Cernavoda 2 NPP in Romania:
A Test Case for the Coherence of
EU Policies in Accession Countries

Campagna per la riforma della Banca mondiale
May 2003
The project of completion of the second 700 MW CANDU reactor of the Cernavoda nuclear power plant in Romania is doubtless a crucial test case for Euratom and European bilateral financiers, such as Export Credit Agencies (ECAs), as regards the definition of their nuclear policies for the coming years. In particular, it is the last project that could benefit from Euratom support before the proposed extension of the Euratom loan ceiling. As a matter of the fact, Euratom is considering to concede Romania a 223 million € loan, the exact amount of money which is left and not committed in Euratom’s treasury.

A final decision by the European Commission on the controversial loan is expected in the next weeks, since the loan request is already at the interservice of the Commission. This will decide on Euratom loans on the proposal of Commissioner for Economic and Monetary Affairs after technical screening of the loan on safety, environmental and economic grounds with the involvement of DG Enlargement, DG Environment and the European Investment Bank respectively. The Romanian government should be able to issue a sovereign counter-guarantee as requested under the Euratom loan mechanism in June 2003. The delay is due to the ceiling on guarantee imposed by the International Monetary Fund onto Romania in order to reduce the risk of generating an unsustainable debt for the country in the long-term. Nevertheless, Romania will not be able to issue further guarantees for attracting further investment in other sectors in the next years because of its extensive financial commitment for the Cernavoda 2 - more than 600 million € in counter-guarantee - in a time when the country still faces a hard economic situation.

### The Financial Package for Cernavoda 2 NPP

<table>
<thead>
<tr>
<th>ECA</th>
<th>Operation</th>
<th>Amount</th>
<th>Applicant</th>
<th>Exporter</th>
</tr>
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<tbody>
<tr>
<td>EDC (Canada)</td>
<td>Investment insurance</td>
<td>316 million CAN (=269 mil. US$)</td>
<td>Société Generale de France’s loans</td>
<td>AECL</td>
</tr>
<tr>
<td>SACE (Italy)</td>
<td>Investment insurance</td>
<td>118 million €</td>
<td>Société Generale de France’s loans</td>
<td>Ansaldo Energia</td>
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<tr>
<td>COFACE (France)</td>
<td>Credit Guarantee</td>
<td>23 million €</td>
<td>Alstom</td>
<td>-</td>
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<tr>
<td>Eximbank (US)</td>
<td>Credit Guarantee</td>
<td>24 million US$</td>
<td>Nexans/General Electric</td>
<td>-</td>
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Société General de France arranged private commercial loans for a total amount of 384 million €, of which 350 million € from Société Generale of France, 25 million € from Romanian Development Bank (which is Société Generale in Romania) and 9 million € from Credit Lyonnais of France.

The Romanian government is also contributing to the project with 80 million US$ from the State budget, thus leading the estimated overall cost of the completion of Cernavoda 2 NPP to more than 700 million €. Any cost over-run will be covered by the Romanian government.

The Romanian government is planning to issue the following counter-guarantee:
- 433 million US$ (split into two parts: December 2002, March 2003) to cover ECA lending;
- 233 million € in June 2003, to cover the Euratom loan.
Last January the four ECAs involved in project financing have approved their guarantees for private commercial banks and exporters. The approval has been made conditional to the fulfilling by the Romanian government of a set of conditionalities during the construction period and before the start-up of the reactor. Apparently these conditionalities have been attached to an Inter-Creditor Agreement signed by the four ECAs, Société Generale, AECL and Ansaldo at the end of 2002. To date ECAs have refused to make public such safety and environmental conditionalities and US NGOs have formally requested Eximbank their disclosure under the Freedom of Information Act procedure. According to what international NGOs understand, environmental conditionalities include the finalisation of several safety, seismic and other studies for the controversial project.

**Violation of the Euratom mandate**

The 700 million € Cernavoda 2 project is not a greenfield project, since works on it has begun under Ceausescu regime, but, as in the case of the first reactor of the plant, functioning since 1996, the second unit can only be completed through the support of foreign financing. At the same time, the core of the nuclear project still has to be implemented and apart of civil and electrical equipment most of the work on the second reactor has been carried out through assistance and equipment already in place for Cernavoda 1. A consortium including SNN, the state-owned nuclear company and lead project sponsor, AECL of Canada and Ansaldo Energia of Italy is implementing the completion project.

The granting of the Euratom loan to the Romanian government would be in clear violation of the Council guidelines for granting Euratom loans to certain non-EU countries since they are not supposed to be used for the building of new reactors. The European Council decided in 1994 “to authorize the Commission to contract Euratom borrowings in order to contribute to the financing required for improving the degree of safety and efficiency of nuclear power stations in certain non-member countries”\(^1\), but not explicitly in support of the construction or completion of new nuclear reactors, as in the case of Cernavoda 2.

It seems clear that Euratom loans are to be used for safety upgrades of existing reactors and not the building of new reactors. This interpretation – that the loans are meant for older Soviet designed reactors – seems to be shared by the Commission in their new Communication, which is trying to argue the case for more Euratom funds: “However, especially as the issue of the safety of Soviet designed nuclear power stations becomes ever more acute, there will be pressure to further extend Euratom coverage and hence a need for increased provisioning. Potential new Euratom commitments could be in the order of €200-300 million a year. Any further Euratom lending will also require raising the ceiling for Euratom loans which is subject to a separate legislative procedure”\(^2\). This document does not either mention that funds would be applied to the building of new reactors.

**Secret project studies funded by the European Commission**

Since 1999 Euratom commissioned through the PHARE programme of the European Commission four studies concerning environmental, safety, economic and financial aspects of the Cernavoda 2 project. Only the environmental study has been made public so far, despite reiterated requests of

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\(^1\) 94/179/Euratom: Council Decision of 21 March 1994 amending Decision 77/270/Euratom (31994D0179)
civil society in European countries and Romania to make all the studies public. The European Commission has made clear to NGOs that the economic and financial documents cannot be made public because of their commercial confidentiality, even though the economic study is currently under review by the European Investment Bank which manages European taxpayers’ money. As concerns the safety study, already approved by the European Council nuclear expert group in July 2002, it is still unclear whether the European Commission is in favour of its disclosure.

**Concerns about safety standards and regulation in Romania**

In any case, the publication of and public consultation about the PHARE funded project studies alone will not be able to guarantee the safety of the projects and that the Romanian government will properly implement and manage the project in its entire lifetime. The Romanian Nuclear Regulator, CNCAN, told NGOs that a new EIA is not mandatory for Cernavoda 2 since the whole plan of construction of the Cernavoda NPP, consisting of 5 nuclear reactors, was licensed at the beginning of the ‘90s. It does not matter that more than 140 changes occurred in the project design of Cernavoda 2 to date. Such interpretation of the Romanian openly conflicts with the environmental licensing procedure carried out by the Romanian Environment Ministry in the last months.

It has to be noted that according to the Western European Nuclear Regulators’ Association in the last ten years the CANDU design has not changed fundamentally. *The basic safety features of the CANDU 600 concept have not developed very much over the years. When construction of Unit 1 restarted in 1991, design improvements were introduced similar to those already implemented in the twin plants of Wolsung (South Korea), Point Lepreau and Gentily-2 as a result of their operating experience and PSA studies. The main improvements include better separation between control and shutdown system, modification of control room design, provision for post LOCA sampling capability in the containment, etc.* Principal safety problems as the positive void coefficient of reactivity, vulnerability to loss of regulation incidents, containment deficiencies, seismic hazard and fire protection are not totally solved. (see Section 2)

According to the energy chapter of the 2002 EU Regular Report for Romania from DG Enlargement of the European Commission, “The unresolved issues of spent fuel and nuclear waste will have to be addressed [by the Romanian government] in the short-term” and although “Romania has accepted and addressed all the recommendations contained in the Report on Nuclear Safety in the Context of Enlargement of June 2001” and “no major difficulties were foreseen for compliance with the Euratom Treaty, Romania should implement some international nuclear norms. Nuclear safety standards, especially those related to plant operation, should be handled appropriately and longer-term solutions needed to be found for radioactive waste.” (see Annex 1)

**Inadequate project EIA studies**

The publication of all Euratom-funded studies is quite crucial since these are complementary to the fully inadequate Environmental Assessment Summary which has been produced by AECL of Canada, one of the foreign sponsor of the project, and the official Environmental Impact Summary

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3 Letter to Fern and Campagn per la riforma della Banca mondiale from Director-General Eneko Landaburu, DG Enlargement, European Commission, January 31st, 2002
4 Ibidem
6 Western European Nuclear Regulators’ Association; Nuclear safety in EU applicant countries, March 1999
carried out by the National Institute of Research and Development for Environmental Protection in Bucharest (ICIM) on behalf of the Romanian State-owned nuclear agency, SNN Nuclearelectrica. Both the documents are available only in a summary format and not as a full version because of apparent commercial confidentiality of some information contained in the documents. Only recently Romanian authorities have made available to international NGOs after their reiterated requests relevant parts in Romanian of the full EIA study carried out by ICIM. (see Section 1)

The AECL study, made public at the end of 2001 in order to comply with environmental requirements of EDC of Canada, fails to properly consider alternatives to complete the Cernavoda 2 reactor, to assess the consequences of a catastrophic nuclear accident and the security provisions, to disclose details of the nuclear emergency plan and the complete nature of the seismic risks, and to finally conduct an adequate Probabilistic Risk Assessment.

According to the independent review of the authoritative Austrian Institute for Applied Ecology, the summary of official Romanian EIA study made public by the Romanian government last August, is incomplete, not systematic, not understandable because of the lack of relevant maps and data included in the full version of the document, so that it is impossible to evaluate whether all needed data have been collected and all project impacts seriously assessed by EIA authors.

**Lack of civil society consultation**

According to the Romanian Law on the Environmental Protection of 1995\(^7\) and the associated implementing procedure, the Romanian “accepted [EIA] report shall be subjected to public debate by the local EPA and shall record the comments and conclusions resulted”\(^8\).

In September 2001 an unofficial presentation of the project by AECL and SNN officials took place in Cernavoda, Constantza and Medgidia. It should be noted that these meetings have been attended mainly by representatives of pro-nuclear NGOs which have been established by officials from the national nuclear agency in the last years, as per their admission to the international NGO Fact-Finding Mission (FFM) in February 2002.

Representatives of the Romanian Environmental Ministry made clear to the FFM that those meetings could not be regarded as official consultation since the official EIA study of the project had not been made public yet at that time.

Subsequently, during meetings a new international NGO FFM to Romania last January nuclear and environmental authorities claimed that no additional consultation were to take place since the official ones had already occurred and were based on the first draft of the EIA of the project prepared by AECL.

To this respect, it should be noted that the full EIA study by AECL was not made available to local environmental authorities in charge of organising the consultations in Romania, although it should have been given as part of the environmental agreement issuance procedure. A follow-up visit to the local authorities in Constanta in February 2003 proved that the report distributed to consultation participants was quite different from the Environmental Assessment Summary made public by AECL and have not got the same structure either. In particular, the two studies include a different assessment of estimated future energy needs in Romania. Furthermore, all the references to

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\(^7\) The Law No. 137/December 29, 1995 was published in the “Monitorul Oficial” (Official Gazette of Romania), Part I, No. 304/December 30, 1995.

\(^8\) Paragraph 4.3.4 of the Ministerial Order No. 125/1996, Permitting Procedure for Economic and Social Activities having an Environmental Impact according to Environmental Protection Law No. 137/1995 – April 11, 1996; Annex 3 on Procedure for the Public Debate.
economic justification of the nuclear project and non-nuclear alternatives included in the AECL summary, even though in a limited and inadequate manner, are not included in the Romanian document, although a study of the alternatives, taking into account the associated environmental impacts, is essential for the public to appreciate the necessity and the relevance of such a project. This is also an explicit requirement under the Permitting Procedure for economic and social activities having an environmental impact according to the Romanian Environmental Protection Law No. 137/1995. Therefore, international NGOs have serious doubts whether the public consultation has been based on appropriate information on the project.

In follow-up correspondence with authorities from the Romanian Environment Ministry, when these have been asked why SNN commissioned a second study this time to ICIM and why this document was not subject to the proper procedure, namely not resubmitted to public consultation at its completion, the Romanian authorities admitted that the public consultation had been based on “illegal” EIA documentation, that “a second study was asked because, according to national legislation, the environmental impact study (EIS) has to be made only by a natural or legal person certified according to Minister Order (MO) 278/1996 and the EIS has to be done according to the MO 125/1996 requirements.” (see Section 1). Thus Romanian authorities recognised that the AECL was not certified to carry out such a study and that the EIS made by them did not meet the national requirement in this matter. Consequently the final and official EIA study is the one produced by ICIM which has not been submitted to public consultation as requested under the Romanian environmental law, EU law and international environmental recognised standards.

As suggested by environmental experts of the EU delegation in Bucharest and requested to Commissioner Wallström by international NGOs (see Annex 2), it is needed to urge Romanian authorities to fully implement the new Environmental Protection Law which entered into force on January 17th, 2003 by adopting the EU directive 85/337/EEC as amended by the 97/11/EC Council Directive within the accession process. Consequently the European Commission should request Romanian authorities to hold new consultations with project affected communities on the ICIM full EIA study as a condition for the approval of the requested Euratom loan. Going ahead with project financing without expecting the outcome of public consultation with local affected communities and international civil society on the full official EIA study for the project would be a clear violation of the principles of the European Union’s environmental law and a terrible example given to an accession country, such as Romania, which has been requested by the European Union itself to live up its environmental rules to European standards as a pre-accession condition.

Finally the FFM was denied access to the nuclear power plant in Cernavoda in January 2003, after providing in advance nuclear authorities with all needed information. While reacting to the Mission’s complaints about the modalities by which the mission was diverted to the Cernavoda site and then not allowed to visit the plant, Mr. Chirica, director of the SNN international affairs division, bluntly stated on-the-record its full lack of interest in the possibility that the FFM had reported to the European Commission and national governments involved in project financing about the unfortunate case. Such attitude by Romanian high-ranking authorities requesting the concession of the Euratom loan poses a serious question about the reliability and credibility of the whole Romanian government in properly implementing the controversial nuclear projects also with the support of EU funding.

**Violation of international environmental law**

The financing of the Cernavoda 2 NPP project under current situation might be in violation also of international environmental law. In particular, Romania and all its neighbouring countries, apart of
the Serbian federation, have all signed and ratified the Espoo Convention on EIA in a Transboundary Context, which came into force in 1997 and to which also the European Commission is party. It should be noted that the Cernavoda NPP is located less than 50 km from the Romanian border with Bulgaria and that this country has been insistently requested by the European Union to close four nuclear reactors at the Kozloduy NPP on safety grounds. The Bulgarian government has been notified by the Romanian government about its intention to go ahead with the project and the project EIA study only at the end of 2002, after the completion of the EIA study, thus in violation of article 3 of the Convention. Furthermore, Bulgarian authorities received only the ICIM EIA summary, which is insufficient to fully evaluate transboundary impacts associated with the Cernavoda 2 project. (see Sections 1 and 2).

After receiving several NGO submissions and extending the timeline for comments, finally Bulgarian authorities sent their comment about the ICIM EIA Summary to the Romanian government last April. Outstanding problems regarding environmental transboundary impacts associated with other projects and affecting the two countries and the intention of the Bulgarian government to go ahead with the construction of the Beline NPP, pushed Bulgarian authorities to keep a low profile in the Cernavoda 2 case vis a vis Romania at the end. A choice that seems to be passively accepted by the European Commission, in order to minimize conflicts with the second wave of accession countries for the time being. Such a political attitude would result in a “lose-lose” situation where two controversial nuclear projects would be completed in violation of national and international environmental law, thus avoiding to use these cases as a political leverage to accelerate the adoption of EU and international rules and standards in domestic environmental law, as requested under the EU accession process, in countries which still have a bad environmental record.

However, in a written reply to NGO concerns, Commissioner Verheugen acknowledged the importance of the Espoo Convention in the Cernavoda 2 case and committed to monitor developments of bilateral relations between Romania and its neighbours as concerns the significance of the project in a transboundary context and the implementation by Romanian authorities of the provisions under the Espoo Convention. (see Annex 3) By financing the Cernavoda 2 project under current conditions it would support the violation of international environmental law that it has been promoting since its inception.

**High risks not considered**

The ICIM study does not address at all outstanding safety problems of CANDU technology and the necessary improvements, which have been suggested in several technical mission reports about CANDU reactors in the past years.

The earthquake risk for the Cernavoda NPP is grossly underestimated by a factor two, even though Romania is one of the most active earthquake regions in Europe. Old seismic data and literature have been used in the EIA study without considering significative events occurred in the last ten years.

On the basis of the EIA summary it is impossible to justify the absence of risk from external events such as flooding, explosions or airplane crash. The estimation of the overall risk associated with accidents with large radioactive releases is underestimated comparing with Western European standards and no sufficient database is provided to verify the transport calculations for the impact of radioactive effluents into air and water under accident conditions. Furthermore, all calculations do not include meteorological and precipitation data. (see Section 2)
Finally, no measure for the permanent monitoring of the water quality and special protection in case of contamination is provided, even though groundwater is used for drinking in many villages and towns in the Cernavoda area.

It should be noted that the FFM to Romania of last January detected the complete lack of independence of the Romanian Nuclear Regulator, CNCAN. The FFM formally requested separate meetings with the nuclear regulator - which is also the Secretary of State of the Romanian Ministry of Water and Environmental Protection - the environmental authorities and the nuclear state-owned company, SNN. Nevertheless the Mission has been allowed to meet environmental experts only in a meeting convened by the Nuclear Regulator and at the presence of representatives of the nuclear company who systematically influenced the Regulator and the overall meeting, even by wrongly translating the interventions of the environmental authorities.

A project for export and not for the Romanian people

The real aim of the Cernavoda 2 project is to produce electricity for export to western European countries and not for matching energy needs of the Romanian people. As a matter of the fact, the country is still experiencing a severe economic crises, its energy demand is not increasing and some of the electricity produced at Cernavoda 1 is being exported. In particular, Italy has a strong interest in importing additional nuclear energy produced at Cernavoda, even though nuclear production on the Italian territory has been banned through a popular referendum since 1987. Quite a clever expedient to relocate nuclear production and associated risks far away to Eastern Europe. The option of exporting nuclear energy produced in the future at Cernavoda has not been excluded by the Romanian Electricity Regulator in its written reply to international NGOs’ concerns. (see Annex 4).

All EIA studies are based on the conclusion of the 1998 Alternatives Study commissioned by the European commission and never made public. The economic due diligence being carried out by the European Investment Bank will not be made public by the Commission as well. No detailed cost-benefit analyses for each of the options considered in the EIA studies has been produced and the Romanian government has kept refusing to disclose the production figures documenting costs at Cernavoda 1 to the public in order to justify the economic viability of the Cernavoda 2 completion project.

At the same time the Romanian energy system needs immediate interventions in energy efficiency as regards existing fossil-fuel fired and hydro power plants and the transmission grid, as admitted by the energy experts of the European Union Mission in Bucharest to the international Fact-Finding Mission in February 2002. Furthermore, the significant renewable energy potential in Romania has not been seriously explored to date. (see Section 3).

In any case, it is clear that in the view of Romanian authorities the completion of Cernavoda 2 would pave the way to the construction of the third and further units – currently preliminary civil works for three more units are in place at Cernavoda, after the suspension of construction activities due to the collapse of the communist regime. As reported by Reuters last February (see Annex 5), the Romanian government has offered a Korean-Canadian-Italian consortium 10-year control of a third planned reactor at Cernavoda under a build-operate-and-transfer scheme, with the aim of turning the European Union aspirant into a key Balkan power exporter for the more and more liberalised European energy market. In this way, Romania would avoid resorting to long-term, state-guaranteed loans as it has done so far. “It would be an easy start for us to get into the EU’s
energy market”, commented a member of the Parliament’s industry commission in charge of the new nuclear deal, while defining western CANDU technology safe in contrast with Soviet-era nuclear plants operating or planned in Eastern Europe.

**Conclusions**

In the approach followed by Romanian authorities in the case of the Cernavoda 2 project there is an assumption that the outstanding environmental issues as well as the issue of spent fuel and nuclear waste in Romania appear small compared to the safety and closure of nuclear plants in other candidate countries, such as Bulgaria, so that the European Commission at the end might tolerate the full development of the Romanian nuclear program in the next years starting soon with the completion of Cernavoda 2. It is necessary that the European Commission intervene actively in the Cernavoda 2 case by delaying the approval of the Euratom loan until when all safety and environmental standards, both at national and international level, are fully met by Romanian authorities.

At the same time, under the current situation of the Romanian energy system requiring non-nuclear energy intervention Euratom financing of the Cernavoda 2 project is not coherent with European Union’s environmental and energy policies and therefore it should be denied to the Romanian government. By approving a 223 million € Euratom loan for the project the European Commission would inevitably lose any political leverage to move the Romanian government to live up its safety and environmental standards before the accession date of 2007.
SECTION 1

Potential breaches under the Romanian Environmental Protection law and Romanian Obligations in a transboundary context (Espoo Convention) associated with the Cernavoda 2 NPP project

By Helene Izidi, consultant
on behalf of Campagna per la riforma della Banca mondiale

I. Potential breaches under the Romanian Environmental Protection law (Law No. 137/December 29, 1995 and its Permitting Procedure No. 125/1996)

A. Background information

At the local Environmental Protection Inspectorate in Constanta that the Fact-Finding Mission visited on Monday 20th January 2003, the FFM was able to briefly consult the whole Environmental Impact Assessment documentation available to the public.

The mission faced with the following documents:

- An Environmental Assessment Study for the Cernavoda 2 NPP project carried out by ICIM and published in January 2002;
- A summary in English of the ICIM EIA Study published in July 2002;
- A summary in Romanian of the ICIM EIA Study published in August 2002;
- “Borderau” of documents needed to obtain environmental agreement for Cernavoda 2 NPP project – due diligence carried out by the local environmental protection inspectorate in Constanta;
- Report on the proceedings of the public consultation which took place between 15.08.2001 and 21.09.2001;
- Governmental order No. 234 31.03.99 regarding environmental agreement for Cernavoda 1 NPP;
- Two ICIM Studies produced in 1999 and 2000 about thermal impacts of the Cernavoda NPP on the Danube Canal;
- A safety study on combined accidents both at unit 1 and 2, #515/25.10.2001.

The environmental impact assessment process apparently began with a first set of environmental studies carried out by the AECL. This led to two summaries, one in Romanian, in July 2001, and the other in English, published in Canada in December 2001 under request of export development of Canada. Initially, it seemed that both summaries were not exactly the same. A public consultation was organised from August 15th to September 21st 2001, following the publication of the Romanian version (the “Raport”). Then at the beginning of 2002, a second set of

Footnote:
9 Campagna per la riforma della Banca mondiale promoted and organised an independent Fact-Finding Mission (FFM) to Romania from January 19th through January 24th, 2003. The Mission was joined by a representative of CEE Bankwatch Network, an independent French consultant expert on international environmental law, Helene Izidi, and two nuclear experts of Greenpeace USA and the Canadian Coalition for Nuclear Responsibility. Campagna per la riforma della Banca mondiale is the only organisation fully responsible for the content of the following analyses.
environmental studies was carried out by ICIM, and led to further summaries, one in English and the other in Romanian.

This numerous studies and reports produced a certain confusion. In fact, the FFM was faced with so many reports, that we were not able to identify with certainty which document was the official one. It should be noted that at this date the team has only received an electronic copy of the ICIM EIA study in Romanian, excluding relevant maps, the “Raport” and other relevant environmental documents, despite requests to the Romanian environmental authorities under the Romanian Law 544/2001 on Access to Information.

**Box I : Romanian Legislation on Environmental Impact Assessment**

The two regulations that were in force at the beginning of the EIA process relating to the Cernavoda II project were:


Under EPL legislation, electrical power plants are bound by environmental agreements, that is to say, “technical and legal act which establishes the condition for implementing a project or an activity from the environmental impact point of view” (Appendix No. I, EPL). The CEPA (Central Environmental Protection Authority) is responsible for issuing this agreement.

In addition to this, Nuclear Production activity are listed as an activity that may have a significant environmental impact through its nature, size or location (Annex II of EPL) and therefore requires an environmental impact study for the issuing of the environmental agreement.

The EPL legislation was amended on June 20, 2002 and came into force in its revised version on January 17, 2003. Among other things this strengthened the public opportunity to be informed and to take part in decisions on specific activities. These amendments harmonize the law with the European legislation and above all the provisions of the UN/ECE Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, ratified by the Romanian Parliament through the Law No. 86/2000, in 2000, with relative implementing procedures issued in 2002. Specifically this Convention enables the public to become more involved in environmental matters and to actively participate in the preservation and protection of the environment. To achieve this aim, the Convention proposes an action in three areas:

- Allow public access to environmental information held by public authorities
- Promote public participation in the decision-making process on certain activities deemed likely to significantly affect the environment
- Widen access to justice in environmental matters.

It came into force on October 30, 2001.

**B. Examination of the EIA documentation and process**

**Box II : The stages of the environmental agreement issuance procedure.**

According to article 4 of the Permitting procedure for economic and social activities having an environmental impact, the following steps are needed:

- The project titleholder should submit the environmental agreement application. The submission must be accompanied by the description of the project and the main information available at that time. At the same time it must advertise the application through at least one of the publicity methods.
- The Local Environmental Protection Authority (LEPA) analyses the application in order to see whether this activity requires an impact study or not. LEPA analyses the purpose of the proposed activity and whether the project can be environmentally regulated. They shall request additional information or preliminary environmental impact study.
- If the project can be regulated, LEPA prepares guidelines in order to figure out what have to be addressed in the EIA study. To prepare these guidelines, LEPA have to consider the preliminary comments received from the public following the public announcement of the application.
The EIA study is carrying out according to the methodology described in Annex 4 of the Permitting procedure No. 125/1996. The would-be Licence holder of the project must give to LEPA the report of the EIA study ("Raport"). This report must contain all alternatives analysed, including that of renouncing the activity. "Minimum contents" of the report on EIA are provided in Annex 5 of the Permitting Procedure No. 125/1996. LEPA analyse the report. For this purpose, they can be helped by the technical review team, consisting of representatives of the local public administration and the bodies that issue the preliminary endorsements required for the release of the environmental agreements. LEPA accept it or request for the report to be revised. The accepted report has to be subjected to public debate by LEPA.

The would-be licence holder must present to LEPA the following documents: technical memo prepared in accordance with the contents provisions stated in Annex 6 of the Permitting procedure, regulatory acts, and the Environmental impact study. LEPA and, if appropriate the technical review team, analyse the documents and verify them if necessary; LEPA submit them to CEPA for activities under CEPA competence. CEPA may carry out verifications.

LEPA or CEPA, make the final decision regarding the issuance of the environmental agreement for the activities under its competence. The decision must be made public and the documents the decision has been based on, made available upon request. The decision can be appealed within 30 days from the announcement.

**The summary, “Raport”, in Romanian of the EIA Study by AECL** has been presented to the FFM as the official one, that was used for Public consultation. At first sight, it seemed to the mission that a summary of 54 pages is rather lightweight for a report of the EIA study. The Environmental Assessment Summary (EAS) made public by AECL at the end of 2001 on the basis of the full Canadian EIA study consists of more than hundred pages. To this respect, it should be noted that the full EIA study by AECL was not available, although it should have been given to the LEPA as part of the environmental agreement issuance procedure (see Box II above).

A follow-up visit to the LEPA in Constanta by an independent consultant of Campagna per la riforma della Banca mondiale in February 2003 proved that the two summary are different and have not got the same structure either. In particular, the two studies include a different assessment of estimated future energy needs in Romania. Furthermore, all the references to economic justification of the nuclear project and non-nuclear alternatives included in the EAS by AECL, even though in a limited and inadequate manner, are not included in the “Raport”, although a study of the alternatives, taking into account the associated environmental impacts, is essential to appreciate the necessity and the relevance of such a project. This is also an explicit requirement under the Permitting Procedure for economic and social activities having an environmental impact according to the Romanian Environmental Protection Law No. 137/1995 (Article 4.3.2). As a result, the FFM has serious doubts whether the public consultation has been based on appropriate information on the project.

To this respect, the FFM’s independent environmental due diligence of the project has detected, moreover, some anomalies in the public consultation process. A public announcement was made in two local and one national newspapers that three public debates be organised about the Cernavoda II Project. A first public meeting took place in Constanta on August 15, 2001, a second one in Cernavoda on the August 21, a third one in Medgidia on the August 30. A meeting with leaders of opinion from the area of the implementation of the project was also organised from

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10 From « Raport » : « The increase of industrial production estimated in next years will cause an increase of about 5-10% of electricity demand » (page 3, paragraph 1.1); from EAS AECL: «On the basis of the forecasted industrial growth, the demand for electrical energy in Romania is expected to increase approximately 3% annually over the next 10 years».
12 « Adevarul » on July 30, 2001
August 16 to 27, 2001 in Cernavoda, as well as a meeting with specialists from the environment protection field in Bucharest on August 30, 2001. The public debates were organised and funded by SNN, state-owned nuclear company and lead project sponsor, under the supervision of the environment protection authorities, as required under the former and current Romanian legislation. Thus, even if such a practice is allowed by European and international standards, the FFM argues that such a provision leads inevitably to a self-interested behaviour from the project developer. In this case, for example, the FFM found out, by reading the list of participants, that the hearings were loaded with pro-nuclear NGOs, some of them directly supported by the industry and that no NGO critical about nuclear issues attended the debates.

The Environmental Assessment Study carried out by ICIM and published in January 2002 is made up of 3 volumes and 1 appendix for maps and looks most like a real EIA study. Nevertheless, it has not been subject to any particular announcement to the public. It also passed unnoticed that only the Summary in English was published on the web site of SNN, the would-be licence holder. Moreover, according to a Review carried out by the Austrian Institute for Applied Ecology\textsuperscript{13}, the information provided in this Summary is completely insufficient to understand EIA data and conclusions.

When asked why SNN commissioned a second study and why the ICIM EIA document was not subject to the proper procedure, namely not resubmitted to public consultation at its completion, the FFM received a surprising answer from the Romanian authorities:

Since the FFM has been allowed to meet environmental experts in Bucharest only in presence of representatives of the nuclear company who systematically influenced the meeting and even the translation of the contributions by the environmental authorities, the Mission was not able to address such issues with them separately. Following up on the unsatisfactory conclusion of the meeting the FFM sent a written request for public information to Mrs. Dumitru\textsuperscript{14} and Mrs. Dumitrita Mereuta\textsuperscript{15} at the Ministry of Waters and Environmental Protection on January 31, 2003, according to the procedures under the Romanian Law on Access to Information. In reply to the FFM’s question of why a second study was commissioned (see in Annex 6 for the full letter), the Romanian authorities admitted that the public consultation had been based on “illegal” EIA documentation, that “a second study was asked because, according to national legislation, the environmental impact study (EIS) has to be made only by a natural or legal person certified according to Minister Order (MO) 278/1996 and the EIS has to be done according to the MO 125/1996 requirements.” Thus Romanian authorities recognised that the AECL was not certified to carry out such a study and that the EIS made by them did not meet the national requirement in this matter. Furthermore, the question of why a second public consultation had not been organised after the publication of the ICIN study remains vaguely answered by the Romanian authorities.

C. Conclusion

The state of disarray of the EIA reports, as well as the lack of fundamental information in the Environmental assessment and the lack of transparency in the public consultation process lead the FFM to question the safety of the project. The mission is doubtful about the intention and the


\textsuperscript{14}General Director for Environmental Regulation, Permitting Certification and Waste Management, Romanian Ministry of Waters and Environmental Protection

\textsuperscript{15}Director for Strategies, Policies, and Regulations, Romanian Ministry of Waters and Environmental Protection
capacity of the Romanian environmental Authorities to ensure an efficient and transparent Environmental Impact Assessment. As a result, the information and data available to the public and the competent authorities are insufficient to properly assess the potential harm to the environment and the population, the risk in the event of an accident, as well as the main alternatives to the project. The content of the EIA documentation is evidently not in compliance with the former Romanian environmental Law, in force at that time. Moreover, the public consultation was based on “illegal” EIA documentation, as admitted by the Romanian environmental authorities in their correspondence with the FFM.

In addition to that, the Environmental Assessment in the Cernavoda project is at odds with the European requirements and standards on this matter. The compliance with the European legislation is, however, a sine qua non condition to the accession to the European Union in 2007. Moreover, as a direct result of the inconclusive environmental assessment, the information disclosed to the public is insufficient and inappropriate to allow the public to participate effectively in the decision-making process. The public participation is nevertheless, a basic requirement under the Aarhus Convention, ratified by Romania in 2000, and under the new environmental law recently amended among other things to comply with this Convention.

For all the above reasons and because it is unclear whether the Environmental Agreement for the project has been already released, the FFM believes urgent to request the missing studies and ask for the provision of all the relevant information, as well as to conduct a proper public consultation. It would be a good opportunity to promote the correct implementation of environmental law in accession countries, in particular in Romania, whose record still remains questionable as repeatedly admitted by EU authorities. It would also allow to raise awareness among decision-makers and civil society in Romania regarding the provisions under the new national environmental law recently enforced pursuant to the new European and international environmental obligations and standards.

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II. Potential breaches under Romanian Obligations in a trans-boundary context - Espoo Convention

The Romanian’s authorities failure to conduct an efficient Environmental Impact Assessment Process is all the more problematical since this project is likely to have a significant adverse transboundary impact on neighbouring countries, starting with Bulgaria, whose border is located less than 50 km from Cernavoda NPP. Romania is therefore obliged to cooperate with neighbouring countries in assessing the Environmental impact under the provisions of the UN/ECE Espoo Convention on EIA in a Transboundary Context. In fact, this Convention has been ratified and entered into force in all neighbouring countries but Yugoslavia in the past years.

Box III: Espoo Convention on Environmental Impact Assessment in a Transboundary Context

International Treaty negotiated by the member countries of the United Nations Economic Commission for Europe (UN/ECE). The ECE covers Europe, the US, Canada, Israel and the five Central Asian which were formerly part of the USSR. This Convention aims to enhance co-operation in assessing environmental impacts, particularly in a trans-boundary context. It came into force on September 10 1997, and currently consists of 40 Parties. Romania ratified it in 2001; all its neighbouring countries, but Serbia, both signed and ratified the Convention in the past years.

The Convention applies to all activities which may have a significant impact on the environment across boundaries, including government, private or semi-public activities. These activities are subject to the permission of the national authority of the country where the project is going to take place, and must be submitted to an environmental impact assessment prior to the decision to authorize or undertake them. A non-exhaustive list of activities which are considered likely to cause such an impact is provided in the appendix I of the Convention.

A. Romania failed to notify in due course

At the beginning of the EIA process in Romania in 2001, the Romanian authorities failed to inform neighbouring countries of the Cernavoda Project, although the completion of a nuclear power plant is listed in Appendix 1 of the Espoo Convention as “the activity that is likely to have significant adverse trans-boundary impact” and must be notified to potential affected parties. The environmental authorities questioned on this issue during the meeting with FFM in Bucharest did not consider transboundary pollution to be credible.

In November 2002, Bulgaria, which is also a contracting Party to this convention, requested information from the Romanian authorities, considering that such a project, less than 100 km from its own borders, could potentially have a significant adverse trans-boundary impact on its territory. They received Notification as well as the Summary in English of the ICIM EIA study completed in July 2002. The Romanian authorities gave Bulgaria a very short deadline, over the Christmas holiday period, to organise the Public consultation and send the public comments back to them. Because Romania failed to notify in due course, that is to say “as early as possible and no later than when informing its own public about that proposed activity” (article 3.1, Espoo Convention), the public in Bulgaria was deprived of their right to participate in the EIA process at the start of the proceedings. It is nevertheless essential under the Espoo and the Aarhus Convention that

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17 Bulgaria ratified the Espoo Convention on May 12 1995
18 The part II of the Aarhus Convention relating to the public participation to the decision-making process on certain activities deemed likely to significantly affect the environment, makes express reference to the decision-making process defined in the Espoo Convention. The Aarhus Convention reinforce the obligation to promote public participation in decision-making process and described in more detail the procedure.
the public participation begins at the earliest stage of the project initiative, when all the options and solutions are still open and the public can have a real determining effect.

Then, the Bulgarian Authorities hurried the process. An announcement was published in the newspaper – namely close to erotic advertisements - on January 10 stating that the Summary produced by the government of Romania as well as the Notification will be made available to the public in the ministry’s building in Sofia and the written comments will be received up until January 24, 2003.

During a meeting with the Bulgarian Environmental Deputy Minister in Sofia on 18 January 2003, representative of Campagna per la riforma della Banca mondiale pointed out that two weeks was not a sufficient time to properly inform the public, and particularly to allow the locally affected communities to get more information, or to conduct an efficient public consultation. The Bulgarian Environmental Protection Act\textsuperscript{19} ensures public access to the EIA documentation for a period of thirty calendar days in respect of such a project in the Republic of Bulgaria\textsuperscript{20}. Furthermore, international recognized standards, such as World Bank standards, provide at least a 60 day-long period for public comments.

Four Non-governmental organisations\textsuperscript{21}, including three from Varna on the Black sea and one from Sofia, sent a letter to Mrs Georgieva, Deputy Environment Ministry, last January to show their interest in this project, and requesting the copy of the Environmental assessment documentation. They also asked them to postpone the deadline of the public consultation and to organise a public hearing in north-eastern Bulgaria, the area likely to be affected. The ministry responded favourably to the information request, by putting the EIA summary and the notification received on their web site\textsuperscript{22} on January 27, 2003. The Bulgarian authorities decided also to extend the deadline for collecting public comments to March 10, 2003.

Finally, all NGO submissions and Bulgarian official comments have been submitted to Romanian authorities in April 2003.

**B. Romania failed to send the minimum information**

The Romanian authorities **have failed to send adequate information to Bulgarians**. In fact, at the meeting with the Bulgarian Environmental Deputy Minister in Sofia on January 18, 2003, NGO representatives realised that the Romanian authorities provided Bulgaria with the English summary of the ICIM Study, even not the full EIA study. In addition to the fact that the information provided in this summary is fully inappropriate according to the Review carried out by the Austrian Institute for Applied Ecology\textsuperscript{23}, this information is also insufficient under the Espoo Convention, that requires the Party of origin of the project to give to the potential affected party some minimum information in the environmental impact assessment documentation. A non-exhaustive list of information is provided for in Annex II of the Convention. (see box IV below).

\textsuperscript{19} Environmental Protection Act, promulgated, State Gazette No. 91/25.09.2002
\textsuperscript{20} Article 97.3 under the Bulgarian Environmental Protection Act
\textsuperscript{21} Mr Petko Kovatchev for CEIE in Sofia, Mrs Darina Ivanova for SEA Club “Friends of the Sea in Varna, Mr Iliyan Iliev for the Public Centre ofr Environment and Sustainable Development in Varna, and Mr Doychin Karshovski for Mayday Foundation in Varna
\textsuperscript{22} www.moew.government.bg
\textsuperscript{23} See footnote 5
Box IV : Appendix II of the Espoo Convention
Information to be included in the environmental impact assessment documentation shall, as a minimum, contain:

a. a description of the proposed activity and its purpose
b. a description, where appropriate, of reasonable alternatives to the proposed activity and also the no-action alternative
c. a description of the environment likely to be significantly affected by the proposed activity and its alternatives
d. a description of the potential environmental impact of the proposed activity and its alternatives and an estimation of its significance
e. a description of mitigation measures to keep adverse environmental impact to a minimum
f. an explicit indication of predictive methods and underlying assumptions as well as the relevant environmental data used
g. an identification of gaps in knowledge and uncertainties encountered in compiling the required information
h. where appropriate, an outline for monitoring and management programmes and any plans for post-project analysis, and
i. a non-technical summary including a visual presentation as appropriate

Thus, in addition to the very poor quality of this summary, the Mission detected several inadequacies:

- No reasonable alternatives are considered in this report. Only one sentence on page 7 of the report, deals with a vague idea of alternatives: “The completion of this project will offer Romania an important source of clean, low-costs, reliable electricity and will avoid the production of over 4 million tons of CO2 per year which would be generated by a comparable coal fired plant”. The comparison to a coal fired plant is however, completely inadequate, and could hardly be considered as a genuine alternative. Moreover, hydro and highly efficient gas-fired alternatives are not adequately explored, and no alternative interventions for the improvement of the efficiency of the national electricity grid and the no-action alternative are not considered at all.

- The potential environmental impacts are not described under severe accident conditions as shortly reported on page 133 of the report. Only 6 severe accidents are very briefly mentioned but not one word on environmental impacts of such accidents, although these kinds of accidents may influence territory far beyond the 30 km wide exclusion zone and reach neighbouring states. It should be noted that the Bulgarian border is located less than 50 km away from the Cernavoda NPP.

Moreover, the assessment of the impact on air quality, as mentioned in the report on page 125, is partial and limited only to some aspects: “Unit 2 is designed to have ventilation and discharge systems for the emission from the reactor building and the services building. These systems recover the D2O vapours and retain other pollutants by filtering before the air is exhausted under continuous monitoring. There are no radiological emission released to the air without control and filtration”. This section is very misleading as tritium and carbon 14 are routinely released and cannot be filtered. It is all the more important that Candu’s release 30 times more the amount of tritium than does a typical BWR or PWR nuclear reactors.

In other respects, the potential impact does not cover the decommissioning stage at all.

Finally, the authors of the EIA Study apply a very restrictive approach to the definition of impacts. For example, they believe that driving species out of their habitats is not an impact:
“As a matter of fact, a survey of pertinent literature shows that fish will move if they find the water temperature intolerable, but they can remain in a zone with tolerable temperatures if they are capable to acclimatizing to it. An adverse effect on fish is therefore not expected” (page 119).

- Mitigation measures are only mentioned in the general description of impacts: “Diminishing the quantity of the radioactive waste should be taken into consideration” (page 29). Neither a clear Environmental Action Plan, nor a division of responsibilities is provided for.

- There is no explicit mention of predictive methods, underlying assumptions as well as relevant environmental data used. There is no clear indication of the methods used. For example, concerning the assessment of the impacts on flora and fauna, the only prediction given is the following “the estimated dose varied between 0.6 and 1 mGy/year, much below the dose criteria accepted by the International Community” (page 129). Neither the method, nor the assumption is described, nor any information on relevant environmental data used for drawing this conclusion.

- No outline of the outside environment monitoring system is included in this report.

- No non-technical summary either as requested by international environmental best practices.

C. Conclusion

The co-operation between Romania and Bulgaria is almost non-existent because the Romanian authorities failed to notify in due course and to send appropriate information to the Bulgarian government under the Espoo Convention. In fact, the report sent by the Romanian authorities to Bulgaria lacks fundamental information about the environmental assessment.

Moreover, although public participation is a fundamental requirement under the Espoo Convention and reinforced under the Aarhus convention, Romanian authorities failed to “provide an opportunity to the public in the areas likely to be affected, to participate in relevant environmental impact assessment procedures regarding proposed activities and ensure that the opportunity provided to the public of the Affected Party is equivalent to that provided to the public of the Party of origin” (Article 2.6, Espoo Convention).

Romania did not respect its obligations towards its neighbouring countries in accordance with the Espoo Convention, as well as under the European directive on EIA which makes specific reference to the Espoo convention in this matter in its recent amendments.

There is therefore a crucial need that Bulgaria receive additional and appropriate information about this project from the Romanian authorities, and that a proper Public consultation, based on relevant information, takes place in Bulgaria before the final decision is taken in Romania.

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24 See footnote 8
SECTION 2

Hazards associated with the Cernavoda 2 NPP that may have transboundary significance, but which are not adequately treated in the ICIM Cernavoda 2 Environmental Impact Summary.

By Gordon Edwards, Ph.D., President
Canadian Coalition for Nuclear Responsibility
on behalf of the International Fact-Finding Mission on Cernavoda 2 (January 2003)

The present paper has been submitted to Dipl. Eng. Manoela Georgieva, Deputy Minister of Environment and Water of Bulgaria on March 10th, 2003, as requested by her office during a meeting with representatives of Campagna per la riforma della Banca mondiale in Sofia on January 18th, 2003. The submission to the Bulgarian government meant to contribute to its evaluation of the environmental information about the controversial Cernavoda-2 NPP project made available to it upon explicit request by Romanian authorities under the provisions of the UN/ECE Espoo Convention on EIA in a Transboundary Context. The paper has been transmitted, along with other NGO submissions, to Romanian authorities in April 2003.

CANDUS and Catastrophic Accidents

First and foremost, it is important to note that CANDU reactors are by no means immune from the threat of catastrophic accidents. In what follows, we call your attention to several official Canadian documents dealing precisely with this point. In the event of such an accident, large quantities of radioactive materials can be released into the atmosphere and can travel for many hundreds of kilometers, contaminating land, buildings, food, and water supplies through radioactive fallout.

Since 1978, when the first of these official documents was published in Canada (A Race Against Time, the report of the Ontario Royal Commission on Electric Power Planning dealing specifically with Ontario's nuclear reactors), there have been no new orders for nuclear reactors anywhere in Canada, nor are there any plans for building more CANDU reactors by any public utility in any of the provinces or territories of Canada.

Potential for Transboundary Effects

Members of the International Fact-Finding Mission on Cernavoda-2, which visited Romania in January 2003, were stunned when told by officials of the Environmental Protection Agency that they considered transboundary impacts from the Cernavoda-2 reactor to be impossible. At the same meeting, the head of the Romanian nuclear regulatory agency insisted that transboundary effects are not relevant because, he said, "we have a containment structure; we have a one-kilometer exclusion zone."

The naiveté of these comments is chilling. Contrast them with the published findings of the Ontario Royal Commission of Inquiry Into Electric Power Planning:

"All operating nuclear reactors accumulate in their cores, as we have indicated, a large quantity of radioactive material. For the most part this is made up of fission products, many of which are short lived and usually very radioactive, and the actinides (e.g. plutonium-239) which are very long lived and highly toxic substances.
"By definition, a major reactor accident would lead to the severe overheating, and subsequent melting, of the nuclear fuel, which would give rise to a substantial quantity of radioactive material escaping, after breaching several formidable barriers, into the environment.

"The major health and environmental threat would be due to the escape of the fission products to the atmosphere. The most important of these are caesium, ruthenium, tellurium and the fission gases, iodine, krypton and xenon.

"... If a substantial quantity of radioactivity were to be released to the atmosphere, the radioactivity would collect in a "cloud" and would be carried down wind.

"... At distances of two or three kilometres depending on wind velocity, the cloud would begin to disperse (the dispersal zone could extend to distances of several hundred kilometres) and radioactive materials would be deposited on the ground. In consequence, both prompt and latent cancers would be produced.

"... When we talk about the safety of a nuclear reactor, we are referring essentially to how effectively the fantastic amount of radioactivity contained in the reactor core can be prevented from escaping into the ground and atmosphere in the event of major malfunctions.

"Clearly, if a major release of this accumulated radioactivity occurred, as discussed in the previous section, the consequences would be extremely serious and could involve several thousand immediate fatalities and many more delayed fatalities."

A Race Against Time, pp. 73-76
Ontario Royal Commission on Electric Power Planning, 1978

Evidently, severe accidents in CANDU reactors -- which by definition are fuel-melting accidents -- do carry with them a potential for serious transboundary effects.

In answer to direct questioning from members of the Fact-Finding Mission, Romanian officials confirmed that the six cases of "severe accidents" listed on page 133 of the ICIM EIA Summary do involve fuel melting. Nevertheless, there is no acknowledgment or discussion of transboundary effects -- nor, for that matter, even of local environmental contamination resulting from such accidents.

**Attitudes and Perceptions**

Following the Three Mile Island (TMI) accident, the Select Committee on Ontario Hydro Affairs -- an all-party committee of the Ontario Legislature -- held public hearings on the hazards of CANDU reactors. From its 1980 Report on this matter:

"It is not right to say that a catastrophic accident is impossible.... The worst possible accident . . . could involve the spread of radioactive poisons over large areas, killing thousands immediately, killing others through increasing susceptibility to cancer, risking genetic defects that could affect future generations, and possibly contaminating large land areas for future habitation or cultivation."

The Safety of Ontario's Nuclear Reactors, pp. 9-10.
Select Committee on Ontario Hydro Affairs, 1980.
None of the Romanian officials we met recognized these threats as credible in the context of the Cernavoda 2 NPP. Indeed, they seemed bewildered that we would even raise such questions. In effect, they were telling us that catastrophic accidents are impossible. Such an attitude of denial, based on ignorance or not, is dangerous.

Following the Three-Mile-Island (TMI) accident in 1979, US President Jimmy Carter ordered a special Presidential Inquiry into the causes of the TMI accident. The Commission found that attitudes of denial on the part of the regulators and operators of nuclear power plants, preventing them from appreciating the danger, was one of the most important factors contributing to the severity of the accident.

"OVERALL CONCLUSION"

"In announcing the formation of the Commission, the President of the United States said that the Commission 'will make recommendations to enable us to prevent any future nuclear accidents.' After a six-month investigation of all the factors surrounding the accident and contributing to it, the Commission has concluded that:

"to prevent nuclear accidents as serious as Three Mile Island, fundamental changes will be necessary in the organization, procedures, and practices -- and above all -- in the attitudes of the Nuclear Regulatory Commission on and, to the extent that the institutions we investigated are typical, of the nuclear industry."

"... the belief that nuclear power plants are sufficiently safe ... must be changed to one that says nuclear power is by its very nature inherently dangerous, and, therefore, one must continually question whether the safeguards already in place are sufficient to prevent major accidents."


Positive Void Coefficient of Reactivity

There is one outstanding feature of the Cernavoda 2 design that makes it particularly vulnerable to serious accidents, including meltdowns.

Instead of containing all the nuclear fuel in one large vessel, CANDU reactors house the fuel in hundreds of separate "fuel channels" each enclosed in its own individual "pressure tube". In this regard, CANDU is similar to the Chernobyl reactor design.

It is well known that such "pressure tube" reactors all share a dangerous characteristic known as "positive void coefficient of reactivity". In plain English, the positive void coefficient means that whenever there is a loss of coolant in one or more channels of the reactor core, there is an immediate power surge. This compounds the accident, for if the power surge is not immediately dealt with -- within seconds -- the core could self-destruct quite violently, and the resulting energy release could breach the containment, providing a pathway for radioactivity.

The world's first severe nuclear accident took place in Chalk River Ontario in 1952, when the Canadian NRX research reactor (a precursor of the CANDU) suffered a loss-of-coolant. It was
accompanied by a power surge, due to the positive void coefficient, and the control rods were unable to stop the fission reaction. This precipitated a series of explosions (either steam explosions or hydrogen gas explosions, no one is certain) powerful enough to fling the four-ton gasholder dome through the air and destroy the core of the reactor. The damaged NRX reactor core is buried somewhere on the Chalk River site.

In 1969, in Switzerland, the Lucens reactor -- another pressure tube design -- exploded inside a rocky cavern when a loss-of-coolant accident (LOCA) provoked an uncontainable power surge; the reactor was totally destroyed.

The pressure-tube design of the ill-fated Chernobyl reactor was an important factor contributing to the sudden surge in power and heat -- brought on by the positive void coefficient -- that led to the melting of the core and the explosive penetration of containment in the accident of 1986.

The positive void coefficient of reactivity is a generic design flaw of all pressure tube reactors; it is one of the worrisome characteristics of the Cernavoda 2 reactor.

**Probability of Meltdown in CANDU Reactors**

On page 133 of the ICIM Cernavoda 2 NPP Environmental Impact Summary, one reads of "severe accidents that are not considered in the design because their probability is lower than \(10^{-7}\) events per year." Thus ICIM claims that severe accidents in CANDUs would occur less than once in 10 million reactor years!

These probability estimates are simply not credible.

In 1974, the US NRC (Nuclear Regulatory Commission) published its 12-volume Reactor Safety Study (commonly known as "The Rasmussen Report"). The report concluded that the probability of a complete core meltdown is about 1 in 20,000 per reactor per year. That is already 500 times greater than the ICIM estimate for the probability of a "severe accident" at Cernavoda 2 with (according to ICIM) no serious environmental consequences worth mentioning.

One of the major findings of the Rasmussen Report was that small pipe breaks, rather than large pipe breaks, are the most significant contributors to the probability of a core meltdown in a nuclear reactor. Because of its "pressure tube" design, the CANDU reactor has a great deal more small piping -- even in the primary cooling system -- than other reactor types. Thus the probability of a small pipe break in a CANDU reactor is significantly higher (one or two orders of magnitude more) than the probability of a small pipe break in an American light-water reactor.

Thus the probability of a core meltdown in a CANDU reactor such as Cernavoda 2 may well be higher than the probability of such an accident in an American Light Water reactor. Indeed, that was one of the conclusions reached by the Ontario Royal Commission on Electric Power Planning in its 1978 Report about Nuclear Power in Ontario, as seen in the following excerpt:

"During normal operation, not only is a great deal of radioactivity created in the reactor core but also a great deal of thermal energy. If the shutdown system fails to operate in response to a fuel temperature rise, caused by a major rupture in the primary coolant circuit, a rapid escalation of heat and temperature would occur. The purpose of the ECCS [Emergency Core Cooling System] is to remove the heat from the core as rapidly as possible."
"If, however, both primary coolant and emergency coolant fail there would probably
be partial or complete melting of the reactor core. An uncontained complete core
meltdown would almost certainly give rise to a large release of radioactivity, the
consequences of which were discussed previously....

"Assuming absolute independence of the process and safety systems, the probability
of a core meltdown per reactor at Pickering is said to be in the order of 1 in
1,000,000 years....

"However, two well-informed nuclear critics who participated in the hearings, Dr.
Gordon Edwards and Ralph Torrie, have argued that the probability of a dual failure
could be about 100 times higher than the theoretical levels. This estimate is based
on failure rates in the high pressure piping of the primary heat transport system being
10 times higher than has been assumed, and also on the fact that the availability of
the Pickering ECCS has been demonstrated to be 10 times lower than postulated
by the designers.

"We believe that the Edwards/Torrie estimate [of 1 in 10,000 per reactor per
year] is more realistic than the theoretical probability, not least because the
Rasmussen Report has concluded that the probability of an uncontained meltdown in
a light water (U.S.) reactor is 1 in 20,000 per reactor per year. It has been
suggested, moreover, that this figure could be out by a factor of five either way.

"Assuming, for the sake of argument, that within the next forty years Canada will
have 100 operating reactors, the probability of a core meltdown might be in the
order of 1 in 40 years, if the most pessimistic estimate of probability is
assumed...."

A Race Against Time – Nuclear Power in Ontario, pp. 78-79,

Thus in Canada, independent assessment of the CANDU industry's probability figures by a credible
and responsible body has shown those estimates to be highly suspect. The same can be said of the
unsupported probability figures for "severe accidents" at Cernavoda 2 quoted by ICIM. Hence the
industry's low probability estimates do not constitute a valid reason for refusing to address the
transboundary health and environmental consequences of severe accidents at Cernavoda 2 NPP.

Unavailability of Safety Systems

Reactor designers have provided special safety features to deal with anticipated emergencies:
containment systems, emergency core cooling systems, fast shut-down systems, emergency
electrical supply systems, and so on. Unlike most other reactor types, each CANDU reactor has
two fully independent fast shut-down systems. This redundancy was prompted by the need to cope
with the sudden surge in power following a loss-of-coolant, due to the positive void coefficient.
The cost of adding a second fast shut-down system was justified by the fact that "loss-of-regulation"
accidents -- those which may require the use of a fast shut-down system -- were occurring about a
hundred times more frequently in Ontario's CANDU reactors than predicted by the industry's
probability calculations.

In operational situations, however, CANDU safety systems are often partially or completely
unavailable. In some cases, CANDU emergency cooling systems have been unavailable for months
at a time. CANDU fast shut-down systems are also unavailable at times. Just recently in Canada, for example, CANDU workers mistakenly installed a neutron detector backwards, so that the second fast shutdown system would have been unavailable during an emergency.

Such unavailability episodes are usually not discovered by plant operators or regulators until long after the fact -- possibly during a maintenance shutdown, and sometimes not even then.

Likewise, CANDU containment systems have suffered impairments for long periods. The kind of problem outlined below is not an isolated instance:

"... a leak was discovered in the wall of the Pickering unit 2 reactor building in June, 1974, and may have existed for 1 and 1/2 years -- this leak 'would have reduced the ability of the containment system to limit radioactive release after any unit 2 accident since the beginning of 1973'... As Ralph Torrie has pointed out, the 'Pickering unit 2 containment would have to operate within target levels for 500 years before the average annual availability would be back within the bounds of the annual regulatory limit'.

"In assessing the legitimacy of the above limits it should be stressed that no study similar to the Rasmussen study has been undertaken in Canada to assess the reliability of the reactor system as a whole and the consequences of major CANDU reactor accidents."


The Cernavoda 2 reactor will be subject to similar problems of unavailability. On page 133 of the ICIM Report, for example, five of the six accident scenarios involve "impairment of the pre-existing containment envelope", while the remaining scenario involves "late containment failure due to steam over-pressurization". Given the hypotheses of impaired containment at Cernavoda 2, it is a mystery why ICIM believes that radiation releases will not continue beyond 24 hours.

In the event of a pipe break in the primary cooling system at Cernavoda 2, the superheated cooling water will flash into steam, instantly pressurizing the interior of the containment building and driving radioactive gases and vapors into the outer atmosphere if there is any impairment of the containment envelope. Such impairment of containment can occur in many different ways -- for example, by failure of ventilation dampers to close properly, by failure of personnel air-lock doors to seal correctly, or by means of undetected leaks around any of the hundreds of penetrations through the containment wall. As long as steam is being generated by the heat of the crippled core, radiation releases would be expected to continue.

Compared with the CANDU reactors in Ontario, leaks in the containment wall of Cernavoda 2 could have more serious health and environmental consequences in the event of a major reactor accident. This is because, at Cernavoda, there is no "Vacuum Building" as there is at every operating CANDU reactor in Ontario.

A "Vacuum Building" is a separate large structure connected to the reactor, designed to "suck up" all the radioactive steam and vapors released from the reactor core during a major accident. CANDU export models, like Cernavoda 2, have been re-designed without a Vacuum Building in order to reduce over-all costs.
Regulatory Concerns About CANDU Safety

In 1989, the Atomic Energy Control Board (AECB) -- the Canadian nuclear regulatory agency -- submitted a report to the Treasury Board of Canada. This report echoed the conclusion of the Ontario Royal Commission on Electric Power Planning cited earlier by re-asserting that there is no basis for believing that CANDU reactors are safer than any other type of reactor. It also added the important perception that safety problems seem to multiply as time goes by and the plants get older:

"When modern nuclear power plants were being designed in Canada two decades ago, their complexity and potential for catastrophic consequences were recognized. The plants were designed to high standards, and special safety systems were incorporated to prevent or reduce the consequences of malfunctions. Reactor designers and owners adopted a relatively simple process for evaluating plant safety. 'Worst credible' accident scenarios were investigated to ensure that their consequences would be acceptably low. It was then assumed that the consequences of less severe but more likely accidents would be acceptable.

"Since that time, experience in Canada and the rest of the world has demonstrated that this approach to safety is too simplistic. It is recognized now that, through the combination of a series of comparatively common failures which, on their own, are of little consequence, accidents can develop in a myriad of ways (as demonstrated most vividly at Three Mile Island and Chernobyl). This makes the calculation of consequences of potential accidents very difficult, research to simulate accident consequences is often incomplete, and, perhaps most significant, human errors are an unquantifiable element.

"As a result, there is a legacy of unresolved safety issues that should be addressed further. This issue is particularly important as twelve of Canada's largest reactors are close to Toronto.

"AECB's review of safety has also been too simplistic. Spot checks of a fairly small number of the key areas were thought to be sufficient. These spot checks have uncovered enough safety problems to demonstrate that more thorough review is essential, since the risk posed by nuclear power plants may be higher than once believed.

"The size and complexity of the task of ensuring and demonstrating the safety of nuclear power plants has not increased suddenly -- it has been building up for the last decade. It has led reactor designers, operators and regulators around the world to demand far more thorough analyses which are far more complex, and a far more detailed understanding of how a plant can malfunction, than was required in the past.

"The task is overwhelming the AECB. It does not have the resources to analyze and understand this increased level of knowledge and information. Three examples will illustrate the problem....

"The consequences of a severe accident can be very high. The accident at Chernobyl has cost the Soviet economy about $16 billion including replacement power costs. The accident has generated anti-nuclear sentiment in the USSR and throughout the world. Three Mile Island has cost the USA $4.8 billion even though the Three Mile Island accident had essentially no radiation impact on the public. The accident was a major contributor to the public distrust of nuclear power in the USA.
"The years of successful accident-free operation which are a hallmark of the Canadian nuclear program are not, by themselves, proof of adequate safety. Canada has amassed about 170 years of operation of large reactors, compared with 480 years in the US and 270 years in the USSR at the time of Three Mile Island (1979) and Chernobyl (1986) respectively. The likelihood of serious accidents cannot be judged from statistics such as these, and CANDU plants cannot be said to be either more or less safe than other types....

"Given the potential consequences of severe accidents everything possible should be done in order to increase the confidence in the AECB's judgment by improving the depth and breadth of its technical evaluations and inspections. The AECB considers that the scope and depth of the reviews on which it makes its judgments currently is insufficient. The resources needed to ensure that licensees are taking all possible measures to prevent accidents and for the AECB to take enforcement action when they do not are also currently insufficient."


In 1997, seven of Ontario's CANDU reactors were voluntarily shut down by the owner. Ontario Hydro, because of an inability on the part of Hydro management to cope with the huge backlog of safety-related maintenance issues:

"Long standing management, process and equipment problems in Ontario Hydro Nuclear (OHN) plants are well known but have not been aggressively resolved. . . . Immediate attention is needed to improve performance. . . .

"OHN staff at every level are reluctant to ask difficult questions of themselves and others. Failure to establish a questioning attitude is a primary cause of the reduction in the "defense-in-depth" concept. There is no real independent evaluation of proposed operations by people not directly involved in formulating the planned actions (e.g. is this the safest way to accomplish an operation? Are the operators challenged unnecessarily by the proposed change? Will all required structures, systems and components remain capable of performing their intended functions for their day-to-day mission and all credible accident scenarios?)"


Those seven Ontario reactors are still shut down today, six years later. Although plans are underway to restart some of them, the combined cost of doing so -- currently estimated at about three billion dollars -- may prove prohibitive.

If Ontario Hydro, despite its wealth of experience with CANDU technology and its stable of well-paid professionals, cannot manage to keep CANDU reactors operating safely, it is not unreasonable to ask how Societata Nationala Nuclearelectrica (SNN) will manage to do so with Cernavoda 2. Yet SNN officials seem completely unfazed by the challenge, perhaps because they do not yet grasp the complexities of the problems.
Meltdown After A Successful Shut-Down

Cernavoda 2 -- like all large nuclear power reactors -- will contain an enormous inventory of radioactive materials. About 300 different kinds of radionuclides will be created inside the reactor as an inevitable result of the nuclear fission process. They all generate heat as a result of radioactive decay. Most of the heat is produced by the "fission products" -- the broken bits of uranium and plutonium atoms that have been "split". In addition to the fission products are the "activation products" -- previously non-radioactive materials that have become radioactive as a result of nuclear transmutation -- and the very long-lived and highly toxic "transuranic elements" (the so-called "actinides") such as americium, plutonium, and curium -- heavy man-made elements, created when uranium atoms in the fuel absorb one or more neutrons without splitting.

As previously noted, large releases of radioactivity into the environment may occur whenever the reactor fuel is severely damaged and the containment of the reactor building is impaired. Moreover, fuel melting can occur in the absence of nuclear fission. The irradiated fuel will melt spontaneously even though the reactor is completely shut down, if there is inadequate cooling of the core. During the TMI accident, for example, the reactor was shut down almost immediately, yet fuel melting took place over the next two or three days.

The Cernavoda-2 reactor operating at full power will generate about 2100 megawatts of heat (only one-third is transformed into electricity). Immediately after shutdown, due to radioactive decay, the core will continue to generate about 7 percent of full power heat -- that is, about 147 megawatts of heat. One hour after shutdown, residual heat generation will still be about 4 percent of full power heat -- that is, 84 million watts of heat. That is more than enough heat to melt the core of the reactor. Unless the "decay heat" is removed promptly and continuously, the core will melt.

Moreover, even in the absence of a pre-existing impairment of containment, the course of the accident itself could unleash forces that would end up breaching the containment envelope through over-pressurization, explosions, or melt-through.

The Canadian Department of Energy Mines and Resources published a report on nuclear issues in Canada in 1981; here's some of what they wrote about meltdowns:

"In the absence of relevant Canadian information, the work done by N. C. Rasmussen, as described in the Reactor Safety Study (WASH-1400) issued in 1975 by the U.S. Nuclear Regulatory Commission is used. The following information borrows extensively from that document and although not strictly applicable to CANDU reactors, does give useful illustrative information on very serious potential accidents.

"The Reactor Safety Study defined two broad types of situation that might potentially lead to melting of the reactor core: a LOCA [Loss Of Coolant Accident], and transients.

- "In the event of a LOCA, the normal cooling water would be lost from the main cooling system but core melting would normally be prevented by the action of the ECCS [Emergency Core Cooling System].

"However, if the ECCS failed to act, melting of metallic components of the core and eventually of the uranium oxide fuel itself would probably occur."
"The term 'transient' refers to those situations where there is an uncontrolled increase in reactor power or a loss of normal cooling flow, both of which require the reactor to be shut down. Following shutdown, the decay heat removal systems act to keep the core from overheating.

However, if the reactor fails to shut down or the decay heat removal systems fail, melting of the core would ensue.

"The Rasmussen study conservatively assumed that if any melting occurred, then complete core melting would occur. It was then predicted that the molten core, consisting of a mixture of molten uranium oxide, stainless steel, zirconium, and other core structural materials, could melt through the bottom of the 20 cm thick steel reactor vessel and through the 3.69 meter thick concrete base slab of the containment structure.

"The study estimated the time for going through the reactor vessel to be 1 to 1 1/2 hours and through the base slab to be an additional 13 to 28 hours. The molten mass was then predicted to sink into the ground an additional 3 to 15 meters before coming to rest.

"Much larger consequences could be associated with core meltdowns which also cause failures in the containment structure above ground. If the containment sprays malfunction or are damaged by flying debris (generated by a LOCA or transient) the steam being released from the reactor core would not be condensed.

"This steam, along with various vapors and noncondensible gases, could cause failure of the containment structure due to over-pressurization. Hot zircaloy from the fuel sheaths and steel would also react with water to produce large volumes of hydrogen. Detonation of this hydrogen (reacting with oxygen) might damage the containment or, if not, the heat of combustion combined with high steam pressure would at least add to the pressure loads on the structure.

"A further contributor to containment pressurization would be the large quantities of carbon dioxide generated as the molten core melts through the concrete base slabs. Another possibility is one in which the molten fuel falls into the pool of water in the bottom of the reactor vessel with the formation of flying debris which could, in turn, damage the containment structure. All post-meltdown occurrences which threaten to damage or breach the containment structure can result in the release of substantial amounts of radioactive material to the environment."

Nuclear Policy Review Background Papers, pp. 210-211, Department of Energy Mines and Resources (Canada), 1981.

As already noted, ICIM lists six accident scenarios involving fuel melting on page 133 of the EIA Summary (although nothing is said about fuel melting in the text). In all of these scenarios, the Cernavoda 2 containment is assumed to be impaired (or breached) and "large" (or "significant") radioactive releases are assumed to take place, at least for the first 6 (or 24) hours. Yet each scenario is allotted only one sentence, and there is not even a definition of terms such as "large" and "significant". Nor is there any discussion of environmental impacts associated with these scenarios.
Consequences of Severe Accidents

The ICIM EIA Summary makes no mention of how much radioactive iodine, cesium, strontium, or plutonium is expected to be released in each of the six cases of severe accidents listed on page 133. There is no description of the behavior of the radioactive plume, no discussion of the degree of long-term environmental contamination remaining once the emergency is over, and no mention of possible transboundary effects. The ICIM document simply refuses to deal with such unpleasant realities.

According to the Rasmussen Report, under the worst conditions, a major nuclear accident could result in:

- about 45,000 cases of radiation sickness requiring hospitalization, of which about 3300 would die;
- about 45,000 fatal radiation-induced cancers in the thirty-year period following the accident;
- about 250,000 non-fatal radiation-induced cancers in the thirty-year period following the accident;
- about 170 genetically defective children born each year to the population surviving the accident;
- about $14 billion dollars (1974 dollars) in property damage, mainly due to radioactive contamination of food, water, land, and buildings.

According to the ICIM EIA Summary, the consequences of severe nuclear accidents at Cernavoda 2 are not even worth mentioning.

There are evacuation plans in the event of a nuclear accident at Cernavoda 2, and officials of the Environmental Protection Agency told the members of the Fact-Finding Mission about an actual rehearsal that was carried out last year.

However, those same officials revealed that they had never questioned the proponents of the project about possible residual radioactive contamination of the environment after the emergency was over.

If such matters were not raised in the report, members of the Fact-Finding Mission were told, then they were of no concern to the Environmental Protection Agency. They did not seem to think it appropriate that the Environmental Protection Agency should question the adequacy of the Environmental Impact Assessment presented to them by the proponent.

Seismic Risks

Romania is an earthquake-prone region. Because of the great depth from which some of these quakes originate, the so-called "sub-crustal" quakes are often less attenuated and more destructive than quakes of comparable magnitude originating in other regions of the world. These sub-crustal quakes have in the past killed thousands and caused great damage. In some cases they have been
felt as far away as Moscow. Earthquakes originating closer to the surface ("crustal quakes") are also common in the region, some with epicenters much closer to the Cernavoda site -- including some just across the border in Bulgaria.

Because Cernavoda 2 uses natural uranium rather than enriched uranium, it is a larger and bulkier structure than reactors of different design but comparable power. Other things being equal, large structures are often more vulnerable to earthquake damage than smaller ones.

Even if the overall structural integrity of the reactor is not challenged, internal damage may occur, possibly affecting the integrity of the containment envelope (e.g. the ventilation dampers) or the special safety systems of the reactor.

As previously mentioned, the Cernavoda 2 reactor will contain proportionately more small piping than most other reactors. During an earthquake, vibrations may precipitate some pipe breakage inside the reactor building, thereby causing a loss of coolant and a power surge. Electrical supply problems could also become manifest.

If a severe earthquake occurred during on-line refuelling -- an activity which is carried out every day in a CANDU reactor -- it is conceivable that mechanical interaction between the fuelling machine and the pressure tubes could cause breakage of pipes at both ends of the horizontal core. This would be a particularly serious situation; emergency coolant could not be expected to flow through the core in such a case, due to a lack of the necessary pressure differential.

This safety concern involving a "double-ended pipe break" was identified many years ago by the US Argonne National Laboratory in a short paper on CANDU reactors. To the best of our knowledge, this concern has never been fully addressed.

In response to direct questions from the Fact-Finding Mission, representatives of the SNN admitted that such accident scenarios, involving the simultaneous breakage of pipes on both sides of the Cernavoda 2 reactor core, have never been analyzed.

**Accelerated Aging of CANDU Reactors**

Experience in Canada has shown that as the years go by, CANDU reactors undergo a process of accelerated aging. In particular, the pressure tubes in the core of the reactor become increasingly brittle, and therefore increasingly likely to crack or split without warning, thus causing a loss-of-coolant accident. Moreover, the sudden influx of cold emergency cooling water into the hot pressure tubes could cause further breakage because of the embrittlement of the tubes. At a certain point, the pressure tubes must be replaced for safety reasons.

Retubing the core of a CANDU reactor is a major operation. The plant has to be shut down completely for one to four years. The reactor has to be "de-fuelled", the heavy water moderator has to be drained out of the core, and the intensely radio-active pressure tubes must be removed and replaced with new ones. The materials in the pressure tube walls have become radioactive through "neutron activation", and must now be treated as highly radioactive waste materials.

Currently, in Canada, there are two reactors operating which are based on the same design as the Cernavoda 2 reactor; these are the Point Lepreau reactor in New Brunswick and the Gentilly-2 reactor in Quebec. Both of them have been operating for less than 20 years. Both of them must be
re-tubed if they are to continue operating safely. The estimated cost of refurbishing the reactors, in both cases, is estimated to be $845 million Canadian (approximately $550 million US).

This is a very large price tag. So large, in fact, that the Public Utilities Commission (PUC) in New Brunswick last year, after hearings, unanimously recommended against refurbishing the Point Lepreau reactor. In their report, the PUC expressed skepticism that the price of refurbishment would be kept to within the $845 million estimate, since the nuclear industry in Canada has an extensive track record of underestimating the costs of nuclear engineering projects by factors of 2 to 4.

Given Romania’s credit situation, it may prove difficult to borrow the $1690 million Canadian ($1100 million US) that may be needed to refurbish both Cernavoda 1 and Cernavoda 2 when the time comes. Yet we were informed by the SNN authorities that they have not established a fund to finance such refurbishment projects.

But there are serious safety implications involved in not refurbishing the reactors. The older the plants get, and the more embrittled the pressure tubes become, the greater the likelihood of a severe accident having transboundary impacts.

**Tritium Contamination from CANDU Reactors**

The most obvious difference between CANDU reactors and other power reactors is the use of "heavy water" or "deuterium oxide" (chemical symbol $D_2O$) instead of "light water" or "hydrogen oxide" (chemical symbol $H_2O$) as a coolant/moderator. Indeed, the word "CANDU" stands for "Canadian Deuterium Uranium".

Heavy water is chemically identical to light water, but it is slightly heavier and very expensive. Although deuterium (D) is a naturally occurring form of hydrogen, much time and energy is needed to produce concentrated $D_2O$. Up to 20 percent of the capital cost of a CANDU reactor is due to its large heavy water inventory.

The nucleus of an ordinary hydrogen atom (H) consists of a single proton. A deuterium atom (D) is twice as heavy; its nucleus consists of a proton and a neutron bound together. Because deuterium atoms already contain one neutron, they are less likely than hydrogen atoms are to absorb other neutrons -- neutrons that are needed to keep the nuclear fission chain reaction going inside the nuclear reactor.

For that reason, heavy water is far more "neutron-efficient" than ordinary light water. By using heavy water instead of light water, CANDU technology allows for the use of "natural uranium" instead of "enriched uranium" as a fuel. Thus the extra cost of the heavy water is offset by the lower cost of the fuel in a CANDU plant.

But there is an environmental price to pay for this technological efficiency. When a deuterium atom does absorb a neutron, which happens all the time during fission, it becomes a tritium atom (T). A tritium atom is three times as heavy as a normal hydrogen atom; it consists of one proton and two neutrons bound together.

But tritium is a radioactive form of hydrogen, hence dangerous. It is a weak beta-emitter with a half-life of 12.3 years. It is released into the environment in large quantities by every operating CANDU reactor; tritium emissions are at least one or two orders of magnitude greater from CANDUs than from light-water reactors.
Tritium appears most often in the form HTO or DTO ("tritiated water"), both of which are chemically identical to ordinary water. Consequently tritium is very difficult to control; it cannot be filtered out, for example. It is given off into the air and the water on a routine basis. From time to time large spills occur in which tens of thousands of curies of tritium may be released into the environment all at once.

Moreover, tritium is constantly being produced in the "heavy water" that is used as both primary coolant and as moderator in the CANDU reactor design. Every year, the inventory of tritium in this large volume of heavy water increases, and so the amount released to the environment also generally increases year after year.

For example, in the ICIM EIA Summary, the following figures are given for releases of tritium into the atmosphere from Cernavoda-1 (Table III.2.5-1):

<table>
<thead>
<tr>
<th>Year</th>
<th>Tritium Released (TBq)</th>
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<tbody>
<tr>
<td>1997</td>
<td>25.57</td>
</tr>
<tr>
<td>1998</td>
<td>50.67</td>
</tr>
<tr>
<td>1999</td>
<td>84.89</td>
</tr>
<tr>
<td>2000</td>
<td>208.03</td>
</tr>
</tbody>
</table>

[These figures are obtained by multiplying the reported emissions in the last four columns of the table by one percent of the annual derived emission limit given in column 1. Note that one TBq = 1 terabecquerel = 1 million million becquerels]

Notice that the atmospheric tritium emissions in the table are roughly doubling each year. Annual tritium emissions to the atmosphere would be expected to continue to increase throughout the lifetime of the plant, unless an expensive tritium-removal plant is built to remove the tritium from the heavy water moderator and coolant of the reactor. Such a tritium removal plant was built in Ontario, Canada, for precisely this purpose.

Although tritium is a very weak beta emitter and therefore difficult to detect, laboratory studies have shown that it is more effective in causing cancer, per unit dose, than gamma rays or x-rays. The "quality factor" (QF) is between 2 and 3. Tritiated water enters easily into animals, plants and soil just as ordinary water does. Also, tritium enters readily into all organic molecules including DNA. In Canada there has been much controversy over rising levels of tritium in drinking water of communities near CANDU nuclear plants. There has also been inter-national concern voiced -- by the International Commission on the Great Lakes, for example -- over the rising levels of tritium in the Great Lakes. This phenomenon is almost entirely due to the CANDU nuclear plants operating on the Canadian side.

Like all radioactive materials, tritium is a cancer-causing agent. However, tritium has also been implicated directly in the production of genetic and teratogenic damage. Here is a small excerpt from the 1980 BEIR-3 Report (BEIR = Biological Effects of Ionizing Radiation) by the US National Academy of Sciences:

"Because tritium (hydrogen-3) is a potential pollutant from nuclear-energy production, its effect on development [of unborn babies] has been the subject of a number of studies.

"Tritiated water (HTO) is a common chemical state of tritium, and it has easy and rapid access to living cells, including those of the embryo or foetus."
HTO administered in the drinking water to rats throughout pregnancy produced significant decreases in relative weights of brain, testes, and probably ovaries, and increases in norepinephrine concentration, at doses of 10 microcuries per millilitre (estimated at 3 rads per day), and produced weight decreases in a number of organs at higher doses.

"Because the length of the critical period for various organs is not known, the total damaging dose cannot yet be estimated. Relative brain weight was found to be reduced at only 0.3 rads per day (one microcurie per millilitre of drinking water) when exposure began at the time of the mother's conception.

"Even lower exposures (0.003 rads per day and 0.03 rads per day) have been implicated in the induction of behavioral damage, such as delayed development of the righting reflex and depressed spontaneous activity. However, because the data fail to show a clear dose dependence, there is some doubt about the validity of this suggestion.


Genetic effects of tritium were discussed in the 1977 Report of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR):

[Paragraph 374.]
"Cumming et al. (128) have completed the first series of experiments on tritium-induced specific locus mutations in mice, providing the only data available on such gene mutations in any mammal.

"In view of possible levels of tritium release, not only from existing nuclear installations but also from contemplated controlled thermo-nuclear reactors, these data are of great relevance. [emphasis added]

"...The results demonstrate that beta radiation from the decay of tritium can induce specific-locus mutations in spermatogonia as well as in post-meiotic stages: 16 mutations have been recovered among a total of 20,626 offspring derived from germ cells irradiated as spermato-gonia and 11 in 7,943 offspring from irradiated post-meiotic stages...

[Paragraph 375.]
"Hori and Nakai (233) and Bocian et al. (39) have reported on the induction of chromosome aberrations in human lymphocytes exposed to tritiated water in vitro. Exposures were carried out by the addition of whole blood to the culture medium containing tritiated water...

[Paragraph 376.]
"The results indicate that with protracted exposures (48 or 53 hours) the chromosome aberrations produced were mostly of the chromatid type, such as gaps, deletions and fragments, and there were relatively few chromatid exchanges.

"In the concentration range used by Hori and Nakai, the dose-effect curve for the number of chromosome breaks induced was quite complex at low concentrations. In the work of Bocian et al. and with the range of concentrations they used, the frequency of chromatid aberrations increased linearly with dose...

[Paragraph 378.]
"Summary and conclusions: During the past few years, there has been a growing interest in the study of the biological effects of radioisotopes, particularly of plutonium-239 and tritium.

"A number of genetic and cytogenetic studies that have so far been carried out in mice demonstrate that these isotopes are capable of inducing dominant lethals [i.e. lethal mutations], chromosome aberrations and point mutations (for the last category, only the effects of tritium have been studied).


For all these reasons, contamination of the North American environment by tritium and carbon-14 (another weak beta emitter produced in particularly large amounts in CANDU reactors) has become a major transboundary concern:

"Carbon-14 and tritium are of comparable and special concern for similar reasons.

"First, they each have long half-lives: 5,730 years for carbon-14 and 12.3 years for tritium. Long half-lives allow them to accumulate in the environment around a reactor and in the global biosphere.

"Second, they are easily incorporated into human tissue. Carbon-14 is incorporated into the carbon that comprises about 18 percent of total body weight, including the fatty tissue, proteins and DNA [molecules]. Tritium is incorporated into all parts of the body that contain water.

"Thus the radiological significance of both elements is not related to their inherent toxicity, as each is a very low energy form of radiation, but to their easy incorporation in the body."

The Safety of Ontario's Nuclear Reactors, Select Committee on Ontario Hydro Affairs, 1980.

The ICIM EIA Summary gives no useful information on health and environmental effects of tritium emissions from Cernavoda 2. There is no discussion of the gradual buildup of tritium in the environment or the possibility of transboundary impacts. There is no discussion of carcinogenic, teratogenic or mutagenic aspects of tritium exposure -- or of exposure to ionizing radiation in general.

References


[IIPA = Independent Integrated Performance Assessment]
[SSFI = Safety System Functional Inspections]


[Annex H: Genetic Effects of Radiation.]
[Annex J: Developmental Effects of Radiation.]
Executive Summary

The reason of the present study originates from the discussion about the completion of the second unit of the Cernavoda nuclear power plant (NPP) in Romania. Since this country plans to access the European Union it has started to adapt its legislation to EU law and sectoral guidelines. This process led to a environmental licensing process for NPP C2 similar to the environmental impact assessment required under EU law. The process was based on an Environmental Impact Assessment study carried out by the National Institute of Research and Development for Environmental Protection (ICIM) in Bucharest. The nuclear state-owned company SNN, owner of the plant through CNE-Invest, presented an Environmental Impact Summary in English on its website last year. This document does not include a proper discussion about the rationale and the need of the nuclear project. In particular it does not adequately explore other non-nuclear options (including the zero-option) and their environmental impacts associated compared to the impact of the NPP.

Especially under the perspective of sustainable development – which is a declared aim of the European Union’s policy - better options than nuclear power are available for meeting the Romanian energy needs. These options are without the risk of disastrous accidents for the population, and do not generate long-term radioactive waste. On the contrary alternative energy options provide new opportunities for the Romanian population: decrease of energy expenditure, creation of new jobs and protection of the environment.

In the last years an EU funded project proved once more that in the case of remote settlements off-grid energy production is cheaper than connecting these houses to the national grid.

The present paper provides an overview of the options for the use of renewable energy in Romania and their potential compared to the output of the NPP C2. In order to replace the electricity generated by the NPP Cernavoda, there is no single action which guarantees the success. However an appropriate mix of measures may lead to high efficiency in energy consumption and to a sufficient production of heat and electricity for Romania.

The most hopeful non-nuclear and renewable energy options for Romania are as follows:

Efficiency Improvement
In November 2000 the national “Law concerning the efficient use of energy” has been approved by the Romanian Parliament.
This law is a step in the right direction, but the realization of the huge energy efficiency potential requires the abolishment of subsidies for fuel, an active policy of dissemination of know-how, the promotion of the advantages of energy savings and an effective financing mechanism.
Wind power
The Romanian State Energy Program planned to install wind power stations with a total capacity of 550 MW until 2010. In further future the installed total capacity should reach 3000 MW - this wind power capacity can replace at least as much electricity as two CANDU 6 units produce. Since wind energy is traditionally established in Romania and some research units have built new and efficient plants the wind energy option is interesting not only regarding the production of cheap and clean energy but it can also contribute to the development of a new industrial sub-sector in Romania.

Solar power
With a solar radiation of 1300 –1500 kWh/m² Romania has a valuable potential for solar energy application. Moreover the country has made efforts to develop solar energy equipment since 1979. Hot water systems as well as drying systems and industrial application have been installed. Because of the poor quality of the equipment only a small part of these collectors are still in use. Nonetheless Romania has know-how installation and the use of solar energy collectors for various purposes. To give a concrete idea, to replace the total amount of thermal energy for district heating in Romania (62.000 TJ) by means of solar heating a 43 km² large collector area is required. To substitute the 5400 GWh annual electricity produced by a CANDU 6 reactor approximately 30 km² photovoltaic panels are necessary.

Biogas
In order to replace the electricity produced by one CANDU 6 unit several small combined cycle biogas plants are necessary. In order to supply the demanded amount of energy plants for gasification, a 3500 km² large farmland is needed, which is less than 2% of the total area of Romania or about 30% of today’s arable area. During the accession process of the Romanian economy in the EU market, agricultural production will become more and more intensive and part of the farmland will become available for new processes. Energy plant generation is a new opportunity for these regions and its inhabitants.

Small hydro power
The total hydroelectric power potential in Romania is about 40 TWh per year of which 12 TWh per year has already been developed. There may be as many as 5,000 locations in Romania that are favorable for small hydroelectric power plants (<30 MW). Planned projects achieve an increase of capacity of 200 MW by refurbishment of one big hydro power plant; This shows that the technical improvement of the existing 640 hydro power plants in Romania could increase the generation capacity substantially. Even if it is not sustainable to develop the total potential of hydro power, an ecologically sound development of a part of the 5000 favorable sites could be seriously considered.

Basic information and data
Climate, landscape, vegetation
Romania’s climate is temperate-continental with oceanic influences from the west, Mediterranean ones from southwest and continental-excessive ones from the northeast. Annual average temperature is 8°C in the north and 11°C in the south and varies with values of -2,5°C in the mountain areas (Omu peak- Bucegi massif) and 11,6°C in the plain (Zimnicea town - Teleorman county). Annual precipitations decrease in intensity from west to east, from 600 mm to 500 mm in
the Romanian plain and under 400 mm in Dobrogea and they reach 1000-1400 mm in the mountain areas. Romanian running waters are radially displayed, most of them having the springs in the Carpathians. Their main collector is the Danube River, which crosses the country in the south for a length of 1,075 km and flows into the Black Sea. In the mountain areas there are numerous glacial lakes and recently, anthropic lakes which help develop the hydro-energetic potential of rivers. The vegetation is determined by the relief and by pedo-climatic elements, being displayed in floors. Mountain areas are covered by coniferous forests (especially spruce fir), mixture forests (beech, fir-tree, spruce fir) and beech forests. Higher peaks are covered by alpine lawns and bushes of dwarf pine, juniper, bilberry a.s.o. In the hills and plateaus there are broad-leaved forests, prevailing beech, common oak or durmast oak; the main forests species often met on low hills and high plains are Quercus cerris and Quercus frainetto. The steppe and silvosteppe vegetation, which covered the areas of low humidity in Dobrogea Plateau, Romanian Plain, Moldova Plateau and Western Plain has been mostly replaced by agricultural crops.

Population and cost of living

Table 1: Population, cost of living and energy

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<tbody>
<tr>
<td>population</td>
<td>22.619.000</td>
<td>22.545.900</td>
<td>22.507.300</td>
<td>22.472.000</td>
<td>22.443.000</td>
</tr>
<tr>
<td>cost of living [in €]</td>
<td>27</td>
<td>34</td>
<td>29</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>cost for housing, water, electricity and other fuels [in % of total]</td>
<td>13.4</td>
<td>12.9</td>
<td>14.9</td>
<td>17.6</td>
<td>19.2</td>
</tr>
</tbody>
</table>

A large part of the Romanian population (approx. 45%) is living in rural areas. About 70,000 rural households are still not electrified. 40% of these are in the Western Mountains of Transylvania.

General characteristics of the Romanian energy sector

Table 2: Annual energy production and consumption in Romania

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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary production – all products [in 1000 toe]</td>
<td>33.856</td>
<td>30.367</td>
<td>27.890</td>
<td>26.811</td>
<td>29.630</td>
</tr>
<tr>
<td>Total primary energy supply – all products [in 1000 toe]</td>
<td>49.114</td>
<td>44.135</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Final energy consumption (all products) by sector in 1000 toe</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transport</td>
<td>4.077</td>
<td>4.205</td>
<td>3.920</td>
<td>3.147</td>
<td>3.541</td>
</tr>
<tr>
<td>Installed electrical capacity [MW]</td>
<td>22.856</td>
<td>22.843</td>
<td>-</td>
<td>-</td>
<td>21.904</td>
</tr>
<tr>
<td>Electricity generation GWh</td>
<td>61.350</td>
<td>57.148</td>
<td>53.496</td>
<td>50.710</td>
<td>51.934</td>
</tr>
<tr>
<td>Output of Nuclear power plant [GWh]</td>
<td>1.396</td>
<td>5.400</td>
<td>5.307</td>
<td>5.198</td>
<td>5.456</td>
</tr>
<tr>
<td>Derived heat output from district heating plants (public and autoproducer plants producing heat)</td>
<td>81.588</td>
<td>76.788</td>
<td>89.572</td>
<td>70.760</td>
<td>62.454</td>
</tr>
</tbody>
</table>

25 www.fict.ro/romania.htm – Foundation for promoting Information and Communication Technology
26 Statistical yearbook on candidate and south-east European countries (EUROSTAT – Statistical Office of the European Commission, 2002); chapter 1 and 4
27 Statistical yearbook on candidate and south-east European countries (EUROSTAT – Statistical Office of the European Commission, 2002), Chapter 9
28 toe – tonne of oil equivalent (conventional standardised unit defined on the basis of a tonne of oil with a net calorific value of 41.868 joules per kilogram)
The energy sector in Romania is still plagued by the specific problems faced by most countries in transition:

- low efficiency of energy production, transmission and consumption;
- high marginal cost of energy production;
- poor legislative, institutional and regulatory infrastructure, plus administrative inefficiency leading to high transaction costs;
- increases in energy prices that consistently exceed the general rate of inflation;
- low collection rates especially from industrial users but also from individual consumers because of the high share of energy bills in total household expenditure;
- poor record on energy conservation and compliance with national environmental requirements.

These problems have been exacerbated by the poor performance of the economy - particularly over the past few years - high inflation rates and the low level of foreign investment. Since the political changes of 1989, the Romanian energy sector has benefited relatively from grants, loans and technical assistance programs from the international community. In addition to multilateral projects, several individual countries, notably Denmark, the Netherlands, France and the United States are active in the energy sector in Romania with bilateral projects. A significant proportion of those resources has been directed towards improving energy efficiency and reducing greenhouse gas emissions.

**Energy efficiency in Romania**

For years, Romanian natural resources have been systematically exploited for the sake of promoting an industrial development with no regard to limits and costs in terms of environmental damage. The former regime developed a highly industrialized economy, based on energy intensive industries, leading to high levels of energy consumption per unit of GDP. Even now, while this situation is readily acknowledged, the solutions generally focus on increasing production output rather than promoting energy conservation principles. As a consequence Romania has reached considerably
high levels of energy intensity - at least twice as much as in the OECD countries - which contributes significantly to environmental pollution in Romania.\textsuperscript{29}

Together with Poland and the Slovak Republic Romania is a transition country where the energy intensity of the industry sector remains constant, but that of other sectors of the economy has improved. These countries are characterised by a large share of heavy industry in GDP and the reluctance of their governments to tackle the politically sensitive restructuring of these sectors.\textsuperscript{30}

The potential for energy savings due to enhancing the efficiency is huge, as it is shown by the comparison of energy intensity in figure 2: The energy intensity in Romania is eight times higher than the one in Germany.

Figure 2: Energy Intensity 1998 – A comparison (EIA)

Romanian policy has acknowledged the importance of enhancing the efficiency in energy production in order to protect the environment as well as the health and welfare of the population. In November 2000 the national law concerning the efficient use of energy been approved by the Romanian Parliament.

"The national policy for the efficient use of energy is an integrant of the energy policy of the state and is based on the following principles:

a) To ensure the normal market operation in the field of energy, including the price formation according to competition criteria and to environment protection costs and benefits;

b) To reduce the hurdles to promote energy efficiency and stimulate investments in this way;

c) To promote financing solutions for the initiatives related to energy efficiency;

d) To educate and create the awareness of the users about different forms of energy to reduce the energy consumption per product unit;

e) To ensure the co-operation between the consumers, producers, energy suppliers and public authorities in view of reaching the objectives set in the national policy of efficient use of energy;

f) To support fundamental and applicable research in the field of efficient use of energy;

g) To promote the private initiative and the development of energy services;"
h) To co-operate with other countries in the field of energy efficiency and to observe the international conventions to which Romania is a party.

The national policy for the efficient use of energy defines both the objectives of the efficient use of energy and the ways by which those objectives are reached, especially referring to:

(a) Reducing energy consumption by unit of gross domestic product in Romania;
(b) Increasing energy efficiency in all the sectors of the national economy;
(c) Refurbishing with new technologies having a high energy efficiency;
(d) Promoting new energy sources;
(e) Reducing the negative impact on the environment of energy production, transmission, distribution and consumption in all its forms.” [Romanian Energy Policy association - ROMANIAN ENERGY LEGISLATION: Law concerning the efficient use of energy, Article 3]

The “law concerning the efficient use of energy” is a step in the right direction, but the realization of the huge potential requires, the abolishment of subsidies for fuel, an active policy of dissemination of know-how, the promotion of the advantages of energy savings and an effective financing mechanism.

Cleaner energy systems, use of renewable energy

Renewable energy refers to power generated by a renewable source. When the energy is generated, the resource is not depleted or used up. They are naturally replenished, and can either be managed so that they last forever, or their supply is so enormous that humans can never meaningfully deplete them. Unlike fossil fuels, most renewable energy sources do not release carbon dioxide and other air pollutants as by-products into the atmosphere. As the amount of fossil fuel reserves on earth decreases, it is becoming increasingly important to find and utilise alternative fuels.

Renewable resources include:
- wind power;
- solar power;
- biofuels;
- hydro-electric power (HEP);
- geothermal energy;
- tidal power; and
- wave energy.

Part of the reason for their limited use is their significant cost relative in comparison with that of fossil fuel or nuclear power generation.

Today subsidies and tax policies are in favor of fossil fuel and nuclear power. The investment for the construction of big centralized power stations is also supported by the policy of the international financial institutions and export credit agencies, from which it is easier to get credits for one nuclear power plant than to get credits for a variety of small decentralized plants which use renewables as hydro, wind, biomass and solar. However the “fuel” for renewables is clean and practically free: wind, hydro, solar radiation.

A sustainable energy system has to minimise the environmental impact of energy production and use. This requires cleaner energy sources and the reduction of the adverse effects of fossil fuels. The cost and the environmental impact of energy conversion processes will also be tackled, making all systems more efficient and cleaner.
However, as renewable energy technology improves its performance, the cost of these more sustainable forms for energy production become much more competitive.

**Contribution of renewables to power production in Romania**

**Small Hydropower:** Romania has a great potential for small hydropower plants. There are about 5,000 favorable locations. Ten years ago there was even an industry producing small turbine/generator sets in Resita and Caransebes. However, due to the relatively high initial investment needed for such plants, they account for very little in covering the overall primary energy consumption.

**Biomass:** Null for practical purposes although Romania has a very rich soil.

**Wind Energy:** Null. Currently there are some experiments under way.

**Photovoltaic Solar Energy:** Null.

**Thermal Solar Energy:** Some timid experiments, such as getting hot water for industrial and humanitarian purposes, have been carried out.

**Geothermal Energy:** Significant potential in some areas, but very little developed.

According to an EU funded project, it is feasible and cheaper to use renewables in remote settlements in the mountain and rural areas than to connect them to the national grid. In principle the government in Romania favours renewable energy equipment (REQ) development, but due to funding shortages the impact of these sources of energy is extremely small.

**Wind power**

The utilization of wind energy has a long history in Romania. In the areas of Moldova, Dobrogea and in the Danube delta windmills from the end of the 19th century are still in operation. Furthermore old water pumps for the irrigation of fields and for cattle watering places, driven by the wind, are still in operation. Some wind power stations were built in high mountain places as well (up to 2,160 meter above the sea level).

The governmental Institute for Technical and Scientific Work developed a wind powered station with vertical axle (type Darrieus) and a capacity of 20 kW. Wind power stations of this type operate in different parts of Romania, some of them drive water pumps. Gradually the capacity of the wind power stations designed in Romania has increased. Romanian universities also participated in the development of wind power stations. The technical University of Timisoara has already installed a wind power station with three wings, horizontal axle and a capacity of 300 kW in the Banat in 1981.

In 1992 a 300 kW wind power station was built in Sulina, which produces electricity for the national grid.

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31 Tantareanu Christian, Renewables use for rural remote households, OPET Romania ENERO
32 National Trade Data Bank, USDOC, ROMANIA - ENERGY PROFILE
Romania has a "state program for energy accumulation, recuperation and utilization of renewable and conventional energy sources". Within the framework of this program wind power stations with an installed total capacity of 550 MW are to be built by 2010. In a further future the installed total capacity should reach 3000 MW, a capacity which could replace as much electricity as two CANDU 6 units produce.

The average wind speed on the Romanian coast of the Black Sea amounts to 5 to 7 m/s, on the top of the Carpathians to 6-10 m/s, on the plateau Dobrogea and in the southern part of Moldavia to about 5.5 m/s.

The average wind speed in Romania in rural areas is about 4.6 m/s\textsuperscript{34}. A wind power plant with a capacity of 600 kW at this speed produces annually 0.5 GWh. If the average wind speed is about 9 m/s the energy production will be 2.4 GWh. The relation of wind speed to energy output is not linear. The energy output increases faster than the wind speed and the duplication of wind speed leads to about fourfold energy production.

The recently inaugurated Alpine Wind Park in the Austrian Mountains is an impressive proof of the advantages of using wind energy in mountain areas: with a monthly electricity production of more than 4 GWh per month in winter the eleven 1.75 MW Vestas V66-plants have already produced as much as the annual energy consumption of 3,300 households since their start-up in December 2002. This energy substituted the burning of 1 million litre oil or of 2.5 million kilogram of brown coal. 1 kWh produced by fossil fuels causes in the average an output of 970 g of carbon dioxide. That means that the Tauernwindpark has already saved the emission of 9700 tons of CO\textsubscript{2} during a working period of two months.

**Solar power**

Solar radiation consists of the radiation that comes directly from the sun as well as the radiation that comes indirectly. Solar radiation changes with the time of day and year. The solar radiation is also reduced by numerous other factors; even with a clear blue sky, only 90 % of the total solar radiation gets through.

**Solar Energy**: The potential of the energy delivered by the sun is practically infinite—at least for the next 4 billion years as experts predict. The amount of energy which strikes the surface of the earth in one day exceeds the daily consumption by 10,000 to 15,000 times. Besides Passive Solar Design, i.e. using different methods of construction taking advantage of the sun (Solar Architecture), Solar Radiation can also be actively used: Photovoltaics produces ‘clean’ electric current ready for use, while a Solar Heating System transforms the radiation into heat.

**Passive Solar Design**: Buildings themselves, or parts of them, are used as collectors. A typical example is a paned sun room. The glass construction prevents heat loss from the building, hence contributing to a reduction of energy consumption. The air which is heated by the sun can be vented from the sun room and can then be used for space heating. Through solar building methods a huge amount of heating energy can be saved. Passive solar design (windows facing south, heat insulation, etc.) alone has the potential to save up to 90 % in the cost of heating, while the remaining heat can be produced using solar collectors. Every roof facing south is also a potential solar energy provider. Solar heat collectors and photovoltaic systems can be built

\textsuperscript{34} Christian Tantareanu, "Renewables use for rural remote households", OPET Romania ENERO
into existing roof structures as well as be included in the plans of future building projects. Coordination between architects and solar technology experts is an excellent basis for the highest efficiency and living comfort. Low- or zero-energy buildings face south and combine heat insulation, demand-oriented ventilation, and ‘intelligent’ solar energy systems. When the energy needed for heating and the CO\textsubscript{2} emissions both decline, then the standard of living will improve.

**Solar Power System:** Systems used to transform solar radiation into useful energy in the form of heat (solar heating) or electricity (photovoltaics). The estimated solar irradiation in a typical rural region in Romania varies between 5 – 6 kWh/m\textsuperscript{2} per day during the summer, and 0.6 – 1.2 kWh/m\textsuperscript{2} per day during the winter\textsuperscript{35}. The whole country has a valuable potential for solar system applications, as the average solar radiation in Romania rages from 1,300 to 1,500 kWh/m\textsuperscript{2} per year\textsuperscript{36}. The total area of Romania is about 238,391 km\textsuperscript{2}. The average solar radiation in Romania rages is about 1,400 kWh/m\textsuperscript{2} per year. Thus the theoretical potential for solar energy for Romania is approximately 330 million GWh per year. Favourable places for the installation of solar collectors for thermal as well as for electrical energy generation are buildings (roofs and fassades) or not used space near settlements (e.g. noise barriers). The technically usable building area is approx. 30% of the available building area. Thus since the available building area in Romania is about 630 km\textsuperscript{2}, of these a 210 km\textsuperscript{2} large collector area could be installed.\textsuperscript{37}

**Solar Heating**

The most important components of a solar heating system are the collector, the water storage tank (heat storage device) and the regulator. Solar heating is the most efficient use of solar energy. Heating collectors convert approx. 25-40 % of the solar radiation into heat.\textsuperscript{38} (New efficient heating systems have a conversion factor of up to 85%)\textsuperscript{39} Every squaremeter collector area in Romania produces about 400 kWh or 1,440 MJ thermal energy per year. To replace the total amount of thermal energy for district heating in Romania (62,000 TJ) by means of solar heating 43km\textsuperscript{2} collector area is required. These are 20% of the total usable area of 210 km\textsuperscript{2}.

Today 100,000 m\textsuperscript{2} (0.1 km\textsuperscript{2}) of collector area in Romania is installed, that are 0,045% of the usable area. The thermal output of these collectors is 144 TJ\textsuperscript{40}. Under the new energy legislation about 2,600,000 square metres of collectors will be installed until 2005 avoiding 1,000,000 tonnes of CO\textsubscript{2} emissions per year\textsuperscript{41}. They will produce 1,000 GWh thermal energy per year.

The ecological advantages of solar heating systems consist in up to a 50% reduction in the demand for conventional heating, and consequently less CO\textsubscript{2} emissions.

**Photovoltaic**

The most important components of a photovoltaic system are the solar cells, which when connected together form a solar module (or solar panel) and the storage battery. If the electricity produced is fed into the grid (grid coupling), then it is done through the use of an inverter in order to convert the

\textsuperscript{35} Christian Tantareau, Renewables use for rural remote households, OPET Romania ENERO
\textsuperscript{36} ESIF – Solar Thermal Strategy – SUN IN ACTION, “The solar thermal market in Romania”
\textsuperscript{37} building area minus space with low solar radiation
\textsuperscript{38} http://www.solarserver.de
\textsuperscript{39} http://www.sses.ch/de/technik/thermisch.html
\textsuperscript{40} ESIF – Solar Thermal Strategy – SUN IN ACTION, “The solar thermal market in Romania”
\textsuperscript{41} ESIF – Solar Thermal Strategy – SUN IN ACTION, “The solar thermal market in Romania”
direct current (DC) from the photovoltaic system into the correct voltage and phase of the grid’s alternate current (AC).
A photovoltaic cell converts 11-17% of the solar radiation into electricity. Thus a square meter PV collector in Romania produces between 150 and 240 kWh electrical energy per year. To substitute the 5,400 GWh annual electricity produced by a CANDU 6 reactor photovoltaic panels covering about 30 km² are necessary which is approximately 15% of the usable building area.

**Biomass**

Biomass is plant material, either raw or processed. For example:
- Fast-growing trees and grasses, like hybrid poplars or switchgrass;
- Agricultural residues, like corn stover, rice straw, wheat straw, or used vegetable oils;
- Wood waste, such as sawdust and tree prunings, paper trash and yard clippings.

Biomass is stored solar energy that can be converted to electricity or heat. When biomass is used for the generation of energy, almost no additional carbon dioxide is set free; the carbon dioxide that does get free through the energetic utilization of biomass is equal to the amount that the plant absorbed from the atmosphere. Biomass can easily be stored in large amounts. That is what distinguishes it from other renewable energy carriers like solar energy, wind- and water-power.

More than any other energy resource, biomass is capable of simultaneously addressing the nation's energy, environmental and economic needs.

- Biomass fuels are sustainable. The green plants from which biomass fuels are derived fix carbon dioxide as they grow, so their use does not add to the levels of atmospheric carbon. In addition, using refuse as a fuel avoids polluting landfill disposal.
- Conversion of solid biomass into gas combustible has all the advantages associated with using gaseous and liquid fuels such as clean combustion, compact burning equipment, high thermal efficiency and a good degree of control. In locations where biomass is already available at reasonable low prices (e.g. rice mills) or in industries using fuel wood, gasifying systems offer definite economic advantages. Biogas production reduces ammonia emissions from liquid manure.
- Biomass gasification technology is also environment-friendly, because of the firewood savings and reduction in CO₂ emissions. Biomass gasification technology has the potential to replace diesel and other petroleum products in several applications, and thus it reduces fuel imports.
- Biomass can pay a dual role in greenhouse gas mitigation, both as an energy source to substitute fossil fuels (bioenergy) and as a carbon sink.
- Biomass production can often occur by the restauation of waste land (e.g. deforested areas) and can prevent erosion and thus it can be cheaper in comparison to other energy sources.
- Biomass use provides jobs in rural communities and improves the agricultural income.

Bioenergy technologies help protect the environment by making use of renewable plant material such as sawdust, tree trimmings, rice straw, alfalfa and switchgrass; poultry litter and other animal wastes. Biological materials are used today in a wide variety of processes, including the production of clean transportation fuels, electricity and chemicals.

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http://www.solarserver.de
Biogas potential in Romania

Biogas is a renewable energy carrier. Anaerobic digestion is a biological process that produces a gas principally composed of methane (CH4) and carbon dioxide (CO2) otherwise known as biogas. Its main component, methane, makes up 40 to 80% of the total volume and is usable for the generation of energy. These gases are produced from organic wastes such as livestock manure, food processing waste, etc.

Agricultural biogas plants use the excrements of their animal stock. Organic material with a high water content is the most suitable. Biogas is produced in a septic tank in a microbial process and is energetically usable after temporary storage. The usage of biogas is especially effective in decentralized block-type engine heating stations. Biogas can also be produced in the agricultural industry and communal disposal industry. However, in these areas, waste management is to be organised before the production of energy.

Anaerobic processes could either occur naturally or in a controlled environment such as a biogas plant. Organic waste such as livestock manure and various types of bacteria are put in an airtight container called digester so the process could occur.

Basic conditions to guarantee economic success of a biogas plant are:
- minimum livestock: 60-100 LSU (Livestockunit)
- high utilization options on location
- economic utilization of the motor rejected heat all over the year
- long standing availability of material
- sufficient subsidies for investment

The investment costs for a 100 LSU-plant in Austria are about 150,000 Euro.
Such a plant with the average daily gas production of 150 m³ can produce 800 kWh fuel energy and 200 kWh electric power.

Animal excrements from agriculture are the most important input for agricultural biogas plants. The following table is an overview about the biogas potential in Romania.

Table 3: Livestock breeding intensity in Romania, 2000

<table>
<thead>
<tr>
<th>Number of Livestock animals in Romania</th>
<th>specific conversion factor</th>
<th>Livestock units</th>
</tr>
</thead>
<tbody>
<tr>
<td>cattle</td>
<td>2,870,000</td>
<td>0.7</td>
</tr>
<tr>
<td>cows</td>
<td>1,649,000</td>
<td>1.2</td>
</tr>
<tr>
<td>pigs</td>
<td>4,797,000</td>
<td>0.135</td>
</tr>
<tr>
<td>sows</td>
<td>323,000</td>
<td>0.425</td>
</tr>
<tr>
<td>sheep</td>
<td>7,657,000</td>
<td>0.075</td>
</tr>
<tr>
<td>goats</td>
<td>538,000</td>
<td>0.075</td>
</tr>
<tr>
<td>poultry</td>
<td>83,000,000</td>
<td>0.0034</td>
</tr>
</tbody>
</table>

Total: 5,669,495

Animal excrements from agriculture in Romania based on 5.7 million livestock units have a caloric value of 62.5 PJ. Biogas can be used as a fuel for combined cycle systems to generate electricity and heat water. These systems have a high efficiency.

In order to replace the electricity produced by one CANDU 6 unit several small combined cycle biogas plants are necessary (e.g. 35 of the below described type). In order to supply the demanded amount of energy plants for the gasification 3,500 km² of farmland are needed, which is less than 2% of the total area of Romania or about 30% of today’s arable area. During the accession process...
of the Romanian economy in the EU market, agricultral production will become more and more intensive and part of the farmland will become available for new processes. Energy plant generation may also be a new opportunity for these regions and its inhabitants.

**BOX 1: Total efficiency of biogas systems in Germany and Austria**

Table 4: Exemplary one Module Program for Sewage Treatment Gas/ Bio-Gas Operation (SCHMITT ENERTEC GmBH, German company producing combined cycle systems, combustion engine units, motor engineering, plant construction; source: http://www.schmitt-enertec.com/)

<table>
<thead>
<tr>
<th>Modultype</th>
<th>Electrical Output kW</th>
<th>Thermal Output kW</th>
<th>Energy Use kW</th>
<th>Total efficiency %</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSB-65-KSM</td>
<td>53</td>
<td>82</td>
<td>158</td>
<td>85,4</td>
</tr>
<tr>
<td>FSB-125-KSM</td>
<td>101</td>
<td>174</td>
<td>312</td>
<td>88,1</td>
</tr>
<tr>
<td>FSB-360-KSM</td>
<td>297</td>
<td>475</td>
<td>869</td>
<td>88,8</td>
</tr>
<tr>
<td>FSB-710-KSM</td>
<td>578</td>
<td>769</td>
<td>1616</td>
<td>83,4</td>
</tr>
<tr>
<td>FSB-950-KSM</td>
<td>771</td>
<td>996</td>
<td>2130</td>
<td>82,9</td>
</tr>
<tr>
<td>FSB-1125-KSM</td>
<td>910</td>
<td>1131</td>
<td>2430</td>
<td>84</td>
</tr>
</tbody>
</table>

Guessing in Austria is a regional center for research and development in the field of utilization of biomass for sustainable energy production. A new type of small power stations was developed here. As a central step a gasification procedure is used, which offers clear advantages by using it as a combined heat and power station. The simultaneous supply of heat (for district heating and process steam) and electricity guarantees a highly efficient fuel exploitation. Thus for example 2 MW electricity and 4.5 MW district heat are made available in Guessing by the utilization of 1,760 kg of wood per hour, which corresponds to an entire fuel use of over 80%. With such new and very efficient technology biogas plants will be competitive to conventional power stations: “The use of abandoned agricultural area of 1 million hectar for the production of energy plants for the biogasification could replace two atomic power plants with a capacity of 1.000 MW each”, said Josef Plank of the Styrian chamber for agriculture. “These new plants for the utilization of biogas represent a capacity of 6 billions kW electricity and 6 billion kW of warmth.”

**Biomass from forest and agriculture**

Biomass material from forest and farmland is firewood, woodshaving, sawdust, bark, pellets, waste of paper and pulp production, straw, organic fuels, energy crops, waste and sludge.

Waste products from agriculture are important input for agricultural biomass plants. The following table contains different agricultural structures and their energy output in Romania.

43 http://www.waste.at/data/ins06_2002_5.cfm
44 http://www.oe-journal.at/Aktuelles/0901/wutearchiv25090110.htm
45 http://www.biomasseverband.at
<table>
<thead>
<tr>
<th>Agriculture Structure</th>
<th>Mio ha</th>
<th>Harvest Amount Per Year MWh/ha</th>
<th>TWh/a</th>
<th>PJ/a</th>
</tr>
</thead>
<tbody>
<tr>
<td>arable</td>
<td>9.4</td>
<td>40</td>
<td>375.2</td>
<td>1350.9</td>
</tr>
<tr>
<td>hayfields</td>
<td>1.5</td>
<td>35</td>
<td>52.7</td>
<td>189.9</td>
</tr>
<tr>
<td>pastures</td>
<td>3.4</td>
<td>20</td>
<td>68.8</td>
<td>247.8</td>
</tr>
<tr>
<td>forest</td>
<td>6.5</td>
<td>16</td>
<td>103.3</td>
<td>371.9</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td><strong>600.1</strong></td>
<td><strong>2,160.5</strong></td>
</tr>
</tbody>
</table>

Wood is available in large amounts in Romania. There are several methods to use for energy generation:

- Producing billet wood requires working with saws and axes; which is labour-intensive and results in high costs.
- Sawing residue is the left-overs from wood-processing industrial companies. It consists of large bulk as well as of smaller material (e.g. saw dust). The bulk material is processed into wood chip.
- The wood used is usually residue from forest conservation measures, which cannot be used for other purposes, but should not be left in the forests because it diminishes the growth and health of better trees. This kind of wood is an energy carrier that is ready without further processing; if it were not used, it would simply decompose. Increased exploitation of this wood for energetic purposes has no negative effects on the strict law of sustainability which is employed in forestry.
- If energy prices rise, energy wood plantations with fast-growing tree populations like poplar and willow might be a realistic option.

In practice only a small fraction of the theoretical increase of wood in forests is usable for energetic purpose. Topografic formation, e.g steep slopes and protection forests limit the utilization possibilities in different regards.

Wood grows with the strength of the sun directly in our municipalities and regions. The drying process of the energy wood is made by the solar power. The energy expenditure for cutting up (cutting, splitting) usually amounts to less than 1 % of the energy contained in the wood. 1 kg of dry wood has a heat value of 5 kWh. In air-dry condition with a water content of approximately 15% the heat value is about 4,5 kWh/kg. Furthermore, modern wood firings show less emissions and high efficiency (up to 95 %).

**Hydroelectric Power**

**Advantages and disadvantages of hydroelectric power**

Hydroelectric power plants have many positive and negative environmental impacts, some of which are just beginning to be understood. These impacts, however, must be weighed against the environmental impacts of alternative sources of electricity. Until recently there was an almost universal belief that hydro power was a clean and environmentally safe method of producing electricity. Hydropower does not consume natural resources. It is a simple and proven technology.
with a high efficiency (about 90%). Although the investment cost are high (500-3000 €/kW of installed capacity), the plant has a very long lifetime and the operating costs are small (cheap maintenance and operation). Moreover there might be indirect advantages due to multi-purpose use (irrigation, navigation, flood protection, potable water supply, recovery, pisciculture). Nonetheless hydropower can cause heavy impacts to the environment by disturbance of the boulders and water balance, overflowing of otherwise usable surfaces and ecologically valuable habitats, interruption and restriction of the habitat for migratory fish, and unfavorable social effects by the evacuation and resettlement of people (i.e. in the case of large scale dams). Finally, recent studies have proved that large artificial reservoirs may produce significant amounts of greenhouse gas emissions, mainly methane, due to the decomposition of the flora submerged.

Opportunities for Romania

With its many rivers, Romania has great potential for hydroelectric power (as much as 14,800 MW). The total hydroelectric power potential is about 40 TWh per year of which 12 TWh has already been developed. There are as many as 5,000 locations in Romania that are favorable for small hydroelectric power plants. Many states define small hydroelectric as facilities of 30 MW or smaller.

The Romanian government has encouraged foreign investment in hydropower through Hydroelectrica, the state-owned hydropower producer. In 1999, Sulzer Hydro of Switzerland won a $154 million contract from Hydroelectrica to refurbish six turbines at the Portile de Fier I (Iron Gates I) power plant on the Danube River. There are twelve turbines at the Iron Gates plant; six are operated by Romania and six are operated by Serbia. It is expected that the project will be completed in 2005 and the capacity of the six Romanian turbines will increase to 1,290 MW from their present capacity of 1,070 MW.

In addition to Portile de Fier, there are eleven other hydroelectric facilities with capacities of at least 100 MW each, and dozens of medium-sized facilities of at least 30 MW. Collectively, these power stations represent about 77% of Romania's currently-operating hydroelectric generating capacity. In addition to these larger hydroelectric facilities, there are also many smaller power stations. The Raul Mare River has a series of 10 hydroelectric power plants, each between 10 and 15 MW. Similarly, the Strei River has a series of seven small hydroelectric power plants, each less than 10 MW.

The planned hydropower projects achieve an increase of capacity of 200 MW alone by refurbishment of one big hydro power plant; This shows that the technical improvement of the existing 640 hydro power plants in Romania could increase the available capacity substantially.

Even if it is not sustainable to develop the total potential of hydropower, an ecologically sound development of a part of the 5000 favorable sites should be seriously considered.
ANNEXES
ANNEX 1

Chapter 14: Energy

Progress since the last Regular Report
Since the last Regular Report, Romania has made progress in preparing for the internal energy market, in particular as regards the level of market opening, pricing policy, and restructuring of some utilities. However, progress in implementing key structural reforms and improving administrative capacity has been limited.

Concerning security of supply, an Emergency Ordinance adopted in April 2002 established an oil stock monitoring system in Romania. While the country has sufficient storage capacity to meet the requirements of the acquis, Romania does not have the requisite stocks of oil products. The Ordinance stipulates that the level of these oil stocks will be gradually increased, and will be 50% financed by the state, through the National Agency for State Reserves, and 50% by private operators.

Significant progress has been made in the field of competitiveness and the internal energy market. In the electricity sector, following a Government Decision in January 2002, market openness was increased to 33%, with licensed suppliers and eligible customers defined by the regulatory authority. In practice, the contracts signed between licensed suppliers and eligible customers amount to around 8% of the market. Electricity prices were adjusted several times and now reflect production costs to an acceptable degree. Prices have also been indexed with the US dollar, which prevents some of the negative effects of inflation. An Ordinance adopted in March 2002 gave the Prime Minister responsibility for appointing the President of the National Electricity Regulatory Authority (ANRE), which reinforces its independence vis-à-vis the Ministry of Industry and Resources. In addition, two regional distribution companies have been prepared for privatisation.

Tests with a view to future interconnection with the Western European UCTE (Union Coordinating the Transport of Electricity) were finalised and the monitoring of the inter-connected operation with UCTE is currently being carried out.

In the gas sector, the rate of market opening was increased from 10% to 25%, and the regulatory authority has selected 45 eligible customers. As with the electricity sector, gas prices have been adjusted to reflect production costs, they are now indexed with the US dollar, and the president of the National Gas Regulatory Authority (ANRGN) is appointed by the Prime Minister.

The Government has adopted an action plan for the improvement of bill collection in the energy sector, including the disconnection of non-paying companies. However, problems of non-payment remain acute in the state sector (state-run industries, local authorities or public services). Although there are no reliable figures available, the energy bill collection rates remain at an insufficient level. In the sectors of oil and solid fuels, no major developments have been recorded.

As far as energy efficiency and renewable energy is concerned, little substantial progress was made during the reporting period. In October 2001, the Romanian Fund for Energy Efficiency was legally established but it is not yet operational.

In the field of nuclear energy, Romania operates, at the Cernavoda Nuclear Power Plant, a Canadian-designed CANDU 6 type reactor with a nominal capacity of 700 MWe. This unit has been licensed following the Canadian licensing requirements for similar reactors in Canada. Cernavoda Unit 1 provides 11% of the country’s electricity. Unit 2 of Cernavoda is being completed and is expected to be operational by 2005-2006.
As regards nuclear safety, Romania has continued to develop the legislative and regulatory framework. However, no progress has been achieved in dealing with spent fuel and nuclear waste. Legislation has been harmonised with the adoption of orders for approving EURATOM safeguards, on radiological safety norms in September 2001, and on international transit of nuclear materials through Romanian space in February 2002.

As part of the Strategic Plan for Safety Analysis, a technical agreement was concluded between the National Company Nuclearelectrica and a Korean nuclear power company in order to assist the Romanian operator to develop its capability to perform accident analyses at Cernavoda Nuclear Power Plant. This Strategic Plan is scheduled to be finalised by 2004.

**Overall assessment**

As regards security of supply, Romania has adopted legislation that should provide the basis for future compliance with the *acquis* on oil stocks. While storage capacities are sufficient, required oil stocks will have to be built up.

In the electricity sector, important steps have been taken to adjust electricity prices to reflect production costs and to establish the legal framework for market opening. Similar positive reforms have taken place in the gas sector. However, there has been a continued lack of progress with restructuring the state-owned energy producer Termoelectrica in order to improve its management and to make its production costs competitive. The key priority should now be a thorough reform of Termoelectrica in order to reduce production costs of thermal power plants.

Poor collection of energy bills remains a fundamental problem in Romania which impacts negatively on the financial situation of the utilities and prevents them from making the necessary investments to modernise their networks and improve their efficiency. This situation distorts the entire Romanian economy and Romanian efforts should be devoted to ensuring a genuine improvement of bill payment. For the solid fuels sector, it is important that Romania continues with its restructuring efforts and, for the hard coal sector, ensures compliance with the Community state aid *acquis*.

Romania does not devote the necessary resources to improving energy efficiency and to promoting renewable energy. The present efficiency of production means and networks is very poor, mainly due to a lack of investment. The Romanian Agency for Energy Conservation is in charge of promoting energy efficiency but has very limited financial and human resources - which is a demonstration of the low priority Romania gives to energy efficiency. This is particularly worrying, since the energy intensity of the economy is very high (estimated at around 8 times the EC average).

The European Union has repeatedly emphasised the importance of a high level of nuclear safety in candidate countries. In June 2001, the Council of the European Union took note of a Report on Nuclear Safety in the Context of Enlargement. This report contains recommendations to all candidate countries to continue their national safety improvement programmes, including the safe management of spent fuel and radioactive waste, and regarding the safety of their research reactors. During the first half of 2002, a special Peer Review on nuclear safety assessed the progress made by candidate countries in implementing the 2001 Report’s recommendations. This exercise under the auspices of the Council resulted in a Status Report, published in June 2002, which concludes that Romania has accepted and addressed all the recommendations contained in the Report on Nuclear Safety in the Context of Enlargement of June 2001.

Most recommendations have been adequately addressed. Romania should devote further attention to six recommendations: to systematically consider and implement relevant safety improvements for similar plants adopted in Canada; to strengthen the co-operation between the Nuclear Safety Regulatory Authority (CNCAN) and the Canada Nuclear Safety Commission; to install an emergency Operating Centre at Cernavoda; to pay attention to the continued financial resources of the operator, as well as to the preservation of its management’s and staff’s
competence; and to complete the update and regulatory reviews regarding fire and seismic hazard assessments at Cernavoda.

The Status Report recommends further monitoring with regard to four recommendations: to ensure the implementation of relevant safety improvements adopted in similar CANDU plants in Canada; to ensure the timely implementation of the Strategic Plan for Safety Analysis of Cernavoda Unit 1 and the development of the Safety Analysis Report for Cernavoda Unit 2; and to ensure that sufficient resources are allocated to the Nuclear Regulatory Authority in order to strengthen its capabilities.

Salaries at CNCAN remain low when compared with employees in the nuclear industry and there is a steady turnover of personnel, who leave the institution to work for Cernavoda or other industries that pay better salaries. Romania is therefore encouraged to address this specific issue and to further strengthen the resources and capabilities of CNCAN within a stable framework.

The unresolved issues of spent fuel and nuclear waste will have to be addressed in the short-term.

In order to ensure compliance with Euratom requirements and procedures Romania should give due attention to preparing the implementation of Euratom safeguards, in particular regarding the direct reporting of nuclear material flows and inventories by the persons or bodies operating nuclear installations or storing nuclear material. Romania has concluded a Full Scope Safeguards Agreement with the International Atomic Energy Agency.

Conclusion
In its 1997 Opinion, the Commission concluded that Romania had to step up considerably its efforts in the energy sector in order to prepare for integration. The following areas were identified as requiring particularly close attention: the adjustment of monopolies; energy pricing; emergency preparedness, including the building-up of mandatory oil stocks; state interventions in the solid fuels sector; and development of energy efficiency. The Commission added that, although no major difficulties were foreseen for compliance with the Euratom Treaty, Romania should implement some international nuclear norms. Nuclear safety standards, especially those related to plant operation, should be handled appropriately and longer-term solutions needed to be found for radioactive waste.

Since the Opinion, Romania has made progress in aligning itself with the relevant acquis. However, many structural issues still have to be addressed in the energy sector. Legislative alignment is limited and the new administrative structures remain to be consolidated.

Negotiations on this chapter continue. Romania should focus further efforts on addressing the structural problems that are facing the sector: non-payment of energy bills, restructuring of Termoelectrica, and improving the efficiency of its energy networks. It should also move away from its current energy production-oriented policy, and towards a policy based on energy saving. Romania should take the necessary measures to ensure the full and timely implementation of legislation in the energy sector as well as strengthening the administrative capacity of the newly established bodies (in particular the energy regulators, the energy efficiency body and the nuclear safety authority). Romania should ensure compliance with Euratom requirements and procedures and take measures for the progressive building up of oil stocks.
Hon. Margot Wallström  
Commissioner for the Environment  
European Commission  
Rue de la Loi, 200  
B-1049 Bruxelles  
Belgium

Rome, February 6th, 2003

SUBJECT:  URGENT: Request of postponement of environmental licensing for the Cernavoda 2 NPP project, Romania

Dear Commissioner Wallström,

we recently came back from a Fact-Finding Mission to Romania regarding the controversial Cernavoda 2 NPP (C2) project for which Euratom is considering a € 223 million loan to the Romanian government. During our mission we held fruitful meetings with the energy and environment experts at the EU delegation in Bucharest. You will be receiving our mission report in the very next weeks.

In the meantime we have the urgency to share with you the main findings of our mission – further detailed in the attached memorandum – and in particular our concerns about the lack of capacity of Romanian nuclear safety and environmental authorities to properly implement national and international legislation in force in the case of the C2 project.

The Romanian Environment Ministry is expected to issue the environmental license for the C2 project by mid February. We urgently request the European Commission to urge the Romanian government to postpone the environmental approval of the project with the aim of allowing a new and adequate public consultation with Romanian affected communities and NGOs and with neighbouring countries, such as Bulgaria, which might be interested in receiving additional and thorough environmental information about the controversial project from Romanian authorities.

We believe it crucial that the EU accession process be a key opportunity to promote the application of environmental law in accession countries, in particular in Romania, whose record still remains insufficient as repeatedly admitted by EU authorities. At this regard the Cernavoda case might offer a good opportunity to raise awareness among decision-makers and civil society in Romania about the provisions under the new environmental law recently enforced.

It should be noted that on January 17th, 2003 the new Romanian Environmental Protection Law came into force by adopting the EU directive 85/337/EEC as amended by the 97/11/EC Council Directive within the accession process. As remarked by the environmental experts at the EU
delegation in Bucharest it is needed to urge Romanian authorities to fully implement the new environmental legislation soon.

Our independent environmental due diligence of the project has detected an inadequate public consultation process potentially in violation of the Romanian Environmental Protection law 137/195, and related Ministerial Order No. 125/1996, in force at the time when public consultations took place. Furthermore, at a first glance the environmental documentation made available to the public during public meetings in August/September 2001 included no adequate information about environmental and safety impacts associated with the C2 project and did not inform about potential non-nuclear alternatives, as explicitly requested under both former and current environmental law.

We welcome European Commission’s commitment to monitor developments of bilateral relations between Romania and its neighbours as concerns the significance of the project in a transboundary context and the implementation by Romanian authorities of the provisions under the UN/ECE Espoo Convention - which has been ratified by and entered into force in all countries but Yugoslavia in the past years.

Bulgarian authorities have recently extended the timeline for collecting comments from NGOs and Bulgarian affected people about the transboundary impacts in Bulgaria of the C2 project. At a meeting with the Bulgarian Environment Deputy Minister in Sofia on 18th January, 2003 we realised that Romanian authorities provided Bulgaria with an inadequate summary of the full EIA project document, thus, in our view, in violation of the provisions under the Espoo Convention. Since the recent difficult relationship between the two countries on environmental and nuclear safety issues, we believe that an intervention of the European Commission could facilitate the consultation process by setting a significant precedent of proper implementation of environmental international legislation between the two countries.

We would like also to draw your attention to the complete lack of independence of the Romanian Nuclear Regulator, CNCAN, that we detected during our mission. The Fact-Finding Mission formally requested separate meetings with the nuclear regulator - which is also the Secretary of State of the Romanian Ministry of Water and Environmental Protection - the environmental authorities and the nuclear state-owned company, SNN. Nevertheless we have been allowed to meet environmental experts only in presence of representatives of the nuclear company who systematically influenced the meeting and even the translation of the contributions by the environmental authorities.

Finally we have to express our regret that the Fact-Finding Mission was denied access to the nuclear power plant in Cernavoda, after providing in advance nuclear authorities with all needed information. While reacting to our complains about the modalities by which the mission was diverted to the Cernavoda site and then not allowed to visit the plant, Mr. Chirica, director of the SNN international affairs division, bluntly stated on-the-record its full lack of interest in the possibility that the mission had reported to the European Commission and national governments about the unfortunate case. We urge you to ask clarification to SNN about this event and also about the lack of consideration that Romanian nuclear officials have of those governments who have been requested to approve a Euratom loan for the Cernavoda 2 NPP project.

We have also informed Commissioners Verheugen and Solbes, who have the responsibility for the Romanian application for a Euratom loan as concerns respectively the safety and lead economic due diligence of the project, about our concerns in a separate letter. We hope you will act soon on project-related environmental legal issues in order to prevent that an environmental license for the project will be issued before adequate environmental due diligence and public consultation in
Romania and with neighbouring countries be carried out by Romanian authorities in compliance with national and international environmental law.

We would be pleased to have the opportunity of meeting you in Brussels in order to personally submit the mission report to your Office and present in detail our concerns about project impacts. We look forward to your reply to our requests and remain

Sincerely yours

Antonio Tricarico
Campagna per la riforma della Banca mondiale
Via Tommaso da Celano, 15
00179 Roma
Italia

Olexi Pasyuk
CEE Bankwatch Network
Kominterna 1
01032, Kiev
Ukraine
ANNEX 3


GUENTER VERHEUGEN
MITGLIED DER EUROPÄISCHEN KOMMISSION

Mr Antonio Tricarico
Campagna per la riforma della Banca mondiale
Via Tommaso da Celano, 15
I – 00179 ROMA

Dear Mr Tricarico,

Thank you for your letter of 27 November 2002, copied to President Prodi and to my colleagues, Commissioners Solbes and Wallstroem.

I would also like to thank you for bringing to my attention that the results of the analyses made on your behalf by the Austrian Institute for Applied Ecology are now publicly available.

I understand you have already been in contact with Commission experts in the Directorate-General for Enlargement in order to exchange views on this issue. As you will know, the involvement of the Directorate-General for Enlargement is limited to completing the management of the various studies foreseen under the Euratom Treaty as necessary for evaluation of the loan request. The lead Commission service with regard to the Romanian application for a Euratom loan is the Directorate-General for Economic and Financial Affairs. For this reason, I am copying my reply to the responsible Commissioner, Pedro Solbes, so that his services are fully informed in case there is further consultation with the European Commission.

I am pleased that you have found useful the publication by the Commission of the Environmental Impact Assessment of the Cernavoda 2 NPP. By contrast, the Commission is not in a position to make public the safety study for the project, because this was established and used for the specific purpose of backing up the Romanian loan application.

I have been aware of your concerns related to the economic viability of the project. It is precisely the purpose of the studies made by independent experts as well as the review by the European Investment Bank to investigate this aspect. This process is currently underway.

Finally as regards the significance of the Cernavoda 2 project in the bilateral relations between Romania and its neighbours, the Commission will monitor developments, including any views or positions to be taken by the relevant national authorities regarding this project.

Your sincerely,

Günter Verheugen

cc: President R. Prodi, Commissioners P. Solbes and M. Wallström
ANNEX 4

E-mail from Ian Longu, President of the Romanian Electricity Regulator, ANRE, to Olexi Pasyuk, CEE Bankwatch Network, on February 26th, 2003

Mr. Olexi Pasyuk, National Ecological Centre of Ukraine

Dear Mr. Olexi Pasyuk,

Regarding your questions sent to ANRE on 26.02.2003

"Does Cernavoda nuclear power plant operator has contracts with consumers outside Romania, or Romanian institution which effectively export this electricity at the end. Are there any legal, technical or political reasons which are preventing this export?"

1. According to the conditions stipulated in the production license, the entire electricity quantity produced and delivered by National Company "Nuclearelectrica" is bought by the suppliers of captive consumers, at price, on a PPA (long term) contract basis, until the company credits are totally reimbursed.

"Will domestic Romanian demand utilise capacities of to-be-built Cernavoda unit 2?"

2. Yes.

"Are there any legal, technical or political reasons which can prevent or limit the export of electricity to be produced ad Cernavoda npp unit 2?"

3. For the future, with our knowledge for this moments, in connection with fully liberalization of the electricity market, National Company "Nuclearelectrica" (inclusive unit 2), can exports energy (after expire the long contract presented at point 1).

Sincerely,

Ion Lungu

President of ANRE
ANNEX 5

ROMANIA: INTERVIEW-Romania offers nuclear plant builders BOT deal.
By Radu Marinas, 19 February 2003
Reuters English News Service (C) Reuters Limited 2003.

BUCHAREST, Feb 19 (Reuters) - Romania said on Wednesday it will offer a Korean-Canadian-
Italian group 10-year control of a third planned nuclear reactor, which it hopes will help turn the
European Union aspirant into a key Balkan power exporter.

In contrast to a Western European trend, Bucharest says it has no choice but to expand into nuclear
energy to compensate for the planned closure of its ageing coal-burning plants and rely less on
energy imports - mostly gas from Russia.

"We'll grant foreigners control of our third nuclear reactor over a 10-year term. It's the best option
we have," Aurel Daraban, a member of the parliament's industry commission which must approve
such major deals, told Reuters in an interview.

He said a build-operate-transfer (BOT) contract will be the best way to get badly-needed funds to
resume the suspended construction of the reactor without resorting to long-term, state-guaranteed
loans as it has done so far.

Romania's only nuclear reactor at Cernavoda on the Danube river has a capacity of 750 megawatts,
accounting for 10 percent of the country's power output.

Work at the plant was suspended after the 1989 collapse of communism due to financial problems.

GROUP TO BUILD THIRD REACTOR

Earlier this week, Korea Hydro and Nuclear Power Co, a unit of state-run giant utility Korea
Electric Power Corp (KEPKO), said it planned to build Cernavoda's third reactor.

It said it was in talks with the Romanian state and two firms already involved in building the plant's
second reactor - Canada's AECL and Ansaldo Energia of Italy, a unit of Italian defence group
Finmeccanica - over a joint feasibility study on the project.

Daraban said the three companies were ready to invest $1.5 billion to complete the third reactor,
which would operate in 2007. The second reactor is being built with a $400 million loan from
Societe Generale and Credit Lyonnais.

"The Koreans and our traditional partners (AECL and Ansaldo) are the only ones who want to
invest," Daraban said. "They will emerge as winners."

An official announcement could be made by April, he said.

Daraban said the third reactor would raise Romania's nuclear power generation to 35 percent of the
country's total energy output from 10 percent now.

He said Romania would then have a competitive advantage against ex-communist nations like
Bulgaria and the Czech Republic where Soviet-designed power plants, Kozloduy and Temelin,
stoked public opposition after the Chernobyl disaster.
Unlike the Soviet-era Kozloduy, Cernavoda is being built with western CANDU-technology, he said.

"We'll probably be better positioned than other easterners which must gradually close their unsafe plants," Daraban said.

The country was also looking at exporting to the EU, which it hopes to join by 2007.

"It'd be an easy start for us to get into the EU's energy market," said Daraban. "We will have power in excess."

The EU says Romania must address issues of spent nuclear fuel and nuclear waste before joining the bloc, problems that appear small compared to the closure of plants in other candidate countries.
Here are the answers to your questions about EIA on Unit 2 Cernavoda.

My best regards,
Daniela Pineta

Written questions about the Cernavoda 2 NPP and the Romanian Environmental Legislation:

- When did the SNN submit the environmental agreement Application to the competent environmental authority?

The Cernavoda 2 NPP application form was received at the Environmental Protection Inspectorate – Constanta in July 2001, as a result of the Law nr.335/11.07.2001 for approval of the Governmental Ordinance nr.126/2000 to carry on the Unit 2 construction.

- Did SNN advertise the application as requested in the Environmental Protection Law? When and through which media? Did you receive preliminary public comments based on this publicity announcement of the project?

Yes, the public announcement was published in 2 local newspapers - “Observatorul” on July, 26th, 2001 and «Telegraful on August, 1st, 2001) and in a central newspaper «Adevarul » on July, 30th, 2001.

After the announcement was published the Environmental Protection Inspectorate in Constanta received written comments from different bodies and institutions acting in the energy production field or in the environmental protection field, regarding the opportunity of this activity. These comments are registered in a file.

- Are the guidelines that the Local Environmental Protection Authority (LEPA) have to prepare in order to figure out what have to be addressed in the environmental impact study, publicly available? (I refer to the guidelines mentioned in article 4.3.1 of the Ministerial order No. 125/1996).

On which technical assistance and survey of the affected population the guidelines have been based?

When did LEPA produced them? Could we get a copy of them?

According to art.4.3.1 of the MO 125/1996 the guidelines are transmitted to the developer and they take into account certain comments of the public.

EPI Constanta had the support of the experts in radioactivity, they paid great attention to the potential affected population, as a consequence, EPI Constanta has asked for the elaboration and implementation of the environmental radioactivity monitoring plans, monitoring of the environmental media, measures for rapid and efficient implementation of the emergency plans outdoor and indoor of the area.

The guidelines were elaborated in November 2001, the guidelines are in Romanian.

- Which documentation was given to the competent environmental authority by the would-be license holder, according to the procedure described in the article 4 of the Ministerial Order No. 125/1996?

Is this documentation, so called “Report on the impact study” in your legislation, fully available to the public? Do you consider that the minimum contents of the Report on the EIA as described in Annex 5 have to be disclosed to the public? automatically or upon request?

The developer submitted to EPI-Constanta the application form, the technical presentation of the project, the Report on EIA made by AECL, the EIA Report made by ICIM, all the preliminary endorsements, the termic impact study, the report on the public debate.
The report on the public debate of the project is entirely publicly available. For 6 months the AECL EIA Report was on the Internet page, publicly available. So, being on Internet it was automatically disclosed to the public, and it is also made public upon request.

- Did you request any additional information or surveys to this report?

EPI Constanta considered that the 2 EIA studies, the thermal impact study and the questions arose during the public debate - questions clarified on the spot or afterward, in writing, have covered all the aspects on the environmental media impact.

We consider additional information the thermal impact study.

- On which documentation was based the Public consultation which took place from 15.08.01 to 21/09/2001?

It was based on: the AECL EIA Report, the technical description of the project, The ICIM EIA Report.

The public consultations took place in Constanta, Cernavoda, Medgidia and Bucharest.

- Who is competent for organizing the public debate and ensure an effective public consultation?

The public consultation is coordinated by the EPI but it is the obligation of the developer to organize and to give financial support of the action, according to MO 125/1996.

- Why a second study was produced by ICIM in January 2002? The first one carried out by AECL was not sufficient?

The second study was asked because, according to national legislation the EIS has to be made only by a natural or legal person certified according to MO 278/1996 and the EIS has to be done according to the MO 125/1996 requirements.

- Your legislation concerning the EIA process and the public participation has changed in order to put the Romanian Legislation in compliance with the European legislation. What are the main changes brought out by this new legislation regarding the Environmental assessment and the public participation to this process?

The main changes are:

The 4 annexes of the Directive 97/11/EC are entirely transposed into the GD nr.918/2002;
The stages of the EIA procedure are well defined: screening, scoping and review of the quality of the EIS, in GD 918/2002;
The transboundary provisions on EIA are entirely transposed in GD 918/2002.
The public and the other authorities consultations, including the transboundary public consultations are provided for in the GD 918/2002.
The detailed provisions for implementing the requirements of the GD 918/2002 are given in the MO 860/2002 and the MO 863/2002.

- You ratified the Aarhus Convention in 2000 (Law No 86, May 10 2000). Could you tell me if once the Convention ratified, it is compulsory for you? Or do you need to transpose it in national law? In this case, are you working on its implementation and, is this Convention already partially applicable?

After ratification, any convention is compulsory, but we need subsequent legislation for implementation.

Apart this, the EC asked us to transpose the Access to Environmental Information Directive 90/313/EEC, so first, we transposed it into GD nr.1115/2002 and we are working now on implementation, that is on MO 1182/2002 regarding the management of the environmental information held by the environmental public authorities.