KENYA ELECTRICITY GENERATING COMPANY PLC

KGN-BDD-012-2024

RFx: 5000015660

REQUEST FOR PROPOSAL FOR FEASIBILITY STUDY FOR OLKARIA II REHABILITATION/REDEVELOPMENT PROJECT

(OPEN INTERNATIONAL))

Date: 18th July, 2024

Addendum No. 2

In accordance with the '**Request for Proposal for Feasibility Study for Olkaria II Rehabilitation/Redevelopment Project,** KenGen hereby issues **Addendum No. 2** as follows.

REVISED SECTION 5. TERMS OF REFERENCE

NOTE: *Interested bidders are notified that Section 5: Terms of Reference have been amended as provided below. These replace Terms of Reference contained in the Request of Proposal.*

1.0. KenGen Company Profile

KenGen is a Public limited liability company registered under the Companies Act of the laws of Kenya. The Company was incorporated in 1954, with its core business being developing, managing, and operating power generation plants. It is listed in the Nairobi Securities Exchange, with the Government of Kenya owning 70% shareholding and the public 30%. The Company has a total installed capacity of 1, 904 MW comprising of Hydropower (825.69 MW), Geothermal (799 MW), Thermal (253.5 MW) and Wind (25.5 MW).

1.1. KenGen's Experience in Geothermal

KenGen's geothermal plants are located within the Olkaria region in Naivasha sub-county, about 120KM northwest of Nairobi. The company commenced exploration of the Olkaria geothermal area in the early 1950s, which identified a geothermal potential zone of about 204 km^2, currently known as the Greater Olkaria. The 204 km^2 extension of the Greater Olkaria geothermal zone was divided into seven sectors for the sake of rationalizing the development efforts: Olkaria East, Olkaria West, Olkaria Northwest, Olkaria Northeast, Olkaria Central, Olkaria Domes and Olkaria Southwest. Kenya has a geothermal installed capacity of 984MW and is currently positioned Seventh in the world. KenGen has developed various power plants in the Olkaria area, as indicated in

Table 1 below, with a total installed capacity of 799MW.

Table 1: KenGen Geothermal Power Plants Installed Capacity

KenGen Geothermal Plant	Installed Capacity (MW)
Olkaria I	45
Olkaria II	105
Olkaria I Units 4 & 5	150.5
Olkaria IV	149.8
Eburru Hill	2.4
Wellheads	86.1
Olkaria V	172.3
Olkaria I Unit 6	86.6
Total	**799**

The Olkaria West geothermal field hosts the Olkaria-III power plant, which is a 150 MW binary technology plant owned and operated by an IPP, Orpower-4 Inc., wholly owned by Ormat International. In the Olkaria Northwest sector, a Horticulture Company, Oserian Development Company, has installed two power plants for internal use: a 2MW Ormat binary-cycle power plant and a 2MW backpressure steam turbine.

Studies estimate that there is still considerable geothermal potential in Olkaria; hence, KenGen plans to install additional generation capacity, with the plants listed in Table 2 below being at advanced development stages. Completing these power plants will bring the total installed geothermal capacity in the Greater Olkaria zone to over 1000MW.

Table 2: Planned additional capacity

No.	Project Name	Capacity (MW)
1.	Olkaria I rehab - utilizes steam formally for Olkaria I 45MW	18.3
2.	Olkaria IV & IAU Uprating - no new steam/wells	40
3.	Olkaria II Extension Project	140
4	Olkaria VII	80
Total		278.3

2.0. Proposed Rehabilitation/ Redevelopment Projects

a) Proposed Olkaria II Rehabilitation/ Redevelopment Project

Olkaria II geothermal power plant was built and commissioned within the expansive Olkaria geothermal field. The plant has three generating Units of 35MW each totalling to an installed capacity of 105MW with a net power export to the national grid of 101MW as per the Power Purchase Agreement (PPA) with Kenya Power (KP). Units 1 and 2 were commissioned in 2003/4 while Unit 3 was brought online in 2010.

The Government of Kenya invested in this power plant to spur economic growth by lowering the cost of power by way of displacing expensive thermal energy and stabilizing the power supply by reducing over-dependence on hydropower, which is prone to erratic weather patterns. The project was co-financed by the European Investment

Bank (EIB), the International Development Association (IDA), and the Agence Française de Développement (AFD). However, the power plant has experienced normal wear and tear during its 20 years of operation, leading to increased O&M costs. There is potential to benefit from adapting new technologies, which may result in increased power output arising from better efficiencies and in steam utilization. Spares for this plant are also proving challenging to acquire from Original Equipment Manufacturers due to their obsolescence. Despite the aging power plant, the Geothermal Reservoir and the Steam field are still in good status and capable of sustaining production for many more years. The PPA term for the plant expires in 2028. Therefore, a feasibility study on rehabilitation options is required to ascertain the possibility of extending the power plant's life beyond its current economic life for a further 25 years.

Against this background, KenGen intends to conduct detailed investigations and studies on the current condition of Olkaria II Power Plant and assess the feasibility of rehabilitating/ redeveloping the plant and steam gathering system. In order to this, KenGen is looking to engage a reputable consulting firm to conduct a feasibility study.

b) Proposed Wellheads Power Plants Redevelopment Project

The Wellheads power plants consist of 15 single type condensing turbine generation units (1x5.5MW units and 2x3.2MW units) located in Olkaria area. The total installed capacity of the wellheads power plants is 86.1MW with the units having various commissioning dates. Table 3 show details of the wellheads power plants.

Table 3: wellheads power plants.

Plant	Well	Installed Capacity (MW)	Comm. date	Well data		
				Northings	Eastings	Elevation (Masl)
KWG 01	OW37A	5.5	2012	9901746.457	198973.158	2016.683
KWG 12	OW37B	5.5	2014	9901664.508	198920.137	2016.822
KWG 13	OW37	5.5	2014	9901697.192	198937.185	2016.928
KWG 02	OW43	6.4	2014	9903462.957	200791.492	2107.556
KWG 03	OW43A	6.4	2014	9903476.106	200760.657	2105.003
KWG 04	OW914B	6.4	2015	9899866	205278.2	2009.288
KWG 05	OW914A	6.4	2015	9899792.62	205292.59	2009.271
KWG 06	OW914	5.5	2015	9899836.945	205290.775	2009.204
KWG 07	OW914	5.5	2015	9899836.945	205290.775	2009.204
KWG 08	OW914C	5.5	2015	9899762	205293.6	2009.352
KWG 09	OW915C	5.5	2016	9899955.078	204422.577	1984.807
KWG 10	OW915D	5.5	2016	9899923.741	204402.723	1984.621
KWG 11	OW919A	5.5	2016	9901473.168	204820.478	1983.908
KWG 14	OW905A	5.5	2016	9901245.501	202777.748	1948.088
KWG 15	OW39	5.5	2016	9901775.091	198166.345	2140.575

The wellheads power plants have experienced normal wear and tear since their commissioning, this coupled with lack of redundancies on critical plant equipment, inherent design and installation challenges and unavailability of spare parts have led to increased O&M costs and prolonged unit outages. The PPA term for most wellheads power plants expire in 2028. There is potential to benefit from adapting new technologies and installation of bigger power plants which may result in increased power output arising from better efficiencies and in steam utilization. The wellheads are located close to the existing big power plants hence the study will analyse the possibility of diverting the steam to install an additional unit. It is therefore against this background, KenGen intends to assess the feasibility of redeveloping the wellheads power plants and their steam gathering systems. To do this, KenGen is looking to engage a reputable consulting firm to conduct a feasibility study.

3.0. Feasibility Study Objectives

The objective of the study is to evaluate the technical, economic, financial, social, and environmental feasibility of the proposed Olkaria II rehabilitation/ redevelopment Project and the wellheads redevelopment project.

For Olkaria II, both redevelopment and rehabilitation options shall be analysed, whilst for the wellheads power plants, the redevelopment option shall be analysed.

3.1. Feasibility Study Scope

The scope of the feasibility study is as follows:

a) Proposed Olkaria II Rehabilitation/ Redevelopment Project

i. Collect and collate relevant reports, data, and information for the Olkaria II – 105MW geothermal power plant rehabilitation/ redevelopment study. Such data includes power plant as built drawings, monthly and annual reports, generation data, availability data, capacity tests, steam and brine parameters, environmental audits, structural audits, and other relevant reports.

ii. Analysis of the entire power plant's components and systems, including but not limited to steam supply and reinjection, venting, mechanical, electrical, protection, control & instrumentation, supervision (DCS and SCADA), and all other auxiliary systems.

iii. Assess the current condition, the remaining lifespan of the equipment, and its corresponding risk, and determine if the components should be rehabilitated or replaced. The assessment shall include but not be limited to Non-Destructive Testing (NDT) of Mechanical, Steamfield, and Civil components.

iv. Review structural audit reports, including planned and already undertaken repairs. Assess the structural integrity of powerhouse, other civil structures, building works and foundations and advice on their current condition and their capability to sustain the extended life of the plant after rehabilitation and necessary modifications/additions required.

v. The consultant shall undertake the redevelopment option: whereby siting of a new geothermal power plant preferably near the existing Olkaria II plant. Detailed geotechnical, technology assessments, detailed concept design and financial studies shall be undertaken for the new plant.

vi. Identify specific and cost-effective ways to rehabilitate the Olkaria II geothermal power plant to determine and optimize the plant life extension period;

vii. Review modern existing technologies for the use of geothermal steam in power generation and identify the appropriate technology or improvements that can be utilized during the rehabilitation/ redevelopment to increase the efficiency of the plant;

viii. Produce conceptual designs for the power plant to guide the proposed rehabilitation and redevelopment;

ix. Identify steam gathering system components to be refurbished and/or replaced, taking into consideration the current Turbine inlet pressures, and develop the Steamfield conceptual designs to be in tandem with this;

x. Prepare an overall budget and assess financing opportunities and implications for the rehabilitation/ redevelopment project;

xi. Evaluate the electric power transmission system to confirm if the expected power output can be evacuated using the existing infrastructure and recommend alternative routes/ enhancements if necessary;

xii. Prepare the financial and economic analysis and carry out a Cost-Benefit Analysis (CBA) of the project over the project life;

xiii. Conduct an E&S risk screening and scoping study and then undertake an environmental and social impact assessment (ESIA) in line with relevant national legislation and in line with the applicable international standards and NEMA regulations.

xiv. Provide an implementation schedule for the rehabilitation/ redevelopment project taking into consideration the demand requirements for the power plant and reduction of revenue due to loss of power production;

xv. Prepare a bankable Feasibility Study Report;

xvi. Recommend project implementation and contracting strategy, based on which, the consultant shall develop draft tender documents for procurement of Contractor and Implementing Consultant.

xvii. Transfer of knowledge to client's counterpart personnel.

b) Proposed Wellheads Redevelopment Project

The scope of the study for redevelopment of the wellheads is as follows;

i. Collect and collate relevant reports, data, and information for the wellheads power plants redevelopment study. Such data includes power plant as built drawings, monthly and annual reports, generation data, availability data, capacity tests, steam and brine parameters, environmental audits, structural audits, and other relevant reports.
ii. Analysis of the entire power plant's components and systems, including but not limited to steam supply and reinjection, venting, mechanical, electrical, protection, control & instrumentation, supervision (DCS and SCADA), civil and structural systems and all other auxiliary systems.
iii. Review modern existing technologies for the use of geothermal steam in power generation, - optimise wells allocated for wellheads plants and identify the appropriate technology or improvements that can be utilized during the redevelopment.
iv. Produce conceptual designs for the power plants and steam gathering systems to guide the proposed redevelopment;
v. Prepare an overall budget and assess financing opportunities and implications for the redevelopment project.
vi. Evaluate the electric power transmission system to confirm if the expected power output can be evacuated using the existing infrastructure and recommend alternative routes/ enhancements if necessary;
vii. Prepare the financial and economic analysis and carry out a Cost-Benefit Analysis (CBA) of the project over the project life;
viii. Conduct an E&S risk screening and scoping study and then undertake an environmental and social impact assessment (ESIA) in line with relevant national legislation and in line with the applicable international standards and NEMA regulations. The scope will only cover the new site within Olkaria Domes field where 900 series wellheads are installed.
ix. Provide an implementation schedule for the redevelopment project taking into consideration the demand requirements for the power plant and reduction of revenue due to loss of power production;
x. Prepare a bankable Feasibility Study Report;
xi. Recommend project implementation and contracting strategy, based on which, the consultant shall develop draft tender documents for procurement of Contractor and Implementing Consultant.
xii. Transfer of knowledge to client's counterpart personnel.

The study for both redevelopment of Olkaria II and wellheads is expected to take not more than **8 months** to be completed.

3.2. Feasibility Study Tasks

Task 1: Project Start and Kick-off Meeting

The Consultant shall hold a kick-off meeting with KenGen within two weeks of the contract award to develop a detailed work plan based on the TOR. The work plan shall detail the study timeline and milestones, and this will form the basis for assessing the Consultant's monthly progress. The Consultant shall present and brief KenGen on the concept of a Feasibility Study for the rehabilitation/ redevelopment of Olkaria II Geothermal Power plant and wellheads power plants redevelopment. During the kick-off mission, the consultant shall conduct a site visit to familiarize himself with the project and collect any site data he may require. The site visit will be comprehensive enough to understand rehabilitation requirements and identification of potential sites for the new projects.

The Consultant shall collate and assess the available information and data to be provided by KenGen with a view of determining adequacy of the information and data available and recommend to KenGen any additional information and data required to enable a comprehensive feasibility study. The Consultant shall review these

materials, identify any information gaps and develop a plan for collecting such information which shall include physical measurements at the site.

The kick-off meeting shall be the start date of the study. The Consultant shall issue an Inception report detailing all the works conducted in this task, four (4) weeks after the start date.

Task 2: Review of Kenya's regulatory framework and Energy Market Overview

The Consultant shall review the various regulatory requirements by Energy & Petroleum Regulatory Authority (EPRA), Energy legislations in Kenya, Least Cost Power Development plans on the targets for renewable energy and the planned installed capacity in line with Kenya Vision 2030. The Consultant shall analyze the proposed projects in terms of generation/demand balance as shown in the latest least cost power development plan and the future trends including the drive to achieve net zero. This task should also include justification of the proposed projects in line with the energy sector plans and the projected power demand and supply patterns. Other demand drivers such as the planned Olkaria green energy park and data centers shall be considered.

Task 3: Technical Assessment
1 Proposed Olkaria II Rehabilitation/ Redevelopment Project

i. Existing Plant rehabilitation option
The study should assess all key structures and equipment in the Olkaria II – 105MW Geothermal Power Plant, such as Civil structural & foundations, Mechanical equipment, Electrical equipment, Protection, Instrumentation, and Control (PIC) equipment, Steam and brine gathering equipment and Switchyard infrastructure. The assessment shall include an NDT of ALL major mechanical, steam field and Civil structural components.
In addition, the consultant will conduct a thorough inspection of all Units in the Plant during a scheduled shutdown during the feasibility study.
Based on the technical and steam resource assessment results, the consultant should make recommendations for retention, rehabilitation, redevelopment or replacement of the equipment and civil infrastructure.
The choice of equipment should consider existing technology in other KenGen Geothermal Plants to allow for parts interchangeability and shared experience for the operation and maintenance of the plants. However, this should not limit the application of better technologies for optimized performance of the Units.

ii. Redevelopment option
The consultant shall in addition undertake the following for redevelopment option,

a. The consultant shall assess various sites preferably near Olkaria II, a ranking criterion for the sites shall be developed from which the most feasible site shall be chosen.

b. Detailed geotechnical studies. The geotechnical analysis shall be detailed enough for development of civil work costs, including any earthwork and foundation costs, for the Project. The geotechnical investigation objective is to identify the general subsurface conditions at the site by means of borehole investigations. Three (3) boreholes of 30m depth for the most feasible site will be drilled to inform the design. Other activities including but not limited to geological profiling, soft ground auger boring, trial pits, SPT, soil and rock lab testing will also be carried out.

c. A detailed topographical survey shall be undertaken, the survey shall be done by a system that is able to deliver a high accuracy Digital Terrain Model (DTM). The topographical survey shall be detailed enough to cover proposed new plant site and its associated facilities for an area of approximately $3KM^2$.

d. Review technology options that shall optimise steam consumption and maximise plant output. the consultant shall be expected to consider at least three technology options such as binary, screw expander technologies, dry/wet/hybrid cooling towers etc.

It is expected that the existing Olkaria II plant shall be in operation during construction of the redevelopment option. The existing plant shall be decommissioned after new plant is ready for Steamfield and transmission line integration.

2 Proposed Wellheads Redevelopment Project

The consultant shall undertake the following for the wellheads redevelopment.

a. The consultant shall assess various sites for redevelopment of wellheads, develop a ranking criterion for the sites from which the most feasible site shall be chosen.

b. Preliminary geotechnical and topographical studies. The geotechnical analysis shall use the existing data for development of civil work costs, including any earthwork and foundation costs, for the Project. The geotechnical investigation objective is to identify the general subsurface conditions at the site.

c. Review technology options that shall optimise steam consumption and maximise plant output. the consultant shall be expected to consider at least three technology options such as single flash, binary, screw expander technologies, dry/wet/hybrid cooling towers etc.

Task 4: Geothermal Resource Assessment

1. Proposed Olkaria II Rehabilitation/ Redevelopment Project

The consultant shall analyze the data of all wells assigned to Olkaria II Geothermal Plant and determine their optimal capacity and characteristics. Based on the recommended development option, the consultant shall determine the full and sustainable electrical power production potential of the wells. The consultant shall also establish current and future requirements for makeup and re-injection wells and other field management considerations from their production effects. The consultant shall also evaluate the optimum turbine inlet pressure. The consultant shall analyse the effects of scaling and clogging, flash point characterization and depletion rate of the existing wells as well as inhibitor dosing and recommend relevant mitigation measures or improvements. Olkaria II Wells and outputs are shown in table 4. Compatible software tools for resource assessment shall be described and required.

Table 4. Olkaria II Wells and outputs

#	Well Name	Northings	Eastings	Elevation MASL	OUTPUT (MW)	Remarks
	Production wells					
1	OW-701	9903659	199494	2024	7	
2	OW-727	9903886	199320	2029		Shared Separator (OW-701)
3	OW-720	9903477	199051	2095	9	
4	OW-728	9903390	199430	2036		Shared Separator (OW-720)
5	OW-713	9903063	199460	2036	2	
6	OW-719	9903503	199739	2055	10	
7	OW-726	9903834	199713	2038		Shared Separator (OW-719)
8	OW-715	9904130	199553	2020	4	
9	OW-725	9903912	200351	2146		Shared Separator (OW-705
10	OW-714	9904213	200554	2167	19	
11	OW-716	9904420	200854	2177		Shared Separator (OW-714)

12	OW-705	9903537	200798	2160	14	
13	OW-712	9904022	198980	2184	3	
14	OW-706	9903924	198679	2102	4	
15	OW-710	9904151	198363	2077	3	
16	OW-709	9903418	198730	2135	9	
17	OW-721	9903082	198852	2172	4	
	Hot reinjection wells					
18	OW-R2	9904906	198426	1978		
19	OW-708	9904657	198929	1990		
20	OW-R3	9902561	199790	1993		
21	OW-34	9901800	199982	1957		
22	OW-03	9900982	199982	1964		
	Cold reinjection wells					
23	OW-201	9903555	197769	2091		
24	OW-204	9904213	197119	2026		
	Makeup wells					
25	OW-742A	9903768	198824	2109	15	
26	OW-742	9903749	198795	2113	5	
27	OW-49	9902168	197690	2198	12	
28	OW-49C	9902132	197696	2196	8	

2. Proposed Wellheads plants Redevelopment Project

The consultant shall analyze the data of all wells assigned to the wellheads power plants and determine their optimal capacity and characteristics. Based on the recommended development option, the consultant shall determine the full and sustainable electrical power production potential of the wells. The consultant shall make a robust case for the optimal utilization of each well. The consultant shall establish current and future requirements for makeup and re-injection wells and other field management considerations from their production effects. The consultant shall also evaluate the optimum turbine inlet pressure. The consultant shall analyze the effects of scaling and clogging, flash point characterization and depletion rate of the existing wells as well as inhibitor dosing and recommend relevant mitigation measures or improvements. The wellheads power plants wells and outputs are shown in table 3. Compatible software tools for resource assessment shall be described.

Task 5: Power plant & Steam field Conceptual design for Olkaria II rehabilitation/redevelopment project and wellheads power plants redevelopment

The consultant shall carry out a detailed review and analysis of the Olkaria II power plant, the steam gathering system and reinjection system and the wellheads power plants steam gathering system and reinjection systems. This task together with the recommended turbine pressure inlet pressure (for turbine upgrade if recommended) shall form the basis of the conceptual design for the entire project. The heat and mass balance models and calculations shall be shared with KenGen. Other activities under this task include but not limited to;

a) **Plant conceptual design:** Depending on the recommendations, the consultant shall prepare a conceptual design for the geothermal power plant project. The concept design shall include the updated plant layout of Olkaria II after rehabilitation/ redevelopment and concept design for the redevelopment of wellheads power plants. Specifications shall be made for all power plant systems and other related systems. For wellheads redevelopment

the option of connecting the wellheads steam to uprate/add an additional the existing power plant shall be analyzed.

b) **Steamfield conceptual design and layout:**
i. The consultant shall analyze the current steamfield design and condition for Olkaria II plant and existing wellheads steamfield to recommend design improvement, automation, optimum operating pressures to mitigate against silica scaling and the need for replacement of worn equipment. The consultant shall then develop the conceptual design incorporating the proposed design improvement and proposed makeup wells in the steam gathering and supply system.

ii. The consultant shall analyze the well parameters and steam system for wellheads and make a robust case for each well optimization. The following options may be considered;

1. Wells to be to be connected to other power plants whereby OW 37, OW37A, OW37B and OW 39 wells shall be allocated to Olkaria VII unit 2
2. Wells for redevelopment into power plants (900 series wells i.e OW905A, OW 919A, OW914, OW914A, OW914B, OW914C, OW914D, OW915C and OW915D) whereby depending on the proposed generation technology, the consultant shall develop concept design for steam gathering and reinjection systems including makeup wells for Olkaria V additional unit or a power plant at a more suitable site to be determined by the consultant.
3. Wells to be reserved as makeup wells for other power plants whereby steam in OW43 shall be diverted to Olkaria II to uprate the redeveloped plant. Concept design for interconnection of these wells to the existing power plant's steam gathering system shall be done. Wells connected to wellhead 43 will therefore be included in Olkaria II redevelopment steam field design.

c) **Power Transmission System:** For the wellheads power plants redevelopment and in case the recommended Olkaria II rehabilitation/redevelopment leads to an uprating of the capacity, the consultant shall carry out load flow studies, short circuit analysis, voltage stability, transient fault analysis and other system stability simulations for the power system. The consultant will also carry out a dynamic stability analysis of the power system including stability analysis using PSS/E software. The consultant will also evaluate the ability of the existing power evacuation infrastructure to cater for any enhanced generation capacity.
KenGen will provide the PSSE model of the current grid network, and the consultant is expected to simulate using compatible software.

d) **Drawings:** Drawings will be prepared to show the selected project details, and as a minimum shall include and be adequate for the project. They shall provide the following but not limited to;

- Project location;
- Generation Project site arrangement;
- Powerhouse floor plans and sections, showing both major and auxiliary equipment;
- Power plant single line diagrams;
- Cooling tower and ancillary facilities;
- Generation substation including step up and step-down transformer, switchgear and switchyard arrangement;
- Transmission system single line diagram;
- Steam supply system;
- Hot and cold reinjection disposal and re-injection strategy;
- Water supply arrangement, domestics sewage disposal and,
- Warehouse and offices, and any other associated infrastructure.

All drawings are to be provided in an editable format.

e) **Cost Estimates:** The consultant shall get budgetary quotations from EPC contractors for feasibility level cost

estimation. The costs should cover all costs required for the Olkaria II rehabilitation/redevelopment and wellheads power plants redevelopment project and all costs required for the steamfield including makeup wells, all costs related to the rehabilitation or replacement of the switchgear and all O&M costs for the entire project over the life of the plant.

Other costs include but not limited to;

- Local costs included in the supply and installation contracts;
- Communication facilities including cybersecurity measures for effective load dispatching, protection and control;
- Cost of environmental and social mitigating measures, including abatement of emissions and effluents;
- Rehabilitation or replacement of switchgear and overall control systems, including distributed control system (DCS);
- The cooling tower, cooling water supply, and treatment systems. The FS should examine the expected lifespan of cooling towers and model rehabilitation costs of cooling towers occurring within the 20yr period as O&M costs in the financial model;
- The operations and maintenance cost estimate will be inclusive of (a) fixed O&M costs (spare parts and maintenance materials); and (b) variable costs inclusive of: staffing requirements, supplies and consumables, and training administration.

f) **Implementation Schedule & Risk analysis:** The consultant shall prepare an Implementation Schedule for rehabilitation/ redevelopment of Olkaria II and redevelopment of wellheads power plants (charts, detailing monitors of critical activities and identify interface points etc. for design, procurement, and rehabilitation/construction of the civil, electro-mechanical and electrical works. Yearly project expenditures shall be assessed based on the schedule. The implementation schedule should consider rehabilitation/redevelopment of the Olkaria II third unit after unit 1 and 2 since Unit 3 was installed 6 years later. The implementation schedule will be in line with Kenya's Least Cost Power Development Plan.

An appropriate procurement and contracting strategy for the Olkaria II rehabilitation/redevelopment works and Redevelopment of wellheads power plants shall be included in the report encompassing warranties on main equipment and the overall scope of works.

The consultant shall identify all risks to the project and suggest mitigation plans. The consultant shall also identify risks related to revenues and costs and conduct relevant sensitivity analyses of the financial results with respect to changes in several key variables. The consultant shall prepare an overall risk management matrix for mitigating identified risks and unknowns during planning stage, procurement stage, rehabilitation/construction stage, commissioning, defects liability, and operation period.
The risk analysis will include an overall assessment of the current operation risk as compared to initially identified risk during the project preparation stage, the overall management of the identified risks including a summary of the gaps and opportunities in the risk management process. This will guide KenGen in the risk management and allocation in the proposed new PPA as well as other relevant contracts relating to the power station O&M. The risk management will be conclusive in the identification of risk, allocation, mitigation and adoption of risks including a comprehensive risk management strategy. The consultant shall also prepare a works contracting strategy for project implementation.

Task 6: Environmental and Social Impact Assessment (ESIA) Studies

The Consultant shall conduct an Environmental and Social Impact Assessment (ESIA) study for the new Olkaria II project and new Olkaria V additional unit or at a most feasible site identified by consultant (one big geothermal unit has been proposed using all the wellheads steam from Olkaria Domes field) .The consultant shall submit the two ESIA reports to NEMA for licensing and address all the comments raised by NEMA during reports review. The report must comply with NEMA {EMCA 1999 and Environmental (Impact Assessment & Audit) Regulations

2003} as well as World Bank, KfW and JICA requirements.
The ESIA shall be undertaken in line with relevant national legislation and in line with

- WB ESS 1 – WB ESS 10 as relevant
- ILO Core Labour Standards
- WB/IFC General EHS Guidelines and relevant industry sector specific EHS Guidelines

The ESIA study shall include but not limited to:

i. Conduct E&S Risk Screening.
ii. Prepare an Environmental and Social scoping report for the project and submission to KenGen for acceptance

The Scoping Report shall comprise the following contents

- Brief description of the project, size and layout of the project area, as well as associated facilities (i.e. energy transmission infrastructure and access roads); including a brief description of the project phases and related activities;
- Outline of project area of influence for the different environmental and social receptors;
- Brief description of the applicable legal, regulatory and institutional framework and standards;
- Initial gap analysis of national legal frameworks in relation to applicable international standards;
- Brief description of the biological & physical environment and socio-economic setting;
- Identification of the key environmental and social risks and potential impacts, i.e. aspects/areas that could potentially be impacted by the project, including identification of potentially affected local communities;
- Brief description of the alternatives to be considered in the ESIA;
- Brief stakeholder analysis/stakeholder mapping to identify the stakeholder groups who may be affected by and/or may have an interest in/influence on the Project, including initial consultation of local communities and statutory stakeholders for the scoping process;
- Outline of methodology and approach for community engagement to be applied during ESIA, including national legal provisions for public information and disclosure;
- Outline of the methodology, the approach and the general timeline for the ESIA, including activities and other necessary studies as required.
- Cover (but not be limited to) issues related to
    - *Physical environment:* Topography, geology, soils, meteorology and climate/climate change, surface, and underground water resources (hydrology, water quality and drainage patterns); ambient air quality and noise levels, land use and land cover, landscape and visual amenity;
    - *Biological environment:* Fauna and flora including rare or endangered species; invasive species; protected areas and critical habitats; overall scoping of relevant biodiversity aspects and corresponding sensitivities and topics which are to be addressed in detail in the ESIA
    - *Ecosystem services:* Use of natural resources by local communities, access to such resources and envisaged use of natural resources by the Project (i.e. land/soil/vegetation, water);
    - *Social, economic and cultural environment:* Local livelihoods, land use (including seasonal land use), land tenure, agriculture/livestock farming, demographics, employment, socio-cultural institutions and cultural norms, community health and safety, education, infrastructure, waste management, landscape aesthetics, cultural heritage, vulnerable groups including persons with disabilities; indigenous groups in the Project Area, requirements for undertaking FPIC; status of land adjudication processes in the project area;
    - *Conflicts* within and between local communities,
    - *Contextual risks:* Identification of contextual risks and external threats which may influence the development and operation of the Project and the security and wellbeing of local communities;
    - Impacts on the environment and local communities from *previous geothermal development activities* and other investments in the project area, any legacy issues, lessons learned and

requirements for improvement.

If potential effects of the Project on these receptors (and any additionally identified receptors) are not considered as relevant, a reasonable explanation must be provided; these items are then considered to be "scoped out".

In the context of the scoping exercise it would be of key importance to ensure coverage of risks and potential impacts which would be typical for geothermal projects such as (without limitation)

- Water consumption and potential conflicts between water needs for project purposes and water needs for local communities;
- Severance effects caused by geothermal infrastructure (i.e. pipelines) on local livelihoods (i.e. pastoralist movements);
- Sensitive receptors regarding well blow out and steam pipeline failures;
- Risks related to brine management, heavy metal contamination, risks due to drilling fluids and cuttings, health, and safety risks from hydrogen sulfide gas;
- Participation rights of local indigenous communities, land rights of local communities;
- Commitments to establish and maintain social license to operate in a conflict prone, natural disaster prone environment and vulnerable local communities
- Specific OHS risks and potential impacts related to working at heights, working in confined spaces, geothermal gases, radioactive water, heat and high noise levels;

- Scoping Report to comprise detailed ToR for ESIA and ESMP (all project phases) including monitoring plan
- Detailed ToR for any specialist studies , including for biodiversity studies as appropriate
- Detailed ToR for any other safeguard instruments and processes to be undertaken for the Project
- Annexes such as maps, schedules of activities and time lines

Required qualifications for full ESIA, ESMP and other studies, plans and instruments;

iii. Preparation of terms of reference for the ESIA studies and get approval of these terms of reference by NEMA.
iv. Description of the nature and location, project components and functions, inputs, outputs, key bio-physical features and biodiversity of the proposed projects and all associated infrastructure;
v. Description of the preliminary design of the project;
vi. Evaluate the international, national, institutional and county environmental legislative and regulatory frameworks including the Requirements by Financiers (such as WB, JICA, KfW, IFC) on the environment and socio-cultural and economic concerns and presenting them in a way that ensures the project meets both local and international financing requirements;
vii. Undertake site baseline studies as per Scoping Report on environmental aspects including biodiversity , social and economic aspects as per Scoping Study;
viii. Carry out air dispersion using US EPA approved models such as CALMET/CALPUFF and noise modeling for the proposed project and existing plants and determine the sensitive receptors in the neighborhood of the project sites and make necessary recommendations;
ix. Description of the activities that shall be undertaken during the project rehabilitation/ redevelopment, operation and decommissioning phases;
x. Identification of the potential environmental impacts of the projects and the mitigation measures to be taken on flora fauna and avifauna during and after implementation and decommissioning of the projects;
xi. Carry out comprehensive environmental risk assessment for the sites;
xii. Assessment of project sites environmental restrictions;
xiii. Waste management: identification of the materials to be used, products and by-products, including waste to be generated by the projects and the methods of their disposal during construction, operation and

decommissioning;

xiv. Carrying out assessment of noise, water and air pollution during construction, operation and decommissioning of the projects;

xv. Assessment/determination of land requirements and land agreements for the projects;

xvi. Identification of the economic and socio-cultural impacts to the local community and the nation in general;

xvii. Development of a plan to ensure the relocation or resettlement of persons affected by the project, if any;

xviii. Social analysis including an estimation of the number of persons and structures to be affected by the projects, if any, as well as the identification and estimation of the existing economic activities on the sites;

xix. Determine the employment and economic opportunities that will arise during and after implementation and decommissioning of the project.

xx. Assess all infrastructural issues associated with the project.

xxi. Develop project alternatives.

xxii. Develop plans to ensure the health and safety of the workers and neighboring communities are taken care of;

xxiii. Develop action plans for the prevention and management of possible accidents and incidents during the projects cycle;

xxiv. Develop environmental and social framework with specific plans such as biodiversity management plan, Traffic Management Plan, Human Wildlife Conflict Mitigation Management Plan, Occupational Health and Safety Plan, Community Health and Safety Plan, Dust Management Plan, Biodiversity Management Plan, An Invasive Species Management Plan among other plans deemed fit for all the phases of the proposed project

xxv. Carry out preliminary analysis of contribution of the projects to Green House Gas (GHG);

xxvi. Integration of climate change vulnerability assessment, relevant adaptation, and mitigation actions into the ESIA studies;

xxvii. Development of stakeholder engagement plans and undertake comprehensive public and other stakeholder consultations to ensure inclusive participation during the studies and provide a summary of issues discussed during all the consultations and engagements; This will include at the minimum conducting: Key Informant Interviews with identified stakeholders, Focus Group Discussions, four (4) public barazas/meeting & a key stakeholders consultative forum;

xxviii. Developing an Environmental & Social Management and Monitoring Plan (ESMP) for the project detailing measures for addressing potential negative environmental and social impacts of the project. In addition, the ESMP should clearly identify institutional roles, responsibilities and costs in addressing the mitigation measures that will be proposed in the ESIA;

xxix. Assessment of energy conservation measures during construction, operation, and decommissioning of the plant.

Once the study is completed, twelve (12) hard copies of the reports and a soft copy in a CD disk shall be submitted to NEMA for approval for the ESIA licensing after review and concurrence by KenGen. In addition, the consultant will submit via NEMA portal an electronic version of the ESIA report. The consultant will follow-up on the licensing process and follow through to the end when NEMA issues the license or makes the final decision.

In case the power plant facilities are located within the National Park and/or PAPs need to be resettled, mitigation measures against negative impact on fauna and flora shall be considered.

Task 7: Financial & Economic Analysis

For Olkaria II rehabilitation/ redevelopment and Wellheads power plants redevelopment, the consultants shall prepare an economic and financial analysis of the project to verify its financial viability as well as determine whether it truly reflects the least cost alternative for expansion of Kenya's electric power system. The analysis will determine both the economic and financial rates of return within prescribed assumptions and conditions. The

variation ranges for these conditions within which profitability will be maintained shall also be determined.

The consultant must provide KenGen with all the necessary information so that KenGen, ascertain how the geothermal project is situated within the least-cost expansion plan, comparing it with other power generation alternatives.

A breakdown of cash flow from the projects will have to be given with respect to all cost and revenue components for the entire life of the plant.

Sensitivity analyses of changes in the fundamental parameters must be carried out. In addition, it will be necessary to analyse the impact of any changes in the plant construction time and cost.

The Consultant shall conduct Life Cycle Cost Analysis (LCCA) and estimate the Levelized Cost of Energy resulting from the project. The LCCA shall assess the total anticipated lifetime capital and operating cost for the project, design, rehabilitate/redevelop, operate, maintain, and decommission all aspects of the project. Such costs include, but are not limited to investment, installation, operation, maintenance, connection of makeup wells, refurbishment, and disposal costs that could be encountered throughout the life of the project.

The consultants must use guidelines and methodologies acceptable to the World Bank and other DFIs. The financial & economic evaluation must be documented in clear and sufficient detail, and the report in question will have to illustrate clearly and precisely the results obtained, including a calculation memorandum and a description of the methodology used.

Other activities shall include but not limited to the following;

a. Analyse the operation and maintenance costs of the plants from its date of commissioning against the negotiated O&M costs in its PPA. Determine the cause & magnitude of variation and recommend appropriate O&M costs for the new plants;
b. Analyse and compute the proposed tariff for the projects once rehabilitated/redeveloped project. Both rehabilitation and redevelopment (new power plants) LCOE and tariffs will be analysed.
c. Calculation of financial and economic Net Present Value for the proposed project. All assumptions shall be clearly stated and sources indicated;
d. A financial analysis to assess the financial viability of the Projects. Cash flow analysis of the Project over its lifetime should be provided, and the financial rate of return (FIRR) on the investment should be determined (from an investor point of view);
e. Calculation of all other key parameters such as Levelized Cost of Energy, NPV, FIRR, EIRR, payback period etc.
f. Estimation of emission reduction and corresponding additional revenue from Certified Emission Reduction (CERs);
g. Carry out sensitivity analysis on critical parameters e.g. Capex, interest rate, discount rate, etc. at different probabilities;
h. Early estimates of the cost required to avoid, minimize and compensate E&S impacts throughout the life of the plants;

A live and editable model with formulae and workings shall be submitted to KenGen for review. The Economic and Financial analysis will be presented to KenGen as part of the draft feasibility study and a workshop/Training of the same will be conducted.
part of the draft feasibility study and a workshop/Training of the same will be conducted.

Task 8: Capacity Building and Workshops

The study is expected to take **8 months** to complete. The Consultant shall hold two virtual workshops and one physical workshop during the Feasibility study. The first virtual workshop shall be organized for the presentation of the Consultant's technical work carried out during the first two months of project duration. The Consultant shall inform about the first study findings and the technical assessment of the existing power plant.
The physical workshop shall include all Tasks leading to Task 5. The consultant shall include in this workshop the conceptual design for the power plant and steam field including the well data as reviewed and the recommended upgrade as well as new systems to improve plant efficiencies.

The last workshop shall be held after submission of the Draft Feasibility Report after 8 months of project duration for presentation and discussion of the draft results. The Consultant shall develop two standalone self-sufficient study reports; one report for Olkaria II rehabilitation/ redevelopment and the other report for Wellheads power plants redevelopment. The Consultant should include in his proposal, virtual a training program (3 days) for the clients' staff, on the contents of the feasibility study, geothermal power plant technologies, design, financial and economic modelling of the project.

Activity	**Month after project start**	**Workshop No.**
On completion of Task 3 (Technical Assessment of Existing Plant)	2 months	1 (virtual)
On completion of Task 5 (Power plant & Steam field Conceptual design for Olkaria II rehabilitation/ redevelopment Project and Wellheads power plants redevelopment)	3-4 months	2 (physical)
After finalization of the Draft Feasibility Reports for Olkaria II rehabilitation/ redevelopment and draft report for Wellheads power plants redevelopment	8 months	3 physical- All Tasks. in-person capacity building for 3 days

4.0 Expert Qualifications

The assignment is estimated to require 8 months. Specifically, the Consultant shall provide qualified and experienced staff with first degree or higher from a recognized university and with experience of not less than 15 years in undertaking feasibility studies both for new geothermal power plants and geothermal power plants rehabilitation projects for the Team Leader and at least 15 years of similar experience for the following additional core staff:
Refer to the data sheet for specific qualifications of the experts.

Skill	**Number of persons**	**Minimum years of Experience**
Team Leader	1	15
Reservoir Engineer	1	15
Steamfield Engineer	1	15
Geochemist	1	15

Civil Engineer	1	15
Topographical surveyor	1	15
Geothermal power plant Engineer	1	15
Power systems Engineer	1	15
Energy economist/ financial analyst	1	15
Environmentalist and Social Scientist	1	15
Geotechnical engineer	1	15

5.0 Counterpart staff

To facilitate faster information gathering (from within KenGen and other relevant local agencies) and synthesizing, KenGen shall second staff to work with the consultant on a full-time basis during the Project Inception and Implementation. This will also serve as an opportunity for knowledge transfer, which is critical for capacity building.

The consultant shall involve the KenGen team in all the aspects of the undertaking. The staff to be seconded by KenGen or be available to assist the Consultant shall include:

(i) Reservoir and Steamfield Engineers/scientists
(ii) Instrumentation and control engineer
(iii) Power systems Engineer
(iv) Mechanical Engineer
(v) Environmental Expert
(vi) Social Expert
(vii) Civil & Structural Engineer
(viii) Economist and financial expert

5.1 Data to Be Provided by The Client

The consultant will be provided with all the relevant KenGen reports and data required for the study. The following reports will be available to the Consultants. Other relevant reports that the consultants consider relevant will be availed as requested.

1. Operation and maintenance reports for the power plant
2. Power plant drawings
3. Power plant manuals
4. Mass flows for steam and brine
5. Layout maps showing location of wells and brine pipelines
6. Steamfield design documents showing design of separators and brine systems
7. Updated GIS Maps of the resource area

8. Steam production status reports for the Olkaria field
9. Previous feasibility studies
10. Chemistry of wells

6.0 Reporting Requirements

Based on the tasks, the Consultant is expected to provide the following reports within the timelines indicated for each of:

(a)Olkaria II rehabilitation/ redevelopment
(b) Wellheads power plants redevelopment

i. Inception Report
ii. Report on the update of conceptual power plant and steam field design
iii. Interim Report - Half time of the study- covering tasks 1-4
iv. Draft Feasibility Study Report complete with all studies, technical design, financial and economic analysis as well as the ESIA report. The consultant shall submit 5 hard copies and a soft copy in a CD of final ESIA report for submission to the National Environment Management Authority (NEMA) for review and licensing.
v. Final Feasibility Study Report and Executive Summary (Final Report).
All drawings are to be provided in an editable format.

The Consultant will prepare an Executive Summary of the findings and recommendations, outlining the project's rationale, providing a description of essential features of the project and embracing a summary of his findings and recommendations. The Executive Summary should be designed as a bankable document as it is intended to be used as a basis for seeking financing from lending institutions or attracting possible sponsors to invest in the project.
Ten (10) copies of the final report (both soft copies and hardcopies) will be submitted two weeks after the receipt of KenGen's comments and the workshop. The Consultant shall also handover, to KenGen, copies of software used for analysis of data including the Financial and the Economic analysis Model and simulation. The software used for data analysis as well as the Final Report shall be handed over in soft copy and/or USB drive.

7.0 Terms of Payment

The Consultant's total remuneration shall not exceed the Contract Price and shall be a fixed lump- sum including all staff costs, Sub consultants' costs, printing, communications, travel, accommodation, withholding tax, Value Added Tax and disbursements incurred by the Consultant in carrying out the Services.
The Contract Price may only be increased above the amounts stated if the Parties have agreed to additional payments in accordance with the public procurement guidelines.

8.0 Improvement of Terms of Reference (TOR)

Whereas an attempt has been made to provide a comprehensive list, any error or omission resulting should be exempted. The Consultant may offer suggestions and improvements on the Terms of Reference, which they consider would result in enhancements of the results of the study. Such proposals, if accepted, will form part of the Terms of Reference of the proposals submitted by the consultant. The effect on time and cost estimates given under the above clause shall be clearly identified. The consultant shall abide by this requirement. Any amendments made by the consultant on the terms of reference will be included in the document.

BIDDER'S ACKNOWLEDGEMENT OF ADDENDUM NO. 2

We, the undersigned, hereby certify that the addendum is an integral part of the document and the alterations set out in addendum have been incorporated in our tender document.

Signed …….

Tenderer …….

Date …….