



## 1. Project Data

<b>Project ID</b> P152039	<b>Project Name</b> Geothermal Exploratory Drilling Project	
<b>Country</b> Armenia	<b>Practice Area(Lead)</b> Energy & Extractives	
<b>L/C/TF Number(s)</b> TF-A0544	<b>Closing Date (Original)</b> 31-May-2019	<b>Total Project Cost (USD)</b> 6,296,250.21
<b>Bank Approval Date</b> 08-Jun-2015	<b>Closing Date (Actual)</b> 31-May-2019	
	<b>IBRD/IDA (USD)</b>	<b>Grants (USD)</b>
Original Commitment	8,550,000.00	8,550,000.00
Revised Commitment	6,296,250.21	6,296,250.21
Actual	6,296,250.21	6,296,250.21

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## 2. Project Objectives and Components

### a. Objectives

**Original PDO:** The objective of the Project, as stated in the Grant Agreement (p.6), was “to confirm whether the geothermal resource at the project site was suitable for power generation and, if confirmed, to involve the private sector in the development of the geothermal power plant”.

The project objective, as stated in the PAD (p.17), was identical to the above.



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

No

**c. Will a split evaluation be undertaken?**

No

**d. Components**

The project had the following two components:

**Component A: Phase I Exploratory Drilling Program** (cost at appraisal: US\$5.375 million, including US\$4.3 million SREP grant; actual at completion US\$7.87 million)

The slim well exploratory program had two sub-components:

**A1.** Construction of access road and drilling of one or two slim exploratory wells (cost at appraisal: US\$5.025 million)

This sub-component was intended to finance: (i) construction of an access road and related infrastructure, including construction of a gravel road, preparation of small rig pads and installation of equipment and minor works at the water source; and (ii) the drilling of up to two slim exploratory wells.

**A2.** Technical Assistance for assessment of the geothermal resource potential and technical supervision (cost at appraisal: US\$350,000)

This sub-component was designed to finance: (i) well logging and well testing, (ii) a Technical Supervision and Support Consultant to support the Renewable Resources and Energy Efficiency Fund (R2E2) in technical supervision of the drilling, producing a Technical Report and other technical advice & support, and (iii) project audit and operating costs.

The project would only proceed to Component B (Phase II) if justified by the results from the drilling of exploratory wells under Component A.

**Component B: Phase II Exploratory Drilling Program and Transaction Advisory** (US\$5.312 million, including a US\$4.25 million SREP grant; actual at completion US\$ nil). The results obtained from Phase I would decide whether to proceed with Phase II of the project.

Component B had two sub-components:

**B1.** Construction of water infrastructure and rig pads, and drilling of a full-size exploratory well (US\$4.175 million)

This sub-component was designed to finance: (i) construction of water infrastructure and rig pads, including supplying water from a nearby well to ensure continuous water supply for drilling operations, and (ii) drilling of a production-sized exploratory well.

**B2.** TA for assessment of the geothermal resource and technical supervision (US\$1.137 million)



This sub-component was designed to finance: (i) well logging, mud logging, well testing and related activities, (ii) feasibility study for a potential geothermal plant, (iii) Technical Supervision and Support Consultant, (iv) transaction advisory (to be cofinanced if necessary by SREP, PPIAF, ESMAP and/or other sources), including advisory services to the Government to design a PPP scheme, (v) project audit and operating costs.

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

**Project Cost:** The original estimated project cost was US\$10.68 million. Actual cost at project completion was US\$7.866 million.

**Financing:** The project's cost was financed partly through a grant from the Scaling-up Renewable Energy Program (SREP), as part of the climate investment funds (TFA544), totaling US\$8.55 million. As Phase II did not take place, this was revised to US\$6.296 million. The Borrower committed US\$2.13 million to supplement this amount – actuals at closing amounting to US\$1.57 million.

**Dates:** The closing date for the original loan was June 08, 2015. The project was designed as a four-year operation, to ensure that all necessary activities could be completed, given the limitations on site accessibility, given weather conditions, and also given the time that would be needed to complete the PPP transaction for the power plant. The original closing date was May 31, 2019, and the project closed on schedule.

**Restructurings:** The project did not undergo a restructuring.

### **3. Relevance of Objectives**

#### **Rationale**

##### **Country Context:**

As mentioned in the PAD (p.12), at the time of appraisal in 2015, Armenia's Gross Domestic Product (GDP) had slowed down from 7.2 percent in 2012 to 2.6 percent in 2014. Poverty rates were relatively high, with 32 percent of Armenians living in poverty, mostly on account of a slowdown in the construction sector. The first phase of power sector reforms introduced in the 1990s had led to the establishment of a regulatory agency and a regulatory framework conducive to private investment, including in renewable energy. Notwithstanding this, by the time of appraisal the power sector still faced major challenges – including supply adequacy and reliability - that would need to be addressed in a second phase of reforms. The Government had already initiated steps to support the development of indigenous renewable energy resources, and was committed to further increasing the share of renewable energy in the generation mix. It was expected that geothermal resources could become an affordable source of base-load electricity generated from indigenous resources, helping to reduce the need for new expensive gas-based thermal generation.

**Alignment with Strategy:** At appraisal, the project 's objectives were consistent with the FY14-17 Country Partnership Strategy (CPS) for Armenia, being centered on Engagement Area 1.3 of the CPS (Improved



access, quality and sustainability of key infrastructure) to eliminate constraints to competitiveness and job creation through selective energy sector investments. It was also consistent with the strategic energy sector objectives of the Government, as expressed in the Armenian Development Strategy for 2014-2025. The project was also expected to contribute to the Bank's twin objectives of reducing poverty and promoting shared prosperity, as low-cost electricity from a potential geothermal plant could help keep electricity affordable. Additionally, the development of geothermal power would contribute to the reduction of greenhouse gas (GHG) emissions. These objectives continued to be consistent with the World Bank's Country Partnership Framework for Armenia (FY19-FY23), specifically Focus Area 3 (Sustainable Management of Environmental & Natural Resources), which placed emphasis on reducing GHG emissions through new renewable energy investments (see page 30). This Focus Area would support the Government's commitment and vision for Armenia as an environmental leader in the region.

**Prior Experience in the Sector:** The Bank Group had considerable previous experience in Armenia's energy sector, in the form of investment operations, policy dialogue and analytical activities, which the Geothermal Exploratory Drilling Project was expected to leverage. This included a number of World Bank projects on-going at the time, including projects on electricity supply and reliability, energy efficiency, and transmission network improvement, plus analytical work. Though the Bank financing had historically focused on the downstream phases of project development, on-going engagements in Kenya, Ethiopia and Djibouti took the form of support for the riskier exploratory and production drilling stages. Surface exploration work financed by the Global Environment Facility (GEF) indicated that a potential geothermal resource might be found at Karkar. The role played by the Bank in the country's sector dialogue and its access to a wide network of geothermal experts built through the Global Geothermal Development Plan made the Bank a strong partner for further exploration and subsequent development of its geothermal potential.

## Rating

High

## 4. Achievement of Objectives (Efficacy)

### OBJECTIVE 1

#### Objective

"To confirm whether the geothermal resource at the project site was suitable for power generation"

#### Rationale

#### Theory of Change:

A fairly direct causal link can be drawn between the project's activities and the expected outcomes. The activities consisted of: (a) exploratory drilling to assess whether the inferred geothermal resources at Karkar would be suitable for power generation, and (b) geothermal development capacity-building activities to support the exploratory drilling and potential transaction advisory activities. The project's support to the Government to secure private sector involvement would be contingent upon confirmation of the power



generation potential. Higher-level outcomes of the project included contributing to reducing the power supply gap and to a reduction in GHG emissions, through off-setting investments in gas-fired thermal generation.

While the activities appear appropriate to achieving the desired outcomes, the theory of change (TOC) discussion in the ICR does not specifically analyze whether they were of adequate scale to create a critical mass for change. However, the TOC does clarify that the phased approach to the project design was intended to ensure the efficient use of limited SREP grant resources, given that the results of surface exploration studies was not unequivocally optimistic about the presence of suitable geothermal resources in Karkar. If the first phase drilling of one or two slim exploration wells confirmed the presence of a high-temperature geothermal resource, the project would move to Phase II, which involved the drilling of a production-sized well to confirm the geothermal resource and assess the productivity of the reservoir. This in turn would lead to the provision of transaction advisory activities to help Government engage a private sector developer to fully develop the field. If the Phase I activities proved unsuccessful, with the drilling revealing reservoir temperatures below 90 degrees C, the project would be terminated. However, should Phase I be partially only unsuccessful, in that the slim wells indicated reservoir temperatures of above 90 but below the threshold of 200 degrees C, the possibility of building a binary geothermal power plant could be considered, depending on associated energy costs.

**Outputs:** The project was implemented largely according to the plan. There were no significant changes to the scope or scale of the project. The one change in drilling procedure – of using a conventional rig with a tri-bit drill cone instead of use of coring technology – allowed the drilling to safely reach a greater depth, of 1,500 meters, to provide more information about the properties of the geothermal resource. The only deviation in the project’s timetable was caused by delays in the construction of the access road to the Karkar site and rig pads, required for transportation of the drilling equipment for the slim wells. The road was 95 percent completed in the 2015 season, when weather conditions worsened sooner than expected, causing a stoppage and an overall delay of about a month to the start of drilling activities in the summer of 2016.

The following outputs were achieved:

Phase I:

- (a) Two slim exploratory wells were drilled as planned, thereby achieving the target (2 wells). The drilling reached the minimum required depth of 1,200 meters.
- (b) 100 percent of project-related grievances were responded to within stipulated service standards.

**Outcomes:**

The project achieved its outcome of confirming whether or not the geothermal resources at the Karkar site were suitable for power generation.

The indicator was framed in terms of providing the necessary evidence to the Government for its decision on this suitability. Towards this end, studies on the technical, economic, environmental and social aspects were carried out. Two slim wells were drilled - the first to a depth of 1,497 meters depth, the second to a depth of 1,684 meters. The drilling helped establish that the temperature of the geothermal reserves was in the range of 130 – 135 degrees C, too low to support a flash power plant, but within the technical feasible range of a



possible binary technology plant, if geothermal flow was present at depth. As per the project design, this left the decision of whether to pursue development of a binary plant to the Government.

The following steps were undertaken by the Ministry of Energy & Natural Resources (MENR) and the Renewable Resources and Energy Efficiency Fund (R2E2) to determine whether it was justifiable to proceed to Phase II of the project: (i) The R2E2 fund explored the possibility of contracting with various drilling companies – but all felt the job was too risky and its scale was too small to undertake. (ii) It updated the original financial and economic analysis for a potential binary plant at the site based on the observed temperatures and water level. As a first step, a pre-feasibility study was commissioned to carry out a preliminary cost calculation of such a plant at the site based on the drilling results and under different temperature and flow rate scenarios. The analysis indicated that even on the assumption of sufficient well productivity at Karkar, a geothermal plant would not be economically viable in comparison to other supply options, and would call for a significant increase in the minimum tariff to render the project financially viable. (iii) MENR reached out to a large number (around 50) international geothermal developers to gauge their interest in developing a plant at the Karkar site, based on the technical interest gathered. Only one firm expressed an interest, but could not provide adequate proof of technical and financial capabilities, and was hence viewed as non-credible.

Based on these steps, the MENR took a decision to close the project without proceeding to Phase II.

**Rating**

High

**OBJECTIVE 2**

**Objective**

“If (geothermal resources) confirmed, to involve the private sector in the development of the geothermal power plant”

**Rationale**

As the results from Phase I did not justify proceeding to Phase II, the project was cancelled (formal closing letter request received on April 29, 2019). As such, there was no need to involve the private sector in developing a geothermal plant at the Karkar site. This objective is hence not rated.

**Rating**

Not Rated/Not Applicable

**OVERALL EFFICACY**

**Rationale**



The project achieved its objective of providing evidence to determine whether or not to proceed to Phase II and construct a geothermal plant at the Karkar site. Since the decision was not to proceed, Phase II did not take place and Objective 2 is not rated.

### **Overall Efficacy Rating**

High

## **5. Efficiency**

### **Administrative and Operational Efficiency**

Actual cost for Phase I of the project were significantly higher than estimated at appraisal: US\$7,870,000 as against the estimate of US\$5,375,000 (an increase of 46 percent). Original cost estimates had been based on benchmark costs for the geothermal sector. However, on account of the small size of the actual contracts, the remoteness of the project site and other logistical challenges, actual costs turned out to be much higher. Additionally, the unexpected increase in the time it took to drill the first well (70 days vs the planned 35 days), on account of unforeseen circumstances and events, also contributed to the increase in actual costs.

The closing of the project after completion of Phase I drilling operations took much longer than necessary. A delay of one and a half years occurred on account of changes in responsible Ministers, as well as of the R2E2 Director. The final request for closure of the operation took place in April 2019, just a few months before the official original closing date. One consequence of this delay was that unutilized funds (which were eventually redirected to another project) could not be swiftly returned to SREP for deployment in other priority projects in Armenia, as soon as the results from Phase I confirmed that the project was unlikely to proceed to the construction of a power plant, thereby imposing an avoidable opportunity cost.

### **Economic and Financial Efficiency**

Economic analysis of the project conducted at appraisal took the form of a least-cost analysis of the potential geothermal power plant to determine whether it would be part of the least economic cost supply plan for Armenia. The analysis was conducted for two different plan concepts, assuming the lowest and highest reservoir temperatures (for a flash cycle plant with expected temperature of 250 degrees C vs ORC [Organic Rankine Cycle] with expected temperature of 130 degrees C). Results of the analysis indicated that a potential flash cycle plant at the site would qualify to be part of the least-cost supply plan. The Long Run Average Incremental Cost of supply (LRAIC) was estimated at \$0.11/kWh and the LEC (Levelized Energy Cost) at \$0.09/kWh. However, if the reservoir temperature was at the low end of the range (130 degrees), such that only a binary plant would be feasible, then the plant would have significantly higher LEC (\$0.15) compared to other supply options (most of which would be \$0.10 or less).

A financial analysis of these two options was also conducted, which indicated that to achieve financial viability the flash cycle plant would require a minimum tariff of \$0.10, which was consistent with being one of the lowest cost supply options available to Armenia, whereas the ORC binary plant would require a tariff of \$0.18, placing it among the highest-cost options for Armenia.



A new economic analysis prepared in September 2017, based on the results of the Phase I drilling, indicated that a geothermal plant based on the Karkar site – of necessity, a binary plant – would be unlikely to be an economically viable option. Only at reservoir temperatures of 140-160 degrees, combined with a high well flow rate, were LEC’s in the same range as for other options; for any less favorable combination of reservoir temperature/well flow rate the LECs would be in a much higher range (\$0.19 to \$0.51/kWh), making it uneconomical compared to other options. Financial analysis conducted on the basis of the drilling results also indicated that tariffs required for almost all temperature and flow scenarios would be much higher than the range of tariffs already in force for existing generation in the country. For example, the financial viability of a plant operating at a resource temperature of 120 degrees and a well flow volume of 30 kgs would call for a tariff rate of at least \$0.30/kWh (five times the rates in force).

Based on the above, the project’s efficiency is rated Modest.

**Efficiency Rating**

Modest

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

	Rate Available?	Point value (%)	*Coverage/Scope (%)
Appraisal		0	0 <input type="checkbox"/> Not Applicable
ICR Estimate		0	0 <input type="checkbox"/> Not Applicable

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

**6. Outcome**

The project’s objectives were highly relevant to the World Bank Group’s Country Partnership Strategy in place at the time the project was initiated, and continued to be relevant to the Country Partnership Framework (FY19-23). Overall efficacy was High, as the project clearly achieved its objectives. Efficiency was however found to be Modest on account of significant cost overruns. Taking all of this into account, overall project outcome is rated Moderately Satisfactory.

a. **Outcome Rating**  
Moderately Satisfactory

**7. Risk to Development Outcome**



Given the results of the exploratory drilling, and of the updated economic and financial analysis, it is not expected that further drilling or technological advances would reveal the presence of an economically exploitable geothermal resource. As such, the risk to development outcome is considered to be low.

## **8. Assessment of Bank Performance**

### **a. Quality-at-Entry**

The design of the project benefited from the World Bank's extensive experience in the geothermal sector. Project design was relatively straightforward. Unlike other renewable energy technologies it is not normally possible to validate geothermal resources with sufficient confidence without performing exploratory drilling to assess specific geological conditions in the field. As such, the project's use of a two-phased drilling process, with the initial drilling of one or two slim wells to assess the temperature of the low-resistivity layer, to be followed by one or two production-size wells, should the initial results warrant further engagement, was logical.

During preparation, the Bank team mobilized additional grant resources to complement the preparation grant provided by SREP. The additional funds were used to provide Bank-executed technical assistance for project design, including assessment of drilling and water supply options, additional surface exploration and expert advice on the two-phase exploration drilling program. The team also reviewed bidding documents for the drilling service contractor, the Technical Supervision and Support Consultant and the well logging and testing consultant.

Project risks were assessed fully, with the technical risk being gauged as Substantial. Given the relatively limited geothermal expertise in Armenia, the project was designed to provide technical assistance in order to ensure that the design of the drilling program was finalized in accordance with international best practice and that the drilling operation was adequately supervised on-site.

Implementation arrangements were adequately provided. The R2E2 Fund was designated to implement the project under the supervision of a Board of Trustees, chaired by the Minister of Energy and Natural Resources. During preparation, the Bank team remained fully engaged with the R2E2 Fund, providing sufficient inputs and guidance on technical aspects, as well as on Bank procedures. The team conducted due diligence on the Fund's implementation capacity and provided guidance on fiduciary requirements. The M&E framework was also adequately set up and the methodology for reporting identified during preparation.

### **Quality-at-Entry Rating**

Satisfactory

### **b. Quality of supervision**

The project appears to have been adequately supervised, with seven supervision missions over three and a half years. The ICR reports (p.22) that the team worked closely with staff from the R2E2 Fund and with



the Technical Supervision and Support Consultant during the planning and implementation period, checking progress and recording the project's implementation status in Aide Memoires and Implementation Status and Results Reports (ISRS). The team was responsive when issues emerged; for instance, by dispatching a geothermal drilling engineer to the site at the beginning of drilling activities, and a reservoir engineer during completion and testing of well B-1, reviewing daily drilling reports by borehole geologists, and providing training on procurement.

The ICR also reports that the team's reporting in ISRs was candid and issues were flagged accurately and on a timely basis for management attention and decision. The ICR does not specifically report on the adequacy of supervision inputs and processes.

One area in which the team may have been less than fully proactive is in regard to the delay in closing the project, when it had become clear, based on the results of Phase 1 drilling, that the project would not be proceeding to Phase II. The Government delayed its decision not to proceed with Phase II and close the project by a year and a half as there had been changes in responsible Ministers as well as the R2E2 Director, as a result of which unused project funds could not be quickly returned to SREP for use in other priority projects. The Bank team did not meanwhile (ICR, p.20) actively pursue moving forward with restructuring or partial cancellation of the operation - though it maintained a dialogue with the Government throughout. Fortunately, an alternative use was found for the funds, which were redirected to scaling up small renewable energy projects under an EBRD-financed operation in Armenia.

### **Quality of Supervision Rating**

Satisfactory

### **Overall Bank Performance Rating**

Satisfactory

## **9. M&E Design, Implementation, & Utilization**

### **a. M&E Design**

The M&E system was aligned to project objectives and the results chain, which in turn contained indicators that were clear and easily measurable. The required data would be furnished by the reports generated by the implementation support consultant, based on data regularly provided by the drilling contractors, mud logging, well logging and chemical sampling analysis consultants. The R2E2 Fund had the responsibility to submit progress reports and engage in regular communication with the Bank team.

### **b. M&E Implementation**

Notwithstanding the relative simplicity of the project's results framework, adequate monitoring by the R2E2 Fund and the Bank team was essential to ensure the safety and technical soundness of the drilling operations. As such, daily reports from the technical supervision and support consultant were shared with the Bank team; regular calls were organized with the consultant and R2E2 to review drilling progress and discuss any corrective measures. Additional data, essential to complete the evaluation of the



project, were provided by the “Well Completion Report”, prepared by the technical consultant and issued in April 2017, and the Update to the Financial and Economic Appraisal of the Potential Geothermal Power Plant at Karkar, prepared in September 2017.

### c. M&E Utilization

Data collected for M&E were used to monitor the status of the project. Project implementation rested heavily on M&E data, for monitoring status as well as to bring relevant issues to management’s attention. The Bank team’s regular supervision missions, including site visits, and inputs from the technical consultants, were also a key component of monitoring activities.

### M&E Quality Rating

Substantial

## 10. Other Issues

### a. Safeguards

The project was classified as Environmental Category B, with Environmental Assessment (OP/BP 4.01) and Involuntary Resettlement (OP/BP 4.12) policies triggered. The project complied with the Bank’s Environmental, Health and Safety Guidelines, and its management of safeguards issues was rated Satisfactory for most of the implementation period (ICR page 21).

The ICR reports (page 21) that the safeguards rating was downgraded to Moderately Satisfactory on one occasion, following the July 2016 mission on account of two deviations from planned activities, decided upon by the R2E2 Fund to meet an anticipated exigency. These involved the construction of small pond to create an alternative source of reliable water supply, and the extraction of earth for construction material for the road being built. Both options had not been mentioned in the original Environmental & Social Impact Assessment (ESIA), and a revised ESIA report and Environmental Management Plan (EMP) had to be prepared to address these issues. Once these were disclosed in-country and by the Bank, the safeguards rating was once again revised to Satisfactory.

The project contributed through its Grievance Redress Mechanism (GRM) to the establishment of an institutionalized inter-community platform among the three villages affected by the project. This was included as an intermediate indicator in the project’s results matrix, and (see Section 4) 100 percent of complaints were in fact responded to within the stipulated service period.

### b. Fiduciary Compliance

**Financial Management (FM):** The project’s financial management was rated Satisfactory, overall. There were some issues during the initial 18 months of implementation, on account of delays by the R2E2 Fund in implementation of internal controls, as well as delays in submitting Interim Financial Reports on timely



basis, but these were resolved thereafter. The Final Audit Report was published in July 2019. The ICR reports (p.22) that the internal control system was assessed to be adequate.

**Procurement:** Procurement compliance was also considered to be Satisfactory overall, despite a downgrading to Moderately Satisfactory at one point, as a result of the need to change cost estimates and procurement method (from QCBS to CQS) for two of the main consulting contracts. The issues reflected a lack of relevant experience with such complex projects on the part of the R2E2 Fund, as well as the fact that qualified developers required a premium to mobilize for such a small drilling project.

**c. Unintended impacts (Positive or Negative)**

N/A

**d. Other**

The project contributed through its Grievance Redress Mechanism (GRM) to the establishment of an institutionalized inter-community platform among the (3) villages affected by the project. This was included as an intermediate indicator in the project's results matrix, and (see Section 4) 100 percent of complaints were in fact responded to within the stipulated service period.

**11. Ratings**

Ratings	ICR	IEG	Reason for Disagreements/Comment
Outcome	Satisfactory	Moderately Satisfactory	No disagreement. Rating is MS on account of Modest Efficiency. ICR (para 48) has same rating.
Bank Performance	Satisfactory	Satisfactory	
Quality of M&E	Substantial	Substantial	
Quality of ICR	---	Substantial	

**12. Lessons**

EG derives the following lessons drawn from the ICR:

**1. The project’s phased approach was appropriate for geothermal energy investments in sites with high resource uncertainty.** In such projects, public funds could be used to cover the risky upstream exploration stages, so that private sector interest and funds can be leveraged for downstream investments. The assessment determined that a power plant would not have been economically viable, even if geothermal flow had been found. This allowed for the preservation of



the remaining SREP grant funds, which could be reallocated to other priority projects in the SREP pipeline (including projects in Armenia funded by other donors, or even projects in other countries).

**2. A comprehensive and open outreach effort to private geothermal developers proves to be an effective way to unequivocally determine the commercial viability of further resource development after exploration drilling:** During the project, after test well results established that the temperature of the geothermal resource fell in a 'grey area' between temperatures suitable for a flash cycle plant and the minimum needed for a binary power plant, the use of market soundings provided a clear indication to the Government that there was no real private sector interest in developing the resource.

### 13. Assessment Recommended?

No

### 14. Comments on Quality of ICR

The ICR is clearly written, concise and consistent with guidelines. It provides adequate details of the project's activities. Its analysis is broadly evidence-based. The ICR could however have usefully provided more details on Bank performance, where the description is relatively brief, especially on the adequacy of supervision inputs and resources.

#### a. Quality of ICR Rating

Substantial