FY2021 Simplified Ex-Post Evaluation Report of Japanese ODA Loan Project

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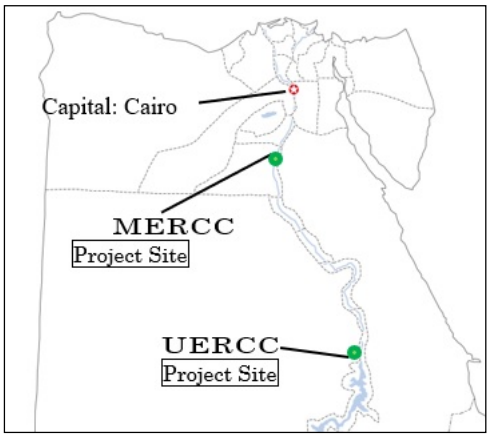
Duration of the Study: September 2021-November 2022
Duration of the Field Study: January 2022

Country Name	**Energy Control System Upgrading Project in Upper Egypt**
Arab Republic of Egypt	



Location of the Project site
（source: JICA）

Multiplexer (MUX), inverter, etc. inside the MERCC

I. Project Outline

Background	In Egypt, electricity demand was on the increase; the reserve margin[1], which was approximately 1.4 % on average during the period 2001–2005, became 0.7 % in 2005 and supply and demand situation became tight. In August 2002, electricity demand, in particular, surged because of heat waves, causing a serious power shortage throughout the country. Power outages became a social issue and questions were asked regarding the operational responsibilities of the Ministry of Electricity and Energy (hereinafter referred to as "MOEE")[2] and each electric power company. Under such circumstances, it was projected that the country's power demand would continue to grow in the future, therefore, to ensure a stable supply of electricity, it was necessary to develop systematic power generation facilities that met the demand. Egypt's power network control system consists of the National Energy Control Center (hereinafter referred to as "NECC"), which has jurisdiction over 500 kV and 220 kV substations and power plants, and six regional control centers (hereinafter referred to as "RCC"), which have jurisdiction over substations of 132 kV and below. One of them, the Upper Egypt Regional Control Center (hereinafter referred to as "UERCC"), was constructed using a Japanese ODA loan in 1988 and has been controlling the power supply of the transmission systems of 132 kV and below, in the Upper Egypt region. Although UERCC had remote monitoring capabilities for the transmission system in the region, the power system could not be adequately monitored, as SCADA/telecom system capacity was insufficient to cope with the rapid expansion of the power system. Spare parts were not available because the old system, which was no longer manufactured, was in use. Thus, it was functionally difficult to operate the system appropriately and smoothly. Consequently, it was necessary to drastically renew the facilities of the UERCC and to establish the Middle Egypt Regional Control Center[3] (hereinafter referred to as "MERCC") in Samalut, Minya Governorate.
Objectives of the Project	The objective of this project is to achieve efficiency and stability of the power system operation in the Upper Egypt region, by upgrading the power network control system of the UERCC and establishing the MERCC, thereby contributing to the economic and social development of the region.
Contents of the Project	1. Project Sites: Upper Egypt Region 1) Civil Engineering Work, Procurement of Equipment, etc. (1) SCADA system (hardware, software) and procurement of related equipment (uninterruptible power supply, backup generator, air conditioner, fire extinguishing system, etc.) (2) Procurement of communication-related equipment (radio communication equipment, power line carrier equipment, remote terminal units, telephone desks, etc.) (3) Procurement of optical ground wire (OPGW) (4) Installation of (1), (2) and (3) above 2) Consulting Services

[1] Reserve margin = {(power generation capacity - peak power demand)/power generation capacity} × 100
[2] After reorganization of the ministries in Egypt, it is now The Ministry of Electricity and Renewable Energy (MoERE).
[3] The Upper Egypt region is very long in a North to South direction. Prior to the start of this project, a wide area was monitored and controlled by the UERCC; it monitored and controlled nearly 180 substations. As for the other RCCs, the Cairo RCC covered the most stations (a little over 120). Based on the numbers, it can be said that the area monitored and controlled by the UERCC was extensive. Under such circumstances, it was difficult for only one RCC to monitor the operating system, in order to control long-distance power grids. While the UERCC alone monitored and controlled the Middle Egypt and Upper Egypt regions, there was an increasing need to install a MERCC in order to set up a power control center in each region and realize stable monitoring and control of the power grids. In addition, the Egyptian Electricity Holding Company (hereinafter referred to as "EEHC"), which is a superordinate organization of the implementing agency of this project, that is, the Egyptian Electricity Transmission Company (hereinafter referred to as "EETC"), had a plan to place RCCs in each region.

	Detailed design, checking pre-qualification (P/Q) and tendering documents, assisting the P/Q examination and tendering evaluation, assisting contract negotiations between the EEHC/EETC and contractors, construction supervision, assisting pre-operation inspection, etc.			
Implementation Schedule	E/N Date	December 4, 2008	Disbursement Date	August 19, 2019
	G/A or L/A Date	December 24, 2008	Completion Date	July 2019 (time of completion of the procurement and installation of the all control system)
Project Cost	E/N Grant Limit/G/A Grant Limit: 10,768 million yen			Actual Grant Amount: 8,380 million yen
Executing Agency	EETC			
Conditions (Loan only)	Interest: 0.7 % (civil engineering work, procurement of equipment, etc.), 0.01 % (consulting services), Repayment Period: 15 years (of which a grace period of five years applies), General Untied			
Borrower (Loan only)	EEHC			
Contracted Agencies	Main Contractors: Ericsson Egypt Ltd. (Egypt)/Egyptian Maintenance Company (Egypt)/Ericsson (Sweden) (JV), Siemens Technologies S.A.E. (Egypt)/Siemens AG (Germany)/Sumitomo Corporation (Japan) (JV) Main Consultants: Electric Power Systems Eng. Co. (EPS) (Egypt)/Tokyo Electric Power Company Holdings, Incorporated (Japan)/Tokyo Electric Power Services Co., Ltd. (Japan) (JV)			

II. Result of the Evaluation

Summary

The project aimed to achieve efficiency and stability of the power system operation by upgrading the power network control system of the UERCC and establishing a new MERCC in the Upper Egypt region. At the time of the project appraisal, the Egyptian government formulated the *Sixth Five-Year Plan* (2007-2012). In relation to the power sector, the plan promoted the international interconnection of power grids and the development of power generation and transmission systems in order to meet the ever-increasing power demand. At the time of the project appraisal, although UERCC had remote monitoring capabilities for the transmission system, power supply and demand situation became tight; a lack of SCADA/telecom system capacity due to the rapid expansion of the power system, and the aging of the system, made it difficult to adequately monitor the power system. Under such circumstances, the UERCC was faced with the aging system and needed to drastically renew its facilities. In addition, it was necessary to stabilize the power supply throughout Upper Egypt by establishing a new MERCC. While "Consistency with Japan's ODA Policy" can be said to be consistent, "internal coherence" (coordination with other projects and assistance by JICA) and "external coherence" (coordination with organizations outside JICA and coordination with international frameworks, etc.) had not envisaged specific cooperation/coordination since the planning stage. Therefore, relevance/coherence is high. Regarding efficiency, outputs were implemented as planned. The project period exceeded the initial plan due to the influence of political instability (unrest after the Arab Spring) in the country. Another reason was that the tendering process, including the checking of the tendering documents, required time. The project cost was within the initial plan because of cost-efficient contractors and exchange rate fluctuations. Therefore, efficiency was moderately low. Regarding effectiveness/quantitative effects indicators, the targets were not met for the "forced outage time annually for transmission lines 132 kV and below" or the "un-served energy annually for transmission lines 132 kV and below" in the Upper Egypt region. Despite these, the targets were mostly achieved for the following indicators: "forced outage duration annually for transmission lines 132 kV and below," "220 kV-33 kV transmission losses," "number of failures of SCADA systems," "average recovery time from failure of SCADA systems." In addition, the qualitative interview survey confirmed that this project played a role in stabilizing power distribution in the Upper Egypt region, thereby contributing to the revitalization of the country's economy and the improvement of public welfare. Based on the above, the effectiveness and impact of this project is high. Sustainability is ensured in terms of the related policy/system, institutional/organizational, technical, financial aspects and the status of the operation and maintenance. There is no negative impact on the social and environmental aspect, and no mitigation measures were taken. There are no concerns regarding risk prevention measures. Therefore, the sustainability of the effects generated by the implementation of this project is very high.

Considering all of the above points, this project is evaluated to be highly satisfactory.

Overall Rating[4]	A	**Relevance & Coherence**	③[5]	**Effectiveness & Impacts**	③	**Efficiency**	②	**Sustainability**	④

<Special Perspectives Considered in the Ex-Post Evaluation/Constraints of the Ex-post Evaluation>

In this evaluation study, the external evaluator did not travel due to the global effects of COVID-19. The field survey assistant was utilized remotely to conduct project site inspections, information/data collections and interviews with individuals concerning the project. The external evaluator carefully examined the information collated, based on which evaluation analyses and judgment were conducted.

1 Relevance/Coherence

<Relevance>

- Consistency with the Development Policy of Egypt at the Time of Ex-Ante Evaluation

The Egyptian government formulated the "Sixth Five-Year Plan" (2007-2012). In relation to the power sector, the plan promoted the international interconnection of power grids and the development of power generation and transmission systems, in order to meet the ever-increasing power demand. Specifically, the plan set out a policy to establish power generation facilities of 8,547 MW and substation facilities of 16,950 MVA, and to expand the transmission network of 52,330 km, thereby aiming to develop a power

[4] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

[5] ④ : Very High ③: High, ②: Moderately low, ①: Low

generation/transmission system to meet the ever-increasing demand for electricity. In addition, the EEHC, the supervisory authority of the EETC, reviewed the long-term power facility plan annually and formulated a power source development plan, a power amortization plan, a power distribution facility (transmission and distribution network) plan, as well as a substation development plan.

- Consistency with the Development Needs of Egypt at the Time of Ex-Ante Evaluation

Before this project began, electricity demand was on the increase in Egypt; the reserve margin, which was approximately 1.4 % on average over the period of 2001-2005, became 0.7 % in 2005 and supply and demand situation became tight. In August 2002 especially, electricity demand surged due to heat waves, causing a serious power shortage throughout the country. Power outages became a social issue, and there were even questions regarding the responsibilities of the MOEE and each electric power company. Under such circumstances, it was projected that the country's power demand would continue to grow in the future. To ensure a stable supply of electricity, it was necessary to develop systematic power generation facilities that met the demand.

Egypt's power network control system consists of the NECC, which has jurisdiction over 500 kV and 220 kV substations and power plants, and six RCCs, which have jurisdiction over substations of 132 kV and below. One of them, the UERCC, was constructed using a Japanese ODA loan in 1988 and has been monitoring the power supply network of the transmission systems of 132 kV and below, in the upper Egypt region. UERCC had remote monitoring capabilities for the transmission system in the region, however, the power system could not be adequately monitored because system capacity was insufficient due to the rapid expansion of the power system, due to the aging of the system. In addition to the aging of the system, the old system that was being used was no longer manufactured, which meant that spare parts were not available; function-wise, it was difficult to operate the system appropriately and smoothly. Therefore, it was deemed a priority to drastically renewing the facilities of the UERCC and to establish the MERCC in Samalut, Minya Governorate, it was deemed necessary to achieve the stable power supply in the entire upper Egypt region, which led to the implementation of this project.

<Coherence>

- Consistency with Japan's ODA Policy at the Time of the Ex-Ante Evaluation

According to the *Overseas Economic Cooperation Implementation Policy* developed by the former JBIC in 2005 prior to the start of this project, "infrastructure development for sustainable growth" was highlighted as a priority area, and a policy was laid out to support the promotion of sustainable growth through the development of economic and social infrastructures, such as electricity, which is indispensable for private sector activities. In addition, in the *Country Assistance Implementation Policy* prepared in 2005, the former JBIC identified the development of economic and social infrastructures and the efforts to address environmental issues as priority areas, considering that Egypt was faced with issues, such as sustainable economic growth and environmental conservation.

This project provided support to the power sector to improve Egypt's economic and social infrastructures, and is consistent with Japan's ODA policy.

- Internal Coherence

At the time of the appraisal, JICA stated the need to improve the environment for investment and businesses, in order to achieve sustainable growth and job creation. Considering that the government still played a large role in economic infrastructure development given the scale of the projects, electric power was positioned as one of the sectors to be assisted.

Until the time of this project's appraisal, JICA had a long track record of supporting the power supply control for the power transmission system of 132 kV and below, as well as the backup work for the 220 kV system operation in the Upper Egypt region through the "Power Control Center Development Project in Upper Egypt[6]." According to the EETC, the RCC constructed by the "Power Control Center Development Project in Upper Egypt" was renewed through this project, and technical staff who had worked at the RCC for many years continued to utilize their experience and skills and are still involved in the operation of the RCC. Regarding internal coherence, although no specific coordination had been envisioned since the planning stage, JICA accurately grasped the need for a stable operation of power distribution and worked on infrastructure development to support Egypt's economic growth. Therefore, it can be said that JICA focused its efforts on enhancing the assistance effects through project continuity and the renewal of equipment and facilities.

- External Coherence

When this project started, power supply systems (introduction of SCADA, RTUs, communication equipment, etc.) were being developed by the United States Agency for International Development (USAID) in Cairo and Alexandria as a grant-in-aid, by the Danish government in the Suez Canal area as a loan and by the French government in the western delta area as a tied loan. This project developed and improved the power supply system in the Upper Egypt region, and it can be said that there is a complementary relationship between the project and these projects by organizations other than JICA in terms of aiming to improve the operational efficiency and stability of the national power system. However, no specific collaboration/coordination had been envisioned since the planning stage.

Regarding the relationship with international frameworks, it can be said that this project is in line with the Sustainable Development Goals (SDGs): "7. Affordable and Clean Energy (Ensure access to affordable, reliable, sustainable and modern energy for all.)," as it contributes to the revitalization of Egypt's economy and society by streamlining and stabilizing power system operations.

<Evaluation Result>

In light of the above, the relevance and coherence of the project are high[7].

[6] The loan agreement was signed in November 1983.

[7] Relevance: ③, Coherence:②

2 Effectiveness/Impacts[8]

<Effectiveness>

<Quantitative Effects>

Table 1 shows the effectiveness/quantitative effects indicators (baseline, target, actual) of this project. At the time of the appraisal, the following six indicators and targets were set: "forced outage time annually for the transmission lines 132 kV and below," "forced outage duration annually for the transmission lines 132 kV and below," "un-served energy annually for the transmission lines 132 kV and below," "220 kV-33 kV transmission losses," "number of failures of SCADA systems" and "average recovery time from failure of SCADA systems." The target year was two years after completion (two years after the facility was put into service), but since the actual data were only available for the year 2020, these show the comparison and analyses between the target and 2020 data for each indicator.

Table 1: Quantitative Effects Indicators of This Project (Baseline, Target, Actual)

Indicator	Baseline (2007)	Target (2014) 2 Years after Completion	**Actual (2020)**
1) Forced outage time annually for the transmission lines 132 kV and below (Unit: number/year) *Note 1	UE: 53 ME: 68 *Note 2	UE: 53, ME: 68	UE: 109, ME: 34
2) Forced outage duration annually for the transmission lines 132 kV and below (Unit: hours/year)	UE: 296 ME: 1,077	UE: 150, ME: 200	UE: 8.40, ME: 4.76
3) Un-served energy annually for the transmission lines 132 kV and below (Unit: MWh)	UE: 115.84 ME: 541.52	UE: 70, ME: 150	UE: 183, ME: 142
4) 220 kV-33 kV transmission losses (Unit: %)	UE+ME: 3.7	UE+ME: 3.6	UE+ME: 3.67
5) Number of failures of SCADA systems (Unit: number/year)	-	UE: 1, ME: 1	UE: 0, ME: 0
6) Average recovery time from failure of SCADA systems (Unit: hours/incident)	-	UE: 0.5, ME: 0.5	UE: 0, ME: 0

Source: JICA document (baseline and target), answers to the questionnaire (actual)

Note 1: Transmission lines 132 kV and below refer to transmission lines of 132 kV, 66 kV and 33 kV in the Upper Egypt region.

Note 2: UE refers to the Upper Egypt region (Upper Egypt), whereas ME refers to the Middle Egypt region (Middle Egypt).

1) Regarding the "forced outage time annually for the transmission lines 132 kV and below," the target was not achieved in the Upper Egypt region. On the other hand, the target was achieved in the Middle Egypt region. As shown in Table 2 and Table 3, this is because electricity demand was increasing year on year in Egypt, and a new power generation facility was constructed in Isna and Nag Hammadi, the Upper Egypt region, while substations were constructed in the West of Aswan and the East Nag Hammadi during the implementation of this project, which expanded the transmission network and sharply increased the load on the transmission line[9]. According to the EETC, although the power grid has also expanded in the Middle Egypt region in recent years, the actual situation in terms of power distribution and transmission is different, with relatively less load compared to the power demand trends in the Upper Egypt region. In other words, in the Upper Egypt region, power demand increased more than anticipated at the time of the appraisal, and with the development of more power generation and transmission facilities than expected, resulting in an increase in the amount of power generated flowing into the transmission lines, which has caused and increased overloads, causing more frequent power outages.

2) Concerning the "forced outage duration annually for the transmission lines 132 kV and below," the targets were achieved in the Upper and Middle Egypt regions: the actual values were significantly lower than the target values. Before the start of this project, the previous power system only monitored 132 kV substation facilities due to aging, and other substation facilities (e.g., 66 kV substation facilities, etc.) were not monitored. For this reason, recovery took a long time in the case of power outages. Through the RCC developed by this project, it became possible to monitor all 132 kV, 66 kV and 33 kV substation facilities, and even if a power outage occurred, recovery would be quick. In other words, the developed RCC was gradually able to cover and monitor many substations, which led to a dramatic reduction in power outage durations. Especially in the Upper Egypt region, although the incidence of power outage was high, the power outage duration was short, which can be attributed to the effect of the new power distribution system installed in the RCC.

3) Regarding the "un-served energy annually for the transmission lines 132 kV and below," due to the situation described in 1) above (expansion of the power grid, increased load on the power transmission line, etc.), the amount of power generated that interferes with supply tends to be slightly greater in the Upper Egypt region. As a result, the target was not achieved, as the actual value exceeded the target. On the other hand, the target was achieved in the Middle Egypt region, as the actual value was lower than the target value.

4) "220 kV-33 kV transmission losses" has been reduced as a result of the new power transmission system installed through this project, which has improved the accuracy of power system monitoring and enabled appropriate system operation. Thus, it mostly achieved the initial target (It is said that this is a slight improvement over the baseline value.). The EETC plans to continue to work to further reduce the loss rate in the near future. Specifically, it is considering the repair and renewal of transmission lines (e.g., 132 kV to 220 kV, 33 kV to 66 kV) by increasing the wire cross section and reinforcing the tower structure and operating voltage, which are considered effective measures to improve transmission losses.

Regarding the 5) "number of failures of SCADA systems" and 6) "average recovery time from failure of SCADA systems," no breakdowns occurred after the project was completed and no time was required for recovery. This means that the function of the facility has been maintained and the network operation is stable, due to the contribution of this project.

[8] When providing the sub-rating, Effectiveness and Impacts are to be considered together.

[9] This means that there are more power outages due to increased load.

<Qualitative Effects (Efficiency and Stabilization of Power System Operation)>

With the upgrade of the UERCC network control system and the new establishment of the MERCC, the operating team can now systematically monitor all the substations managing the transmission lines of 132 kV and below and smoothly monitor the 220 kV network. Due to the versatility and high performance (technical operation aspect) of the introduced SCADA system and communication-related equipment, etc., the power system operation has become efficient, leading to the stabilization of the supply. According to the EETC, even if a new substation facility is introduced or some facility/equipment is updated in the future, the system and equipment introduced will ensure the continuity of supervision and monitoring, leading to the realization of stable power distribution.

During the project implementation, the technical maintenance staff working at the UERCC and the MERCC received training on system operation from the contractor of this project. The EETC emphasizes that the power system can now be properly operated through the installed power transmission system. When interviewing UERCC and MERCC staff, comments such as the following were received: "I gained knowledge and skills useful for the operation of the SCADA system" and "Through the training, I became able to properly manage the ways of reducing power transmission loss."

From the above, it can be said that the role this project plays is not small in improving the efficiency and stabilization of power system operations in the Upper Egypt region.

<Impacts>

"Quantitative and Qualitative Effects"

(1) Contribution to Economic Revitalization and Improvement of Public Welfare Through the Stable and Efficient Supply of Electric Power

Before this project began, the supply and demand balance of electricity was predicted to continue worsening in Egypt. In order to secure a stable supply of power, it was necessary to develop systematic power generation facilities that met the demand. A response to the increase in power generation through the development of thermal power plants was urgently required, as well as the development of transmission and distribution networks.

For reference, Table 2 shows the total amount of power generated and consumption from the start of the project to the time of the ex-post evaluation, while Table 3 shows the power supply and demand situation.

(Reference) Table 2: Electricity Generated and Power Consumption Throughout Egypt

(Unit: Gwh)

	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015
Power Generated	139,000	146,976	157,406	164,628	168,050	174,785
Power Consumption	120,180	126,934	135,838	140,918	143,585	146,645
	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021
Electricity Generated	186,320	189,550	196,760	199,843	197,357	n.a.
Power Consumption	156,300	151,606	157,610	151,908	148,517	n.a.

Source: EETC

(Reference) Table 3: Electricity Supply and Demand Situation Throughout Egypt

	2009/2010	2010/2011	2011/2012	2017/2018	2018/2019	2019/2020
Power Generation Capacity (Unit: MW)	28,044	28,570	30,240	55,213	58,353	59,530
Peak Power Demand (Unit: MW)	22,250	23,650	25,110	30,800	31,400	32,000
Reserve Margin (Unit: %) *Note 1	20.7	17.2	17.0	44.2	46.2	46.2

Source: EEHC/EETC

Note 1: Reserve margin = {(power generation capacity - peak power demand)/power generation capacity} × 100

For reference, Table 4 shows the GDP growth rate, while Table 5 shows the changes in population numbers across the whole of Egypt up to the time of the ex-post evaluation.

(Reference) Table 4: GDP Growth Rate of the Whole of Egypt[10]

(Unit: %)

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
5.15	1.77	2.23	2.19	2.92	4.37	4.35	4.18	5.31	5.56	3.57

Source: World Bank[11]

[10] It should be noted that there are no GDP data solely for the Upper Egypt region. Although the GDP growth rate in the region may have a trend similar to that nationwide, it is considered difficult to prove the relationship with this project. However, there is not a great deal of regional difference in the GDP growth rate nationwide, and it is considered that the Upper Egypt region has similar trends to the national GDP growth rate.

[11] Quoted from: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=EG

(Reference) Table 5: Total Population of Egypt

(Unit: thousand people)

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
82,761	84,529	86,422	88,405	90,425	92,443	94,447	96,443	98,424	100,388	102,334

Source: World Bank[12]

As shown in Table 2, the amount of power generated, as well as consumption was on the rise nationwide until the time of the ex-post evaluation[13]. As shown in Table 3, the Egyptian government is steadily securing installed capacity[14] and meticulously working towards keeping a sufficient reserve margin to meet peak demand[15]. At the same time, the government is also developing and expanding transmission and distribution networks and RCCs in various parts of the country, in which this project plays a part. This is influenced by the fact that there is a high demand for electricity, due to steady economic growth since the Egyptian Revolution (2011) as shown in Table 4, and high population growth as shown in Table 5. The following comments were received from the EETC: "Stabilization of power supply is a top priority. It is a source of improving people's lives, improving corporate productivity and vitality," "More than 10 years ago (before this project began), people often faced a shortage of electricity supply. There were also power outages. It is currently improving," "Owing to the stable supply of electricity in the Upper and Middle Egypt regions, operations of water distribution pumps in irrigation facilities have become stable in the agricultural sector, which is a major industry. Besides, it supports many fields such as mobile phone call quality and factory operations." Based on interviews with the field staff of the UERCC and the MERCC, comments such as the following were received: "I think that the introduction of the new facility (this project) has reduced power distribution loss," "There are many substation facilities around the UERCC and the MERCC, and I think that this project will support the development of industry in the surrounding areas by stabilizing the operation of power transmission system and its network status."

Based on the above, it can be said that this project, which plays a role in stabilizing power supply and distribution in the Upper Egypt region alongside the government's responses to increasing power demand, is contributing to the economic revitalization and improvement of civilian life nationwide in Egypt.

(2) Other Positive and Negative Impacts

1) Impact on the Natural Environment

This project did not fall under the vulnerable sectors/characteristics and vulnerable areas listed in the *JBIC Guidelines for Confirmation of Environmental and Social Considerations* (issued in April 2002) and the undesired impact on the environment was considered insignificant; thus, it was classified as category B. In addition, the preparation of the Environmental Impact Assessment (EIA) report was not required for this project as per the domestic law of the country.

It was confirmed via the questionnaire, interviews with the field staff of the UERCC and the MERCC and site inspections that there was no negative environmental impact (air pollution, water quality, noise/vibration, negative impact on ecosystem, etc.) during the project implementation or after the project completion. It was also confirmed during site visits that there was no negative impact of air pollutants, noise/vibration or incidence of health hazards[16].

2) Resettlement and Land Acquisition

No resettlement or land acquisition occurred during this project. The project sites were set up within the existing land owned by the EETC.

3) Gender Equality, Marginalized People, Social Systems and Norms, People's Well-being and Human Rights

It can be said that this project contributes to a stable power supply and improvements in the living and working environment of the surrounding areas and citizens nationwide. No specific case indicating that this project has a direct impact on gender, equality, social system norms or people's well-being was confirmed through the interview survey, etc. Nevertheless, while population growth and economic revitalization have been observed in Egypt, it is possible that this project will bring extensive and equal benefits to people and businesses.

<Evaluation Result>

Regarding the actual values of the effectiveness/quantitative effects indicators: 1) "forced outage time annually for the transmission lines 132 kV and below" and 3) "un-served energy annually for the transmission lines 132 kV and below," the targets were not achieved in the Upper Egypt region. This is because electricity demand increased nationwide during the project implementation, and the load on transmission lines increased due to the development of substations and the expansion of the transmission network in the Upper Egypt region (i.e., an increase in the number of power outages and un-served energy annually due to the increased load). The targets were mostly achieved in terms of 2) "forced outage duration annually for the transmission lines 132 kV and below," 4) "220 kV-33 kV transmission losses," 5) "number of failures of SCADA systems" and 6) "average recovery time from failure of SCADA systems." This is because the RCC introduced by this project became able to monitor all the 132 kV, 66 kV and 33 kV substation facilities, etc. It was confirmed through

[12] Quoted from: https://data.worldbank.org/indicator/SP.POP.TOTL?locations=EG

[13] The reason for the slight decrease from 2018/2019 to 2019/2020 is considered to be due to the influence of COVID-19. According to the EETC, there was a decrease in electricity consumption in the economic/industrial sector. As the power consumption decreased, the amount of power generated also decreased slightly. On the other hand, Table 3 shows that the power generation capacity did not decrease from 2018/2019 to 2019/2020, as the Egyptian government continued to improve the power facilities even in the midst of COVID-19. It can be said as an indication of the government's focus on securing supply reserve ratios.

[14] Large scale power generating facilities that were constructed after this project began, include Nubaria Thermal Power Plant (1,500 MW) and North Cairo Thermal Power Plant (1,500 MW).

[15] The Egyptian government has increased investment in the power sector over the last decade, focusing on measures such as establishing the resource and energy security, raising awareness of the global warming, and improving the external balance of payments.

[16] According to UERCC and MERCC, the environmental monitoring has not been conducted for this project because the environmental impact of the developed facilities and procured equipment on the surrounding area is infinitely low. On the other hand, according to on-site staff, if negative impact on the environment is identified in the vicinity of facilities or procured equipment, efforts will be made to address them as soon as possible. However, no serious problems have been identified so far.

the interview with the EETC management and the questionnaire that this project plays a role in stabilizing power supply in the Upper Egypt region and is contributing to the revitalization of the Egyptian economy and the improvement of public welfare. Considering the above comprehensively, it can be stated that the outcomes and impact expected from the implementation of this project have been achieved almost as planned. It can also be said that there have been no long-term negative impacts on social aspect (including human rights and gender equality), the environment or the economy. Therefore, the effectiveness and impacts of the project are high.

3 Efficiency

<Project Outputs>

The project outputs described in "I. Project Outline" were implemented as per the plan.

<Project Inputs>

The project period was planned to run from April 2008 to December 2012 (57 months). The actual period was from April 2008 to July 2019 (136 months), which was longer than the plan (approximately 238 % of the plan). This was due to complex factors, such as political instability (2011, 2013) in Egypt, which occurred after this project began and prolonged the tendering process including the checking of documents, as well as a delay in the bid procedure related to consultants and main contractors. There was also insufficient coordination, which was required to connect the RCC to scattered substations; in particular, there were difficulties with the temporal power outage, which was needed for the construction.

On the other hand, in this ex-post evaluation there were delays lasting three years and three months (39 months) from January 2011 (at the time of the occurrence of a large-scale anti-government demonstration) to March 2014 (at the time of the election of Prime Minister Mahlab and the inauguration of the new cabinet following a referendum to draft a new constitution) due to external factors. As it can be stated that the timing of tendering and civil engineering work was directly affected, it was considered appropriate to exclude this period. Therefore, as mentioned above, although the project was delayed—approximately 238 % of the plan—the actual duration was set at 97 months (= 136 - 39 months), therefore, by excluding the abovementioned period, this period was judged to equate to approximately 170 % of the plan when comparing the situation before and after. Delays other than this external factor (political instability) are as described above.

The total cost for this project was 16,672 million yen in the initial plan. The total actual amount was approximately 8,357 million yen — approximately 50 % of the plan, which was within the budget. The main reason for this was that although the actual cost of the consulting services was more than the plan due to the extension of the project period, certain costs related to civil engineering works and the procurement and installation of materials and equipment, such as Lot 1 (procurement and installation of the SCADA system) and Lot 2 (procurement and installation of communication equipment), were less than the initial plan. This is because the foreign exchange fluctuated (strong Japanese yen and weak Egyptian pound) during the project period and had a major impact, aside from the fact that efficient contractors were secured[17].

<Evaluation Result>

Based on the above, although the project cost was within the plan, the project period was significantly longer than planned as previously explained. Therefore, the efficiency of the project is moderately low.

(Reference) Internal Rate of Return (IRR)

- Economic Internal Rate of Return (EIRR)

At the time of the appraisal, the EIRR was calculated to be 14.61 %, assuming that the fuel cost margin due to the reduction of transmission loss and the margin due to the reduction of power supply disruption are the "benefits," and the project cost and operation and maintenance cost are the "costs," with a project life of 15 years. As a result of an attempt to recalculate at the time of ex-post evaluation, using the same conditions as at the time of the appraisal, the EIRR became 12.24 %, which is slightly lower than at the time of the appraisal. Although the actual construction cost, which was one of the "costs," was less than the initial plan, fuel consumption in Egypt (barrel) and crude oil prices (USD/barrel), used to calculate the benefits, were overestimated at the time of the appraisal[18], compared to the figures used in the recalculation at the time of ex-post evaluation.

- Financial Internal Rate of Return (FIRR)

As it was not calculated at the time of the appraisal (i.e., it was not considered to be a project with a characteristic of increasing profitability), recalculation was not conducted at the time of the ex-post evaluation.

[17] As a side note, there was a price competition when tendering for Lot 1 and Lot 2 contractors; as a result, the actual project cost became less than the originally planned amount. However more than that, there were exchange rate fluctuations that had a significant impact on the project costs. The exchange rate at the time of the appraisal was 20.4 yen to an Egyptian pound (as of January 2008), whereas the average during the project implementation (between 2013 and 2020 when costs were incurred) was 10.2 Japanese yen to an Egyptian pound based on the International Financial Statistics (IFS) of the International Monetary Fund (IMF)—the value almost dropped by half. Behind this was the introduction of the floating exchange rate system by the Central Bank of Egypt in the latter half of 2016 as well as the subsequent economic turmoil. It can be said that the actual project cost was also greatly affected.

[18] At the time of project appraisal, it was estimated that future fuel consumption would be consumed at a high level. At the time of the appraisal, international crude oil prices were at a high level (94.2 USD/barrel). Fuel consumption was calculated as 302 thousand barrels. On the other hand, at the time of the ex-post evaluation (2021), the average crude oil price level is 68.17 USD/barrel (source: https://www.macrotrends.net/1369/crude-oil-price-history-chart, accessed January 10, 2022) and fuel consumption is calculated as 187 thousand barrels (source: https://www.theglobaleconomy.com/Egypt/gasoline_consumption/ as of 2018's data, accessed January 10, 2022). Comparing the time of the appraisal to the time of the ex-post evaluation, the difference between crude oil prices and fuel consumption can be considered significant, which also affects the fuel cost margin due to the reduction of transmission loss.

4 Sustainability

- Policy and System

According to the *Electricity Sector Strategy*, announced at the Egypt Economic Development Conference held in March 2015, the government advocates a plan to increase the installed capacity of power generation by 54.5GW nationwide by 2022 and to strengthen and update the transmission and distribution networks. The government also formulated the *Sustainable Development Strategy (SDS): Egypt Vision 2030* in February 2016, which states that the power sector will meet the nation's development requirements that are sustainable and contribute to the realization of economic growth, improved competitiveness, social justice, and environmental conservation. This project contributes to improving the stability and reliability of the power supply, and is in line with the Egyptian government's policy and direction at the time of the ex-post evaluation.

- Institutional/Organizational Aspect

The executing agency of this project is the EETC. It is responsible for the construction, operation and maintenance of power transmission related facilities[19] in Egypt. As of the second half of 2021, the total number of EETC staff was approximately 27,444.

At the UERCC and the MERCC developed by this project, the power control system (SCADA), air conditioner (HVAC), uninterruptible power supply (UPS) and RCC building facilities are inspected and maintained almost daily. Remote monitoring and control devices (RTUs), power line carriers, etc. are regularly inspected and maintained. Table 6 shows the number of operation and maintenance staff working at both RCCs.

Table 6: Operation and Maintenance Staff at the UERCC and the MERCC

Responsibility	UERCC	MERCC
SCADA system	6	6
RTUs, etc.	18	18
RCC facility management	7	8
RCC operators	27	19

Source: EETC

As a result of the questionnaire and interviews, it was confirmed that a sufficient number of staff members in the operation and maintenance department shown in Table 6 have been assigned, therefore, there was no particular excess or deficiency in staffing levels. Neither of the RCCs outsource to external specialists. According to the EETC, there is no need for outsourcing and the necessary staff are allocated according to the scale of the facilities and the equipment.

From the above, it has been judged that there is no major problem in the operation and maintenance system of this project.

- Technical Aspect

The UERCC and MERCC have many technical staff who are familiar with operation and maintenance work and have abundant experience. It was confirmed following a questionnaire to the EETC, site visits and interviews with staff working at both RCCs that there was no technical insufficiency. In addition, on-the-job training (OJT) for new recruits is conducted as required under the guidance of employees with considerable work experience.

Manuals relating to the operation of communication-related equipment and SCADA systems are also available. These are referenced and utilized as required.

During the implementation of this project, the EETC technical staff assigned to both RCCs received training on the equipment and facilities from the contractors and were able to respond to the expansion of the transmission and distribution network and the appropriate operation of equipment and facilities.

Considering the above, it is judged that the technical level in terms of the operation and maintenance of this project is adequate and that there are no problems.

- Financial Aspect

Table 7 shows the operating and maintenance costs of the UERCC and the MERCC, while Table 8 shows the financial statements[20] of the EEHC Group, including the EEHC, which is the supervisory body of the EETC.

Table 7: Operation and Maintenance Costs of the UERCC and the MERCC

(Unit: Egyptian pound)

	2019/2020	2020/2021
<UERCC>		
Operating cost	14,110,700	28,335,172
Maintenance cost	238,000	240,000
<MERCC>		
Operating cost	11,115,000	26,684,155
Maintenance cost	238,000	240,000

Source: Answer to the questionnaire

[19] Including substations that are not attached to power plants.
[20] Compliant with Egyptian accounting standards

(Reference) Table 8: EEHC Group's Latest Financial Statements

(Unit: billion Egyptian pound)

Item	2018/2019	2019/2020
Fixed assets	368.2	414.4
Inventory assets	35.3	37.4
Cash deposit	14.6	7.8
Working capital	(108.6)	(51.0)
Net assets	29.4	45.7
Total revenues	165.4	163.5
Total expenditures	162.0	153.8
Net profit	3.5	9.7
Investments in projects	55.4	33.0
Financial burdens (interests, etc.)	45.4	50.6
Debt balance	312.2	281.7

Source: EEHC/EETC

Table 7 shows the operation and maintenance costs (for the last two years) of the UERCC and the MERCC, which were developed and renewed, and supplied with equipment and facilities by this project. The completion date of this project was 2019, therefore, this table presents data relating to the actual amounts over a two-year period up to the time of the ex-post evaluation[21]. The operating cost includes operating costs for SCADA systems and communication-related equipment, personnel costs, utility costs, etc., whereas the maintenance cost is expenses related to facility maintenance. Comments were received from the EETC headquarters and two of the RCCs: "In 2020/2021, there was no case in which operation and maintenance was insufficient due to lack of budgets. Necessary budgets have been allocated. There are no particular failures/problems or major burden of expenditure," "Operation and maintenance costs for 2021/2022, which is the current fiscal year, are expected to increase by approximately 5 % from last year, due to the effects of soaring global fuel costs and inflation. The EETC will cover the necessary costs." Based on these comments, it is believed that there is no particular financial problem with regard to operation and maintenance.

For reference, Table 8 shows the EEHC group's financial statements (for two years)[22]. Although the financial burdens and the debt balance occupy a large proportion of the total revenues, projects are proceeding and generating profits, and the expenditure is not exceeding the revenues. However, it is difficult to judge based on these financial statements whether the finances appear healthy or to consider the future financial outlook and any immediate concerns. As discussed above, the EETC has indicated a policy of allocating the necessary operation and maintenance costs, so it is unlikely that the situations depicted by these financial statements will have a significant impact immediately.

- Environmental and Social Aspect

No negative impact on the environment and society was observed. No particular mitigation measures were taken, either.

- Preventative Measures to Risks

Through the questionnaire to the EETC headquarters, site visits, and interviews at both RCCs, it was confirmed that the points noted during the project appraisal (external conditions and risk control) were properly addressed during the project implementation. It was confirmed that there were no particular risks, external conditions, or controls that should have been controlled during the project implementation. There were no events considered as risks by the EETC. The reason for this is that the contractors of the project worked diligently on facility development and the introduction of equipment and facilities, such as OPGW, under the supervision of the EETC and the construction supervision consultants.

- Current Status of Operation and Maintenance

At the time of the ex-post evaluation, there were no particular concerns regarding the maintenance status of the facilities developed by this project, or the equipment/facilities introduced by this project, and no problems have occurred subsequently. As mentioned above, the technical staff of both RCCs are engaged in daily and regular maintenance work.

Spare parts are neatly placed on the racks and shelves in the storage rooms within both RCCs. Parts are procured according to the EETC's procurement guidelines and used when needed. Many parts are procured from abroad (European countries).

Based on the above, it is judged that there is no problem with regard to the operation and maintenance status of both RCCs.

<Evaluation Result>

Therefore, the sustainability of the project effects is very high.

III. Recommendations & Lessons Learned

- Recommendations to Executing Agency:

None.

- Recommendations to JICA:

None.

[21] Since it was completed during 2019, the actual operating cost of 2019 is less than the 2020/2021 actual amount.

[22] Financial data for 2020/2021 were not published at the time of the ex-post evaluation (November 2021).

- Lessons Learned:
(Necessary to Consider the Importance of Developing Infrastructure Facilities and Securing and Training Human Resources with a Long-Term Perspective)

Prior to the start of this project, Japan provided support for power supply control and operation in the Upper Egypt region through the "Power Control Center Development Project in Upper Egypt," contributing to the stable operation of power supply and distribution. Approximately 30 years after the RCC was developed by the aforementioned project, it was updated by this project. Technical staff who have been working at the RCC for many years continue to utilize their experience and skills. JICA continues to support the Egyptian power sector, while the Egyptian side is creating an environment where experienced and skilled staff can continue to work. This is proof that the importance of the project from a long-term perspective has been understood and that the need for a stable operation of power distribution is accurately grasped. When formulating similar projects in the future, it would be desirable for both the donor and the recipient to consider the importance of developing infrastructure facilities and securing/nurturing human resources from a long-term perspective, especially when supporting such an important sector that contributes to the growth of the national economy, and to focus on enhancing the aid effects.

IV. Non-Score Criteria

- Performance:
None.

- Additionality:
None.

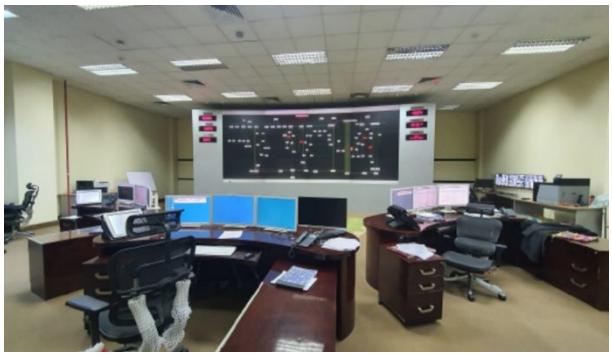


Photo 1: Control Room (UERCC)

Photo 2: Communication Equipment, Air Conditioning Equipment (UERCC)

Photo 3: Inside the MERCC Compound

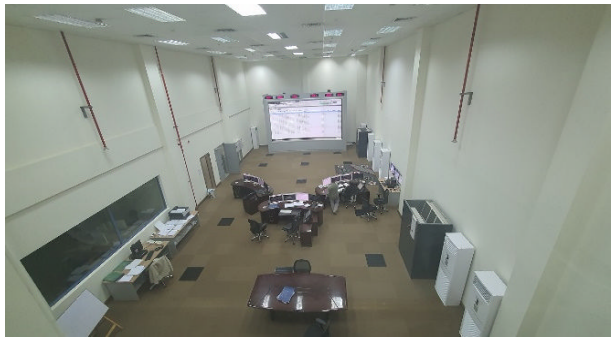


Photo 4: Control Room (MERCC)