

# Chernobyl 25 years on: New Safe Confinement and Spent Fuel Storage Facility



European Bank  
for Reconstruction and Development

The New Safe Confinement



Scene from Pripyat,  
town closest to site of accident



Reactor 4 after the explosion

26 April 2011 marks the 25th anniversary of the accident at the Chernobyl nuclear power plant. Since then Ukraine and the international community have been working on overcoming the legacy of the accident and converting Chernobyl into a safe and secure site. Recognising the magnitude of the task, the international community has supported Ukraine continuously in efforts to find solutions for Chernobyl.

After the shutdown of the last operating reactor in Chernobyl in 2000, today two major technical tasks remain to be accomplished: The first is to make the destroyed unit 4 environmentally safe. The second is to safely and securely store the spent nuclear fuel from reactors 1-3. This is one of the most important stages of the decommissioning of these units.

The construction of the **New Safe Confinement (NSC)** is an unparalleled project in the history of engineering. With a height of more than 100 metres it would be big enough to house the Statue of Liberty. The new structure will be assembled on site, but away from the highly radioactive unit 4 and then slid in place, covering the remains of the reactor building and the old shelter.

## International contributions

The plan to make the site of the 1986 accident safe is funded by the EBRD managed Chernobyl Shelter Fund. To-date the Fund has received €864 million from 30 donors.

Funding of the Interim Storage Facility 2 is provided through the Nuclear Safety Account. To-date it has received €321 million from 17 donors.

## New Safe Confinement

A new structure which will be slid over the shelter of unit 4 to allow for the future decommissioning of the damaged reactor.

The New Safe Confinement will have a span of 257 metres, a length of 164 metres, a height of 110 metres and a weight of 29,000 tons.



Nuclear Safety web site  
[www.ebrd.com/nuclearsafety](http://www.ebrd.com/nuclearsafety)

In the 1986 accident the reactor core of unit 4 melted and left significant amounts of material containing nuclear fuel in the lower floors of the building. Under extremely perilous conditions engineers and workers managed to cover the open reactor with an enclosure within months. However, this construction, known as the “shelter” or “sarcophagus”, was never intended as a permanent structure.

A longer term strategy for the site of unit 4 was laid out by a team of Western and Ukrainian experts in 1997 in the **Shelter Implementation Plan (SIP)**. In the same year the international community led by the G7 set up the **Chernobyl Shelter Fund (CSF)** to implement the Plan and invited the EBRD to be its administrator.

### Chernobyl Shelter Fund

Established in 1997 as an multinational donor fund to finance the SIP, administered by the EBRD.

The Fund has financed the necessary research and engineering, infrastructure and preparatory works to achieve the SIP objectives. Stabilisation measures inside and outside the shelter to minimise the risk of the old structure collapsing were successfully completed in 2008.

While the detailed design for the New Safe Confinement is being finalised, work on the foundations has already started. Work on the structure will begin as soon as the design receives regulatory approval from the Ukrainian authorities, currently expected in early 2011.

### Shelter Implementation Plan

The plan, developed in 1997 by Western and Ukrainian experts, sets out a step-by-step approach to the fundamental technical problems faced at Chernobyl and allows for the development of solutions as knowledge about the actual situation increases.

### Thomas Mirow, EBRD President

25 years after the accident at the Chernobyl nuclear power plant two crucial projects are entering the completion phase: The construction of the New Safe Confinement for the destroyed reactor 4 is about to begin and a storage facility for spent fuel from the operations of reactors 1-3 can now be finalised after the Ukrainian regulator has approved the project design.



These two projects, in which the EBRD is involved as fund manager and administrator, would not have been possible without the determination of the Ukrainian authorities and the solidarity of the international community. I am particularly grateful to our shareholders who agreed to use part of the EBRD's net income to support these projects.

However, at this stage funding for the two projects is not yet fully secured. In total, €740 million in additional financing still needs to be raised. I am fully aware that this is a considerable amount of money which is particularly difficult to raise at a time of universal fiscal constraints.

Nevertheless, we must not forget that it is in the best interest of Ukraine and the international community to bring to a successful conclusion the important work we have started in Chernobyl. Transforming Chernobyl into a safe and secure site is a truly global task. 25 years after the accident we now have the opportunity to finalise the process. It is a chance we must not miss.

Laying the foundations for the New Safe Confinement



## Timeline

- |  |  |   |
|--|--|---|
| <b>1986</b>  | <b>1995</b>  | <b>1997</b>   |
| <ul style="list-style-type: none"> <li>▶ 26 April: Explosion of reactor 4 of the Chernobyl Nuclear Power Plant.</li> <li>▶ April - October: Construction of sarcophagus as a temporary measure.</li> </ul> | <ul style="list-style-type: none"> <li>▶ G7/EU and Ukraine sign Memorandum of Understanding</li> <li>▶ EBRD Nuclear Safety Account extended to include the decommissioning of Chernobyl reactors 1-3.</li> </ul> | <ul style="list-style-type: none"> <li>▶ May: G7/EU and Ukraine agreement on the Shelter Implementation Plan (SIP);</li> <li>▶ September: Establishment of the Chernobyl Shelter Fund (CSF) at the EBRD</li> <li>▶ November: First pledging event in New York</li> <li>▶ December: CSF becomes operational</li> </ul> |

## Interim Spent Fuel Storage Facility 2



The second major task is from a safety point of view by no means less important. About 10 years after the end of nuclear power generation at Chernobyl the **Interim Spent Fuel Storage Facility 2 (ISF-2)** will provide a crucial component of a preparatory stage for the decommissioning of units 1-3.

Contributors to the EBRD-managed **Nuclear Safety Account (NSA)** have agreed to finance the construction of two facilities required to prepare the plant for the decommissioning, one to safely store the spent fuel from the operations of the Chernobyl nuclear power plant and one to treat liquid radioactive wastes. This was implemented in addition to bilateral projects like the construction of a

heat generation station, co-funded by the USA, and a facility for the treatment and storage of solid radioactive waste, funded by the European Commission.

### Outlook

As the 25th anniversary of the 1986 accident approaches, both projects – the New Safe Confinement and the Interim Storage Facility 2 – are nearing completion.

Both projects are now also at a stage where reliable cost estimates are possible for the first time. Together additional €740 million will need to be raised for these important projects to be completed.

### Interim Spent Fuel Storage Facility 2

A key facility for the decommissioning of units 1-3 which will provide safe and secure storage of the spent nuclear fuel generated during the operation of Chernobyl powerplant. Design of the facility was approved in October 2010.

### Nuclear Safety Account

Established in 1993 at the EBRD to finance nuclear safety measures in Eastern Europe. Today the NSA finances two decommissioning facilities at Chernobyl.

#### 1998

- ▶ Year-end: Implementation of first projects: Contracts for project management unit and engineering tasks signed; SIP implementation begins

#### 1998-1999

- ▶ First emergency works: repair of beams supporting the roof and stabilisation of ventilation stack of the sarcophagus

#### 2000

- ▶ May: Second pledging event in Berlin
- ▶ Year-end: Ukraine shuts down last operating Chernobyl reactor (Unit 3).

# Achievements

The Shelter Implementation Plan (SIP) has the goal to decrease the risk to workers, the population and the environment and to transform Chernobyl into an environmentally safe site for at least the next 100 years. It was developed by Western and Ukrainian experts in 1997 and funded by the European Commission and the United States of America.

The plan sets out a step-by-step approach to the fundamental technical problems faced at Chernobyl, responding to new challenges as they arrive and applying state-of-the-art solutions. Although the SIP defines five central goals, it does not prescribe specific remedies but defines a route to reach the targets.

As an example, the concept for the NSC was defined in 2002 taking into account many options and previous studies and radiation protection considerations.

During implementation it became apparent that numerous infrastructure facilities not foreseen by the SIP had to be provided.

Many SIP objectives have already been achieved. Among them are:

### Stabilisation

The roof and the western wall of the Chernobyl shelter were successfully stabilised 2004-2008. Eighty per cent of the roof load was transferred to a new external support structure. Extremely challenging tasks inside the shelter such as the installation of new structural supports in the “de-areator” were also successfully carried out, reducing the risk of collapse.



Western wall stabilisation

The stabilisation was finished on-time and within the cost estimate of about US\$ 50 million. It is the largest internationally-funded and completed project at the site to date.

### Workers' protection and safety

A radiological protection strategy and programme for workers are in place and an emergency plan for accidents has been developed. State-of-the-art biomedical protection and screening programmes have been installed and radiation protection equipment has been procured. In the neighbouring town Slavutych a hospital wing has been refurbished and equipped. Training courses have introduced a new safety culture among the workforce.

### Infrastructure

The necessary infrastructure has been put in place without which the construction of the New Safe Confinement could not take place.

The future main construction area has been fitted with road and rail connections. Site services like power, water, drains and communications supplies have been comprehensively refurbished. A new, state-of-the-art facility for 1,430 workers has been built which offers medical and radiation protection facilities and an ambulance.

### Monitoring

Detailed studies were carried out to assess the site's risks. The probability of criticality incidents (spontaneous start of a nuclear chain reaction in the material containing nuclear fuel) was examined and assessed as virtually non-existent. Today, measurement of neutron flux is part of an integrated monitoring system which combines data on important parameters such as radiation levels but also seismic activity and the structural behaviour of the old shelter. This hugely complex system has been completed in 2010.

## 2001

- ▶ April: Decision in principle on the design of the New Safe Confinement (NSC)

## 2004

- ▶ Start of biomedical protection and screening programmes for workers in Chernobyl
- ▶ Year-end: Shelter stabilisation works begin

## 2005

- ▶ November: Two compliant bids for NSC construction received

## The New Safe Confinement

This is a spectacular undertaking. The New Safe Confinement will have a span of 257 metres, a length of 164 metres, a height of 110 metres and a weight of 29,000 tons.

The new structure will be assembled on site, but away from the highly radioactive unit 4, and then slid into place, covering the reactor building. It will prevent the incursion of water and snow, protect against the escape of radioactivity and create the conditions under which the deconstruction of the reactor and the shelter will be possible.

For that purpose the New Safe Confinement will be equipped with two cranes with a lifting capacity of 50 tons each. Dismantled shelter components can be laid down or processed inside the New Safe Confinement. It will be able to operate for at least 100 years.

The contract for design and construction of the New Safe Confinement was signed in September 2007 with the consortium Novarka, formed by the construction companies Bouygues and Vinci.

Work on the detailed design of the structure and its systems such as cranes, fire protection, ventilation etc is completed. Regulatory approval is expected in early 2011. Clearance of the assembly site right next to the shelter and excavation work for the foundations in this contaminated area have been completed. Piling for the foundations and the lifting cranes started in September 2010.

The New Safe Confinement represents some two thirds of the cost of the Shelter Implementation Plan.

### Chernobyl Shelter Fund

The Chernobyl Shelter Fund was established at the EBRD in 1997. The Bank acts as the fund manager and works closely together with the Government of Ukraine to help ensure that the project is implemented efficiently. The Bank enters into grant agreements with the recipient organisation and disburses funds to contractors.

The highest decision-making body of the Fund is the Assembly of Contributors, comprising representatives of 23 countries and the European Commission. Since its establishment in 1997 it has been chaired by Hans Blix. As of end-2010, the Chernobyl Shelter Fund has recorded contributions of €864 million. The Donor Assembly has so far approved nine grant agreements committing €811 million to the completion of the project.



### Hans Blix, Chairman of the Chernobyl Shelter Fund

I visited Chernobyl of the first time right after the 1986 accident as IAEA Director General. When we saw what had happened we realised what



a colossal task it would be to bring the site to a safe state. I am grateful that both in my former post and now as CSF Chairman I have the opportunity to contribute to the solution of this problem.

Many challenges at the site have been overcome and we are entering the final phase with the construction of the NSC to enclose the destroyed reactor and object shelter.

Ukraine has to bear a heavy burden which is the legacy of the 1986 accident but the international community has displayed great solidarity in the face of this disaster. We all realise that overcoming the legacy of the accident and learning from it will strengthen nuclear safety in the world.

I am confident that the ambitious programme can be brought to a successful conclusion if Ukraine and its international partners continue to cooperate effectively. This is also a prerequisite to raise the still required funds.

#### 2006

- ▶ December: Stabilisation of Western wall structures in place

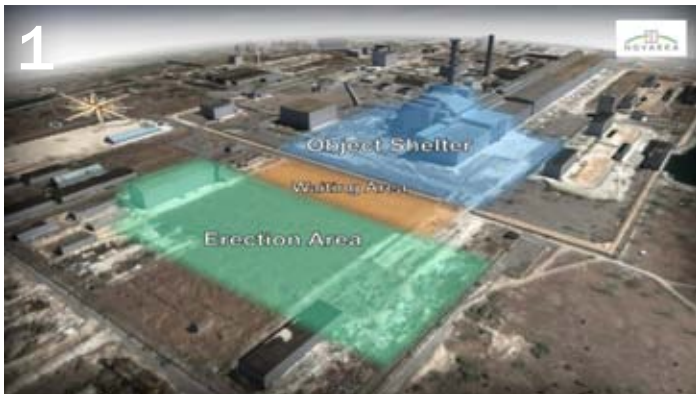
#### 2007

- ▶ 17 July: Donor assembly approves grant allocation of €330 million to permit start of NSC construction.
- ▶ 7 August: Ukraine and EBRD sign grant agreement
- ▶ 17 September: Chernobyl Nuclear Power Plant signs contract with Novarka consortium for NSC construction and with Holtec about completion of Interim Storage Facility 2.

#### 2008

- ▶ 80 per cent of roof load of Chernobyl Shelter to external support structure
- ▶ Beginning of site clearance (future assembly area for NSC)

## New Safe Confinement construction process



Shelter and NSC areas



Clearing of NSC assembly area and preparations of lifting tower foundations



Piling for NSC foundations (current stage)



For worker protection a 90,000 square metre concrete work area will be laid

## Work in progress...

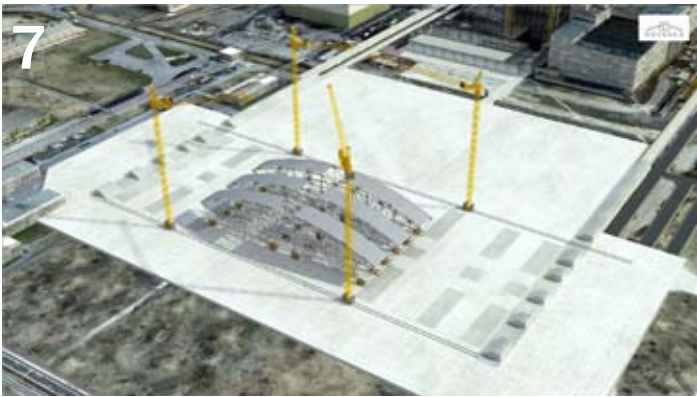




Lifting cranes and sliding pad elements installed



Prefabricated NSC elements transported to site



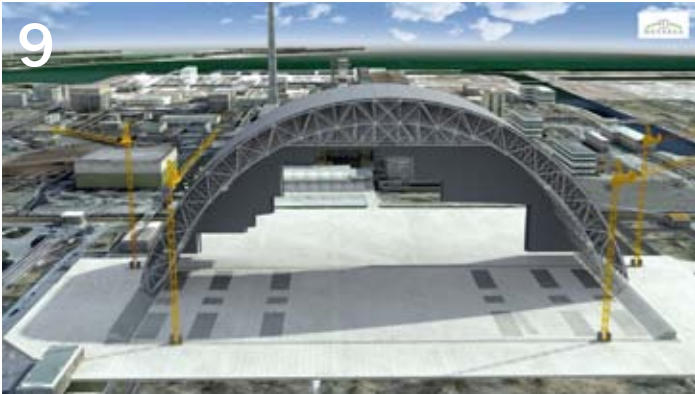
NSC elements assembled and lifted into position



Shelter segments lifted and further elements added to create first section



## New Safe Confinement construction process (continued)



End wall installed and first section moved into holding area



Second section assembled



Two sections joined



Whole structure slid into place over object shelter

## Work in progress...







Final structure will cover unit 4 and object shelter for at least 100 years



New Safe Confinement design images provided by Novarka



# The Interim Spent Fuel Storage Facility

The Interim Storage Facility on the site of the Chernobyl nuclear power plant is a key facility for the decommissioning of the units 1-3 as it will provide safe and secure storage of the spent nuclear fuel generated when the plant was operational.

Spent fuel is currently stored at the site in an interim wet storage facility constructed in Soviet times (ISF-1) and in pools in the units. This facility does not conform to modern standards and it appears unlikely that its current licence would be extended when it expires in 2016.

Some spent fuel is still stored in the fuel ponds inside the three units, which means that certain safety and operational functions – such as cooling – need to be maintained and that the actual decommissioning or dismantling of equipment cannot start.

The Interim Storage Facility 2 (ISF-2) will provide dry storage for the more than 20,000 spent fuel assemblies in Chernobyl for a period of at least 100 years. The project will use existing concrete storage modules and a building for the processing of the assemblies. Processing will include cutting, drying and fitting of spent fuel into storage containers.

The contract to design and complete the facility was signed with the American company Holtec International in September 2007. The design of the new facility was approved by the Ukrainian regulator in 2010 and the Assembly of Contributors agreed to start implementation in October 2010. Work can commence once the contract

amendment for the implementation is signed. It is expected that the construction work will be finalised by 2014.

## The Nuclear Safety Account

The Nuclear Safety Account was set up at the EBRD in 1993 as a consequence of a G7 initiative to provide financial support for safety assessments and the short term safety upgrades of old Soviet designed nuclear power plants (VVER 440/230 and RBMK). In the following years nuclear safety projects were successfully implemented in Bulgaria, Lithuania and Russia.

In Chernobyl, the Nuclear Safety Account funded security and safety measures and two decommissioning facilities. One provides for the treatment of liquid radioactive waste from the operation of reactors 1-3, while the other is an interim storage facility for fuel spent during the operation of the reactors (ISF-2).

The Nuclear Safety Account comprises 16 countries plus the European Commission and has so far received about €320 million in contributions from its donors.



## Ian Downing, Chairman of the Nuclear Safety Account

It was a huge challenge to find a viable technical solution for the nuclear spent fuel from the Chernobyl reactors 1-3. Today, however, I am pleased that as chair of the Assembly of Contributors to the Nuclear Safety Account which finances the Interim Spent Fuel Storage Facility 2, I can report significant progress. The new design for the completion has been given regulatory approval and construction can now begin.



However, the project is currently facing a funding gap which is seriously threatening its completion. This we must not allow to happen. The facility is essential for the decommissioning of the Chernobyl nuclear power plant and safety at the site.

The implementation is overdue and should not be delayed any further. To bring the project to a successful conclusion will depend on the continued solidarity of the international community and the commitment of all parties. This was always our spirit and this is the spirit in which we shall prevail.

### 2009

- ▶ Concept Design Safety Document (key licensing documents) approved.

### 2010

- ▶ Site clearance completed
- ▶ Piling for NSC foundations begins
- ▶ Approval of ISF2 design
- ▶ Orders for steel and crane for NSC placed
- ▶ Integrated Automated Monitoring System completed

### 2011

- ▶ 26 April: 25th anniversary of Chernobyl accident

## An international effort

The international efforts to support Ukraine in its endeavours to overcome the legacy of the 1986 Chernobyl accident are a demonstration of international solidarity. As recently as in June 2010, the G8 leaders declared at their summit in Muskoka, Canada: "As we approach the 25th anniversary of the Chernobyl accident in 2011, we will take the necessary steps to complete the final stages of the safety and stabilisation projects."

Considerable contributions have been made to both Funds. After an initial pledge of US\$ 300 million at the G7 summit in Denver 1997 for the CSF, two pledging conferences took place in November 1997 (New York) and May 2000 (Berlin) followed by a pledging event in 2005 (London). A separate pledging event was held in 2008 to raise additional funds for the NSA. Preparations are now underway for a pledging event for both Chernobyl projects in Kiev in April 2011 to coincide with the 25th anniversary of the accident.

### Total costs

Both projects have reached a phase where reliable cost estimates on the basis of detailed engineering are available. According to these projections, the completion of the Shelter Implementation Plan requires an additional €600 million (overall cost including support to the regulatory authorities as well as project and fund management is close to €1.6 billion) and construction of the Interim Storage Facility (ISF-2) an extra €140 million (overall cost including regulatory support as well as project and fund management is close to €300 million).

To date the Chernobyl Shelter Fund has received contributions from 23 countries, the European Commission and donations from six countries. EBRD shareholders provided a €58 million grant for the New Safe Confinement.

### CSF Contributions

Donor	Contribution (€ million)
European Community	250.0
United States	182.8
Germany	60.5
United Kingdom	53.1
France	52.5
Japan	45.7
Ukraine	45.0*
Italy	41.5
Canada	34.9
Russia	15.3
Switzerland	9.3
Ireland	8.0
Austria	7.5
Sweden	7.2
Norway	7.0
Netherlands	5.7
Kuwait	5.4
Spain	5.1
Denmark	5.0
Greece	5.0
Finland	4.9
Belgium	4.3
Poland	2.5
Luxembourg	2.5

\* In addition, Ukraine has accepted to take over one SIP task valued at US\$ 22 million.

Donations have been made by Iceland, Israel, Korea, Portugal, the Slovak Republic and Slovenia.

As of end-2010, the total amount received for the Chernobyl Shelter Fund is €990 million (including the proceeds of management of liquid assets, the EBRD contribution and some projected income).

The Assembly, including 23 countries and the European Community, as the highest decision-making body of the Chernobyl Shelter Fund has approved nine grant agreements committing over €800 million to-date. Within the nine grant agreements 162 contracts have been concluded to date, of which 135 have been completed.

### NSA contributions

Donor	Contribution (€ million)
France	63.3
United Kingdom	40.4
Germany	37.5
European Community	36.2
Japan	27.0
United States	26.3
Italy	21.2
Canada	15.3
Switzerland	10.9
Sweden	9.0
Russia	7.6
Finland	6.0
Ukraine	5.8
Netherlands	4.2
Denmark	4.0
Norway	4.0
Belgium	1.9

The Interim Storage Facility is financed through the EBRD-administered Nuclear Safety Account. In July 2007 donors agreed to fund the completion of this facility which is a key facility for the decommissioning of the Chernobyl reactors 1-3. Contributors to the Nuclear Safety Account are the following 16 countries plus the European Commission.

In addition, the EBRD provided a €77 million grant for the Interim Spent Fuel Storage Facility in 2008. As of end-2010, the Nuclear Safety Account held some €520 million (including proceeds from management of liquid assets, the EBRD contribution and projected and other income). Projects in Bulgaria, Russia and Lithuania with a total value of €140 million have been successfully completed.



## The EBRD and Nuclear Safety

Transforming Chernobyl is the biggest, but not the only task the EBRD Nuclear Safety Department is facing. Financed by the international community the EBRD is currently managing six nuclear safety funds to assist with the nuclear legacy in Eastern Europe and the former Soviet Union. The task includes the decommissioning of Soviet-designed nuclear power plants and the safe treatment and storage of nuclear fuel and radioactive waste.

EBRD-managed decommissioning funds have also taken a leading role in the promotion of energy efficiency projects in countries which are faced with the closure of nuclear power stations.

The Nuclear Safety Account, set up at the EBRD in 1993 following a G7 initiative, financed projects related to Soviet-designed VVER 440/230 or RBMK reactors. These projects provided at that time short term and emergency upgrades to decrease the risk of accidents. The Fund also supports the construction of decommissioning facilities and assists national safety authorities.

The Chernobyl Shelter Fund was established at the EBRD in 1997 following the agreement between Ukraine and the EU/G7 on the Shelter Implementation Plan, the concept to transform the Chernobyl site into safe and secure conditions. The EBRD acts as fund manager and ensures the oversight of the effective implementation of the project together with the Government of Ukraine. The SIP comprises 300 sub-projects the largest of which is the New Safe Confinement.

The EBRD also manages three International Decommissioning Funds for the nuclear power plants in Jaslovské Bohunice, Slovak Republic, Ignalina, Lithuania, and Kozloduy, Bulgaria. The three countries all committed themselves to close their first generation Soviet-designed nuclear power plants after



Nuclear Safety activities include decommissioning of nuclear-powered vessels in North-Western Russia

EU accession. The EBRD-managed funds play an important role in the decommissioning process and also in finding viable solutions to compensate for the loss of generating capacity, through a variety of energy sector and energy efficiency projects.

The Northern Dimension Environmental Partnership (NDEP) Support Fund was established in 2002 at the EBRD for the improvement of the environment in North-West Russia. The NDEP “Nuclear Window” provides funding for projects that mitigate the legacy of the operation of nuclear-powered ships and submarines of the Northern fleet in Russia that are in different stages of decommissioning.

All funds are managed by the EBRD’s Nuclear Safety Department on behalf of the contributing countries. The department, in cooperation with specialised services of the Bank, is responsible for all technical, financial, administrative and legal aspects of fund management and compliance with EBRD rules and policies, particularly with respect to procurement, environmental protection and public information.

Each Nuclear Safety Fund is governed by fund rules agreed by the respective Assembly of Contributors (Donors) to the fund and approved by the EBRD Board of Directors. The Assembly approves and oversees fund

management, work programmes and financial statements and decides on the financing of individual projects.

In addition to managing nuclear safety grant funds, the EBRD Nuclear Safety Department also plays an important role in EBRD projects to upgrade nuclear safety standards in existing power plants. The EBRD, together with Euratom, has provided a loan for the safety upgrade of two nuclear units in Ukraine. Since the review of the Bank’s energy policy in 2006 the EBRD can finance nuclear waste management, decommissioning and safety upgrade projects with loans. The EBRD is currently considering a loan to bring the remaining Ukrainian nuclear power plants to the same high level of safety as the two units covered by the first loan.

The EBRD Nuclear Safety Department currently has over 20 staff, including local experts based in Russia and Ukraine. Director of the department is Vince Novak.

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