Estonia: Narva Power
Environmental Issues Associated with Narva Power Plants
Executive Summary

1 Background and Objective

Narva Power owns and operates two oil shale fired power plants located in the Narva region, North-east Estonia. The power plants, Balti and Eesti, are the principal electricity generating plants in Estonia. Balti power plant also produces hot water and steam for residential and industrial customers in the Narva region. The combined available capacity of the two power plants is 2,900 MW_e and 582 MW_{th}. The oil shale for these plants is supplied from Narva oil shale mines located in the vicinity of the power plants.

The Narva power plants are associated with environmental issues characteristic for oil shale, which is a low-grade fuel with high ash content. Additionally, both plants use outdated technology and have partly inadequate pollution control. Consequently, Narva power plants are currently emitting a significant amount of particulates into the atmosphere and producing large quantities of ash. Atmospheric SO_2 emissions are also considerable.

Narva Power has recognised that it will need to implement significant technical improvements in both Balti and Eesti power plants to continue their operation in compliance with increasingly stringent environmental requirements. This has resulted in an investment programme to provide Estonia with a sustainable electricity generation based on local oil shale, which meets all relevant national and international environmental requirements. The key environmental issues associated with this investment programme are summarised below.

A comprehensive environmental study is currently being carried out by Eesti Energia, the owner of Narva Power, on the request from the Ministry of the Environment of Estonia to fill in any gaps in the existing information. When available, this report will be appended to the environmental documentation that is in the public domain, which is anticipated in June-July 2002.

2 Narva Power Facilities

The Balti power plant (Balti PP) was built between 1959 and 1966. It is located 5 km south-west of the town of Narva, which has a population of about 80,000. The available capacity of Balti PP is 1,290 MW of electricity and 505 MW of heat.

Balti PP is divided into an old and a new part. The old part initially had altogether eighteen TP-17 boilers and eight 100 MW_e turbines. Eight boilers and four turbines are currently in operation, while the others have been taken out of service. Two further turbines and four boilers will be taken out of service in 2004. The new part of the plant

has eight TP-67 boilers and four 200 MW_e turbines. Two boilers are equipped with new, efficient electrostatic precipitators (ESP), while the other blocks have old, less efficient ESPs of Russian design. Bottom ash form the boilers and dry ash from the ESPs are deposited next to the power plant. Cooling water is supplied from the Narva reservoir, which is closely connected to the Narva River via two 1 km long inlet channels.

The Eesti power plant (Eesti PP) was built between 1969 and 1973. It is located approximately 25 km southwest of the town of Narva. The available capacity is 1,610 MW of electricity and 77 MW of heat.

Eesti PP initially had sixteen TP-101 boilers and eight 200 MW_e steam turbines. Fourteen boilers and seven turbines are currently in service. Eight boilers have been equipped with new, efficient ESPs while six boilers have old, less efficient ESPs of Russian design. Bottom ash from the boilers and dry ash from the ESPs are deposited next to the power plant. Cooling water is supplied from the Narva River and Mustajõgi River via a 7 km long open channel.

An oil shale retorting plant, the UTT-3000 refinery, was built next to Eesti PP in the late 1970's, to provide shale oil as a start-up fuel for the power plants. It comprises of oil refining and cleaning equipment to produce different fractions of shale oil. Main products are fuel grade shale oil, raw material for bitumen and antiseptics.

3 Relevant environmental regulations and international treaties

3.1 International Agreements

On 2nd July 1993, the Republics of Finland and Estonia entered into an agreement, the "Contract on the Atmosphere-Protection Co-operation between the Republic of Estonia and the Republic of Finland". One of the principal objectives of the agreement is to "reduce the spread of air contaminants and avoid the contaminants exceeding their critical loads on the territories of the Republic of Estonia and the Republic of Finland".

In partial fulfilment of this objective, Article 2 of the agreement specifies that each country reduce its annual SO_2 emissions to at least 50% of 1980 levels by the end of 1997. Estonia has already met this objective. The two countries also agreed to compile by the end of 1994 an operating strategy for reducing SO_2 emissions by at least 80% of 1980 levels by the year 2005.

In April 1997, the Republic of Estonia formally adopted an Environmental Strategy based on this operating strategy, which sets out the following targets relevant to Narva PPs:

- Ash and dust emissions should be reduced by 25% of 1995 levels by 2005;
- The use of heavy liquid fuels with a sulphur content of above 2% should be phased out by 2005;
- SO_2 emissions should be reduced by 80% of 1980 levels by 2005; and
- EU emission requirement targets for power production should be met by 2010.

3.2 Estonian Legislation

Regulation No 60 of 26th October 1998 of the Estonian Ministry of the Environment established quantitative limit values for the release of pollutants from power plants. The Regulation laid down different limitations for new and old facilities. The limitations on new facilities took effect as of 2000, whilst the limitations on old facilities come into effect in 2003. Regulation is expected to be changed in May 2002 in line with EU LCP Directive so that limit values for old facilities will become valid in 2008.

3.3 EU Directives

Upon Estonia's accession to the EU, Narva Power will be subject to the requirements of the EU Council Directive 2001/80/EEC on air emissions from large combustion plants (the LCP Directive). The Directive applies to new power plants from 2002 and existing plants from 2008 and allows limited operation of non-compliant existing plants until 2015.

Narva Power will also be subject to the EU Directive on Landfill of Wastes 1999/31/EC (adopted into Estonian law by the Decree of the Minister of Environment No 34 of 26th June 2001) which sets out requirements for landfills and waste disposal technologies.

4 Current regulatory compliance and key environmental issues

4.1 Regulatory compliance

Narva Power is in compliance with current Estonian environmental laws and regulations and has obtained all required operational and environmental permits. It has not received any notices of violation.

4.2 Air emissions

Narva Power's current air emissions are presented in the table below.

.	Eesti and Balti actual emissions by boilers in 2001 mg/Nm^3			Narva Power total emissions in 2001 t/a
	TP-17	TP-67	TP-101	
SO_2	3,499	1,520	1,915	68,800
NO_X	254	259	270	8,800
Particulates	2,354	1673/ 34*	1858/ 97*	47,400

* after new ESP installation

SO_2 and NO_X emissions are causing acidification in the area of deposition. Fly ash from oil-shale plants has an alkaline nature due to the high limestone content of the fuel.

4.3 Ash disposal

As the ash content of Estonian oil-shale is very high (on average 46%), Narva Power is currently producing approximately 4.5 million tonnes of ash per year. A total of approximately 200 million tonnes of ash are stored at ash-storage areas at Narva PP. Balti PP's ash deposit currently occupies an area of 10 km^2 and contains approximately 113 million tonnes of ash; Eesti PP's ash deposit currently occupies an area of 5 km^2 and contains approximately 90 million tonnes of ash. Ash is deposited of in accordance with current disposal permits.

4.4 Site contamination

A two-phase environmental assessment of the Balti PP and Eesti PP sites, of the oil shale retorting plant and the mining and subsidiary operations of Eesti Põlevkivi was undertaken by Jaakko Poyry in 1999-2001. The study assessed the extent of historical environmental contamination and the necessary remediation work required to meet current Estonian regulations and the expected future requirements for accession into the EU. The key findings of this assessment (relating to the Narva power stations) are summarised below.

4.4.1 Soil contamination

Some soil contamination with mineral oils, volatile organic compounds (VOC), polyaromatic hydrocarbons (PAH) and phenols was detected at both Balti PP and Eesti PP sites. The investigations also showed that contaminants are migrating both vertically and horizontally with upper layer groundwater and soil. Although soil was not heavily contaminated at the sampling locations, it is likely to be contaminated at the sites where contamination of upper layer groundwater was observed. The contamination is more extensive in the Eesti PP area than at the Balti PP. One of the main polluting sources is the UTT-3000 refinery.

4.4.2 Groundwater contamination

Both the upper and the middle aquifers at the Eesti PP and Balti PP are clearly impacted and are contaminated with PAH- and VOC –compounds, mineral oils and several metallic and non-metallic elements. Phenols were also observed in two wells in the upper aquifer at the Balti PP. It is possible that the contaminants have migrated in the flow direction of the groundwater. The activities in the power plant areas are an obvious source of the pollution. The Russian City of Ivangorod's groundwater intake could potentially be impacted by pollution from Narva PPs.

4.4.3 Surface water contamination

The environmental effects of the power plants are associated with cooling water thermal loading to the Narva River and Narva Reservoir. Due to the high dilution rate the temperature rise in the Narva River and Narva Reservoir is very localised and the resulting downstream increase in the temperature after mixing is very low.

4.4.4 Balti ash disposal area No 2

The area of Balti ash disposal area No 2 (without the settling pond and channels around the ash heap) is approximately 400 hectares. The area consists of twelve lagoons, which are separated from each other by 2 to 4 m wide banks. It is no longer operational, but is

sometimes used as reserve storage and evaporation area for excess water from the ash transport system. Some of this water is occasionally discharged into the cooling water outlet channel under a temporary environmental permit. Leaching of the highly alkaline ash water into soil and groundwater is an issue for the power plant.

4.4.5 Industrial landfills

Contaminated leachate and runoff waters from the industrial landfills at Eesti PP and Balti PP are discharged in the surrounding soil, groundwater and surface waters. Concentrations of harmful substances, such as mineral oils, phenols, polyaromatic hydrocarbons (PAH) and chlorinated organic compounds were found in the surface water near the landfills.

4.4.6 Liquid wastes at the Eesti PP and the UTT-3000

Several non-hazardous and hazardous liquid waste streams, such as coagulant from the water treatment department, oily waters from UTT and washing water from the turbine department, are discharged in the ash disposal system. These wastes will ultimately end up in the ash disposal area.

4.4.7 Asbestos

An asbestos survey in the Eesti PP units 1 – 7, in the Balti PP units 9, 10 and 12 and in the UTT-3000 shale oil refinery showed that asbestos has been used for insulation nearly everywhere in construction. Asbestos was found in the surface layers of pipe insulation, in the external insulation of the walls and tops of boilers and electrostatic precipitators, in the insulation of tanks and ducts, as asbestos cord seals and in asbestos cement plates. Asbestos has also been used to replace cement mortar in overlaying fire insulation on steel structures. Asbestos waste has so far been deposited in the ash disposal areas or in various intermediate storage sites. Historically it was not marked as asbestos waste nor confined to designated and controlled areas in the landfills. However, from January 2002 onward asbestos has been disposed in designated area in accordance with EU Landfill Directive.

4.5 Transboundary environmental issues

In addition to its local environmental impacts, Narva Power is also associated with transboundary environmental issues mainly due to its significant SO_2 emissions. Elevated sulphur deposition levels have been measured in neighbouring areas in Finland and in Russia as a result of Narva Power's SO_2 emissions. Finnish and Russian authorities and interested NGOs have participated in scoping meetings for the environmental studies.

The impacts of discharges to surface water (Gulf of Finland and Baltic Sea) are currently being assessed and the study will be made available when completed in early summer alongside the existing information in the public domain.

5 The Proposed Investment Programme

The Investment Programme of Narva Power is aimed at securing sustainable local oil shale-based electricity production, which meets all relevant national and international environmental requirements. The programme involves repowering, renovation and environmental remediation measures with three specific objectives:

- To reduce the total level of SO_2 emissions to enable Estonia to meet its international environmental obligations;
- To address other environmental issues at the power plants, such as particulate emissions, ash pond rehabilitation, soil and ground water contamination and water plant renovation; and
- To improve the efficiency and reliability of the power plants.

5.1 Repowering projects

Repowering projects involve conversion of two boilers at both Balti PP (Block 11) and Eesti PP (Block 8) to circulating fluidised bed (CFB) boiler technology. The main design advantages of CFB technology compared to pulverised combustion technology used in the existing units are:

(i) A significant reduction of emissions to the atmosphere:
  - SO_2 emissions are reduced by approximately 95%
  - NO_x emissions are reduced by approximately 55%
  - CO_2 emissions are reduced by approximately 23%
  - Particulate emissions are reduced by approximately 97%

(ii) An increase in the gross output of the repowered units from 170 MW_e at Balti PP and 180 MW_e at Eesti PP, to 215 MW_e;

(iii) An improvement in the efficiency of each repowered unit from 30.0% to 36.5%, which is expected to result in a fuel saving of 20% or more and an associated reduction of air emissions per unit of electricity or heat produced; and

(iv) A significant reduction in operational and maintenance costs.

The repowering projects will also enable decommissioning of several existing boilers. At Balti PP, eight TP-17 boilers at the old plant will be taken out of service at or immediately after the commissioning of the new CFB units.

5.2 Renovation projects

Renovation projects are designed to improve plant performance, to address current environmental concerns and to minimise the future environmental impact of energy production. The renovation projects involve various measures of environmental significance.

Renovation of water treatment plant will upgrade the water treatment plant at Eesti PP and will reduce costs.

Upgrading the ash handling systems will improve the ash disposal process at both Eesti PP and Balti PP. The transport and disposal of ash will be modified to reduce water consumption and the potential impact of ash disposal on the environment.

Oil-fired back-up heating boiler plant will introduce three oil-fired hot water package boilers at Balti with a maximum aggregate capacity of 150 MW_{th} and one steam package boiler with a maximum capacity of 200 MW_{th} if there is no demand for steam. These boilers will be used for heating water and for producing industrial steam for start-up of the Balti main generating Blocks. They will also serve as a back-up steam source for the Narva PP district heating system.

District heating filtration system will introduce a filtration system for the Narva district heating system.

Interconnection and metering will improve the interconnections with the transmission grid and metering at both Eesti PP and Balti PP. Work is currently under way and will be completed in 2004.

Electrostatic precipitator project will equip six boilers at Eesti PP with new high efficiency ESPs by end of 2003.

Ash pond rehabilitation of active ash landfills and associated ponds at both Eesti PP and Balti PP form a major part of the Renovation Projects. A 'dry' ash transport system will be developed to reduce the quantity of disposed water. This is particularly important at Balti PP where discharges have occurred in recent years. This work will be carried out at Balti PP through to 2004 and at Eesti PP from 2005 onwards.

Chemical and oil spill prevention will implement improvements to the chemical and oil leakage and spill prevention systems at both Balti PP and Eesti PP. This work will include the replacement of old tanks and pipelines, replacement of underground tanks with surface tanks, repairs on secondary containments and installation of appropriate storm water collection and treatment systems.

Asbestos will be removed and disposed during repowering and renovation projects.

5.3 Environmental remediation programme

The environmental remediation programme is based on a two-phased environmental assessment of the Balti PP and Eesti PP sites and the oil shale retorting plant. The remediation measures are additional to the environmental investments included in the Renovation Projects. They include:

- Construction of a waste collection and treatment system
- Reclamation of Balti no. 2 ash landfill
- Construction of a waste management centre
- Closure of industrial landfills
- Upgrading or removal and disposal of asbestos from operating boiler installations
- Removal and treatment of contaminated soil

6 Assessment of the Environmental Impacts of the Investment Programme

The investment programme has mainly environmental objectives and will result in significant reduction of the environmental impact of Narva PPs. Some minor adverse environmental impacts may temporarily occur during the construction phase, such as increased traffic and noise, but these are estimated to be limited both in time and scale. The key environmental impacts are summarised below.

6.1 Alternatives to the investment programme

A scoping meeting held 4 April 2002 identified three alternatives, the environmental impacts of which are being investigated and compared in the current study. The alternatives are:

- Do nothing;
- Equip existing facilities with end-of-pipe pollution control device; and
- Proposed investment programme.

In the "do nothing" scenario, Narva Power's environmental status and issues would remain unchanged compared with the present situation described above in section 4. The "end of pipe" scenario is based on equipping the present power production facilities with end of pipe pollution control device. Its impacts will be investigated as a third alternative in the comprehensive environmental study currently under way.

6.2 Air emissions

The primary reason for the introduction of Circulating Fluidised Bed (CFB) combustion technology at Narva Power is to reduce the high SO_2 emissions. SO_2 emission levels of the repowered units are expected to be up to 95% lower compared with the existing plants. In parallel, the turbines are to be modernised to achieve efficiency improvements. NO_X and CO_2 emissions will also be reduced.

Eight further boilers are being equipped with new high efficiency ESPs to reduce particulate emissions. The specific particulate emissions per unit of electricity or heat with a new ESP are an order of magnitude lower than those of units with old ESPs.

Current and estimated future annual air emissions of Narva Power compare as follows.

.	Narva Power total emissions in 2001 t/a	Narva Power total emissions after the Investment Programme (2004) t/a	Reduction of air emissions t/a	Reduction of air emissions %
SO_2	68,800	38,000	30,800	44.8
NO_X	8,800	8,300	500	5.7
Particulates	47,400	3,100	44,300	93.5

Future regulatory compliance of air emissions
Narva Power's future regulatory compliance, particularly with SO_2 emissions, is based on the assumption that new CFB boilers will be continuously in service, whereas the old boilers will serve for peak and winter heating demand only. It is assumed that the operation time of old boilers will be limited to 20,000 h for the period from 2008-2015. One more block consisting of two boilers may have to be converted to CFB at a later stage to ensure sustainable, environmentally compliant energy production. The planned replacement of ESPs will bring the particulate emissions within the regulatory limits.

Narva Power's future regulatory requirements and emissions are as follows.

.	EU Directive 2001/80/EC (new solid fuel plants of > 500 MW from 11/02) mg/Nm^3	EU Directive 2001/80/EC (existing solid fuel plants of > 500 MW from 01/08) mg/Nm^3	Decree No. 60 of the Estonian Government (new plants from 2000) mg/Nm^3	Decree No. 60 of the Estonian Government (existing plants from 2003) mg/Nm^3	Narva Power future emissions with CFB boilers mg/Nm^3
SO_2	200	400	400	2000	200
NO_X	200	500*	400	450	200
Particulates	50	50	50	400	30

* 200 from 2016

6.2 Other improvements

6.2.1 Contaminated soil clean-up
A total of 15,500 m^3 of contaminated soil will be removed and treated. This will also mitigate the risk of further groundwater and surface water contamination.

6.2.2 Waste management rehabilitation
The waste management system of Narva PPs will be rehabilitated, including the establishment of new inert waste landfills, the renovation of the ash transport system, the improvement of oil handling and storage and the establishment of a waste management centre. The implementation of a more controlled and modern waste management system will ensure that Narva Power can successfully implement the waste related remediation measures, including the closure of the industrial landfills, establishment of a composting field for contaminated soil remediation and the asbestos landfill. The waste management centre will also enable Narva Power to meet tightening future environmental requirements for waste management.

6.2.3 Balti ash disposal area No 2
Reclamation of Balti ash disposal area No 2 by installing and designing of the top layer of the ash and drainage system (channels) on the top of the disposal area will reduce the leaching of alkaline ash water into the surrounding soil, groundwater and surface waters.

6.2.4 Industrial landfills

Closure and encapsulation of three industrial landfills at the Eesti PP and one industrial landfill at the Balti PP will reduce the amount of leachate from the sites and prevent further contamination into the surrounding soil, groundwater and surface waters.

6.2.5 Asbestos

Removal and repair of the present asbestos insulation in accordance with hazardous material handling guidelines will enable safe plant operation and environmentally acceptable asbestos disposal.

6.3 Worker health and safety

Safety is of primary concern to Narva Power at all of their facilities. Worker health and safety programmes are encouraged and enforced throughout the power plants and new safety and employee training programmes and process improvements will be introduced. In addition, Narva Power is in the process of adopting ISO 14001 Environmental Management System to ensure that work practises and documentation are carried out in accordance with international environmental standards.

6.5 Transboundary environmental issues

The investment programme will reduce Narva Power's SO2 emissions by approximately 45 %. Narva Power's transboundary sulphur load to adjacent areas in Finland and Russia is expected to reduce in the same proportion as the emissions.

The investment programme will also reduce surface water contamination and thus reduce Narva Power's impact on the Gulf of Finland and the Baltic Sea. More details on the assessment of discharges and mitigation measures will be included in the current study.

7 Additional Environmental Mitigation Measures

The proposed investment programme will address most key issues. Further remediation and mitigation measures are to be included in an Environmental Action Plan (EAP). The EAP is proposed to include the following measures:

- Continuous monitoring of groundwater at the power plant sites and their surroundings
- Identification of oil discharges and rehabilitation of oil handling and storage to exclude oil discharge into the environment.
- Completion of the reclamation of the Balti ash disposal area No 2.
- Improvement of waste management by establishing an alternative industrial waste disposal facility and improving the waste tracking system.
- Treatment of hazardous liquid wastes from the UTT-3000 refinery before disposal.
- Establishment of a storage area for hazardous intermediate waste from the UTT-3000 refinery, including oily solid wastes, maintenance waste and other industrial waste.
- On-going monitoring and informing of public of results and improvements.

Further measures to either enhance the environmental benefits or reduce the adverse environmental impact of the project and the operation of Narva Power may be identified during the EIA process, and will be added to the existing EAP as necessary.

8 Public Consultation

Eesti Energia is currently carrying out a comprehensive environmental study of the environmental impacts of the Narva Power investment programme on the request of the Estonian Ministry of the Environment (MoE). The study includes consultations with the public as required under Estonian law. Due to Narva Power's transboundary environmental issues, the Estonian MoE has also notified the relevant Finnish and Russian authorities in accordance with the UNECE Convention on Environmental Impact Assessment in a Transboundary Context as well as the Estonian-Finnish intergovernmental agreement on assessment of transboundary environmental impact.

An initial public hearing (scoping meeting) of the study programme was organised on 4 April 2002 at Balti Power Plant to identify relevant issues to be addressed in the study. The relevant Finnish and Russian authorities have also been requested to provide their comments on the study programme.

Eesti Energia will organise a final public meeting to discuss the findings and recommendations resulting from the study in August. Estonian MoE will submit the final study report to the relevant Finnish and Russian authorities and request their comments.

Disclosure of information
The public has been notified in Estonian daily newspaper that this executive summary, together with Environmental site Assessment report and a research report on Correspondence Of Fluidized Bed Boilers Powered by Estonian Oil Shale to Environmental Protection Demands in both Estonian and English languages have been disclosed for public at municipal offices of the City of Narva and Vaivara municipality at Narva Power office in Narva, Eesti Energia's headquarters in Tallinn as well as in EBRD Resident Office in Tallinn and Business Information Centre (BIC) in London. The public comment period is 120 days and will close on 5 September 2002. This executive summary and the comprehensive study programme have also been made available for public on Eesti Energia's (www.energia.ee) and EBRD (www.ebrd.com) websites.

The final report and its executive summary of the comprehensive environmental study of the environmental impacts of the Narva Power investment programme in both Estonian and English languages will append to the environmental documentation in the public domain in the above mentioned locations. Eesti Energia will notify the public of the availability of these reports in accordance with the Estonian public consultation requirements. EBRD's Board will also be provided with amending information.

Eesti Energia will organise on-going disclosure of information on results and improvements throughout the project implementation on its website, in annual environmental reports and through periodic press releases.

9 Conclusions

Based on the above summary of environmental issues of Narva power plants, the following conclusions can be drawn:

- Narva Power's environmental performance is currently in compliance with relevant Estonian environmental requirements.
- Nevertheless, the two power stations are Estonia's major sources of air pollutants and urgently require rehabilitation to meet current and more stringent EU legislation.
- The Narva Power investment programme, which has mainly environmental objectives, will result in significant environmental benefits, enabling Narva Power to meet increasingly stringent future Estonian, EU and International environmental requirements.
- Any potential adverse environmental impacts of the construction works are assessed to be limited both in time and scale.
- Further environmental mitigation measures and improvements will be addressed in an Environmental Action Plan to be implemented in addition to the investment programme.

The findings and recommendations resulting from the comprehensive environmental study currently being carried out by Eesti Energia and the associated public consultation will be used to amend this summary of environmental issues and append to the environmental documentation that is in the public domain.