

Republic of Iraq

FY2023 Ex-Post Evaluation of Japanese ODA Loan
“Al-Mussaib Thermal Power Plant Rehabilitation Project”

External Evaluator: Takako Haraguchi, i2i Communication, Ltd.

0. Summary

This project aimed to enhance the efficiency and stability of Iraq’s electric power system by rehabilitating the thermal power plant in Al-Mussaib, located 75 km south of Baghdad in Babylon Governorate. The project plan was consistent with Iraq’s development policies and needs, as well as with Japan’s ODA policies. In addition, the project was closely linked with the Japan International Cooperation Agency (JICA) training programs and the Japanese government’s grant aid through the United Nations Development Programme (UNDP) for the “Emergency Rehabilitation of Mussaib Power Station” (“UNDP Grant Aid Project”). Therefore, the relevance and coherence of the project are high. As a result of the project implementation, the output of the Al-Mussaib Thermal Power Plant was restored, enabling stable electricity supply and reducing the risk of power shortages during peak times. Although the anticipated impact of contributing to Iraq’s economic and social reconstruction could not be directly confirmed based on data, stable power supply undoubtedly supports Iraq’s economic and social activities. Thus, the project generally achieved the expected outcomes as planned, and effectiveness and impact are high. Efficiency is moderately low, as the project cost slightly exceeded the plan, and the project period significantly exceeded the plan. In terms of the operation and maintenance of the project, there were no issues with the related policy/system, institutional/organizational, technical, and financial status. Therefore, the sustainability of the project’s outcomes is very high.

In light of the above, this project is evaluated to be highly satisfactory.

1. Project Description



Project Location (source: JICA)



Image 1: Al-Mussaib Thermal Power Plant. The boilers for Units 1 to 4 are on the left.
(source: Photographed by field survey assistants)

1.1 Background

Due to prolonged economic sanctions and conflicts, Iraq's economy and society suffered significant damage. After these conflicts, the country began reconstruction efforts with the support of the international community. Although the electricity sector is the foundation of all economic and social activities, it experienced a severe decline in functionality across generation, transmission, and distribution due to years of underinvestment, inadequate maintenance, and looting. As a result, it had become one of the most critical sectors for the nation's reconstruction. The country's power generation capacity, which exceeded 9,000 MW in the 1990s, dropped to 3,000 MW by 2003 when the hostilities subsided. Although efforts by the U.S. and others helped to restore the capacity to 4,000 MW by 2005, it still could not meet the estimated demand of 7,000 MW. Consequently, nationwide planned power outages for extended periods became a regular occurrence. Power supply to essential infrastructure, such as waterworks and hospitals, was also disrupted, posing a significant obstacle to economic recovery and the restoration of social stability. Therefore, the restoration of power generation facilities was an urgent issue.

The Al-Mussaib Thermal Power Plant (300 MW x 4 units) is a large-scale power station constructed in the late 1980s as part of a joint project involving Japanese companies. Despite its proximity to the Baghdad metropolitan area and its status as one of the most important power generation facilities in Iraq, inadequate maintenance due to economic sanctions and other factors had led to significant declines in both output and operational rates. While repairs to the boiler of Unit 4 had begun in 2005 through the UNDP Grant Aid Project,¹ comprehensive rehabilitation of related facilities, including the inactive Unit 3, had become an urgent necessity.

1.2 Project Outline

The objective of this project is to streamline and stabilize Iraq's electric power system by rehabilitating the thermal power plant in Al-Mussaib, located 75 km south of Baghdad, thereby contributing to the economic and social reconstruction of Iraq.

Loan Approved Amount / Disbursed Amount	36,764 million yen / 36,537 million yen	
Exchange of Notes Date / Loan Agreement Signing Date	January 2007 / January 2008	
Terms and Conditions	Interest Rate	0.75%
	Repayment Period	40 years
	(Grace Period	10 years)
	Conditions for Procurement	General Untied

¹ As will be discussed later, the original plan was to repair the boiler of Unit 1, but it was later changed.

Borrower / Executing Agency	The Government of the Republic of Iraq / Ministry of Electricity (MOE)
Project Completion	June 2021
Target Area	Al-Mussaib, Babylon Governorate
Main Contractors (Over 1 billion yen)	- Hyundai Engineering & Construction Co., Ltd. (Republic of Korea) - Black Sea Power Generating FZCO (United Arab Emirates) - Siemens AG (Germany) - Hitachi, Ltd. (Japan) / Toyota Tsusho Corporation (Japan) (JV)
Main Consultant (Over 100 million yen)	Tokyo Electric Power Services Co., Ltd. (Japan)
Related Studies (Feasibility Studies, etc.)	“Feasibility Study on Global Environment and Plant Vitalization Projects in FY2004” (2005, Feasibility Study by Japan External Trade Organization) “Procurement support consultancy for the Al-Mussaib Thermal Power Plant Rehabilitation Project” (2007-2008, JICA assistance with the preparation of pre-qualification (P/Q) documents, procedural support, and bid document preparation)
Related Projects	[ODA Loan] Electricity Sector Reconstruction Project I-III (2008, 2015, 2017) [Non-JICA Project] Emergency Rehabilitation of Mussaib Power Station (2005-2012) (Japanese government’s grant aid through the UNDP, utilizing the International Reconstruction Fund Facility for Iraq)

2. Outline of the Evaluation Study

2.1 External Evaluator

Takako Haraguchi, i2i Communication, Ltd.

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: October 2023-January 2025

Duration of the Field Study²: February 4, 2024-February 15, 2024 and June 23, 2024-June 27, 2024

3. Results of the Evaluation (Overall Rating: A³)

3.1 Relevance/Coherence (Rating: ③⁴)

3.1.1 Relevance (Rating: ③)

3.1.1.1 Consistency with the Development Plan of Iraq

The development plans at both the national and sectoral levels during the appraisal and ex-post evaluation stages aim for economic development through the enhancement of power infrastructure, including the expansion of generation capacity. Therefore, the consistency of the project with the country's development plan is high.

At the time of the appraisal, the *Second National Development Strategy*, announced in June 2005, set forth four major pillars: "Strengthening the foundation for economic growth," "Revitalizing the private sector for growth and employment," "Improving the quality of life for citizens," and "Strengthening good governance and improving security." By identifying the reduction of periods of electricity interruptions and the fulfillment of electricity demand as key objectives for electricity sector development, the Strategy regarded the enhancement of power generation capacity along with the strengthening of transmission and distribution capabilities as critical development issues. A similar perspective was presented in the *Electricity Sector Development Master Plan (2006-2015) (Draft)* announced by the Ministry of Electricity (MOE) in November 2006, which laid out specific development plans.

At the time of the ex-post evaluation, *Iraq Vision 2030* aims to achieve a 24-hour electricity supply by 2030 under Goal 3-5, "Developed Infrastructure." Additionally, the *White Paper: Final Report of the Emergency Cell for Financial Reform (2020)* provides a detailed analysis of the challenges in the electricity sector, identifying power infrastructure, including generation, as a top priority for infrastructure sector reforms.⁵

The MOE's *Electricity Production Plan (2024-2030)* aims to increase generation capacity (rated output) from 24,820 MW in 2023 (of which 5,358 MW is thermal) to 60,510 MW in

² For safety reasons, the evaluator was unable to visit Babylon Governorate. Consequently, interviews with the executing agency located in this governorate were conducted by inviting the responsible officials in Baghdad. The site survey of the Al-Mussaib Thermal Power Plant (the project site) and interviews with the plant staff were carried out by field survey assistants under the direction of the ex-post evaluator.

³ A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

⁴ ④: Very High ③: High, ②: Moderately Low, ①: Low

⁵ The *National Development Plan (2023-2027)* is still under formulation and has not been published as of July 2024. However, the previous *National Development Plan (2018-2022)* aimed to enhance infrastructure for economic growth, with the expansion of power generation capacity as the top priority for electricity sector development. The Plan also outlined measures such as the rehabilitation and maintenance of existing power plants.

2030 (of which 19,658 MW is thermal). Out of the new power generation target of 35,690 MW, 14,300 MW is planned to come from thermal power, which includes 5,480 MW from the MOT-operated power plants (including a 700 MW expansion at the Al-Mussaib Thermal Power Plant) and 8,820 MW from Independent Power Producers (IPPs).

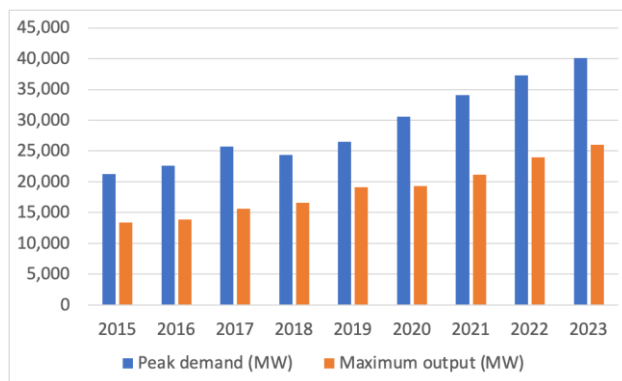
3.1.1.2 Consistency with the Development Needs of Iraq

From the time of the appraisal to the time of the ex-post evaluation, electricity demand has consistently remained high, highlighting the urgent need to address the power shortage through the rehabilitation of the Al-Mussaib Thermal Power Plant, which is regarded as one of the most critical facilities in Iraq's power grid. Therefore, the consistency between this project and the development needs is very high.

At the time of the appraisal, as stated in "1.1 Background," the power shortage in Iraq was severe. The output of the Al-Mussaib Thermal Power Plant, which had a rated capacity of 300 MW per unit for a total of 1,200 MW across four units, was limited to 180 MW each for Units 1, 2, and 4, while Unit 3 was non-operational, resulting in a total output of only 540 MW.

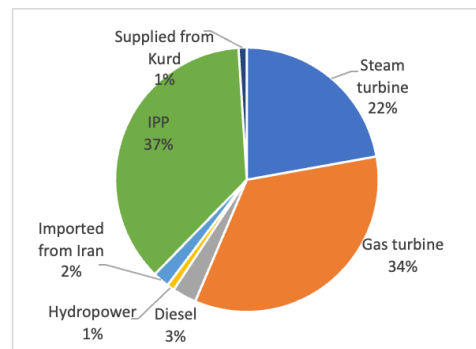
Electricity demand continued to increase towards the time of the ex-post evaluation. In 2023, peak demand reached approximately 40,000 MW, with an average demand of around 13,900 MW. Both peak demand and maximum power supply increased at an annual rate of over 8%, and the supply-demand gap remained unresolved. The total national power generation capacity in 2023 was 24,820 MW in terms of rated output but only 17,902 MW in terms of available capacity. Of the effective generation capacity, thermal power (steam turbines) accounted for 3,970 MW (22%), including 865 MW from the Al-Mussaib Thermal Power Plant. While the shares of IPPs and gas turbine power plants were higher, the State Company of Electricity Production Middle-Euphrates Region ("SCEP"), the entity within the executing agency responsible for implementing this project, placed significant importance on thermal power plants, which have shorter and easier maintenance downtimes compared to gas turbines, and for which fuel procurement is easier than for natural gas.

At the time of the ex-post evaluation, the SCEP recognizes that the Al-Mussaib Thermal Power Plant remains one of the most important power generation facilities in Iraq. As will be discussed later, although this project was originally scheduled to be completed in 2012, it was significantly delayed and completed in 2021. However, the high demand for the project was evident from the fact that the SCEP partially rehabilitated and temporarily operated Unit 3 using parts that had already been procured in order to meet the summer peak demand (when air conditioning demand is extremely high due to temperatures reaching up to 50 degrees Celsius). Afterwards, during the off-peak period, the SCEP shut down the unit again to conduct comprehensive rehabilitation. This effort to utilize the project as much as possible, even before its completion, further underscores the urgency of the need.



Source: Prepared from MOE data

Figure 1: Peak Power Demand and Supply in Iraq



Source: Prepared from MOE data

Figure 2: Effective Power Generation Capacity in Iraq by Energy Source (2023)

3.1.1.3 Appropriateness of the Project Plan and Approach

There are no issues with the project plan's logic. Regarding the components of the project, choosing rehabilitation rather than constructing a new power plant was appropriate given the urgency of the project, as it allowed for a relatively shorter time for the project effects to materialize. Although the project was ultimately delayed, the fact that it was a rehabilitation project allowed the power plant to be operational during peak periods even before the project's completion.

The response to changes in the project scope and procurement methods can also be considered appropriate. First, regarding changes to the project scope, the components of the Unit 1 rehabilitation under this project had to be revised due to changes in the facility targeted by the UNDP Grant Aid Project. Specifically, the power generation units targeted by this project were Units 1 and 3, with Unit 1's turbine-generator and control system scheduled for rehabilitation under this project in coordination with the boiler rehabilitation undertaken by the UNDP Grant Aid Project, while Unit 3 was planned for comprehensive rehabilitation under this project. However, due to a serious defect in the boiler components of Unit 4, the boiler rehabilitation under the UNDP Grant Aid Project was switched from Unit 1 to Unit 4. Although the executing agency desired to modify the plan so that Unit 1 would also undergo comprehensive rehabilitation similar to Unit 3, this was not feasible due to financial constraints. As a result, the rehabilitation of Unit 1's turbine-generator under this project was initially canceled, and it was later decided to use the unused portion of the Japanese ODA loan to install the equipment and materials procured by the executing agency, thereby carrying out partial rehabilitation. According to the UNDP, the failure of Unit 4 was unforeseen at the time of the feasibility study and required urgent action, making this change unavoidable. It was also appropriate that this project sought to improve the output of Unit 1 by reinstating the turbine-generator rehabilitation in the scope of the project as much as possible.

Regarding the changes in procurement methods, the main contract for this project was altered from international competitive bidding (ICB) to a direct appointment contract with a

consortium of the original contractors that constructed the thermal power plant in order to shorten the project implementation period. Furthermore, due to increased costs and the need for enhanced safety measures resulting from the deteriorating security situation in Iraq (which led the contractors to determine that they could not perform on-site installation work), the contract was changed from an Engineering, Procurement, and Construction (EPC) contract with the consortium to separate material supply contracts with the original contractors and an ICB-based installation contract. While these changes contributed to delays in the project, they were necessary given the worsening security situation at the time and are considered appropriate responses aimed at completing the project as quickly as possible.

The operation and maintenance system, which was highlighted as a lesson from similar projects in the past, has met expectations in this project. The training provided under this project, participation in JICA training programs, and the training conducted through the UNDP Grant Aid Project have all enhanced the operational and maintenance capabilities of the power plant staff, contributing to effective operation and maintenance.

Given the project's nature as a power plant rehabilitation, consideration for people marginalized from fair social participation does not apply to this project both at the time of the appraisal and the time of the ex-post evaluation.

From the perspective of an ex-post evaluation with attention to conflict-affected countries and regions, two points are particularly noteworthy. First is the timing of the project's commencement. This project was planned in 2005 and launched in 2008, during a period when recovery from the impacts of war had begun, but the withdrawal of U.S. combat troops was not yet complete, and the situation remained unstable. Considering the security risks, undertaking this project at that time was highly significant as it addressed the severe power shortage at the right time and contributed to stabilizing the security situation. Second is the response to the security conditions that deteriorated after the commencement of the project. Despite the worsening security situation during the project's implementation, stakeholders from Iraq, Japan, and the UNDP closely coordinated efforts to continue the project without interruption and to achieve an early supply of electricity (see "3.1.2.3 External Coherence" and "3.2 Efficiency"). This can be evaluated as an appropriate response to maintain the project's relevance amidst changing security conditions.

3.1.2 Coherence (Rating: ③)

3.1.2.1 Consistency with Japan's ODA Policy

The consistency with Japan's ODA policy at the time of the appraisal was high. At the donor conference in Madrid in October 2003, Japan pledged \$ 1.5 billion in grant aid for Iraq's urgent reconstruction needs and up to \$3.5 billion in ODA loans for mid-term reconstruction needs starting in 2005. This project forms part of that support. In addition, the *Medium-Term Strategy for Overseas Economic Cooperation Operations* (April 2005) by JICA (the former Japan Bank for International Cooperation (JBIC)) cites "assistance for building peace" as a priority area.

Furthermore, one of the goals explicitly identified in the Strategy's discussion on the assistance policy for the Middle East is the mid- and long-term assistance to establish social stability and peace in Iraq. Thus, these policies are consistent with this project, which assisted in the reconstruction of economic infrastructure in Iraq.

3.1.2.2 Internal Coherence

The internal coherence is high. First, at the time of the appraisal, it was anticipated that synergies would be created between this project and a set of ODA loan projects, "Power Sector Reconstruction Projects I–III" (loan agreements signed in 2008, 2015, and 2017), which involved the rehabilitation of substation facilities. According to the SCEP, there was no deliberate coordination or alignment between this project and these projects, as each was implemented individually by the respective departments of the MOE. Nonetheless, as a result of this project and these ODA loan projects, substation capacity and power generation capacity were enhanced, playing mutually complementary roles in achieving the common goal of stabilizing Iraq's power grid.

Second, although not explicitly anticipated at the time of the appraisal, over 2,000 participants from Iraq took part in JICA's country-specific training, issue-specific training, third-country training, and in-country training programs in the electricity sector between 2008 and 2021 during the implementation of this project. Several employees of the Al-Mussaib Thermal Power Plant also participated. Two of these employees, who were interviewed by field survey assistants, reported that they had gained new knowledge and experience through the practical and well-structured training programs. According to the SCEP, these training programs provided extensive and comprehensive knowledge in related fields. The outcomes of these training programs, along with the capacity-building efforts focused on the operation and maintenance of the equipment installed at the power plant under this project, had a mutually complementary effect on the operation and maintenance of the plant.

3.1.2.3 External Coherence

The external coherence is high. As previously mentioned, the rehabilitation of the Al-Mussaib Thermal Power Plant, which was planned through close coordination between this project and the UNDP Grant Aid Project (2005-2012), went through adjustments during the project implementation. This project's plan had to be changed because the UNDP Grant Aid Project's target was switched from the Unit 1 boiler to the Unit 4 boiler (see "3.1.1.3 Appropriateness of the Project Plan and Approach"). The Iraqi government, the executing agency, JICA, the Japanese government and embassy, and the UNDP worked closely to discuss the resulting changes on the plan and their impact on the project and implement a coordinated response. In terms of project outcomes, although the UNDP Grant Aid Project originally aimed to achieve an additional output of 60-80 MW at Unit 1, it, in the end, achieved an additional

100 MW at Unit 4 after the plan was modified. For Unit 1, this project's partial rehabilitation increased the output from the planned 180 MW at the time of the appraisal to 199 MW (an additional 19 MW) as of 2023. Thus, the rehabilitation efforts in the two projects complemented each other to produce outcomes that exceeded initial expectations. Additionally, the training provided under these projects contributed to the effective operation and maintenance of the power plant.

In this way, the project demonstrated consistency with Iraq's development policies and needs, as well as the appropriateness of the project plan and approach. The project was also consistent with Japan's ODA policies. There was effective coordination and collaboration with other JICA projects during implementation, as well as with the project by another organization, specifically the UNDP Grant Aid Project. Concrete outcomes of such coordination and collaboration were confirmed. Therefore, its relevance and coherence are high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

The outputs of this project consisted of the rehabilitation of power generation facilities and consulting services. Although there were some changes, these were largely completed as planned (see the "Comparison of the Original and Actual Scope of the Project" on the final page of this report), and no issues were identified with such changes.

The rehabilitation of power generation facilities—including the emergency rehabilitation of Unit 1 (turbine-generator, control system, auxiliary equipment, etc.), the comprehensive rehabilitation of Unit 3 (boiler, turbine-generator, control system, auxiliary equipment, etc.), and the rehabilitation of common facilities (fuel supply system, demineralized water system, hydrogen supply system, etc.)—was largely completed as planned, with the exception of the following points, and completion was confirmed through visual inspection⁶ at the time of the ex-post evaluation.

- Reduction of Scope for Unit 1: As a result of switching boiler rehabilitation from Unit 1 to Unit 4 under the UNDP Grant Aid Project, the rehabilitation of the turbine-generator for Unit 1 under this project was removed from the scope. Since the changes to the UNDP Grant Aid Project could not have been anticipated at the time of this project's appraisal, the corresponding change in the scope of this project was unavoidable. Ultimately, partial rehabilitation of some of Unit 1's boiler equipment⁷ and turbine-generator⁸ was included as an additional scope of this project, resulting in an improvement in power output. This change was appropriate in that it did not hinder but rather facilitated the achievement of project outcomes (see "3.1.1.3 Appropriateness of

⁶ Performed by field survey assistants.

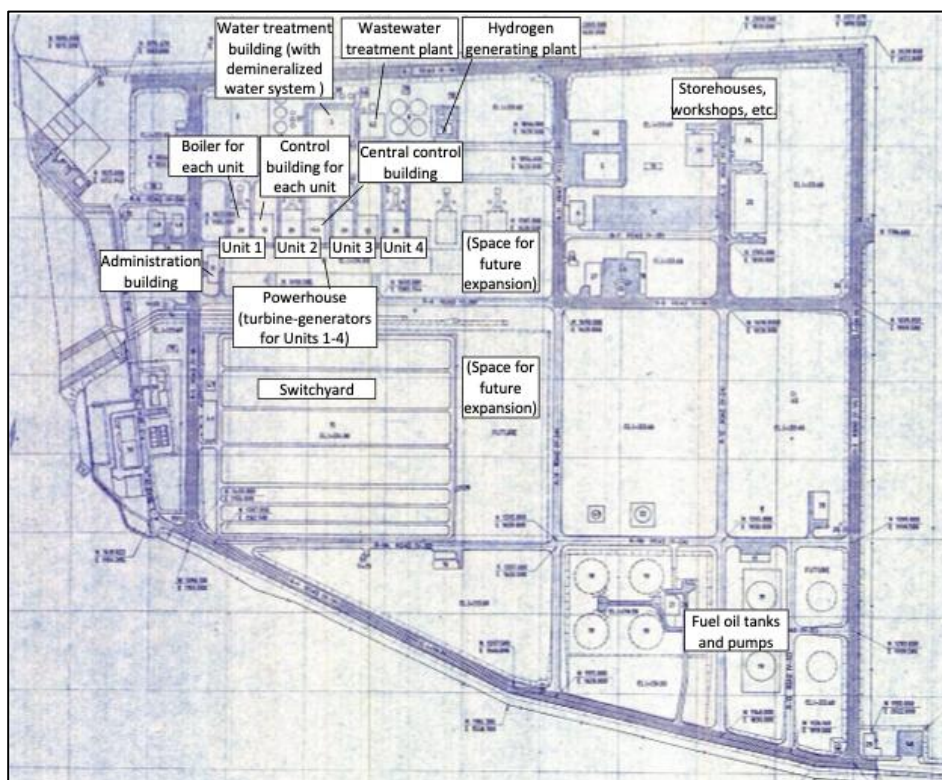
⁷ A repair of the hanger supports that hold the steam pipes connecting the boiler and turbine.

⁸ The equipment and materials were procured by the Iraqi side and installed under this project's installation contract.

the Project Plan and Approach” and “3.1.2.3 External Coherence” for details). The rehabilitation of the control system was removed from this project’s scope and carried out at Iraq’s own expense, while the auxiliary equipment rehabilitation was modified and involved partial replacement of on-site equipment.

- **Exclusion of Part of the Scope for Unit 3 Boiler Rehabilitation:** In 2015, to meet peak electricity demand, the Iraqi side installed equipment procured under this project’s material supply contract at its own expense without waiting for the execution of the installation contract. This action was appropriate as it helped the project avoid delays and facilitated, rather than hindered, the achievement of project outcomes.
- **Removal of the Installation of the Main Turbine-Generator Equipment for Unit 3 from the Scope:** To avoid exceeding the ODA loan amount, the equipment procured under this project’s material supply contract was installed using funds from UK Export Finance (UKEF). Since the installation was completed within the project period and did not hinder the achievement of outcomes, this adjustment was appropriate.
- **Removal of the Hydrogen Supply System from the Scope of Common Facilities:** Due to its urgency, the Iraqi side constructed the hydrogen supply system at its own expense. This adjustment was appropriate as it helped the project avoid delays and did not hinder the achievement of project outcomes.

The consulting services consisted of capacity building for the MOE (including staff training), procurement support (such as bid implementation, evaluation, and contract assistance), and construction supervision. To expedite the project’s implementation, assistance with the preparation of pre-qualification (P/Q) documents, procedural support, and bid document preparation was carried out as part of a JICA-commissioned study titled “Procurement Support Consultancy for the Al-Mussaib Thermal Power Plant Rehabilitation Project” (April 2007 - March 2008), which ran parallel to this project. Although the workload significantly increased due to project delays, the scope of work was generally as planned. The planned training program in Japan for MOE staff was canceled due to the COVID-19 pandemic, but training was conducted domestically in Iraq (at the project site) and abroad (in countries where the power plant equipment was manufactured) by the contractors.



Source: SCEP

Figure 3: Layout of Al-Mussaib Thermal Power Plant



Image 2: Unit 3 boiler equipment (source: Photographed by field survey assistants)



Image 3: Unit 3 turbine-generator (source: Photographed by field survey assistants)

3.2.2 Project Inputs

(For details, see the final section of the report, “Comparison of the Original and Actual Scope of the Project.”)

3.2.2.1 Project Cost

The planned total project cost at the time of the appraisal was 42,198 million yen, with the ODA loan covering the entire foreign currency portion of 36,764 million yen. The actual cost slightly exceeded the plan, amounting to 46,954 million yen, with the ODA loan covering 36,537 million yen of the foreign currency portion (111% of the planned amount). The actual cost included the expenses for project outputs that were excluded from this project's scope and implemented at the Iraqi side's expense (including foreign currency expenses covered by UKEF funds). These outputs were essential to the project's outcomes.

The main reasons for the increase in the project cost were the rise in project management costs under the main contract due to the deterioration of security and the increase in consulting services costs caused by delays.

3.2.2.2 Project Period

The project period for this project is defined as the duration from the signing of the loan agreement to the handover of the facilities (after the completion of a one-year warranty period). The planned period at the time of the appraisal was estimated to be 60 months, from January 2008 to December 2012. In comparison, the actual period significantly exceeded the plan, lasting for 162 months from January 2008 to June 2021 (270% of the planned duration by a straightforward calculation). The loan disbursement period was extended to June 30, 2021, from the original deadline of June 30, 2018.

The reasons for and the duration of the delays are as follows. Among them, (c) to (f) can be considered force majeure, which could not have been anticipated at the time of the appraisal. If we disregard the periods corresponding to (d) through (f), which affected the overall project period, the adjusted project period would be 120 months. If we take the latter as the actual project period, it amounts to 200% of the planned period.

- (a) Changes in the Scope (2010): A delay of approximately six months due to the changes in the plan resulting from modifications to the UNDP Grant Aid Project.
- (b) Contract negotiations and splitting due to cost overruns (2011): A delay of 23 months occurred because the original price offered by the consortium of contractors significantly exceeded the estimated cost.
- (c) Damage to parts caused by a bomb attack (2013): A bomb attack at the port of Um Qasr, which was the port of discharge for the equipment, damaged reheater coils, necessitating design changes and partial repurchasing. This caused a 27-month delay. However, since the installation contract did not begin until 2017, there was no impact on the overall project period.
- (d) Change in contract lot allocation due to the invasion by the Islamic State of Iraq and the Levant (ISIL): Following the ISIL invasion of Iraq in June 2014 and the subsequent deterioration in security, the contractors determined that installation work could not be

carried out, necessitating a new bidding process for the installation contract. The executing agency had to conduct detailed inspections of the delivered materials, a task usually handled by the contractor under an EPC contract, which significantly delayed the preparation of bidding documents. Additionally, the bidding for the installation contract was unsuccessful, and re-bidding took place. This resulted in a 24-month delay.

- (e) Suspension of construction due to worsening security: Following the deterioration of security in Iraq from October 2019 onward, some contractors for specific lots withdrew from the site, resulting in a 6-month delay.
- (f) Suspension of construction due to the COVID-19 pandemic (2020), which caused a 12-month delay.
- (g) The originally planned construction period was too short: During the summer, the power plant needed to be operational to meet the high electricity demand, limiting the time available for shutdowns for installation work to a maximum of eight to nine months per year. Therefore, it was necessary to carry out the rehabilitation work in phases over several years. However, the construction period planned at the time of the appraisal was set short, at two years and eight months (from May 2009 to December 2011), assuming that the plant would remain non-operational during three entire peak seasons.

As a measure to mitigate delays, minimizing the risk of further delays was made a key criterion when selecting alternative plans. Additionally, the UNDP and JICA entered into a monitoring contract, under which the UNDP conducted progress monitoring and provided advice to the MOE on the implementation of this ODA loan project, as well as training related to the project's execution. Furthermore, the monitoring committee consisting of the Iraqi Prime Minister's Advisory Commission, the executing agency, the Japanese Embassy, JICA, and the UNDP held meetings quarterly to raise awareness of the project's progress.

3.2.3 Results of Calculations for Internal Rates of Return (Reference Only)

The Financial Internal Rate of Return (FIRR) at the time of the appraisal was calculated to be 10.6%. The project life was set at 15 years from the start of operation, with costs including project cost and maintenance costs and benefits including revenue from electricity sales. When recalculated at the time of the ex-post evaluation using actual cost and benefit data, the FIRR turned negative. This is likely due to increased project cost, higher maintenance costs,⁹ and reduced benefits caused by project delays. Additionally, according to JICA's ex-post evaluation calculation method, where the project life is considered to be 15 years from the signing of the loan agreement, the FIRR at the time of the appraisal would be 8.9%, while at the time of the

⁹ At the time of the appraisal, the annual maintenance costs were initially estimated to be 2% of the project cost, but the actual amount turned out to be approximately 4% of the project cost.

ex-post evaluation, it was impossible to calculate (due to the project delays resulting in extremely low amounts that could be counted as benefits).

The Economic Internal Rate of Return (EIRR) could not be calculated at the time of the appraisal due to the lack of reliable data on the effects on the national economy. As the same situation remained at the time of the ex-post evaluation, it was not recalculated in this evaluation.

Therefore, efficiency of the project is moderately low.

3.3 Effectiveness and Impacts¹⁰ (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

The quantitative effect indicators set at the time of the appraisal for Units 3 and 1 of the Al-Mussaib Thermal Power Plant were maximum output, plant load factor, plant availability, and annual amount of net generated output. All of these indicators can be considered measures of the project's contribution to the objective of streamlining and stabilizing Iraq's electric power system. As shown in Table 4, these indicators generally achieved their target values by the target year, which was two years after the project's completion.¹¹ The status of each power generation unit is as follows.

- Unit 3: Before the project, this unit was not operational. In June 2015, it resumed operations (with an output of 200 MW) after partial rehabilitation using materials procured under this project in response to peak demand prior to the project's completion. The unit was then shut down in October 2017 for the rehabilitation of the boiler and auxiliary equipment for the turbine-generator, and the operation resumed in June 2018. Following that, the unit was shut down again in November 2018 for the main turbine-generator rehabilitation (which was funded by UKEF instead of the yen loan) and was brought back online in August 2019. In October 2020, the unit was shut down due to some issues, but after measures taken by the executing agency, the operation resumed in May 2021. Since then, although the output has been maintained at 220-230 MW, slightly lower than the highest-ever maximum output of 270 MW in 2019, small issues have been addressed incrementally during regular maintenance. The actual results for supplementary indicators, which were only set for Unit 3 at the time of the appraisal, are shown in Table 5. Although there have been frequent shutdowns due to mechanical failures, deliberate efforts have been made to maintain maximum output.
- Unit 1: Due to a change in scope, the rehabilitation under this project had been limited, and the output had been primarily maintained through repairs and maintenance carried out

¹⁰ When providing the sub-rating, Effectiveness and Impacts are to be considered together.

¹¹ The set indicators, based on their content, are regarded as both operation indicators and effect indicators. The target year was adjusted to 2023, which is two years after the actual project completion.

by the executing agency. However, as of April 2020, the output had dropped below 150 MW, prompting partial rehabilitation of the turbine-generator under this project, which led to a recovery in output. Since 2000, the maximum output has generally been maintained at around 200 MW.

The power supply capacity of the Al-Mussaib Thermal Power Plant accounts for approximately 4.8% of the national electricity supply, with Units 3 and 1 alone contributing around 2.4% (based on 2023 data). According to an analysis from the UNDP Grant Aid Project, an additional 100 MW of power allows 50,000 households connected to Iraq's power grid to receive stable electricity.¹² Therefore, the additional output from this project—234 MW from Unit 3 (2023 maximum output) and 49 MW from Unit 1 (the difference between the 2023 maximum output of 199 MW and the pre-rehabilitation maximum output of 150 MW in April 2020), totaling 283 MW—is estimated to have provided stable electricity to an additional 141,500 households (50,000 households x 283 MW ÷ 100 MW).

Table 4: Operation and Effect Indicators for the Al-Mussaib Thermal Power Plant Units Targeted by This Project

		Baseline value	Target value	Actual value						
		2005	2014 2 Years After Completion	2015	2016	2019	2020	2021 Completion Year	2022 1 Year After Completion	2023 2 Years After Completion
Maximum output (MW)	Unit 1	180	180 or higher	198	0	160	204	197	178	199
	Unit 3	0	240 or higher	200	200	270	268	220	220	234
Plant load factor (%)	Unit 1	N/A	65 or higher	15.05	0	44.12	42.14	54.33	57.61	63.87
	Unit 3	0	65 or higher	40.20	73.00	28.86	67.20	51.40	87.03	63.77
Plant availability (%)	Unit 1	N/A	91 or higher	20.57	0	70.83	58.20	71.68	79.47	83.60
	Unit 3	0	91 or higher	44.08	78.28	33.14	75.58	52.97	94.86	67.06
Annual amount of net generated output (GWh)	Unit 1	N/A	953 or higher	295.65	0	869.60	827.82	1,064.30	1,123.40	1,343.0
	Unit 3	0	1,270 or higher	792.53	1,438.13	568.80	1,320.50	1,013.09	1,714.70	1,307.4

Source: Documentation provided by JICA, SCEP

Note: Plant load factor = annual output of gross generation output / (240MW x 24 x 365) x 100. Plant availability = (annual operation hours / (24 x 365)) x 100. The rated output for both Unit 1 and Unit 3 is 240 MW, and calculations are based on 24 hours per day, 365 days per year. The results for Unit 1 up until 2019 are unrelated to this project. The 2019 results for Unit 3 are for the period from August to December.

¹² *Final Report, Emergency Rehabilitation of Mussaib Power Station Stage II*
https://mptf.undp.org/sites/default/files/documents/15000/undp_e4-15_final_itf_report.pdf (accessed July 9, 2024)

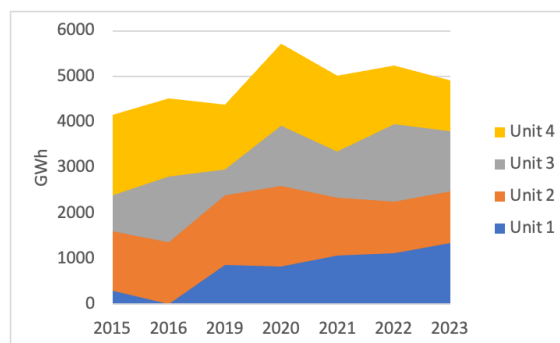
Table 5: Supplementary Indicators for Unit 3 at the Al-Mussaib Thermal Power Plant

	Baseline value	Target value	Actual value						
	2005	2014 2 Years After Completion	2015	2016	2019	2020	2021 Completion Year	2022 1 Year After Completion	2023 2 Years After Completion
Auxiliary power rate (%)	0	7.0 or lower	8.21	7.95	7.20	6.29	7.02	7.43	6.74
Gross thermal efficiency (%)	N/A	36 or higher	19	30	34.55	32.75	25.41	39.7	36.36
Outage times by human errors (time/year)	N/A	0	0	0	0	0	0	0	0
Outage hours by human errors	N/A	0	0	0	0	0	0	0	0
Outage times by machine errors (time/year)	N/A	4	7	8	5	18	5	7	10
Outage hours by machine errors	N/A	100 or lower	574	638	504	993	134	125	228
Planned outage times for periodical inspection (time/year)	N/A	1	2	3	1	2	2	1	2
Planned outage hours for periodical inspection	N/A	720	4,324	1,288	5,353	1,170	3,985	325	2,657

Source: Documentation provided by JICA, SCEP

Note: Auxiliary power rate (%) = (annual amount of auxiliary power / annual amount of gross generated output) x 100. Gross thermal efficiency = (annual amount of gross generated output x 860) / (annual amount of gas consumption x gas heating value) x 100. The planned outage hours target was set at 720 hours, calculated as 24 hours x 30 days. However, according to the SCEP, the shutdown period for regular maintenance is set at one and a half months, or 1,080 hours (24 hours x 45 days).

All units including Unit 2 (which was rehabilitated by the SCEP and not as part of this project) and Unit 4 (which was rehabilitated through the UNDP Grant Aid Project) are maintaining good operation and output (see Figure 4). The common facilities that were rehabilitated or constructed under this project are contributing to the performance of all units. According to the SCEP, the effects of this project have not been hindered by external factors, such as the condition of the transmission network.



Source: SCEP

Figure 4: Net Generated Output of All Units at the Al-Mussaib Thermal Power Plant

3.3.1.2 Qualitative Effects (Other Effects)

The qualitative effects anticipated at the time of the appraisal were: (1) improvement in the efficiency and stability of the power grid, (2) revitalization of the economy and industry, and (3) strengthening of the implementation, operation, and maintenance systems of the MOE. Considering the nature of each effect, (1) is addressed under Effectiveness (this section), while (2) and (3) are categorized for confirmation under “3.3.2 Impacts.”

Regarding (1), as mentioned above, the increased output of Units 3 and 1 at the Al-Mussaib Thermal Power Plant due to this project, along with the contribution of the common facilities in maintaining stable output across all four units, helped improve the reliability and stability of the power grid. Additionally, by reducing power shortages during emergencies and peak periods, the project has reduced the risk of power shortages (which could lead to increased costs due to emergency measures or reliance on additional supply sources) and thus contributed to improved efficiency.

Although specific data on outage durations was not available, the SCEP reported that power outages during the summer have clearly decreased. In the capital region, where the population is dense and electricity demand is high, the supply-demand gap remains significant, and the shortfall is felt more strongly than the increase in supply. However, in other regions with smaller populations, the improvement is reportedly more pronounced. Field survey assistants residing in Baghdad and their families also consistently observed a reduction in power outages.

Additionally, the restoration of functionality at this power plant, which is close to the capital, has contributed to a stable and efficient electricity supply to the capital region with minimal losses.

3.3.2 Impacts

3.3.2.1 Intended Impacts

Regarding the impact anticipated at the time of the appraisal, specifically “contributing to economic and social reconstruction” (and the qualitative effect (2) “revitalization of the economy and industry”), it is clear that the electricity supply from the Al-Mussaib Thermal Power Plant supports economic and social activities through the improved efficiency and stability of the power grid. However, because changes before and after this project are not reflected in macroeconomic data, the impact could not be quantitatively confirmed.¹³

¹³ For example, the growth rate of non-oil GDP (year-on-year) was -11.2% in 2020, 4.9% in 2021, 0% in 2022, and an estimated 4.0% in 2023 (World Bank data). Due to the stagnation in the oil sector, on which the Iraqi economy heavily depends, the non-oil sector is expected to drive growth in the coming years from 2023 onwards. Direct investment has continued to be negative (with outflows). According to the World Bank's analysis of the investment environment, there is no indication that infrastructure, including electricity, has contributed to improving the investment environment (it continues to be cited, along with political and institutional constraints, as a factor in the poor investment climate).

3.3.2.2 Other Positive and Negative Impacts

1) Impacts on the Environment

This project was classified as Category B based on the *Japan Bank for International Cooperation Guidelines for the Confirmation of Environmental and Social Considerations* (April 2002). This classification was based on the assessment that, considering the sectoral, project, and regional characteristics, the project was not expected to have significant adverse environmental impacts.

Regarding environmental permits, the preliminary Environmental Impact Assessment (EIA) report for this project was not required under Iraqi law. According to the feasibility study, the environmental permits related to the rehabilitation of existing facilities at the Al-Mussaib Thermal Power Plant had been obtained in 1984 at the same time as the construction permit for two new units (which have not yet been built but included in the *Electricity Production Plan* for the period through 2030). The conditions imposed at that time with respect to the rehabilitation of the existing facilities, such as the installation of wastewater and sewage treatment facilities, had already been satisfied. Additionally, since residential areas are more than 10 km away from the power plant, it was concluded that public explanation or consultation was not necessary.

During the project implementation, monitoring was conducted through consulting services based on the above-mentioned guidelines and the environmental checklist agreed upon at the time of the appraisal. It was confirmed that various parameters were within Iraq's national standards. After the project's completion, the SCEP has continued regular monitoring, using equipment, including exhaust gas measurement devices procured under this project, to monitor parameters such as oil discharge, power generation wastewater, sewage, lighting, ventilation, air conditioning, exhaust gas, and noise. The parameters have consistently remained within the standard limits. According to the power plant, there have been no complaints from the surrounding area during or after the project's implementation.

A positive environmental impact of this project was the improvement in water quality resulting from the rehabilitation of common facilities. Before the project, the wastewater treatment facilities were not functioning properly, and wastewater that did not meet standards was being discharged into the Euphrates River. However, with the improvement of the wastewater treatment facilities, one of the common facilities, the discharged water now meets the required standards. As mentioned above, the environmental monitoring equipment procured under this project is also being utilized.

2) Resettlement and Land Acquisition

This project involved the rehabilitation of an existing thermal power plant, and there was no resettlement or land acquisition.

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

In the documents from the time of the appraisal, there was no specific mention of these points, and during the ex-post evaluation, no outcomes were observed that could be factored into the evaluation. According to the executing agency, no particular groups or individuals were negatively affected.

4) Other Positive / Negative Impacts

As a positive impact, the strengthening of the MOE's implementation, operation, and maintenance systems (one of the anticipated qualitative effects) was realized through the enhancement of the operational and maintenance capabilities of the SCEP and power plant personnel. According to the SCEP, on-site training provided by contractors under this project, the dispatching of personnel to factory acceptance tests in the countries where the equipment was manufactured, JICA's training programs in Japan, third-country training (see "3.1.2.2 Internal Coherence"), and training through the UNDP Grant Aid Project all contributed to improving the operation and maintenance systems. The knowledge and skills acquired are being utilized in the operation and maintenance of the power plant after the project's completion.

There were no negative impacts. Security measures included the deployment of police and national military forces, as well as the hiring of security companies, ensuring the safety of contractors and consultants, with no adverse effects on the security of the surrounding areas.

The project has mostly achieved its objective of "streamlining and stabilizing Iraq's electric power system." Although the anticipated impact of "contributing to the economic and social reconstruction" could not be confirmed through data, it is fairly reasonable to infer that this impact is being realized through improvements in power supply. Therefore, as intended effects have manifested mostly as planned as a result of implementing the project, effectiveness and impacts of the project are high.

3.4 Sustainability (Rating: ④)

3.4.1 Policy and System

As mentioned in "3.1.1 Relevance," economic development through the improvement of power infrastructure is being pursued, and the policies and systems for operation and maintenance have been established.

3.4.2 Institutional/Organizational Aspect

The operation and maintenance system for this project is largely in line with what was anticipated at the time of the appraisal. The MOE, as the regulatory authority and power service

provider, bears comprehensive responsibility for the operation and maintenance of power facilities. At the time of the appraisal, the ministry's power generation sector was managed by four regional electricity production directorates. The Al-Mussaib Thermal Power Plant was under the jurisdiction of the Directorate of Electricity Production in the Middle-Euphrates Region, which was responsible for the execution of this project. With the corporatization of the generation, transmission, and distribution sectors in 2018 (all remaining under the MOE), the directorate became the State Company of Electricity Production Middle-Euphrates Region (referred to throughout this report as "SCEP"). After the project's completion, the SCEP has been responsible for the operation and maintenance of the Al-Mussaib plant and 13 other power plants. There have been no major changes in the organizational structure of the MOE or the SCEP, and the division of roles remains clear. There are no immediate plans for privatization.

The Al-Mussaib Thermal Power Plant has assigned between 150 and 200 staff members to each of its four power generation units, and both the SCEP and the power plant have reported that there are no issues with the number of staff for operation and maintenance.

Thus, the institutional/organizational aspect of operation and maintenance has been established.

3.4.3 Technical Aspect

At the time of the appraisal, the MOE was considered to have sufficient technical capability, as it had been carrying out operation and maintenance (including routine repairs) of power facilities under severe constraints during multiple conflicts and sanctions periods. Therefore, no specific issues were anticipated in managing the equipment to be procured and installed in the future. Likewise, no technical issues were observed at the time of the ex-post evaluation. Both the SCEP and the director of the Al-Mussaib Thermal Power Plant reported that the plant's operation and maintenance personnel possess the necessary skills and qualifications, such as bachelor's degrees in mechanical, electrical, control, systems, computer, or chemical engineering for professional-level staff, and technical education diplomas for mid-level specialists. To maintain technical standards, the SCEP and the plant's training departments conduct an annual training program that identifies skill gaps and provides necessary training at the corporation's training center. As previously mentioned, training opportunities provided by this project, JICA training programs, and the UNDP Grant Aid Project have also been instrumental in helping staff acquire the latest, internationally recognized skills. It was also confirmed that manuals provided by the contractors under this project are being utilized.

Thus, the technical aspect of operation and maintenance has been established.

3.4.4 Financial Aspect

The operating budget for the Al-Mussaib Thermal Power Plant is allocated by the SCEP Middle-Euphrates Region, whose revenue sources consist of the income from selling electricity

to the State Companies of Electricity Transmission and the budget provided by the MOE. The financial results are shown in the table below. Electricity sales revenue varies from year to year, and the cost recovery rate has fluctuated at around 80%. Shortfalls are fully covered by the MOE, and both the SCEP and the power plant reported that there are no budgetary issues. The electricity sales price to the State Companies of Electricity Transmission has increased from 13.6 Iraqi Dinars (IQD)/kWh in 2016 to 36.8 IQD/kWh in 2022.

Table 6: Revenues and Expenses of the SCEP Middle-Euphrates Region

(Unit: Billion IQD)			
	2021	2022	2023
Energy sales	791.2	803.0	794.5
Expenses	902.2	984.8	1,020.6
Breakdown Wages and salaries	102.7	109.7	117.8
Chemical materials (including fuel)	364.2	435.6	460.1
Oils and greases	3.9	5.1	6.2
Other goods	12.0	51.6	73.8
Maintenance	12.7	18.5	22.5
Other service costs	5.0	6.3	6.9
Loss of values due to aging/use (Extinction costs)	400.7	357.7	332.1
Investment	1.0	0.2	1.2
Balance (Subsidized by the MOE)	(111.1)	(181.8)	(226.1)

Source: SCEP

In the Iraqi electricity sector as a whole, there are structural issues such as a very low cost recovery rate due to low retail prices and unpaid electricity bills, as well as a heavy reliance on subsidies.¹⁴ However, in the power generation sub-sector, financial issues are not as significant as in the transmission and distribution sub-sectors, and therefore, no issues are expected for this project.

Thus, the financial aspect of operation and maintenance has been established.

3.4.5 Environmental and Social Aspect

As mentioned in “3.3.2.2 Other Positive and Negative Impacts,” the Al-Mussaib Thermal Power Plant has conducted regular monitoring after the project completion on items such as oil discharge, power plant effluent, sewage, lighting, ventilation, air conditioning, exhaust gases, and noise, and no environmental impacts exceeding standards or negative social impacts have occurred. Monitoring is also scheduled to continue to be carried out by the executing agency in the future.

¹⁴ Retail prices for consumers are kept low and are on a downward trend, with an average of 49.7 IQD/kWh in 2022. Furthermore, the cost recovery ratio from electricity tariffs is estimated to cover only about 20% of the total cost of electricity supply, including generation, transmission, distribution, and administration. Subsidies to the electricity sector amount to approximately 10 trillion IQD (about 1 trillion yen) annually, accounting for 1.2% of the GDP in 2018. Source: JICA (2019), *Data Collection and Communications Strategies Survey on Public Infrastructure Projects in the Republic of Iraq: Final Report*; Emergency Cell for Financial Reform, the Government of the Republic of Iraq (2020), *White Paper: Final Report of the Emergency Cell for Financial Reform*.

3.4.6 Preventative Measures to Risks

According to the *White Paper: Final Report of the Emergency Cell for Financial Reform* (2020) and the field survey assistants living in Baghdad who are involved in this evaluation, the low cost of electricity has led to a lack of effort by the public to conserve energy. Some individuals mentioned that due to the frequent occurrence of outages, people tend to use as much electricity as possible when the power is restored. Additionally, dissatisfaction with power outages can easily translate into dissatisfaction with the government and lead to protests. The lack of energy conservation and dissatisfaction with power shortages represent a long-term risk associated with the low-cost electricity supply provided by unprofitable state-owned enterprises. While this project is not directly at risk—since it aims to reduce these risks by ensuring a stable power supply—it is important to note this issue as a broader challenge within the electricity sector, including this project.

3.4.7 Status of Operation and Maintenance

The Al-Mussaib Thermal Power Plant is operating relatively stably. The maintenance plan consists of routine maintenance (such as O-ring and gasket replacements, alignment checks, cleaning, etc.), annual maintenance (45 days), and emergency maintenance (typically a few days, depending on the issue). These maintenance activities are being carried out as planned. During the survey for this ex-post evaluation, the condition of the facilities and equipment, as well as their operational status, were all found to be good. Both the SCEP and the power plant reported that not only the plant itself but also the transmission network from the plant is operating without any issues.

Thus, the status of operation and maintenance is satisfactory.

No issues have been observed in the policy/system, institutional/organizational, technical, financial, and environmental and social aspects, including the current status of operation and maintenance. Future risks have been mitigated effectively. Therefore, sustainability of the project effects is very high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project aimed to enhance the efficiency and stability of Iraq's electric power system by rehabilitating the thermal power plant in Al-Mussaib, located 75 km south of Baghdad in Babylon Governorate. The project plan was consistent with Iraq's development policies and needs, as well as with Japan's ODA policies. In addition, the project was closely linked with the Japan International Cooperation Agency (JICA) training programs and the Japanese government's grant aid through the United Nations Development Programme (UNDP) for the "Emergency Rehabilitation of Mussaib Power Station" ("UNDP Grant Aid Project"). Therefore, the relevance

and coherence of the project are high. As a result of the project implementation, the output of the Al-Mussaib Thermal Power Plant was restored, enabling stable electricity supply and reducing the risk of power shortages during peak times. Although the anticipated impact of contributing to Iraq's economic and social reconstruction could not be directly confirmed based on data, stable power supply undoubtedly supports Iraq's economic and social activities. Thus, the project generally achieved the expected outcomes as planned, and effectiveness and impact are high. Efficiency is moderately low, as the project cost slightly exceeded the plan, and the project period significantly exceeded the plan. In terms of the operation and maintenance of the project, there were no issues with the related policy/system, institutional/organizational, technical, and financial status. Therefore, the sustainability of the project's outcomes is very high.

In light of the above, this project is evaluated to be highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

None.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

1) Development of a power plant rehabilitation schedule while ensuring operation during peak periods

The power plant under this project is critically important and cannot be shut down for extended periods due to high electricity demand. It would have been preferable to carry out the rehabilitation work in phases over several years while keeping the plant operational during the summer peak periods. However, the plan at the time of the appraisal aimed to minimize the construction period by scheduling the plant to be shut down for two summer seasons. In practice, the rehabilitation work was divided into two stages to ensure operation during the summer, which led to further delays. Additionally, since the cost of the second stage exceeded the approved ODA loan amount, it was excluded from the project and was installed at the expense of the Iraqi side. For the rehabilitation of high-demand power plants, it is preferable to plan phased work that allows the plant to meet peak electricity demand while undergoing necessary repairs.

2) Recognizing the additional burden on the executing agency when separating material supply and installation contracts

The original plan for a single EPC contract with the consortium of original contractors was altered due to cost overruns and worsening security conditions, leading to separate contracts for

material supply and installation with individual contractors. This change required the executing agency to take on the detailed inspection of delivered materials, a task typically handled by the contractor under an EPC contract, which caused significant delays in obtaining information from contractors and preparing bidding documents. Additionally, scheduling the dismantling and installation work while considering the timing of material deliveries from multiple procurement lots proved challenging.

When setting the bidding method, it is crucial to thoroughly consider costs, security, and technical consistency. If circumstances permit, an EPC contract or a material supply and installation contract with the original contractor's consortium is preferable. In cases like this project, where separate material supply by individual companies and installation by non-original contractors are unavoidable, it is important to recognize the additional time needed for bid preparation and schedule the bidding accordingly while also securing cooperation from the original contractors.

3) Conducting training in parallel with facility and equipment rehabilitation

In this project, various capacity-building opportunities were provided, including contractor-led training, training under the UNDP Grant Aid Project, experience with factory acceptance tests, and JICA training programs in Japan and third countries. These opportunities were beneficial for the operation and maintenance after the project's completion. The executing agency particularly valued the practical content and the transfer of skills for operating and maintaining internationally standardized equipment. This project underscored the importance of implementing both hard and soft components together.

Regarding the different training schemes, the executing agency noted that the JICA training programs provided broad and comprehensive knowledge in related fields, while the training conducted within the individual project was more directly beneficial for enhancing the capacity to operate and maintain the equipment installed at the power plant. The combination of these trainings had complementary effects on the operation and maintenance of the project.

4) Insights from applying the *Perspective of Ex-post Evaluation Considering Conflict-affected Countries and Regions*¹⁵

In this evaluation, the *Perspective of Ex-Post Evaluation Considering Conflict-Affected Countries and Regions* from JICA's ex-post evaluation guidelines was referenced, particularly when considering the impact of security conditions by analyzing factors that promoted or hindered each evaluation criterion. Additionally, in assessing the relevance of the project, this evaluation focused on the appropriateness of the project in terms of two perspectives—"timing" of implementing a project in conflict-affected countries and regions and "changes in external conditions during the project implementation period." However, regarding "timing," the *Perspective of Ex-Post Evaluation Considering Conflict-Affected Countries and Regions*

¹⁵ Annex 9, JICA Ex-post Evaluation Reference (FY2023).

primarily considers this as a viewpoint for examining the development policies of the partner country's government. In the case of this project, it was more appropriate to evaluate the timing not only in relation to development policies but also in the context of Iraq's overall situation at the time (especially the security situation). This suggests that in ex-post evaluations, it may be necessary to adjust both the perspectives to use and the manner in which they may be applied not only by referring to the classifications in the *Perspective of Ex-Post Evaluation Considering Conflict-Affected Countries and Regions* but also by tailoring the approach to the specifics of the project.

5. Non-Score Criteria

5.1 Performance

5.1.1 Objective Perspective

JICA fulfilled its role as a relevant project agency and contributed to the results. The project documents indicate that the necessary procedures were followed. Although the scope was changed and the loan disbursement period was extended, there were no particular issues observed in the handling of these matters.

The supervision system, which took into account the evolving project environment, was appropriate. This project faced numerous challenges, including changes in procurement methods due to cost and security constraints, scope changes in the UNDP Grant Aid Project, and the impact of terrorism. These issues led to delays, cost increases, and deterioration in the relationship between the executing agency and contractors, creating many difficult situations. According to the consultant, such difficulties were severe enough that project cancellation was a possibility. However, given the critical importance of rehabilitating this power plant, the Japanese government, JICA, and the UNDP (which not only collaborated on the grant aid project but also entered into a monitoring agreement with the JICA Iraq Office to conduct project monitoring and provide training to the executing agency) worked together to find ways to continue the project. Project documents and interviews with the Japanese Embassy and the UNDP also indicate that the JICA office maintained frequent communication with stakeholders to address these challenges.

5.2 Additionality

None.

(End)

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs		
Rehabilitation of power-generating installations		
Unit 1	Urgent rehabilitation (turbine/generator, control system, and auxiliary items)	Partial rehabilitation of the turbine-generator (control system rehabilitation was changed to be funded by Iraq, and auxiliary equipment was partially replaced with on-site equipment)
Unit 3	Comprehensive rehabilitation (boiler, turbine/generator, control system, and auxiliary items)	Mostly as planned (part of boiler rehabilitation and main turbine-generator installation were changed to be funded by Iraq)
Rehabilitation of common facilities	Fuel supply system, demineralized water system, hydrogen supply system, etc.	Mostly as planned (hydrogen supply system rehabilitation was changed to be funded by Iraq)
Consulting Services	Capacity building for the MOE, procurement support (bid implementation, evaluation, contract assistance, etc.), construction supervision, etc. Total: 350 person-months	The scope of work was mostly as planned (the training program in Japan for MOE staff was canceled) Increased workload (exact figures unknown)
2. Project Period	January 2008-December 2012 (60 months)	January 2008-June 2021 (162 months)
3. Project Cost		
Amount Paid in Foreign Currency	36,764 million yen	41,092 million yen
Amount Paid in Local Currency	5,434 million yen (67,671 million Iraq Dinar (IQD))	5,994 million yen (70,269 million IQD)
Total	42,198 million yen	46,954 million yen
ODA Loan portion	36,764 million yen	36,537 million yen
Exchange Rate	1IQD = 0.0803 yen (As of January 2006)	1IQD = 0.0853 yen (Average between 2008 and 2021)
4. Final Disbursement	June 2021	