

CLIMATE INVESTMENT FUNDS

February 6, 2015

**APPROVAL BY MAIL: ARMENIA: GEOTHERMAL EXPLORATORY DRILLING PROJECT (GEDP)
(SREP)**

Response from the International Bank for Reconstruction and Development to the
Sub-Committee

Scaling Up Renewable Energy Program

Armenia: Geothermal Exploratory Drilling Project

Responses to comments from Switzerland

Comment	Response
<p>1.</p> <p>Reminding the conditions under which the SREP Investment Plan for Armenia was approved and notably our concerns regarding risk (\$8.55 million grant) and reward (28.5 MW proven geothermal potential), we take note that the exploration drilling is sequenced and may be stopped, if the results are not promising. The conditions for the stop or go on decisions during the process are however not clear in the PAD. Please detail the sequencing of project components (exploration drilling and technical assistance parts) in a way that shows the actually to be incurred costs depending on the drilling results. At least the following questions should thereby be answered:</p> <ul style="list-style-type: none"> a. Under what conditions will the second slim well be drilled or not and what are the financial implications? b. Under what conditions will the drilling of a production-sized well be justified? c. What will be the financial implications if it is not, i.e. what components of the project would remain relevant? 	<p>The Appendix to this matrix of responses includes a revised break-down of project activities in order to better show their sequencing and financing implications of the different drilling results. Phase One covers the activities associated to drilling slim exploration wells, while Phase Two includes all the activities associated with drilling the production-size wells and proceeding with feasibility analysis and structuring of the PPP transaction.</p> <p>As explained in the PAD (p.23-24), drilling one (or two) slim wells will be the most inexpensive way of obtaining information not only about temperature and pressure of the geothermal resource, but also about the lithological, stratigraphic, and mechanical stability information required to plan larger diameter wells if warranted by the temperatures and permeability discovered. This will not only reduce the project costs if drilling of the slim wells is unsuccessful, but also reduce the risk of having to face expensive drilling issues during drilling of the production-size wells.</p> <ul style="list-style-type: none"> a. The second slim well will be drilled if the results from the first slim well (e.g. temperature, pressure, rock formations) are not conclusive. The design of the drilling program will be such that as much information as possible is obtained from the first well, in order to minimize the chances that a second slim well is needed. It is not possible to foresee the specific circumstances under which a second well will be necessary; since this will depend on the joint interpretation of all the data obtained from the first well (the

		<p>Technical Supervision and Support Consultant will be responsible for this interpretation). Drilling of a second slim well is estimated to cost about \$1.5 million dollars, which could either be saved if the project stops after the first well, or reallocated to the second phase, which would help implement a drilling program from which the maximum possible information on the resource is obtained.</p> <p>b. Please, see response to Question 2 below</p> <p>c. See revised description of project components in Appendix.</p>
2.	<p>The economic analyses indicate that only a flash cycle geothermal power plant would produce electricity at a levelized cost which would be competitive enough to justify its construction. We understand that the flash cycle technology requires a high temperature (about 250°C) geothermal resource. We conclude that the drilling would be stopped if the drilling of the slim well(s) indicates temperatures significantly lower than 250°C. Please clarify if our conclusion is correct</p>	<p>The project would not proceed to the second drilling stage (i.e. production-size exploration wells) if the results from the slim well(s) show that the reservoir temperature is below 110°C -130°C. If results from the slim wells show that the reservoir temperature is above 200°C , which is considered adequate for a flash plant, then the project would proceed with drilling the production-size exploratory wells.</p> <p>If the results from the slim wells show that temperature is in the 110°C-200°C range, the Government will decide whether it would like to build a binary geothermal power plant and proceed with further drilling. LCOE for a binary power plant is highly correlated to the resource temperature and the capacity of the plant. The E&FA analysis shows that, below 130°C, the LCOE for a binary plant would be above any of the alternative supply options. Above that temperature, a binary plant can still make economic sense, and the Government will need to decide whether to drill the additional exploratory wells in order to obtain additional information (e.g. resource flow and chemical composition) that would provide the necessary information to prepare a feasibility study for a binary power plant.</p>
3.	<p>What is foreseen to be done with possible savings due to an abortion of the exploration drilling in relation to obviously insufficient geothermal resources?</p>	<p>If drilling of the slim wells proves that the geothermal resource is not adequate for commercial power generation, the project would be closed and the remaining grant resources would be reallocated to other priority areas identified in the Armenia SREP IP (see para. 41). The eventual</p>

		reallocation of resources would merit a revision of the SREP IP and therefore be subject to SREP Sub-Committee approval.
4.	We noticed that the \$2.13 million contribution from the recipient is equivalent to the taxes related to the different project components (Annex 7 Procurement Plan). Given that the Government of Armenia owns the recipient, the question arises, whether “taxes only” can/should be considered a legitimate co-financing of an SREP project.	This expected contribution from the Government of Armenia is consistent with the co-financing for all IBRD projects in Armenia. The Government will be financing 75% of all expenses under the project. The team will make that explicit in the PAD. Moreover, the Government will provide in-kind contributions.
5.	The procurement risk was qualified as “substantial” notably in relation to the weakness of the R2E2 Fund. Capacity building and the hiring of procurement consultants are mentioned as mitigation measures but no budget is therefore requested. How will these mitigation measures be financed?	Sub-component 2.5 of the project will cover incremental operating costs for the R2E2 Fund, which can cover the costs of procurement consultants with international and local experience. In addition, the Technical Supervision and Support Consultant (TSSC, financed under sub-component 2.3) will be responsible for the technical aspects of the procurement process for the drilling company and for any additional specialty contracts and would provide the direct technical management of the contracts that are entered directly by the R2E2. This would include development of the TORs after which the TSSC would take a lead role in the technical evaluation of the proposals for various drilling related highly specialized consultant services (see Implementation Arrangements in Annex 3)
6.	In general, the amounts provided for the consultancy mandates (300’000 USD + taxes for technical supervision and support and 200’000 USD + taxes for transaction advisory) seem low for a \$100 million renewable energy project. Please explain. Also, does that include a provision for post-transaction advisory?	The scope of the technical supervision and support services is limited to the drilling program that will be financed by the proposed SREP project (Stage 1 of the geothermal project – USD 8.55 million total), which comprises 1 or 2 slim wells and, if those are successful, 1 or 2 production-size wells. The \$300,000 budgeted for supervision of such drilling program is in line with international standards given the scope of activities to be financed under the proposed SREP project. As for transaction advisory services, the PAD acknowledges that the Government may need to seek additional funding from SREP, Public Private Infrastructure Advisory Facility (PPIAF), Energy Sector

		Management Assistance Program (ESMAP), and other sources to complement the SREP financing for transaction advisory services.
7.	<p>In the Procurement Plan it is indicated that the shortlist of consultants may consist entirely of national consultants. While we encourage the use of national consultants as far as possible, this raises the question whether specialized consultants and transaction advisories for geothermal projects under PPPs of this magnitude can be found under adequate competitive conditions, if restrained to the national market</p>	<p>The World Bank Guidelines for the Selection and Employment of Consultants state that, for consultant contracts below \$300,000, the short list may comprise entirely national consultants. This is not a requirement, but a possibility and would only be applicable if such national firms are compliant with the minimum capacity and prior experience requirements specified in the call for proposals. For highly specialized services for which no relevant experience is available in-country, the short list may in fact comprise entirely international consultants.</p>

Revised Component Description

Phase One

Component A.1: Construction of access road and first phase of exploratory drilling (US\$4,300,000 SREP grant). This component will finance:

1. **Sub-component A.1.1: Construction of access road (US\$620,000).** This will include construction of a gravel road with sufficient length and width to allow for safe transportation of equipment and other materials to the site.
2. **Sub-component A.1.2: Drilling of slim exploratory wells (US\$3,400,000 SREP grant).** This will include drilling of one or two slim wells. The decision on whether to drill the second slim well will be made after drilling the first one and will depend on whether the information obtained from the first well is or not conclusive regarding the nature of the geothermal resource. The coordinates of the two slim wells were determined through field investigations works (see Annex 2 for details). The project will proceed to Phase B depending on the results obtained from drilling the slim well(s).
3. **Component A.2: Technical assistance for assessment of the geothermal resource potential and technical supervision (US\$380,000 SREP grant).**
4. **Sub-component A.2.1: Well logging and mud logging (US\$150,000 SREP grant).** This will include analyses of the cuttings from the borehole, well temperature and pressure measurements and gathering of essential data (such as drilling progress, changes in temperature, etc.), both as the drilling progresses and at the end of each drilling stage for the slim well(s).
5. **Sub-component A.2.2: Technical supervision and support consultant (US\$100,000, SREP grant).** This will include support to the R2E2 Fund in technical supervision of the drilling of slim exploratory wells; review of the results and findings of well logging, mud logging, flow testing, and chemical analyses of cuttings; and other technical advice and support.
6. **Sub-component A.2.3: Project audit and operating costs (US\$30,000 SREP grant).** This will include: (a) incremental operating costs of the R2E2 Fund related to implementation of the first phase of the project; and (b) project audits.

Any project funds that are not used during the Phase One of the project will be made available for implementation of the Phase Two if the results from drilling of exploratory wells during Phase One justify the need for Phase Two.

Phase Two

Component B.1: Construction of water infrastructure and rig pads and second phase of exploratory drilling (US\$4,250,000 SREP grant). This component will finance:

7. **Sub-component B.1.1: Construction of water infrastructure and rig pads (US\$250,000 SREP grant).** This will include construction of (a) infrastructure to supply water from the nearby springs or the river to ensure the continuous water supply required for the drilling operation if drilling of production-size exploratory wells is warranted; and (b) preparation of the rig pads where the rig and the associated equipment will be placed, if drilling of production-size wells is warranted.

Sub-component B.1.2: Drilling of production-size exploratory well (US\$3,090,000 SREP grant). This will include drilling of one (or two, if there is enough budget available after completion of Phase One) production-size well if the results from Phase One warrant such drilling. The production-size well(s) will be drilled at the same location as the slim wells and the final coordinates will be determined after the drilling of the slim wells is completed and if results justify the drilling of production-size wells.

8. **Component B.2: Technical assistance for assessment of the geothermal resource potential and technical supervision (US\$910,000 SREP grant).**

9. **Sub-component B.2.1: Well logging and mud logging (US\$150,000 SREP grant).** This will include analyses of the cuttings from the borehole, well temperature and pressure measurements and gathering of essential data (such as drilling progress, changes in flow line temperatures, etc.), both as the drilling progresses and at the end of each drilling stage for the slim well(s).

10. **Sub-component B.2.2: Feasibility study for a geothermal power plant (US\$300,000 SREP grant).** This will include: (a) assessment of the possible power output of the wells, the ratio between brine and steam; (b) assessment of enthalpy; (c) sampling of the brine to decide the type of power conversion techniques to be used and the type of the plant to be constructed, and estimate the power generation potential for a potential geothermal power plant; (d) assessment of the economic and financial viability of the potential plant; (e) legal gap analyses of the institutional and regulatory framework for construction and operation of a geothermal power plant; and (f) preparation of conceptual/preliminary design of transmission lines and a substation, and other infrastructure required for connection of the potential power plant to the grid.

11. **Sub-component B.2.3: Technical supervision and support consultant (US\$200,000, SREP grant).** This will include support to the R2E2 Fund in technical supervision of the drilling operation for the production size exploratory wells; review of the results and findings of well logging, mud logging, flow testing, and chemical analyses; and other technical advice and support.

12. Sub-component B.2.4: Transaction advisory (US\$200,000 SREP grant). This will include provision of transaction advisory services to the Government in order to structure and complete a PPP transaction involving the private sector in construction and operation of the geothermal power plant if adequate resources are confirmed. If needed, the Government will seek additional funding from SREP, Public Private Infrastructure Advisory Facility (PPIAF), Energy Sector Management Assistance Program (ESMAP), and other sources to complement the SREP financing for transaction advisory services.

13. Sub-component B.2.5: Project audit and operating costs (US\$60,000 SREP grant). This will include: (a) incremental operating costs of the R2E2 Fund related to implementation of the second phase of the project; and (b) project audits.