8 %
Combustibles fossiles et autres[b]	35 145	43.2 %	+ 0.9 %
Énergie hydraulique, énergie de pompage, énergie éolienne	1 961	2.4 %	+ 0.3 %
TOTAL	**81 420**	**-**	**- 1.5 %**

a. La part française dans la centrale nucléaire de Tihange 1 est comprise dans ces chiffres.
b. Cette rubrique comprend également les combustibles renouvelables et de récupération.

Remarque : Les chiffres donnés ci-dessus pour la production nette d'électricité sont encore provisoires. Une révision est en cours.

➲ Consommation d'électricité

La consommation totale de l'énergie électrique en 2006 s'est élevée à 89 899 GWhe. On constate donc une nette augmentation de la consommation d'électricité, soit environ 3 %. Cette augmentation a lieu, malgré tous les efforts d'économie d'énergie.

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

- Production nette 81 420 GWhe
- Importations 18 864 GWhe
- Exportations - 8 695 GWhe
- Énergie de pompage - 1 690 GWhe
- Énergie appelée 89 899 GWhe

On constate une nette augmentation des importations (grosso modo égale à 4 600 GWhe). Elles dépassent largement les exportations. C'est une situation inquiétante. On a commencé à examiner les actions à prendre pour remédier à cette situation.

* Service public fédéral économie, P.M.E., classes moyennes & énergie – Direction générale énergie – Division des applications nucléaires.

Les évènements les plus importants dans les centrales nucléaires belges en 2006

Le taux d'utilisation moyen des centrales nucléaires en 2006 était égal à 87.2 %. C'est une légère diminution par rapport à l'année 2005. Ceci est dû au long arrêt d'une des unités en raison de la révision décennale.

➲ Situation politique

La loi de sortie du nucléaire est toujours en vigueur. Excepté en cas de force majeure, les centrales nucléaires commerciales doivent être arrêtées après 40 ans d'opération industrielle. Ceci signifie que :

- les réacteurs Doel 1-2 et Tihange 1 devront être arrêtés en 2015;
- les réacteurs Doel 3 et Tihange 2 devront être arrêtés en 2022;
- les réacteurs Doel 4 et Tihange 3 devront être arrêté en 2025.

Le moment des premières fermetures s'approche. Le climat politique est en train de changer peu à peu. Contrairement au passé, il y a maintenant des parties politiques qui osent se prononcer ouvertement en faveur de l'énergie nucléaire et du maintien en service des centrales nucléaires actuelles. D'autres restent plus réticentes. Quelques-unes continuent toutefois à se prononcer contre l'énergie nucléaire, surtout pour des raisons électorales.

Le Ministre de l'Énergie a créé en 2005 une commission pour l'analyse de la politique énergétique belge à l'horizon 2030, en abrégé « Commission Énergie 2030 ». Cette commission a été chargée d'élaborer un rapport sur les choix stratégiques de politique énergétique belge à moyen et à long terme. Le rapport devait fournir les analyses scientifiques et économiques nécessaires à l'évaluation de ces choix; il devait mettre l'accent sur les aspects économiques, sociaux et environnementaux des différentes options de politique d'investissement en production, stockage et transport d'énergie, prenant en considération les différentes sources et types d'énergie renouvelables ou non. Le rapport devait soumettre en conclusion une proposition de choix stratégiques à moyen et à long terme.

La Commission Énergie 2030 a déposé son rapport provisoire à la fin de l'année 2006. Ensuite, il a été soumis à six groupes d'experts nationaux et internationaux. En fonction des remarques et observations de ces groupes d'experts, le projet de rapport a été adapté. Le rapport final a seulement été publié le 15 juin 2007. Le temps a manqué d'incorporer ici les conclusions les plus importantes du rapport. Ils seront envoyé ultérieurement.

Le rapport fait l'objet des discussions dans le cadre des négociations sur la formation du nouveau gouvernement belge après les élections du 10 juin 2007.

➲ Cycle du combustible et gestion des déchets

Entreposage du combustible irradié

À la fin de l'année 2006, la situation relative à l'entreposage de combustible irradié déchargé des réacteurs de puissance était la suivante.

	Élements de combustible	**Uranium** Tonnes
▪ Piscines de désactivation	1 911	862
▪ Entreposage à sec à DOEL	1 639	664
▪ Entreposage humide à TIHANGE	1 643	786
▪ **TOTAL**	**5 193**	**2 312**

Transports de déchets vitrifiés depuis la France vers la Belgique

Conformément aux engagements contractuels entre les parties concernées et aux autorisations octroyées, les transports depuis la France vers la Belgique de déchets vitrifiés hautement radioactifs, issus du retraitement en France de combustibles irradiés belges se sont déroulés comme suit :

- Trois transports ont eu lieu en 2006;
- Deux transports (les derniers) ont eu lieu dans la deuxième moitié de l'année 2007.

Ainsi, tous les déchets vitrifiés résultant du retraitement des combustibles irradiés belges, pour lesquels un contrat a été conclu, ont été retournés en Belgique. Maintenant, il faut encore rapatrier des déchets bituminés et des déchets compactés.

On a profité du dernier transport pour rapatrier également trois canisters de déchets vitrifiés résultant du retraitement du combustible irradié du réacteur de recherche BR2.

Gestion des déchets radioactifs

Plan de gestion des déchets radioactifs

En 1992, l'ONDRAF, le gestionnaire belge des déchets radioactifs, avait rédigé un premier plan de gestion des déchets radioactifs. Vu le long laps de temps écoulé et les discussions qui ont eu lieu au niveau européen, l'ONDRAF avait jugé nécessaire de rédiger un nouveau plan de gestion des déchets radioactifs. Initialement, il était prévu de publier ce nouveau plan vers la fin 2008. Entre-temps, la loi du 13 février 2006 relative à l'évaluation des incidences de certains plans et programmes sur l'environnement et à la participation du public dans l'élaboration des plans et des programmes relatifs à l'environnement est venue transposer en droit belge les dispositions des Directives européennes 2001/42/CE et 2003/31/CE. Les dispositions de cette loi prévoient explicitement qu'elle s'applique au plan général de gestion à long terme des déchets radioactifs. Elles ne sont pas sans conséquences sur le contenu du plan de gestion et la manière dont ce plan doit être établi. En raison de ces nouvelles obligations, la date de publication du plan est reportée jusque fin 2010.

Un premier projet du plan de gestion (donnant la situation actuelle en matière de gestion prévisionnelle, courante et à long terme) sera publié fin 2007. Parallèlement, l'ONDRAF prépare le dialogue avec les parties prenantes, ainsi que la création d'un comité d'accompagnement. En décembre 2007, un atelier est planifié pour présenter le projet de plan de gestion et les modalités de dialogue avec les producteurs et les parties prenantes.

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

Le programme établi en 1998, suite à 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 (déchets de catégorie A) est terminé. Dans le cadre de ce programme trois partenariats locaux ont été créés dans les communes de DESSEL, de MOL et de FLEURUS-FARCIENNES. Ces trois partenariats ont chacun rédigé leurs rapports relatifs à leurs propositions de projets intégrés consistant en l'installation d'évacuation proprement dite et un volet économique/social, permettant d'incorporer l'installation dans le développement plus global de la région.

Les trois rapports acceptent un site d'évacuation sur le territoire de leur commune, moyennant le respect d'un certain nombre de conditions associées. Les trois rapports ont été soumis à leurs conseils communaux respectifs. Ceux de DESSEL et MOL ont approuvés les rapports de leurs partenariats. Les conseils communaux de FLEURUS-FARCIENNES ont refusé le rapport de leur partenariat. Les rapports des partenariats et les décisions associées des conseils communaux ont été envoyés à l'ONDRAF qui les a transmis au Ministre de l'Énergie.

Sur base des rapports reçus de la part de l'ONDRAF, le Ministre de l'Énergie a soumis une note au Conseil des Ministres, qui a permis de prendre les décisions suivantes :

- Pour la gestion à long terme des déchets de catégorie A, le dépôt définitif en surface est retenu.
- L'installation de dépôt sera implantée sur le territoire de la Commune de Dessel, sur le site désigné par le partenariat de cette commune et accepté par le conseil communal.
- L'ONDRAF est chargé de maintenir le processus participatif, en premier lieu avec la commune de Dessel, mais également avec les communes voisines (Mol, …).
- Le coût des conditions associées doit rester dans la limite d'environ 70 MEUR. Une estimation précise de ce coût est demandée pour fin 2008. Les mécanismes de financement de ces conditions associées via un fonds à moyen terme (FMT) doivent être déterminés.
- L'ONDRAF est chargé de continuer à développer le projet intégré de dépôt, avec comme objectif d'obtenir les autorisations nécessaires, ainsi qu'un accord contraignant entre les parties prenantes pour la mise en œuvre des conditions associées.
- Une base juridique pour le financement des conditions associées sera développée et soumise au Conseil des Ministres.

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

Le programme d'études et de R&D en matière d'évacuation géologique des déchets de moyenne et haute activité et de longue durée de vie pour la période 2004-2008 suit son cours normal.

Comme point particulier, on peut mentionner la construction d'une galerie d'évacuation d'environ 40 m de longueur dans le laboratoire souterrain à Mol. Dans cette galerie, qui est en cours de réalisation, les préparations ont débutés pour pouvoir y effectuer les démonstrations à grande échelle suivantes :

- Un essai de chauffage (avec des canisters de déchets simulés), afin d'étudier l'impact thermique des déchets vitrifiés sur le revêtement de la galerie d'évacuation, la zone perturbée par l'excavation et le champs lointain.
- Un essai de bouchonnage, afin d'étudier la performance de bouchons des galeries d'évacuation et de transport.

Pour le reste, les études et recherches continuent sur les sujets suivants : résistance à la lixivation des matrices de confinement (verre, …) ; assurance de transport diffusif et retardé dans l'argile de Boom, le développement d'un modèle équilibré géo-chimique, migration et rétention dans l'argile de Boom, évolution à long terme de l'argile de Boom, évaluations de sûreté, renforcement du dialogue avec les parties prenantes, développement d'une architecture intégrée d'une installation de dépôt, travaux sur le superconteneur (essais de corrosion; essais de faisabilité relatifs à la construction et la manipulation; essais de remplissage de l'espace libre entre le conteneur et la paroi de la galerie d'évacuation); examen des perturbations induites par l'installation de dépôt, etc.

➲ La recherche nucléaire

Par la fermeture de la firme BELGONUCLEAIRE, le SCK•CEN perdait beaucoup de revenus. Afin de ne pas compromettre le programme scientifique du SCK•CEN, le Gouvernement a accordé une augmentation de la subvention au Centre pendant une période transitoire de 3 ans (2006-2008). Pendant cette période transitoire, le SCK•CEN doit effectuer une réorganisation permettant de réaliser de meilleures synergies entre les différents services et de réaliser ainsi des économies non négligeables. Après la période transitoire, la subvention au Centre doit retomber au niveau original (à l'inflation près).

Par la réorganisation, on vise de créer quatre instituts au Centre, dont les lignes stratégiques sont les suivantes :

a) Institut pour sciences de matières nucléaires :

- évaluation scientifique/technique de la bonne qualité et de la durée de vie des matériaux dans les réacteurs de puissance existants ;
- développement et validation de nouveaux matériaux pour des réacteurs de fission avancés (y compris ADS) et réacteurs de fusion ;
- qualification de combustibles évolutionnaires pour les réacteurs actuels ;
- développement et validation de combustibles (et cibles de transmutation) pour des réacteurs avancés (y compris ADS) et concepts de cycles de combustibles évolutionnaires (et cibles de transmutation) pour des réacteurs avancés (y compris ADS) et concepts de cycle de combustible ;
- développement de nouveaux radio-isotopes pour la médecine nucléaire et réalisation d'une production plus élevée de dopage de silicium.

b) Institut pour systèmes nucléaires avancés :

- extension de la connaissance et de la participation belge (économique et technique) au développement des réacteurs de la quatrième génération et à la recherche de fusion (ITER-DEMO) ;
- développement du concept d'une installation expérimentale à spectre rapide avec une dimension européenne (le projet Myrrha) ;
- développement et épreuve (en coopération avec l'industrie et les groupes de recherche internationaux) de technologie et d'instrumentation pour réacteurs ;
- donner des avis et prester des services pour l'industrie et les instances nucléaires sur les plans nationaux et internationaux.

c) Institut pour l'environnement, la santé et la sûreté :

- poursuite du développement et de l'application de la connaissance du comportement de matières radioactives dans l'air, dans l'eau et dans la géosphère sur la base de modèles et d'expériences ;
- évaluation de l'impact radiologique sur la population et l'environnement (y compris le secteur médical) ;
- application de la biologie moléculaire et cellulaire dans des environnements ionisants ;
- contribution à une évacuation sûre et acceptée socialement des déchets radioactifs, en étroite collaboration avec l'Ondraf et l'AFCN ;
- recherche et soutien à la politique relative à la planification d'urgence ;
- optimisation des opérations de démantèlement et de décontamination.

d) Institut pour communication, services généraux et administration. C'est un institut de soutien qui s'occupe d'un système de gestion intégré, d'un système informatique adéquat, d'un rapportage alerte, du bien-être du personnel, d'une logistique optimale, du maintien de la connaissance scientifique et technique, etc.

Finland*

Nuclear in Energy and Climate Strategies in Finland

In January 2002 the Finnish Government made a favorable decision-in-principle on the fifth nuclear power plant unit, and the **Parliament ratified the decision on 24 May 2002 (votes 107-92)**. The industry owned Finnish nuclear operator Teollisuuden Voima Oy (TVO) had submitted an application two years earlier for a 1 000-1 600 MWe LWR unit. The whole process for the fifth plant started with an Environmental Impact Assessment back in 1998.

In 2003 TVO first decided that the site would be Olkiluoto and then TVO chose the French-German consortium Areva NP and Siemens as the supplier for an EPR (European Pressurised Water Reactor). On 8 January 2004 TVO submitted to the Government an application for a construction license for Olkiluoto 3. The reactor thermal power will be 4 300 MW, electrical output about 1 600 MW and its technical operating lifetime 60 years. **The granting of the construction licence took place on 17 February 2005**.

The construction of the reactor building started in August 2005. The construction will probably take more than five years. At the final construction stage TVO must submit a statutory application for an operating licence to the Government. TVO is obviously planning to file in the application for the operating licence in mid 2008. The handling of this licence application, too, is expected to last for a year or so. After granting the operating licence, the **commissioning of the plant unit could take place in 2010 and commercial operation begin in 2011, according to TVO and the supplier**.

The project is delayed approximately 18 months due to quality deficiencies in design documentation, some heavy components manufacturing processes and building concrete deliveries. STUK published July 2006 an investigation report which found insufficient guidance of subcontractors' work in the project as the main reason for the delays.

An Industry Initiative but a part of the Energy and Climate Strategy

Even if TVO's basis for the new plant was the company's own interest, the government, according to the Nuclear Energy Act, had to consider whether the use of nuclear energy is in line with the overall good of society. The decision-in-principle (DIP) ratified in 2002 supported the implementation of the national climate strategy adopted in 2001. It has been counted that with Olkiluoto 3 Finland avoids annually about 10 million tons of greenhouse gas emissions. The Government sent the new energy and climate strategy to the Parliament in December 2005 and the new strategy was finalised by the Parliament in 2006.

FINLAND 6?

According to the new energy and climate strategy nuclear power is an option also in the future but the initiatives have to come from the industry. TVO and Fortum decided in 28 March 2007 to commence an environmental impact assessment (EIA) process at theirs Olkiluoto and Loviisa nuclear power plants for one new nuclear power unit (size 1 000-1 800 MW) possibly to be built adjacent to the existing units in one site. TVO left the EIA program for Olkiluoto 4 to MTI in May 31 and Fortum is expected to do so for Loviisa 3 in the end of June.

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* Finnish Ministry of Trade and Industry [Mr. Jorma Aurela].

As stipulated in the Nuclear Energy Act, an EIA process must be carried out in Finland before an application for a decision-in-principle can be submitted to the Council of State. In the first phase of the EIA process, possible alternatives for carrying out the nuclear power project will be described. In addition, a detailed report on how the new unit's possible impacts on the surrounding communities, the environment, nature and utilisation of natural resources will be studied is composed during the first phase of the EIA.

During the EIA process, the citizens of Eurajoki and Loviisa municipalities and surrounding communities as well as other stakeholders will be provided an opportunity to express their opinions on the EIA and to influence how it will be carried out. Later on, stakeholders will have an opportunity to comment on the actual estimated environmental impacts. TVO and Fortum estimate that the process will be completed in 2008. Ministry of Trade and Industry is the contact authority for both processes. The new plant would be in operation in 2018. See our site www.ktm.fi.

During spring of 2007 also E.ON Finland published in media its intentions to construct a nuclear power plant. Its first effort has been to buy land for a new site at Loviisa, but in early May Loviisa City Council rejected this. In June 6 a new company Fennovoima initiated its new nuclear project. A consortium of industrial and energy companies has formed this new power company with the aim of constructing a new unit (1 000-1 800 MW) in Finland that could be operational by 2016.

Nuclear Power Generation in 2006

There are four nuclear power plant units in operation in Finland: two BWR's (Boiling Water Reactor) on the west coast of Finland, in the municipality of Eurajoki on the island of Olkiluoto, and two PWR's (Pressurized Water Reactor) on the south coast in the town of Loviisa. The total amount of electricity produced by the four nuclear power units in 2006 was 22.0 TWh (net). This corresponds to about 25% of the electricity consumption.

It can also be estimated that with this production almost 19 million tons of greenhouse gases has been avoided in 2006, compared to the situation that this amount of electricity would have generated with coal condensing. After completion of Olkiluoto 3 the nuclear share could be one third of the electricity consumption. The load factors and production of the units were the following: Olkiluoto 1: 93.8% (7.0 TWh); Olkiluoto 2: 96.9% (7.3 TWh); Loviisa 1: 93.3% (3.9 TWh); and Loviisa 2: 88.6% (3.8 TWh). All four units are planned to be in operation for at least two decades from now.

The automation systems of Loviisa plant will be changed from analog systems to digital systems. This EUR 100 million project started in 2004 and will be finished in 2014. The supplier of the project is Areva NP. In November 2006 Fortum applied for a new 20-years operation licence which would mean 50 years operation for both units (until 2027 and 2030).

Radioactive Waste Policy and Developments

The Parliament endorsed in 2001 the government's decision-in-principle (2000) concerning the construction of a disposal facility of nuclear spent fuel planned by Posiva Oy, a company jointly owned by the two Finnish nuclear power companies. The intended site of the disposal facility is Olkiluoto. On 24 May 2002 the Parliament also ratified a separate decision-in-principle on the final disposal of nuclear spent fuel from the new nuclear power plant unit. On this basis of this decision the spent fuel of the possible new nuclear power plant unit would also be disposed of in the bedrock in Olkiluoto. The planned depth is 500 meters and the fuel is planned to be placed in copper canisters surrounded by bentonite clay and bedrock.

According to the plans, the construction license of the final disposal facility itself would be applied by the end of year 2012 by Posiva Oy. The ongoing step in the project is the construction of an underground research laboratory. **The work has started in 2004 and ONKALO has now reached the depth of more than 200 meters and the length 2 kilometers**. The disposal of the spent fuel should start in 2020 according to a decision-of-principle by the Government from already 1983.

The cost of the spent fuel disposal for five plants is estimated to be around EUR 2.5 billion and whole waste handling about EUR 5 billion including the decommissioning of the facilities. The waste program cost estimate is 5-10% of all costs of Finnish nuclear electricity. The Nuclear Waste Management Fund has now holdings of EUR 1.5 billion, which should cover the costs needed to handle the waste generated up to this date. The low- and intermediate-level waste repositories are already now in operation both at Loviisa (from 1997) and Olkiluoto (from 1992) sites in the depth of 60-100 meters.

Nuclear Safety Research

The financing of the both national nuclear safety research programs SAFIR2010 (reactor safety, around 6 MEUR/a) and KYT2010 (nuclear waste research, around 1 MEUR/a, here the utilities are running a much bigger program) has been changed by new legislation from 2004 so that the utilities have the mandatory biggest share in financing. The magnitude of all nuclear research activities is more than 30 MEUR/a.

The only research reactor in Finland, a 250 kW Triga Mark II reactor in Espoo was as before, used for boron neutron capture therapy (at the reactor site), research, education and isotope production.

Uranium Exploration in Finland?

From 2004 some foreign companies like Areva NC (former Cogema) have been interested in the uranium in the Finnish bedrock. Several uranium-prospecting companies have begun to show interest in Uusimaa, Northern Karelia and Lapland provinces. Several claim applications have been filed in the Ministry of Trade and Industry. Some claims for Northern Karelia were approved in October 2006 with conditions. In January 2007 the Ministry rejected all the claims in Uusimaa.

After MTI approval of a claim application, the mining companies are permitted to explore for uranium. There has been also strong local opposition against the proposed exploration projects. Claims can remain in force for many years, given that the time from the beginning of uranium exploration to the beginning of possible mining operations may span an estimated 10-15 years. A uranium mine needs also a licence from the Government according to the Nuclear Energy Act.

Germany

Energy Policy

Nuclear energy policy in Germany is set out in an agreement between the German Government and energy utilities of 11 June 2001 and in resulting amendments to the Atomic Energy Act enacted in April 2002 by way of an act governing the planned phase-out of nuclear energy use for commercial power generation.

The April 2002 changes to the Atomic Energy Act enshrined the nuclear phase-out in German law. The main feature of the legislation is a time limit for commercial electricity generation using nuclear power stations in Germany. Each power station is assigned a residual electricity output such that total output corresponds to an average 32 year lifetime. When a nuclear power station has generated the agreed output, it must be shut down. This has resulted in two nuclear power stations being taken offline so far: Stade (672 MW) in 2004 and Obrigheim (357 MW) in 2005. On a rough estimate, all nuclear power stations in Germany will be out of service by about 2023. As output allowances can be legally transferred between power stations, however, it is not possible to forecast precise shutdown dates for individual power stations.

The November 2005 coalition agreement between the parties constituting the present German Government included the following passage on future nuclear energy policy:

"The CDU, CSU, and SPD do not share the same opinion on the use of nuclear energy for power generation. For that reason, we cannot change the agreement between the Federal Government and power supply companies of 14 June 2000 or the procedures contained therein or the corresponding regulations of the amended Atomic Energy Act (Atomgesetz). The safe operation of nuclear plants is of the highest priority for the CDU, CSU, and SPD. In this context, we will continue and expand research on the safe operation of nuclear plants.

The CDU, CSU, and SPD acknowledge Germany's responsibility to ensure the safe final disposal of radioactive waste and will tackle this issue in a speedy and result-oriented manner. We intend to solve this question by the end of the current electoral term."

Energy Summit

In connection with the phase-out policy and the ambitious CO_2 reduction goals, Federal Chancellor Merkel called in an energy summit of all major partners from industry, politics, and research. Two energy summit meetings took place on 3 April and 9 October 2006. A third energy summit is planned to be held on 27 June 2007. It is aimed at setting up an integrated energy policy concept by the end of 2007, which shall combine in a coherent manner the safety of supply, competitive energy costs that are acceptable for the consumers, and effective climate protection. Doing this, it will also be investigated how nuclear energy might be replaced in an economically acceptable manner. The three working groups of the energy summit are focusing on:

- National aspects;
- International aspects;
- Research and energy efficiency.

Intermediate results obtained by the working groups can be found on the following website: http://www.bundesregierung.de/nn_774/Content/DE/Artikel/2006/10/2006-10-09-zweites-spitzengespraech.html.

In view of the third round of the energy summit the utilities have already underlined that an exclusion of nuclear energy from the future energy mix would not be reasonable. Although Federal Chancellor Merkel has confirmed again that she will stick to the phase-out policy, the issue of the limited operation periods of existing nuclear power plants might be reconsidered again.

Italy*

Introduction

The following table presents the energy balance of the Country in the year 2006 and in particular the electricity production and demand from the various sources, as well as their variations with respect to the former year. The zero contribution of the nuclear source refers to the national production, whilst the net electricity import (44.7 TWh, i.e. about 12.6%) is practically all of nuclear origin.

Table 1. Italy – Electricity Production and Demand in 2006

	2005		Change 2006/2005
	TWh	%	%
Thermoelectric energy	**257.0**	**72.8**	**4.1**
oil	35.2	10.0	-1.7
natural gas	158.3	44.9	6.0
solid fuels	44.6	12.6	2.3
other fuels	18.9	5.3	3.8
Primary electricity	**51.7**	**14.6**	**3.6**
hydro	36.7	10.4	1.7
geo-renewable	15.0	4.2	8.7
nuclear	0.0	0.0	0.0
Total gross production	**308.7**	**87.4**	**4.0**
Net electricity import	44.7	12.6	-9.1
Total availability	**353.4**	**100.0**	**2.1**
Network demand	**337.8**		**2.1**

	2005	2006	2006-2005 Δ %
Net domestic electric power available for peak demand (MWe)	57 400	57 700	0.5
Winter peak electric power demand (MWe)	55 015	54 387	1.1
Variation %	4.2	5.7	

Source: Italian Ministry of Economic Development.

The slight increase in overall electric energy demand has been met by an increase of the natural gas import. The production from renewable sources is increased (mainly hydro) and nevertheless the energy dependence of Italy remains relatively high (85.4% approximately).

In 2006, Italy has reduced the net imported electrical energy both because some power stations have returned to operation after refurbishment, and because new power plants (mainly combined cycle plants) were commissioned. The electrical national system is gradually approaching the minimum safety margin to the peak demand with only domestic generation, leaving to the imports the role of increasing the technical-economical flexibility between demand and generation.

* National Agency for New Technology, Energy and the Environment (ENEA).

Natural gas consumption increase continued in 2006 for electric power generation, while the total use is decreasing mainly as a consequence of its reduction in civil uses.

The constant increasing trend in the use of natural gas for electric power generation (6%) further reduces the flexibility of the national energy system, since nuclear energy is not contributing and also significant expansion of clean coal technology meets increasing difficulties.

General Issues

In Italy nuclear activities are progressing mainly in the following fields:

- R&D is performed mainly by ENEA both in fission and fusion, and, more in general, in all others nuclear related fields, as well in the universities of Pisa, Roma, Palermo and in the Polytechnic Schools of Milano and Torino; these are the five universities entitled to graduate with slightly different denominations nuclear engineers.
- Decommissioning and waste treatment activities are performed by SOGIN and are progressing, even in the absence of a clear road-map for the national surface repository.
- ENEL is expanding its acquisition of power plants abroad, including nuclear power plants and is building again a nuclear competence center.
- The industry is involved in all above activities.

The sharp increase in the cost of oil barrel, the respect of Kyoto protocol and the need to assure the strategic supply of energy are three strong elements in favour of nuclear energy. Recently concerns about global warming have increased and more favour is seen about nuclear energy as a massive source of carbon-free electrical energy.

A new consensus process about the choice of a national repository is going to be started by the Government. This should lead to the opening of a national surface repository in a reasonable time and hopefully before 2018.

Main national programme and resources on nuclear fission in Italy are still concentrated on decommissioning of shut-down NPP's and fuel cycle facilities and on the management of radioactive waste and spent fuel. According to a Directive issued by the Ministry of Productive Activities on 28 March 2006, all remaining national spent fuel (less than 300 metric tonnes of Uranium Oxide) will be shipped abroad for reprocessing.

Appointed subject to deal with decommissioning and waste management is the state-owned company SOGIN.

Furthermore, 2004-law concerning "Restructuring of the national energy sector" states that: "National electricity producers can – in case in joint venture with foreign companies – realise and operate energy plants, including nuclear power plants, located abroad, even with the aim to import electricity generated from those power plants". As a consequence, in 2005 ENEL purchased 66% stake of state-owned utility Slovenske Elektrarne in Slovak Republic, whose asset includes 4 VVER reactors. ENEL finalised an agreement with French EdF, which includes participation in the 1 600 MWe EPR, expected to be built at Flamanville site in France.

Ansaldo Nucleare is engaged in the completion of Cernavoda Unit 2 in Romania and in the feasibility study of Cernavoda Unit 3 and – in joint venture with Westinghouse – it is also participating to the bid in China for the realisation of AP1000; Ansaldo Nucleare is also involved in Chernobyl radwaste treatment.

Ansaldo Camozzi – an independent manufacturing industry – is working on a main supply of Steam Generator replacement at the US Palo Verde NPP in Arizona.

As for ENEA – the national agency in charge of R&D in energy sector – reorganisation following the new Bill of September 2003, where the constitution of a renewed Nuclear Energy Area (*Presidio Nucleare*) was specifically recommended, is going to be completed and implemented.

A three-year R&D national programme based on "strategic funding devoted to the National Electric System R&D" and focused on participation to international initiatives like INTD (International Near Term Deployment) and Generation IV nuclear systems, is going to receive support by the Minister of Economic Development in the months ahead. Total fund for the first year amounts to EUR 5.5 million and comparable yearly funds are expected for the rest of the programme. Objectives of this programme are:

- Keep open the future nuclear energy option in the country.
- Contribute to development of innovative nuclear energy generating systems able to compete in the perspective of the national energy mix re-arrangement expected to take place in the years ahead.
- Contribute to development of innovative systems able to match public acceptability and economical interest.
- Sustain growth of necessary competences through participation to real-founded projects promising to be successful.
- Sustain the effort required to national industry for keeping the pace at world and domestic level.

In parallel to this forthcoming programme, another R&D programme supported by Minister of Research and University is going to be started very soon. It consists of the follow up of the former national TRASCO (TRAsmutazione SCOrie, i.e. Waste Transmutation in ADS) programme carried out from 1997 to 2001. The new phase of TRASCO will rely on a EUR 6.8 million overall budget and will span over 2006-2008.

Main subjects of these two R&D programmes are:

- Government research institutions: ENEA (National Agency for New Technologies, Energy and the Environment), INFN (National Institute for Nuclear Physics) and – at a limited extend – CNR (National Research Council).
- Universities still active in nuclear field, grouped in the CIRTEN Consortium (POLIMI (Milan), POLITO (Turin), U-Pisa, U-Rome, U-Bologna, U-Pavia, U-Palermo).
- Industries: Ansaldo Nucleare; Ansaldo Camozzi.

Other actors could join in the future (ENEL, SOGIN, APAT, i.e. the Italian Safety Authority).

Research Activities

➲ ENEA activity update

ENEA, the Italian National Agency for New Technologies, Energy and the Environment is a public undertaking operating in the fields of energy, the environment and new technologies to support competitiveness and sustainable development. Following the Bill n. 257 (3rd September 2003) ENEA, which is heavily involved in Nuclear Fusion and Fission R&D activities, is responsible, at the national level, of the Scientific and Technological Presidium in the Field of Nuclear Energy.

➲ Nuclear Fission

European Lead-cooled System (ELSY)

The ELSY project aims at the demonstration that it is possible to design a competitive and safe fast power reactor using simple technical engineered features.

The ELSY reference design is a 600 MWe pool-type fast reactor cooled by pure lead. This concept is under development since September 2006, and is sponsored by the Euratom FP6. The ELSY project, coordinated by Ansaldo Nucleare, is being performed by a consortium consisting of twenty organisations including ENEA, CIRTEN and CESI Ricerca from Italy.

ELSY aims to demonstrate the possibility of designing a competitive and safe critical fast reactor using simple engineered technical features, whilst fully complying with the Generation IV goal of minor actinide (MA) burning capability.

The activities carried out in 2006 were mainly devoted to requirements definition, options selection and critical issues verification. Requirements reflect the GEN IV goals of sustainability, economics, safety, proliferation resistant and physical protection. Sustainability is the leading criterion for core design, focusing on the demonstration of the potential to be self sustaining in plutonium and to burn its own generated MA. To this end, two different core configurations are being studied: wrapperless assemblies in square lattice where pins are arranged in square bundle as well, or more conventional wrapped assemblies in hexagonal lattice.

ADS Transmutator

All ENEA activities were performed in the framework of international initiatives and mainly of European projects.

Activities on Partition and Transmutation, started within the 5th European Framework Program (FP), have continued in the frame of the 6th one. ENEA activities on chemical partitioning were carried out in the frame of the EUROPART (EUROpean Research Programme for the PARTitioning of Minor Actinides) Project which concerns the partitioning of long-lived radionuclides (LLRN) contained in the nuclear waste issuing the reprocessing of nuclear spent fuel. After separation, the LLRN will be destroyed in sort-lived or stable nuclides by nuclear means or conditioned into stable dedicated solid matrices. ENEA activities on transmutation were carried out in the frame of EUROTRANS (EUROpean TRANsmutation) Project submitted by ENEA, CEA, FZK and SCK•CEN with the objective to demonstrate experimentally the Acceleration Driven System (ADS) operations and its dynamic characteristics. The final purpose is to deliver a conceptual design for a European Transmutator Demonstrator (ETD), including to provide its overall technical feasibility and to perform an economic assessment.

ENEA is also partner in the EC funded projects:

- PATEROS (PArtitioning and Transmutation European Roadmap for Sustainable nuclear energy). The goal will be to establish global P&T roadmap up to the industrial scale deployment with indication of the critical milestones, preferred options and back ups, according to timescales and shared objectives at the European level.
- SNF-TP (Sustainable Nuclear Fission – Technology Platform). The main goal is to develop reactors that can both optimise use of uranium resources, keep long-lived waste to a minimum – the trend is towards closing the fuel cycle – and meet electricity-generation requirements. The SNF-TP is aiming to promote more wide-ranging use of nuclear energy, involving the generation of thermal power for industry and hydrogen for transport. Another goal of the SNF-TP is to improve the performance of existing reactors and those now commissioning (Generation III).

This platform will also provide the necessary training to maintain skill levels and optimise the use of infrastructures through appropriate renewal.

➲ **Technological Development for ADS and LFR**

In Italy, lead and LBE technologies are studied mainly at the medium and large scale facilities CHEOPE, LECOR and CIRCE at ENEA-Brasimone, to characterise structural materials behaviour and to control corrosion/erosion phenomena and impurities treatment.

With a contribution of the European Commission, ENEA coordinates a network of European laboratories (VELLA, Virtual European Lead Laboratory, Integrated Infrastructure Initiative) for the study of technologies related to liquid heavy metals as heat vectors, spallation and transmutation sources in ADS and Lead Fast Reactors.

The project has the ambitious intent to homogenise the European research area in the field of lead technologies for nuclear applications in order to produce a common platform of work which continues also after the end of the specific initiative. The issues of this activity are of interest for evolutive and innovative reactors activities too.

➲ **Evolutive and Innovative Reactors**

The main issue in this field, in 2006, was the definition and launch of a three-year R&D national programme based on "strategic funding devoted to the National Electric System R&D" and focused on the participation to international initiatives like INTD (International Near Term Deployment) and Generation IV nuclear systems. The programme is being managed through a specific agreement between Ministero dello Sviluppo Economico and ENEA, with the joint involvement of major national organisations still active in the nuclear sector, i.e. Ansaldo Nucleare, Ansaldo Camozzi, SRS, Del Fungo Giera Energia, CIRTEN (Italian Universities Consortium for Research in Nuclear Technologies) and SIET (an ENEA subsidiary SME). Main goals of this programme are:

- Keep open the future nuclear energy option in the country;
- Contribute to development of innovative nuclear systems which promise to be "sustainable", whilst matching public acceptability and economical interest;
- Sustain growth of necessary competences through participation to real-founded projects promising to be successful;
- Sustain the effort required to national industry for keeping the pace at world and domestic level.

This national programme is also intended to be synergic and coherent with the Generation IV initiative, as well as with a number of projects of the 6th Euratom Framework Programme (FP6), which the so-called "Presidio Nucleare" (Nuclear Presidium) – set up within the Nuclear Department – is significantly contributing to. These on-going projects are:

- ELSY – European Lead-cooled SYstem, coordinated by Ansaldo Nucleare;
- RAPHAEL – ReActor for Process heat, Hydrogen and Electricity generation;
- EISOFAR – Roadmap for a European Innovative SOdium cooled FAst Reactor;
- ALISIA – Assessment of LIquid Salts for Innovative Applications.

➲ **Nuclear Fusion**

The ITER Agreement (IA) among the seven participating Parties (EU, China, India, Japan, the Russian Federation and the United States) has been signed the 24 November 2006 in Paris. The signature of the IA is a fundamental milestones along the path towards the utilisation of nuclear fusion as energy

source. In parallel to the IA, EU and Japan signed an agreement, called "Broader Approach" (BA), aimed at to accelerate the fusion development. The BA includes the engineering validation phase of IFMIF which consists in the construction of the prototype of the deuterium ions accelerator and the lithium target, as well as the construction of the new superconducting Tokamak experiment, JT60 SA. Italy is deeply involved in both the aforesaid activities.

➲ **Magnetic confinement**

FTU (Frascati Tokamak Upgraded)

The experimental activity on FTU in 2006, focused on three main streams:

Development of advanced scenarios with dominant electron heating: In this respect quasi-stationary regimes were developed with internal transport barriers as wide as 60% of the minor radius. The preliminary exploitation of the Liquid Lithium Limiter generally produced very clean plasma operations and allowed high density discharges with peaked profiles suggesting the existence of internal barriers on particles.

Control of Magneto-hydrodynamics mode and disruptions: Algorithms were developed for using the 140 GHz FTU Electron Cyclotron Resonant Heating (ECRH) system in real time for tracking and stabilisation of modes. Plasma disruptions triggered by impurity injection were fully avoided when the ECRH was fired aiming at the location of the mode ultimately responsible for the disruption.

Dynamics of dust in the plasma periphery: A new experimental activity was initiated to study the generation and dynamics of dust in fusion plasmas, this problem is relevant both for plasma performances and reactor safety. Preliminary results have shown the possibility of using Langmuir probes in the plasma periphery to detect dust.

Design of a new magnetic confinement experiment

The design of a new experiment, FT3, aimed at supporting ITER operation and develop DEMO relevant technologies has been continued. The first report has been issued.

Fusion Technologies

ENEA was engaged in the development of the traditional field of interest for ITER and DEMO: superconductivity, remote handling, plasma facing components, materials and magnets, remote handling, visual inspection and metrology, control.

In particular the most relevant developments and achievements are:

Plasma facing components: The qualification test on the ITER divertor prototype developed in ENEA, armoured with graphite composite and tungsten, has been successfully completed. The prototype showed no damage after the cyclic tests up to 20 MW/m^2. Moreover, for the first time it has been possible to measure the critical heat flux (35 MW/m^2 average) in an armoured component.

The prototype of a reactor relevant helium cooled plasma facing component has been successfully performed. The components were made of tungsten and tungsten alloy material. A brazing process at temperature greater then 1400°C has been qualified.

Nuclear data: New radiation resistant sensors based on single crystal diamond have been developed and characterised in Frascati Neutron Generator and JET. This sensor can be utilised for neutron, gamma and also UV measurements. They are proven to be very accurate and much more reliable than the silicon based sensors under heavy irradiation.

Development of Nb3Sn high performance advanced strand: Major activities are:

- Development of the high performance conductor for the new superconducting test facility "Dipole".
- Development of the high performance cable for ITER magnet.
- Design and characterisation of the strand for the JT60 SA toroidal magnet.

High temperature superconductivity: The activity was focused on films of YBa2Cu3O7(YBCO). A new chemical deposition technique is being developed allowing the fabrication of long tapes at low cost. Progress has been made in increasing the current bearing capability.

Fuel cycle: The fabrication of a tritium separation system based on Pd membrane has been developed and fabricated. This system is part of the setup for the final clean up of ITER exhaust gases pilot line in construction at FZK (Germany).

Other Nuclear Activities

In the ENEA research reactors (TRIGA RC-1 thermal reactor and RSV TAPIRO fast reactor, both in Casaccia Center) activities have been devoted essentially to:

- Neutron activation analysis.
- Neutron radiography.
- Radioisotopes production for medical application in cooperation with hospital structures.
- Research on Boron Neutron Capture Therapy to realise human treatment in TAPIRO epithermal column.

➲ **Biotechnologies, Agroindustry and Health Protection Department (BAS)**

R&D activities on Biotechnologies, Agroindustry and Health Protection Department are within six main topics: Agrofood, Health, Radiation protection, Ionizing radiation metrology, Sustainable ecosystem management and bio-fuels.

The Department policy in developing research in the above six main topics is based on integrated and multi-disciplinary competences and cultural resources with initiatives which are related to the EU 7 Framework Program and priorities of the Italian National Plan.

Metrology of ionising radiation: The primary standards for ionising radiation measurement are developed and maintained at the National Institute for Ionising Radiation Metrology. This research Institute belongs to ENEA which has, by law, the duty as National Metrological Institute in the field of ionising radiations. The Institute's main task is to enhance the reliability of the country's ionising radiation measurement capabilities in various fields of interest. This is accomplished by carrying out R&D aimed at improving measurement methods and devices, while also providing calibration and certification services even through a network of calibration centres, recognised worldwide on the basis of mutual accreditation agreements. The Institute's activities are essential for the certification of quality of radiation measurements relevant to: medical radiodiagnostics and radiotherapy, radiation protection in the environment, hospital and industrial sectors, the treatment, sterilisation and diagnostics of materials using radiation, the scientific research, the radioactive waste disposal. A strong demand from industry and public administrations for certification services in the field of ionising radiation is expected to increase even further as a result of the requirements imposed under the EU and national legislation.

The Radiation protection Institute (IRP): Since 1993 all ENEA activities in radiation protection field were aggregated in the IRP, whose staff is today of 70 people. IRP serves 2 ENEA research reactors and

about 50 ENEA laboratories in 9 research centers; in addition it serves about 400 external customers all over Italy.

IRP is developing dosimetric techniques and dosimeters, e.g. characterisation of personal dosimeters and radon concentration meters (on this last activity IRP has registered two patents in 2002 and 2006), new validated radio-bioassay methods to determine contamination in human body for exposed workers and also for medical applications (e.g. nuclear medicine), numerical anthropomorphic phantoms (analytical and voxel phantoms) to allow dosimetric quantities to limiting quantities (i.e. fluence of kerma to organ or effective dose), test on new metabolic models for various radionuclides an the basis of physiological parameters and experimental data from occurred contaminations, new techniques to detect and measure radioactive aerosols, especially for natural radiation sources (i.e. radon and NORM). Moreover, with experimental molecular biology studies in vitro and in vivo IRP is developing studies on radiation damage at low doses.

At the moment, IRP participates with experts to each of the following working groups: ICRP Task group INDOS (INternal DOSimetry), ISO WG13 ISO Performance Requirements for internal dose evaluation of bioassay results, ISO WG 19 Performance requirements for passive dosimeters for external dosimetry, EURADOS WG Assessment of internal exposures: uncertainty studies and guidelines, WG EURADOS Computational Dosimetry, EURADOS WG Harmonisation of Individual Monitoring in Europe, EURADOS WG Internal dosimeter: nuclear emergencies.

SIET Activity Update

➲ SIET Nuclear R&D Activities

SIET company owns and manages large scale thermal-hydraulic test facilities aimed at testing both component and systems of LWR-Nuclear Power Plant. At present the SIET main shareholders are: ENEA (44%), ENEL (42%), Ansaldo (7%), Politecnico di Milano (3.5%). The SIET capabilities, in terms of testing fluids and energy allow to conduct the LWR experiments at full thermodynamic conditions.

SIET has been involved since twenty years in a wide international cooperation, aiming at studying and comparing several concepts such as the Westinghouse AP-600 and the General Electric Simplified BWR. The SIET nuclear R&D activities in the last twenty years can be shortly shared into four main items as follows:

- Tests on the integral test facility SPES simulating a PWR plant;
- Tests on the In-Pool Heat Removal Systems;
- Tests on both PWR Steam Generators and BWR Steam-Water Separator and Dryers;
- Tests on Steam Injectors (or Steam Jet Pumps) for ALWR.

During the 2006 year SIET has been mainly involved in the following R&D activities:

➲ Steam Injector R&D

Both performance and endurance tests have been conducted on a multi-stage Steam Injectors to be used on the Toshiba ABWR feed water system. Such experiment followed a similar one already performed during the 2005 year on a single-stage Steam Injector.

In all the case the test section was designed and manufactured by Toshiba Corporation.

Also thanks to the SIET Laboratory Steam Injector R&D activities, Toshiba received an important award from the Japan Society of Mechanical Engineers.

➲ **Heat Transfer experiments on helical-shaped tubes**

During 2006 fluid-dynamics tests (Pressure Drops and Critical Heat Flux measurements) have been performed on a full scale Steam Generator tube of the IRIS reactor: it consists of a 32 m long helical-shape stainless steel tube.

Moreover an experimental campaign has been conducted on the IRIS reactor Emergency Heat Removal System by using the Steam Generator tube as above mentioned.

A new experimental campaign concerning the study of the flow instability occurrence in two helical-shaped tubes when operating in parallel has been planned for the next year.

➲ **A new integral test facility for IRIS reactor simulation**

IRIS (International Reactor Innovative and Secure) is a 1 000 MW-th pressurised water reactor with an integral configuration (all the primary system is inside the reactor vessel). IRIS reactor is considered one of the most promising design belonging to the generation 3+ reactors. In the framework of an international program SIET, thanks to ENEA sponsorisation, will build up a new integral test facility (named SPES-3) for IRIS simulator. The facility is full scale in elevation with a volume scaling factor of 1:100. Both the process fluids and their thermodynamic conditions will be the same as the reference plant. Both the reactor primary side and the containment will be completely simulated. During the 2006 year, SIET began the facility design; the experimental program, consisting of twenty experiments, will be completed in the 2010 year.

Main Industrial Activities

➲ **Ansaldo Nucleare Activity Update**

Ansaldo Nucleare is involved in Heavy Water Reactors (HWR), Light Water Reactors (EPP and AP1000), Decommissioning and Waste Management including activities on Superphenix NPP in France, Chernobyl NPPs and Khmelnitsky NPP in Ukraine and in the European Programme (IP-EUROTRANS, ELSY, RAPHAEL) for developing new reactors (EDT/EFIT, EDT/XT-ADS, ELSY, VHTR).

➲ **Service on Cernavoda Unit 1 (Romania)**

Service activities on Unit 1 are ongoing. In the year 2006 Ansaldo Nucleare has been awarded for new contracts concerning the in service inspection and replacement of expansion joints in Balance Of Plant Lines checking structural behavior and thermal displacements in each involved system thermal mode; expansion joints inside Condenser have been replaced at the completion of the In Service Inspection activity. Control Check Valves (nozzle type) for feedwater lines, procured in 2005 by a German Company and modified by an Italian workshop to fit the special requirements in terms of welding procedures, have been installed by Ansaldo Nucleare during Outage October 2006.

➲ **Completion of Cernavoda Unit 2 (Romania)**

The contract for the completion of Unit 2 entered in force in March 2003; the unit is scheduled for full operation by 2007. Ansaldo Nucleare acts as the Design Authority for the Balance of Plant (BOP) as member of the Project Management Team, together with AECL and SNN (the Romanian national electric company). The Ansaldo Nucleare tasks cover home office design activities, equipment supply and technical assistance for thermal cycle, electrical distribution and auxiliary systems. The main supplies are the BOP Digital Control System, Electrical Distribution Equipment and non-nuclear valves for the entire plant. The in field erection activities have been completed; all the systems have been commissioned. The fuel loading will be carried out at the beginning of 2006 and the plant first criticality is scheduled in May 2007.

➲ **Cernavoda Units 3 and 4**

The Romanian Government has decided to complete Units 3 & 4 of Cernavoda through an *IPP* model and has selected Deloitte as financial advisor to evaluate the economic viability of the project. Ansaldo Nucleare, together with the Canadian AECL, has ascertained the technical viability of the plant and has provided support to Deloitte setting out the characteristics of the reference plant, assessing the needed design changes and evaluating their impact. The outcome of the study has demonstrated the technical and financial viability of the project.

➲ **European Passive Plant (EPP)**

The European Passive Pressurised Water Reactor (EPP) Program was initiated in 1994 between several European utilities, Westinghouse and its Industrial Partner Ansaldo Nucleare. The EPP Phase 2D has been completed in 2006, the current EPP Phase, called Phase 2E, has been initiated. AE is the overall project manager of the program together with Westinghouse. The main focus of Phase 2E is:

- Continue to support progress in developing the AP1000 base design details.
- Address EUR non-conformances, highlighted in Phase 2D.
- Address initial licensing steps in the EPP member countries.

➲ **AP1000**

Ansaldo Nucleare is strictly cooperating with Westinghouse for the design of the AP1000 in the frame of the DOE-sponsored NUSTART activities that are concerned with the definition of the design details required for a Combined License Application. More in particular, Ansaldo Nucleare has been involved and is still cooperating with Westinghouse in the following areas: Reactor Building plant layout, Containment Internal Structure Structural Evaluation, Structural Module Design, Mechanical Module Design, Piping Stress Analysis for the primary system connected Class 1/2/3 piping, including Leak Before Break Qualification, Emergency Procedure Definition and Computational Fluid Dynamic analyses for thermal stratification evaluation in the stagnant lines connected to the RCS. In addition, Ansaldo Nucleare is also responsible for the mechanical design of the Passive Residual Heat Removal System and of the RV lower internals. Ansaldo Nucleare, with the cooperation of ENEA is also involved in the Heating rates evaluation for vessel internals to be used for input to mechanical design. Ansaldo Nucleare participated as Westinghouse supplier to the AP1000 offer to China. End of February 2005, Westinghouse presented a proposal to the China's State Nuclear Power Technology Company (SNPTC) to build four AP1000 plants at two sites in China – San Men in Zhejiang Province, and Yangjiang in Guangdong Province. The bid essentially encompasses two twin-unit projects, technology transfer and initial fuel loads for all four plants. Ansaldo Nucleare participates to this offer with a primary role between the Westinghouse partners. At the end of 2006, a memorandum of understanding (MOU) has been signed between Westinghouse and the SNPTC for the construction of the two twin units. The MOU has been further detailed as a framework agreement in March 2007. The contract award is expected by the end of 2007.

➲ **Plant Life Extension study for Embalse (Argentina)**

Embalse Plant Life Extension (PLEX) project work has started in 2006 and is being executed by AECL and Ansaldo Nucleare, for nuclear and BOP systems respectively; NA.SA., the Plant owner, has assigned a contract to Ansaldo Nucleare for the BOP PLEX pre-project first phase, as part of an overall Plant Life Management program. The job is organised in order to get within the Plant outages of April 2007 and late November 2008 the residual life evaluation of the as built configuration of the Plant; within the outage 2010 (end of the Plant Design Life) it is planned to produce the intervention planning to be implemented in the years 2009 and 2010 to get the required life extension. Through this strategic approach it would be possible to get the life extension without being forced to stop the Plant for updating implementation.

➲ **Chernobyl NPP (Ukraine): Liquid Radwaste Treatment Plant (LRTP)**

Turn-key supply of a liquid waste treatment plant at Chernobyl NPP. This installation aims at the retrieval and conditioning of spent resins and perlite sludges, by centrifugation or evaporation followed by cementation. Ansaldo Nucleare activity includes design of plant lay-out, equipment specifications, equipment procurement, sub-suppliers follow-up and management of site works relevant to installation and commissioning activities. The LRTP Plant was handed over to the Client in October 2006.

➲ **Chernobyl NPP (Ukraine): Integrated Automatic Monitoring System (IAMS)**

A turn key supply of the Integrated Automatic Monitoring system of the Chernobyl shelter is in charge to Ansaldo Nucleare; the main purpose of "IAMS" is to implement a "nuclear", "radiological", structural" and "seismic" integrated monitoring system of the shelter. The Integrated Monitoring will supply information and monitor continuously the shelter configuration in order to be able to decide preventive protection actions. In the year 2006 the procurement activities (for computers, instrumentation and data acquisition devices) and the software for managing the on line information process has been almost completed; today the activities concerning "integration tests" are started.

➲ **Khmelnitsky NPP (Ukraine): Treatment of Backlog of Radioactive Waste Water**

The TACIS-96 on-site assistance contract deals with the turn-key supply of a liquid waste treatment composed by a centrifugation system and a remotely controlled drum handling system for the slurries. During 2006 the installation onsite was completed and testing was started.

➲ **High-Level Radioactive Liquid Waste Storage Facility at the ENEA Research Center of Saluggia (Vercelli, Italy)**

The contract (awarded by SOGIN SpA in October 2003) deals with the design, procurement, construction and turn-key delivery to the ENEA Research Center of Saluggia (Vercelli, Italy) of a facility including three stainless steel tanks equipped with transfer, interconnecting and sampling lines for storage of high level radioactive waste generated by nuclear fuel reprocessing at laboratory level. The tanks are located in a building designed to withstand the loads induced by seismic events and aircraft impact. The activity has been completed during 2006.

➲ **Ignalina B234 Project – retrieval unit 1 landfill separation facility**

The contract (awarded by NUKEM in July 2006) deals with the design, supply and supervision to installation/erection, licensing and commissioning support of equipment and systems for the retrieval unit 1 (RU1), landfill separation facility (LSF) and control building (CB) including the office container for the RU2 and RU3 facilities for the solid waste retrieval. The Ansaldo Nucleare scope includes: the civil works; some equipment and systems (e.g. handling equipment for landfill separation facility, HVAC and ventilation, radiological monitoring and control, control room, liquid waste collection, communication, alarm, fire protection, power supply); project management and training. The activity started on 2006 and the design will be completed in 2007.

➲ **Technical assistance to safe shutdown of Superphenix**

Ansaldo Nucleare participate to the following engineering and on-site implementation activities: removal of the fuel elements from core, installation of electric heating outside the reactor safety tank, detailed studies for cutting large diameter tubes and components, sodium sampling and final disposal.

➲ **European research programme for the transmutation of high level nuclear waste in an accelerator driven system (IP-EUROTRANS)**

In the frame of the project IP EUROTRANS of the 6th Framework Programme of the European Union (2005-2009), Ansaldo Nucleare together with 51 European Organisations (including Industries, Research Centers and Universities) have the strategic R&D objective to pursue forward an European Transmutation Demonstration (ETD) in a step-wise manner. The aim of the 4-year lasting IP-EUROTRANS programme is twofold: i) Develop the conceptual design of EFIT (European Facility for Industrial Transmutation) with a pure lead-cooled reactor of several hundreds MW with MA burning capability and electricity generation at reasonable cost (design features will be worked out to a level of detail which allows the study cost estimate); ii) Carry out the detailed design of the smaller XT-ADS (eXperimental Transmutation in an ADS) as irradiation facility and for demonstration of key features of EFIT to be constructed in the short-term (XT-ADS is an irradiation facility intended to be as much as possible a test bench of the main components and of the operation scheme of EFIT, but at lower working temperatures using LBE as primary coolant and spallation target. XT-ADS uses standard MOX-fuel, but it is designed also to handle some MA Fuel Assemblies). Ansaldo Nucleare is the coordinator of the Work Package 1.2 "Development and Assessment of XT-ADS and EFIT Design" and is mainly involved in the functional analysis and design of main system/components of both reactors as well as in contributing to the definition of the requirements, of the safety approach and of the R&D needs.

➲ **European Lead Cooled System (ELSY)**

In the frame of the project ELSY of the 6th Framework Programme of the European Union (2006-2009), Ansaldo Nucleare together with 18 European Organisations (including Industries, Utilities, Research Centers and Universities) and 3 International partners have taken the initiative to promote the design of a competitive and a safe critical fast reactor cooled by pure Lead (the European Lead System – ELSY). This initiative has been successful and the European Union has awarded the 18 European Organisations with a contract for carrying out, over the time frame of three years, the specific targeted research and innovative project ELSY. Ansaldo Nucleare is the coordinator of the whole project and is mainly involved in the functional analysis and design of main system/components of both reactors as well as in contributing to the definition of the requirements, of the safety approach and of the R&D needs.

➲ **Sogin Activity Update**

SOGIN decommissioning activities on the 8 Italian sites hosting NPP's and Fuel Cycle Facilities (FCF) continued in 2006, focused both on completion of the upgrade of safety and security measures and on operations related to plants dismantling.

Looking forward to the completion of decommissioning plan licensing processes, which are not completed yet, major efforts have been devoted to maintain safety levels and to address most urgent issues on a case-by-case basis.

➲ **Nuclear Power Plants Major Activities**

Waste treatment and decommissioning activities have proceeded with important achievements. In general asbestos removal has been completed or it is well underway in all plants. Dismantling of non-contaminated or slightly contaminated components and systems has seen significant achievements. Detailed radiological characterisation remains to be completed in some plants.

A major step, which has caused delays in the decommissioning plans, has been overcome with the reprocessing contract of the remaining 235 HMt of spent fuel in Italy signed in May 2007 with AREVA. The contract covers transport, reprocessing and packaging of irradiated fuel and includes 190 t of BWR fuel from the Caorso plant, 32 t of PWR fuel from the Trino Vercellese plant and 13 t of BWR fuel from the

Garigliano plant. The fuel will be shipped to La Hague reprocessing plant between 2007 and 2015. The contract, worth about EUR 250 million, includes the obligation of return of the residues of reprocessing in Italy.

Another important achievement has been the start of the Eurex spent fuel pool emptying in Saluggia. This operation is described below.

An event to be mentioned is that, after the adoption of more extensive and sophisticated monitoring techniques, a slight Pu contamination has been identified in a few workers in Eurex and in Casaccia; the relative doses are well below any medical significance and below the dose limits, but SOGIN started a complete review of the working procedures.

A safety culture assessment project has been started in order to maintain and promote the highest standards of safety culture in the Company in line with international experiences and with the indications of the international conventions. Specific issues related to decommissioning have been analysed and corrective actions proposed.

The major activities just completed or underway on each site are reported below.

➲ **Trino NPP**

Detailed plant radiological characterisation activities have proceeded and have been completed in 2006.

The dismantling of conventional components has proceeded as well. Asbestos removal has been completed also in the Reactor Building and in all controlled areas.

Activities to remove a barrier on the Po river, which supplied cooling water to the plant, have completed and a new water supply system, based on wells, has been built.

➲ **Caorso NPP**

In the Caorso plant the removal of asbestos is going on in the entire plant, while in the turbine building and in the Reactor building have been completed. The main generator removal has been also completed, and the cutting and decontamination of the less contaminated components of the thermal cycle has allowed to dispose them and to prepare the area for the construction of the Waste Management Facility, including the chemical decontamination facility (Phadec), whose construction is expected before the end of 2007.

➲ **Latina NPP**

Also in Latina NPP removal of asbestos is well underway and has been completed in the turbine building and in several rooms of the Reactor building as well as from the boilers. Primary circuit ducts removal has been largely completed and their detailed characterisation is underway. Testing is underway on boilers removal and treatment in a melting facility abroad.

Activities are underway for the construction of a building dedicated to treatment and conditioning of operating radioactive sludges, its vacuum extraction system, a cementation facility and finally a storage building of the cemented wastes. An ad-hoc control room has been built and a completely new electrical system has been added. Removal of turbine building components has been completed.

One of the major problems still under investigation with the cooperation of other operators in France, Spain and United Kingdom is the treatment and disposal of the irradiated graphite of the reactor core. This remains one of the outstanding issue for the completion of a decommissioning plan of a gas-graphite reactor.

➲ **Garigliano NPP**

The Garigliano NPP is the most advanced in the decommissioning process because it has been definitely shutdown earlier than others, in 1978.

Asbestos removal has been completed in selected areas and its removal from turbine building has been authorised. The feasibility of a primary circuit decontamination after the experiences of Trino and Caorso is currently assessed.

The emergency diesel generator building adaptation to waste storage is underway, since it was not possible to obtain all local licenses for a new dedicated building.

➲ **Fuel Cycle Facilities major activities**

The update on the most important technical projects is reported below.

The new liquid waste storage tank park construction in EUREX for the 120 m^3 of highly radioactive liquids produced in the reprocessing of MTR and CANDU fuels has been completed and hot test program is undergoing.

An issue that required prompt action is related to the limited leaks that have been identified in the spent fuel pool (total volume 625 m^3) of the Saluggia installation, built in the sixties with the criteria applied at that time and, therefore, without a metallic liner and without a leak recovery system, but only a leak detection system. In the pool there are currently 52 cruciform fuel elements that were the followers of the control rods of Trino PWR. Operations are undergoing in May-June 2007 to remove all this fuel and to proceed with the clean-up of the pool.

Main reasons that have contributed to the creation of hairline cracks on pool walls and bottom may be traced to:

- Concrete and rebar deterioration due to ageing and to chemical action.
- Inadequate foundation design and local excessive tensile stresses.
- Unforeseen soil settlement due to the late erection of the contiguous new building (south side).
- Abnormal thermal expansion/contractions of structures during 2003.
- Improper constraint due to the balcony all around the pool.
- Soil vibration during the hydraulic defence wall erection in 2001.
- Groundwater level variation during/after the hydraulic defence wall erection in 2001.

The other very important project is CEMEX, the cementation plant of all radioactive liquids in EUREX produced during the reprocessing campaigns and all related plants and infrastructures. This project includes: the cementation plant, the storage building of high level cemented waste, the storage building of medium level wastes, the modification of water supply system, the new office building. All pre-qualification activities of the cement matrix have been completed. The project is currently under revision after a number of comments received from the safety authority.

At the beginning of 2005 the work for the clean-up of about 60 glove boxes in the Plutonium plant of the Casaccia Center started. In the Casaccia Center the OPEC2 plant, never commissioned as Hot Cell facilities, will be transformed into a waste storage facility for plutonium plant wastes. Design has been completed and the licensing process is planned to be completed by the middle of 2007.

For the ITREC plant the preliminary design of the cementation plant for the uranium/thorium solution is underway and is planned to be completed by the middle of 2007. Meanwhile, qualification of the cement matrix and design of the mock-up facility will proceed in parallel.

Other projects include the removal of the so-called “irreversible (grouted) trench”, the conditioning of the operating wastes, the update of the environmental data, etc.

Finally, while still waiting for the approval of the Overall Decommissioning Plan for Bosco Marengo, preparation activities are underway. Meanwhile al fresh fuel scraps have been removed from the site.

➲ **Spent Cycle**

As mentioned before the reprocessing contract with AREVA of the remaining power reactors spent fuel in Italy has been signed in May 2007.

The only exception to total reprocessing, at this moment, is the Uranium/Thorium spent fuel (irradiated in the US Elk River power reactor), which is currently stored in the ITREC plant pool and will be dry stored on site. Construction of the spent fuel bottles and of the storage/transport casks is underway. The casks will be temporally stored on-site.

➲ **Engineering Services**

It is worth mentioning the SOGIN activities in the field of services supply in the environmental restoration and nuclear plants. In particular, the latter ones are related mostly with eastern European countries and namely Armenia, Russia, Kazakstan and others, with a special mention to the role of SOGIN in the G8 Global Partnership Initiative for the reduction of Russian mass destruction weapons, including the dismantling of nuclear submarines.

Another important SOGIN involvement is related to the decommissioning planning and design of several old nuclear installation of the Ispra JRC, with the opportunity of being responsible also of the consequential activities.

SOGIN has also provided essential technical support in the Due Diligence performed by ENEL before the acquisition of Slovenské Elektràrne and its Nuclear Power Plants and is continuing the technical support after the acquisition. A similar support is being given to ENEL in the assessment of ENEL participation in the EPR French Flamanville project, as well as in Romania and Bulgaria.

Cesi Ricerca Activity Update

➲ **Evaluation of the Impact on the Electricity Sector**

One of the main goals of the researches carried out at Cesi Ricerca about power plants is the evaluation of their influence on the electricity system. For this reason, the technological evolution of the nuclear energy is analysed through engineering and economic evaluations.

The potential impact of the construction of nuclear power plants, and their subsequent operation, is evaluated by simulating realistic scenarios of electric grid evolution and calculating the Levelised Unit Electricity Cost through a financial model properly developed.

➲ **Reactor Physics**

As far as the reactor physics is concerned, Cesi Ricerca is developing models and calculation methods allowing the solution of various problems connected to the design, the analysis and the operation of a nuclear reactor.

In particular, an integrated code system was developed to allow the simulation of steady state and transient analyses of a generic core in all plant situations, starting from the plant design data, the operating conditions and the relevant assembly nuclear libraries.

These codes are interfaced among them making up an integrated calculation system. Both the models and the computer codes were tested, adapted and integrated to permit an efficient evaluation of the GenIV reactor designs.

Also the important problem of the radioactive waste are object of a careful analysis. In particular, some studies are carried out with regard to the possibility of an effective burning of the minor actinides and the long-lived fission products directly into a reactor core.

As regards the study of the neutron population behaviour outside the core, studies are performed to improve the calculation of shielding, dose, material activity, with particular attention to decommissioning problems.

➲ **Simulation and Control Tools for Generation IV**

In the field of real time power plant dynamic simulation, Cesi Ricerca developed an integrated software environment, named "Lego Plant Simulation Tools" (LegoPST), able to model the whole plant, from the field (plant process and machinery) to the Human Machine Interface (HMI). This package is useful for plant control and automation system design and testing, systems integration dynamic check, plant operation transient analysis, as well as plant operators training.

Well tested in LWR simulation in the past, now LegoPST extension to liquid metal cooled fast reactors modelling is ongoing in the framework of GenIV studies. Particularly, liquid lead physical properties and channel one dimensional model were built on. The model of the BREST-300 steam generator was built and successfully tested.

For the time being, new component models development, validation activities and the ELSY Lead Fast Reactor plant simulator to verify plant operating procedures and control system design are foreseen.

➲ **Reactor Safety**

As one of the key-points for the acceptability of nuclear energy is the safety of the power plants, Cesi Ricerca performs analyses of hypothetical accident transients, looking at the thermal-hydraulic system and structural response also accounting seismic conditions. Most of the research attention is focused on the potential consequences outside the nuclear island in terms of abnormal radioactive releases.

At this purpose, significant efforts are addressed to the study of severe accident phenomena, as the core reactivity and coolability, and, overall, to those phenomena potentially responsible for the release of airborne radiotoxic chemical species to the outside environment.

The lessons learned in the field of LWR safety led to the development of a complex source term code, called ECART, dedicated to the coupled analysis of thermal-hydraulic behavior of the circuits and the containment together with the chemistry and the vapor/aerosol phenomena under severe accident conditions.

In connection with the SARNET Project of the Euratom 6^{th} Framework Programme and the development of the european code ASTEC, those models are continuously upgraded and discussed with the other international experts, also studying new experimental tests devoted to solve some open issues about the aerosol phenomenology, as the resuspension of deposited particles and the retention within concrete cracks. Efforts are also dedicated to transfer the LWRs source term know-how to the physics and chemistry of GenIV reactor systems and nuclear fusion experimental tokamaks. Fires and explosive dust clouds are also considered in the researches about accident phenomenology, with ad-hoc experimental and theoretical studies.

Japan

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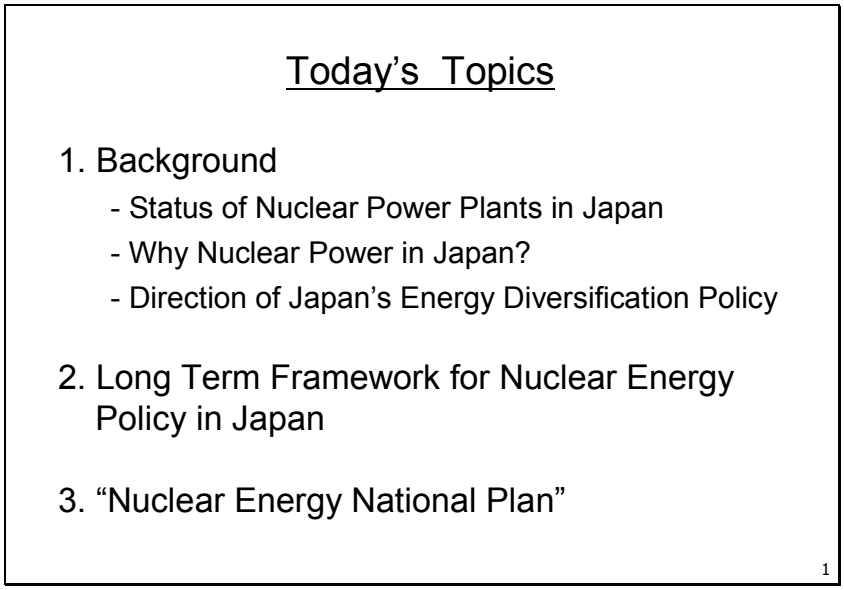
Slide 2



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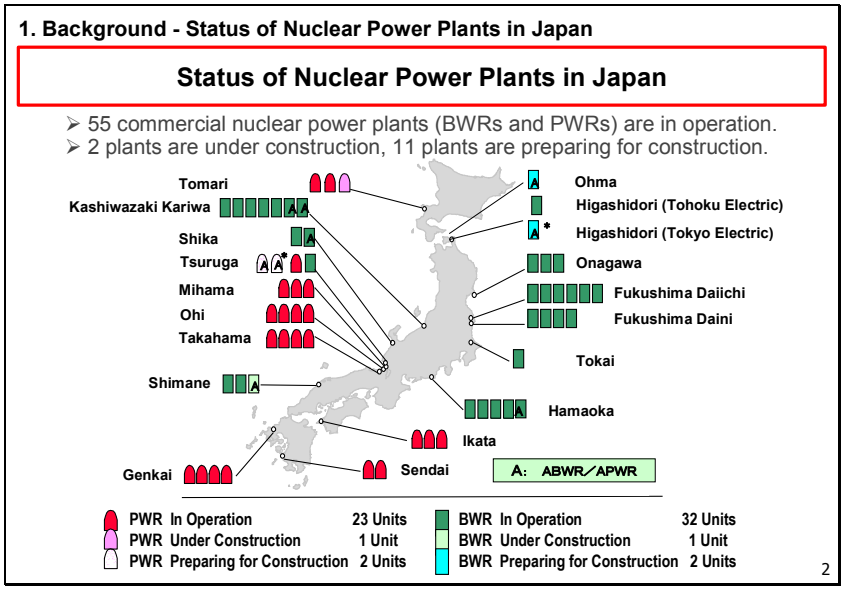

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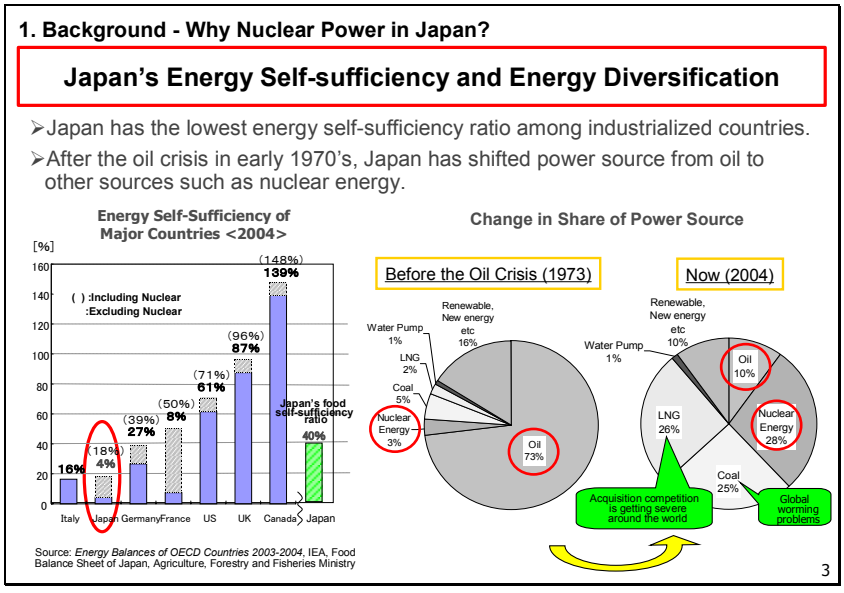

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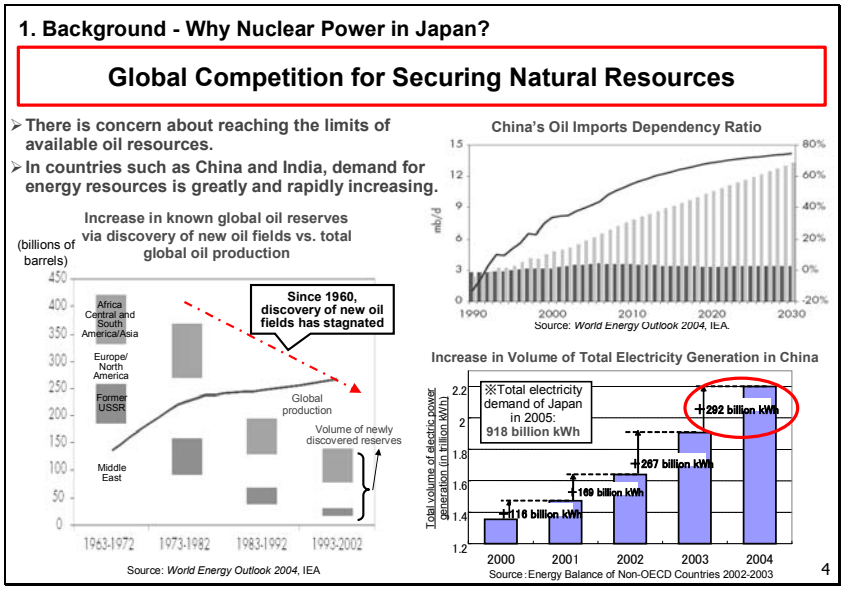

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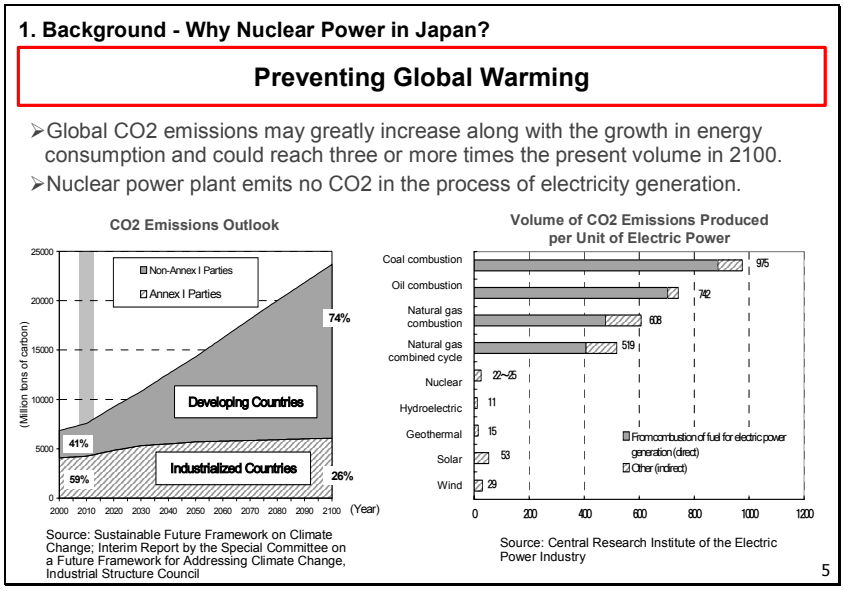


Slide 7

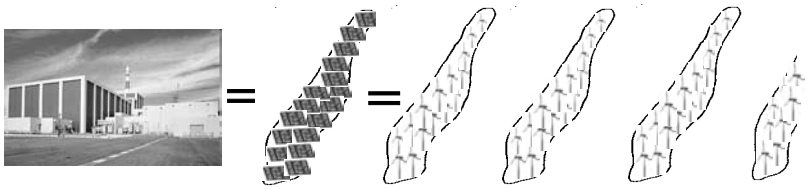
1. Background - Why Nuclear Power in Japan?

Renewable Energy

- Introducing solar, wind and other renewable energy sources is also an extremely efficient means of reducing CO2 emissions.
- At present, however, these renewable energy sources still have issues of supply stability (energy cannot be generated on rainy days or when the wind does not blow), economic feasibility, etc.

Comparison of Each Type of Electricity Generation

One Nuclear Power Reactor 1 million kW class (300 billion yen)	Photovoltaic Power Generation An area the size of Manhattan Island (approx. 67km²) (6–7 trillion yen)	Wind Power Generation An area 3.5 times the size of Manhattan Island (approx. 246km²) (1 trillion yen)



* Under the present conditions, the power output of systems using natural energy such as solar power generation and wind power generation is prone to fluctuation, so backup power sources are essential.

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Slide 8

1. Background – Direction of Japan's Energy Diversification Policy

Direction of Japan's Energy Diversification Policy

Considering stable energy supply and the response to global warming :

The direction of energy diversification policy is not

Nuclear energy "OR" Renewable energy

but

Nuclear energy "AND" Renewable energy

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Slide 9

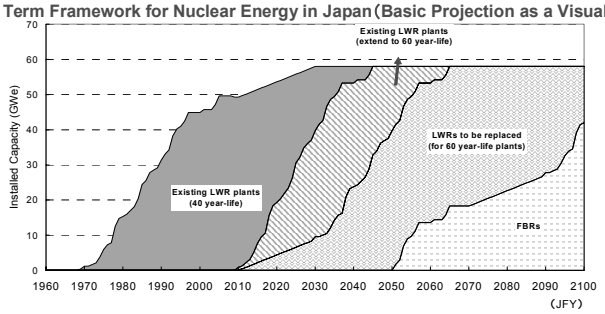
2. Long Term Framework for Nuclear Energy Policy in Japan

Basic Targets under the Framework for Nuclear Energy Policy

Basic Targets under the Framework for Nuclear Energy Policy (Adopted by Cabinet Oct. 2005)

1. Keeping the share of nuclear power generation at least 30-40% beyond 2030
2. Steady promotion of the nuclear fuel cycle
3. Introduction of the first commercial FBR in 2050

Long Term Framework for Nuclear Energy in Japan (Basic Projection as a Visual Image)



* The installed capacity is assumed to reach saturation at 58GW, for illustrative purpose.

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3. "Nuclear Energy National Plan"

"Nuclear Energy National Plan"

The Essentials of Japan's Nuclear Energy National Plan (Concluded Aug. 2006)

POLICY PACKAGES FOR

- New Nuclear Build in a Liberalized Electricity Market
- Appropriate Use of Existing Nuclear Power Plants with Assuring Safety as a Key Prerequisite
- Deploying Strategy for Acquiring Natural Resources
- Steady Promotion of Nuclear Fuel Cycle
- Early Commercialization of FBR Cycle
- Maintenance of Technology and Human Resources
- Support for Overseas Activities by Japanese Nuclear Industry
- Active Involvement in the Global Framework to Uphold both Non-proliferation and the Expansion of Nuclear Power Generation
- Building Trust between National Government and Local Communities through Close Communication
- Reinforcement of Measures for Radioactive Waste Disposal

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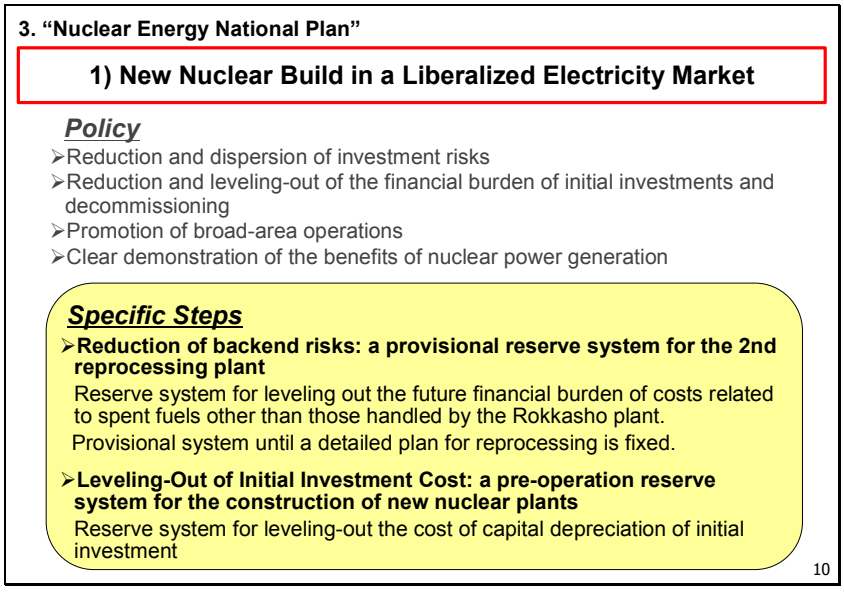

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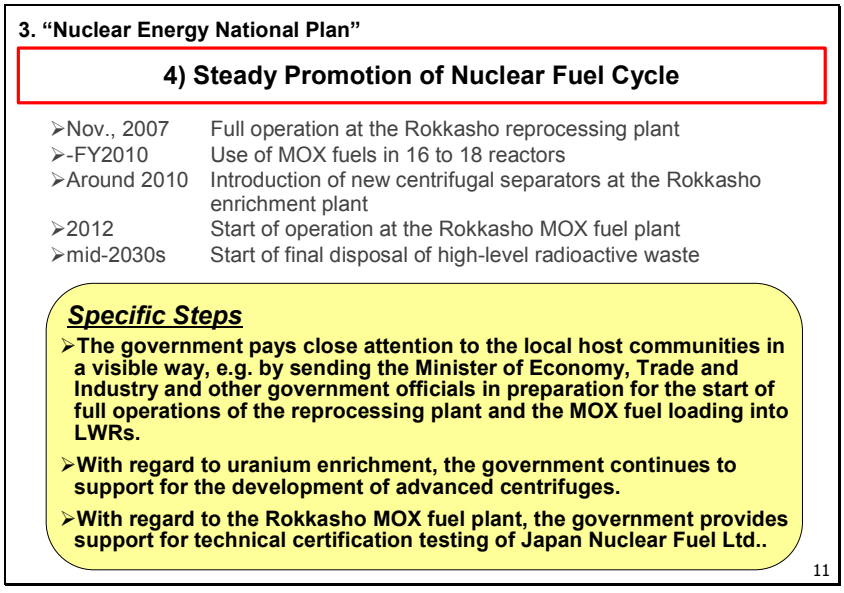

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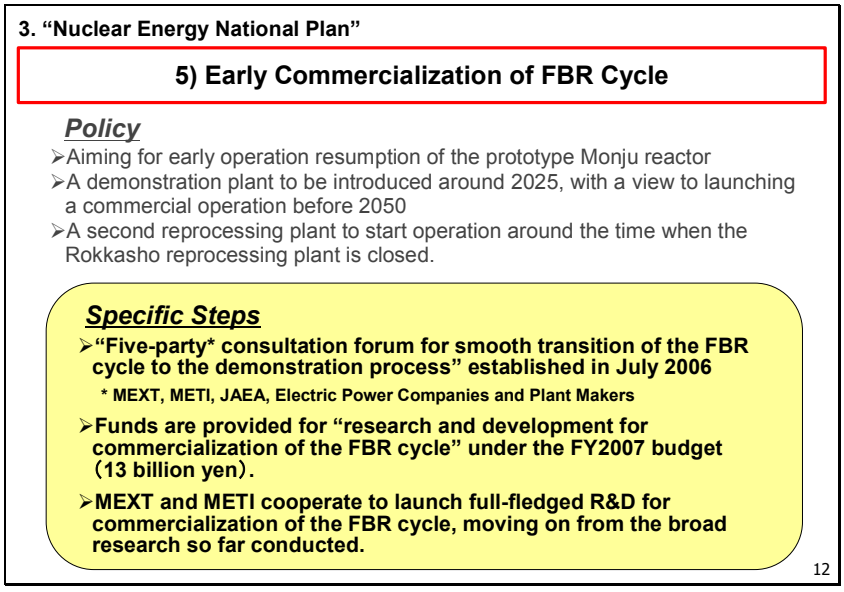

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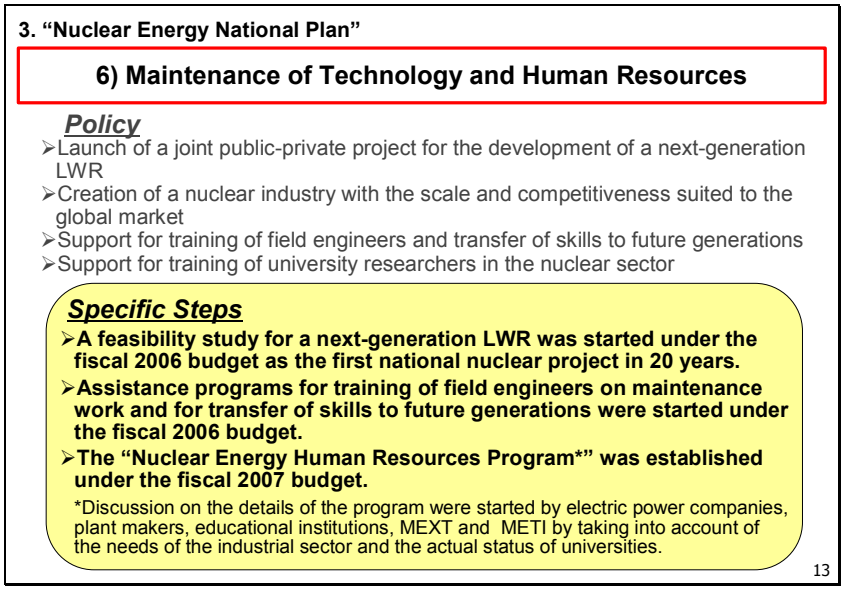

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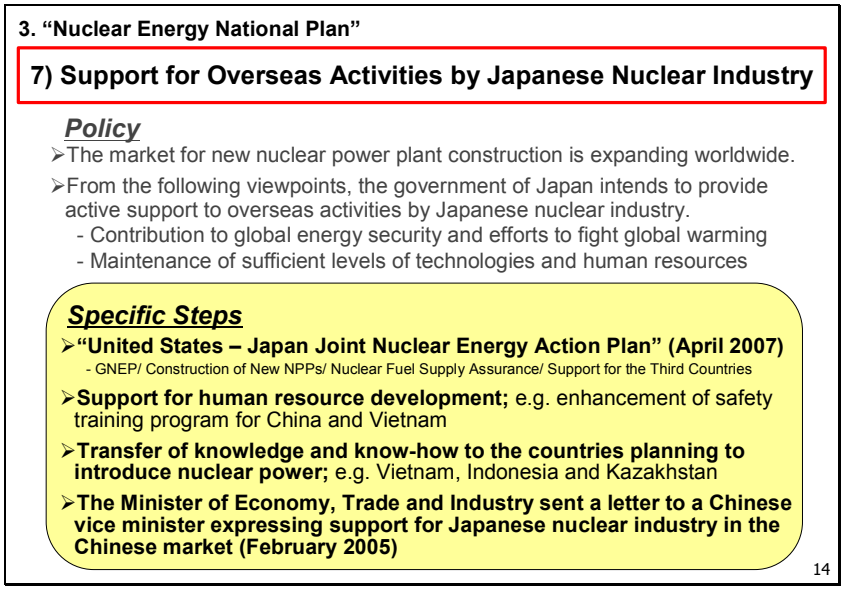

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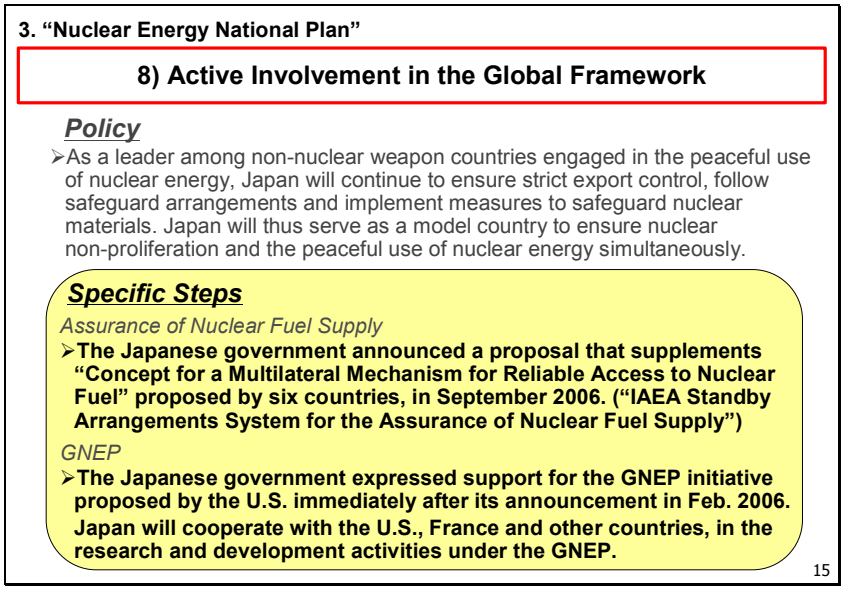


Korea

General Nuclear Policy

In order to achieve the objectives of the long-term nuclear energy policy, the government established a legal basis to formulate the "Comprehensive Nuclear Energy Promotion Plan (CNEPP)" every five years through the amendment to the Atomic Energy Act in 1995. The CNEPP includes long-term nuclear policy objectives and basic directions, sector-by-sector objectives, budget and investment plan, etc.

The Atomic Energy Act stipulates that Ministry of Science and Technology (MOST), in consultations with concerned Ministries, shall formulate sector-by-sector implementation plans for those areas under their jurisdiction every five years in accordance with the CNEPP and shall establish and implement annual action plans according to the sector-by-sector implementation plans.

In January 2007 the Korean government announced the 3rd CNEPP covering the years from 2007 to 2011, which has the vision contributing to energy security, environmental protection, human welfare and science and technology development by utilising nuclear energy as prime power for future Korea. In order to realise it, the Plan stipulates six policy goals as follows;

① Securing nuclear energy supply for sustainable development.
② Promoting nuclear energy based on public support through improved safety.
③ Breeding nuclear export industry by securing international competitiveness.
④ Improving public health and living quality through radiation technology (RT) utilisation.
⑤ Establishing Infrastructure for efficient promotion of nuclear energy; and
⑥ Strengthening nuclear diplomacy and international cooperation.

Electricity

Electricity use and production in Korea has grown continuously in recent years by demands from economic growth and improvement of the living standard as shown in Table 1. In 2006, 39.0% of national electricity production, a little lower than in 2005, was provided by nuclear power as shown in Table 2.

Table 1. Electricity Consumption

	2003	2004	2005	2006
Industrial	150 387	158 337	166 813	174 661
Residential	44 572	48 615	50 873	52 522
Commercial	87 405	92 726	100 987	106 948
Public & Others	11 235	12 417	13 740	14 588
Total	293 599	312 095	332 412	348 719

Unit: GWh.

Table 2. Electricity Generation

	2003	2004	2005	2006
Nuclear	129 672 (40.2%)	130 715 (38.2%)	146 779 (40.3%)	148 749 (39.0%)
Coal	120 276 (37.3%)	127 158 (37.2%)	133 658 (36.7%)	139 205 (36.5%)
Oil	26 526 (8.2%)	22 415 (6.6%)	20 895 (5.7%)	19 706 (5.2%)
LNG	39 090 (12.2%)	55 999 (16.3%)	58 118 (15.9%)	68 302 (17.9%)
Hydro	6 887 (2.1%)	5 861 (1.7%)	5 189 (1.4%)	5 219 (1.4%)
Total	322 451 (100.0%)	342 148 (100.0%)	364 639 (100.0%)	381 181 (100.0%)

Unit: GWh.

Nuclear Power Programme

Energy security is the primary concern of the energy policy in Korea. In order to meet increased demands for electricity, the Korean government has been committed to an ambitious nuclear power programme.

As of the May of 2007, a total of twenty nuclear power plants (16 PWRs and 4 CANDU) are in commercial operation and four more units (4 PWRs) are under construction: two(Shin-Kori #1&2) at Kori and two (Shin-Wolsong #1&2) at Wolsong sites as shown in Table 3. In addition, four more nuclear units are scheduled to be constructed by 2015.

In 2006, installed nuclear power capacity was 17.7 GWe accounting for 27.0% of the total installed capacity and nuclear power generation was 148.7 TWh. The share of nuclear power capacity and nuclear power generation will be increased to 30.3% and 46.7%, respectively by 2015.

Korea has developed an advanced power reactor with a capacity of 1 400 MWe, called APR1400, to enhance the safety, availability and lifetime and to cut the costs of nuclear power plants. The first unit of APR1400 is expected to be in service by 2012.

It is well understood in Korea that this large nuclear programme has contributed to reducing the growth ratio of CO_2 emission against the high energy consumption growth. In this regard, it is expected that Korean government will consider nuclear power as one of possible alternatives to solve the greenhouse gas emission problem in the new long-term electricity development programme.

Table 3. Status of Nuclear Power Plants in Korea

Status	Plant Name	Type	Capacity (MWe) Gross	Reactor Supplier	Turbine Supplier	COD year
In operation	Kori 1	PWR	587	WH	GEC	1978
	Kori 2	PWR	650	WH	GEC	1983
	Kori 3	PWR	950	WH	GEC	1985
	Kori 4	PWR	950	WH	GEC	1986
	Wolsung 1	PHWR	679	AECL	HP	1983
	Wolsung 2	PHWR	700	AECL/Hanjung/KAERI	Hanjung/GE	1997
	Wolsung 3	PHWR	700	AECL/Hanjung/KAERI	Hanjung/GE	1998
	Wolsung 4	PHWR	700	AECL/Hanjung/KAERI	Hanjung/GE	1999
	Yonggwang 1	PWR	950	WH	WH	1986
	Yonggwang 2	PWR	950	WH	WH	1987
	Yonggwang 3	PWR	1000	Hanjung/KAERI/CE	Hanjung/GE	1995
	Yonggwang 4	PWR	1000	Hanjung/KAERI/CE	Hanjung/GE	1996
	Yonggwang 5	PWR	1000	Doojung/KOPEC/CE	Doojung/GE	2002
	Yonggwang 6	PWR	1000	Doojung/KOPEC/CE	Doojung/GE	2002
	Ulchin 1	PWR	950	Framatome	Alsthom	1988
	Ulchin 2	PWR	950	Framatome	Alsthom	1989
	Ulchin 3	PWR	1000	Hanjung/KAERI/CE	Hanjung/GE	1998
	Ulchin 4	PWR	1000	Hanjung/KAERI/CE	Hanjung/GE	1999
	Ulchin 5	PWR	1000	Doojung/KOPEC/CE	Doojung/GE	2004
	Ulchin 6	PWR	1000	Doojung/KOPEC/CE	Doojung/GE	2005
Under construction	Shin-Kori 1	PWR	1000	Doojung /KOPEC/CE	Doojung/GE	2010
	Shin-Kori 2	PWR	1000	Doojung /KOPEC/CE	Doojung/GE	2011
	Shin-Wolsung1	PWR	1000	Doojung /KOPEC/CE	Doojung /GE	2011
	Shin-Wolsung2	PWR	1000	Doojung /KOPEC/CE	Doojung /GE	2012
In Plan	Shin-Kori 3	APR1400	1400			2012
	Shin-Kori 4	APR1400	1400			2013
	NGU 1	APR1400	1400			2014
	NGU 2	APR1400	1400			2015

WH: Westinghouse Electric; **GEC**: General Electric; **AECL**: Atomic Energy of Canada Limited; **HP**: Howden Parsons; **Hanjung**: Korea Heavy Industries and Construction Co., Ltd. (Now Doojung).

➲ Fuel Supply

Korea's demand for uranium and nuclear fuel cycle service has continuously increased with the expansion of its nuclear power capacity. The demand is expected to account for more than 5% of the world's demand.

Korea depends on imports from overseas for all uranium concentrate, conversion and enrichment required for its nuclear power plants except fuel fabrication. As of May 2006, Korea imports annually approximately 4 000 tons of uranium concentrate from Australia, Canada, Kazakhstan, France, Russia, South Africa, the United Kingdom and the United States.

The commercial programme of fully localised fuel fabrication is now divided into two projects, one for PWRs and the other for PHWRs. Since 1989, KNFC (Korea Nuclear Fuel Corporation), with an annual capacity of 400 MTU, has been supplying domestically produced PWR fuel assemblies to all PWR nuclear

power plants in operation. KNFC has also been supplying PHWR fuel since 1998, of which fabrication capacity is about 400 MTU per year.

Korea Hydro and Nuclear Power Company (KHNP), the sole consumer of nuclear fuel in Korea, has a basic guideline to ensure the stable supply of nuclear fuel as well as to pursue the economic efficiency by applying both long-term contracts and spot-market purchase.

➲ Radioactive Waste Management

Status of LILW storage and spent fuel storage in sites is shown in Table 4 and 5.

Table 4. Status of LILW Storage in Korea (As of the end of 2005)

Site	capacity	Storage	Estimated Year for Saturation
KORI	50 200	34 099	2014
WOLSONG	9 000	5 328	2009
YOUNGGWANG	23 300	14 325	2012
ULCHIN	17 400	13 136	2008
TOTAL	99 900	66 888	

Unit : Drum (200 L).

Table 5. Status of Spent Fuel Storage in Korea (As of March of 2006)

Site	capacity	Storage	Estimated Year for Saturation
KORI	1 737	1 521	2008
WOLSONG	4 960	4 385	2006
YOUNGGWANG	1 696	1 329	2008
ULCHIN	1 642	949	2008
TOTAL	10 035	8 184	

Unit : Ton of Uranium.

* Storage capacity can be extended to 2016 by high density rack module, dry storage, etc.

In November 2005, Korea finally came to designate Kyungju as a favourable site for a permanent disposal facility of low and medium level radioactive waste through a vote of the local residents. The disposal facility is scheduled to be constructed by the end of 2009.

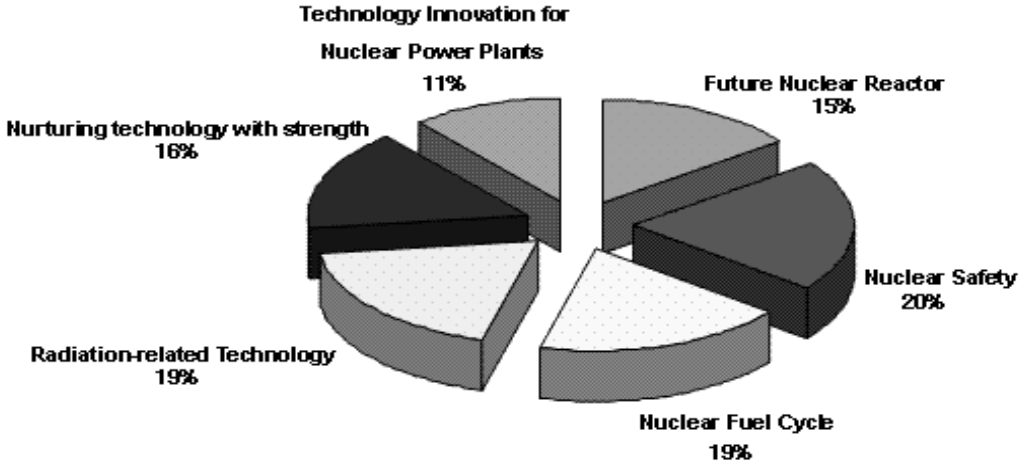
➲ Nuclear R&D Program

The Nuclear R&D Program is formulated to improve national competitiveness of nuclear energy as well as public welfare by developing fundamental nuclear technologies and nuclear fuel cycle and expanding the application of radiation and radioactive isotope to the medical, agricultural, environmental, and industrial purpose.

The national nuclear R&D program was initiated following the resolution of the 10 year-long "National Mid- and Long-term Atomic Energy R&D Program" approved by the Atomic Energy Commission in June 1992. The Program has been operated by the Nuclear R&D Fund and contribution of the government's general account since 1997.

In 2007, a total of KRW 190.9 billion will support four programs: Nuclear R&D Program; Radioactive Technology Development Program; Nuclear R&D Infrastructure Building Program; and Research Planning/Policy/Assessment Program. The largest portion of the fund (KRW 145 billion) was allocated to the Nuclear R&D Development Program which involves six areas as shown in Figure 1.

Figure 1. Nuclear R&D Fund Distribution by Sector (2007)



The Netherlands

Nuclear Electricity Generation

The only nuclear power plant in the Netherlands is sited in Borssele (PWR, 480 MWe net). Commercial operation started in 1973. The plant was refurbished in the year 1997. The previous Government (coalition of liberals and christen-democrats) has decided that the Borssele power plant may operate until 2033. The owner of the NPP got the licences to increase the enrichment of the fuel by which a higher burn-up can be reached. The new fuel is applied since 2005. Besides an upgrade of the turbine facilitated an increase in power level of 7% or 35 MWe which brought the net output level to 480 MWe net.

➲ Uranium Enrichment

Uranium enrichment is the most important fuel cycle activity in Netherlands.

Urenco Nederland BV increased its capacity to 3 500 tSW/y last year. A licence application for extension up to 4 500 tSW/y is in preparation. The share of the Urenco-group in the Western world is nearly 20%. Urenco has concluded contracts with 17 countries, including many European Union countries, Switzerland, Brazil, South Africa, the United States, as well as in the Far East (Korea, Taiwan 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 2005. Construction of a new plant – SP5, fifth plant – was started in 1999. In its first, second and third hall the ultra centrifuges ran smoothly in 2005. The fourth hall is already in operation and will be completed in 2007. The construction of a new Urenco enrichment plant in New Mexico/USA started. Urenco concluded an agreement with Areva to found the new joint-venture ETC (Enrichment Technology Company) which goal is the construction of George Besse II at the Tricastin site.

Further Urenco is the world's largest supplier of depleted Zinc-64, which is used for dose rate reduction of nuclear power stations and also against stress corrosion. Urenco Nederland is supplying other stable isotopes to the market as well like Cadmium, Molybdenum, Iridium, Selenium, Tungsten and may more.

➲ RD&D and Nuclear Technology

NRG (Nuclear Research and consultancy Group) is performing most nuclear R&D in the Netherlands. NRG is committed to national and international research projects (inside as well as outside European Union) and performs a number of activities. Its services have been divided into five product groups, viz. Materials, Monitoring and Inspection; Fuels, Actinides and Isotopes; Radiation and Environment; Irradiation Services; Plant Performance and Technology. NRG makes use of the complete nuclear infrastructure at the Petten site which is necessary for performing nuclear Research and Development, e.g. 1) HFR for material irradiation, testing and medical radio-isotope production, 2) hot laboratories for manipulation of radio-active specimen and radio-isotope separation as well as 3) computer models for risk analysis and computational fluid dynamics.

Slovenia

Slide 1

Slovenia
Country report 2007

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Slide 2

GEN energija, d.o.o.

- According to the bilateral Contract between two independent states Republic of Croatia and Republic of Slovenia the Nuclear Power Plant Krško (NEK) is equally owned by both states (50:50).
- "GEN energija" is legal entity representing the Slovenian rights over NEK and is the promoter of nuclear option in Slovenia.
- The company was established as "ELES GEN" in the year 2001 after the bilateral Contact was signed.
- "ELES GEN" was renamed to "GEN energija" in July 2006 by the Government of RS

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Slide 3

ENERGIJA

GEN energija, d.o.o.

- GEN bares financial responsible and has all rights over the Slovenian part of the NEK
  - GEN pays for ½ of all the costs
  - GEN distributes ½ of the energy generated
- GEN supports (together with Croatian HEP) reliable and safe operation of NEK.
- NEK is licensee and is the sole responsible for safety of the power plant!
- GEN owns also some smaller producers in Slovenia
  - Gas fired power plant Brestanica (TEB)
  - Hydro power plants on upper Sava river (SEL)

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Slide 4

ENERGIJA

Electricity generation and consumption in Slovenia

- There was a special situation in the years between 1998 to 2003. In those years all the electricity from NEK was available for Slovenia alone.
- This gave false impression that we have surplus electricity in the country.
- In fact we are strong importers of electricity.
- Slovenia imported 21 % of all the electricity in 2003.
- In 2004 we imported 15 % (very wet year).
- In 2005 we imported more than 20 % of all the electricity consumed in Slovenia.
- In 2006 we imported 21,9 % of all the electricity consumed in Slovenia

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ENERGIJA

Electricity generation and consumption in Slovenia (cont.)

	Total generation [TWh]	Nuclear generation (total NEK) [TWh]	Total consumption [TWh]
2005	10,4	2,8 (5,6)	13,1
2006	10,5	2,7 (5,3)	13,4
2007 (prediction)	10,4	2,8 (5,6)	13,8

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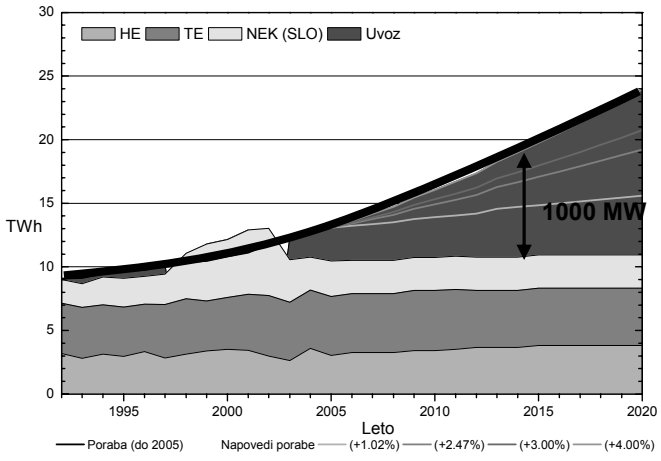
ENERGIJA

Electricity generation and consumption in Slovenia (four different consumption growth scenarios)



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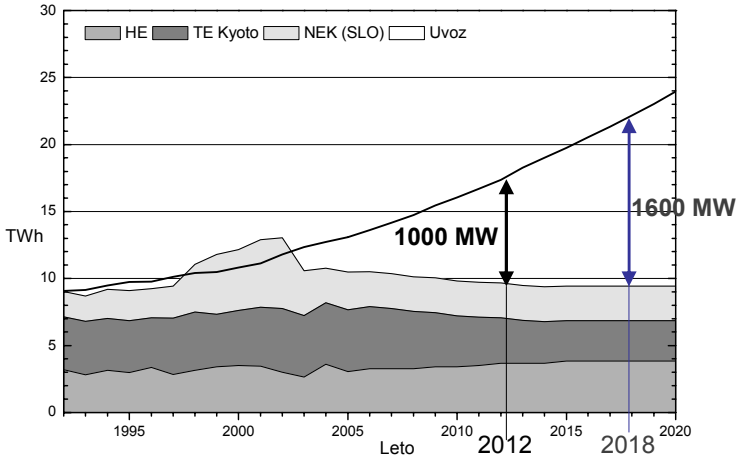
ENERGIJA

Electricity generation and consumption in Slovenia
(coal fired power plants reducing production to meet Kyoto)



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ENERGIJA

Krško 2 Project - Introduction

- Nuclear option was neglected in Slovenia in last 15 years due to political reasons. Nuclear option was marginalized and neglected in national reports and plans.
- However Krško NPP has operated safely and successfully in all those years. This positive experience improved overall acceptance of nuclear energy in Slovenia.
- Government of Slovenia has adopted a package of 35 new projects important for development of Slovenia in October 2006. Krško 2 NPP is one of those projects accepted by our government.
  - PWR technology, 1000 MWe, prod.7,5 to 8,5 TWh/a, earliest construction start 2013, earliest start of commercial operation 2017, production cost 35 to 40 €/MWh.

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ENERGIJA

Installed Nuclear Generating Capacity

	Low [MWe net]	High [MWe net]
2006	676	676
2007	696	696
2010	696	696
2015	696	696
2020	696	2200
2025	696	2200
2030	696	2200

Spain*

Electrical Generation

In Spain there are 8 nuclear units in operation, in 6 sites, with an installed power of 7 742 MWe, which represents 9.4% of the whole installed power.

The total nuclear origin gross energy during 2006 has been 60 072 GWh, which represents 19.9% of the total electrical output of Spain. The average Load Factor of the Spanish nuclear park has been 88.18%.

In 2006 nuclear generation increased in 4.4% with respect to the previous year, in spite of the definitive shut-down of the José Cabrera NPP (160 MWe) on 30 April 2006. This is due to the long outages of Vandellós 2 NPP (1 087 MWe) and Cofrentes NPP (1 092 MWe), which took place in 2005.

Pursuant a resolution of the Spanish Parliament, the Ministry of Industry, Tourism and Commerce set up a "Table of dialog on the evolution of nuclear energy in Spain", to debate about nuclear energy matters among nearly 50 representatives of political, social, environmental, technical and scientific sectors. Its activities took place between November 2005 and May 2006. The aim of this table was – once being analysed several issues related to the use of nuclear power in Spain, such as, Spent fuel and high level wastes management strategy, Information to society and public participation in decision-making processes, Nuclear energy legislation, and Energy demand and nuclear energy, to elaborate a set of conclusions and general recommendations that has been delivered to the Government.

Front-end of the Fuel Cycle

In 2006, the Fabrication plant of nuclear fuel, that ENUSA Industrias Avanzadas, S.A. has at Juzbado (Salamanca), manufactured 920 fuel assemblies containing 258.4 tU; 440 of them PWR type and 480 BWR. 528 fuel elements, containing 134.3 tU have been exported to Belgium, Finland, France, Germany and Sweden.

Back-end of the Fuel Cycle

➲ Legal and Policy Framework

The Sixth General Radioactive Waste Management Plan was approved by the Cabinet of Ministers on 23 June 2006. The Sixth Plan replaces that previously passed in July 1999 (5th GRWP) and constitutes a formal revision of it, following what is provided in the Royal Decree 1349/2003, of 31 October, on the ordering of the activities performed by ENRESA and their financing. The Plan addresses changes that have occurred during that period of time, the necessary actions and technical solutions and the economic-financial forecasts being updated in certain cases, and modified in others and widens the timeframe to the year 2070. (English version available at: www.enresa.es).

The main courses of actions set by the 6th GRWMP could be summarised as follows:

1. LILW and VLLW
   - Minimisation of waste production and optimisation of existing technological means and occupation in El Cabril.

* The Spanish Nuclear Sector in 2006.

- Finalisation and start of operation of a VLLW facility in El Cabril complementary to the existing one for LILW.

2. SF and HLW
   - Implementation of a Centralised Storage Facility (CSF) for SF and HLW by the year 2010.
   - Consolidation and updating of knowledge acquired in final disposal options taking advantage of international developments in the field in this respect.
   - Study the feasibility of new technologies, in particular the possibilities for separation and transmutation.

3. Decommissioning
   - Decommissioning of José Cabrera NPP should start in April 2009.

Concerning public participation the mandate of the GRWMP to ENRESA is to prepare a report in the next years, which includes the experiences of decision-making processes in relation to SF and HLW management in countries having similar problems to Spain. This report must include the legislative initiatives, site assignment procedures and methods for participation by the different stakeholders in the project as well as the current situation of the respective programmes. This information would serve as the basis for the analysis and formulation of possible parliamentary initiatives that might facilitate the decision-making process and the definition of a more adequate framework for participation.

On the same date of approval of the GRWMP, the Government passed the Royal Decree 775/2006, creating the Inter-ministerial Commission for the establishment of the criteria that must be met by the site of the centralised spent nuclear fuel and high-level waste temporary storage facility, and of its associated technology centre. An Inter-ministerial Commission is hereby created that will be responsible for establishing the criteria that must be met by the site, and for drafting a proposal of possible sites candidates, for submission to the Government. The Committee is chaired by the representative of the Ministry of Industry, Tourism and Commerce, the Secretary General of Energy. The stated missions of the Committee are the following:

a. To establish the technical, environmental and socio-economic specifications to be met by the sites selected as potential candidates for housing the CSF facility.
b. To establish and encourage the public information and participation processes.
c. To develop the procedure that the interested municipalities must follow in order to be candidate sites.
d. To draft, for submission to the Government, a proposed list of candidate sites, selected from among the interested municipalities, based on the technical evaluations conducted with respect to their suitability and taking into account any proposals that may be put forward by the autonomous communities involved.

The Inter-ministerial Commission has a Technical Advisory Committee formed by people of recognised academic and professional prestige in matters involving radioactive waste management, in order to prepare pertinent opinion, evaluation and technical studies that the Commission requests from them.

➲ SF and HLW Activities of the Inter-ministerial Commission

The first meeting of the Inter-ministerial Commission was held on July of 2006 and whose Minutes could be found at www.emplazamientoatc.es. At request of the Commission, the Advisory Committee has produced several Technical Documents dealing with the most demanded aspects (ranging from international references of centralised storage of SF to risks of this solution for human beings and the environment).

Thus the main activities of the Inter-ministerial Commission or organised under his aegis are the following:

Until the end of February an information period on the implications of the CSF was opened. The start of the information period was publicly announced in the main Spanish Daily Newspapers.

It is expected that the Commission will issue a Public Call for Applications to host the CSF, as the prerequisite is the volunteerism of the local communities. The Public Announcement will include the Terms of Reference for those municipalities willing to apply.

Regarding the interim storage facility in Trillo NPP, 12 containers with 252 fuel bundles are stored. At José Cabrera NPP, under predecommissioning works, an interim storage facility is under construction. This will be able to accept over 100tU fuel remaining at the plant.

➲ LILW

In relation to low- and intermediate-level waste (L/ILW), El Cabril Centre is the fundamental basis for the management of such wastes 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, which is in operation since 1992, has operated without any kind of incidents since the 52nd meeting, properly managing the L/ILW generated at radioactive and nuclear installations. As of 30 April 2007 some 22 600 m^3 of conditioned waste have been disposed of, and 1 500 m^3 of conditioned and not conditioned waste were placed in the existing storage facilities at the installation.

Following the Resolutions of a Congress Commission, which stated the necessity of a very low-level waste disposal facility, in December 2004, and the Regulatory Authority (Nuclear Safety Council) report on this project, the construction of this facility started soon after the permit was given in February 2006. This facility which consists on four cells with a capacity of 130 000 m^3, will allow managing, together with the existing one, all expected LIL/VLLW generated under the new GRWP. The first cell to be commissioned is at 75% construction and should be in operation by the end of the year.

Decommissioning and Dismantling of Nuclear Installations

With regard to José Cabrera NPP, ENRESA is working on the strategies for its dismantling and for the spent fuel management. Level 3 dismantling is expected to last 6 years starting in 2009, once its spent fuel pool is emptied. Engineering project and licensing actions have been going on during 2006 and beginning 2007. Besides, in the course of actions that the utility is doing at the plant in the predecommissioning activities, decontamination of the primary circuit was undertaken.

Several facilities whose decommissioning has started under authorisation given in early 2006, belong to the CIEMAT research centre. This nuclear research centre was built from 1952 and onwards. The main buildings to be decommissioned are a research reactor, metallurgy buildings, hot cells, an old pilot reprocessing plant and some installations for waste treatment. As of 30 April 2007, works have reached 37% of the project.