ÖSTERREICHISCHES
ÖKOLOGIE INSTITUT

PLEX

Information around Plant Lifetime Extension
In the Nuclear Industry

Table of Content:

Set 01:
General Information

Set 02:
Climate Change

Set 03:
Case Studies

Set 04:
Participation in EU-policy

Set 05:
PAKS Lifetime Extension

Austrian Institute of Ecology

Seidengasse 13
1070 Vienna - Austria
Phone +43-1-523 61 05-0
Fax + 43-1-523 58 43
Email oekologieinstitut@ecology.at
www.ecology.at

PLEX
Information around Lifetime Extension in NPP

An aging generation of nuclear power plants is going to be in operation in the coming 30 years in Europe. During the last 10 years some NPPs got unlimited or renewed operational licenses.

Regarding this development, this information package supports NGOs and administrative personal with technical expertise, case studies and also legal information concerning participation according to the ESPOO Convention and other possibilities for legal objection due to the law of nations.

Vienna, 2006-2007

This project was supported by
Wiener Umweltanwaltschaft

Land Niederösterreich

Land Oberösterreich

SET 1
General Information

Content

Introduction 2
What is PLEX? 2
Why PLEX? 5
Actual Projects 5
Risks and Problems related to PLEX 6
Glossary 10
Literature 11

Authors:
Ing. Antonia Wenisch, DI Barbara Rappl, DI Markus Meissner
Austrian Institute for Applied Ecology
Seidengasse 13, 1070 Vienna, Austria
www.ecology.at

2006

Introduction

An aging generation of nuclear power plants is going to be in operation in the coming 30 years in Europe. During the last 10 years some NPPs got unlimited or renewed operational licenses. It started with the oldest British reactors in Calder Hall (life time extension to 50 years) followed by Mühleberg and Beznau in Switzerland, which got an operational license until 2012 (40 years) and an unlimited operational license, respectively.

In comparison to the German "Atomkonsens", which is based on an operational time of 32 years of the German NPPs, operation through 40 and more years seems very long.

The NPP Dukovany in the Czech Republic has passed an extensive modernization program. In 2005 CEZ has announced that the NPP Dukovany will continue to operate until 2035 which will result in a life time of more than 50 years!

For Paks NPP in Hungary a licensing process (including an EIA procedure) is going on. Paks applies for a license to generate electricity another 30 years.

Other countries – e.g. Russia – allow their NPPs to succeed with operation without specific legal procedures.

The Nuclear Regulatory Commission in the USA has created a simplified generic licensing procedure for life extension of the aging US nuclear plants.

Regarding this development, this information package supports NGOs and administrative personal with technical expertise, case studies and also legal information concerning participation according to the ESPOO Convention and other possibilities for legal objection due to the law of nations.

Since this is the first part of the information package, it provides general information on the subject and the major points of criticism.

What is PLEX?

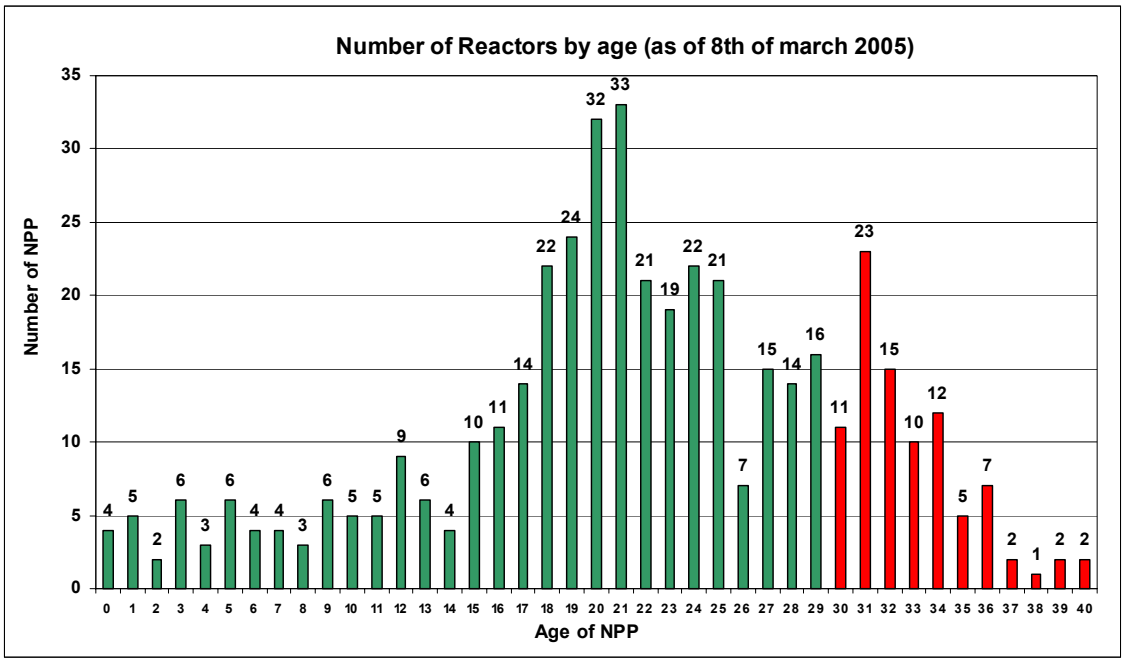
Plant Lifetime Extension (PLEX), Plant Life Management (PLIM) and Long-Term Operation (LTO) are different names for the same activity - extending the operation of old nuclear power plants beyond the time, it was assumed that NPPs could be used without major problems.

For existing nuclear power plants generally a commercial lifetime of 30 to 40 years was assumed, because of the weakening impact by neutron irradiation, high temperature and pressure to the components which have to contain the reactor core and the core cooling system. Of all these influences only neutron irradiation is specific to nuclear power plants, all other effects of material aging are well known at the chemical industry, gas, coal and other power plants as well as in the transport sector: broken wheels and axis endanger travellers in trains and cars; Pressure vessels are also a hazard in chemical plants.

Neutron irradiation is the specific contribution to hazard of using nuclear fission. Neutron irradiation leads to embrittlement of the pressure vessel steel and its welds. Because of increasing danger with operational time and energy produced, this effect has to be monitored carefully.

Many reactors have reached the age of 30 years and more will follow in the next years. The reality of operating NPPs proofed that after 30 years and in some cases even before this time serious problems with material degradation occurred:

- at the 900 MW series PWR in France all plants developed leakages at vessel head penetrations
- the first CANDU series reactors developed degradation of the pressure tubes,
- steam generators in many PWRs leaked because of corrosion, and most of them had to be changed
- RPVs in first generation VVER 440 reactors had to be thermally annealed because of excessive embrittlement



picture 2-1: operating time of NPP worldwide (IAEA PRIS 2005)

Ageing Effects:

Ageing already occurs during the lifetime of a NPP as originally planned, over the years ageing mechanisms become increasingly important. Particularly with plant lifetime extension, ageing effects become a more and more important contribution to the overall plant risk.

The most important influences leading to ageing processes in a nuclear power plant are:

- Irradiation
- thermal and mechanical loads
- corrosive, abrasive and erosive processes;

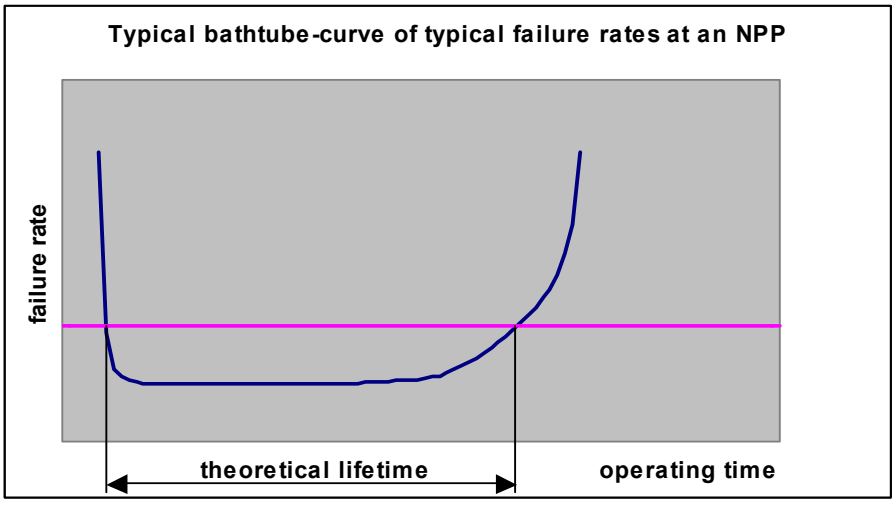
In many cases, **non-destructive examinations** permit to monitor crack development, changes of surfaces and wall thinning. But changes of mechanical properties frequently cannot be recognised by non-destructive examinations. Therefore it is difficult to get a reliable, conservative assessment of the actual state of materials. However, because of limited accessibility due to the layout of components and/or high radiation levels not all components can be examined one hundred percent. Therefore, it is necessary to rely on model calculations in order to determine the loads and their effects on materials (GREENPEACE, 2005).

The consequences of ageing are on the one hand the increasing number of incidents (e. g. small leakage, cracks, short-circuits due to cable failure etc.) and on the other hand, the effects leading to gradual weakening of materials which could lead to catastrophic failures of components with subsequent severe radioactive releases.

Most notable among those is the embrittlement of the reactor pressure vessel, increasing the hazard of vessel bursting. Failure of the pressure vessel constitutes an accident beyond the design basis. Safety systems are not designed to cope with this emergency. Hence there is no chance that it can be controlled. Furthermore, pressure vessel failure can lead to immediate containment failure as well, for example through the pressure peak after vessel bursting, or by fragments of the ruptured vessel break through walls. Catastrophic radioactive releases might be the consequence. (GREENPEACE, 2005).

picture 2-2: Brunsbuettel ruptured tube (HIRSCH 2005)

In probabilistic risk assessment studies (PRAs), which are increasingly used as a tool by nuclear regulators, ageing is usually not taken into account. PRAs assume that equipment failure rates are taken from the low centre portion of the "bathtube curve". This leads to underestimation of the risk (LOCHBAUM, 2000). The "bathtube curve" shows that a high rate of incidents occur at the start-up of the NPP and after the planned lifetime.



picture 2-3: Typical bathtube-curve of typical failure rates at an NPP (HIRSCH 2005)

Since some ageing mechanisms are still not completely understood, a complete and satisfactory treatment of ageing effects in the framework of a PRA is not possible today and would require extensive further research.

Why PLEX?

Why are operators and energy enterprises interested in PLEX?

„ One of the major trends in the global energy and electricity sector is the privatisation of electric utilities and deregulation of electricity markets. The increasingly competitive environment has significant impact on nuclear power. .... Competition from fossil fuels has increased. New and more efficient coal and gas technologies with comparatively low initial capital costs and substantially faster construction time schedules are being introduced. Joint studies by the International Energy Agency (IEA) and the Nuclear Energy Agency (NEA) have shown that new nuclear plants in OECD countries can only be competitive with other base load electricity generation alternatives under certain conditions. ....It is difficult for new nuclear generation to compete with gas, combined cycle, or even with coal, in regions where coal is abundant and economical." (IAEA-TECDOC-1309)

As it is stated in the IAEA document for a profit oriented enterprise there is not much incentive to build a new NPP. It takes high capital investment, a long licensing process and a long construction period to realize it (e.g. 7 years planned for the EPR in Finland or up to 20 years in Japan). In addition to it there are several options to provide cheaper capacities for electricity generation in less time (gas, gas-combined-cycle, wind power, biomass...).

However, to generate electricity in an old NPP as long as possible, is profitable, because the investment has been recouped long ago. Therefore utilities prefer life extension to construction of a new NPP.

Frequently PLEX programs are carried out together with measures to increase the efficiency of electricity generation, known as 'power uprating'. Various measures contribute to this target: some concern only the turbine, others require changes in the reactor core and the operating cycle, leading to a higher burn up of the fuel.

Both processes, plant life extension and power uprating contribute to a decrease of safety margins of NPPs. As a worldwide tendency this will result in higher risk for all of us.

Actual Projects

The regulation of plant lifetimes varies from country to country. Some have operating licenses with a fixed plant lifetime (e. g. US: 40 years, Hungary: 30 years) and others have open licenses with regular safety reviews (e. g. Czech Republic, France, Spain). However, a commercial lifetime of 30 to 40 years is generally assumed.

Life extensions are planned in many countries operating NPP for many of the existing NPP:

- In the United States, licensing for life extension from 40 to 60 years is now well under way. The first extensions were granted in spring 2000 (for Calvert Cliff and Oconee) and license renewal appears to be speeding up in the USA.
- In France, there are definite plans to extend the lifetime of the whole PWR fleet from 30 to 40 years. Lifetime extension will begin at the earliest, 900 MWe-series PWRs for which the 30th year-outage could become the springboard to life extension.

Life extensions are also planned in South Korea, Sweden (total operation of 60 years) and India.

For NPPs with Soviet-designed reactor types, PLEX is already planned:

- The operating lifetime of Paks NPP in Hungary (four units of second-generation VVER440-V213 reactors) shall to be increased from 30 to 50 years.
- The Ukrainian government recently has approved a comprehensive programme for life extension of the 13 nuclear units operating at four power plants.
- Life extension plans do not even stop for the most hazardous and obsolete Soviet reactor types, first-generation VVERs and RBMKs. For example, in Russia, operating lifetime of the two Kola VVER-440/V230s is to be extended by 15 years. Leningrad-1 RBMK reached its design lifetime at January 2004. After a "modernization program" which was completed in October, lifetime was extended by 15 years, despite protests from scientists working at the All-Russian R&D-Institute for Atomic Power Engineering. Life extension is also planned for the three other RBMK units of the Leningrad NPP.

Source: Rosenergoatom 2005, GREENPEACE 2005, nucleonics week, NEA 2000, NEA 2002

Risks and Problems related to PLEX

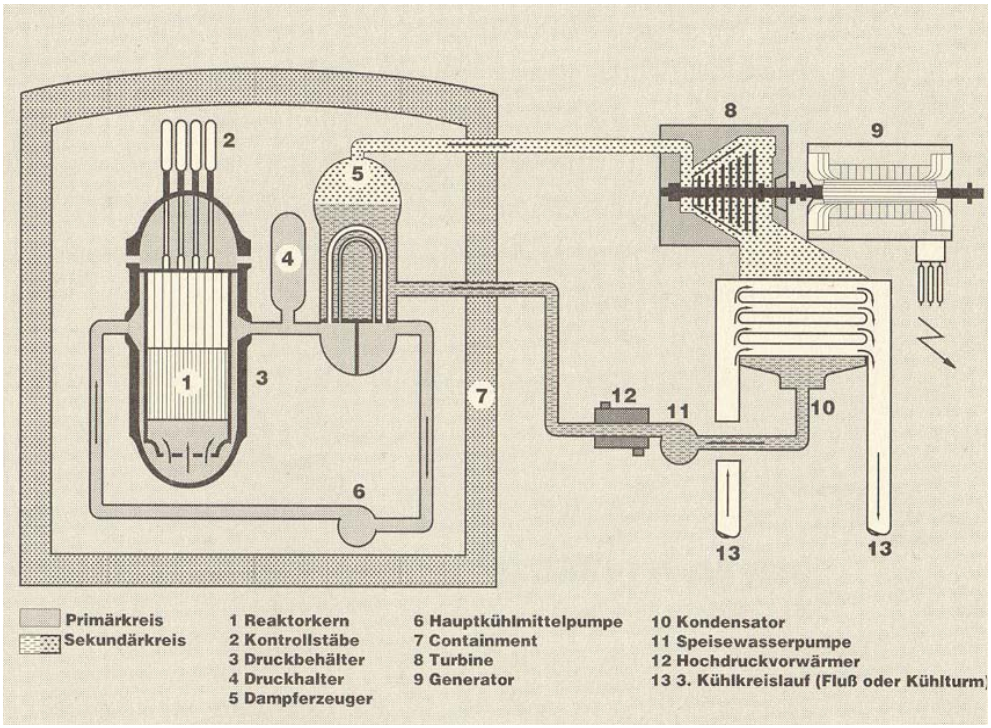
In any industrial plant, material properties are deteriorating during operation due to the loads the components are subjected to. The International Atomic Energy Agency (IAEA) defines ageing as a continuous time-dependent loss of quality of materials, caused by the operating conditions (IAEA, 1990).

Of particular importance, and potential safety significance, is the ageing of the reactor pressure vessel, the steam generators, as well as of the containment system.

Pressure vessels are used not only in NPPs; they can contain a multitude of things, including air, water, chemicals, nitrogen, and fuel. They are used in paper and pulp, energy, food and beverage, and chemical industries.

Pressure vessels also frequently control temperature as well as pressure. This is especially important when they hold more volatile substances. Signals on the outside can be read that will show what the internal pressure and temperature is. If the substance inside is potentially dangerous, alarms, pressure release valves, and other safety-measures have to be built-in to the pressure vessel.

Rupture of a pressure vessel presents a hazard for every kind of pressure vessel, not only would the vessel be damaged but injury could result due to shrapnel and dangerous chemicals. Because they are containing substances at greater than normal pressures, upkeep and maintenance of the vessels is very important.



picture 5-4: scheme of PWR: 1-core, 2-control rods, 3-reactor pressure vessel, 4-pressurizer, 5-steam generator, 6-main cooling pump, 7-containment, 8-turbine, 9-generator, 10-condensor, 11-main feed water pump, 12-preheater, 13-third cooling circuit (WENISCH, 1991)

Reactor Pressure Vessel (RPV) - the heart of the NPP

The reactor pressure vessel is a thick-walled cylindrical steel vessel enclosing the reactor core in a nuclear power plant. The vessel is made of special fine-grained low alloy ferritic steel, well suited for welding and with a high toughness while showing low porosity under neutron irradiation. The inside is lined with austenitic steel cladding to protect against corrosion.

For a typical 1,300 MWe pressurized water reactor, the pressure vessel is about 12 m high, the inner diameter is 5 m, and the wall of the cylindrical shell is about 250 mm thick. The overall weight amounts to approx. 530 t without internals. The vessel is designed for a pressure of 17,5 MPa (175 bar) and a temperature of 350°C.
[http://www.euronuclear.org/info/encyclopedia/r/reactor-pressure-vessel.htm]

The most important ageing effect on the RPV in a nuclear power plant is embrittlement. Embrittlement leads to the reduction of toughness of the materials and thus to a higher risk of vessel failure.

Materials close to the reactor core, i.e. walls and welds of the RPV, are exposed to neutron irradiation. Neutron irradiation induces a shift of the ductile-to-brittle-transition temperature to higher values - meaning that the material is still in a brittle state, and hence more prone to brittle failure under increasingly higher temperatures.

Impurities like copper and phosphorus are known to increase embrittlement, as well as nickel and manganese. Reactor pressure vessel embrittlement increases the hazard of vessel bursting - particularly in case of the injection of emergency core cooling water during an incident, which leads to cooling of the vessel wall (so-called thermo-shock). The rupture of the pressure vessel constitutes a beyond design base accident for all light water reactors. Furthermore, pressure vessel failure can lead to immediate containment failure as well, for example through the pressure peak after vessel bursting. A core melt accident with high and early radioactive releases would be the consequence. [UBA 2005]

In order to control this hazard, the following must be available, in accordance with internationally recognized standards:

- Reliable data on the original state of the pressure vessel, and the composition of the materials (base material and welds).
- A surveillance programme, with representative samples, providing reliable data on the progression of embrittlement to be expected.
- A database on the embrittlement properties of the materials used in the vessel that is sufficient for describing the dependence of material properties on temperature.
- A reliable, state-of-the-art system of in-service-inspection (in particular, ultrasound tests), regularly used for testing all the relevant parts of the vessel for small cracks.
- Fracture mechanics analyses for all potentially relevant sequences, taking into account appropriate crack sizes, shapes and locations, to determine the critical ductile-to-brittle-transition temperature. This critical temperature is a most decisive parameter – if it is reached by vessel materials, brittle failure cannot be excluded in case of a DBA.
- Definition of an appropriate safety margin between the critical temperature as determined by analyses, and the maximum ductile-to-brittle-transition temperature that the materials concerned are permitted to reach. [UBA 2005]

A measure to reduce the neutron flux on the vessel is to protect the walls by absorbing material in the outer fuel assemblies, but this reduces the capacity. (Loviisa, Finland)

In order to reduce the embrittlement effects some operators undertake the reactor vessels an annealing procedure. (Bohunice/ CR, Loviisa /FI)

Also other types of material degradation can occur in the reactor pressure vessel, the vessel head, core internals and shroud, nozzles and bolts: cracks develop in welds and in vessel head penetrations, corrosion and erosion lead to damages at various parts of the vessel and the core internals. [UBA 2005]

Steam Generator (SG)

The function of the steam generator is to transfer the heat from the reactor cooling system to a separate cooling system: the secondary cooling (or feed water) system.

The SG is a big vessel where water from the secondary circuit is heated by several thousand small tubes. Through these tubes water from the reactor core is pumped. The water in the core cooling system is under high pressure, and thus prevented from boiling. Only in the secondary cooling system steam is building up, which is needed to drive the turbine.

Most popular are vertical steam generators: generally they have a feed water ring supply header on the outer edge of the steam generator. The water is directed downward and flows along a wrapper sheet then is directed upwards to flow along the steam generator

heating tubes where the water temperature increases until boiling occurs so that the water converts into steam. In the upper part of the steam generator is a moisture separator region which forces the steam-water mixture through channels which allow only steam to pass. A vane arrangement in these steam generators also force a swirling action that enhances the steam-water separation.

The water supplied to the steam generators must be very pure, free of particles, and chemicals. In the boiling environment of the steam generator these chemicals can concentrate resulting in undesired corrosion.

Russian reactors are equipped with horizontal steam generators.

Corrosive and erosive damage in steam generators has occurred repeatedly world wide, as well as wall thinning. Steam generator ageing is particularly hazardous since it weakens the separating border between primary and secondary circuit. A leakage between the two circuits implies a loss of coolant which is bypassing the containment. Hence, the cooling water lost is not available for the emergency core cooling system.

Furthermore, there is a direct pathway for releases into the atmosphere, potentially leading to large source terms.

These problems have led to comprehensive ageing management activities. Increasingly, they include exchanges of the whole components.

Concerning the aging effects it is important to note that it is more complex to change a vertical SG than a horizontal one. (E.g. Paks NPP wants to prevent the exchange of the SG because it would be a too expensive measure).

The Containment

The containment is a large steel building, usually with a hemispherical dome. Containments are often not visible since they are usually surrounded by a steel or concrete building that provides additional boundaries and aesthetically pleasing designs.

The containment houses the reactor, reactor cooling system including the SG, the pressurizer and the coolant pumps.

The containment is one of the barriers in a nuclear power plant which makes it difficult for radioactive substances to escape into the environment. It surrounds the nuclear part of the plant and is designed so that in case of serious malfunctions it collects the exiting steam without failing itself. The containment of a typical pressurized water reactor is e.g. a steel ball with a diameter of approx. 50 m and a wall thickness of 30 mm. It includes rapidly closing valves in the piping leading out of the containment and personal and material locks. The case is enclosed by an up to 2 m thick reinforced concrete dome to protect against external impacts. The inner wall of the dome is lined with a gas-tight steel skin. Negative pressure exists in the annular gap between containment and steel skin. The radioactive substances exiting the containment during normal operation enter the negative pressure zone and reach the vent stack via filters. During an incident, the air from the negative pressure zone is pumped back into the containment. [http://www.euronuclear.org/info/encyclopedia/containment.htm]

Containments do have fans or chillers for cooling during normal conditions and in case of an accident.

Below the containment basement, sumps are located, that can be used during accident conditions. The sumps can be routed to cooling systems so that the fluid may be

circulated and cooled. A grating system is installed over the containment sump to prevent materials from being sucked into the cooling system.

The concrete parts of the containment are subjected to thermo mechanical loads, but also to effects of the weather, chemical attacks and partly also to high radiation doses. Corrosive damage of steel reinforcements are difficult to inspect. Hence reductions in strength may occur unnoticed. The damage mechanisms to concrete through corrosive processes similar to high radiation doses are still largely unknown. It is particularly difficult to quantify the uncertainties of the models that were developed. (NAUS, 1996).

Ageing management

Measures to monitor and control ageing processes are known as ageing management. Ageing management includes programmes with accelerated samples, in-service-inspections, monitoring of thermal and mechanical loads, safety reviews and also the precautionary maintenance or even exchange of components, if feasible. Furthermore, it includes optimizing of operational procedures in order to reduce loads.

Counter measures	Costs
Exchange of components: In case of obvious shortcomings, leakages developing and other problems that directly influence the power plant operation is the exchange of the appropriate component. Even large components like steam generators and reactor pressure vessel heads can be exchanged. But there is a wide consensus among plant operators that in principle, all components crucial for safety in PWRs or BWRs can be replaced except two: The reactor pressure vessel (RPV), and the containment structure.	high
Annealing: In some plants thermal annealing of the RPV was carried out, in order to reduce embrittlement effects in the walls and welds.	high
Reduction of loads: To avoid thermal shock emergency cooling water can be preheated. To reduce neutron irradiation and hence the progress of embrittlement, neutron fluency in the vessel wall can be reduced by putting dummy elements or highly burnt-up fuel elements in outer core positions. This measures are primarily applied to the reactor pressure vessel.	moderate
Intensify inspections and plant monitoring: The measures of the intensification of plant monitoring and/or more frequent examinations, coupled with appropriate maintenance both rely on the optimistic assumption that cracks and other damage and degradation will be detected before they lead to catastrophic failure.	low

table 5-1: Counter measures against ageing of components and systems

Glossary

CEZ	Czech electricity utility	PLIM	Plant Life Management
IAEA	International Atomic Energy Agency	PRA	Probabilistic Risk Assessment
IEA	International Energy Agency	PWR	Pressurized Water Reactor
LTO	Long Term Operation	RPV	Reactor Pressure Vessel
NEA	Nuclear Energy Agency / OECD	SG	Steam Generator
NPP	Nuclear Power Plant	VVER	Russian type of PWR
PLEX	Plant life Extension	BWR	Boiling Water Reactor

Literature

GREENPEACE 2005: Hirsch, H.; Becker, O.; Schneider, M.; Froggatt, A.; Greenpeace International (editor): Nuclear Reactor Hazards, Ongoing Dangers of Operating Nuclear Technology in the 21st Century.

HIRSCH 2005: Hirsch H., PLEX **-** presentation at the Joint Project Workshop Vienna, 2005

IAEA, 1990: International Atomic Energy Agency: Safety Aspects of Nuclear Power Plant Ageing; TECDOC-540, Vienna, 1990

IAEA 2002: International Atomic Energy Agency: Cost drivers for the assessment of nuclear power plant life extension,TECDOC-1309, Vienna, 2002

LMD, 2002: L.M.D. Consultancy: Nuclear Power Plant Life Management in Some European Countries; Oxford, March 2002

LOCHBAUM, 2000: Lochbaum, D.: Nuclear Plant Risk Studies – Failing the Grade; Union of Concerned Scientists, August 2000

NAUS, 1996: Naus, D.J. et al.: Aging management of containment structures in nuclear power plants; Nuclear Engineering and Design. 166, 367-379.

NEA 2000: Status Report on Nuclear Power Plant Life Management, NEA/SEN/NDC (2000)6

NEA 2002: International practices with respect to licence periods/terms for nuclear facilities in NEA member countries, NEA/CNRA/R(2002)1

UBA 2005: Becker O., Hirsch H., Lercher J., Seibert P., Wenisch A., UBA(editor): Report to the Austrian Government - EIA procedure for the lifetime extension of Paks NPP: Statement on the Preliminary Impact Assessment Study, Vienna, 2005

WENISCH 1991: Wenisch, A.: Atomkraftwerke - radioaktive Zeitbomben = Jaderné Elektrárny - Radioaktivní Casované Bomby - Wien : Hochschülerschaft - ÖH, o.J.. - 20 S, Wien, 1991

Coming up: Climate change and NPP
PLEX case studies

SET 2
Climate Change

Content

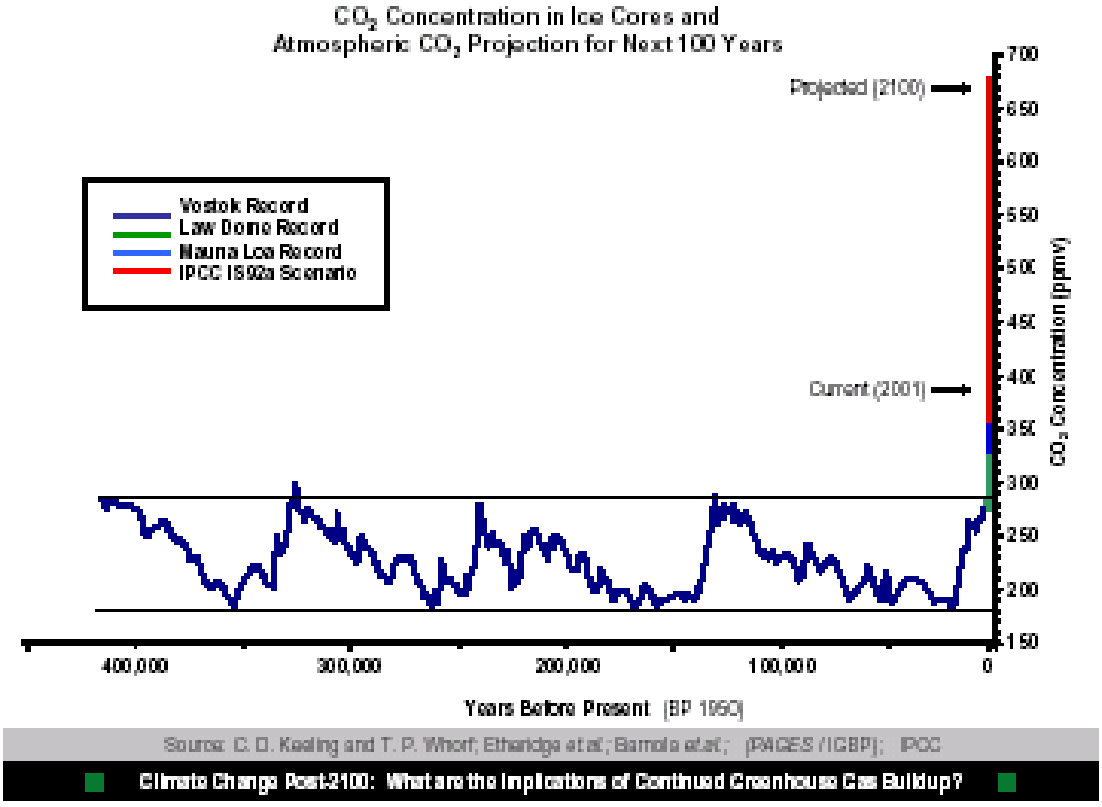
Will Nuclear Power meet the challenge of Climate change? 2
Climate change is a safety risk for aging nuclear plants 4
Glossary 7
Literature 7

Authors:
Ing. Antonia Wenisch, DI Markus Meissner
Austrian Institute for Applied Ecology
Seidengasse 13, 1070 Vienna, Austria
www.ecology.at

2006

Will Nuclear Power meet the challenge of Climate change?

"Atmospheric indicators show that the concentration of carbon dioxide (CO_2) of the lower atmosphere has increased from its pre-industrial concentration of 280 ppm (parts per million) to its 2003 concentration of 375 ppm. This is the highest level in the last 500 000 years. At the same time, the climate in most parts of the world, including Europe, is warming. The global average temperature has increased by about 0.7 °C and the European average temperature by 0.95 °C in the last hundred years. It is estimated that temperatures will further increase by 1.4–5.8 °C globally and 2.0–6.3 °C in Europe by the year 2100. Precipitation patterns show a more varied picture. Recently, central and northern Europe have received more rain than in the past. In contrast, southern and southeastern Europe have become drier. These changes are projected to continue in the future. In addition, extreme weather events, such as droughts, heat waves and floods, have increased while cold extremes (frost days) have decreased." (EEA REPORT 2/2004).



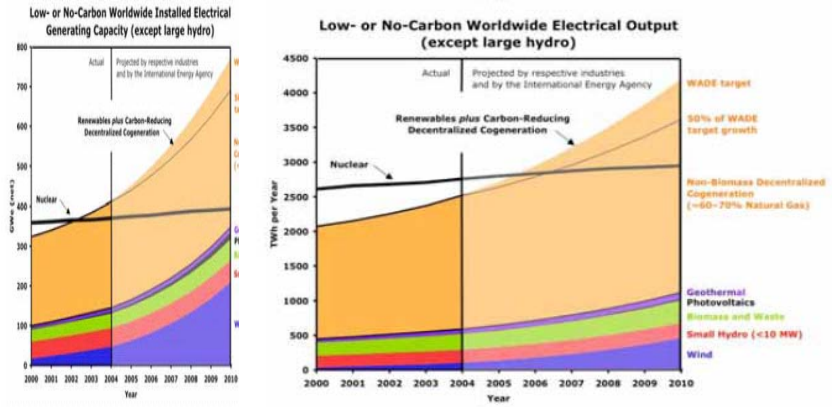
picture 1: CO_2-concentration in various ice cores over the last 400.000 years and the projected concentration for the year 2100 (MOORE 2004)

The limitation of increase of global mean temperature to 2°C above pre-industrial levels is widely seen as a thresholds for prevention of unacceptable consequences to nature and human societies. In order to be in 2050 on the safe side, greenhouse gas concentration must be limited to 400 ppm CO_2 equivalent, with the consequence greenhouse gas emissions have to be decreased by about 50% compared to 1990 level! For the industrialized countries the reduction target is 80 %. (MATTHES 2005)

The decay of CO_2 in the atmosphere is a slow process. The impact of today's CO_2 emission reduction will be visible only after decades. If we want to prevent the worst we have no time to loose. The reduction measures have to be effective and fast to implement. Can nuclear power be part of these measures?

Similar to all other energy suppliers the nuclear industry combats for its market share. Every blackout, oil crisis, or gas supply problem is used as an argument in its public relation campaign. In the last months politicians (Blair, Chirac) promoted the nuclear renaissance as a powerful contribution to minimize CO_2 emissions. European media opened the discussions on this issue (BBC News from Nov. 2005 on, DPA 05.01.06, Profil Feb. 2006)

"Nuclear power is often described as a big, fast and vital energy option—the only practical and proven source big and fast enough to do much to abate climate change. Yet industry and government data tell the opposite story. Nuclear power worldwide has less installed capacity and generates less electricity than its decentralized no- and low-carbon competitors—one-third renewables (excluding big hydroelectric dams), two-thirds fossil-fueled combined-heat-and power. In 2004, these rivals added nearly three times as much output and six times as much capacity as nuclear power added." (LOVINS 2006)



picture 2: Installed capacity and produced electricity (LOVINS 2006)

Worldwide, low- and no-carbon decentralized sources of electricity surpassed nuclear power in capacity in 2002 and in annual output in 2005. In 2004 their increment was three times higher then for the nuclear power. (Large hydro, over 10 MWe, isn't shown in these graphs) The post-2004 forecasts or projections shown are industry's and are imprecise but qualitatively clear.

Moreover LOVINS (2006) points out the enormous importance of improving energy efficiency:

"These comparisons don't count more efficient use of electricity, which isn't being tracked, but efficiency gains plus decentralized sources now add at least ten times as much capacity per year as nuclear power."

At the moment the majority of operating nuclear power plants are outdated, aged plants. New plants (most of these under construction in Asia) are so-called advanced reactors, like the evolutionary Light Water Reactor (LWR), which share a lot of flaws with the actual operating plants with the result that this plants will not be substantially safer. In Europe only one of these is under construction: the Fifth Finnish reactor a 1600 MW EPR (European Power Reactor) which is the European prototype for an advanced PWR – it should be in operation in 2009.

OECD forecast indicate only a slow growth of nuclear power by 2030 – with a net growth rate of only 600 MW annually (MATTHES 2005). In 2030 the nuclear industry hopes to get forward with their Generation IV reactors. Generation IV International Forum (GIF) is a joint research program for new nuclear energy systems with enhanced safety features, breeding of fissile materials, including re-use of fuel and reprocessing. Based on this new nuclear energy system the nuclear industry promises a carbon free power system (SCHULENBERG 2004).

The nuclear industry wants to handle the lack of power supply that is created through the moderate net growth rate and the readiness for use of GIF in 2030 by PLEX. But common energy policy is now on a crossroad where it has to decide whether nuclear fission could be part of a sustainable energy future or not. Since there is not much time to develop new technical solutions for the fuel chain and uranium is a non renewable material we are convinced, that it is much more efficient in terms of abatement of global warming to deploy existing and develop new safe & cheap solutions: improving efficiency and renewable energy resources.

Freedom from carbon emissions is no sufficient argument for nuclear power, because renewables and end-use efficiency provide the same attribute at much lower cost, and co-generation does so partially; a fossil-fueled co-generator that saves, for example, half as much carbon per kWh and costs half as much per kWh as a zero-carbon resource thereby saves carbon at the same cost per ton. Nuclear power can not significantly contribute to abating global warming because its too time consuming in construction and too expensive to provide the needed capacities.

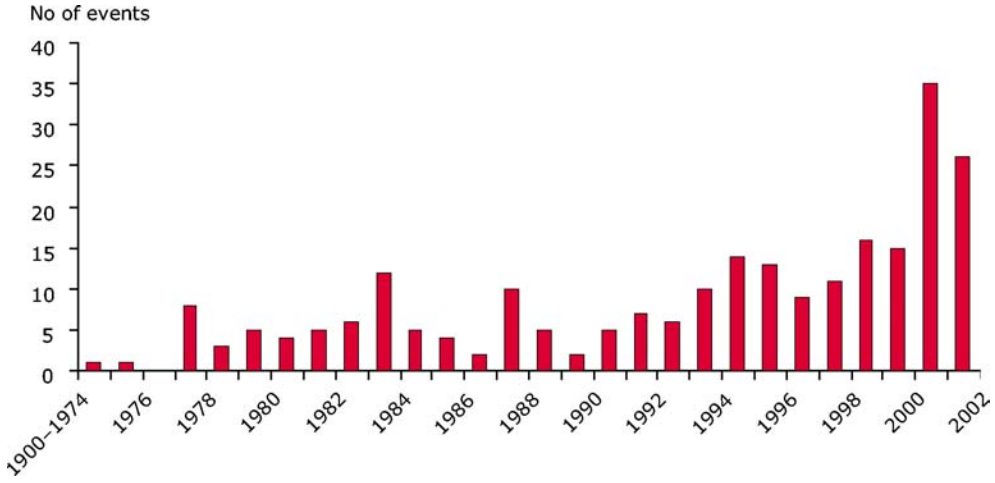
> Buying a costlier option, like nuclear power, instead of a cheaper one, displaces less carbon per dollar spent. This opportunity cost is an unavoidable consequence of not following the least-cost investment sequence: the order of economic priority is also the order of environmental priority. (LOVINS 2006)

Climate change is a safety risk for aging nuclear plants

Adverse weather and climate related events have increased significantly during the past 20 years. The average number of annual disastrous weather and climate related events in Europe doubled over the 1990s compared with the previous decade, while non-climatic events such as earthquakes remained stable. In Europe 64 % of all catastrophic events since 1980 are directly attributable to weather and climate extremes like floods, storms, droughts and heatwaves. Climate change projections show an increasing likelihood of extreme weather events. (EEA REPORT 2/2004)

Licensing of nuclear installations is based on external events. External events are directly or indirectly affected by climate change. Since intensities and frequencies of extreme meteorological events have already changed and will change further over the next decades a re-assessment of the license concerning external events in connection with PLEX is required. (KROMP 2005)

Between 1975 and 2001, 238 flood events were recorded in Europe. Over this period the annual number of flood events clearly increased. Climate change is likely to further increase the frequency of extreme flood events in Europe (WHO-ECEH 2003).



picture 3: Number of European flood events between 1976 and 2002 (WHO-ECEH 2003)

As reported at least during the flooding which destroyed New Orleans NPPs have to be shut down during flood events. Several NPPs in central Europe are located near rivers (e. g. Paks), higher water levels and more flooding events reduce the safety margins of these ageing plants.

Heatwaves are projected to become more frequent and more intense during the twenty-first century. (EEA REPORT 2/2004) Heatwaves and droughts in the last years have caused the shutdown of several nuclear plants in Southern Europe – meaning that NPPs are not able to produce electricity when cooling is required.

Heavy storms or heavy snowfall can not only damage high-voltage lines, but also ventilation stacks and cooling towers, which also cause the immediate shutdown of a NPP. (NNI 2005)

PLEX licensing processes have to consider climate change. If NPPs shall be operated during the next 30 years they must be reconstructed in order to be safe in a changing environment. The French nuclear authority has recognised this problem in its third report to the Convention on Nuclear Safety:

"*What is striking about 2003, is that in a single year nuclear installations were affected by two types of extreme weather conditions: the heat wave and drought in the summer followed by flooding in the autumn. In the first case, safety was not at issue, in that none of the safety-related operating limits in the installations was reached or exceeded, but* ***release temperature limits, which may affect the environment had to be temporarily modified to allow plant operation to continue and avoid power cuts****. In the second case, safety was not at issue either. It is clear that the work done following the late 1999 flooding on the Blayais NPP has borne fruit, since no nuclear installation was actually flooded. However, the exceptional flow rates of the rivers and the materials they were carrying led to clogging of water intakes at two plants, requiring EDF to shut down four units as a precautionary measure. The probable rise in the number of such weather events in the coming years means that even greater emphasis will have to be placed on prevention of their potential consequences. Generally speaking, national and international operating feedback is showing weather-related problems the scale, frequency and nature of which raise questions concerning the initial design of the installations. Thus, certain exceptional phenomena, whether or not related to climate change, are causing EDF and the ASN to be particularly vigilant on this subject. Hazards related to storms, snow, tornadoes, heat sink drying up, frazzle ice, high heat sink water temperature, high air temperature, lightning and forest fires will be reassessed within the framework of the third ten-yearly outages for the 900 MWe series." (CNS F NR 2004)*

Scientific progress must be followed by licensing requirements

In the last couple of years the field of evaluation of seismic hazards was under rapid development new insights and experiences were gained and new methods developed. As seismic events also can potentially lead to severe accidents with large radioactive releases the design of NPPs has to be re-assessed concerning seismicity. The scientific progress has to be taken into account and it is of particular importance that all investigations and analyses correspond to the most recent state-of-the-art.

A licence for PLEX should only be issued if all necessary reconstruction has been done. The actual state-of-the-art concerning seismicity is represented in the latest IAEA publications (of 2002 and 2003), whereas determination of site seismicity in old NPPs is on the level of knowledge of the early 1990s, as compiled in the IAEA Safety Guide of 1991 (e.g. PAKS). (UBA 2005).

Glossary

EEA	European Environmental Agency	NNI	No Nukes Infosource
EPR	European Power Reactor	NPP	Nuclear Power Plant
FZKA	Forschungszentrum Karlsruhe	PLEX	Plant life Extension
GIF	Generation IV International Forum	PWR	Pressurized Water Reactor
IAEA	International Atomic Energy Agency	UBA	Umweltbundesamt
IEA	International Energy Agency	UNFCCC	United Nations Framework Convention on Climate Change
LWR	Light Water Reactor		

Literature

CNS F NR 2004: Convention on Nuclear Safety, France National Report 2004

EEA REPORT 2/2004: European Environment Agency, Impacts of Europe's changing climate

EEA Report 8/2005: European Environment Agency, Greenhouse gas emission trends and projections in Europe 2005

KROMP 2005: Climate Change and Nuclear Energy, Kromp W., Institute of Risk Research - University of Vienna, 2005

MOORE 2004: Dr. Berrien Moore III; Climate Change Post-2100: What are the Implications of continued Greenhouse Gas Buildup?, 21 September 2004, Environmental and Energy Study Institute

http://www.energiesystemederzukunft.at/results.html/id3982

LOVINS 2006: Amory B. Lovins, Nuclear power: economics and climate-protection potential, Rocky Mountain Institute, 2006

MATTHES 2005: F. C. Matthes, Nuclear Energy and Climate Change, Nuclear Issues Paper No.6, Heinrich Böll Stiftung, 2005

NNI 2005 : no nukes infosource, webservice http://www.ecology.at/nni

SCHULENBERG 2004: Schulenberg T. et al. Was ist Generation IV; Forschungszentrum Karlsruhe,Wissenschaftliche Berichte FZKA 6967, 2004

UBA 2005: Becker O., Hirsch H., Lercher J., Seibert P., Wenisch A., UBA(editor): Report to the Austrian Government - EIA procedure for the lifetime extension of Paks NPP: Statement on the Preliminary Impact Assessment Study, Vienna, 2005

WHO-ECEH 2003: Extreme weather events and human health, Third intergovernmental Preparatory Meeting; Evora 2003.

Coming up: PLEX Case Studies

SET 3
PLEX Case Studies

Content

Overview - national PLEX programs 2
France 2
Japan 3
Borssele NPP - The Netherlands 3
Dukovany NPP - Czech Republic 4
Bulgaria 7
Cost comparison of different PLEX programs 8
Glossary 10
Literature 10

Authors:
Ing. Antonia Wenisch, DI Markus Meissner
for the Czech Case study also Edvard Sequens, Calla
Austrian Institute for Applied Ecology
Seidengasse 13, 1070 Vienna, Austria
www.ecology.at

2006

Overview - national PLEX programs

France

The 58 pressurised water reactors in France have a single operator Electricite de France (EDF). Another feature is the standardisation of the nuclear power plant fleet, with a large number of technically similar reactors, justifying a "generic" presentation. In 2003 the PWR reactors supplied approximately 80% of the electricity generated in France. They are located into 19 nuclear power generation sites (NPPs), which are on the whole similar. All are equipped with two to six PWR units 8 (PWR), giving a total of 58 reactors, built by the same company, Framatome. The 34 older of the the 58 units are 900 MWe reactors including:

- the CP0 series, comprising the two Fessenheim reactors and the four Le Bugey reactors (units 2 to 5),
- the CPY series, comprising the other 900 MWe reactors, which can be subdivided into
  - CP1 (18 reactors at Dampierre, Gravelines, le Blayais and le Tricastin) and
  - CP2 (10 reactors at Chinon, Cruas and Saint-Laurent-des-Eaux);

The CPY series differs from the Bugey and Fessenheim reactors (CP0 series) in the building design and in the addition of an intermediate cooling system between the circuit for containment spraying in the event of an accident and the circuit containing river water. It also provides for a more flexible reactor control. (CNS F NR 2004)

Until 2002 the French regulator was the Direction de la Surete des Installations Nucleaires (DSIN). February 2002 saw the creation of the Directorate General for Nuclear Safety and Radiation Protection which, with the support of the Divisions for Nuclear Safety and Radiation Protection within the Regional directorates for research, industry and the environment, constitute the new **Nuclear Safety Authority (ASN)**, in charge of Nuclear Safety and Radiation Protection. At the same time the former technical support organisations of the regulatory authorities both IPSN (nuclear safety) and OPRI (radiation protection) were merged into the Technical Support Organisation (TSO) responsible with technical assessment and research: the Institute for Radiation Protection and Nuclear Safety (IRSN). (CNS F NR 2004)

France does not give its NPPs a license for a specified period of time. The original design life of the units is 40 years. The Safety Authorities give an authorization to restart each unit after reloading at the end of each cycle (roughly every 12 to 16 months). (IAEA 2002)

In 2002, French nuclear safety authorities have signed off a decade of operation for Electricite de France's (EDF) 900-MW-class PWRs, marking the end of a systematic safety review and upgrade process that itself took more than a decade.

The French chief regulator decided that the safety level of EDF's oldest reactors at Fessenheim and Bugey (the six-unit CP0 series) is now equivalent to that of the other 28 standardized units in 900-MW PWR series and that the exercise had significantly raised the safety of the entire series. EDF can thus continue to operate the plants until their 30-year statutory outages. That means EDF's 900-MW units are licensed to operate, for the youngest among them, until 2015. Before the 30-year outages a new safety review cycle will be initiated for the plants. (NNI 2005).

The standardisation has advantages for the owners, but it also creates an obligation to anticipate any risk of occurrence of generic defects. This first of all concerns the problem of ageing for both the primary system and for the civil engineering side. **Preparation for the 900 MW third ten-yearly outage is under way but the time-frame of the files prepared by EDF is still limited to 40 years. At the same time EDF is talking about the possibility of extending the life of some power plants beyond that**. Tests and checks conducted during the ten-yearly outages are an opportunity for owners and authority to gain a clear picture of the current safety of the installations. This proactive approach must therefore continue and will lead to back-fitting work, for which the completion dates must be both justified in terms of safety and realistic in terms of implementation. The operator must also aim to improve safety through periodic safety reviews which compare the reactors with the most recent standards. ASN will be continuing to update the basic safety rules and develop probabilistic safety studies, within the framework of a realistic approach to risk reduction. (CNS F NR 2004).

Japan

In Japan the regulatory authority is the Ministry of International Trade and Industries (MITI). The operational licence for a NPP is granted for an indefinite period. There is no specific regulatory point of view, therefore no specific regulatory process is in place for plant life extension. A periodical inspection system is defined, and a nuclear power plant is shut down yearly to undergo annual inspections before approval to operate for another year. MITI endorses the safety of a plant as long as it meets the safety standards at the time. Nuclear power plants can continue to operate as long as the operator can prove annually that the plant can operate safely for one more year. In addition, periodical safety review shall be conducted at each plant at approximately 10-year intervals.

In 1996, MITI has launched a program to provide a conceptual framework by which the integrity of ageing nuclear power plants are examined and addressed, using three plants that have been in operation since 1970/71 (Mihama 1, Tsuruga 1 and Fukushima Daiichi-1) as pilot projects. This programme assumes that the plants will operate for 60 years. (IAEA 2002)

Borssele NPP - The Netherlands

Borssele is the only NPP in operation in the Netherlands. It has a net power of 480 MW(e) and is owned and operated by NV Elektriciteits Productiemaatschappij Zuid (EPZ).

Borrsele NPP has been put in commercial operation in 1973 and had a 40 years technical design life. Actual licensing regulations require a PSR every ten years to continue the license. The plant original investment being paid off in 1993, EPZ decided to invest and upgrade the plant to 1993/94 state of the art technologies in order to run it for another 20 years. A new safety concept was developed were a new design basis based on deterministic regulations combined with the findings of PSA was defined. The new predominant external events considered were: earthquake (0.1g); The main steam and feed water piping, which cannot be demonstrated to have leak-before-break were replaced. To meet the new design basis back fitting measures were implemented in seventeen areas including: decay heat removal; emergency core cooling system; emergency power system; reactor protection system and backup control room fire protection; and containment. Among the key modifications are: a new emergency power system; additional redundant decay heat removal, new primary safety/relief valves; etc. Following the back fitting the total core damage frequency improved from 5.6 E-5/year to 4.5 E–6/year. (IAEA 2002)

In January 2006, the centre-right coalition government of the Netherlands submitted a draft contract to the Parliament, to be signed between the State of The Netherlands, the EPZ utility and its two shareholders, the Delta and Essent utilities. This contract will guarantee Borssele to serve a 60 year lifetime, up to 2033.

Moreover the contract states that, if the Borssele plant will be closed by the government for any other reason than safety deficiencies, all extra cost and all lost revenues up to December 2033 will be compensated for by the State. In return for the 60-year lifetime, EPZ and its shareholders will donate 250 million Euro for sustainable energy projects.

The EPZ utility will ascertain that the Borssele reactor will remain in the group of 25% safest reactors of water-cooled reactors in Western countries. A commission of experts will be charged with periodic evaluation of this. EPZ will also start the decommissioning process immediately after shut-down in 2033. (WONUC 2006), www.wonuc.org)

Dukovany NPP - Czech Republic

At Dukovany NPP 4 units WWER 440/V213 are operating. Their originally planned operational time was 30 years, thus ending in 2015 and 2017, respectively for the first and for the second double block.

picture 1: Dukovany NPP

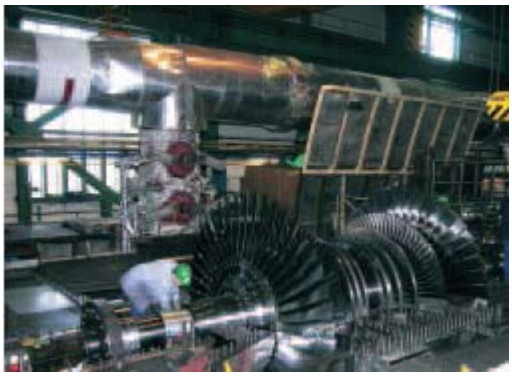
Nuclear safety reassessment of the units began in the early 1990ties: analyses, application of support programs and evaluations performed within various international activities including OSART, ASSET, IAEA missions as well as WANO and WENRA reports. Also some common activities by VVER 440/V213 reactor operators took place. The results of all analyses was used as input data for the project called **"Modernization Program for Dukovany NPP**". (CNS CZ NR 2004). Safety improvements have been implemented concerning fire protection (coating of cables) and prevention of explosions after LOCAs by installation of a hydrogen recombination system inside confinement.

Dukovany participated in the **PHARE/TACIS PH 2.13/95 project – Bubbler Condensate Experimental Qualification** (BCEQ) and the following experiments of the **joint project for Dukovany, Bohunice, Mochovce and Paks NPPs ,** were pre-test and post-test analyses were performed. The bubbler system verification was completed in 2003 (CNS CZ NR 2004). **With this testing program the confinement integrity has been proved in case of all design base accidents; The behaviour of the bubble condenser in case of beyond design base accident has not been investigated.**

In addition, Dukovany NPP actively participated in the 5th Framework Program of the EU within the VERLIFE project aimed at **controlling life span of components and piping of the VVER power plants** and further in the VERSAFE project comprising of two parts. The first one addressed problems related to serious accidents and the second one dealt with extension of VVER reactors life span. (CNS CZ NR 2004)

MORAVA Modernization Program for Dukovany NPP

This program for modernization was established in 1997-1998. Essentially, the program represents a prioritized list of partial projects, their schedule for preparatory works and implementation and assessment of their feasibility. The implementation of the modernization program is in progress. **The purpose of the MORAVA program is to achieve compliance with worldwide safety practices.** (CNS CZ NR 2004)



picture 2: Working at the turbine of DUkovany unit 3

In 1999 the emergency cooling pumps were replaced, in 2000 the super-emergency feed water system was improved, in 2002 measures were carried out to minimize the vulnerability of the steam and feed water pipes on level 14,7 m (shock absorbers).

The most important project currently under way is the **replacement of the I&C system** on safety-important parts for digital systems. **The replacement is and will be performed gradually during refuelling outages of units and its completion has been scheduled for 2010**. A tender was conducted for preparation and implementation of the project and a **contract was signed in September 2000 with a consortium of FRAMATOME and Schneider Electric. Implementation of the I&C system renovation was commenced in 2002 for unit 3 and in 2004 for unit 1.** (CNS CZ NR 2004)

The **major alteration** concerns the reactor core, where the **fuel cycle is to be prolonged from 3 to 5 years, resulting in a higher burnup of the fuel,** i.e. higher radioactivity of the fuel elements connected with a decrease of safety margins, potentially higher emissions in case of an accident and a higher radioactive inventory in the spent fuel storage facilities.

Safety evaluation of Dukovany NPP units is required every 10 years of operation: After ten years, an overall revision of the Safety Report is regularly prepared. A precondition for the SUJB decision for grant of ten-year license allowing the Dukovany

NPP units to operate after 2005 is the revision of the Safety Report. In 2003 the Periodic Safety Review Process was also updated for the Dukovany NPP after 20 years of operation in accordance with new requirements of the IAEA Safety Guide. The Safety Review will be carried out in 14 areas including equipment qualification, ageing, risk analyses, human factors, emergency planning.

This Safety Review process shall help in providing documentation for preparation of the operating licenses renewal for the Dukovany NPP units after 2015. The final report on PSR of the Dukovany NPP will be submitted in 2007. (CNS CZ NR 2004)

Probabilistic Safety Assessment (PSA) of the Dukovany NPP:

The first PSA of the Dukovany NPP was completed in 1993. Currently the level 1 PSA study has established the resulting Core Damage Frequency (CDF) for the Dukovany NPP:

- CDF = 1,27.10E-5/reactor-year for operation at full power
- CDF = 3,69.10E-5/reactor-year for low-power modes and outage
- Total CDF = 4,96.10E-5/reactor-year for all operating modes (summary of previous values) (CNS CZ NR 2004)

Plant Life Management (PLIM)

The Ageing Management Program has been used at the Dukovany NPP since the beginning of operation. In view of the fact that Dukovany NPP exceeded already half of its life originally set by the design and further that ČEZ a. s. declared a strategic objective for its NPPs to stretch out the life span by 10 year, the work was commenced in order to develop Long Term Operation program in accordance with world wide experience. (CNS CZ NR 2004)

A component life monitoring program focuses particularly on the main plant components important for nuclear safety. The primary circuit equipment residual service life is monitored of the reactor (pressure vessel, steam generator, main circulation pumps, pressurizer, main circulation pipeline). For the secondary circuit a similar program focuses on the piping systems, where the erosive corrosion is the most significant damaging phenomenon. (CNS CZ NR 2004)

The most important component in Dukovany as in every other NPP is the reactor pressure vessel (RPV). The neutron flux inside of the reactor core causes embrittlement of the RPV. The Dukovany RPV is made from a pure steel - therefore embrittlement is not that much advanced as it was in Bohunice. Thus annealing of the RPV is not in discussion for Dukovany. However, embrittlement is more advanced at the RPV's welds as it is proofed by the in-vessel samples.

It seems that NPP Dukovany is on to extend the operating time beyond the planned life-time of the NPP, without any public debate. The modernization program will not solve all safety deficiencies of the Dukovany plant e.g. the problems with missiles from turbine failures, or the qualification of the reactor building concerning airplane crashes. Also the lack of qualification of the bubbler condenser in case of a beyond design base accident at the VVER 440/V213 series reactors is not concerned by the modernization program. Moreover, the modernization program includes significant changes in the reactor core which will lead to a reduction of safety margins, to higher radioactive inventory which means a bigger source term in case of an accident, and a higher radioactive inventory in the spent fuel storage facilities.

Bulgaria

Kozloduy 1/2

In 2002 the two oldest WWER 440/ V230 plants in Kozloduy have been closed - according to Bulgaria's accession process to the European Union.

Kozloduy 3/4

Under the acession treaty Kozloduy 3 and 4 have to be closed in 2006. At the moment it seems that Kozloduy seeks to extend the operational period for unit 3 & 4 beyond the agreed closing date. In 2002 a separate independent study of the safety level of units 3&4 was carried out, including a comparative study with model V-213 reactors. The results of the study performed by a ENCONET confirmed compliance of the new design status of units 3&4 with the current requirement for light water reactors in operation. The general conclusion of the study is quoted in the National Report to the CNS in 2004:

„The *safety level achieved at upgraded Kozloduy NPP 3&4 is comparable with that of operating plants of similar vintage in the West and in the East with respect to international safety standards and practices. It did not find any safety issues that would prevent further operation of the plant." (CNS BG NR 2004)*

The unit 3 license was issued in June 2003 with an 8 years term of validity and the license of unit 4 was in February 2003 with a term of validity of 10 years.

Financing

The implementation of the Modernization program for Unit 3 & 4 is completed. It was financed mainly from the Kozloduy NPP's own investment program resources. For the implementation of the activities of the last stage between 2000 and 2002, USD 99 Million were spent. (CNS BG NR 2004)

The issued long-term licenses demand that Kozloduy NPP execute a complex of long-term programs for continuation of the activities in certain aspects. Financing of these programs in the next three years is planned to be 28.4 Million, 91% of which are Kozloduy's own resources and the rest are already granted by the EU PHARE program.

Kozloduy 5/6

The younger reactors in Kozloduy units 5 & 6 are WWER-1000/V320. They were commissioned in 1988 and 1993, respectively. The design life of the units is 30 years. These Plants are subject to a Modernization Programme (MP) with the aim to eliminate some safety deficiencies of the design, which date to early 70s, and to increase the plants availability.

The MP comprises modernization of the I&C systems, severe accident management, replacement of mechanical equipment of the basic production and safety systems, modernization of electrical equipment and systems for reliable power supply, replacement of monitoring and control systems with state-of-the-art digital control systems, Improvement of fire protection and seismic resistance. (CNS BG NR 2004)

To guarantee a high quality of implementation Kozloduy hired an international team of experts for consultancy. According to the implementation schedule the units 5&6 modernization program should be completed in 2006.

In October 2003, the Nuclear Regulatory Agency granted licenses for Units 5 & 6 operation with term of validity of 6 years.

By the end of 2005, the activities on main technological systems and replacement of electrical and I&C equipment should be completed. It is planned to complete the final studies, including update of units' Safety Assessment Report in 2006.

Financing

According to Bulgaria's CNS Report (CNS BG NR 2004) the implementation of the modernization program for units 5 & 6, was funded by:

- EURO 135 Million from the cash flow of Kozloduy NPP
- EURO 212 Million - EURATOM (loan)
- USD 80 Million - ROSEXIMBANK (loan)
- USD 76 Million - CITIBANK (loan)

Cost comparison of different PLEX programs

In 2002 the IAEO published a report on investment cost for PLEX programs based on experiences in different countries. Not all countries participating in the project agreed to publish their investments in the report. In this report the economic advantages of continuing operation of these plants should be demonstrated in the framework of cost-benefit analysis. One important factor for this analysis is the cost needed to continue operation beyond the planned life.

The technical report on "Cost Drivers for the Assessment of NPP Life Extension" develops a methodology to determine the cost inputs required to perform cost-benefit analysis for plant life extension schemes and presents cost and technical data on life extension/life management collected through a questionnaire sent to selected Member States.

The report was prepared in 1999–2001, by the Nuclear Power Engineering Section and Planning and Economic Study Section under the Department of Nuclear Energy. PLEX/PLIM cost data were reported for five PWRs, one BWR, one Magnox, four WWERs and six PHWRs.

The IAEA report provides us with a compilation of cost data estimations from different countries, which are not necessarily directly comparable and they have to be interpreted considering, different types, size, design and vintage of the plants; different regulatory and environmental requirements, spent fuel and radwaste storage policy, the extent of modifications, labour cost etc. Even if we consider all differences and uncertainties we find some instructive results:

Comparison of PLEX cost estimation in US$/kWe

group 1: <120 US$/kWe
Borssele (PWR 450 MW), Kozloduy-5 (WWER 1000), Kola (WWER 440/V230)

group 2: 120 - 250 US$/kWe
small BWR (400-500 MW) Japan, PWR 900 MW France

group 3: 250- 410 US$/kWe
small PWR (500 MW) Korea, PHWR India

group 4: 410 - 680 US$/kWe
Gentilly 2 (630 MW CANDU), Fort Calhoun (PWR 470 MW) USA

group 5: > 680 US$/kWe
small Magnox (120 MW) UK, Pickering A (PHWR/CANDU 500 MW) CAN,
small PWR (300-400 MW) Japan

Since PWRs are the majority of reactors in operation and the first models were of a small capacity, 400-500 MWe PWRs are the most investigated subjects for the PLEX cost estimation in the IAEA technical report (IAEA 2002).

The cost distribution reaches from the cheapest group to the most costly PLEX programs In this spectrum we find reactors with completely different initial situations in the same price group, and reactors with a similar initial safety status in the low and the high price groups as well.

Most astonishing is that Kola the most criticised old Russian PWR type reactor, a plant without any containment and only marginal safety systems shall be operated safely for 45 years for the same cost as an old Western PWR which originally had a distinctly higher safety standard.

Glossary

ASN	French Nuclear Safety Authority	PLIM	Plant Life Management
CEZ	Czech electricity utility	PSA	Probabilistic Safety Assessment
CNS	Convention on Nuclear Safety	PSR	Plant Safety Report
DSIN	Direction de la Surete des Installations Nucleaires	CDF	Core Damage Frequency
EDF	Electricite de France	PWR	Pressurized Water Reactor
IAEA	International Atomic Energy Agency	RPV	Reactor Pressure Vessel
IEA	International Energy Agency	TSO	Technical Support Organisation
LTO	Long Term Operation	SG	Steam Generator
NEA	Nuclear Energy Agency / OECD	SUJB	Czech Nuclear Safety Authority
NNI	No Nukes Info source	VVER	Russian type of PWR
NPP	Nuclear Power Plant	WONUC	World Council of Nuclear Workers
PLEX	Plant life Extension		

Literature

CNS BG NR 2004: National Report on Fulfillment of the obligations of the Republic of Bulgaria on the Convention on Nuclear Safety, 2004

CNS CZ NR 2004: Convention on Nuclear Safety; Czech Republic National Report, 2004

CNS F NR 2004: Convention on Nuclear Safety, France National Report 2004

IAEA 2002: International Atomic Energy Agency: Cost drivers for the assessment of nuclear power plant life extension,TECDOC-1309, Vienna, 2002

NEA 2000: Status Report on Nuclear Power Plant Life Management, NEA/SEN/NDC (2000)6

NEA 2002: International practices with respect to licence periods/terms for nuclear facilities in NEA member countries, NEA/CNRA/R(2002)1

NNI 2005: http://www.ecology.at/nni/, No Nukes Infosource, webservice provided by Österreichisches Ökologie-Institut.

UBA 2005: Becker O., Hirsch H., Lercher J., Seibert P., Wenisch A., UBA(editor): Report to the Austrian Government - EIA procedure for the lifetime extension of Paks NPP: Statement on the Preliminary Impact Assessment Study, Vienna, 2005

WONUC 2006, http://www.wonuc.org, 2006

SET 4

Participation in EU policy - A guide for NGOs and citizens

Legal and political options to participate in antinuclear energy policy

Content

Introduction 3
The Aarhus Convention becomes EU law 4
Treaty Infringement Proceedings 6
The European Ombudsman 8
Petitions to the European Parliament 10
Consultations 11
Debates and Chats 11
Lobbying 12
Lobbying at the European Commission 12
Lobbying at the European Parliament (EP) 12
Links and Literature 13
European NGOs 13
Read more 13

Authors:
Mag[a]. Gabriele Mraz, MA; Ing. Antonia Wenisch
Austrian Institute of Ecology
Seidengasse 13, 1070 Vienna, Austria
www.ecology.at

Mag. Norbert Hörmayer
Vienna Ombuds-Office for Environmental Protection
Muthgasse 62
A-1190 Vienna, Austria
http://www.wien. at/wua

2007

Introduction

This paper is written for NGOs and citizens who want to engage themselves in antinuclear and energy policy on a EU level.

Surveys like the Eurobarometer show in regular intervals that European citizens do not know much about the EU and do not believe that they can influence EU policy: "Close to six out of ten European citizens have the feeling that their voice does not count in the European Union (59 %)." (Eurobarometer 64 2005: p. 33). So the European Commission is planning to widen opportunities for citizens and stakeholders (including NGOs) to participate in EU policy by launching the European Transparency Initiative (http://ec.europa.eu/comm/eti/index_en.htm).

Friends of the Earth Europe (FOEE) point out some of the problems of the present situation: Nowadays more than 15000 professional lobbyists operate in EU institutions, most of them are from trade federations, consultants, companies etc, and only 11% are NGO representatives. There are no transparency rules, it is not known who is paying whom. Right now, FOEE characterizes the EU as an organisation that keeps its decisions secret (see www.foeeurope.org). So NGOs and citizens have difficulties to get information about and to take part in decision-making processes.

Lobbying is not the only option for getting active, there exist some legal and political options for participating in EU policy. The aim of this paper is to inform NGOs and citizens about their possibilities on a EU level.

The following table gives you an overview of these possibilities:

What if	**You can**
your rights under the Aarhus Convention are violated?	seek redress from your Member State
a Member State infringes EU law?	file a complaint with the European Commission
an EU institution infringes EU law?	file a complaint with the European Ombudsman
you want to participate in EU-policy?	file a petition to the European Parliament take part in consultations of EU institutions take part in debates and chats lobby at EU institutions get in contact with European environmental NGOs
you are not satisfied with the policy of a Member State (maladministration of non-EU law)?	take national legal action. In this paper we deal only with EU policies and legal action in the EU.

If you need more information about the structure of the European Union and environmental legislation take a look at the link list at the end of this paper.

This information is part of a series called "PLEX – Information around Plant Lifetime Extension in the Nuclear Industry" which can be downloaded at www.nuclear-waste-watch.org. under "news", "plex".

Nuclear-waste-watch exists since 2003. It is a coalition of Central European organisations to support each other in their activities to achieve more transparency and influence of NGOs and the people in the regions during the selection process of sites for nuclear waste repositories and other nuclear issues. The Austrian Institute of Ecology is coordinating this coalition.

The Vienna Ombuds-Office for Environmental Protection provides an independent service to citizens, to the Viennese city administration and to other stakeholders with the aim of improving the environmental situation in Vienna. The Ombuds-Office also supports the Viennese antinuclear policy.

The Aarhus Convention becomes EU law

What can you do if your rights are infringed?	Seek redress from your Member State File a complaint with the European Commission – see chapter Treaty Infringement Proceedings
Who is granted this right?	Any citizen of a EU Member State or resident in a EU Member State Any NGO resident in a EU Member State
Legal base	Directive 2003/4/EC Directive 2003/35/EC Regulation (EC) 1367/2006

The Aarhus Convention opens new possibilities for participation in environmental matters by establishing a number of rights of the public, including the right of access to environmental information, the right of public participation in environmental decision-making, and the right of access to justice.

The **Aarhus Convention** is an international legal Convention. The United Nations Economic Commission for Europe (UNECE) "Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters" was adopted on 25 June 1998 in the Danish city of Aarhus and entered into force on 30 October 2001. At the end of 2006 40 parties have signed the Convention, including all Member States of the European Union. Also the European Community is a party to the Convention (more information see http://www.unece.org/env/pp/ctreaty.htm).

In 2003 the European Commission adopted two Directives concerning the first and second pillars of the Aarhus Convention, the right of access to environmental information and the right of public participation. The Directives were to be implemented into national law of the EU Member States by 14 February and 25 June 2005 respectively. For new Member States (Bulgaria, Romania) these Directives are also to be implemented (additionally, both countries have signed and ratified the Aarhus Convention).

In 2006 the European Parliament and the European Commission adopted a Regulation on the application of the Aarhus Convention to European Community institutions and bodies. This Regulation shall apply from 28 June 2007. As a regulation it has not to be implemented into national law like a directive has to be.

What rights do these laws guarantee?

1. **Directive 2003/4/EC** of the European Parliament and of the Council of 28 January 2003 **on public access to environmental information** and repealing Council Directive 90/313/EEC:

The central elements of the directive are:

- To grant a right of access to environmental information and to ensure that environmental information is made available and disseminated actively to the public;
- A broad definition of environmental information as well as a more detailed definition of public authorities;
- A deadline of one month for public authorities to supply the information requested;
- Clarification of the circumstances under which authorities may refuse to provide information. Access to information shall be granted if the public interest served by the disclosure outweighs the interest served by a refusal;
- Two types of review procedures have been laid down for the public to challenge acts or omissions of public authorities relating to requests for environmental information. First Member States shall ensure that any applicant who considers that his/her request for information has been ignored, wrongfully refused or inadequately answered, has access to a procedure in which the acts or omissions of the public authority concerned can be reconsidered by that or another public authority or reviewed administratively by an independent and impartial body established by law. In addition Member States shall ensure that an applicant has access to a review procedure before a court of law, in which the acts or omissions of the public authority concerned can be reviewed and whose decisions may become final.

2. **Directive 2003/35/EC** of the European Parliament and of the Council of the 26 May 2003 providing for **public participation** in respect of the drawing up of certain plans and programmes relating to the environment and amending with regard to public participation and access to justice Council Directives 85/337/EEC and 96/61/EC.

- Stronger rules enabling citizens in Europe to have their say before public authorities take decisions affecting the environment. The directive lays down rules giving individuals and NGOs the right to express their opinion to national, regional or local public authorities before they decide on, for example, waste management plans or the siting of a new industrial plant.

3. **Regulation (EC) 1367/2006** of the European Parliament and of the Council on the **application of the provisions of the Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters to Community institutions and bodies** ("Aarhus Regulation"):

- The Regulation covers all three pillars of the Aarhus Convention (access to information, public participation, access to justice).
- NGOs which are independent, which have a primary objective of promoting environmental protection and which existed for more than two years have the right to make a request for internal review before the Court of Justice of the European Communities.
- All institutions, bodies, offices or agencies established by, or on the basis of the EC Treaty will have to adapt their internal procedures and practice to the provisions of the Regulation until 28 June 2007.

More information: http://ec.europa.eu/environment/aarhus/index.htm

If a Member State disobeys central elements of the Directives 2003/4/EC and 2003/35/EC, any natural or legal person will be allowed to lodge a complaint with the Commission against this Member State under the following procedure.

Treaty Infringement Proceedings

What is the problem?	A Member State infringes EU law
What can you do?	File a complaint with the European Commission
Who is granted this right?	Any natural and legal person
Legal base	Art. 226 Treaty on European Union

If a Member State breaks EU law you can file a complaint with the European Commission. It does not matter if a national, regional or local authority of the Member State has fulfilled the infringement.

Infringement means that the institution or body fails to fulfil its obligations under Community law, whether by action or by omission. Community law includes primary and secondary legislation.

- Primary legislation includes the Treaty on European Union, the Euratom-Treaty and the Accession Treaties.
- Secondary legislation includes regulations, directives and decisions of the Commission, and Judgements and Opinions of the Court of Justice.

Under the Treaties, the European Commission is responsible for ensuring that Community law is correctly applied. Consequently, if a Member State fails to comply with Community law, the European Commission has powers of its own (action for non-

compliance) to try to bring the infringement to an end and, if necessary, may refer the case to the Court of Justice of the European Communities. The European Commission takes whatever action it deems appropriate in response to either a complaint or indications of infringements which it detects itself.

Any natural and legal person (for example Non Governmental Organisations) may file a complaint with the European Commission against a Member State about any measure (law, regulation or administrative action) or practice which they consider incompatible with a provision or a principle of Community law. *Complainants do not have to prove that they are principally and directly concerned by the infringement complained about.*

The European Commission may decide whether or not it will take further action on a complaint in the light of the rules and priorities laid down by the European Commission for opening and pursuing infringement procedures.

If the European Commission refers the case to the Court, the Court investigates the allegations and gives its judgment. The accused Member State, if it is indeed found to be at fault, must set things right at once. If the Court finds that the Member State has not complied with its judgement, it may impose a fine on that country.

Anyone who considers a measure (law, regulation or administrative action) or administrative practice to be incompatible with Community law is invited, before or at the same time as lodging a complaint with the European Commission, to seek redress from the national administrative or judicial authorities (including the national or regional ombudsman and/or arbitration and conciliation procedures available). The European Commission advises the prior use of such national means of redress, whether administrative, judicial or other, before lodging a complaint with the Commission, because of the advantages they may offer for complainants.

For those who decide on a complaint against a Member State the European Commission has published a form at
http://ec.europa.eu/community_law/complaints/form/index_en.htm

There is no obligation to use the form, but it helps to include as much relevant information as possible.

Contact:

Commission of the European Communities (Attn: Secretary-General)

Rue de la Loi 200,

B-1049 Brussels

Email: sg-plaintes@ec.europa.eu

The form can also be handed in at the Commission's representative office in your Member State.

The European Ombudsman

What is the problem?	An EU institution or body infringes EU law
What can you do?	File a complaint with the European Ombudsman
Who is granted this right?	Any citizen of a EU Member State or resident in a EU Member State Any NGO resident in a EU Member State
Legal base	Decision of the European Parliament on the regulations and general conditions governing the performance of the Ombudsman's duties. Adopted by Parliament on 9 March 1994 (OJ L 113, 4.5.1994, p. 15) and amended by its decision of 14 March 2002 deleting Articles 12 and 16 (OJ L 92, 9.4.2002, p. 13).

The European Ombudsman investigates complaints about maladministration of institutions and bodies of the European Community. Maladministration means that a EU institution does not fulfil EU regulations that are binding to its work.

You can complain about every EU institution, except about the Court of Justice and the Court of First Instance acting in their judicial role. That means that the Ombudsman cannot look into matters that are before a court or that have been settled by a court. Please note that the European Council is not a body of the EU, but the Council of the European Union (Council of Ministers) is. The Ombudsman also does not investigate national, regional or local authorities, even if they infringe against EU regulations.

If you want to file a complaint you do not have to prove that you are directly concerned by this maladministration. Before complaining at the Ombudsman you first have to directly contact the EU institution concerned. Also you have to make your complaint within two years of the date when you got to know about the maladministration.

All citizens of EU Member States and all companies, associations and other bodies (including NGOs) with a registered office in the EU can file a complaint with the Ombudsman. *If citizens or organisations from Non-member States complain, the Ombudsman can start an investigation on his own initiative.*

A form for complaints can be found on the homepage of the Ombudsman.

The Ombudsman exists since 1995 and has since dealt with more than 20.000 complaints, over 300 complaints are now sent per month. Most complaints concern unnecessary delays, refusal of information, failure to reply, unfairness, administrative irregularities, discrimination and abuse of power. Until 2005 no complaint has been rejected solely because the complainant was not an authorised person or organisation.

The procedure for the complaints is as follows:

- Within one week the complaint is registered and acknowledged.
- Then the complaint is forwarded to the institution or body concerned with the request of sending an opinion to the Ombudsman within two to three calendar months. This opinion is sent to the complainant who has the possibility to reply, and vice-versa.
- If maladministration is found the Ombudsman first tries to achieve a friendly solution.
- If this is not possible the Ombudsman either closes the case with a critical remark to the institution or body concerned or makes a draft recommendation. A critical remark confirms to the complainant that his or her complaint is justified and indicates to the institution or body concerned what it has done wrong. This is the normal case if it is no longer possible for the EU institution to eliminate the maladministration, if the maladministration appears to have no general implications and no follow-up action by the Ombudsman seems necessary.
- In all other cases the Ombudsman makes a draft recommendation to the institution or body concerned. The institution or body must send a detailed opinion within three months. If a Community institution or body fails to respond satisfactorily to a draft recommendation, the Ombudsman may send a special report to the European Parliament including recommendations.

The Ombudsman's decisions are not legally binding and do not create legally enforceable rights or obligations for the complainant, or for the institution or body concerned.

Some decisions of the Ombudsman deal with environmental matters, for example a decision concerning a complaint from Friends of the Earth Europe with the European Commission about concealed documents dealing with dangers of genetically modified organisms (http://www.ombudsman.europa.eu/decision/en/050582.htm).

Contact:

The European Ombudsman

1 Avenue du Président Robert Schuman B.P. 403

FR-67001 Strasbourg Cedex

Tel: +33 (0) 3 88 17 23 13

Fax: +33 (0) 3 88 17 90 62

Email: euro-ombudsman@europarl.eu.int

http://www.ombudsman.europa.eu/home/en/default.htm

Petitions to the European Parliament

A petition to the European Parliament may take the form of a complaint or a request. The subject of the petition must be concerned with issues of European Union interest or responsibility such as your rights as a European citizen, environmental matters, consumer protection, etc.

Every citizen or resident in a Member State, and every member of an association, company or organisation with its headquarters in a Member State can submit a petition to the European Parliament. This right is granted under Article 194 of the EC Treaty.

It is also possible for persons or organisations not included in the above listing to submit a petition. In this case the responsible committee can choose to consider it or not (rule 191 of the European Parliament).

Your petition must bear your name, nationality and permanent address (in the case of a group petition, it must bear the name, nationality and permanent address of the presenter or, at least, the first signatory). The petition has to be signed. Petitions must be written in one of the official languages of the European Union.

The procedure for the petitions is as follows:

- If the subject of your petition concerns an area of activity of the European Union it will be declared admissible by the Committee on Petitions.

Depending on the circumstances, the Committee on Petitions may:

- ask the European Commission to conduct a preliminary investigation and provide information regarding compliance with relevant Community legislation,
- refer the petition to other European Parliament committees for information or further action (a committee might, for example, take account of a petition in its legislative activities),
- in some exceptional cases submit a report to Parliament to be voted upon in plenary or conduct a fact-finding visit,
- or take any other action considered appropriate to try to resolve an issue.

Meetings of the **Committee on Petitions** take place every month except during the month of August when Parliament is in recess.

The European Parliament cannot override decisions taken by competent authorities within Member States. As the European Parliament is not a judicial authority, it can neither pass judgement on, nor revoke decisions taken by, the Courts of Law in Member States.

Contact:

European Parliament

The President of the European Parliament

Rue Wiertz

B-1047 Brussels

http://www.europarl.europa.eu/parliament/public/staticDisplay.do?language=EN&id=49

Consultations

Consultations are a possibility to bring your comments about EU policies into the European debate. At the homepage of Your Voice in Europe (link see below) all open and closed consultations can be found. You can take part by filling out an online-questionnaire. Sometimes also public hearings are held. At each topic it is listed who is addressed and who can take part in the discussion.

For example the last consultation concerning energy questions was about the Green Book on Energy in September 2006. You can find a comment from the NGO coalition nuclear-waste-watch at http://www.nuclear-waste-watch.org/green_paper.htm.

Your Voice in Europe, Consultations:

http://ec.europa.eu/yourvoice/consultations/index_en.htm

Debates and Chats

Online discussions are another possibility to make public statements about EU policies, to discuss them with other participants and to make ones opinion heard by the EU Commission.

A debate started in 2006 about Europe's Future: It is conducted about given topics like Europe's economic and social development. Summaries of the discussions are made and sometimes commented by members of the Commission. In a press release the Commission stated that contributions on the forum feed into the Commission's analysis in the ongoing reflection on the future of Europe (IP/06/989, 13.7.2006).

Taking part in online debates is time consuming because the structure of the threads is a bit complicated, and there are contributions in different languages. Analyses show that participants are mainly male and aged 18-44. So the topics discussed represent mainly the interests of this population group.

Ongoing debates are about European Union in general, but nuclear issues and energy policy are also brought into discussion and therefore can be found in the summaries.

Online chats with members of the EU Commission are held one to four times a year, transcripts are made. In 2006 until November there has been no chat at all.

http://ec.europa.eu/yourvoice/discussions/index_en.htm

http://europa.eu/debateeurope/index_en.htm

http://ec.europa.eu/chat/index_en.htm

Lobbying

Lobbying means to influence the actions of the EU legislation and executive through direct contacts, media, mailings etc.

Professional lobbying in the EU started at the end of the 1970ies and became more important as the EU covered more policy areas. Most lobbyists are professionals who are paid for their work. Therefore big environmental NGOs have their own bureaus in Brussels. For single citizens on the other hand it is quite difficult to lobby effectively on a European level. It helps to get in contact with an environmental NGO (see Links and Literature).

Lobbying at the European Commission

In the database CONECCS organisations of the civil society can register if they want to be consulted in a formal or structured way, meaning in committees and other frameworks of the EU Commission. Only non-profit organisations, which have members in three or more EU or candidate countries, can take part. The Green 10 (see Links and Literature) are registered and take part in consultations relating to their field of work.

CONECCS:

http://ec.europa.eu/civil_society/coneccs/index_en.htm

Lobbying at the European Parliament (EP)

A list of all members of the European Parliament (MEP) can be found on the homepage of the EP, sorted by country, name or political party.

http://www.europarl.europa.eu/members/public.do?language=EN.

For each member his/her functions in the Parliamentary Committees and Delegations are listed. You can also find his/her parliamentary activities in plenary (questions, speeches etc.) so you know about the working fields.

The European Parliament offers a contact possibility for citizens, the "Correspondence with Citizens Unit". At this Unit, which is an electronic mailbox, citizens can ask questions, request information and make proposals to the EP. The EP will only deal with issues that relate to matters within the European Parliament's sphere of activities.

http://www.europarl.europa.eu/parliament/public/staticDisplay.do?language=EN&id=48

Parliament has set up 20 standing committees to prepare work for plenary sittings. Committees meet in public, once or twice a month, generally during the weeks that follow plenary sittings in Strasbourg. Meeting documents are available to the public.

Committee for Environment, Public Health and Food Safety

http://www.europarl.europa.eu/activities/expert/committees/presentation.do?committee=1239&language=EN

Links and Literature

European NGOs

The following NGOs are concerned with energy policy and nuclear issues and lobby on a European level.

Friends of the Earth Europe (FoEE)
Rue Blanche 15,
B-1050 Brussels
Phone: +32.2.542 0180
Fax: +32.2.537 5596
Email: info@foeeurope.org
Web: www.foeeurope.org

Greenpeace European Unit
Rue Belliard 199
B-1040 Brussels
Phone: +32 2 274 1900
Fax: +32 2 274 1910
Email:
european.unit@diala.greenpeace.org
Web: www.greenpeace.eu

European Environmental Bureau
Federation of Environmental Citizens Organisations
34, Bd. de Waterloo
B-1000 Brussels
Phone: +32 2 289 10 90
Fax: +32 2 289 10 99
Email: eeb@eeb.org
Web: www.eeb.org

CEE Bankwatch Network
Central Office
Jicinska 8
Praha 3
130 00 Czech Republic
Phone: +420 274 816 571
Fax: +420 274 816 571
Email: main@bankwatch.org
www.bankwatch.org

Read more

EU Environmental Policy Handbook of the European Environmental Bureau:
http://www.eeb.org/publication/policy_handbook.htm

Information of the EU Coordination of the DNR (Deutscher Naturschutzring, German League for Nature and Environment), about EU institutions and legislation, in German:
http://www.eu-koordination.de/index.php

Citizen's Guide to European Complaint Mechanisms (CEE Bankwatch):
http://www.bankwatch.org

SET 5

Paks NPP Lifetime Extension

Authors:
Ing. Antonia Wenisch, Mag[a]. Gabriele Mraz, MA;
Austrian Institute of Ecology
Seidengasse 13, 1070 Vienna, Austria
www.ecology.at

2007

Paks Lifetime Extension

The four units of NPP Paks were originally built for a lifetime of 30 years.

Paks Unit No.	End of original lifetime
Unit 1	2012
Unit 2	2014
Unit 3	2016
Unit 4	2017

NPP Paks' operator wants to extend their lifetime for another 20 years. For this purpose three types of licenses are needed:

- nuclear license
- environmental license
- water license

Hungary is the first case where for a plant lifetime extension an environmental impact assessment (EIA) is required. Hungarian NGOs had the possibility to participate in the EIA process, and they participated from the beginning. Austria and later also Romania stated their interest to participate according to the ESPOO-Convention.

Environmental License

Timetable:

2002	The licensing process for the environmental license started.
5.4.2004	The Preliminary Environmental Study from Paks NPP was delivered to the environmental authority ADUKÖFE, and ADUKÖFE wanted some supplements.
3.5.2005	Ruling of ADUKÖFE, in which the creation of a detailed Environmental Impact Study was ordered until 2007 (this EIA study was completed in March 2006). After that the Preliminary Environmental Study was published. Authorities of neighbouring countries, citizens and NGOs had the possibility to make their comments.
Sept 2005	Austria sent a Statement based on an expert analysis ("Report to the Austrian Government") to the Hungarian authorities. In this report comments and questions concerning the Preliminary Environmental Study are summarized. Also Hungarian, Romanian and Austrian NGOs and citizens made their statements.
March 2006	The Environmental Impact Study by Paks NPP was published, authorities of neighbouring countries, citizens and NGOs had the possibility to make their comments. Hungary also submitted to Austria the "Answers of NPP Paks to the Austrian Report and to some statements of other Austrian institutions"
28.4.2006	Hungarian hearing in Budapest
6.6.2006	Austrian hearing in Mattersburg
Summer 2006	Bilateral exchange of questions and answers between Hungary and Austria
Nov 2006	Hungary issued the environmental license for Paks lifetime extension.

The **"Report to the Austrian Government"** from Sept. 2005 is published at http://www.umweltbundesamt.at under uvp/sup/emas, espoo, Hungary.

This report includes legal and technical comments. Austria took the position to be significantly affected by the planned lifetime extension. Arguments for this position are listed in the executive summary of the report:

1. The case of the extension of the operating time of the nuclear power plant Paks is covered by the application scope of the EIA-Directive of the EU respectively the ESPOO-Convention.

2. The position of the Hungarian authorities on to the question of whether their neighbouring states are likely to be significantly affected, which only takes into account the probability of the occurrence of accidents while at the same time excluding severe accidents (beyond design basis accidents) is not in line with the ESPOO-Convention and the EIA-Directive.

Austria stated that this exclusion of severe accidents (beyond design basis accidents) in the preliminary study was neither in line with the ESPOO-Convention nor with the EIA-Directive. Therefore a detailed analysis of beyond design basis accidents and their potential effects should be included in the EIA-Documentation.

The technical evaluation results in a list of missing or incomplete issues that are seen as relevant for neighbouring countries. The detailed elaboration of the following issues in the EIA-Documentation is therefore requested:

(1) The overall treatment of ageing in an NPP is of importance for the risk of extended plant operation. Of particular importance and safety significance is the ageing of the reactor pressure vessel, the steam generators, and the confinement system.

(2) Reliable data on the original state of the pressure vessel, the composition of the materials, the embrittlement surveillance program, the thermo-shock analyses performed etc. should be presented in the documentation.

(3) Also treated in some detail should be the corrosion of steam generators and the option of steam generator exchange; as well as the connection between steam generator corrosion and fuel element contamination.

(4) The long-term behaviour of the confinement system (steel liner, barbotage system etc.) should be discussed in the documentation.

(5) Furthermore, the ageing of many other systems, structures and components can also be of safety significance. A comprehensive ageing management program is required and should be presented in the documentation.

(6) The effects on the safety margins of the plant related to ageing in connection with power uprating should be presented in the documentation, including the specifications and effects of the new type of fuel to be used.

(7) The issue of seismic hazards (including both site seismicity and seismic design) will have to be presented and discussed in a comprehensive manner in order to permit the assessment to which extent appropriate, state-of-the art data and methods have been applied and which additional analyses might be required.

(8) The issue of terror attacks and sabotage can and should be discussed without disclosing sensitive information.

(9) A comprehensive discussion of DBA and BDBA scenarios and severe accident management measures, including the results of safety analyses concerning BDBA (initiating events, scenarios, source terms) is required to assess the potential risk for the Austrian population in greater detail.

For further details see:
http://www.umweltbundesamt.at/umweltschutz/uvpsupemas/espooverfahren/ungarn/

Parts of the EIA procedure were **two hearings:** one in Hungary (28.4.2006) and the other in Mattersburg, Austria (6.6.2006).

1. The Hungarian NGO Energia Klub criticized in its report about the Hungarian hearing that on behalf of the authority no independent experts participated in the hearing, all experts who answered questions belonged to the crew of Paks NPP. There was no time for clarifying questions after a question was answered once, even if the answer was not satisfying. Several topics were not dealt with at all (e.g. HLW).

See also Energy Club (2006): Report from the Hearing in Hungary 28.4.2006, published at www.nuclear-waste-watch.org.

2. At the Austrian hearing open questions from the Austrian side were presented, and also statements of the Hungarian side. See the presentations at: http://www.umweltbundesamt.at/umweltschutz/uvpsupemas/espooverfahren/ungarn/uvpkkwpaks/mattersburg/

The questions of Austria that were summarized in the "Report to the Austrian Government" from Sept. 2005 were answered by Paks NPP. These answers together with the Ruling from May 2005, the Environmental Impact Study from 2006 and the results of the Austrian hearing were used for **revising the "Report to the Austrian Government"** (revised version see www.umweltbundesamt.at).

In this revised report the following assessments were made. Generally it can be stated that the information that was asked for in the first Austrian report were not answered satisfyingly.

(1) In the Environmental Impact Study a high seismic risk for NPP Paks was estimated (CMF[1] 2,58 10^{-4} per year and unit). At the hearing in Mattersburg it became clear that this problem has been realized by the NPP and the Hungarian nuclear authority announced a seismic improvement (reduction to 6,6 10^{-5} per year and unit).

(2) From the discussions with the Hungarian side it became clear that beyond design base accidents couldn't be excluded from the debate. A release of radioactivity can affect regions in a distance of several 100 km from Paks.

(3) Ageing Management Program: Considerable changes and developments were announced at the Austrian Hearing as part of the Ageing Management Program of Paks NPP during the next years. Further information on this process is of high importance for assessment of severe accident risk. In particular, further observation should permit to ascertain that the new approach to in-service-inspections to be introduced at Paks, which is to include reductions in inspection

1 CMF = core melt frequency

efforts without a decrease of the safety level, indeed does not lead to any safety level decreases.

(4) Reactor Pressure Vessel (RPV) Ageing: The safety assessment of the Paks reactor pressure vessels, in connection with lifetime extension, is in an early stage. The Austrian Government stated its interest in an information exchange on the further development of RPV ageing management and its results.

(5) Steam Generator Ageing: The safety assessment of the Paks steam generators, in connection with lifetime extension, is still in an early stage. The inspection system is still under development. Observation of the further development of in-service-inspections is required, particularly because of possible modifications of the practice in the coming years (longer inspection intervals).

(6) Confinement Ageing and Capability: The confinement system is important for plant safety, especially the ageing of the barbotage condenser system, the backfitting measures which were performed in the last years, or are planned for the immediate future, and the behavior of the confinement system in case of a severe accident (as well as for variations of certain DBAs[2]), including a discussion of safety reserves and of capabilities for accident mitigation, should be provided, as well as the consequences of the leak rate for the timing and extent of releases during beyond design base accidents.

As far as can be concluded from the available literature, there have been no comprehensive and systematic tests and investigations (such as have been performed for DBAs) into the capabilities of the confinement in case of beyond design basis events. In particular, it appears that no investigations have been performed regarding the behavior of the bubble condenser, which constitutes the critical part of the confinement system.

(7) Seismic Hazard: Seismic hazards contribute considerably to the overall risk at Paks. Therefore it is necessary to get more information about the current state of seismic backfitting, further backfitting activities and all new investigations and assessments of seismic hazards that will be performed in the next years.

(8) Terror Attack: Paks life extension is the first licensing procedure for a VVER 440/213 reactor since the attacks of September 11, 2001. The issue of terror attacks is discussed worldwide and should be discussed also in the procedure of Paks lifetime extension. Vulnerabilities, attack scenarios and potential consequences can and should be discussed in an appropriate general manner, and in an appropriate setting. Regarding public debates, the criterion applied should be that it would be pointless to attempt to keep secret information, which a competent group of attackers can easily acquire.

(9) Power Uprating: Life Extension of NPPs is often connected with power uprate. In Paks this power uprate will be performed as usually in several stages. The first stage concerns the enhancement of the efficiency of turbine and generator. This is of low safety relevance compared to the second stage when changes in the reactor core and the fuel cycle are intended. These activities can substantially

[2] DBA = design basis accident, BDBA = beyond design basis accident

reduce the safety margins of the plant. NPP Paks is planning two phases of fuel development; of particular interest is the schedule of the second phase, when a higher burn-up which will be achieved then and its possible effect on source terms for DBAs and BDBAs. As an important first step, provision of the related part of the Safety Report would be helpful for the clarification of the open questions.

(10) Spent Fuel Storage: The fuel storage facility at the Paks site already contains a large amount of radioactive materials, which will grow considerably in the coming decades if lifetime extension is implemented. The storage concept employed appears to be more vulnerable to external impacts and terror attacks than the cask storage concept. Furthermore, it is likely that it will pose more problems in case of contamination of the store through a reactor accident.

There are indications that the planned storage duration (50 years) is likely to be exceeded, more information about it is necessary.

In November 2006 Hungary issued the **environmental license** for Paks lifetime extension. A German translation is available at www.umweltbundesamt.at.

The main problem with the licensing procedure is that the EIA, the one with the most opportunities for participation of the public is the first to be finished. Only after that the nuclear (operational) licensing process can start, on the other hand the operational constraints issued by the nuclear regulatory authority are not known at the time of the issue of the environmental license. The content of the nuclear license is not part of the EIA. But locally there are neighbouring villages (and inhabitants) that have to be parties in the nuclear licensing procedure.

NGOs could use all opportunities due to the Aarhus Convention to get information about the process.

The Government of Austria has a bilateral information agreement with Hungary concerning all nuclear issues. Under this information agreement the development of the licensing process of Paks LTE, the progress of work and the experiences will be discussed between Austrian and Hungarian experts.

Operational License

The first operational license has to be acquired four years before lifetime extension starts. This is a “theoretical license”, meaning that there has to be another operational license to be issued at the year of the start of lifetime extension. Paks Unit 1 needs its first operational license in 2008, the second one in 2012.

ÖSTERREICHISCHES
ÖKOLOGIE INSTITUT