January 12, 2022

Renewable Energy Sector Development Project (RESDP)
Terms of Reference
Exploration Management Consultant
For the Management of an Exploration Drilling Program

1 Background

Saint Lucia has a population of about 180,000 and a Gross Domestic Product (GDP) of US$1.19 billion. The country's economic growth and development are primarily driven by the success of its tourism industry and associated activities. Presently, Saint Lucia depends mainly on the importation of petroleum products to satisfy its commercial energy requirements. Seventy five percent of the diesel oil consumed in the economic sectors is utilized for the production of electricity by the Saint Lucia Electricity Services Limited (LUCELEC).[1] Consequently, energy security including the dependence on diesel oil in the power sector remains a matter of concern.

Additionally, the extremely high and volatile cost of electricity is a major impediment that erodes the country's competitiveness as it seeks to attract a larger share of regional tourism revenues. This not only undermines growth in business and services, but also creates hardship and burdens to private consumers, especially the poor. Additional background information is provided in Appendix 1.

Given these challenges the GOSL has secured funding under the Renewable Energy Sector Development Project (RESDP). The Project will assist the GOSL in continuing to meet achievements made in geothermal development through various investments. The development objective of the RESDP is to inform the Government of Saint Lucia on the viability of its geothermal resource for power generation and strengthen the enabling environment to scale-up clean energy investments with the private sector. Additional information on the Drilling Program under the RESDP is provided in Appendix 2 and in the publicly available Project Appraisal Document[2].

The World Bank's previous safeguards policies apply to this project. An Environmental and Social Impact Assessment (ESIA) specific to the project has been completed by the GOSL based on the potential drilling locations identified as part of a Pre-Feasibility Study completed in 2017 (see Appendix 2 for more information). These documents underwent stakeholder consultations and were publicly disclosed on December 18, 2018[3]. The ESIA provides an Environmental and Social Management Plan (ESMP), a Stakeholder Engagement Plan (SEP), a Resettlement Policy Framework (RPF) and a draft resettlement action plan (RAP). Once the final drilling site locations have been confirmed (as part of this consultancy), the project's safeguards documentation will be updated accordingly, consulted and disclosed.

To implement the RESDP, the Government of Saint Lucia (GOSL) has established a dedicated Project Implementation Unit (PIU) in the Department of Infrastructure, Ports and Transport (DIPT, the "Client").

[1] Saint Lucia Energy Balances (2010 – 2012).
[2] https://projects.worldbank.org/en/projects-operations/project-detail/P161316
[3] Documents are publicly available:
http://www.govt.lc/media.govt.lc/www/resources/publications/01-draft-esia-st-lucia-geothermal-exploration-project.pdf
http://www.govt.lc/media.govt.lc/www/resources/publications/appendix-d-esmp.pdf
http://www.govt.lc/media.govt.lc/www/resources/publications/appendix-e-rap.pdf
http://www.govt.lc/media.govt.lc/www/resources/publications/appendix-f-rpf.pdf
http://www.govt.lc/media.govt.lc/www/resources/publications/appendix-g-sep.pdf

The PIU will provide overall project management and technical inputs on behalf of the GOSL and will be responsible for safeguards, procurement and financial management services.

2 Objectives of the Assignment

The GOSL is seeking management and technical support to supervise and successfully implement geothermal exploration drilling activities under the RESDP (the "Project"), in accordance with international best practices and to manage project-related risks. The GOSL intends to achieve these objectives by contracting the services of an Exploration Management Consulting firm (EMC).

3 Scope of Services

The assignment will be undertaken in two phases:

Phase 1 - Preparation Phase: Comprising of design services, technical engineering support, and assistance with procurement of two main contracts to be financed under the Project and contracted directly by the DIPT: (1) Integrated Drilling Services, and (2) Drilling Civil Works.

Phase 2 - Implementation Phase: Comprising the supervision of the civil and infrastructure works, drilling and logging services and the undertaking and reporting of well testing.

A more detailed description of the deliverables to be prepared under this contract is provided below. For all work to be conducted under this consultancy, the EMC shall take into consideration international best practice, local laws and regulations, as well as World Bank policies and guidelines.

Phase 1 - Preparation Phase: This stage includes all the preparatory work needed to successfully implement the project; viz., project management, design management, detail design for all aspects needed for project implementation, procurement and negotiation assistance. The scope shall include design work (detail design, corrections if needed and as built) needed to drill three (3) slim holes, the scope includes but is not limited to, the deliverables presented below.

1. **Inception Report**: This Report shall include but not limited to description of the methodology to be applied for the complete scope, time schedule (showing traveling and supervision handover at site), work breakdown demonstrating workload for each individual in the Consultant's team. The report shall:
   a. Outline the Consultant's work plan;
   b. Define the review and implementation schedule by task;
   c. Specify submission dates for each one of the required reports (draft, review period, final);
   d. Assign personnel by name and date period for each task. The intent is to minimize COVID risk backup personnel assigned to the project;
   e. Include a Project schedule, broken down by tasks and sub-tasks and presented in an acceptable format, using project scheduling software, such as MS Project;
2. **Market Report**: This Report to include an assessment of potential international drilling contractors as well as local civil contractors, market prices and an identification of potential non-resource related risks associated with the implementation of the proposed drilling campaign. It is assumed that drilling will commence 24h per day and the market sounding shall consider the market appetite and capacity to perform drilling 24h per day. Recommendations on drilling time per day shall consider drilling duration, cost and competition;

3. **Project Manual**: The Consultant shall prepare a project site specific Project Manual covering project administrative issues, construction (including drilling), environmental, social and safety considerations, to reflect the requirements of the ESMP;
4. **Project Summary Report**: The Consultant shall review the Final Report of the pre-feasibility study provided by the DIPT and prepared by GeothermEx. The summary report shall summarize the main findings from the review of the Final Report and itemize any decisions and changes to the proposed design.

   The Project Summary Report shall include but not limited to:
   a. Based on the information provided by the review of the prefeasibility report, the final well locations and targets selected. The locations and targets shall be based on all available data;
   b. A description of the well testing methods/testing techniques that will be utilized to evaluate the geothermal resource potential;
   c. The drilling program prepared by the Consultant, based on a review of the designs presented in the pre-feasibility study, to include preparation of well designs and a decision tree to determine the requirement to either curtail the drilling program or extend to a fourth (directional) well. The suggested location of the fourth deviated well, the target and the slant angle from vertical to be included;
   d. The well prognoses (forecast of geological formations to be penetrated and drilling conditions to be encountered at various depths) prepared by the Consultant, for all wells. The prognoses may be revised during the implementation phase depending on drilling results obtained for earlier wells;
   e. A review and confirmation of the requirements for civil and infrastructure works based on the designs prepared by the pre-feasibility study Consultant. Consideration shall be taken of the local topography, weather conditions and regulatory requirements.

5. **Interim Resource Capacity Report** after reviewing any other preliminary resource capacity reports and available data, the Consultant shall setup and prepare an Interim Resource Capacity Report. This report will be updated after finalization of well testing of the wells (see deliverable below under Implementation Phase - Final Resource Capacity Report).

The Interim Resource Capacity Report shall include but not limited to:
   a. A description of the planned drilling program, including a decision tree for a fourth (directional) well. The suggested location of the fourth deviated well, the target and the slant angle from vertical to be included;
   b. A description of the planned well test program and its compliance with the project's publicly disclosed safeguards documents (see Background) and applicable environmental and social (eg. Access to Information, Consultations, Participation) regulations;
   c. Well prognoses (for all wells);
   d. A description of the expected potential capacity of a future geothermal power plant, in line with UNFC code. Please refer to https://unece.org/sustainable-energyunfc-and-sustainable-resource-management/unfc-and-geothermal-energy.

6. **Detailed Designs**

The Consultant shall prepare detailed drawings (e.g. pipelines, foundations, cellars), P&I diagrams and all other drawings needed. The scope shall include but not limited to:
   a. Civil works design criteria;
   b. The Consultant shall perform all necessary geotechnical investigations needed to finalize the infrastructure design;
   c. Make recommendations on the findings of the geotechnical investigations;
   d. Revise the infrastructure and civil works designs if necessary, based on the findings of the geotechnical investigations;

e. The water supply disposal design criteria, including recommendations for how drilling water is to be supplied;
f. Brine disposal design criteria for all wells to be drilled;
g. Civil works drawings;
h. Detail designs for all infrastructure requirements (water supply, roads, well pads and other);
i. Detail design for well test facilities and equipment as well as brine disposal equipment and facilities. The well testing equipment shall be designed such that they can be easily moved (disassembled and assembled) between wells. The design shall take into consideration equipment available at site and to be provided by the Contractor for relocating the well testing equipment;
j. Work closely with DIPT to ensure that the designs reflect local conditions and construction practices;
k. Ensure Civil and Infrastructure Contractors receive in a timely manner, all information regarding the load bearing structures for the rig equipment and culverts for roads, etc.;
l. Provide technical support and substantial material documentation to facilitate application and obtaining of any Permits required by the Development Control Authority, or other local Permits or Licenses as may be required by fire, road, or other agencies;
m. Advise DIPT on the extent of land required for the civil and infrastructure works based on the final designs;
n. The Consultant shall deliver a **Design Report** containing but not limited to i) design assumptions for infrastructure and well testing, including land requirements ii) cost estimates and iii) time schedule (including design, procurement, negotiation and implementation).

7. Environmental and Social Management (Report on ESMP and Social Assessment Report)

With respect to the Environmental, Social, Health and Safety requirements of the Project, the Consultant shall:

a. Work with the environmental and social consulting firm to be hired separately by the Client to perform the ESIA of the final drilling site locations, and update the ESMPs for those sites accordingly;
b. Participate in all public consultations related to the key project components and update the safeguards documentation of the project;
c. Deliver in a **ESMP Report** (covering environmental and social issues) all the aspects influencing the design of proposed activities for infrastructure and drilling;
d. In coordination with the ESIA Consultant for the final drilling site locations, as well as the PIU's Environmental Safeguards Officer (ESO) and Social Development Officer (SDO), update all relevant Environmental and Social documents e.g. ESIA, ESMP, SEP, RAP, RPF, and any other required safeguards documentation in accordance with the final design;
e. The EMC will review and provide comments on all documentation received from the ESIA Consultant prior to its submission to the World Bank for approval and public disclosure;
f. Work with the PIU's SDO to streamline construction schedule, in line with the implementation schedule of the resettlement action plan and stakeholder engagement plan;
g. Support the PIU to ensure that land required for construction is secured, in readiness for construction activities, in compliance with national and World Bank requirements;
h. Work with stakeholders, including but not limited to: local communities, Forestry, Water Resource Management Agency, Department of Sustainable Development, St Lucia Archaeological Society, St Lucia National Trust, Soufriere Marine Management Authority, Piton Management Area, Solid Waste Management Authority, Environmental Health and the Technical Unit of the DIPT for successful implementation of the Project and compliance with the ESMP contained in the ESIA;

i. Support the PIU in ensuring establishing and maintaining good relationships with the local communities involved and with other stakeholders during the Preparation Phase;

8. Procurement

a. The Consultant shall work with the PIU to develop the procurement strategy and procurement plan for the proposed works, including the selection of the appropriate procurement method and standard procurement documents for each contract, based on the appropriate World Bank Procurement Regulations;
b. Preparation of cost estimates & schedules for all drilling related activities, including infrastructure and civil works;
c. Work closely with DIPT to ensure that the cost estimates and schedule accurately reflect local conditions;
d. Prepare technical specifications for all well testing equipment and detail design;
e. Prepare the technical specifications related to the integrated drilling services including but not limited to requirements to drilling equipment and safety;
f. Prepare technical specifications for infrastructure works including civil works (access roads, strengthening roadways/bridges, straightening of roadways (hairpin bends), drilling site preparation, reserve pits, water supply, camp facilities);
g. Support the PIU in the bid tendering process, including providing clarifications on technical specifications including the preparation of technical evaluation reports;
h. Support the PIU in conducting site visits for all contracts, in person visits is preferred but virtual site visits shall be considered and decided on a case-by-case basis;
i. Provide support to the PIU for contract negotiation/finalization, in line with World Bank Procurement Rules.

9. **Project Site Manual:** The Consultant shall prepare the manual which shall include description on all site related activities, that are required to manage the contractors' activities on site and including environmental, social, health and safety requirements to be observed by all contractors, site staff and visitors, with a written record of any complaints received at the site.

10. Other duties

a. Presentation and discussion of progress reports;
b. Regular status meetings;
c. Prepare all drawings needed for construction and As Built for all aspects of the work

Phase 2 - Implementation Phase: This phase shall include all work directly related to drilling the exploration wells, including well completion; e.g. project management, contract management, supervision, testing, technical assistance and completion of the project. In accordance with the market study and decision on drilling time per day the Consultant shall ensure relevant staff to on-site at all times and available to ensure effective supervision, monitoring and management of drilling activities. The Consultant shall implement all activities, both drilling and infrastructure, in accordance with the laws, customs and practices of Saint Lucia and use the appropriate international standards for carrying out the activities.

Phase 2 Detailed scope

1. Be responsible for the day-to-day contract management of all contracts as "Engineer-to-Contract" or "Employer's Representative" as appropriate;
2. Review and approve contractor quality assurance plans and that the contractor ESMP is consistent with the conditions of the contract. These plans should also be reviewed and approved by the PIU;
3. Use the existing Environmental and Social Management Plan (ESMP) and Resettlement Policy Framework (RPF) developed as part of the ESIA and as updated to reflect final drilling locations,

to ensure compliance, during execution of the works, with the environmental and social monitoring measures;

4. Support the PIU in ensuring, establishing and maintaining good relationships with the local communities involved and with other stakeholders during the Implementation Phase; in line with the Stakeholder Engagement Plan (SEP);
5. Certify all completed works, ensuring quality and standards are maintained before acceptance by the PIU;
6. Supervise and monitor the construction of the necessary infrastructure and civil works (including, but not limited to: roads, drill sites and reserve pits, storage and water supply, well test equipment);
7. Provide mitigation plan consultation for issues as needed during the construction process;
8. Coordinate and work collaboratively with other independent supervising firms that may be engaged or by other independent works contractors within the project area (site) for effective monitoring of works contracts;
9. Inspect all equipment include the drilling rig prior to mobilization to site by the drilling Contractor. The rig inspection should preferably be conducted at the point of origin of the mobilization;
10. Supervise mobilization, infield moves and demobilization;
11. Provision of on-site supervision and management of drilling works by the Drilling Contractor including monitoring and interpretation of geological and other drilling data;
12. Supervise the on-site logging services;
13. Prepare well completion reports and well test reports;
14. Continuously review the planned drilling program in order to ensure early decision making as to any changes to the program, including either early curtailment of the program or the drilling of the optional fourth well;
15. Undertake well testing and certify the test results and interpretation thereof in accordance with an acceptable Geothermal Reporting Code (the Geothermal Reporting Code to be agreed by the EMC and the PIU);
16. Supervise, monitor and report on Health, Safety & Environment (HSE) for compliance on site;
17. Maintain project records, including complaints received at site, using an international reporting system (e.g., Infostat, RIMBASE or equivalent);
18. Track and control costs in accordance with approved contracts, in particular certifying the Drilling Services Contractor (DSC) and other cost claims;
19. Review all design and give timely feedback to the design team to incorporate changes;
20. Represent the best interest of the Client in administration of the contract;
21. Ensure that the Contractor maintains a grievance log register, in compliance with the Project Grievance Redress Mechanism and promptly inform the PIU SDO of any unresolved issues;
22. Provide monthly compliance and assessment reports to PIU on the contractor's performance and execution of the ESMP and Resettlement Action Plan (RAP), and related ESHS (Environmental, Social, Health and Safety) matters as required by Contract;
23. Any other duties related to the scope of the assignment to ensure best practices are implemented throughout the project, including but not limited to the necessary management, monitoring and testing operations to inform the drilling works;
24. Be responsible for convening weekly progress on-site meetings;
25. **Drilling Completion Report**

    Upon completion of the Project's activities, the Consultant shall prepare a completion report, to include:

    a. A description of changes or modifications to the design;
    b. Problems encountered, and solutions adopted;
    c. Overall accomplishments;
    d. Well completion report for each well;
    e. Well testing report for each well;
    f. Conclusions and recommendations.

26. Final Resource Capacity Report

a. Based on the findings from the Drilling Program, the report shall update the Interim Resource Capacity Report to provide the expected potential capacity of a future geothermal power plant, in line with UNFC code. For further information see https://unece.org/sustainable-energyunfc-and-sustainable-resource-management/unfc-and-geothermal-energy;

b. The report shall include an updated geothermal field conceptual model and other models needed.

27. **Interim Feasibility Study**

a. The Consultant shall prepare an interim feasibility study for a geothermal plant, based on the findings in the Drilling Completion Report and the Final Resource Capacity Report;

b. It is recognized that the testing from exploration wells will not likely be sufficient to prepare a full-fledged feasibility study; nonetheless, the findings from the Final Resource Capacity Report shall be used to inform an interim feasibility study, using the best available local data and market information. A final feasibility study will be prepared only once delineation drilling is complete (outside the scope of this consultancy);

c. The report will estimate the economic and financial viability of the geothermal resource and provide recommendations on the legal, contractual, institutional and other key arrangements. The report will support the PIU to make a decision whether to engage with a private developer to undertake subsequent geothermal development stages (delineation and production drilling, and power plant construction) or suggest alternative path to develop the geothermal resource.

4 Working Arrangements and Logistics

The services of the EMC will be provided to the PIU within DIPT. The Permanent Secretary/designate of DIPT will have day to day responsibility for contract administration and supervision of the Consultant.
The PIU will:

1. Ensure timely review of reports submitted by the consultant and facilitate the provision of feedback within ten working days of receipt of reports;
2. Initiate the timely consultation and co-operation of other agencies required to provide support to the consultant for realization of the relevant aspects of the assignment;
3. Facilitate access to the sites;
4. Provide access to relevant existing information, including relevant GIS data, and survey maps in a secure electronic Data Room;
5. Site facilities (offices and canteen) will be provided by the Client or the Drilling Contractor. Depending on the situation with the COVID-19 pandemic, it is possible that on-site accommodation will be provided to the EMC staff. Notwithstanding, all EMC proposals shall include accommodation of the EMC staff as a separate cost item.

The Consultant will:

1. Be responsible for the supervision of its technical experts (key and non-key) involved with implementation of the assignment including providing all office space, software, equipment, materials, accommodation, office requirements and transportation, both on-site and off-site;
2. Submit reports and plans within the stipulated timeframes stated in the Terms of Reference for review by the PIU;

5 Reporting Requirements

The Consultant is required to ensure timely submission of Deliverables during the course of the assignment. Reports shall be delivered to PIU in both MS Word and Adobe PDF format. All report shall be reviewed

by the DIPT and the Consultant shall allow for at least 2 weeks for the review. All reports shall be delivered in soft copies except drilling reports which shall also be delivered in hard copies.

5.1 Progress Reports

The Consultant shall prepare and submit to the Client, regular monthly progress reports throughout the services, in a format to be agreed with the Client and lending institutions.
The progress reports shall at least include written description of:

1. Progress of the works and expenditure to-date;
2. Progress of the works during the reporting period;
3. Future planned works and expenditure;
4. Technical problems, if any encountered, with remedial action taken;
5. Delays of any kind, if any, with proposed action to minimize the impact of the delay;
6. Any other issues, which could facilitate or affect the progress of the work;
7. Expenditure against budget;
8. Site safety, environmental and social issues and incidents, and other ESHS matters as described elsewhere in these TOR;
9. Graphical presentation of physical progress planned/actual, cash flow planned/actual, expected future progress and expenditure, photographs of site related activities.
10. The reports shall include project Gantt charts, scheduling highlight issues affecting Project implementation including scope, cost, time and quality, project critical path and corrective actions taken.

6 Deliverables and Timeline

Table 1. Time Schedule of Deliverables for Phase 1

Deliverable	Copies	Deadline
Deliverable #1 – Inception Report and Market Report Submission of Inception Report including an updated Market Report outlining contacts made, replies obtained and the appetite of operators and investors in the geothermal project	Soft	Within four (4) weeks of contract effectiveness
Deliverable *#2* –Report on the outcome of review of options presented in Pre-Feasibility report, defining the final well locations, well prognoses, and nature of the proposed well tests	Soft	Within ten (10) weeks of contract effectiveness
Deliverable #3 –Report on the Environmental Assessment and ESMP for the execution of civil and drilling works (including social impacts)	Soft	Within twenty-two (22) weeks of contract effectiveness
Deliverable #4 – Design Report including (i) requirements – including land -for infrastructural works (ii) cost estimates for infrastructural works and (iii) a schedule of all infrastructure activities	Soft	Within twenty-eight (28) weeks of contract effectiveness
Deliverable #5 – Interim Resource Capacity Report	Soft	Within twenty-eight (28) weeks of contract effectiveness
Deliverable #6 –Technical Specifications for preparation of the Bidding Documents for civil works contract	Soft	Within twelve weeks (12) weeks upon acceptance of Deliverable #5 by the PIU

Deliverable #7 –Final Technical Evaluation Report for civil works contract	Soft	Within three weeks (3) weeks of receipt of bids on civil works contracts
Deliverable #8 –Technical Specifications for preparation of the Bidding Documents for integrated drilling services contract	Soft	Within sixteen weeks (16) weeks upon acceptance of Deliverable #5 by the PIU
Deliverable #9 –Project site manual	Soft	Within three weeks (3) weeks of receipt of bids on the integrated drilling services contract
Deliverable #10 – Full Construction drawings and approvals for civil works	Soft	Within three (3) weeks of notification of award of contract for civil works
Deliverable #11 – Full Construction drawings and approvals for integrated drilling services	Soft	Within three (3) weeks of notification of award of contract for integrated drilling services

Table 2. Time Schedule of Deliverables for Phase 2

Deliverable	**Copies**	**Deadline**
Monthly progress reports of the civil and drilling works	Soft	By the 15th day of the ensuing month, except the DCR
Drilling Completion Report	Soft and Hard copy x3	Within 1 month after all Consultant demobilize from site.
Final Resource Capacity Report	Soft	Within 1 month after all Consultant demobilize from site.
Interim Feasibility report	Soft	Within 2 months after all Consultant demobilize from site.

7 Schedule of prices

Deliverables and all work related to Phase 1 will be paid on a lump sum basis, as proposed in Table 3. For Phase 2 work, the Consultant will be paid on daily rates (DR) for on site supervision but on hourly basis (HR) for home office support.

Description	**Type of payment**	**Price**
Phase 1: All deliverables	Lump sum	

The PIU will activate Phase 2 of the Assignment – the Implementation Phase by issuing a Notice of Effectiveness of Contract to the Consultant. Work shall not commence unless the Notice has been issued.

Table 3: Schedule of prices for phase 2

Description	**Estimated Quantity**	**Unit**	**Rate**
Project manager	100	DR	
	3000	HR	
Senior Drilling Engineer	130	DR	
	880	HR	
Drilling Engineer	130	DR	

	880	HR	
Exploration Geologist	40	DR	
	1600	HR	
Well-Site Geologists	240	DR	
	50	HR	
Drilling Supervisors (Company Man)	240	DR	
	50	HR	
Civil Engineer	90	DR	
	50	HR	
Environment Expert	480	DR	
	60	HR	
Social Expert	480	DR	
	60	HR	

8 Consultant's Qualifications

Qualification Requirements and Evaluation Performance Criteria
The required minimum qualifications and experience of the Firm, as well as of Key Staff are as defined below in Table 4:

1. At least fifteen (15) years' experience in geothermal exploration and development including technical design of geothermal wells;
2. At least five (5) years' experience in management and supervision of a geothermal deep hole exploration program, experience with slim hole wells is preferred;
3. Completion of at least four (4) geothermal exploration projects during the past ten years;
4. At least three (3) years' overall experience in the Caribbean or similar Small Island Developing States working on similar assignments (not necessarily/specifically geothermal)

Table 4: Qualifications of key staff

POSITIONS	**QUALIFICATIONS**	**SPECIFIC EXPERIENCE**
Project Manager/Team Leader	At least MSc in Geothermal Engineering, Geoscience or related discipline	Not less than fifteen (15) years' experience of geothermal exploration and development, including drilling operations. Not less than ten (10) years' experience in project management. Demonstrable management of drilling and exploration testing in several projects of similar size
Senior Drilling Engineer (Required to work on rotation with the Drilling Engineer during the drilling period, plus to be available for consultation when off-site)	At least a BSc in Drilling Engineering or a related discipline	Ten (10) years' experience in the design of geothermal wells and supervision of geothermal drilling, with the proven ability to anticipate and troubleshoot unplanned events and three (3) years of experience in geothermal deep slim hole drilling

Drilling Engineer (Required to work on rotation with the Senior Drilling Engineer during the drilling period)	At least a BSc in Drilling Engineering or a related discipline	Five (5) years' experience in the supervision of geothermal drilling, with the proven ability to anticipate and troubleshoot unplanned events
Exploration Geologist	At least a BSc in Geology	A minimum of seven (7) years' experience in geothermal investigations, exploration and development, including at least 5 years' experience of drilling operations in a volcanic geothermal environment. Experience in training and supervising rig geologists
Well-Site Geologist (2 positions – to work on rotation during the drilling period)	At least a BSc in Geology	A minimum of one (1) year experience in geothermal activity post graduating, to include at least 50% of time working in the field.
Drilling Supervisor (Company Man) (2 positions – to work on rotation during the drilling period)	Internationally recognized certification in well control	A minimum of ten (10) years' experience of geothermal drilling, including at least five (5) years in a position of responsibility (Tool Pusher, Rig Supervisor, Company Man) and at least 2 years as a Company Man on a drilling rig in a volcanic geothermal environment
Civil Engineer	At least a BSc in Civil Engineering	A minimum of five (5) years' experience in the construction of roads, well pads and other infrastructure for geothermal development projects in a rugged volcanic environment.
Environment Expert	At least MSc in Environmental Engineering or a related discipline	Minimum ten (10) years' experience in Environmental Assessment of projects.
Social Expert	At least an MSc in Social Sciences or a similar discipline	Minimum ten (10) years' experience in Social Assessment of projects

APPENDIX 1: Detailed Background

In 2015, LUCELEC generated 338 GWh of electricity that was distributed amongst its 67,011customer base, comprising 59,766 residential customers and 7,226 commercial and industrial customers. LUCELEC operates 88.4 MW of name-plate generation capacity at a single power plant, the Cul De Sac Power Station (CDSPS), utilizing diesel, although the actual firm generation output capabilities are lower (68 MW) due to the advanced age of some of the generation units. LUCELEC also operates and maintains a 66 kV transmission and an 11 kV distribution network. LUCELEC's 66 kV transmission network is close to the location of the areas of potential geothermal interest. In 2016 for the first time, LUCELEC added 75 kW of solar PV generation capacity and plans to add a further 3 MW of utility scale solar PV and 12 MW of wind energy, both intermittent generation.

Geothermal development is a useful option for diversifying the power generation mix in Saint Lucia, as it can provide reliable base load electricity in an environmentally sustainable manner at lower and less volatile costs. The Geothermal potential in Saint Lucia has preliminarily been estimated at about 75 MW (Soufriere Geothermal Resource – Integrated Assessment Report of March 2016), which is comparable to the currently installed generation capacity in the island, and, if realized, adequate for supplying the average demand of less than 40 MW.

There have been numerous efforts to explore the resources in the Soufrière region in the past. The area that was explored is called the Qualibou depression and it is where the Sulphur Springs are located, which lies just south of the coastal town of Soufriere and approximately 20 km from the capital, Castries. The Sulphur Springs area has long been considered to be near the center of the region having geothermal potential in Saint Lucia. It has been studied since 1951 when the United Nations sponsored reconnaissance investigations visited the Sulphur Springs area, and via drilling in the 1970s and 1980s.

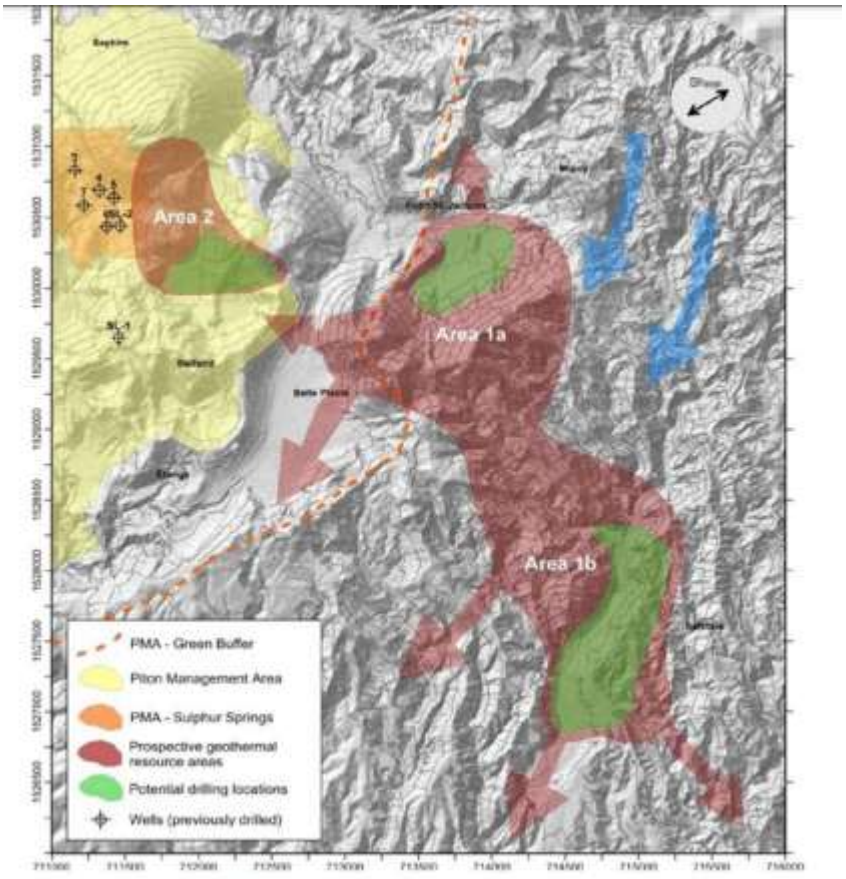
In the 1970's, seven wells were drilled to approximately 750 meters depth in the immediate vicinity of the Sulphur Springs. Several of the wells encountered temperatures in excess of 200^{o}C and penetrated a steam cap. In the 1980's field studies were re-initiated including geology, geochemistry and geophysics within the greater Qualibou depression. This work was followed by the drilling of two deep exploration wells, SL-1 at Belfond and SL-2 at the Sulphur Springs. Both wells encountered temperatures above 250^{o}C, with poor permeability in SL-1. On the other hand, SL-2 was productive with a flowing enthalpy of 2,900 kJ/kg and a mass flow rate decreasing from an initial 17.4 kg/s to 9.2 kg/s at the end of the short-term test, with aggressive (highly acidic) thermal fluid chemistry. SL-2 subsequently suffered mechanical failure (casing collapse).

The Sulphur Springs are also a major tourist attraction that contributes significantly to the Saint Lucia economy, and together with the two dramatic Gros and Petit Pitons (sharp-peaked mountains) which symbolize the island, they make up the Pitons Management Area (PMA). In 2004, the PMA was declared by United Nations Educational, Scientific and Cultural Organization (UNESCO) to be a World Heritage site and inscribed on the World Heritage list. In order to maintain this desirable designation, the Government of Saint Lucia (GOSL) has established development limits and criteria for areas of the PMA and placed Sulphur Springs within their "Policy Area 2 – development exclusion area" so as to prevent environmental degradation.

Figure 1. Location of the PMA on Saint Lucia and Policy Areas of the PMA

The previous drilling in the Sulphur Springs area did not yield results that confirm all of the major field characteristics necessary to confirm commercial viability. However, a recent review, by the World Bank, of existing surface reconnaissance and drilling data, identified an area of interest away from the Sulphur Springs (where most of the previous drilling took place). These areas were of interest since they could still have sufficiently high temperatures while the fluid chemistry may be more benign (given its distance from Sulphur Springs area), thus presenting the possibility of an operation that can be commercialized. Given these findings, the GOSL has decided to further explore the geothermal prospects in areas south-east of the Sulphur Springs, to determine their commercial viability. The RESDP supports an exploratory deep slim hole well drilling program to be financed by multiple development partners. Potential geothermal resource development areas and possible locations for exploratory drilling were identified in the Soufriere Geothermal Resource – Integrated Assessment Report of March 2016. The area delineated as Area 2 is within the PMA. The areas delineated as Area 1a and Area 1b are outside the PMA (see Figure 2) with the main focus of the program on Areas 1a and 1b (see Figure 2). Consequently, Area 2 is of secondary interest.

Figure 2. Areas of Exploration Interest identified in Integrated Assessment Report (March 2016)



Despite constraints on some parameters, field inspections carried out by the Pre-feasibility study Consultants, indicate that exploratory drilling is feasible at the sites identified in Figures 3, 4 and 5.

Figure 3. Preferred Drilling Area at Belle Plaine identified in final Pre-feasibility study Report (December 2017)

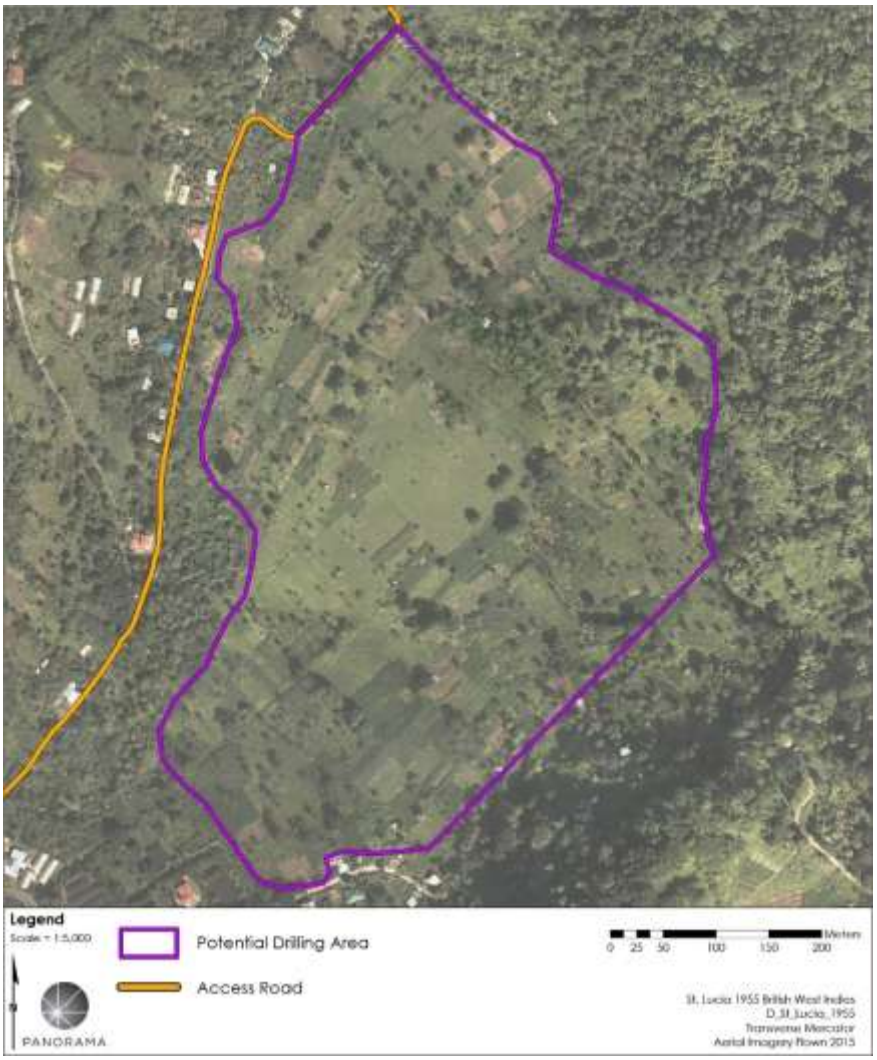
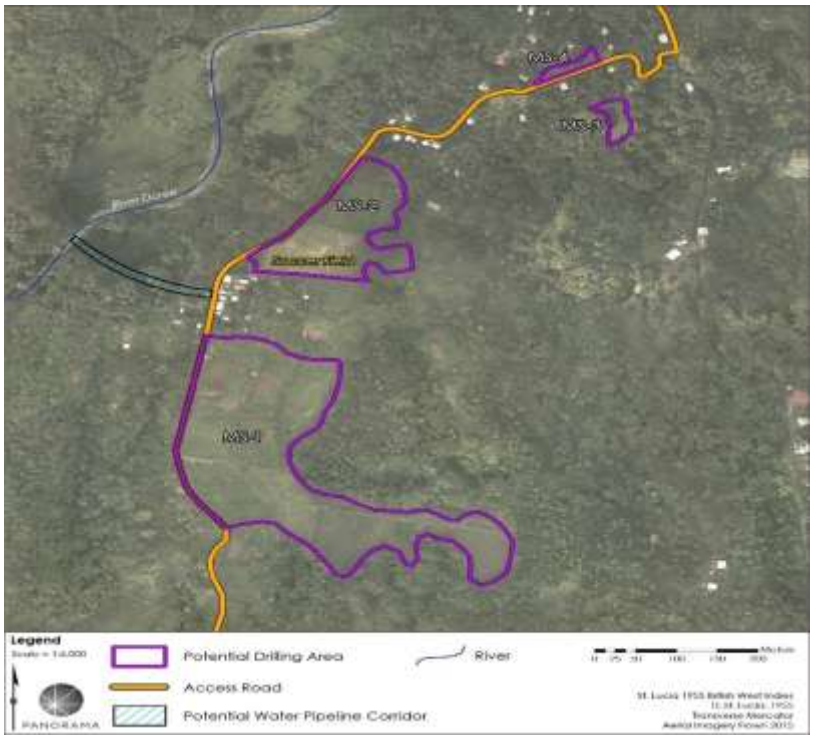


Figure 4. Preferred Drilling Area at Fond St. Jacques identified in final Pre-feasibility study Report (December 2017)

Figure 5. Preferred Drilling Area at Mondesir-Saltibus identified in final Pre-feasibility study Report (December 2017)



The RESDP will undertake a deep, slim hole exploration drilling program, which is designed to confirm and characterize the resource base, and thus mitigate risks for the development of the first geothermal power

plant in Saint Lucia. This exploration drilling program intends to publicly finance a targeted drilling campaign, specifically including the drilling of at least three and possibly four deep slim-hole exploration wells, to a nominal depth in the range of 1,200 to 1,500 m with the option to drill to 2,000 m, well testing, and provision of related geo-scientific services. Given the high risk involved in the early stage of a geothermal project, public sector de-risking of the exploration drilling phase will strongly improve the overall economics of geothermal development. At the completion of the public sector funded exploration drilling campaign, the delivered exploration drilling report will provide sufficient data and information to confirm or otherwise modify the current hypothetical reservoir model and, with a reasonable degree of confidence, whether a geothermal resource of sufficient quantity and quality exists in the project area of interest.

APPENDIX 2: Detailed Description of the Drilling Program

It is envisioned that the exploration drilling program under the RESDP will consist of a (1) general Civil/Infrastructure contract, and (2) an Integrated Drilling Services contract.

A general Civil/Infrastructure contract for the following:

a. Strengthening and straightening roadways and crossings between the landing port and the drilling sites to support the transport of the drilling equipment;
b. Construction of any new roads to provide access to the drilling sites;
c. Preparation of drill pads and sumps;
d. Preparation of drilling water supply system;
e. Provision (fabrication) of equipment required for well testing (probably under sub-contract);
f. Manpower assistance during well testing to erect well test equipment, including brine reinjection temporary piping, operating valves and other equipment under the direction of the well test engineer;
g. Site maintenance works during and after the drilling operations, including restoration works that may be required after drilling;
h. Other civil works determined to be necessary to ensure satisfactory completion of the exploration activities.

A drilling services contract to be undertaken on an Integrated Services Contract (ISC) basis, not on an Integrated Project Management (IPM) basis. This contract will (depending on the results on the initial market survey) include:

i. Provision and operation of a suitable drilling rig, capable of rotary drilling and of continuous wire-line coring and potentially drilling to 2000 m vertical depth, but capable also of slant drilling if required to drill the fourth well off one of the other well pads and capable of conventional rotary drilling of the shallow sections of the well;
j. Provision of long lead items (casings and well heads);
k. Provision of drilling fluid materials and services;
l. Provision of cementing materials and services;
m. Provision of core boxes, plus equipment for site examination of cores and cutting samples;
n. Provision of base camp facilities, security and all safety equipment and systems;
o. Provision of downhole wire line logging services;
p. Other services that may be required to complete the exploration drilling program.

Depending on the results of the drilling and general contract market survey, additional contracts may need to be established for some of the above activities.