Report Number : ICRR0020606

1. Project Data

Project ID	Project Name	
P083702	HYDROPOWER REHAB	
Country	**Practice Area(Lead)**	**Additional Financing**
Ukraine	Energy & Extractives	P110298,P115515
L/C/TF Number(s)	**Closing Date (Original)**	**Total Project Cost (USD)**
IBRD-47950,IBRD-77910	30-Jun-2012	374,500,000.00
Bank Approval Date	**Closing Date (Actual)**	
21-Jun-2005	30-Jun-2016	

	IBRD/IDA (USD)	Grants (USD)
Original Commitment	106,000,000.00	0.00
Revised Commitment	161,921,713.40	0.00
Actual	137,899,733.86	0.00

Prepared by	Reviewed by	ICR Review Coordinator	Group
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2. Project Objectives and Components

a. Objectives

The Government of Ukraine (GoU) requested the World Bank's support for the implementation of its multiphase long-term Energy Sector Reform and Development Program (Energy Program 2005-2012) whose objectives were to:(1) help the Ukraine energy market to better meet increasing demand in a secure and reliable manner, while converging toward legal, regulatory and technical standards of the EU Internal Energy Market; and (2) provide priority investment support for rehabilitation and upgrading of hydropower plants. The Hydropower Rehabilitation Project was the first Specific Investment Loan (SIL) to support the Energy Program and was approved by the Bank in June 2005.

The Loan Agreement (p.22) states that the Project Development Objectives (PDOs) were:

"(i) to improve operational stability and reliability of power supply through increased regulating capacity, efficiency and safety of hydroelectric plants; (ii) to enhance the institutional development of UHE [UkrHydroEnergo]; and (iii) to support the MFE [Ministry of Fuel and Energy] and NERC [National Energy Regulatory Commission] in developing and implementing an energy sector reform and development program, including the Wholesale Electricity Market concept."

The PDOs described in the Project Appraisal Document (PAD, p.7) were:

"to improve operational stability and reliability of power supply by increasing regulating capacity, efficiency and safety of hydroelectric plants, and, therefore, facilitate unimpeded operation and opening up of the electricity market. Additional objective is to support the Ministry of Fuel and Energy and NERC in preparing and implementing the Energy Sector Reform and Development Program, including the Wholesale Electricity Market concept."

Following IEG procedures, this ICR Review is based on the project development objectives as stated in the Loan Agreement.

b. Were the project objectives/key associated outcome targets revised during implementation?

No

c. Will a split evaluation be undertaken?

No

d. Components

The project consisted of five components.

A: Hydropower Rehabilitation. (*Appraisal cost: US$207.6 million; Actual cost: US$383.60 million*) This component included the rehabilitation of nine hydroelectric power plants by (i) refurbishing 46 hydroelectric units; (ii) replacing protective relaying, metering, telecommunication systems, monitoring and control systems; and (iii) refurbishing plant switchyards and associated auxiliary systems.

B: Dam Safety. (*Appraisal cost: US$6.7 million; Actual cost: US$51.9 million*) The activities included in this component were (i) the installation of computer-aided dam safety monitoring systems; (ii) rehabilitation of drainage facilities, design profiles, slope protections and concrete spillways; (iii) protection against high piezometric lines in some of the dam embankments; (iv) rehabilitation of hydro-mechanical gates of two dams/spillways; (v) detailed review of the necessity of spillway gates rehabilitation at two other dams; and (vi) technical assistance for safe design floods study for two reservoirs, upgrading of hydrological instrumentation for HydroMet, the study of sedimentation in one reservoir, and training of professionals in dam safety, operation and monitoring aimed at strengthening the safety of existing dams on the Dnipro and Dnister rivers.

C: UHE Institutional Development. (*Appraisal cost: US$7.1 million; Actual cost: US$8.7 million*) This component included (i) the development and establishment of a modern corporate-wide management information system (MIS) in UHE; and (ii) provision of technical assistance for procurement and project management, design and phased implementation of the MIS, revaluation of UHE's fixed assets, and carrying out of the audit of the project and UHE's accounts.

D: Implementation of the Energy Sector Reform and Development Program. (*Appraisal cost: US$2.5 million; Actual cost is not given in the ICR.*) This component included provision to the MFE of advisory services and consultant assistance in developing and implementing: (i) an action plan for legal and technical harmonization of the Ukraine's energy market with the European Union Internal Energy Market; and (ii) a program of priority investments in energy infrastructure.

E: Implementation of the Wholesale Electricity Market Concept. (*Appraisal cost: US$3.0 million; Actual cost is not given in the ICR.*) This component included the provision of technical assistance to National Energy Regulatory Commission (NERC, later National Energy and Utilities Regulatory Commission - NEURC) in implementing the wholesale electricity market (WEM) concept. The activities consisted of (i) clarifying the market design and main principles of market operations; (ii) drafting of main codes and market rules; and (iii) defining technical requirements for the supporting tools such as software for market operation, telecommunications systems and metering.

e. Comments on Project Cost, Financing, Borrower Contribution, and Dates

Project Cost: The total project cost was originally estimated at US$374.5 million. The actual project cost estimated by UHE at project completion was US$540.7 million. The ICR states that the increase of 44% in project cost was mostly due to the significantly higher actual costs of equipment, materials and labor during implementation compared to the appraisal estimates. The ICR (Annex 1.a) did not include a breakdown of actual project cost per component. The project team addressed the IEG's request to provide more detailed breakdown of actual project cost per component. The itemized components costs were used in Section 2 d above. As the table below shows, which is prepared according to the additional information provided by the project team, US$540.7 million is the total actual cost for Components A, B and C which were implemented by UHE. The actual costs for Components D and E, which were implemented by MFE and NERC, respectively, were not reported by the project team.

$ million	Appraisal	Actual
Comp A	**207.60**	**383.60**
Comp B	6.70	51.9
Comp C	7.10	8.7
A+B+C	**221.40**	**444.20**
Comp D*	2.50	-
Comp E*	3.00	-
A+B+C+D+E	**226.90**	**444.20**
Physical Con*	17.20	-
Price Con*	52.90	-
Taxes	64.80	81.4

Interest	12.70	15.1
Total	**374.50**	**540.70**

* Appraisal figures for these entries are not reported in the additional document provided by the project team on June 1, 2017.

Financing: Initial Bank financing was US$106 million. However, faced with a deficit in its own funds, UHE could not co-finance a part of the local project costs, which halted the rehabilitation process. A second loan agreement was signed on February 3, 2010, for the provision of US$60 million taking the Bank's total financing commitment to US$166 million. Due to continued depreciation of the local currency in 2014 and 2015, substantial loan savings were accumulated, and US$4 million and S$24 million were cancelled from the first and second loans, respectively, at project closing.

Borrower contribution: At appraisal, the Borrower's contribution was agreed at US$268.5 million. Because of the additional financing of US$60 million provided by the Bank to cover a part of Borrower's funding obligations, the Borrower's revised contribution decreased to US$208.5 million from the original appraisal amount. At project closing the actual project cost increased to US$540.7 million (excluding Components D and E). The Borrower's (UHE's) contribution, therefore, increased to US$402.7 million.

Dates: The loan closing date was extended twice.

The first extension was for two years from June 30, 2012 to June 30, 2014. The reasons for this extension were the time needed for the approval of the second loan, delays with the start of the project, and payment delays in UHE's contracts caused by GoU's slow processing of approvals for annual budget allocations.

The second extension was also for two years from June 30, 2014 to June 30, 2016. The extension was given because of delays in the implementation of several contracts caused by late delivery of hydropower plant turbines, and structural defects discovered in the shafts of one of the hydropower plants which prevented the installation of new turbines.

3. Relevance of Objectives & Design

a. Relevance of Objectives

The project objectives to improve operational stability and reliability of power supply in Ukraine were relevant to country challenges. Ukraine heavily relies on electricity produced by nuclear and coal power plants, thus, it lacks regulating capacity for load following. The project aimed at solving this problem through the rehabilitation of hydropower plants and improving dam safety, which would increase hydropower capacity and production of peaking hydroelectric energy, and ensure a safe operation of the hydropower cascade system on the Dnipro River consisting of six dams.

The objective to enhance institutional development of UHE is relevant because, although UHE was in a financially sound condition at appraisal due to improved financial discipline in the power sector, there still was the need to improve the management of the company, including financial management. Development of a corporate-wide management information system would assist UHE in automated information exchange and analyses of critical data related to sales, billing and collections, hence improving the financial viability of UHE. Technical assistance would also support UHE in dam safety and efficient management of the hydropower cascade system.

The development objective to support government in developing and implementing the energy reform program and the wholesale marketing concept is relevant because the overall objective of the Energy Sector Reform and Development Program (Energy Program, 2005-2012) was to improve the security, reliability and quality of energy supply and facilitate unimpeded operation of the energy market through liberalization. Project objectives would also support Ukraine's aspirations with regard to legal, institutional, regulatory and technical harmonization and increasing energy trade with the EU Internal Energy Market, which was also an objective of the Energy Program.

Objectives were relevant at the time of the ICR. The GoU was exploring the possibility of a follow-on hydropower rehabilitation project with the Bank for the rehabilitation of remaining ten hydro-electric turbines.

The objectives were in line with the main priorities of the Bank's country strategies at appraisal FY2004-2007 and during implementation FY 2008-2011. The Project development objectives remained relevant to the Bank's Country Partnership Strategy for FY 2012-2016. They correspond to Outcome 4 under Pillar 1 which aims at improving governance in the energy sector and Outcome 15 under Pillar 2 which aims at improving the performance of power sector.

Rating
High

b. Relevance of Design

The choice of the hydropower sector was relevant to improve overall operational stability and reliability of power supply. Availability of hydropower generation capacity is crucial for meeting peak load demand and providing frequency control and ancillary services. The activities listed in Components A and B (such as the replacement of turbine and generator parts and high voltage circuit breakers, along with the installation of the Supervisory Control and data Acquisition (SCADA) and improved monitoring of dams) were designed to achieve this objective by increasing the hydropower generation capacity and availability, and by improving dam safety.

Regarding UHE's institutional development, Component C aimed at establishing a modern management information system (MIS), including a financial management system (FMS) in UHE. This would help the company management to exercise better control over critical matters, such as its financial transactions. This component also included provision of technical assistance to build UHE's capacity in procurement and project management, enhancing dam safety, optimal scheduling of the multi-purpose cascade of hydropower plants

(the eight-hydropower-plant system on Dnieper River), revaluation of UHE's assets and auditing of project and company financial statements.

On the policy reform side, the activities listed under Component D and E were to support the Ministry of Fuel and Energy (MFE) and National Energy Regulatory Commission (NERC) in developing and implementing an energy sector reform and development program, including the wholesale electricity market concept.
As the ICR (p.6) states, the project was a result of an agreement to provide financing for an investment program, i.e. hydropower rehabilitation, in return for policy reform, in which the GoU's interest was not high. The objectives and the components were designed to reflect these two parts of the project. Hence, the project design was rather complicated where the project focus was on the rehabilitation of hydropower plants, but the policy reform targeted the overall energy sector. In that regard, the scope of the activities for policy reform, which is slow-paced, was rather ambitious compared to the scope of infrastructure improvement activities. This dilemma was also recognized in project design (PAD, p.7).

Although a broad causal relation can be established between the project activities and the achievement of project objectives, the Results Framework did not explicitly articulate the different levels of results expected from the project. Firstly, the objectives defined in the Results Framework were those of the Energy Program where rehabilitation of hydropower plants was added, not the objectives defined in the Loan Agreement. The Results Framework did not define the outcomes expected from each activity, but targeted the achievement of project outputs. It did not capture how the outputs on the supply side of the intervention would lead to demand side responses as outcomes, either. Hence, the indicators did not capture the progress towards the achievement of project objectives.

Overall, although the project had a complex design where an investment project was to be implemented along with a policy reform agenda, the activities supported by the project, especially those on the investment side, could lead to the achievement of project objectives, but the Results Framework failed to show the logical and expected cause-effect relationships among outputs, intermediate results and outcomes.

Rating
Modest

4. Achievement of Objectives (Efficacy)

Objective 1

Objective
To improve operational stability and reliability of power supply.

Rationale
Outputs

- Forty-six hydroelectric units were rehabilitated and commissioned compared with the original target of 51 units and the revised target of 46.
- Nine automatic power-metering systems on the hydropower plants were consolidated at the central level in UHE.
- Six private automatic branch exchanges (PBAXs – a telephone network) for hydropower plants were installed.
- 144 SCADA/Energy Management System, protection, alarm systems (unit, block and plant levels) were installed.
- High voltage equipment in nine switchyards were connected to the nine hydropower plants.
- Four automated dam safety monitoring system are operational at the Kaniv, Dniprodzerhynsk, Dnipro and Dnister dams. Another one was installed and put into operation at the Cascade Safety Center.
- Permanent deformation monitoring systems were installed and put into trial operation at the same four dams.
- Dam monitoring software was installed at eight hydropower plants, except Hydropower 1 in Dnipro. Data online consolidation and monitoring system was also installed at UHE's Dam Safety Center.
- Sedimentation study of Kyiv Reservoir was completed.
- The analysis of all existing hydrometeorological stations was performed. The proposals for the best scope of the stations' rehabilitation in Dnieper and Dnister basins were developed to upgrade the hydrometeorological forecasting equipment, issued in the form of a bidding document, and submitted to the hydrometeorological service.
- The completion of activities for institutional development in dam safety was confirmed at the meeting with the project team.

Outcomes

- The generation capacity of hydropower plants rehabilitated under the project increased by 192.2 MW achieving the revised target of 192.2 MW, but falling short of the original target of 225 MW. The revision was made in the fourth structuring in October 2015.
- UHE started to provide ancillary services, such as fast responding generation reserve, load following, frequency control, etc., which are critical for maintaining power system stability and ensuring reliable power supply.
- At project completion, dam safety systems were operational at Kaniv, Dnieper, Dniester and Dniprodzerhsynk dams.

The ICR states that the results framework did not include indicators directly measuring the improvements in operational stability and reliability of power supply. ICR also argues that even if such indicators had been included in the results framework, it would not have been so easy to measure the project's impact on operational stability and reliability of power supply due to two reasons: (i) same objectives were addressed in other projects which were implemented concurrently with the Hydropower Rehabilitation Project in Ukraine; therefore, measuring the impact of each project on operational stability and reliability of power supply would require a detailed analysis; and (ii) the scope of the current project was only a part of a bigger UHE hydropower plant rehabilitation program, because of which separating the project's impact from that of the

UHE's own rehabilitation program would require carrying out an excessive organizational exercise by UHE. In light of this argument, the ICR points out that the results framework focused on the means by which such operational stability and reliability could be improved, i.e. by increasing regulating capacity, efficiency and safety of hydroelectric power plants (ICR, p.19).

In the results framework, there is only one indicator measuring regulating capacity, but no indicator for efficiency or safety of hydroelectric power plants. As explained in Relevance of Project Design above, regulating capacity is crucial during peak loads, especially in a system where electricity is heavily generated by nuclear and thermal power plants, such as the Ukrainian system. The ICR states that the hydropower generation capacity increased by 192.2 MW through the rehabilitation of 46 units out of a total of 99. This incremental increase in hydropower generation capacity fell short of the target value of 225 MW. However, this achievement can be treated as a proxy for improved operational stability and reliability of power supply. Although incremental, the availability of additional hydropower capacity as a result of the rehabilitation of the hydroelectric turbines under the project should be expected to improve the system stability through the provision of increased hydro-generated power during peak-load demand.

There is no indicator in the results framework measuring the change in the efficiency of hydroelectric units. Yet, the key project performance indicators included two parameters, i.e. the increased production of hydroelectric energy by 360 GWh and reduced operation and maintenance (O&M) costs in rehabilitated hydropower plants by 20% (PAD, p.7-8). The UHE estimated these values as 155 GWh per year and $4.2 million per year, respectively, at project completion. Lower than expected additional hydroelectric generation is attributable to the adverse hydrological conditions which lowered UHE's power generation to 60 percent of average levels. Therefore, under normal hydrological conditions, the increased hydroelectric generation is expected to reach the target value of 360 GWh (ICR, p.36). The decrease in the O&M costs also shows that the efficiency of hydroelectric units has incrementally improved.

The operational stability and reliability of power supply is also linked to the safety of hydroelectric plants. The ICR states that "[t]he successfully installed comprehensive and state-of-the-art dam safety monitoring system has significantly improved the efficiency and accuracy of the data collection and analyses" (ICR, p.11). It is not clear how the aforementioned "efficiency" and "accuracy" were measured. It should be expected that this system will not only provide UHE with tools necessary to control the safety level and any anomalies at dams, but also help discover potential need for remedial works on time, but there is not enough evidence in the ICR to support these claims about dam safety. There was only one indicator related to dam safety which merely measured whether the monitoring systems were installed or not. The ICR notes that the monitoring systems did not have tools to measure the number of outages or safety-related incidents at the dams (ICR, p.18).

Rating
Substantial

Objective 2

Objective

To enhance the institutional development of UHE.

Rationale

Outputs

- Two MIS Modules (documentation workflow, and equipment and maintenance accounting) out of six were commissioned. The remaining four will be installed by UHE. Training related to MIS was given to UHE staff in office and at the stations.
- A project management consultant (PMC) was hired to assist UHE with the preparation, execution and oversight of 25 packages under international competitive bidding (ICB) procedure.
- Ten audits of the financial statements of UHE and the project were conducted by external auditors.
- UHE experts participated in a program held at the International Training Center of the International Labor Organization (Torino, Italy) about investment projects implementation under IBRD funding and ICB arrangements.
- Asset revaluation study for UHE was completed.
- Vehicles and office equipment were procured to improve working conditions at HPP sites.

Outcomes

- Financial management and procurement capacity of UHE were reportedly improved. This claim is not supported by evidence.

The project activity to achieve this objective was the installation and implementation of the MIS under Component C. Although only two modules, i.e. documentation workflow, and equipment and maintenance operations accounting, out of six, could be installed and put into implementation, this was the first time a power company in Ukraine had embarked upon such an ambitious and broad reform of its internal corporate procedures. (The other four components were (i) budgeting and financial analysis; (ii) project management; (iii) stock control; and (iv) analytical module. These will be funded by UHE′s own funds.) In terms of institutional development, implementation of two modules of the MIS is an achievement to be noted, but the project was not successful in achieving this objective. There is also no project outcome associated with this objective other than the installation of the MIS which is merely a project output.

Institutional development of UHE was also supported by a set of financial covenants in the Loan Agreement (ICR, p.7). The Loan Agreement included two financial covenants: i) annual current ratio of not less than 1.2; and ii) annual debt service coverage of not less than 1.5. UHE was in compliance with the first covenant until 2007. Due to the changes in the national accounting system, a substantial amount of overdue receivables under UHE′s current assets were transferred to non-current receivables. As a result, UHE′s current ratio dropped into the range of 0.5 and 0.8, which was lower than the covenanted level of 1.2. UHE failed to continuously meet the covenanted level of current ratio despite the implementation of an Action Plan supported by the Bank. Since UE was able to fulfill its payment obligations with some delay beyond the end of year, which is not reflected in the current ratio, the Bank agreed in 2015 to replace the current ratio covenant with self-financing ratio which UE had been successful in meeting. UHE was in compliance with

the second covenant throughout the project implementation period (ICR, p.39-40).

Completion of technical assistance activities for optimal scheduling of the multipurpose cascade of hydropower plants and training for the UHE staff in dam safety were confirmed by the project team.

Rating
Modest

Objective 3
Objective
To support the MFE and NERC in developing and implementing an energy sector reform and development program, including the Wholesale Electricity Market concept.

Rationale
Outputs

- Consultancy services were provided, including services for the harmonization of the Ukrainian energy legislation with the *acquis communautaires* of the EU, for the development of legal acts to stimulate renewable energy development, and for the development of legislative acts in the field of regulation of power sector infrastructure facilities construction.
- Technical support is provided to the MFE/MoECI on Power Sector Property Reform, and Electricity Market Reform; new Energy Strategy was prepared.
- An Internal Electricity Market Study was conducted to identify the sector investment needs by 2016.
- Feasibility studies for the thermal power plant rehabilitation project, second power transmission project and Kaniv pumped storage plant project were completed.
- Analysis of the current electricity market legislation was carried out, which resulted in the approval of the Government's Regulation on WEM Concept Implementation Plan.
- Pieces of legislation (both primary and secondary) for introduction of the new model of the electricity market were elaborated.

Outcomes

- The Action Plan for Energy Sector Reform and Development was developed, agreed with key stakeholders, and approved by the Order of the Cabinet of Ministers of Ukraine dated June 13, 2007, No. 408.
- The Conceptual Plan for Technical and Legal Harmonization with the EU is in the implementation phase.
- The Protocol for Implementation of EU Directives is also in the implementation phase.
- Law No.663 "On Operating Principles of the Electricity Market of Ukraine," which complied with the requirements of the 2nd EU Energy Package, was adopted in 2013, but due to the GoU's commitment to implement the 3rd EU Energy Package, a new law had to be prepared and the implementation of WEM

concept was delayed. The first reading of the draft law at the Ukrainian parliament, which was prepared by MoECI in cooperation with the Energy Community Secretariat, was completed in September 2016. The second reading was completed in April 2017, and the law became effective on June 9, 2017.
- The WEM concept, New Market Rules and the normative base for new model of power market were developed.

There is a clear correlation between the activities completed under Components D and E, and the achievement of this objective. However, GoU's commitment to implement the 3rd EU Energy Package, due to its commitments within the Energy Community membership, resulted in a delay in sector reforms. As the Borrower pointed out (ICR, p.65) "drafts of primary and secondary legislation that were elaborated within the framework of Project Part E, require updating, adaptation and further improvement" because of the adoption of the new electricity market. Nevertheless, project activities contributed to the sector reform in Ukraine which will be further supported by the Second Power Transmission Project funded by the Bank.

Rating
Substantial

5. Efficiency

Economic Analysis
'With project and 'without project' scenarios were used to carry out the economic evaluation of the project. While the economic investment cost did not include the activities under Components B, C, D and E the economic internal rate of return (EIRR) was calculated for 93.20% of total project cost.

The project economic benefits were assessed under five categories: (i) an increase in hydroelectric production of about 360 GWh per year due to the improved efficiency of the rehabilitated equipment and improved plant management and control; (ii) an increase in (winter firm) peaking hydropower capacity of about 250 MW due to the increased capacity of rehabilitated units and improved reliability and availability of units and plant; (iii) power system dynamic benefits due to the enhanced ability of hydropower plants to provide load following and frequency control; (iv) reduced O&M costs due to the introduction of modern technologies and standards in operation and maintenance; and (v) environmental benefits due to the reduced emissions from thermal power plants by increasing production of renewable hydroelectric energy.

The calculations resulted in an EIRR of 14.4% at project completion compared to the estimate of 23.2% at appraisal. The net present value (NPV) at project completion was US$75.0 million compared to US$126.0 million at appraisal using 10% as the discount rate.

The ICR states that the increase in project cost from US$374.5 million at appraisal to US$540.7 million at project closing was mostly because of the significantly higher actual costs of equipment, materials and labor

during implementation compared to the appraisal estimates. Hence, the actual delivered incremental output per unit of cost is estimated at about 1.9 GWh per US$1 million, which is lower than the 6.4 GWh per US$1 million projected at appraisal (ICR, p.21).

In conclusion, substantially higher capital costs compared to those at appraisal, significantly longer implementation period, and significantly lower incremental energy output, which was partly affected by adverse hydrological conditions, were the main reasons for lower than estimated economic viability indicators.

Financial Analysis
Project-level financial analysis was also carried out by comparing 'with project' and 'without project' scenarios. Post-completion financial internal rate of return (FIRR) estimate was calculated as -9.7% (negative nine point seven percent) compared to the appraisal estimate of 7%. In addition to substantial increase in project cost and a significantly longer implementation period, the other reasons for this negative FIRR were the lower than expected reduction in O&M expenses, lower electricity production and lower tariffs. However, it should be noted that tariffs, which are approved by NEURC annually, were high enough to meet UHE's overall financial requirements, but they fell short of enabling a project-level FIRR at least equal to UHE's estimated WACC of 3.5%.

Operational and Administrative Efficiency
The project implementation period of 11 years was significantly longer than the appraisal projection of six years. The major factors which contributed to a longer implementation period were (i) initial slow progress in implementation; (ii) periodic delays by the GoU in processing approvals necessary for financing the project and approving officials' signature cards and the project's budget projections; (iii) delays in the delivery of the equipment; (iv) energy system requirements imposed by the system operator which prevented the shutdown of hydro units for rehabilitation works ; (v) lack of continuous political commitment and support for the development of the energy sector program, largely due to political instability in Ukraine; (vi) a deficit in UHE's budget which put rehabilitation process on hold; and (vii) external factors, such as civil unrest in Eastern Ukraine which caused delays in the execution of several manufacturing contracts (ICR, p.9).

The actual project cost of US$540.7 million, consisting of the costs of Components A, B and C, was substantially higher than the estimated project cost of US$374.5 million. This is 44% higher in nominal terms and 30% in real terms. Even then, not all the originally planned works or institutional capacity building were fully completed as several were still under implementation at the end of the project.

Efficiency Rating
Modest

a. If available, enter the Economic Rate of Return (ERR) and/or Financial Rate of Return (FRR) at appraisal and the re-estimated value at evaluation:

	Rate Available?	Point value (%)	*Coverage/Scope (%)

Appraisal	✓	23.20	93.20 ☐Not Applicable
ICR Estimate	✓	14.40	0 ☑Not Applicable

* Refers to percent of total project cost for which ERR/FRR was calculated.

6. Outcome

The relevance of the project objectives is rated High, but the relevance of design is rated Modest, because of the poor design of the results framework. The failure of the project in directly measuring Objective 1 to achieve operational stability and reliability of power supply was a major shortcoming, but, given that most of the rehabilitation works were completed resulting in an incremental increase in hydropower generation capacity and decrease in O&M costs, and that dam safety measures were also completed, the achievement of this objective is barely rated Substantial. The other two objectives are rated Modest and Substantial, respectively. Efficiency is rated Modest due to large cost overrun and a significantly longer project implementation period of 11 years compared to six years projected at appraisal. Thus, the overall project outcome is rated Moderately Satisfactory, but only marginally so.

a. Outcome Rating

Moderately Satisfactory

7. Rationale for Risk to Development Outcome Rating

- **Financial viability of UHE stands out as one of the major risks** that might materialize and negatively impact the project outcomes which is closely related to the economic activity in Ukraine and government's commitment to the energy reform. During poor economic performance, the government might opt out to minimize tariff increases on essential services, including electricity, due to social concerns which in return would worsen the financial situation of UHE. Inadequate financial resources might result in poor maintenance of rehabilitated hydropower plants. Specific to this project, without adequate financial resources, UHE might not be able to complete the remaining activities, such as the turbine rehabilitation works at the Kremenchug Hydropower Plant, installation of SCADA and the remaining modules of the MIS (ICR, p.17).

- **Continued commitment of the GoU to the Energy Program and specifically to the electricity market reform is crucial in maintaining the outcomes of the project.** The Electricity Market Law becoming effective in June 2017 was a strong signal that the GoU is committed to reforming the electricity market. Not only will this open up the market, but also harmonize it with the European Union system.

- **The possibility of an escalation of conflict in Eastern Ukraine poses another risk which might circumvent the ability of the GoU to continue with the Energy Program.** This might shift the budgetary priorities and focus from the energy program and might also prevent EHU from continuing with its hydropower

rehabilitation program.

- **Key staff changes and rotations might result in the loss of knowledge gained by the implementing agencies through technical assistance.** Especially MoECI suffered from frequent staff changes and rotations, which negatively affected the implementation of activities of Component D, Implementation of Energy Sector Reform and Development Program. Therefore, retaining such key staff is crucial in not only implementing similar projects, but maintaining the outcomes of this project.

a. Risk to Development Outcome Rating

Modest

8. Assessment of Bank Performance

a. Quality-at-Entry

The project was strategically relevant with the objectives of the GoU's Energy Program and consistent with the Bank's Country Assistance Strategy. The project directly benefitted from the experience gained from the Hydropower and Rehabilitation and System Control Project (P038820) which was completed in 2002, and also from the Bank's extensive experience in Ukraine and the energy sector. Lessons learned in the past were reflected in the project design (PAD, p.9).

Technical, economic and financial analyses for the project appraisal were sound. Fiduciary and safeguard issues were adequate, and mitigation measures consistent with the World Bank's fiduciary role were properly designed. Implementation arrangements were defined in detail (PAD, Annex 6). Although UHE had experience in all aspects of hydropower development and operations, due to the large scope of works in this project, which constituted the entire investment program of UHE over the next six years, an experienced international consultant was to be engaged to assist UHE in project management, scheduling, procurement and contract management. Selection of such a consultant under Terms of Reference acceptable to the Bank was a condition for loan effectiveness. Policy and institutional environment were conducive for a successful implementation of the project, which were further supported by activities to strengthen the institutional capacities of the project implementation agencies.

On the other hand, there were some shortcomings in quality at entry. Although the PDOs were highly relevant to the country and Bank priorities, they were defined broader than such a project could achieve with the activities defined under five components. The results framework failed to show a cause and effect relationship between the project outputs and outcomes. Hence, the M&E was inadequate given the development objectives. The indicators selected at appraisal were not aligned with the PDOs making monitoring of implementation progress and achievement of the project outcomes difficult. The risks identified at appraisal materialized except the misuse of funds. The decision at the appraisal to procure hydropower equipment on a sole-source basis from a domestic supplier caused implementation delays. This was partly overcome through the additional financing which enabled UHE to use international

competitive bidding (ICB) procedures which increased the number of suppliers.

Lastly, the cost estimates at appraisal were not accurately calculated. There was a 44% cost overrun due to significantly higher actual costs of equipment, materials and labor during implementation compared to the appraisal estimates. However, it should have been expected that UHE must have had a good knowledge of current market prices at the time of appraisal since DniproHydroEnergo (DHE), one of the two predecessor companies of UHE, had successfully implemented the first Bank-financed project (Hydropower Rehabilitation and System Control Project - P038820) between 1996 and 2002. After the completion of that project, DHE, and later UHE, implemented and completed the refurbishment of additional 10 units in 2005. Furthermore, at the appraisal of this project, cost estimates were calculated based on the feasibility study prepared by UkHydroProject (UHP). This study utilized and updated the results of the feasibility study of the first project which was prepared by a Swiss company in 1994.

Quality-at-Entry Rating
Moderately Unsatisfactory

b. Quality of supervision
During the first couple of years of the project implementation, most of the project team members were based in Kiev. Supervision missions were held regularly. Some of the missions had multiple agenda and were conducted together with supervision missions for other projects implemented in the energy sector in Ukraine, such as the Power Transmission Project. The mid-term review had to be postponed by one year due to the slow start of the project. Regular meetings were held with the project implementation unit where pending issues were discussed in order to assist them in procurement issues and accelerate the procurement process. The Borrower stated that trilateral meetings held by the Bank, UHE, and the manufacturers and contractors had been useful in solving contract implementation problems. The Bank team's visits to the manufacturers' plants to review and monitor the production process were seen by the Borrower as a "significant promoting element for manufacturers" (ICR, p.60).

Overall safeguard compliance and compliance with respect to each safeguard policy were rated satisfactory throughout project implementation. Financial management (FM) visits were carried periodically by the Bank staff. A wide range of FM and disbursement issues were found during implementation, such absence of automated accounting and reporting system, significant delays in submission of annual audit reports, lack of management action to address issues raised by auditors, low quality of submitted withdrawal applications, and delays in submission of quarterly Interim Financial Reports. The project could only be given a Satisfactory rating in FM at the closing of the project due to full compliance with the auditing and reporting requirements at that time and a satisfactory performance in the preceding year.

The Bank's quick response in approving an additional loan amount of US$ 60 million to finance the UHE's inability to meet its own-funding obligation can be an indication of the Bank's focus on the success of the project, hence achieving the development objectives. However, the Bank's inadequate action in revising the results framework, which was poorly designed at appraisal, in order to better monitor implementation and achievement of the project development objectives was a significant shortcoming. It restricted Bank's focus more on the realization of outputs and less on the achievement of outcomes.

It took one and a half years for the Bank to review and approve the bidding documents for the procurement of Supervisory Control and Data Acquisition (SCADA). Regardless of the quality of the documents submitted by UHE to the Bank for the latter's review, the lack of necessary technical expertise and experts on the Bank side to review and approve the documents of an important project activity, which constituted 30% of the loan amount, was another serious shortcoming (ICR, p.16 and 59).

Quality of Supervision Rating
Moderately Satisfactory

Overall Bank Performance Rating
Moderately Satisfactory

9. Assessment of Borrower Performance

a. Government Performance
Initially, the GoU's commitment to and support of the Energy Program and the project were strong. However, affected mostly by economic and political events in the country, including the unrest in Eastern Ukraine, the GoU's focus shifted to address those issues. This resulted in lack of continuity and sustainability in GoU's commitment to the project and achieving the development objectives. Frequent government changes also played an important role in this. During the course of the project implementation, nine different ministers for energy were appointed and the management teams in the MoECI, the Ministry of Finance, and NEURC, were replaced nine times. The WEM concept was prepared and ready for implementation after the approval of the electricity market law in 2014, but it could not be implemented due to the introduction of a new electricity market legislation by the then newly elected GoU for approval to the Parliament. NEURC was periodically unable to approve the tariff adjustments for UHE on time due to delays by the GoU in processing necessary approvals.

Delays in approving annual budget allocations for the project and the officials' signature cards caused interruptions in the financing of the project and payments by UHE to contractors. Without necessary tariff adjustments, adequate revenues could not be generated to cover the local part of the financing. As a result, a second loan had to be extended by the Bank in the amount of US$60 million. The Energy Program Coordination Unit (EPCU) also experienced some problems with financing and appointments of key personnel and this made coordination among governmental entities in the implementation of the energy program more difficult.

Although most of the issues which were considered problematic during implementation were fully or partially resolved as a result of the GoU's improved cooperation with UHE and the Bank during the final years of the project, and the GoU agreed to continue supporting the EPCU under the Second Power Transmission Project in order to further use the institutional capacity and maintain the momentum gained by the EPCU, the overall performance of the GoU was Moderately Unsatisfactory.

Government Performance Rating
Moderately Unsatisfactory

b. Implementing Agency Performance
The investment part of the project and the installation of MIS, which constituted around 97 percent of the appraisal project cost, was implemented by UHE. Because of the experience gained at the previous hydropower rehabilitation project, UHE′s team had good knowledge of the Bank′s rules and procedures, but due to the size of the project, UHE had difficulties in managing multiple contracts at the same time, and a consultant was hired to help UHE with the project management. In addition to the consultant′s positive contribution to the increase in the efficiency of contract management activities, UHE also took some measures to this end by appointing managers within the project implementation unit. As a result, the pace and the quality of procurement procedure and contract management efficiency improved and UHE′s procurement capacity increased markedly. This manifested itself in the form of UHE′s ability to quickly process procurement packages to purchase additional equipment by using parts of the funds which accumulated due to the devaluation of the local currency two years before project closing.

UHE′s commitment to and ownership of the project was strong, especially in the second half of the implementation period. UHE′s interaction with the Bank on project issues was found to be efficient by the Bank. Except for a few minor delays, UHE′s project reporting and audit compliance was adequate. With the assistance of consultants, UHE completed a revaluation of its fixed assets in 2008. UHE was also in compliance with the debt service coverage ratio covenant during the project implementation period. However, UHE failed to comply with the current ratio covenant starting from 2007. Due to the changes in the national accounting system, a substantial amount of overdue receivables under UHE′s current assets were transferred to non-current receivables. As a result, UHE′s current ratio dropped into the range of 0.5 and 0.8, which was lower than the covenanted level of 1.2. With the help of the Bank, UHE prepared and implemented an Action Plan to restore the current ratio to comply with the covenant. Despite some improvements, UHE failed to continuously meet the covenanted level of current ratio. Since UE was able to fulfill its payment obligations with some delay beyond the end of year, which is not reflected in the current ratio, the Bank agreed in 2015 to replace the current ratio covenant with self-financing ratio which UE had been successful in meeting. The fourth restructuring enabling those amendments was approved in October 2015.

Implementing Agency Performance Rating
Moderately Satisfactory

Overall Borrower Performance Rating
Moderately Satisfactory

10. M&E Design, Implementation, & Utilization

a. M&E Design
Although the objectives were stated clearly, they were very broad. The second and third objectives did not

define the expected outcomes. There was a clear disconnect between the indicators and the PDOs. There was no quantifiable indicator to monitor the achievement of the first objective which aimed at improving operational stability and reliability of power supply through increased regulating capacity, efficiency and safety of hydroelectric plants. This was a serious shortcoming of the M&E design which caused difficulties in directly monitoring the achievement of the outcomes despite the efforts to introduce additional indicators later in the implementation phase.

Frequency of reporting, data collection instruments and the party responsible for data collection were defined for the indicators listed in the results framework and monitoring table. The responsibilities of UE, MoECI, MFE, NERC and Dam Safety Center (DSC) in monitoring and evaluating project progress, and in reporting were also defined at appraisal.

b. M&E Implementation

There were efforts to improve the quality of M&E by introducing new indicators to capture the progress in all of the development objectives of the project. This shortcoming was reported in the first implementation review carried out in 2006. However, the new indicators introduced during the project implementation also fell short of properly monitoring the progress in achieving the project objectives.

UHE and the Energy Program Coordination Unit at the MoECI reported the project progress regularly. The frequent change of key personnel at the MoECI caused some difficulties with data collection and M&E. The ICR does not report what those difficulties were.

Furthermore, the ICR reports that the control and monitoring functions at UHE, which were carried out manually and at times unsystematically, required improvement. Although, the ICR claims that this issue was solved during the last two years of the project, it does not provide information about how this was achieved (ICR, p.14).

c. M&E Utilization

Due to the weakness in the design of the M&E and insufficient efforts to improve its quality during project implementation, the M&E findings could only measure inputs and outputs, rather than progress towards achieving the project objectives. The limited set of intermediate indicators were used in reacting to implementation delays, but even this did not prevent the project implementation period from extending beyond ten years. With the information given in the ICR, it is not possible to come to a conclusion about the extent of the M&E focus on assessing the soundness of the theory of change within the project causality logic.

M&E Quality Rating

Modest

11. Other Issues

a. Safeguards

The project was classified as a Category "B" under OP/BP 4.01 (Environmental Assessment), and OP/BP 4.37 (Safety of Dams) and OP/BP 7.50 (Projects on International Waterways) were triggered.

Environmental Assessment OP/BP 4.01: Key environmental issues associated with the rehabilitation of the hydropower plants and dam safety measures included noise and engine exhausts from construction machinery, fumes from welding and painting, oily wastewaters from roofing and waterproofing operations and disposal of scrap metal and building material (concrete, bricks, etc.) wastes. At four locations, disposal of old batteries and battery acid were expected to be an issue. Other than mineral oil waste, there were no significant hazardous wastes were expected at appraisal, such as heavy metals, polychlorinated biphenyls (PCBs), or asbestos. Public consultations were held at each of the nine project sites. UHE's Environmental Management Plan (EMP) was found acceptable by the Bank on March 9, 2005. The English version of the EMP was placed in the InfoShop. Ukrainian language versions were disclosed at each of the nine project sites. UHE's capacity for implementing the EMP was found to be adequate by the Bank. As a result of the rehabilitation activities and installation of better control systems, the risk of pollution from the use of lubricating oil was minimized. No new hazardous materials were created during implementation. The project was found in compliance with OP/BP 4.01 and received a Satisfactory rating (ICR, p15).

Safety of Dams OP/BP 4.37: The PAD includes a detailed discussion of the dam system in Ukraine, its geological and hydrological features and the measures to be taken within the scope of the project to improve dam safety and to comply with OP/BP 4.37. As the ICR reports, before the midterm review, UHE established an adequately staffed Dam Safety Center under the terms of reference that was acceptable to the Bank and proposals for dam safety measures were completed and implemented. The project was found in compliance with the safeguard measures and was rated Satisfactory (ICR, p.60).

Projects on International Waterways OP/BP 7.50: The project falls within the exception set forth under paragraph 7(a) of the safeguard, since the project was not expected to adversely affect the quality or quantity of water flows to the other riparian. An exception was obtained from the notification requirement under OP/BP 7.50 at appraisal.

Overall, the project was rated Satisfactory for safeguards compliance (ICR, p.15).

b. Fiduciary Compliance

Financial Management

As detailed in "Annex 7: Financial Management and Disbursement Arrangements" of the PAD (p.59-64), the existing institutional financial management systems within UHE, the Ministry of Finance and MoECI were used for project financial management. Although UHE's financial management structure and financial

management staff were seen adequate for project implementation at appraisal, trainings and assistance by the Bank staff were needed to increase the FM capacity of both UHE and MFE during project implementation. But the project still had a wide range of FM and disbursement issues (ICR, p15-16):

- Between 2006 and 2010: (i) absence of an automated accounting and reporting system; (ii) significant delays in submission of annual audit reports; (iii) issues raised by auditors and absence of action by the management to address those issues; (iv) low quality of withdrawal applications and errors in Statement of Expenditure reports; and (v) delays in submission of quarterly Interim Financial Reports and recurrent issues with the reporting quality.
- There were some improvements in FM after the installation of the accounting and reporting system at UHE and full transition to automated project accounting and reporting, although a number of issues continued between 2011 and 2014, such as (i) insufficient frequency of Statement of Expenditure reports; (ii) delays in submission of audit reports; (iii) minor issues with the quality of quarterly Interim Financial Reports; and (d) frequent changes or temporary absence of FM staff and project signatory officials.
- At project closing, full compliance with auditing and reporting requirements was achieved and a Satisfactory rating was assigned in August 2016, also by taking into account the satisfactory performance the preceding year.

The ICR does not offer comments on external auditing. However, the summary of Borrower's ICR states that that UHE's and project's financial statements were audited (ten times) with the help of international auditors (ICR, p.33 and P.52). The Task Team Leader confirmed that the audits had been conducted by external auditors and found satisfactory.

Procurement

Except a small fraction of contracts which were post-reviewed, all other contracts were subject to prior review of the Bank. Supervision missions included procurement accredited staff. Following appraisal, a plan to mitigate procurement risks was agreed with UHE and MoECI, and intensive trainings were conducted to improve the procurement capacity of the project implementing agencies. (ICR, p.16.)

On the other hand, there were some implementation delays due to procurement-related issues. The initial slow progress in implementation was caused by the lack of capacity to manage multiple bidding packages of different complexity at the same time. First set of contracts could only be signed one-and-a-half years after the loan became effective. A project management consultant (PMC) was hired to assist UHE in project implementation and increase the efficiency of contract management. The PMC advised on 25 contracts out of 54. In addition, the Bank's lengthy review of the SCADA contract contributed to procurement delays as explained above under Bank Performance/Quality of Supervision (ICR, p.16).

c. Unintended impacts (Positive or Negative)

None.

d. Other

None.

12. Ratings

Ratings	ICR	IEG	Reason for Disagreements/Comment
Outcome	Moderately Satisfactory	Moderately Satisfactory	---
Risk to Development Outcome	Modest	Modest	---
Bank Performance	Satisfactory	Moderately Satisfactory	Below the line ratings are rounded up when the Efficacy rating is in the satisfactory range. The ICR's rating should also have been Moderately Satisfactory, as per the guidelines, when above the line ratings are rounded down.
Borrower Performance	Moderately Satisfactory	Moderately Satisfactory	---
Quality of ICR		Modest	---

Note

When insufficient information is provided by the Bank for IEG to arrive at a clear rating, IEG will downgrade the relevant ratings as warranted beginning July 1, 2006.
The "Reason for Disagreement/Comments" column could cross-reference other sections of the ICR Review, as appropriate.

13. Lessons

The first lesson below, which is taken from the ICR with some adaptation of language, is identical to one of the lessons learned from the Power Transmission Project in Ukraine. The other lessons are also taken from the ICR with some adaptation of language.

Experience gained by an agency in successfully implementing a project does not necessarily mean that there exists sufficient capacity within that agency to implement a similar project, especially so, if the scope of the second project is larger than that of the first one. Since UHE had successfully completed the first hydropower rehabilitation project in 2002, the Bank expected that UHE had sufficient capacity to implement the Hydropower Rehabilitation Project, which was larger in terms of scope than the first project. UHE's initial lack of capacity in managing a project of such scale and scope resulted in project implementation delays.

Combining an ambitious sector reform program with significant investment activities in a fragile political economy carries high risks. In these circumstances a single focus infrastructure project may

be a more focused and effective solution. One of the objectives of this project was to support the GoU to achieve the opening up of the electricity market. This was a rather ambitious objective for a project which primarily aimed at rehabilitating a number of hydropower plants. As a result of political instability and frequent government changes, GoU's commitment to the sector reform decreased during the course of the project, and as a result, the implementation of the WEM concept was not achieved with the support of the project.

Preparation of bidding documents as early as possible during the project preparation phase can prevent delays during implementation in countries where administrative procedures are complicated, political and economic uncertainties are common. and project implementation agencies lack sufficient project management capacity. As was experienced in couple of projects in Ukraine, projects faced initial delays due to cumbersome administrative procedures and lack of project management capacity of the project implementing agencies. Having bidding packages ready by the time of loan effectiveness might kick-start the bidding process with the prospect of awarding first contracts early in the implementation period. This would significantly increase the project's sustainability and its chance for timely completion.

A poorly designed results framework where objectives are not fully supported by quantifiable and measureable indicators can shift the focus from the achievement of project development outcomes to the achievement of outputs. The results framework of the Hydropower Rehabilitation Project was poorly designed at appraisal and subsequent efforts to improve it could not be successful. As a result, during the course of project implementation, focus shifted from achieving project objectives, which were over ambitious, to the achievement of outputs. This had adversely affected efficacy.

14. Assessment Recommended?

Yes

Please explain

The Bank has been supporting since 2005 Ukraine's Energy Program through a series of projects, such as the Hydropower Rehabilitation Project, the Power Transmission Project, the Second Power Transmission Project and a possible Kyiv Pumped-Storage Plant Project. A group assessment of these projects would help IEG to better understand how a series of such interventions has been instrumental, or not, in achieving the Bank's development objectives. There might be some very important lessons to be learned especially about the impact of these projects on the demand-side of the results chain.

15. Comments on Quality of ICR

The ICR is concise and informative. The ICR provides a candid presentation of shortcomings in Bank and Borrower performances, and project design. Efficiency analysis is well presented. The ICR is consistent with OPCS guidelines.

However, the ICR is more of an implementation narrative rather an outcome-driven explanation of the project. The ICR frequently evaluates outcomes by outputs, a judgment made more difficult where indicators did not fully reflect project objectives. The Supervision and M&E sections could have benefited from a more detailed discussion. Incomplete “Project Cost by Components” table in Annex 1 is a serious shortcoming of the ICR. The discussion of the results framework and indicators in different parts of the ICR is not consistent. For example, while the results framework and indicators are critically evaluated in one section (para.75), the shortcomings in indicators are defined as “minor design shortcomings” in another section (para.54). The Bank Performance rating is given as Satisfactory in the Data Sheet, whereas it is Moderately Satisfactory on page 26.

a. Quality of ICR Rating
Modest