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Report No: ICR00002167

IMPLEMENTATION COMPLETION AND RESULTS REPORT

(IBRD 7633-EG)

ON A

LOAN

IN THE AMOUNT OF US$600 MILLION

TO THE

ARAB REPUBLIC OF EGYPT

FOR THE

AIN SOKHNA POWER PROJECT

June 26, 2019

Energy And Extractives Global Practice
Middle East And North Africa Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective December 31, 2018)

Currency Unit	=	Egyptian Pound (EGP)
EGP 17.8683	=	US$1
US$	=	SDR 1

FISCAL YEAR
January 1 to December 31

Regional Vice President:	Ferid Belhaj
Country Director:	Marina Wes
Senior Global Practice Director:	Riccardo Puliti
Practice Manager:	Erik Magnus Fernstrom
Task Team Leader(s):	Mohab Awad Mokhtar Hallouda
ICR Main Contributor:	James Sayle Moose

ABBREVIATIONS AND ACRONYMS

CAS	Country Assistance Strategy
CPF	Country Partnership Framework
EDEPC	East Delta Electricity Production Company
EEAA	Egyptian Environmental Affairs Agency
EEHC	Egyptian Electric Holding Company
EETC	Egyptian Electric Transmission Company
EGP	Egyptian Pounds
ERR	Economic Rate of Return
FY	Fiscal Year
GWh	Gigawatt Hours
HFO	Heavy Fuel Oil
ICR	Implementation Completion and Results Report
ISR	Implementation and Status Report
kWh	Kilowatt hour
M&E	Monitoring and Evaluation
MMBTU	Million British Thermal Units
MVA	Megavolt Amp
MW	Megawatt
NGO	Non-Governmental Organization
NPV	Net Present Value
OCC	Opportunity Cost of Capital
PAD	Project Appraisal Document
PDO	Project Development Objective
PMU	Project Management Unit
PT	Egyptian Piaster
RAP	Resettlement Action Plan
TTL	Task Team Leader

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DATA SHEET

BASIC INFORMATION

Product Information

Project ID	Project Name
P100047	EG-Ain Sokhna Power Project
Country	**Financing Instrument**
Egypt, Arab Republic of	Investment Project Financing
Original EA Category	**Revised EA Category**
Full Assessment (A)	Full Assessment (A)

Organizations

Borrower	Implementing Agency
Arab Republic of Egypt	EEHC

Project Development Objective (PDO)

Original PDO

The project development objectives are to (i) assist the Government of Egypt to ensure continuous electricity supply to meet demand in a sustainable manner through investment in new generation capacity; and (ii) improve the sector's financial sustainability by providing assistance to the Egyptian Electricity Holding Company (EEHC) to support sector revenue improvements.

FINANCING

	Original Amount (US$)	Revised Amount (US$)	Actual Disbursed (US$)
World Bank Financing			
IBRD-76330	600,000,000	600,000,000	488,422,431
Total	**600,000,000**	**600,000,000**	**488,422,431**
Non-World Bank Financing			
Borrower/Recipient	570,000,000	0	0
African Development Bank	450,000,000	0	0
Arab Fund for Economic and Social Development	200,000,000	0	0
KUWAIT: Kuwait Fund for Arab Economic Development	104,000,000	0	0
Total	**1,324,000,000**	**0**	**0**
Total Project Cost	**1,924,000,000**	**600,000,000**	**488,422,431**

KEY DATES

Approval	Effectiveness	MTR Review	Original Closing	Actual Closing
29-Jan-2009	13-Aug-2009	22-Dec-2016	31-Dec-2015	31-Dec-2018

RESTRUCTURING AND/OR ADDITIONAL FINANCING

Date(s)	Amount Disbursed (US$M)	Key Revisions
04-Dec-2013	329.53	Change in Results Framework Change in Components and Cost Change in Loan Closing Date(s) Change in Financing Plan Change in Disbursements Arrangements Change in Safeguard Policies Triggered Change in Institutional Arrangements Change in Financial Management Change in Procurement Change in Implementation Schedule
27-Mar-2017	421.35	Change in Results Framework Change in Loan Closing Date(s) Change in Implementation Schedule

KEY RATINGS

Outcome	Bank Performance	M&E Quality
Satisfactory	Moderately Satisfactory	Modest

RATINGS OF PROJECT PERFORMANCE IN ISRs

No.	Date ISR Archived	DO Rating	IP Rating	Actual Disbursements (US$M)
01	23-Jun-2009	Satisfactory	Satisfactory	0
02	23-Dec-2009	Satisfactory	Moderately Satisfactory	0
03	23-Jun-2010	Satisfactory	Satisfactory	41.59
04	04-Jan-2011	Satisfactory	Satisfactory	41.59
05	25-Jun-2011	Satisfactory	Satisfactory	85.13
06	26-Dec-2011	Satisfactory	Satisfactory	113.44
07	24-Jun-2012	Satisfactory	Satisfactory	134.67
08	23-Dec-2012	Satisfactory	Satisfactory	275.66
09	01-Jul-2013	Satisfactory	Satisfactory	318.78

10	26-Dec-2013	Satisfactory	Satisfactory	344.80
11	13-Jun-2014	Satisfactory	Moderately Satisfactory	349.46
12	15-Dec-2014	Satisfactory	Moderately Satisfactory	363.18
13	18-Jun-2015	Satisfactory	Satisfactory	379.11
14	21-Dec-2015	Satisfactory	Satisfactory	409.49
15	27-Jun-2016	Satisfactory	Moderately Satisfactory	409.49
16	28-Dec-2016	Satisfactory	Moderately Satisfactory	417.10
17	06-Jun-2017	Satisfactory	Moderately Satisfactory	428.90
18	18-Dec-2017	Satisfactory	Moderately Satisfactory	442.47
19	17-Jul-2018	Satisfactory	Moderately Satisfactory	467.55
20	12-Dec-2018	Satisfactory	Moderately Satisfactory	480.25

SECTORS AND THEMES

Sectors

Major Sector/Sector	(%)
Energy and Extractives	**100**
Non-Renewable Energy Generation	100

Themes

Major Theme/ Theme (Level 2)/ Theme (Level 3)	(%)
Urban and Rural Development	**100**
Urban Development	100
Urban Infrastructure and Service Delivery	100

ADM STAFF

Role	At Approval	At ICR
Regional Vice President:	Daniela Gressani	Ferid Belhaj
Country Director:	Emmanuel Mbi	Marina Wes
Senior Global Practice Director:	Laszlo Lovei	Riccardo Puliti

Practice Manager:	Jonathan D. Walters	Erik Magnus Fernstrom
Task Team Leader(s):	Anna M. Bjerde	Mohab Awad Mokhtar Hallouda
ICR Contributing Author:		James Sayle Moose

I. PROJECT CONTEXT AND DEVELOPMENT OBJECTIVES

A. CONTEXT AT APPRAISAL

1. When the project was prepared in 2008, the Egyptian Economy had been growing rapidly (7.1 percent in fiscal year FY2007 and 7.2 percent in FY2008) but was beginning to slow sharply due to the world recession. Inflation was high and energy subsidies were at 6.7 percent of the gross national product (GNP). The Government had a reform program to increase energy prices to more cost-reflective levels, and this was being implemented with price increases for electricity of 5 percent per year on average. Prices of petroleum products were also increased. A new Electricity Law had recently been approved by the Cabinet, which, among other things, provided for: (a) a greater role for the private sector, (b) feed-in tariffs for renewable energy, and (c) a more active role for the Energy Regulatory Agency.

2. Electricity demand was growing quite rapidly in Egypt, having increased 7.5 percent a year between FY2003 and FY2008. According to the Project Appraisal Document (PAD), this rate of growth required "an increase of new capacity in the order of 1500 MW per year." It was planned that this capacity increase would be mostly (a) combined cycle power plants using natural gas and (b) steam plants (mostly more efficient supercritical plants) capable of using either natural gas or heavy fuel oil (HFO). Although it was not mentioned in the PAD, the country had adequate nominal capacity but was short of available capacity at periods of peak demand. According to the Egyptian Electricity Holding Company (EEHC), this lower available capacity was due to outdoor temperature derating of gas turbine technology (about 8 to 10 percent for the Egyptian Climate), aging of power plants, and dependence of hydropower plants on the amount of water allowed to be used by the Ministry of Irrigation and Water Resources. As a result, in FY2008 and 2009, there was load shedding, although nominal capacity was 8 to 10 percent above the peak. To be safe from load shedding, Egypt needed nominal capacity of around 15 to20 percent above peak in addition to keeping up with demand growth. The Government's strategy was to not only have the EEHC build these new generation plants as rapidly as possible but also to restart private investment in power plants and raise electricity prices closer to costs.

3. The Ain Sokhna Power Project, described below, was fully supportive of the Government's Strategy and consistent with the program outlined in the Country Assistance Strategy (CAS for FY 2006 to 2009, Report 32190 EG), which had three pillars: (a) facilitating private sector development, (b) enhancing the provision of public services, and (c) promoting equity. The Ain Sokhna Power Project directly supports the second pillar by helping fund a new 1,300 MW supercritical power plant and the first pillar by providing technical assistance to help create a more favorable environment for private investment in the electricity sector and improving the reliability of electricity supply for industrial and commercial activities.

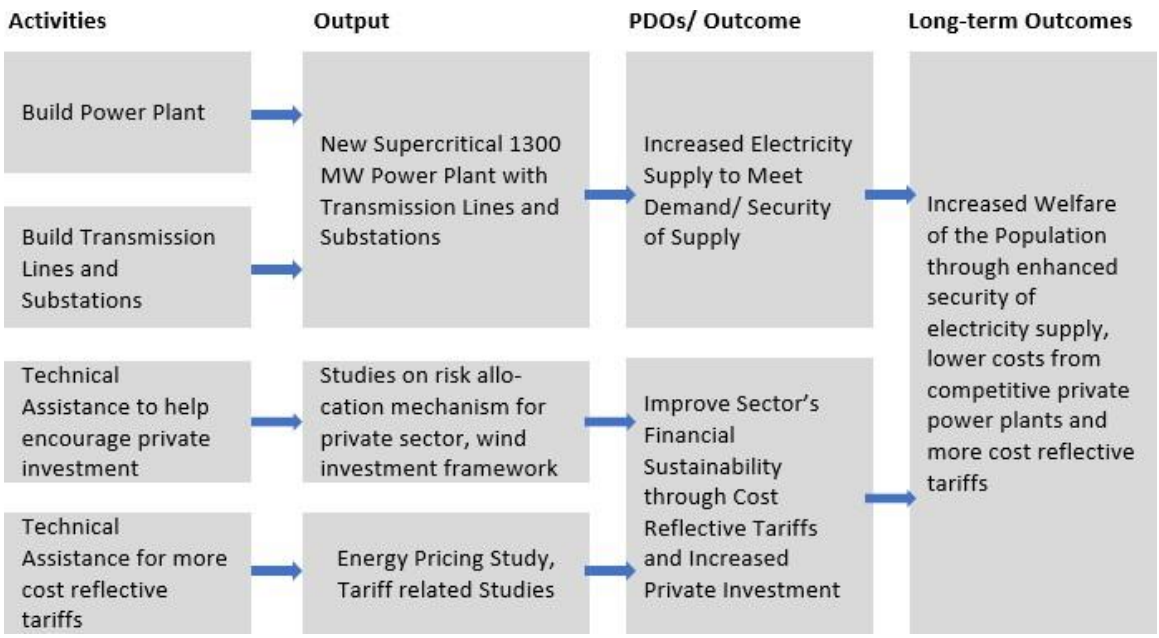
4. The World Bank was one of the co-financiers in the Ain Sokhna Power Project. In addition, the African Development Bank, the Arab Fund for Social and Economic Development, the EEHC, and later the Kuwait Fund for Arab Economic Development provided financing.[1]

[1] See also information in the datasheet.

Theory of Change (Results Chain)

5. The theory of change of the project is shown below in Figure 1. The construction of the Ain Sokhna Power Plant would increase generation, leading to increased electricity supply to meet rising demand. Part of the technical assistance would contribute to attracting private investors in electricity generation, especially renewable generation, thus reducing the amount[2] that the EEHC would need to invest. The other part of the technical assistance would help achieve more cost-reflective tariffs, allowing the saving on subsidies to be used for health and education. A transmission component was added to the project at the first restructuring but had no impact on the theory of change. Some transmission was already part of the theory of change as construction of a power plant almost always involves some transmission to get the power to its customers.

Figure 1. Theory of Change



Project Development Objectives (PDOs)

6. The project development objectives (PDOs) according to the PAD (page 10) were to "(i) assist the Government of Egypt to ensure continuous electricity supply to meet demand in a sustainable manner through investment in new generation capacity and (ii) improve the sector's financial sustainability by providing assistance to the Egyptian Electricity Holding Company (EEHC) to support sector revenue improvements."

7. The first component of the project was designed to achieve the first development objective by providing funding for the new Ain Sokhna Power Plant which in turn was designed to provide electricity supply to the growing Egyptian market. The second component was designed to achieve the second development objective by providing technical assistance designed to; (a) help produce more cost-

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reflective tariffs and (b) encourage private investment in the sector, thereby reducing the EEHC's capital requirements. The first two activities in the Theory of Change reflect the first component, whereas the second two reflect the second component.

Key Expected Outcomes and Outcome Indicators

8. The expected outcomes and outcome indicators are tied closely to the PDOs discussed above. The main expected outcome from the project (Component 1) was a large new power plant (Ain Sokhna) designed to supply the Egyptian Electricity Market, which at the time of the PAD, was short of electricity generation capacity. The second expected outcome (Component 2) was an electricity tariff structure that was more reflective of the long run costs of the system. In the PAD (page 38), there were two PDO indicators for these outcomes which were:

- "Annual increase of 6000 GWh on average in the electricity sold to consumers (i.e. additional 1300 MW of generation capacity) with the construction of the Ain Sokhna Power Plant;"

- "Electricity tariff structure is adjusted to reflect prices that are better aligned with its long run marginal cost and aim at reducing demand in peak periods."

9. The PDO indicators were changed in both project restructurings, in 2013 and in 2017. This is further explained in the section on 'Significant Changes during Implementation'.

10. Components The project initially had two components. The first was the construction of a supercritical (high pressure, high temperature, more efficient) power plant at Ain Sokhna on the Gulf of Suez, a branch of the Red Sea. The plant was designed to have 1,300 MW of generating capacity and to use either HFO or natural gas. This decision to have the plant capable of using HFO as well as natural gas substantially increased its cost and lowered the plant's efficiency compared with building a combined cycle power plant, which can only use natural gas. There are several reasons given by the EEHC for having the plant capable of using HFO, and these are elaborated in the 'Efficiency Section' below. However, the main reason was probably the increased supply security provided by the ability to use HFO if there were to be a problem with natural gas supplies. The base cost of this component was estimated in the PAD to be US$2,139.6 million with an additional US$50.2 million in contingencies for a total of US$ 2,189.8 million. The EEHC/Egyptian Government was expected to provide US$831.3 million in financing; the African Development Bank US$550 million; the Arab Fund for Economic and Social Development US$208.5 million, and the World Bank US$600 million with an IBRD loan.

11. The second component was a series of studies and ad hoc work related to achieving more cost-reflective tariffs and encouraging private investment in generation, thus reducing the financial pressure on the EEHC. These studies were to be funded from grant funds and the World Bank's Budget. None of the World Bank loan was allocated for these studies or the ad hoc work. The studies were; (a) an energy pricing study, (b) a framework and risk allocation mechanism for private sector engagement, and (c) development of a commercial framework for the stimulation of investment in wind power. There was also to be assistance for ad hoc policy support and reports dealing with various energy-related issues, such as time-of-use tariffs, energy pricing, energy conservation, and a program to support energy-efficient lighting through the electricity distribution companies. The cost of this component was not fully determined. The

three studies, that were to be financed from grants, were expected to cost US$1.47 million. In addition, an amount of US$750,000 from the World Bank's Budget was planned to be available for ad hoc policy support and reports over the following three years, as needed.

12. A third component was added during the first project restructuring. This transmission component was funded from the savings achieved with lower-than-expected construction costs for the power plant. Its main function was to provide transmission facilities to evacuate power from the Helwan South Power Plant, which was under construction, and improve the offtake of power from the Ain Sokhna Power Plant.

Table 1. Estimated Cost of Components (US$, Millions)

	PAD 2009	First Restructuring 2013	Second Restructuring 2017	Final Cost
Ain Sokhna Power Plant	2,139.6[a]	1,655.3	1,655.3	1,159.4
Technical Assistance	1.47	1.47	1.47	1.47
Transmission Investments	0.00	190.0	190.0	69.8[b]

Note: a. Base cost without contingencies. With contingencies, US$2,189.8
b. This is the cost as of March 31, 2019, after the project closing on December 31, 2018. It is probably 85 percent of the total cost which, however, will not be known until the component is completed in August 2019. The EEHC is providing the additional financing

B. SIGNIFICANT CHANGES DURING IMPLEMENTATION (IF APPLICABLE)

13. The project went through two restructurings. The first restructuring in November 2013 was designed primarily to use the estimated savings of US$179.5 million from the sections of the Ain Sokhna Power Plant that the World Bank was financing. The second restructuring was primarily to extend the term of the loan, although there were some updates to the indicators. There was no reallocation of funds and no new components. In both restructurings, there were no changes in the PDOs, although the indicators were expanded.

14. First restructuring. In the fall of 2013, it had become clear that the cost of the Ain Sokhna Power Plant was going to be substantially less than estimated in the PAD (see also discussion in the 'Efficiency' section). Also, a loan to help construct the Helwan South Power Plant had just been approved (June 27, 2013) by the Board of Executive Directors of the World Bank. It was therefore decided to use the estimated savings of US$179.5 million in the Ain Sokhna Power Project loan to build a large new 500/220 kV substation (Zahraa El-Maadi) and a connector line to strengthen the grid and evacuate the power which would be generated by the Helwan South Power Plant. Also, the connection of the Ain Sokhna Power Plant to the grid would be strengthened as well as the connection of the Tebbin Power Plant (also World Bank financed). A new component, Generation Transmission Connection and Strengthening, was created for these transmission investments (this was added as Part A1 of the Loan Agreement). This new component was implemented by the Egyptian Electric Transmission Company (EETC), the national transmission company, instead of the generation company, East Delta Electricity Production Company (EDEPC), which was overseeing the construction of the Ain Sokhna Power Plant. Both the EETC and EDEPC are subsidiaries of the EEHC. In addition, the first restructuring added several outcome indicators and changed the targets on others, as is discussed in some detail in the following paragraphs. Finally, the closing date of the loan was changed from December 31, 2015, to June 30, 2017.

15. Second restructuring. The 2017 restructuring extended the closing date of the loan from June 30,

2017, to December 31, 2018, when it closed. In addition, there were further changes in the project outcome indicators, which are discussed below.

Revised PDOs and Outcome Targets

16. There were no changes in the PDOs.

17. The two PDO outcome indicators that were in the PAD and mentioned above (new generation plant and more cost-reflective tariffs) were basically unchanged in both the first and second restructurings, although the cost-reflective tariff outcome was quantified. However, a new PDO indicator for strengthening the grid and evacuating power was added in the first restructuring as well as a number of additional PDO indicators for generation and cost-reflective tariffs. The PDO indicators were modified again in the second restructuring with the project ending up with nine PDO outcome indicators. The three sets of indicators are shown in table 2 below.

Table 2. PDO Indicators

PDO Indicators in 2009, from the PAD
1. Annual increase of 6 000 GWh on average in the electricity sold to consumers (i.e. additional 1300 MW of generation capacity) with the construction of the Ain Sokhna Power Plant
2. Electricity tariff structure is adjusted to reflect prices that are better aligned with its long run marginal cost and aim at reducing demand in peak periods."
PDO Indicators after First Restructuring 2013, from Project Amendment Letter
1." Generation Capacity of Ain Sokhna Power Plant". The target was 1300 MW
2. " Increase in Electricity Supply (Net) with the construction of the Ain Sokhna Power Plant". The target was 6000 GWh."
3. "Increase in annual Electricity Supply (Net) with the network upgrade (A1)" The target was 6,723 GWh per year.
4. "Electricity Average Tariff". The target was 31.3 PT/kWh.
5. "Direct Project Beneficiaries". The target was 7,196,267 persons.
6. "Female Percent". The target was 49 percent
7. "Transmission lines constructed under component A1" The target was 280 km.
8. "Substation MVA" The target was 1,500 MVA.
9. "Minimum Ain Sokhna Power Plant Capacity Factor" The target was 80%.
PDO Indicators after Second Restructuring 2017, from Restructuring Paper
1. "Generation: Capacity of Conventional Generation constructed under the project." The target was 1,300 MW.
2. "Meeting Demand: Increase in annual electricity supply (Net) with the construction of the Ain Sokhna Power Plant." Target was 6,000 GWh per year.
3. "Meeting the demand: Increase in annual electricity supply (Net) with the network upgrade." The target was 6,723 GWh per year.
4. "Direct Project Beneficiaries." The target was 7,196,267 persons.
5. "Female Beneficiaries." Target was 49 percent of beneficiaries.
6. "Financial Sustainability: Electricity Average Tariff (PT/kWh)." The target was adjusted to 55 PT/kWh.
7. "In a sustainable manner: Maximum Ain Sokhna Power Plant Capacity Factor." The target was 75 percent.
8. "In a sustainable manner, Minimum Thermal Energy Efficiency." The target was 40 percent.
9. "Ratio of Average Load Shedding to Peak Demand." The target was 0.0 percent

Revised Components

18. A third component was added to the project in the first restructuring. This was "Generation Transmission Connection and Strengthening" and, as mentioned above, it was funded with savings from

the construction of the Ain Sokhna Power Plant. This new component funded the large Zahraa El Maadi substation, a 500 kV overhead connector line from Zahraa El Maadi to the Helwan South Power Plant, and expansion of the Sokhna substation including connections.

Other Changes

19. The transmission lines required taking some private property, although this was minor, and no one was required to move. A resettlement action plan was prepared, which is discussed below.

II. OUTCOME

A. RELEVANCE OF PDOs

Assessment of Relevance of PDOs and Rating

20. The relevance of the PDOs is rated High. The PDOs of the Ain Sokhna Power Project are aligned with the current Country Partnership Framework (CPF)[3] FY2015 to FY2019, and thus remain highly relevant. The first PDO to "ensure continuous electricity supply to meet demand in a sustainable manner through investment in new generation capacity" is aligned with the CPF Focus Area 2 "Improved opportunities for private sector job creation" by providing electricity for economic development. It supports CPF Objective 2.2 "Improved energy generation capacity and improved efficiency" (page 31 of the CPF). The CPF explains this objective, stating that "Egypt is a fully electrified country with more than 99 percent of households connected to the electricity grid. Consequently, the power sector has a direct impact on every household, business, school, and hospital in the country. Availability of reliable energy supply has been identified as a major constraint by the private sector in expanding businesses and therefore job creation. The brisk energy demand growth is expected to continue for the foreseeable future, and investments in the supply side of the power sector and efficiency enhancing measures will have to expand significantly."

B. ACHIEVEMENT OF PDOs (EFFICACY)

Assessment of Achievement of Each Objective/Outcome

21. The efficacy of the project is rated as Substantial. The project had two objective/outcomes and efficacy is assessed based on these two interrelated objective/outcomes.

Objective/Outcome 1: "Ensure continuous electricity supply to meet demand in a sustainable manner through investment in new generation capacity". This corresponds to Component 1

22. The project resulted in new generation capacity of 1,300 MW in the new Ain Sokhna Power Plant, which was completed on time and under budget during a period of economic and political turmoil. This plant can provide up to about 8,000–9,000 GWh per year of electricity to consumers, although it normally produces less, and played a significant role in ending blackouts and brownouts. It improved consumer welfare by providing needed capacity at peak and generation as needed. After the second restructuring, there were seven direct PDO indicators for this objective/outcome. Using the list of PDO indicators for the second restructuring shown above, the supply/generation indicators were (1) Capacity, (2) Generation, (4) Direct Project Beneficiaries, (5) Female Beneficiaries, (7) In a sustainable manner, Maximum Ain Sokhna

[3] Report 94554-EG November 20, 2015.

Power Plant Capacity Factor, (8) In a sustainable manner, Minimal Thermal Energy Conversion Efficiency, and (9) Ratio of Average Load Shedding to Peak Demand. Six of these seven indicators were clearly met, whereas the beneficiaries indicator was arguably met.

23. For Indicator 1, the target was that the plant should have a gross generating capacity of 1,300 MW. This was achieved in 2015 at a cost of US$1,159.4 million compared to a PAD estimated cost of US$2,139.6 million.

24. For Indicator 2, the target was generation of 6,000 GWh (Net) per year. The plant generated 6,516 GWh (Net) in FY2016. The actual amount generated each year will depend on the need for the plant. It is capable of generating substantially more than 6,000 GWh per year, probably close to 9,000-9,500 GWh per year.

25. For Indicator 4, Direct Project Beneficiaries, the target was 7,196,267 beneficiaries. This was calculated according to the first Restructuring Paper, based on the combined amount of electricity supplied by Ain Sokhna and Helwan South Power Plants divided by consumption per capita with the latter increasing at 2.7 percent per year. The target was to be achieved in the year when both power plants were operating. The Helwan South Power Plant is still not operating, so it would appear that this indicator may not be applicable. In any case, the Ain Sokhna Power Plant alone cannot achieve this target. However, it can be argued, as was done in the Giza North Project, that the entire electricity-using population of Egypt benefits from a new large power plant capable of supplying electricity at peaks, such as the Ain Sokhna Power Plant, since it helps meet peak demand and avoids blackouts and brownouts. Using this argument, the beneficiaries would be over 95 million people. It is suggested that this measure of beneficiaries be used rather than the current indicator which may not be applicable and is really tied to another project.

26. For Indicator 5, the target was that 49 percent of the beneficiaries should be women. This target was met.

27. For Indicator 7, “In a sustainable manner: Maximum Ain Sokhna Power Plant Capacity Factor,” the target was 75 percent. This indicator is not very clear. However, the power plant has achieved this level of capacity utilization and is certainly capable of achieving substantially higher levels of capacity utilization. Actual capacity utilization will of course depend on the demand for the electricity supplied by the plant.

28. For Indicator 8, “In a sustainable manner energy conversion efficiency,” the target was 40 percent. The Power Plant, according to the EDEPC, is 42 percent efficient at normal load and 44 percent at full load.

29. For Indicator 9, the “Ratio of Average Load Shedding to Peak Demand,” the target was 0.0 percent meaning that there should be no load shedding. This has been the case on a nationwide basis since 2015– when a number of power plants including the World Bank-financed Giza North and Ain Sokhna Power Plants came on stream. In FY2015, 3,203 MW of capacity was added to the Egyptian System of which 2,050 MW was from Ain Sokhna Power Plant and one of the units at the Giza North Plant. There was no nationwide blackouts and brownouts in that year, largely due to the new capacity from these two power plants. In later years, other plants were added, further increasing capacity.

30. Conclusion. The plant was completed on time and under budget. The outputs and outcomes were achieved. All of the indicators related to the Ain Sokhna Power Plant were achieved, and the power plant

has been operating for four years with no significant problems.

31. Transmission (Component 3) is related to the first objective/outcome. This component was added to the project during the first restructuring when the savings from construction of the Ain Sokhna Power Plant were allocated to the upgrading of the grid. This transmission component was not part of the original project although it is consistent with the first PDO, which is to "ensure continuous electricity supply to meet demand…through new generation capacity" since almost any generation has to go through the transmission grid. This transmission component aimed to upgrade the grid, specially to allow evacuation of power from the Helwan South Power Plant and increase the options for evacuating power from the Ain Sokhna Power Plant

32. This component consists of: (a) the construction of a large new substation at Zahraa el Maadi, (b) a transmission line from this substation to Helwan South Power Plant, and (c) a second substation for the Ain Sokhna Power Plant. This transmission component was not finished as of December 31, 2018, due to procurement delays, primarily the need to rebid one of the major procurement packages, and an initial lack of bidder interest as a result of the 2016 devaluation of the currency. Construction on the Zahraa El Maadi substation was completed; commissioning and testing were completed, but it had not yet been handed over to the EETC. The transmission line was also complete and undergoing commissioning and testing. Both the substation and line were completed and handed over to the EETC by April 2019—a delay of four months. The construction of the additional substation for the Ain Sokhna Power Plant is lagging and will not be completed until the summer of 2019.

33. The indicator (Indicator 3) for this transmission component is "Increase in annual electricity supply (NET) with the network upgrade (Component A1)" with a target of 6,723 GWh per year. This target was not achieved as of December 31, 2018, since it primarily concerns construction of the Zahraa El Maadi substation and the transmission line to Helwan South, and these were not completed until April 2019. It is also not clear whether this indicator is applicable to the Ain Sokhna Power Project since it primarily concerns evacuation of power from the Helwan South Power Plant which is delayed until later in 2019.

34. Achievement of Objective/Outcome 1 is rated as Substantial. The Ain Sokhna generation component was completed on time and under budget and met all of the Ain Sokhna generation-related PDO indicators. The smaller and later transmission component was mostly complete at project closing and was almost fully complete by April 2019. The one PDO indicator for this component was not met and could not be met without completion of another World Bank project (Helwan South Power Plant) later this year. Also, it is not clear that this indicator is relevant.

Objective/Outcome 2: "Improve the sector's financial sustainability through the provision of technical assistance to the Egyptian Electricity Holding Company (EEHC) to support sector revenue improvements." This corresponds to Component 2

35. The achievement of the Objective/Outcome 2 for revenue improvements is rated Substantial. Average tariff revenue per kilowatt hour has increased over time in both local currency and U.S. dollar terms, which would allow for a reduction in electricity subsidies and the use of these funds for social welfare purposes. The PDO indicator for this outcome was Indicator 6 "the average electricity tariff" and the target was "55 PT/kWh" by the end of 2018. The average tariff in December 2018 was 83 PT/kWh. Thus, the target for the indicator was met and the financial position of the EEHC has improved as a result, although it has not yet reached long-run cost recovery levels. In FY2020, which starts next month (July

2019), it is planned to raise the tariff to 94 PT/kWh, which at the current (June 1, 2019) exchange rate of EGP 16.76 per US$ is US¢5.6 per kWh and is close to the estimated long-run cost of electricity supply in Egypt of US¢5.7–6.0 per kWh. If cost recovery tariffs are not achieved by the next fiscal year, due to a devaluation of the currency or sharp unexpected cost increases, they should be attained in FY2021. The Government is fully committed to tariffs that cover long-run costs.

36. At inception of the project, the EEHC was profitable due to subsidies, but tariffs (around US¢3.0 per kWh) were below long-run costs and the natural gas price was set very low. Over time, tariffs were increased, and by FY2015 the EEHC had a profit and the tariff was at or above long-run costs. However, in 2016, the Egyptian pound was allowed to float freely, and its value dropped sharply from about EGP 8.8 per US$ to around EGP 15 per US$ and then continued to decline. As a result, costs soared, the tariff dropped far below long-run costs, and the company made large losses in FY2016 and FY2017, which were offset to a substantial extent by subsidies from the Government. As the project comes to an end, it is recovering from this situation and tariffs are again getting close to long-run costs, as is indicated in the paragraph above.

37. The Government's commitment to cost recovery tariffs is due to domestic economic considerations. The World Bank, through technical and economic assistance, provides help with this issue. Cost recovery tariffs were not a covenant in the project.

38. Private sector investment in power generation. This is part of Component 2 and is related to the second PDO since private investment in generation will "improve the sector's financial sustainability" by reducing the investments the EEHC would need to make in power generation and perhaps increasing efficiency. There is no PDO indicator for this component. However, it was successful. The studies were done and assisted with the revival of private investment in Egypt, including private thermal plants and renewable plants.

39. Since the average electricity tariff indicator for this objective/outcome was achieved and even overachieved, the tariff is now again approaching long-run costs, and the studies make a contribution to attracting private investment; this outcome is rated as Substantial.

Justification of Overall Efficacy Rating

40. This project is given an overall efficacy rating of Substantial. Achievement of the two PDOs was Substantial with both the generation and revenue PDOs attained according to the PDO indicators. The transmission component was largely completed at closing, and the two main transmission components were completed by April 2019. One PDO indicator for the transmission component was not achieved at closing but may not be relevant since it seems to assume the Helwan South Power plant is operating. Finally, private sector investment in power generation was strengthened, especially in construction of wind farms, with over 1,000 MW of wind capacity under construction with the plants scattered around the country. This is related to PDO 2, although there is no indicator for it.

C. EFFICIENCY

Assessment of Efficiency and Rating

41. The economic efficiency of the Ain Sokhna Power Plant (the original project) is rated as

Substantial. In the PAD, the economic efficiency of the plant was measured by comparing its economic costs to its estimated benefits. The PAD also states that the Ain Sokhna Power Plant is part of the least cost expansion plan for supplying electricity to Egypt.

42. It is difficult to value the benefits of the plant since there is no market for electricity in Egypt and therefore no market prices for electricity. The actual tariffs are set by the Government and have been somewhat below cost recovery levels. In the PAD, the benefits were taken to be the willingness of consumers to pay for electricity. It was estimated that consumers would be willing to pay the cost of generation using diesel generators, which was taken to be the alternative to electricity supplied from the grid. The cost of diesel generation and therefore the willingness to pay was then calculated to be US¢12.1 per kWh.

43. Two other measures of willingness to pay are also available. First is an updated cost of diesel generation which was obtained from the EEHC. The second is the willingness of consumers to pay, used in the Giza North Power Plant Project, which is based on a demand function and is not a single number but a series, which starts low and rises sharply overtime.

44. Since all these measures of willingness to pay are at the final consumer level, distribution and transmission costs and losses have to be subtracted from them to get the value of the electricity at the power plant. The information on distribution and transmission costs and losses was obtained from the EEHC and its subsidiary, the Egyptian Electric Transmission Company (EETC).

45. In calculating the economic rates of return (ERRs) for this Implementation Completion and Results Report (ICR), the actual capital cost of the Ain Sokhna Power Plant was used excluding land and taxes. The 500 kV line, used by the Ain Sokhna Power Plant, had been built by the EETC to serve other power plants as had the natural gas transmission line, so their costs were not included in the project total. For generation by the plant, actual data were used for the first couple of years and forecasts from the EDEPC, (the parent company of Ain Sokhna) were used for outer years. Natural gas costs were assumed to remain at US$3.00/MMBTU.

46. With this information and information on the actual operating costs, the ERR was calculated for the project using the three alternative estimates of the willingness to pay. Using the estimate of the willingness to pay shown in the PAD (updated to reflect inflation), the ERR is 38.9 percent compared to 23.0 percent in the PAD. Using the actual cost of diesel-generated power adjusted for inflation, the ERR is 47.4 percent. Using the estimates of the willingness to pay that were used for the Giza North Power Plant, the ERR is 17.8 percent. These three estimates all exceed the assumed opportunity cost of capital (OCC) in Egypt, which is 10 percent, and therefore show that the project is efficient. Except for the ERR calculated using the willingness to pay estimate from the Giza North Project PAD, the ERRs exceed the ERR estimated in the Ain Sokhna PAD. The primary reason that these ERRs are higher is that the Ain Sokhna Power Plant's finished cost was substantially less than was anticipated in the PAD (see Table 1). This in turn was due to several factors, including a sharp drop in power equipment costs while the project was being procured and devaluations of the currency while it was under way.

47. The Ain Sokhna Power Plant was part of the least cost generation expansion plan for several reasons (see annex 4) but most importantly because it was designed to use either HFO or natural gas as fuel. This reduced its efficiency compared to a combined cycle power plant, which only uses natural gas or

light fuel oil and increased the cost of construction. However, it has the major advantage that the plant can operate if there were a natural gas shortage since it can easily import large amounts of HFO, especially since it is located on the Gulf of Suez.

48. The efficiency of the transmission component. Most of the investments in the transmission component (Overhead Transmission Line [OHTL] from Helwan South to Zahraa El Maadi Substation and this substation itself) are part of the World Bank-financed Helwan South Power Project and need to be evaluated as part of that project. The Restructuring Paper produced in 2013 (page vii) states that "The economic analysis of the investments financed by the proposed restructuring of the Ain Sokhna Power Project follows the economic analysis for the Helwan South project. This is because most of these investments are for construction of the transmission facilities for connecting the new Helwan South power station to the national transmission system to enable the output from the power station to be delivered to electricity users." "The economic return on the investment in the power generation capacity and associated transmission facilities under the Helwan South Power project is computed for a base-case scenario that is formed from the expected values for the cost of (i) natural gas used in the Project plant, (ii) the construction cost for the Project plant and connecting facilities, and (iii) the future growth rate of Egyptian power demand. The economic benefits for the Project are derived from the willingness to pay of Egyptian electricity consumers for the forecasted increase in electricity consumption..... At 10 percent discount rate - taken to be the Opportunity Cost of Capital (OCC) to Egypt - the Project Net Present Value (NPV) for the base case of the evaluation is estimated to be US$ 5,270 million, and the economic rate of return (ERR) to the. Project is 20.2 percent, which shows a positive economic return relative to the OCC." Since the Helwan South Power Project is not yet complete (although it will be later this year) and no new calculations of its ERR have been done, the ERR for that project and the transmission part of that project, which is financed under the Ain Sokhna loan, should continue to be estimated at 20.2 percent.

49. Aspects of design and implementation of the construction of the Ain Sokhna Power Plant, although initially delayed, ended up by being completed about when expected. The two units started synchronization in the first half of 2014, and the plant was effectively completed in the first half of 2015 when both generating units entered commercial operation. The loan could have closed on December 31, 2015, as initially planned. However, as the 2013 Restructuring Paper states on page 25 "The proposed extension (of the loan) is necessary for the implementation and completion of the new activities (the transmission component)."The same Task Team Leader (TTL) who began the project continued with it for the entire project, which increased efficiency. Also, he was located in Cairo, which improved coordination and supervision. As shown in table 1, the plant cost substantially less than anticipated primarily due to effective procurement and an improving market for power equipment. Overall, the achievement of efficiency of design and implementation is rated as Substantial.

50. The efficiency of the project is rated as Substantial. In short, the plant was completed on schedule, in spite of political turmoil, at a lower cost than anticipated and with a higher ERR. The savings were used to provide transmission for another power project which also has a high ERR.

D. JUSTIFICATION OF OVERALL OUTCOME RATING

51. The overall outcome rating is Satisfactory based on a High rating for relevance, a Substantial rating for efficacy, and a Substantial rating for efficiency. The Ain Sokhna Power Plant has been supplying needed power to the Egyptian economy since 2015 as well as providing peaking capacity to avoid blackouts and

brownouts. (The addition of 1,300 MW of additional capacity from Ain Sokhna and 750 MW from Giza North was one of the major reasons that system-wide capacity shortages at peak were largely stopped in 2015. They contribute about two-thirds of the increase in capacity in that year.) The financial condition of the EEHC has improved and tariffs are approaching long-run costs. Private investment in generation has resumed in Egypt, especially in the area of renewable energy, and is progressing well. The transmission component was delayed but was almost completed at project closing. The two main transmission subcomponents, the OHTL from Helwan South Power Plant to Zahraa El Maadi substation and the substation itself, were completed by April 2019 with the final component, the small Sokhna substation, to be completed in August 2019.

52. Use of the split rating methodology does not appear to be justified, according to the World Bank Guidelines,[4] given that the PDOs of the project remain unchanged and the restructuring was to expand the scope of the project to include transmission investments primarily to evacuate power from the new Helwan South Power Plant, which the World Bank was also financing.

E. OTHER OUTCOMES AND IMPACTS (IF ANY)

53. Poverty reduction and shared prosperity. All groups in Egypt are benefiting from the project. The reduction in electricity outages and increased supply of electricity assists everyone across the income distribution and beyond. In addition to households, businesses benefit by having a more reliable electricity supply, and this should help increase investment by the private sector. The introduction of private companies and competition into the electricity generation business should help lower costs of generation in the longer term. Furthermore, there is also a human capital development impact as schools and health facilities benefit from improved electricity services, which contribute to a better learning environment due to continuous lighting and air-conditioning. In addition, schools and health services benefit from reduced electricity cost as they save money that would have been spent for expensive diesel generation.

Other Unintended Outcomes and Impacts

54. Simulator. The EDEPC purchased a simulator to train the crews operating the Ain Sokhna Power Plant. This turned out to be quite useful and is now being used to train crews for other power plants in Egypt.

55. Transformer oil laboratory. The EDEPC established a laboratory at the Ain Sokhna Power Plant to test transformer oils. It has been doing this for the transformers associated with the power plant, those owned by the EETC, and those from other power plants. So far, the EEPC has conducted more than 2,000 tests. It expects to turn this into a business—testing transformer oil from private plants and from plants in other countries when it gets ISO certification.

[4] World Bank Guidelines for ICR Reports for Investment Project Financing July 1,2017 p17-18

III. KEY FACTORS THAT AFFECTED IMPLEMENTATION AND OUTCOME

A. KEY FACTORS DURING PREPARATION

56. The following factors or actions taken during the preparation stage of the project had a significant impact on its successful outcome:

- The PDOs selected for the project were important and realistic. The project had as objectives "(i) ensure continuous electricity supply to meet demand in a sustainable manger through investment in new generation capacity; and (ii) improve the sector's financial sustainability by providing technical assistance to EEHC to support sector revenue improvements." Achieving these objectives was feasible while more grandiose objectives might not have been.

- The project design was quite simple. The project was to construct the Ain Sokhna Power Plant and provide technical assistance to increase revenues through higher tariffs and to encourage more private sector investment. As the project progressed, savings from the construction of the power plant were reallocated to strengthen the grid and allow for the evacuation of power from the Helwan South Power Plant. This expansion was consistent with the objectives of the project as it also aimed at providing "continuous electric supply to meet demand."

- The Results Framework and initial project outcome indicators were simple, reasonable, and likely to be achieved by the project. The indicators were "1) annual increase of 6000 GWh on average in the electricity sold to consumers (.e. additional 1300 MW of generation capacity) with the construction of the Ain Sokhna Power Plant, 2) electricity tariff structure is adjusted to reflect prices that are better aligned with its long-run marginal cost and aim at reducing demand in peak periods." Both are fairly standard indictors for power projects. However, it would have been helpful to have a measure of the desired tariffs and/or long-run marginal costs as a PDO indicator.

- Monitoring of the project was done through appropriate outcome and intermediate outcome indicators. The three intermediate indicators were (a) construction of Ain Sokhna Power Plant completed, (b) EEHC improves current and debt service ratios, and (c) a pilot on time-of-use tariffs is implemented. (These were reasonable although limited intermediate indicators but as the project evolved, the indicators were changed.)

- Four major risk factors were identified, and mitigation measures were taken. The main risks identified (PAD, pages 17 to 19) were (a) "shortage of demand due to a slowdown in domestic economic growth following the global downward trend;" (b) "limited ability to continue electricity price increases in light of price increases in other commodities, notably food and due to the overall impact from the slowdown in domestic economic growth;" (c) "Insufficient volumes or delays in gas supply to fuel the proposed power plant;" and (d) "difficult bidding and availability of plant equipment." All these risks were considered to be moderate, except for the limitation on the ability of the EEHC to increase prices, which was considered high.

Risk mitigation measures were planned for the potential difficulty of raising prices. The primary measure was "ensuring that any price increases that adversely impact vulnerable customers are mitigated through targeted social safety nets." The Government took action on this issue.

B. KEY FACTORS DURING IMPLEMENTATION

57. In 2013, the Energy/ Social Safety Nets Sector Reforms Technical Assistance Project (P144305) was approved by the World Bank with financing from a Trust Fund. This project improved the targeting and delivery of assistance to the poor and vulnerable, which were particularly affected by energy price increases. It ran parallel to the Ain Sokhna Project from 2013 to 2018, when both projects closed. This project was particularly successful in ensuring that (a) cash subsidy schemes (Takaful and Karama) were developed and implemented to offset the impact of the reduction of energy subsidies on the poor and vulnerable and (b) that a communication program was developed to make sure that the public was aware of this shift. This project is described in the recently completed ICR (ICR00004524).

58. Political turmoil. A key factor during implementation was political turmoil. Throughout most of 2011 and 2012 and much of 2013, the country was facing considerable political instability as the result of the departure of President Mubarak, the election of a new President and then his replacement, and the eventual election of the current President. This turmoil interfered with the pursuit of the project. It was difficult to get decisions made. Some companies suspended operations. As a result, during this period, progress on the power plant was slow.

59. Despite the turmoil, the World Bank Team and the EEHC/EDEPC continued to work on the project. After the political situation stabilized in mid-2013, progress accelerated and testing and synchronization of the two 650 MW units with the grid began on August 30, 2014, for unit 1 and October 23, 2014, for unit 2. Both units entered commercial operation in the spring of 2015, more or less on schedule.

60. Environmental impact of flooding. Early in the project implementation, the construction of the plant was delayed by a flood. This was caused by a heavy rain storm and runoff of groundwater to the site. Drainage systems for the plant had not yet been built to divert rainwater, so the site was flooded. Damage was limited by the fact that construction was barely under way. There was no loss of life. After this, bypasses and flood diversion tunnels were constructed to protect the plant site from future flood risks.

61. Transmission component. The project restructuring in November 2013, including the addition of a transmission component, made the project more complex and delayed project closure. A new implementing agency (EETC) was added, and procurement started on substations and an overhead line connecting the new Zahraa El Maadi substation with the Helwan South Power Plant. Without this new component, the project would have probably closed in 2015, when both the generation units at Ain Sokhna had entered commercial operation. Nevertheless, the new component, by strengthening the grid and allowing evacuation of power from Helwan South, contributes significantly to the PDO of ensuring "continuous electricity supply to meet demand."

IV. BANK PERFORMANCE, COMPLIANCE ISSUES, AND RISK TO DEVELOPMENT OUTCOME

A. QUALITY OF MONITORING AND EVALUATION (M&E)

62. M&E design. Initially in the PAD (page 38), there were only two PDO outcome indicators which were: (a) "annual increase of 6000 GWh on average in the electricity sold to consumers (i.e. additional 1300 MW of generation capacity) with the construction of the Ain Sokhna Power Plant," and (b) "Electricity tariff structure is adjusted to reflect prices that are better aligned with its long run marginal cost and aim at reducing demand in peak periods." There were three intermediate indicators: (a) "construction of Ain Sokhna Power Plant is complete," (b) "EEHC improves current and debt service ratios," and (c) "a pilot on time of use tariffs is implemented." These were aligned with the PDO-level indicators and allowed monitoring progress toward reaching the PDOs. Targets were assigned to each of these PDO and intermediate-level indicators by year. The first intermediate indicator, construction of the power plant, was followed closely and could be monitored easily. The current ratio and debt service coverage ratios could be accurately determined only yearly, when the audited financial statements were available, although estimates and projections were made available during the year.

63. One drawback of the PAD indicators was that the indicators which were used to measure the financial health of the EEHC, the current ratio and debt service ratio, also seemed to be used to determine whether electricity prices reflect long-run marginal costs—at least there are no other indicators for long-run marginal costs in the PAD. However, these ratios can reflect other factors besides long-run marginal costs, for example, whether investments are financed through equity or debt and whether the company receives subsidies. An alternative and better measure would have been a target level for an average tariff, which would reflect long-run marginal costs. (This indicator was not in the design but introduced during the restructurings.) However, this indicator has the drawback that it would need to be changed occasionally if the costs of major inputs, such as fuel, change.

64. M&E implementation. The number of PDO outcome indicators was substantially increased from two to nine in the first restructuring. There were basically two purposes for this: (a) to expand the PDO indicators and make them more precise and (b) to put in indicator(s) for the new transmission component, which was added to the project. The number of intermediate indicators was expanded from three to five. The main effects were to make the indicators more precise and include the transmission component.

65. The second restructuring modified the indicators again. Seven of the PDO indicators in the first restructuring were retained and two new PDO indicators were added, covering power plant thermal efficiency and load shedding. One of the five intermediate indicators was dropped (current ratio for the EEHC) and one new indicator (grievances) was added.

66. All these indicators were monitored regularly. Some were relatively easy to monitor, such as construction progress, whereas others could only be ascertained once a year when the audited financial statements were available such as the debt service ratio.

67. M&E implementation had two major weaknesses: (a) the indicators were changed significantly twice and there were three different sets of indicators and (b) some of the indicators were less helpful, for example, the target for the average electricity tariff was 55 PT/kWh. However, costs are mostly in

foreign currency. The price of the natural gas or HFO used as fuel is set in US Dollars, whereas the cost of equipment and spare parts is in euros or U.S. dollars. Thus, without knowing the U.S. Dollar/Egyptian Pound exchange rate, it was not possible to determine how cost reflective this tariff was. Also, the indicator on capacity utilization is not clear. Lastly, the midterm review was conducted late during project implementation.

68. M&E utilization. The information obtained from M&E was reported regularly to management in Implementation Status and Results Reports (ISRs), Aide Memoires, and emails. It was used to discuss the progress of the power project with the EEHC, the EETC, and the EDEPC. When the M&E information showed that the project was falling behind schedule, the ratings on the project were lowered and discussions about what could be done to accelerate the project were undertaken between World Bank staff and management on the one hand and the EEHC, the EETC, and the EDEPC management on the other. Other indicators, such as tariffs, were discussed with the Government and the Regulatory Agency.

Justification of Overall Rating of Quality of M&E

69. The overall rating of the quality of M&E is Modest. This rating is based on the issues discussed above: (a) the changes in indicators during the course of the project and (b) the quality of some of the indicators which were either unclear or not very helpful in measuring what they were supposed to measure. The actual utilization of M&E seems to have been satisfactory.

B. ENVIRONMENTAL, SOCIAL, AND FIDUCIARY COMPLIANCE

70. Environmental, social, and fiduciary compliance were generally Satisfactory, and the two safeguard policies triggered by the project—OP 4.01 - Environmental Assessment and OP 4.12 - Involuntary Resettlement—were complied with in this Category A project. There were, however, a substantial number of reports that had to be written on potential environmental and social issues connected to the project. This was especially true after the World Bank agreed to finance the OHTL from the Zahraa El Maadi substation to the Helwan South Power Plant with the savings from the original project.

71. The major environmental and social issues dealt with are the following:

- Air quality. The plant meets the World Bank and Egyptian Emission and Ambient Air Quality Standards. It now uses only natural gas as fuel, which helps in this process since natural gas is a clean fuel. In the past, due to a shortage of natural gas, the power plant had to use HFO, which was dirtier and not in compliance requirements. The plant still, however, managed to meet air emission standards since it has a desulfurization unit which removed almost all of the main pollutant, sulfur, from the emissions. The continuous air monitoring of the stack emissions provided instantaneous data on air quality, which allows the plant operator to take corrective measures in case there is any exceedance of the emission standards. In addition, the plant operator is sharing the stack emission reports with the Egyptian Environmental Affairs Agency (EEAA) as a legal obligation. Any violations of emission standards will be reported, and corrective actions will have to be implemented as per the EEAA regulations.

- Water quality. The water in the Red Sea adjacent to the plant was tested before and during plant construction. The water quality levels were not affected by any of the construction

activities, as determined by the water monitoring tests that were conducted monthly. Before the construction began and as part of developing the baseline, there were traces of heavy metals found in the shoreline sediments. A thorough investigation was carried out, which determined that the presence of these heavy metals is most likely due to the adjacent port and the high level of maritime traffic offshore in the Gulf of Suez. Construction has not affected the heavy metal issue. Cooling water is taken from the Red Sea, then desalinated, used for cooling, and returned to the Sea. Before it is sent back to the Sea, it is discharged into cooling tanks; mixed with sea water; and checked for temperature, pH, and other factors to ensure it does not pollute the Red Sea water.

- Waste. All construction and operation wastes are disposed of through an agreement with licensed waste collection and disposal contractors who receive their license from the local authority (Suez Governorate). Hazardous wastes (such as empty chemical containers) were separated from the construction waste and operation domestic wastes and stored temporarily within the plant until removed by specialized contractors.

- Health and safety. Serious health and safety measures were implemented during construction and continue to be implemented during operation, which resulted in no fatalities and minor occupational incidents. No major occupational incidents occurred.

- Noise. The plant site is very far from residential or tourism activities. It is surrounded by the commercial Ain Sohkna Port (operated by Dubai Ports) to the North, a privately operated power station to the South, the Suez -Hughada highway to the West, and the Gulf of Suez to the East. No sensitive receptors to noise were identified.

- Land. The power plant and the Zahraa El Maadi Substation were built on land that was unoccupied and owned by the Government. The line from the Zahraa El Maadi Substation to Helwan South Power Plant traverses mostly desert. The Government owns most of the land. However, eight towers are on land that was allocated to an Agricultural cooperative. The land was then transferred to individual members of the cooperative. All the tower footprints are in the desert, and there are no houses, crops, or other assets. There are some olive trees and vineyards in the general area but they are not affected by the tower construction or stringing. The land is zoned for agriculture, awaiting reclamation. For the eight tower sites required, there were six landowners. Five of the six owners accepted the compensation offered by the Government. The sixth refused the compensation amount offered. Seven of the towers were built with no issue. For the 8th tower, the EETC obtained an eminent domain decree to access the site and construct the tower. They paid the owner of the site the standard compensation fee which is in escrow. He has not sued or raised any issues, but the EETC has also not been able to contact him, and his location is unknown. That tower is now completed, and the line was tested and transferred to the EETC four months after loan closing. For this land taking, an Abbreviated Resettlement Action Plan was prepared by the EETC and accepted by the World Bank.

72. Procurement of the power plant by the EEHC and the EDEPC went relatively smoothly once the political turmoil was resolved. Procurement for the power plant was also quite effective and, as is mentioned earlier, the cost of the plant was significantly less than forecast in the PAD. This was due to

several factors, most importantly, (a) the price of electrical equipment declined sharply while procurement was under way, (b) the Egyptian pound and other relevant currencies were devalued relative to the U.S. dollar, and (c) the procurement process attracted the main players globally and resulted in very competitive prices.

73. In retrospective, the EDEPC thinks that it made a mistake by including too few spare parts in the bidding documents. Two years of certain spare parts were included, but the EDEPC now thinks it should have more types of spares and more years of spares. It has found buying spares separately from the manufacturer to be expensive.

74. The EETC's procurement for the transmission component was slower than would be desirable due to understaffing and a lack of personnel familiar with World Bank Procurement.

75. Fiduciary. The EDEPC, EETC, and EEHC had their accounts audited, although only the EEHC provides financial statements to the public and they are limited. There was an independent auditor who audited the project accounts, as required in the Project Agreement. No significant problems emerged, although some of the audits were late.

C. BANK PERFORMANCE

Quality at Entry

76. The quality of the project at entry is rated Moderately Satisfactory. On the positive side, the project was designed to help resolve two major problems in Egypt: (a) a shortage of electricity at peaks with resultant blackouts and brownouts and (b) electricity tariffs that were not cost reflective. It was consistent with the CAS at the time and the CPF that followed. The project design was simple and robust. Cost estimates turned out to be high, but lower costs were attained due to better than expected market conditions and good procurement. However, the costs in the PAD were thought to be reasonable at the time they were made. Beneficiaries included the entire population of Egypt that uses electricity (99 percent). Conditionality was kept to a minimum to ensure that the project proceeded rapidly. No environmental safeguards were waived. The M&E design was also simple and robust. The risk assessment correctly identified the major risks including the highest risk which was that the Government, for whatever reason, would not allow electricity tariffs to increase as fast as needed.

77. On the negative side, the whole project concentrated on the first PDO (ensuring electricity supply) with little attention paid to the second PDO (improving the sector's financial sustainability). The only activities designed to ensure that the second PDO was achieved were three studies, one PDO indicator, and an intermediate indicator. Although the second PDO is likely to be achieved either in FY2020 or FY2021, given the importance it had to the project, it might have been better to have a covenant on that PDO. Alternatively, it might have been better not to have had it as one of the PDOs since this project had little influence on determining electricity prices, which are set by the Government based on political and macro-economic factors. A second weakness, based on the restructuring papers, was the shortage of indicators. The PAD had only two indicators for the project, with neither indicator involving the EEHC's finances. Both restructurings added indicators to the project, not only for the transmission component but mostly for the power plant including a tariff indicator. If the financial health of the EEHC was to be a PDO, there should have been at least one good indicator for its health such as a debt service coverage ratio.

Quality of Supervision

78. The quality of the World Bank supervision is rated Satisfactory. World Bank supervision and assistance in implementation of the project was good, and the World Bank team continued to advance the project during the period of turmoil, when conditions were difficult. The good quality of supervision was in part enabled by the fact that the TTL and several others involved in the project were resident in Egypt and had good relations with the EEHC, the EETC, and the EDEPC. In addition, procurement was successfully done since the project cost substantially less than forecast.

79. Several necessary restructurings were done as the project expanded overtime. These restructurings were timely and significantly expanded the efficacy and efficiency of the project. However, they also slowed down implementation. Without the restructurings and the addition of the third component, the project could have been completed in 2015 since the power plant was in commercial operation by that time and the technical assistance studies were completed.

80. There were no major environmental or social issues as the power plant met Egyptian Environmental Standards and almost all the land on which construction took place was Government owned. The only real social issue occurred when the transmission line from Zahraa El Maadi to Helwan South Power Plant needed to take some unoccupied private land (for the footprints of transmission towers) which was zoned agricultural but could not be farmed due to lack of water. Seven of the eight footprints were acquired for the offered compensation but the eighth required use of eminent domain and a decision by the courts on the value of the land acquired.

81. Financial management seems to have gone smoothly with no major issues mentioned, as the World Bank team worked well with financial staff from the Project Management Unit (PMU) and the EEHC, the EDEPC, and the EETC.

Justification of Overall Rating of Bank Performance

82. The overall rating of the World Bank's performance is Moderately Satisfactory based on the moderately satisfactory quality of the project at entry. While supervision was satisfactory, especially given the major effort to keep the project on track during the period of political turmoil, the quality of entry offsets this to a large extent

D. RISK TO DEVELOPMENT OUTCOME

83. The risks to the development outcomes are Modest but not nonexistent. The first risk, which applies to most power plants, is that electricity tariffs will be set so low as to not cover the costs of running the plant including fuel, labor, maintenance, and major repairs. If this were to happen, the plant's performance would deteriorate over time, and it would become unreliable and prone to breakdowns when put under stress, such as in periods of peak demand. Tariffs are unlikely to be set this low since the Government has committed to keeping tariffs high enough to fully cover costs, and it has raised tariffs overtime. Furthermore, supply interruptions, which would result from very low tariffs, are unpopular and damaging to the economy.

84. A second risk is that the Ain Sokhna supercritical steam plant will not be used fully because the new combined cycle power plants built and being built in Egypt are more energy efficient with lower cost.

This should, however, not be a major problem since the central dispatch center does not dispatch purely on a merit order basis but takes other factors into consideration such as transmission congestion and tries to rotate the load. Also, the EEHC seems to think the plant is more reliable than some of the combined cycle plants and therefore provides a reliable source of power, when the combined cycle plants are having problems.

85. The third major risk is that technologies will change so rapidly that the supercritical technology used in the Ain Sokhna Power Plant will be obsolete. This is a fairly low risk, but technologies change, and solar technology in particular is advancing quite rapidly, while Egypt has extensive solar resources. Nevertheless, the chances of the Ain Sokhna Power Plant and its technology being sufficiently obsolete to risk the development outcome seem remote.

V. LESSONS AND RECOMMENDATIONS

86. The first lesson is the need for procurement staff trained in World Bank procedures. The EEHC argued and the World Bank staff agreed that it was better to get people who have experience on World Bank-financed projects to undertake procurement on these projects rather than trying to train existing procurement staff to use World Bank procedures. This is because the EEHC found that their procurement people would continue to use standard Egyptian procurement procedures even when they were supposed to be using World Bank procedures. Their procurement people found it very difficult to shift away from systems and procedures they were familiar with to different systems and procedures.

87. The second lesson is the need for dedicated project Implementation units or teams. The EDEPC had a whole team dedicated to ensuring that the power plant was built as rapidly and cost efficiently as possible. This worked well. The EETC had a couple of people who were supposed to manage the transmission component and to oversee its implementation along with several other duties. As a result, largely due to other duties and the limited staff, the transmission component lagged and was not fully completed at project closure on December 31, 2018. It is recommended that the World Bank tries to ensure that the group implementing the project (PMU or Project Management Team) be freed from outside duties and adequately staffed. Otherwise the project may lag as other issues take priority.

88. A third lesson is that project preparation/implementation should continue to the extent possible during periods of political turmoil. During the period the project was under implementation, the Arab Spring Demonstrations occurred in Egypt, followed by political turmoil, which slowed decision making and created obstacles. The World Bank staff and the Egyptian Electric Authorities (EEHC, EDEPC),) continued working on the project, which accelerated once the turmoil ceased.

89. A fourth lesson is that spare parts are less expensive and easier to get during the project than after. In retrospect, the EDEPC believes that it should have asked for more spare parts as part of the bid for the Ain Sokhna Power Plant. This is reasonable as spare parts bought as part of the bid are likely to be considerably less expensive than buying them later from the manufacturer.

90. Finally, a fifth lesson is that greatly expanding the scope of the project when it is largely completed creates procedural problems. In this case, a large transmission component was added to the project in 2013 after the project had been under way for four years and the power plant was

mostly complete. This new transmission component was needed for the Helwan South Project approved by the World Bank at approximately the same time in 2013. It was probably a good idea to use the savings from the Ain Sokhna Power Project for the Helwan South Power Project, in that it accelerated the availability of funds for the Helwan South Power Project. However, it slowed the completion of the Ain Sokhna Power Project by three years and tied its results to some extent to the Helwan South Power Project.

ANNEX 1. RESULTS FRAMEWORK AND KEY OUTPUTS

A. RESULTS INDICATORS

A.1 PDO Indicators

Objective/Outcome: Ensure continuous electricity supply to meet demand through investment in new generation capacity

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Generation Capacity of Conventional Generation constructed under the project	Megawatt	0.00 30-Jun-2008	1300.00 30-Jun-2008		1300.00 31-Dec-2018
Comments (achievements against targets):					

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Meeting demand: Increase in annual electricity supply (Net) with the construction of the Ain Sokhna Power Plant	Gigawatt-hour (GWh)	0.00 30-Jun-2008	6000.00 30-Jun-2008		6516.00 31-Dec-2018
Comments (achievements against targets):					

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Meeting the demand: Increase in annual electricity supply (Net) with the network upgrade (A1).	Gigawatt-hour (GWh)	0.00 30-Jun-2008	0.00 30-Jun-2008	6723.00 20-Nov-2013	0.00 31-Dec-2018
Comments (achievements against targets):					

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Direct project beneficiaries	Number	0.00 30-Jun-2008	0.00 30-Jun-2008	7196267.00 20-Nov-2013	95000000.00 31-Dec-2018
Female beneficiaries	Percentage	0.00	0.00	49.00	50.00
Comments (achievements against targets):					

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
In a Sustainable Manner: Maximum Ain Sokhna power plant capacity factor	Percentage	0.00 04-Nov-2013	0.00 04-Nov-2013	75.00 04-Nov-2013	75.00 31-Dec-2018

Comments (achievements against targets):

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Ratio of average load shedding to peak demand	Percentage	4.00 30-Jun-2013	0.00 30-Jun-2013	0.00 30-Jun-2013	0.00 31-Dec-2018

Comments (achievements against targets):

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
In a Sustainable Manner: Minimum thermal energy conversion efficiency	Percentage	0.00 30-Jun-2008	0.00 30-Jun-2008	40.00 20-Nov-2013	42.00 31-Dec-2018

Comments (achievements against targets):

Objective/Outcome: Improve sector's financial sustainability by assisting EEHC to support sector revenue improvements

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Financial Sustainability: Electricity average tariff (Pt/kWh)	Number	18.00 30-Jun-2008	0.00 30-Jun-2008	55.00 20-Nov-2013	83.00 31-Dec-2018

Comments (achievements against targets):

A.2 Intermediate Results Indicators

Component: Component 1: Construction of Ain Sokhna Power Plant

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Progress in construction of Ain Sokhna power plant	Percentage	0.00 30-Jun-2008	100.00 30-Jun-2008		100.00 31-Dec-2018
Comments (achievements against targets):					

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
EEHC Debt Service Coverage Ratio (for generation only)	Percentage	1.52 30-Jun-2008	1.40 30-Jun-2008		0.65 31-Dec-2018
Comments (achievements against targets):					

Component: Component 2: Technial Assistance

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Construction of transmission	Percentage	0.00	100.00	100.00	98.00

lines		19-Nov-2013	20-Nov-2013	20-Nov-2013	31-Dec-2018
Comments (achievements against targets):					

Component: Component 3: Transmission (added during the 2013 project restructuring)

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Grievances registered related to delivery of project benefits addressed (%)	Percentage	0.00 24-Feb-2017	100.00 24-Feb-2017	100.00 22-Mar-2017	95.00 31-Dec-2018
Comments (achievements against targets):					

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Construction of Substations	Percentage	0.00 19-Nov-2013	100.00 20-Nov-2013	100.00 20-Nov-2013	90.00 31-Dec-2018
Comments (achievements against targets):					

A. KEY OUTPUTS BY COMPONENT

Objective/Outcome 1: Ensure continuous electricity supply to meet demand in a sustainable manner through investment in new generation capacity (Component 1, and 3 after the first restructuring)	
Outcome Indicators	1. Generation Capacity of Conventional Generation constructed under the project - Target 1,300 MW. 2. Increase in annual electricity supply with the construction of the Ain Sokhna Power Plant - Target 6,000 MW 3. Increase in annual electricity supply (Net) with the network upgrade - Target 6,723 GWh/year 4. Direct Project Beneficiaries - Target 7,196,267 5. Female Beneficiaries - Target 49 percent of beneficiaries 6. In a sustainable manner: Maximum Ain Sokhna Power Plant Capacity Factor - Target 75 percent 7. In a sustainable manner, Minimum Thermal Energy Efficiency - Target 40 percent 8. Ratio of Average Load Shedding to Peak Demand - Target 0.0 percent
Intermediate Results Indicators	1. Progress in construction of Ain Sokhna Power Plant - Target 100 percent 2. Construction of Transmission Lines - Target 100 percent 3. Construction of substations - Target 100 percent 4. Debt Service Coverage Ratio (generation only) - Target 1.4 5. Grievances registered related to delivery of project benefits addressed - Target 100 percent
Key Outputs by Component (linked to the achievement of the Objective/Outcome 1)	1. Ain Sokhna 1,300 MW Power Plant completed (Component 1) 2. Ain Sokhna net generation 6516 GWh (Component 1) 3. 95 million electricity users benefit, of whom 49 percent women (Component 1) 4. Capacity of plant 75 percent or greater. (Component 1) 5. Thermal efficiency of plant 42 percent under normal average conditions (Component 1) 6. No nation-wide load shedding (Component 1) 7. Zahraa El Maadi Substation 98 percent complete at loan closing (Component 3) 8. OHTL Zahraa El Maadi Substation - Helwan South Power Plant 98 percent complete at loan closing (Component 3) 9. Sokhna Substation - 85 percent complete (Component 3)

ANNEX 2. BANK LENDING AND IMPLEMENTATION SUPPORT/SUPERVISION

A. TASK TEAM MEMBERS

Name	Role
Preparation	
Anna M. Bjerde	Task Team Leader
Husam Beides	Team Member
Chaogang Wang	Lead Social Development Specialist
Abduljabbar Hasan Al Qathab	Lead Procurement Specialist
Supervision/ICR	
Mohab Awad Mokhtar Hallouda	Task Team Leader(s)
Luis R. Prada Villalobos	Procurement Specialist(s)
Wael Ahmed Elshabrawy	Financial Management Specialist
Chaogang Wang	Social Specialist
Mark M. Njore	Team Member
Elisabeth Maier	Team Member
Layla Mohamed-Kotb Abdel Wahab	Team Member
Ehab Mohamed Mohamed Shaalan	Environmental Specialist
Hebatallah Mohamed Mady Abdelz Aboelleil	Team Member
Joern Torsten Huenteler	Team Member
Marwa Mostafa Mohamed Mohamed Khalil	Team Member

A. STAFF TIME AND COST

Stage of Project Cycle	Staff Time and Cost	
	No. of staff weeks	US$ (including travel and consultant costs)
Preparation		
FY06	.750	3,004.20
FY07	.600	2,812.56

FY08	20.917	121,699.44
FY09	41.933	257,071.94
FY10	.400	473.91
Total	**64.60**	**385,062.05**
Supervision/ICR		
FY10	17.500	111,214.85
FY11	16.600	76,549.64
FY12	20.500	93,836.18
FY13	22.325	83,094.81
FY14	19.310	64,776.24
FY15	18.975	85,459.63
FY16	14.507	73,235.50
FY17	18.936	71,804.87
FY18	18.024	105,965.28
FY19	28.680	170,511.25
Total	**195.36**	**936,448.25**

ANNEX 3. PROJECT COST BY COMPONENT

Components	Amount at Approval (US$, millions)	Actual at Project Closing (US$, millions)	Percentage of Approval (US$, millions)
Construction of Ain Sokhna Power Plant	2,139.60	1,159.40	54.0
Technical Assistance	1.47	1.47	100.0
Generation Transmission Connection and Strengthening	0.00	69.80	—
Physical Contingencies	33.90	—	—
Price Contingencies	16.30	—	—
Total	**2,191.30**	**1,230.70**	**56.2**

ANNEX 4. EFFICIENCY ANALYSIS

Economic Efficiency

1. In the PAD, the economic efficiency of the Ain Sokhna Power Plant, a supercritical steam plant, was measured by comparing its economic costs to its estimated benefits. The PAD also states that it is part of the least cost plan for supplying electricity to Egypt.

2. Given Egypt's situation with adequate low-cost gas supplies, a combined cycle power plant should be the least cost solution, as was argued in the PAD for the Giza North Power Project which was built at the same time. Combined cycle power plants are less expensive to build, less polluting, can be built more rapidly, and are more energy efficient. However, to some extent in the PAD and from talks with the EEHC and the EDEPC, there appear to be four other factors which led to the choice of a supercritical steam power plant at Ain Sokhna (that is a steam plant with high steam temperatures and pressures) capable of using natural gas or HFO. These other factors were:

- First, the EEHC wanted the ability to use HFO as well as gas which the combined cycle plants could not do. This would be useful if there was a problem with gas supplies and is mentioned in the PAD.
- Second, the EEHC thought that a steam plant would require less maintenance than a combined cycle plant.
- Third, the company thought that a combined cycle would be less efficient in the summer than a steam plant due to the high temperatures in Egypt.
- Fourth, the EEHC thought a steam plant would be more stable.

3. These factors were sufficient to lead to the choice of a supercritical plant, which was then justified by showing that its estimated benefits exceeded its costs.

Economic Rate or Return for Ain Sokhna Plant

4. The key issue in calculating the ERR for this project was how to value the electricity produced. There is no wholesale market for electricity, and retail prices are set at very low levels by the Government. In the PAD, it was therefore decided to use the consumer's willingness to pay as the value of the electricity. It was estimated that consumers would be willing to pay the cost of generation by diesel generators which was the alternative to grid supplied electricity. The cost of diesel generation was then calculated in the PAD to be US¢12.1 per kWh in 2008 dollars. This value for the willingness to pay, updated for inflation, was used for the first calculation of the ERR for the project.

5. A second approach was to use a current value for diesel generation. The EEHC provided this number which was US¢18.8 per kWh. This cost of diesel generation, adjusted for inflation, was then used to calculate a second ERR for the project.

6. A third approach was that used for the Giza North Power Project which started a year after the Ain Sokhna Power Project with the plants being finished about the same time. For Giza North, a demand function was used to calculate the willingness to pay, although it is not very clear where this demand function came from.

7. This measure of willingness to pay per kWh, starts low and rises rapidly over time.

8. Since all these measures of willingness to pay are at the consumer level, distribution and transmission costs and losses have to be subtracted to get the value of the electricity at the power plant. This information on costs and losses was obtained from the EEHC and its subsidiary, the EETC.

9. In calculating the ERRs for the ICR, only the actual capital cost of the Ain Sokhna Power Plant was used along with the switchyard. The 500 kV line used by the Ain Sokhna Power Plant, had already been built by the EETC to serve other power plants as had the natural gas transmission line, and so their costs were not included in the project total. The Sokhna substation is not included in the costs since it will be completed 4 years after the plant went into operation and is designed to provide a second means of evacuating power.

10. For generation by the plant, actual data were used for the first couple of years and forecasts of generation from East Delta Electricity Production Company (the EDEPC, the parent company of Ain Sokhna) were used for outer years. Natural gas costs were assumed to remain at US$ 3.00/MMBTU.

11. With this information and information on the actual operating costs, the ERR was calculated for the Ain Sokhna Power Plant using the three alternative estimates of the willingness to pay. For the updated estimate of the willingness to pay shown in the PAD, the ERR is 38.9 percent compared to 23.0 percent in the PAD. Using the inflation-adjusted estimate of the actual cost of diesel generated power provided by the EEHC, the ERR is 47.4 percent. Using the estimates of the willingness to pay that were used for the Giza North Power Plant, the ERR is 17.8 percent.

12. These ERRs are all quite good and except for the ERR using the Giza North willingness to pay, they are all above the ERR calculated in the PAD. The main reason for this is that the actual cost of the Ain Sokhna Power Plant was substantially less than forecast in the PAD. In turn this lower cost was due to a conjunction of factors including a major devaluation of the Egyptian Currency, which lowered local costs, and a sharp drop in the cost of power generation equipment. Also, the original cost included a significant contingency factor which turned out not to be needed.

Economic Rate of Return for the Transmission Component

13. As the First Restructuring Paper[5] (page vii) states "The economic analysis of the investments financed by the restructuring of the Ain Sokhna Power Project (mainly the OHTL line from Zahraa El Maadi substation to the Helwan South Plant and the Zahraa El Maadi substation itself) follows the economic analysis for the Helwan South power generation project. This is because most of these investments are for the construction of the transmission facilities for connecting the new Helwan South power station to the national transmission system to enable the output from the power station to be delivered to electricity

[5] Report RES 12184

users. Since these facilities form an integral part of the Helwan South project, their economic justification is the economic justification for the Helwan South project that covers investments in both the new generation capacity and the transmission connection of the power plant."

14. The Restructuring Paper goes on to state "The economic evaluation of the Helwan South project is presented in the Project Appraisal Document (PAD) for the project… The economic return on the investment in the power generation capacity and associated transmission facilities under the Helwan South project, is computed for a base case scenario that is formed from the expected values for the cost of (i) natural gas used in the Project plant, (ii) the construction cost for the Project plant and connecting facilities, and (iii) the future growth rate of Egyptian power demand. The economic benefits for the Project are derived from the willingness to pay of Egyptian electricity consumers for the forecasted increase in electricity consumption…. At 10 percent discount rate - taken to be the Opportunity Cost of Capital (OCC) to Egypt - the Project Net Present Value (NPV) for the base case of the evaluation is estimated to be US$ 5,270 million, and the economic rate of return (ERR) to the Project is 20.2 percent, which shows a positive economic return relative to the OCC."

15. No more recent estimate has been made of the ERR for the Helwan South Project, so the 20.2 percent ERR for the transmission investments tied to the Helwan South Power Plant is the best estimate available.

16. The Sokhna substation is an addition to the Ain Sokhna Power Plant. If its cost was included with that of the plant, the impact on the ERRs for the Ain Sokhna Power Plant above would be about 0.2 percent or very little.

17. Combining the ERRs for the Ain Sokhna Power Plant (based on updated estimates of willingness to pay from the PAD) and the transmission component and weighing them by the amount of the World Bank funds invested in each of these components produces an overall ERR of 36 percent.

18. The US$110 million of the World Bank funds that were not used could be viewed as reducing the efficiency of the project. If these were just added as costs to the Ain Sokhna Power Plant it would reduce the weighted ERR for the project from 36 percent to 34 percent, still a long way above the OCC estimated value of 10 percent. In fact, these funds remained with the World Bank, and have been used for other projects or invested.

19. Table 4.1 shows the ERRs for the Ain Sokhna Power Plant with different measures of the consumers' willingness to pay and the NPVs discounted at 10 percent. It also shows the ERR on the main transmission investments as part of the Helwan South Power Project and a weighted ERR for the Plant and the main transmission investments. The ERR(s) exceed the opportunity cost of capital in Egyptof10 percent, and the project is therefore economically attractive.

Table 4.1. Efficiency

Ain Sokhna Plant with different estimates of the benefits, Helwan South Line and Zahraa El Maadi substation	ERR (%)	NPV (US$, Millions)
Ain Sokhna Plant using the willingness to pay estimate in the PAD updated	38.9	3,725
Ain Sokhna Plant using willingness to pay based on current cost of diesel generation adjusted	47.4	4,894
Ain Sokhna Plant Using the Willingness to Pay from the Giza North PAD	17.8	1,378
Helwan South Connector lines and Zahraa el Maadi Sub Station as part of Helwan South Project	20.2	n.a.
Weighted ERR including both Ain Sokhna Plant and Transmission Component as part of Helwan South Project	36.0	n.a.

Aspects of Design and Implementation

20. The construction of the Ain Sokhna Power Plant, although initially delayed, ended up by being completed about when expected. The two units began synchronization and test operations in the first half of 2014 and entered commercial operation in the first half of 2015 (The first unit entered commercial operation on March 3, 2015, and the second on June 4.) It is possible that the loan could have closed on December 31, 2015 as initially planned

21. The same TTL who began the project continued with it for the entire project which increased efficiency. Also, the TTL was located in Cairo, which improved coordination and supervision. Furthermore, as shown in annex 3, the plant cost substantially less than anticipated (around 57 percent or less of what was anticipated) primarily due to effective procurement and an improving market for power equipment

22. In summary, the plant was completed more or less on schedule, in spite of political turmoil, at a lower cost than anticipated and with a higher ERR. The savings were then used to provide transmission for another power project which also has a high ERR.

ANNEX 5. BORROWER, CO-FINANCIER AND OTHER PARTNER/STAKEHOLDER COMMENTS

HFO Fired Power Plants

1. The EDEPC said that one of the major lessons learned from the project was to always use supercritical boilers in HFO fired power plants. There are two reasons for this. First, they are more efficient than subcritical boilers. Second, the EDEPC argued that they were now probably less expensive to build than subcritical boilers. They believe that manufacturers are now mainly getting orders for supercritical boilers and as a result have been getting more efficient at producing them while the demand for subcritical boilers is falling, and with falling numbers, the cost of producing these boilers is increasing.

2. Other suggestions and ideas from the EDEPC, the EETC, and the EEHC are included in the lessons learned.

ANNEX 6. SUPPORTING DOCUMENTS

Arab Republic of Egypt, Ministry of Electricity and Renewable Energy, Egyptian Electric Holding Company. Annual Reports FY2009, FY2010, FY2011, FY2012, FY2013, FY2014, FY2015, FY2016, FY2017.

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