



From Bad to Worse...

**Critique of the Third Stone and Webster (April 1999)
Economic Due Diligence for K2R4.**

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Introduction

The proposals for funding the completion of Khmelnytsky 2 and Rovno 4 (K2R4) have been under development by the European Commission and the European Bank for Reconstruction and Development (EBRD) for over five years and consumed tens of million Euro and thousands of person days of work. Despite a concerted and continual effort by many companies, institutions and individuals to see this project move ahead with financing from the EBRD, Euratom and Western Export Credit Agencies, the project is no closer to meeting the lending criteria of these institutions than it was in June 1994.

While there are many standards and conditions that the completion project must fulfil to be acceptable as a project for funding by these agencies, such as environmental and nuclear safety, much of the media, Non-Government and Governmental interest has been focused of late on the economic viability of the project. There are a number of reasons for this:

Lending Requirements:

The international agreement which first connected the closure of Chernobyl with the possible completion of K2R4 was the Memorandum of Understanding (MoU) signed by the G7, EU and the Ukrainian Government in December 1995. The MoU states: -

"Ukraine and the G-7 will work with the international financial institutions as well as foreign and domestic investors to prepare loan-financed projects based upon least cost planning principles for completion of Khmelnytsky II and Rovno IV nuclear reactors... the investment program will identify least-cost power supply investments to meet Ukraine's future national power requirements in the context of a competitive market based power sector"¹.

Since conception of the project EBRD has been proposed as the prime co-ordinator for the funding package. Further EBRD's energy policy states: -

"Such projects [Completion and upgrade of nuclear plants] would have to meet the same least-cost criteria (including the review of supply and demand side energy alternatives) as non nuclear projects..."²

Limited Investment Opportunities:

The investment climate in Ukraine is such that there is only limited access to the necessary finance and availability of Ukrainian Government guarantees. Over 1998-9 Ukraine has been close to defaulting on its international debt, and the position shows little sign of improvement, if any. As of January 1999, Ukraine foreign exchange reserves stood at less than \$US 1 billion, just enough to cover half a months imported goods and services, and its foreign exchange debt stood at \$US 11 billion, with \$US 1.8 billion due for repayment in 1999. Therefore, any investment needs to be reviewed in the light of both what benefits such project brings against what other projects will have to be delayed or abandoned through the consequent non-access to funding, the so-called „crowding out,, effect. This is of particular relevance with large projects, such as K2R4, as their financial needs will exclude a large number of smaller projects.

Economic Due Diligence Panel:

In 1996, the EBRD commissioned an independent panel of internationally recognised experts to conduct the necessary economic due diligence. It was said that given the sensitivity of this issue, it was of the utmost importance that an independent authority undertakes this work.³ The Panel's findings were unambiguous

¹ Memorandum of Understanding between the Government of Ukraine and the Governments of the G-7 countries and the Commission of the European communities on the closure of the Chernobyl nuclear power plant. 20th December 1995.

² Energy operations policy 7th March 1995, European Bank for Reconstruction and Development.

³ Terms of Reference for Economic Due Diligence by an International Panel of Experts, EBRD 2nd August 1996.

„We conclude that K2/R4 are not economic. Completing these reactors would not represent the most productive use of \$US1bn or more of EBRD/EU funds at this time,,⁴

Given the explicit nature of the Panel's conclusions and their clear mandate to undertake the economic due diligence, future analysis not surprisingly has been treated with scepticism by independent experts and the environmental community.

In April 1999, however, EBRD requested, the US consultants Stone and Webster (S&W) to undertake new analysis of the economics for the completion of K2R4 nuclear power plants in Ukraine. This analysis updated two previous assessments undertaken by S&W, the others being completed in April 1997 and May 1998. This third assessment has not been subjected to the same transparent scrutiny as other economic analyses because its existence has not been widely publicised and because it was produced after the public consultation process, concluded in 1998. This latter study, therefore, lacks the international acceptability and independence that is paramount for such a project.

⁴ Economic Assessment of the Khmel'nitsky 2 and Rovno 4 Nuclear Reactors in Ukraine, Volume 1: Main Report, 4th February 1997, (Panel) page 6

S&W III – main conclusions:

The April 1999 S&W report concludes⁵: -

„On the basis of these combined conclusions from the sensitivity analysis, the probability analyses and the decision risk analysis, the decision to complete Khmelnytsky 2 in 2002 and Rovno 4 in 2004, is most likely to be the least-cost and least risky economic choice,,

The major changes, from the 1998 report are: -

- A reduction in the estimated completion cost of K2 and R4. The costs of the components that are linked to Ukrainian prices have become substantially lower in US Dollar terms as a result of the devaluation of the Ukrainian currency from 1.86 Hryvna to 3.70 Hryvna to the US Dollar.
- A reduction in the forecast demand for electricity in the Ukraine, since the EBRD's projection of Ukrainian GDP has been revised downwards.
- The assumption that K2 and R4 will now be completed in sequence, rather than simultaneously. The revised estimated in-service dates are mid 2002 for K2 and mid-2004 for R4.

This new information was „provided to Stone and Webster by EBRD in March 1999,,⁶.

Completion Costs.

The revised Stone and Webster analysis assumes the following decrease in construction costs.

	S&W 1998 ⁷ US\$/kW	S&W 1999 ⁸ US\$/kW	Difference US\$/kW	% difference
K2	660	535	125	18.9
R4	630	577	53	8.4
Total	1290	1112	178	13.8

These conclusions give raise to a number of questions: -

- Why have the individual costs for K2 and R4 changed so significantly? For both years the analysis was based on the sequential completion of the two reactors and so should be similar, varying only in a percentage change, due to a decrease in the value of the Hryvna. However, the costs for K2 have decreased by nearly 20%, while for R4 by only about 10%. Furthermore, in 1998 K2 was more expensive to complete, but now it is R4. The S&W reports makes no explanation of why the change in value lead to a particular decrease in construction costs and why such variation occurred between the two reactors.
- It is possible to see that the figures supplied to S&W suggest on average a 14% decrease in construction costs. As has been stated this is due to a devaluation of the local currency, making the work undertaken locally cheaper relative to the US dollar. However, no attempt is made to assess the impact on this devaluation on the other power plant options within the economic analysis. For all other options construction costs used have remained the same as can be seen below and therefore the S&W study is not

⁵ Completion of Khmelnytsky 2 and Rovno 4 in Ukraine Economic Due Diligence. Stone and Webster Management Consultants, Inc. EBRD April 1999 (S&W 1999).

⁶ S&W 1999, page 15

⁷ Appendix A: Khmelntisky 2 and Rovno 4 Completion Due Diligence, Least Cost Planning Analysis, In service Data Capital costs – 10% cost of capital, Completion of Khmelnytsky 2 and Rovno 4 in Ukraine Economic Due Diligence. Stone and Webster Management Consultants, Inc. May 1998. (S&W 1998)

⁸ S&W 1999, Table A13.

comparing like with like. While it is recognised that the construction costs for K2R4 would be larger than for the alternatives, it is also true that in many of the non-nuclear alternatives the percentage of local components in the construction are likely to be much greater. Consequently, the percentage decrease in the overall construction cost would be greater than for K2R4.

Plant Type		S&W 1998 ⁹ US\$/kW	S&W 1999 ¹⁰ US\$/kW
Fossil High Rehabilitation			
	Low 200 MW	602.1	602.1
	300 MW	569.1	569.1
	Medium 200 MW	718.1	718.1
	300 MW	678.1	678.1
	High 200 MW	857.1	857.1
	300 MW	809.1	809.1
Fossil Middle Rehabilitation			
	Low 200 MW	333.0	333.0
	300 MW	292.0	292.0
	Medium 200 MW	400.0	400.0
	300 MW	350.0	350.0
	High 200 MW	480.0	480.0
	300 MW	420.0	420.0
Fossil Low Rehabilitation			
	Low 200 MW	100.0	100.0
	300 MW	100.0	100.0
	Medium 200 MW	120.0	120.0
	300 MW	120.0	120.0
	High 200 MW	144.0	144.0
	300 MW	144.0	144.0
Combustion Turbine		375.0	375.0
Combined Cycle		750.0	750.0
New Coal-fired Unit with AFBC		1250.0	1250.0

Once again the 1999 S&W report makes no attempt to justify this apparent inconsistency. This is of particular importance as the retrofitting of the smaller thermal units has the added advantage of flexibility of the completion of K2R4. This is extremely beneficial given the financial and economic uncertainties of Ukraine.

Fuel Costs.

Similarly, the 1999 S&W study fails to take into consideration the impact of the changing value of the Hryvna on the cost of fossil fuels. The S&W studies give the same values for the cost of fuels in US\$ and thus imported fuel would remain at around the same price with a decreased Hryvna. However, domestic fuel sources, such as some coal and Schlamm should decrease in cost, when priced in US\$. This has not occurred in the 1999 S&W analysis. Therefore, one can only conclude that no attempt has been made to include in the economic forecasts any assessment of the devaluation of the Hryvna on the fuel costs. This must undermine the results of the least cost assessment given the importance of the fuel costs in the economic analysis.

⁹ Appendix A: Khmelntisky 2 and Rovno 4 Completion Due Diligence, Least Cost Planning Analysis, In service Data Capital costs – 10% cost of capital, S&W 1998.

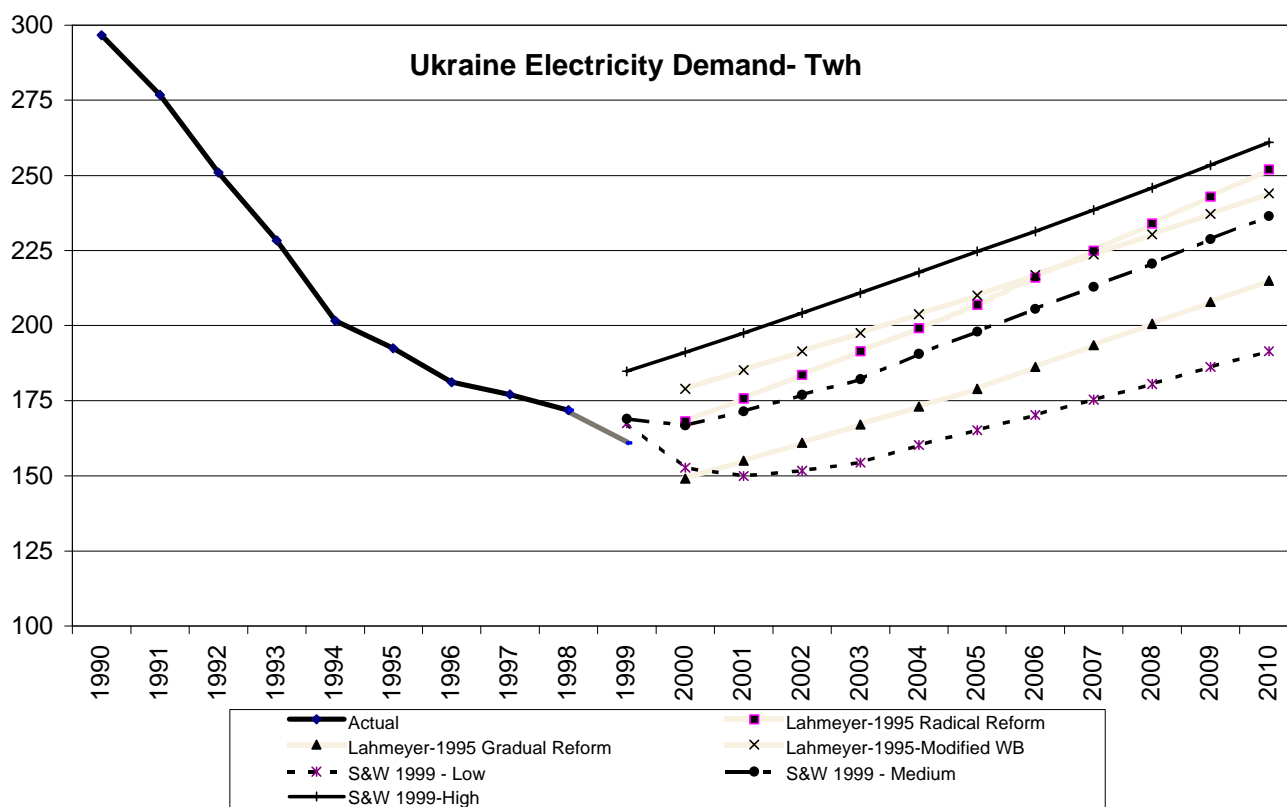
¹⁰ S&W 1999 Table A13.

Demand Scenarios.

Although the S&W 1999 study does take into consideration the current demand projects for Ukraine the analysis is both overly optimistic in its forecasts and inconsistent in its application to the projected capacity needs.

Inconsistencies:

The Base-case scenario in both the 1998¹¹ and 1999¹² S&W reports state that „installed capacity is technically sufficient (but not economically the best) to supply system energy needs and peak load until around 2007“ However, as has been noted the 1999 S&W report gives a lower electricity demand forecast than the previous version, but not account of this is taken in predicted when the new capacity will be needed.



Forecasts:

The graph shows the various predictions put forward for future electricity demand in Ukraine. What is not surprising is that the predictions undertaken in 1999 give a lower demand forecasts than those in 1995. No direct comparison between the S&W 1998 and 1999 reports are possible due to the variation in the presentation of the data and insufficient accompanying explanations. The 1998 report only gives figures for Gross Annual Energy Generation, while the 1999 report produces the figures for Gross Annual Energy Demand. However, what is interesting is the scenario description for the low (slow reform) prediction put forward by Lahmeyer¹³.

„it is assumed that comprehensive power sector reorganisation and financially viable tariffs come into affect by 1998, and that the pursuit of a more gradualist/piecemeal approach to transforming the economy, while

¹¹ S&W 1998, page 21

¹² S&W 1998, page 22

¹³ Ukraine Power Sector Least Cost Investment Plan and Training Program, undertaken by Lahmeyer International for the EBRD, July 1995

slowing down the ongoing recession, postpones recovery and reduces GDP growth during the initial years of the subsequent upswing...

This scenario describes the current situation and indicates the likelihood of lower future electricity demand. The lack of reform in the electricity sector was highlighted by the decision by the World Bank in June 1999 to abandon its Electricity Market Development Project citing the lack of reforms in the sector as its motivation. This does not bode well for the introduction of a financially viable tariff reform, which rightly forms the basis for any economically sound public utility service.

Furthermore, preliminary figures from the Ukrainian Energy Ministry for electricity consumption in the first part of 1999 show a 3.4% decrease in electricity consumption during the first seven months of 1999. This equates to a 5.8% annual decrease. Under such a scenario, consumption would fall to 161.86 Twh for 1999. This falls well below even the low scenario put forward by S&W in 1999, or 167.5 Twh.

Failure to investigate alternatives:

Nuclear Upgrades:

It has been suggested by a number of bodies that rather than complete further nuclear reactors a better use of limited investment opportunity in the nuclear sector would be to upgrade the existing nuclear power plants, mainly the other VVER 1000 reactors. S&W suggest that it will be possible to increase the efficiency from 67% to 75%. This would effect eleven VVER 1000 reactors in Ukraine, as can be seen below.

Reactors	Capacity Factor – 1998	Electricity Production 1998 – TWh
Khmelnitsky 1	66.00	5.78
South Ukraine 1	74.23	6.50
South Ukraine 2	46.24	4.05
South Ukraine 3	70.77	6.20
Rovno 3	68.30	6.50
Zaporozhe 1	66.62	5.82
Zaporozhe 2	59.52	5.21
Zaporozhe 3	60.37	5.29
Zaporozhe 4	72.83	6.38
Zaporozhe 5	70.58	6.18
Zaporozhe 6	70.92	6.48
Total :		64.39
Average:	66.03	5.85

An increase in efficiency of around 8% would lead to a corresponding increase in output of around 8TWh, the production of more than one reactor (it equates to the current production from 1.3 VVER 1000 reactors). The S&W 1999 report suggests that this would costs around \$78 million per unit. However, this is the same cost estimate as the 1998 report by S&W. Given the expected decrease of 13.7% in the construction costs for K2R4 reflected in the two reports, it is somewhat surprising that a similar decrease has not been identified for the VVER 1000 upgrading program. If a similar (13.7%) cost decrease were applied to the upgrading program, it would cost \$740 million for the eleven VVER 1000 reactors.

Consequently, more than the proposed electricity production from K2 or R4 could be met by upgrading the current VVERs. This would have the environmental advantage of not increasing the production of radioactive waste and have no financial or environmental impact of decommissioning the power station at the end of its life. Furthermore, the VVER upgrading option will not result in any increase in operating costs and thus although its initial construction costs may be higher, \$740 million compared to \$577 for R4, its overall production cost for electricity is likely to be lower.

Sustainable Energy Sources:

The revised S&W study has not reviewed its position on energy efficiency and renewable energy options. Most surprising is the apparent disregard of the energy efficiency potential in Ukraine. In 1998 the EBRD and World Bank, signed with the Ukrainian government a plan of action on energy efficiency. The plan noted the extremely high levels of inefficiency in Ukraine which was effecting the economic competitiveness of the country. The 500 MW energy saving potential identified by S&W represents about 1% of the installed capacity or less than 2% of the peak capacity. Given that audits financed by the US and Dutch Governments and Tacis have identified measures that could save 10% of energy, through stand a lone energy efficiency actions in the industrial sector, it is clear that the S&W analysis is incomplete.

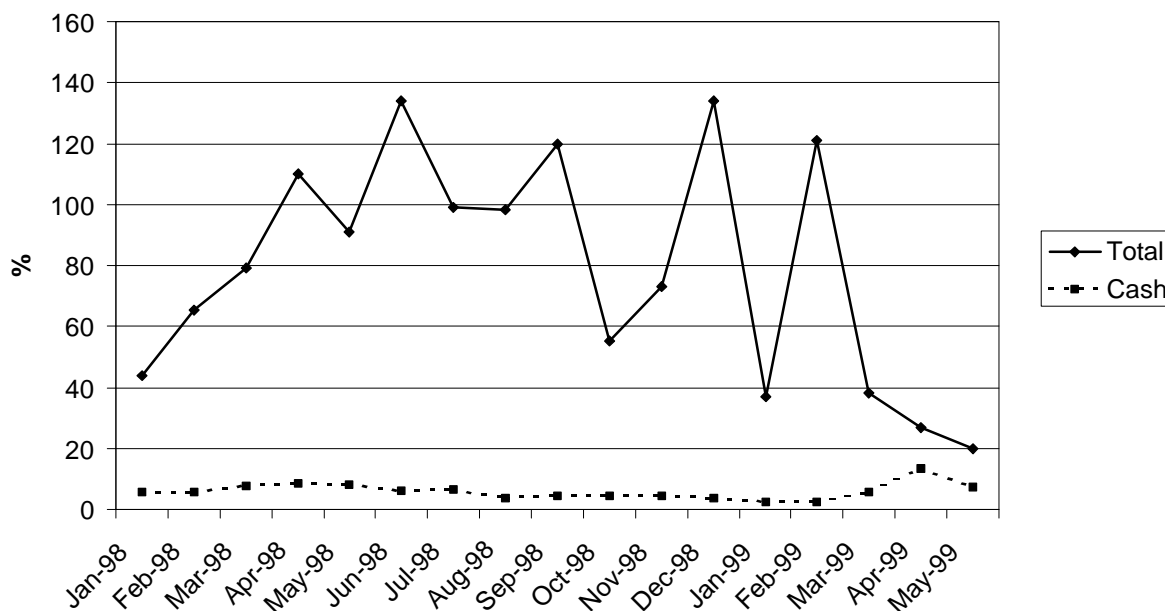
The S&W states on renewable energy „Renewables such as solar and wind energy plants were not considered as options for new capacity in this study since no background work was found to support solarization, wind potential or costs for these types of generation in Ukraine,.. This dismissive nature for renewable energy is extremely surprising given the number of national and international studies have been performed on renewable energy for Ukraine. These have shown that there are abundant sources of economic renewable energy sources throughout Ukraine. The 1996 National Energy Strategy for Ukraine predicts a five fold increase in the installed capacity of renewable energy between 2000-2010, to over 4 GW, twice the capacity of K2R4.

Debt Servicing:

The revision of S&W in April 1999 was largely driven by the August 1998 currency collapse. As has been stated the study noted there was a devaluation of the currency from 1.86 to 3.7 Hryvna to the US Dollar. This will affect the cost of construction projects in Ukraine. However, this will also impact upon the economic viability of the project.

The revenue that the nuclear power plants will generate will be based on the tariff and collection rate of electricity sold domestically. Given that K2R4 are supposed to be needed replacement capacity for the closure of Chernobyl it is politically unacceptable for the electricity from K2R4 to be sold outside Ukraine. The decrease in the value of the Hryvna will decrease the US Dollar value of the electricity sales. Furthermore, given that the majority of the proposed lenders – European Commission, EBRD, Coface and Hermes – all will require payment in Euros, Dollars or their equivalents, the levels of Hryvna cash collection will have to increase at a comparable rate as the currency decreases just to remain constant. Alternatively, the tariff level

Energatom Collection Rate 1998-9



will have to increase significantly and in line with the decreasing value of the Hryvna, which is politically difficult in Ukraine at the present time.

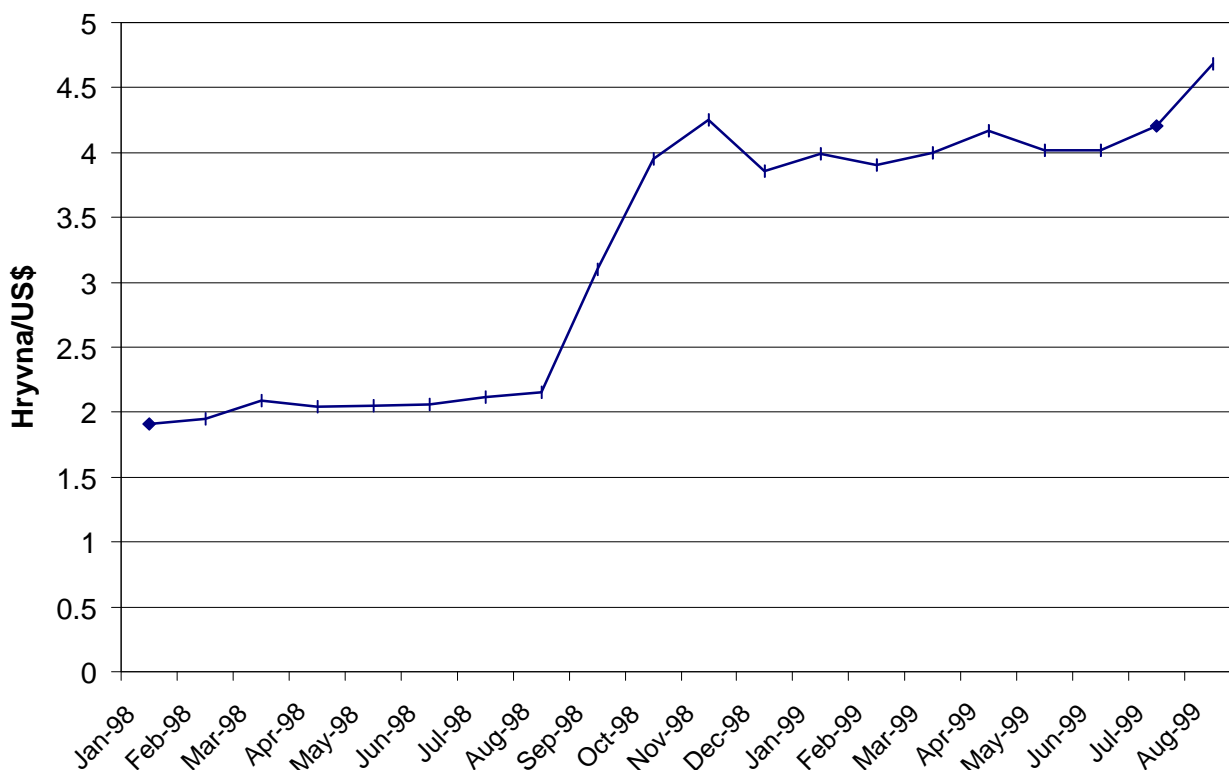
As can be seen, the Hryvna continues to fall. In August the Hryvna came out of the exchange rate corridor as it fell to 4.68 Hryvna to the US\$. The National Bank pledged to support the currency to enable it to move back into the corridor, but with the further fall of the rouble, this may prove difficult.

Collection of Electricity Bills:

In addition to the problems associated with the low value of the Hryvna, Energoatom has an incredibly low level of collection, in particular for cash collection. In 1998 senior EBRD staff told NGOs that they would not proceed and present the project to the Board of Directors unless specific targets were met. It is reported that this included the requirement that cash collection would have had to reach 17% for a three-month period prior to discussion within the Board. This level was further expected to increase to 25% prior to the loan being made effective. This was said to be the sound banking principles that the EBRD were based upon. However, it is now clear that these targets cannot be met during 1999. Information from the World Bank gives a month by month account of the collection levels achieved by Energoatom, as can be seen in the graph below.

Already, there is insufficient cash within the nuclear sector in Ukraine. Levels of maintenance and repairs have reached an all time low. In 1998 Energoatom was only able or willing to spend \$3 million on safety related improvements a drop from \$5 million in 1997. One consequence of this was that in 1998 there had been a 20% increase in incidents at the power plants and a decrease in capacity from 71.3% to 66% over the previous year. The proposals to ensure that K2R4 repayment take priority over other financial requests made upon Energoatom will make this situation worse and thus further reduce the safety level of the existing reactors

History of Ukrainian Hryvna 1998-9



Conclusion:

Significant changes have taken place in the energy sector in Ukraine during 1998 and 1999. Consequently, the appropriate step was taken in March 1999 to revisit the economic analysis undertaken in May 1998. However, the 1999 report fails to address some of the concerns raised about its predecessor and it is inconsistent in its approach of implementing new conditions. These problems are so significant that they undermine the conclusions of the 1999 study. In particular the 1999 study: -

- Fails to adequately predict the decrease in Electricity demand in Ukraine.
- Does not take into consideration the impact of a decrease in Hryvna on non-nuclear options for either construction or fuel costs, and thus distorts the results of the economic analysis.

The revised report also fails to seriously consider the alternatives to K2R4 in particular: -

- No detailed assessment has been made on the economic viability of increasing the efficiency of the existing VVER 1000 reactors.
- No serious attempt has been made to review the other main flexible conventional power plant options, energy efficiency and energy saving programs available to Ukraine.
- Renewable energy opportunities are dismissed without serious assessment.

Furthermore, since its completion in April 1999 events have occurred which further undermine the justification and viability of K2R4. These include: -

- The withdrawal of the World Bank's Electricity Market Development Loan, in July 1999. Senior EBRD staff had said that the loans re-implementation was one of the conditions for EBRD funding of K2R4.
- A further decline in electricity consumption and production during the first seven months of 1999.
- The refusal of the IMF to continue dispersal of credits from its Extended Fund Facility, in August 1999.
- The further decline in the value of the Hryvna makes the financial viability of the project less likely.

It is clear that the financial and economic conditions necessary for the EBRD to proceed with this project cannot be met. Consequently, on these grounds alone the project should be abandoned. In the inexplicable event that the EBRD staff choose to proceed, a further economic analysis needs to be undertaken. Such an analysis should not be undertaken by S&W and should take into consideration the current situation in Ukraine and applies it to all possible alternative variants to K2R4 not an ad hoc and distorted approach as has been seen to date.

This report was prepared by CEE Bankwatch Network

CEE Bankwatch Network organises environmental NGOs from 11 countries in Central and Eastern Europe (Armenian, Belarus, Bulgaria, Czech Republic, Estonia, Georgia, Hungary, Lithuania, Poland, Romania, Slovak Republic and Ukraine).

Our main goals are:

- To create public awareness about the activities of International Financial Institutions (IFIs) in Central and Eastern European (CEE) countries, and their impacts on the environment.
- To promote public participation in IFI decision-making processes, policies and projects on the local, national and regional levels.
- To help environmental non-government organisations (NGOs) and citizens' groups to monitor IFI activities in Central and Eastern Europe.
- To propose alternative policies and projects that are more consistent with a sustainable development path .



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