UNIVERSIDAD PARA LA COOPERACIÓN INTERNACIONAL
(UCI)

DEVELOPMENT OF A PROJECT MANAGEMENT PLAN FOR A 2 MW SOLAR FARM PROJECT IN GROS ISLET SAINT LUCIA

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This Final Graduation Project was approved by the University as
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DEDICATION

Dedicated to the people of Saint Lucia,
who I want to serve and contribute to,
by advocating and working for
improved energy security,
a cleaner environment,
increased ability to stand out on the world stage,
and a better standard of living.

ACKNOWLEDGMENTS

Several people have contributed to the FGP presented today. I would like to sincerely thank all the staff, lecturers, advisors and academic assistants who have guided, advised and mentored me along this journey. These investments into my life and personal development have culminated not just in this FGP document, but in the growth, I have experienced during my time with the University for International Cooperation. I especially thank my tutor, Osvaldo, for his patient guidance and support throughout this process, especially since I had many competing priorities with my current employment while trying to complete this FGP.

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Finally, I wish to thank my family and friends who have supported me throughout this journey in various ways. Most of all, I have two people to thank: The first one is my husband, for his unwavering support and patience throughout the process. Thank you for staying up with me, investing your time and effort. Thank you for the sacrifices we have made for our future. The second person is my father, who always pushes me to do more and to do better and expects only greatness from me.

My sincere gratitude to all who have been a part of this FGP process, and to all who have contributed to this work and my growth as an engineer, academic, and a well-rounded person.

ABSTRACT

This Final Graduation Project aims to develop a project management plan according to PMI standards and best practices for the construction and implementation of a 2MW solar farm in the Gros Islet quarter of Saint Lucia. Saint Lucia is a small island developing state in pursuit of aggressive climate goals which involve, in large part, a commitment to install increasing amounts of utility scale renewable energy. The goals are not just climate specific, but also have implications for energy security due to the importation of diesel fuel and the associated price volatility.

The FGP resulted in the development of scope, cost, schedule, quality, resource, risk, communication, stakeholder, and procurement management plans for the 2MW Solar Project according to PMI standards. It will also measure the project against the P5 sustainability standard and make recommendations for compliance. The final deliverable is a project management plan inclusive of integration, scope, cost, quality, procurement, resource, communication, risk, stakeholder and sustainability management plans. Some sample project template documents for the project are also included. The work is completed primarily using analytic synthetic research methods and the Project Management Institute, and GPM Global guidelines.

Key Words: Sustainable, Renewable Energy, Life cycle Management Solar, Project Management Plan.

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CPI	Cost Performance Index
CPM	Critical Path Method
CV	Cost Variance
EPC	Engineering Procurement and Construction
ESIA	Environmental and Social Impact Assessment
FGP	Final Graduation Project
GDP	Gross Domestic Product
GPM	Green Project Management
KPI	Key Performance Indicator
kWh	Kilo Watt hour
LUCELEC	Saint Lucia Electricity Services Ltd.
NDC	National Determined Contributions
P5IA	People, Planet, Prosperity, Process and Products Impact Analysis
PMBOK® Guide	Project Management Body of Knowledge
PMI	Project Management Institute
PMIS	Project Management Information System
POI	Point of Interconnection
PSC	Project Steering Committee
PV	Photovoltaic
RBS	Resource Breakdown Structure
RCA	Root Cause Analysis
SDG	Sustainable Development Goals
SPI	Schedule Performance Index
SV	Schedule Variance
US DOE	United States Department of Energy

EXECUTIVE SUMMARY

Saint Lucia is a 238-square mile island in the Eastern Caribbean with climate goals of reducing emissions and drastically increasing the island's renewable energy penetration. The energy environment is ablaze with actors, proposals and potential for development as efforts continue towards achieving the country's National Determined Contributions (NDC) emissions targets. Historically, local energy projects have consisted of diesel engine generation, carried out by the local utility company. In 2017, a 3 MW solar farm was erected by the local electrical utility company: Saint Lucia Electricity Services Ltd or LUCELEC, in Vieux Fort, an area located in the southern part of the island.

In line with the energy goals for the country, a 2 MW solar farm has been conceptualized for installation in the northern part of the island as there is a high demand for power there. Currently, regulations to produce energy from renewable sources by an entity other than the local utility company, St. Lucia Electricity Services Ltd. are still being developed. The likelihood is that a bidding process will ensue which will determine which projects are built and when. This project is intended to be constructed by an independent power producer with support from Konfyans Consulting for project management. This FGP will, with the assistance of a consultant, develop a project management plan for the construction of this solar farm, and thereby establish the precedent for future solar farm installations in Saint Lucia. It will define the project and make it eligible for a potential bidding situation.

The general objective of the final graduation project is to develop a project management plan for the design and construction of utility scale 2 MW solar renewable energy project in Gros Islet, Saint Lucia in compliance with PMI standards and international best practice to increase the likelihood of successful project implementation. The specific objectives of the final graduation project, in line with the general objective, are to establish a project charter, a series of project management plans to ensure that all project aspects are covered, and the project is executed according to PMI standard, and to conduct a sustainability analysis of the project to ensure alignment with the P5 Sustainability standard. The specific objectives comprise the production of a series of deliverables. These deliverables include a project charter to validate the existence of the project, a project scope management plan to define the project requirements and deliverables, a schedule management plan, a cost management plan to establish project budget and cashflows, a quality management plan to ensure that the solar farm can optimally operate upon commissioning, a resource management plan to identify the materials and staffing required for a successful project, a procurement management plan to ensure that all resources are available when required, a communication management plan, a stakeholder management plan to ensure that all stakeholders are aware, on board and adequately informed, and a risk management plan to establish contingencies and take advantage of opportunities.

The methodologies used in the elaboration of this final graduation project include the utilization of analytic, synthetic, as well as empirical research methods. This involved the collection of data from various sources including the experience of the author, expert

interviews, local and international institutional expert documentation of renewable energy projects, policies and industry trends. Some of the most important data sources on renewable energy best practice from the National Renewable Energy Laboratory, and the Rocky Mountain institute were used. Benchmarking, interviews, flowcharts, gap analysis, brainstorming and analysis were the key tools used in the design and analysis of the project management plan for the 2MW utility scale solar renewable energy project for the island of Saint Lucia.

The FGP developed has produced a workable project management plan for the 2MW Solar Project which aligns with many of the United Nations Sustainable Development Goals. The project will reduce emissions from power generation by displacing fuel consumed, and at the end of the life cycle, the panels will be recycled, reducing waste from the project. The project will also cause minimal disturbance to the neighboring community and ecosystems, bolstering buy-in from the community.

The conclusion and recommendations of the FGP provide an overview of the project with respect to the integration, scope, cost, schedule, communication, risk, quality, stakeholder and sustainability management plans that were developed. They highlight some of the focus areas emerging from the FGP analysis. For the success of this FGP, the project manager is a critical stakeholder and must ensure that the integration plan, change control process, scope baseline, schedule baselines and cost baseline are kept under control. The manager must also ensure the use of quality materials, ensuring that site acceptance controls are carried out, for the benefit of both the procurement and quality plans. The conclusions also emphasize the importance of rewards and recognition, proactive team and stakeholder communications and engagement, and a comprehensive and inclusive risk management process. Finally, the project manager was charged to exhaust the P5 framework for continuous sustainability-based evaluation of the project at all project stages to maximize project value creation.

1 INTRODUCTION

This first chapter of the Final Graduation Project (FGP) gives a bird's eye view of the main aspects of the proposed project. It first defines the context within which the problem has been identified, and the company providing the solution will operate. It clearly states the problem, and the purpose of the FGP; breaking down that purpose into a broad general objective, and 11 specific objectives, which become the chapters of the Results section.

1.1. BACKGROUND

SAINT LUCIA'S ELECTRICTY INDUSTRY

Saint Lucia is a small island developing state located in the Windward Islands of the Caribbean. The island has an area of 238 square miles, and a population of about 180,000. In 2019, the island had a peak electricity demand of 62.5MW (LUCELEC 2020). Electricity development in Saint Lucia began with the establishment of many small and disparate facilities scattered throughout the island's terrain (LUCELEC, n.d). Thereafter, the sole electricity company on the island was established, consolidating these small facilities (LUCELEC, n.d). The company has directed the island's energy future from its incorporation in 1964 and it has been governed by the Saint Lucia Electricity Supply Act. The passing of that Act gave the company an 80 monopoly on the transmission, distribution, generation, and sale of electricity of Saint Lucia. Several amendments to this act have since been made to the sector, including the addition of a regulator, the National Utilities Regulatory Commission (NURC) with responsibility for the regulation of the electricity sector including regulating the electricity grid, the entrance of new actors into the electricity sector, and management of distributed solar deployment among other duties. Saint Lucia signed onto and ratified the Paris agreement on April 22nd, 2016, thereby agreeing to play its part in limiting global warming to "well below 2^{o}C" with a goal of a limit of 1.5^{o}C. Associated with the agreement are nationally determined contributions, or actions and sub goals that the countries undertake to see to it that the goals are

accomplished. The current national determined contributions (NDCs) target for sector-wide emissions is a 7% reduction of greenhouse gases (GHGs) produced in the energy sector by 2030 (GOSL 2021). The local energy sector consists of the transport and power generation industries. The reduction of greenhouse gas emissions associated with energy industries target three greenhouse gases; carbon dioxide, methane, and nitrous oxide. Some of the actions proposed to achieve this target include carbon sequestration and the installation of renewable energy projects.

KONFYANS CONSULTING

Konfyans Consulting is a relatively new consulting firm based on the island of Saint Lucia. It exists with the primary purpose of supporting government and private sector entities in the pursuit of their energy goals. The mission of Konfyans is "To champion the global energy transition through local action and empowerment, to leverage opportunities for SIDS economic growth, to leave a legacy of prudent and climate-conscious citizens." The company's vision is "To empower small island states to sustainably attain energy best practice."

The company team has qualifications in electrical and mechanical engineering, energy management, modeling, research and project management, making it well suited to undertaking the assigned task. The team has established relationships and a keen understanding of the inner workings of the three main institutions existent in the energy industry in Saint Lucia, namely the electric utility company, the regulator, and the Government of Saint Lucia.

1.2. STATEMENT OF THE PROBLEM

Previously, there has been no full project management plan constructed for a solar farm project of this magnitude for the Government of Saint Lucia. The Energy and Public Utilities division is a small unit and cannot design and recommend energy policy –their core function, as well as implement the recommended projects coming out of policy action plans. The division is tasked with designing, facilitating and sourcing funding for programs and projects

in line with the national energy transition strategy for the country. However significant technical (engineering), project management and modelling support is required. Furthermore, additional generation is required to be installed in the north of the island to reduce the loading on the transmission lines as loads in the north of the island continue to grow.

1.3. PURPOSE

As mentioned in the problem statement, there is no existing project management plan for the execution of the 2MW grid scale solar farm project intended for implementation in Gros Islet, Saint Lucia. It is therefore in the interest of the energy unit to invest in technical support. This is where Konfyans Consulting has stepped in to provide engineering, project management and modelling support.

Establishing a project management plan for the 2 MW solar farm will ensure that the development of the solar farm will run as smoothly as possible. The project will generate 3.5 GWh annually and 87.5 MWh over its operational lifetime. This will mean a significant contribution to the reduction in emissions because of not using diesel fuel to generate 87.5 MWh over the operational life of the project.

Establishing this project management plan will also help to standardize the project management process because the implementation of several additional solar projects is expected over the next 10 to 20 years in pursuit of the country's climate goals. Each time the plan is used, lessons learned can be documented and applied in order to improve all the components of the plan. The increased success of subsequent projects following the implementation of the project management plan will go a long way in assisting Saint Lucia with meeting its nationally determined contributions and climate goals.

1.4. GENERAL OBJECTIVE

To develop a comprehensive project management plan, within the framework of the standards set by the Project Management Institute, to implement a new 2 MW solar farm in Gros Islet Saint Lucia effectively, efficiently and sustainably.

1.5. SPECIFIC OBJECTIVES

1. To create a project charter that formally sanctions the new 2 MW Solar Farm Project and grants the project manager the authority to use project resources efficiently.
2. To develop a project scope management plan to describe and define the scope of the 2 MW solar farm. The scope management plan will define, develop, monitor, and control the project to meet stakeholders' stated and unstated requirements and avoid scope creep.
3. To create a schedule management plan that establishes how the project schedule will be created, monitored, and controlled for the implementation of the new 2 MW solar farm within the appropriate time.
4. To develop a cost management plan, outlining how the project costs will be planned, structured, managed and controlled to complete the 2 MW Solar Farm Project within the allocated budget.
5. To establish a quality management plan to establish the guidelines, policies, and procedures to be implemented in achieving the quality objectives of the grid operator, Saint Lucia Electricity Services Limited, within the triple constraint of time, scope, and cost.
6. To define a resource management plan which establishes the categorization, allocation, management, and release of the resources required to complete the 2 MW Solar Farm Project successfully.
7. To create a communication management plan to define how the information regarding the new 2 MW Solar Farm Project will be communicated to all stakeholders involved, on a timely basis and in an appropriate manner to ensure effective communication during the project implementation.
8. To outline a risk management plan to establish how risk management activities will be formulated and executed for the 2 MW Solar Farm Project.
9. To create a procurement management plan to define which approaches, processes, procedures and appropriate goods and services will be acquired to ensure that the 2 MW Solar Farm Project is completed on time.

10. To create a stakeholder management plan to define the strategies and actions to promote stakeholder engagement in decision-making and in the execution of the 2 MW Solar Farm Project.
11. To assess the compliance of the implementation of the 2 MW solar farm with regenerative development and the P5 Standard.

2. THEORETICAL FRAMEWORK

Chapter 2 of the FGP establishes the theoretical framework of the FGP by setting out the company framework, and project management concepts foundational to the establishment of the FGP. The company framework sets out the background, mission, vision, organizational structure, strategy, as well as the products offered by the company, Konfyans Consulting. Since the FGP produces a project management plan for the solar farm project, an overview of the PMI project frameworks namely: the project management performance domains, principles, knowledge areas and processes were identified. The project management concepts section also describes and defines adaptive, predictive and hybrid approaches to projects. Finally, the theoretical framework outlines other theories which are applicable to this project.

2.1. COMPANY FRAMEWORK

The company conducting this research is a consultant company, Konfyans Consulting, working on behalf of the Government of Saint Lucia to provide project planning and oversight on the 2MW Solar Farm Project to ensure that the project is executed in accordance with best practice.

2.1.1. ENTERPRISE BACKGROUND

Konfyans Consulting is a new consulting firm based on the island of Saint Lucia. It exists with the primary purpose of supporting government and private sector entities in the pursuit of their energy goals.

2.1.1.1. Mission and Vision statements

Mission Statement

To champion the global energy transition through local action and empowerment, to leverage opportunities for SIDS economic growth, to leave a legacy of prudent and climate-conscious citizens.

Vision

To empower small island states to sustainably attain energy best practice.

Note: Own Work

2.1.2. ORGANIZATIONAL STRUCTURE

The company structure of Konfyans Consulting consists of the CEO, who is a trained mechanical engineer with a Master of Energy degree and several years of experience working for electric utility companies as well as with energy projects. She is supported by a technical team in four main divisions. These divisions are project management, energy efficiency, research and modelling, and energy economics. The teams converge to provide a comprehensive perspective to a variety of energy focused initiatives from long term focused modelling and forecasting endeavors to shorter term feasibilities, project plans and technical advising.

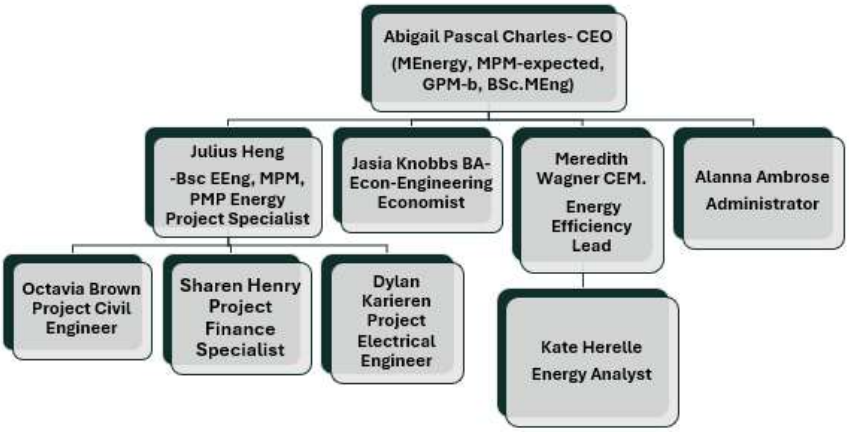

Figure 1 Organizational structure: Konfyans Consulting

Note: Own Work

The project management unit is headed by Sharen Henry MPM, while Meredith Wagner heads the energy efficiency unit, Jasia Knobbs the energy economics unit, and Julius Heng leads the research and modelling unit. The entire team is supported by Alanna Ambrose, the administrator.

The consultancy is designed to work alongside the three main stakeholders in energy project development in Saint Lucia. These main stakeholders are the Government of Saint Lucia through the Division of Energy in the Ministry of Infrastructure, Ports, Transport, Physical Development, and Urban Renewal, the Regulator, National Utilities Regulatory Commission, and the electric utility company, Saint Lucia Electricity Services Limited.

2.1.3. PRODUCTS OFFERED

2.1.3.1. PROJECT MANAGEMENT

The project management arm of Konfyans Consulting provides project preparation, planning, technical support and funding sourcing services. Project preparation involves project design support from conceptualization and funding. The company also weighs on its history of project experience to provide owner's engineering support to governments, and utilities in need of technical support in designing and overseeing the construction of energy projects.
The company also provides project management best practice consultancy services supporting project management maturity development through its project unit. This unit provides project development frameworks for various types of projects and helps to implement strategies to close in on gaps to achieve best practice.

2.1.3.2. ENERGY EFFICIENCY AUDITS

The company performs energy audits for companies by evaluating their monthly energy consumption. The energy star rating of equipment and how that equipment performs is also evaluated and a recommendation report is submitted to the client for implementation. The company can also facilitate (but not actually implement) any recommendations for retrofitting energy devices for improved energy efficiency and provide monitoring of that performance on an ongoing basis.

2.1.3.3. ENERGY SECTOR CONSULTANCY SERVICES

Having a broad area of expertise in the energy industry, the company provides technical consulting services in the areas of energy policy, energy legislation, and tariff setting through the economics, research and modelling sections.

2.1.4. COMPANY STRATEGY, PORTFOLIOS, PROGRAMS AND PROJECTS

The company's strategy is defined in 4 quadrants.

1. Financial
2. Customer
3. Internal processes
4. Enablers

These four quadrants lay out the focus of the company in terms of achieving its mission and vision of supporting the energy transition in small island developing states.

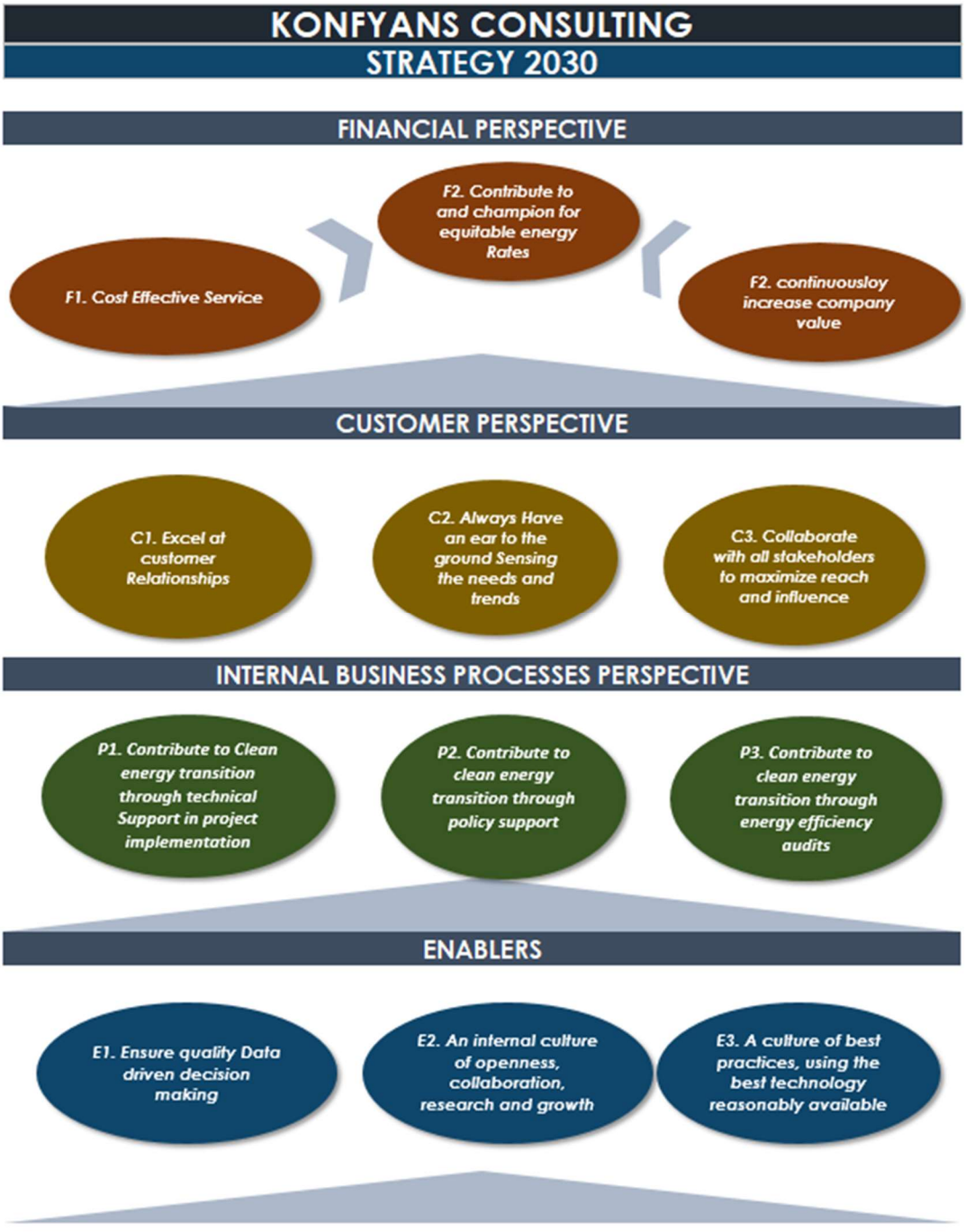

Figure 2 Konfyans Consulting Strategy Map

Note: Figure Content – Own Work. Figure format- Adapted from "Strategy Map template-Excel" SmartSheet. (2004). Copyright 2004 by SmartSheet.

The company strives to be customer-centric –where its indirect customers are the people of the country, while its direct customers are the major energy stakeholders of Saint Lucia. It needs to remain connected to these stakeholders to always be aware of the most pertinent issues so that it can provide the appropriate consultancy services. This helps to meet its own bottom line and increase company value.

The company provides services in –energy efficiency, project management and policy and planning support (including modelling) all of which are documented as part of the company's internal processes. All of the company's internal processes and objectives are supported by a need to maintain a quality, focused, data driven culture that is open and attentive to changes in technology and keeps abreast of these. With this strategy, Konfyans is well positioned to achieve its mission and vision.

The company takes on consultancy work in line with its corporate mission and vision and its strategy of supporting the energy sector development in small island developing states. The projects currently being worked on by Konfyans Consulting are listed in TABLE 1.

TABLE 1 KONFYANS CONSULTANCY PROJECTS

PROJECT	EXPERTISE AREA(S)	STRATEGIC ALIGNMENT	YEAR COMPLETED
Development of Project Management Plan for a 2MW Solar Farm in Gros-Islet Saint Lucia	Project management energy economics	P1	2024
INVESTIGATING THE CO-BENEFITS OF ELECTRIC VEHICLES AND SOLAR FOR THE ISLAND OF SAINT LUCIA	Energy economics modelling	P2, F2	2020

Note: Own Work

2.2. PROJECT MANAGEMENT CONCEPTS

2.2.1. PROJECT MANAGEMENT PRINCIPLES

The most applicable project management principles based on the PMBOK 7th Edition are elaborated below.

2.2.1.1. STEWARDSHIP

The principle of stewardship in the context of this project speaks primarily to environmental stewardship and the fact that the energy projects implemented through this project management plan should comply with regenerative development principles as much as possible. This will help ensure the reversal of years of environmental damage prompted by past energy projects.

2.2.1.2. STAKEHOLDERS

The energy landscape is typically perceived in a limited manner and often reduced to its infrastructural components: Generators, poles, lines, and technical efficiency. However, the structures that support and create energy landscapes, or champion new practices are determined by stakeholder input. Government, regulators, and utilities must work together to ensure a stable electricity sector. As the energy sector continues to diversify, and with multiple actors potentially coming on board as generators, the pool of stakeholders will constantly increase. Power systems require demand and supply to be in constant equilibrium, or to remain as close as possible to that equilibrium to stably serve all customers (Eicke et al., 2021). Stakeholder management is therefore crucial for the creation of the right conditions for the market to thrive, and for all customers to be equitably served.

2.2.1.3. ADAPTABILITY AND RESILIENCY

Typically, electricity generation projects have been characterized by large power plants housed in buildings. For small islands, these generation types include diesel engines, combined cycle power plants, et cetera. The renewable energy transition involves technologies like solar and wind which are not enclosed in buildings, although supportive

infrastructure like substation equipment and batteries may be stored in buildings. As the effects of climate change become more apparent and weather systems more unpredictable, it is important now more than ever that every energy project constructed is built to be resilient against the threat posed in whatever context of operation.

2.2.1.4. TAILORING BASED ON CONTEXT

Each project is unique (Project Management Institute 2017). Moreso, each energy project is unique to its local values, grid topology, regulatory, climatic, and resource-constrained context. Therefore, the project management plan for the 2MW solar farm and its development methodology need to be both specific to the Saint Lucian context, and effective in engaging and addressing the project environment in Saint Lucia, including its social, political and environmental aspects.

2.2.1.5. NAVIGATING COMPLEXITY

Many energy projects are innately complex. A project is a system of interacting elements (Project Management Institute, 2021). Best practices may be defined well in large countries and grid contexts. Even when best practice is enacted, each project has unique resource characteristics and unique grid interaction capabilities. Furthermore, the initiation and conceptualization of energy projects must be done based on thorough and complex modeling-based integrated resource –and now resiliency plans. Therefore, managing complexity is a critical underlying thread to developing a unique project successfully, and therefore for the development of this project management plan. Integrated resource and resiliency plans have both technical and human complexity. Most of the complexity, however, is human, due to varying and sometimes conflicting opinions involved in making energy plans and procurement decisions.

2.2.1.6. QUALITY

Quality is a key principle of project management with the goal of ensuring quality projects that meet both short and long terms goals. In the case of electricity generation projects, this means satisfying stakeholder expectations of reasonable cost, and reliability of supply, as

well as the project and product requirements of a functional, resilient energy system which is well integrated into the grid and compliant with the grid code and other regulations.

2.2.1.7. LEADERSHIP

"Everything rises and falls on leadership" (Maxwell 2019). In order to support the energy transition, adequate leadership and championing the cause of clean energy and well-executed projects are necessary at the highest level of the electric utility, government, and regulator. Moreso, the championing and leadership, regardless of style, need to be well-coordinated for success. This means national strategies need to underpin the transition (Deloitte 2022).

2.2.1.8. RISK

Risk in energy projects is a key factor in the project management plan development. Known risks from previous projects may be documented, but they may not be available for application to future projects. Risks need to be continually evaluated because new risks may develop at any time due to internal human factors or unpredictable market changes which affect supply chains and project economics. A notable example of this is the fact that 2022 post-covid supply chain factors fueled scarcity and price hikes for many critical commodities. In the context of energy projects, one of the best examples of this was the project risks associated with a sevenfold lithium price increase in May 2022 over early 2021 prices (International Energy Agency 2022), fueling increases in battery energy storage projects. Risks like these can be the deciding factor in project failure and so an energy project framework needs to consider practices for the mitigation of project risks.

2.2.2. PROJECT MANAGEMENT DOMAINS

The project management domains are functional groupings of project activities, placed together for increased efficacy of implementation (Project Management Institute 2021). The new PMBOK 7th Edition has 8 project management domains. They operate in an integrated and interdependent manner to facilitate the successful completion of a project that is

compliant. The domains most applicable to the framework will be explained below, as well as their impact on the project methodology this final graduation project refers to.

2.2.2.1. STAKEHOLDER PERFORMANCE DOMAIN

The stakeholder performance domains speak to the creation and maintenance of a positive and functional relationship between project stakeholders with various levels of power, interest, and influence during the project (Project Management Institute 2021). Effective operation of a project within this domain requires stakeholder analysis by the project team and strategizing the best ways of engaging these stakeholders during the project.

Producing a project management framework for analyzing projects in Saint Lucia means the development of a consistent stakeholder management framework inclusive of the main organizational stakeholders of the energy project development process, the main actors within these organizations and the typical culture which bear on the process. However, it will involve an awareness of how quickly these factors can change due to the political climate, or simple changes in leadership. Therefore, the framework should allow for flexibility and consideration of factors like personality and style, and how these can be well managed to leverage the best outcomes for the country.

2.2.2.2. TEAM PERFORMANCE DOMAIN

The team performance domain, when executed well, means that the project culture facilitates a diversity of thought and actors, yet shares focus and ownership of the ultimate task of completion of the project to meet stakeholder requirements (Project Management Institute 2021). Excelling in this domain means that the project manager is a servant leader, who knows when it is most appropriate to implement various leadership styles. The project manager will also facilitate team member development by providing opportunities for growth while ensuring the quality of the expected team member deliverables. The team supporting a successful project should be a high-performance team, displaying among other attributes resilience, empowered behavior, recognition for excellence, openness, and collaboration (Project Management Institute 2021).

The framework for energy projects for implementation in Saint Lucia developed through this work will interact quite lightly with this project domain. The framework will speak to the optimal team composition in terms of skillset, along with more general factors like the need for recognition and empowerment in team dynamics.

Team dynamics and team performance are crucial to project success, however, it may be difficult to determine what the best practice is, since personality, environment and culture of the teams may be highly unpredictable. This may be a gap to be analyzed in future research, but currently, such factors are best fleshed out by the individual teams and project managers for the specific project context and project management plan.

2.2.2.3. PLANNING PERFORMANCE DOMAIN

The planning performance domain warrants a methodical and realistic approach to the project resulting in the project meeting its deliverables. Some of the variables involved include the developmental approach, the related organization process constraints, and external conditions. All these variables must be accounted for in the project plan. The planning domain will involve estimations for budgeting, and schedules at the least, and many techniques exist for performing this estimation, as well as for strategizing how to deal with issues arising which affect the ability to confirm the planned estimates.

This domain also includes procurement, resource, and communication planning.

For the framework, this domain is key and will form the bulk of the framework, as many of the anticipated gaps in project implementation exist in the procurement, resource as well as human communication and interaction areas.

2.2.2.4. DELIVERY PERFORMANCE DOMAIN

This domain exists to ensure that projects achieve their strategic intent. It includes ensuring that the right requirements (scope, and quality) are defined and understood by all, and that projects are aligned with the overall business objectives and strategies. For the framework's purposes, delivery performance means that it ensures that any project it covers is in line with Saint Lucia's National Energy Transition Strategy.

2.2.2.5. MEASUREMENT PERFORMANCE DOMAIN

Measurement performance domain ensures that there are quantifiable means of assessing project success during the project. The data measured via this domain provides scope for benchmarking projects and providing useful and reliable data for making critical project and strategy decisions (Project Management Institute 2021).

The project framework will need to ensure the implementation of standards measurement frameworks so that project successes can be suitably and reliably measured for project accountability.

2.2.2.6. UNCERTAINTY PERFORMANCE DOMAIN

The uncertainty domain proactively looks at the operational environment seeking out opportunities and threats so that these can be realized and mitigated respectively. It requires a knowledge of the project environment, and the uncertainties associated with that environment, as well as the appropriate budget and time reserves for mitigating these.

This domain will form one of the key approaches to developing the framework in that the gap analysis required to identify the shortfalls in the current process, is analogous to conducting a risk assessment of the energy project environment, and so this domain area is key to framework development.

2.2.3. PREDICTIVE, ADAPTATIVE AND HYBRID PROJECTS

The main features of predictive and adaptive projects are described in

TABLE 2.

TABLE 2- PREDICTIVE AND ADAPTIVE PROJECT DEVELOPMENT APPROACHES

Project Type	Predictive	Adaptive
Common Name	Waterfall	Agile
Risk	Typically, can be well defined.	Usually applied to projects with a lot of uncertainty.
Requirements	Typically, can be well defined.	Usually there is some understanding of requirements, but they may not be very easily defined.
Availability of previous project examples	Yes, and document templates are also usually available.	Adaptive projects should be handled on a case-by-case basis.
Customer feedback	Occurs in defining requirements and at fixed reporting periods or as is agreed upon.	Regular feedback at least at the end of every sprint.
Format of project plan	A large plan at the beginning which is usually maintained with small tweaks.	Small sprints of 1 to 2 weeks associated with a single deliverable. The sprints may shorten as feedback from the customer is continually received.

Note: The data concerning the various approaches is from A guide to the Project Management Body of Knowledge (PMBOK® Guide) Sixth Edition. Project Management Institute (PMI), 2017, Copyright 2017 by Project Management Institute, Inc.

and A guide to the Project Management Body of Knowledge (PMBOK® Guide) Seventh Edition. Project Management Institute (PMI), 2021. Copyright 2021 by Project Management Institute, Inc.

2.2.3.1. HYBRID DEVELOPMENT APPROACHES

Hybrid development approaches are a blend of adaptive and predictive approaches utilizing the applicable components of each as is seen fit for the project. They tend to be either iterative or incremental approaches (Project Management Institute 2021). Incremental approaches involve a single deliverable, which is steadily improved or built through each of the sprints and is only considered complete at the end of the final sprint. An iterative approach, however, improves the deliverable at each sprint, and may produce a usable product at the end of each sprint.

2.2.3.2. APPLICATION TO THE ENERGY PROJECT METHODOLOGY

The framework will seek to provide guidance for selecting the correct approach for the various types of energy projects which may occur in Saint Lucia. Typically, energy projects are waterfall type projects, particularly generation projects, which tend to be relatively low risk and proven in implementation. However, implementing distributed generation and geothermal energy projects entail much more risk, both in a global context and also in the Saint Lucian context and so, hybrid type approaches will be more applicable.

2.3.PROJECT MANAGEMENT

The project management institute defines project management as a temporary effort using specific resources (tools, knowledge, techniques et cetera), carried out for the purpose of producing a unique result or product (Project Management Institute 2017). Projects and project management also provide the tools and basis for firms to achieve their strategic priorities and competitive advantage if a proactive approach is taken in implementing them with strategic goals in mind. However, it is not enough to simply conduct projects in line with the company strategy, the projects must be measured along their life cycle to ensure

that they remain compliant with and supportive of the strategy, using not only the triple constant, but also ensuring benefit realization (Keenan et al 2016). An emerging area which is key to project management is the area of sustainability. As previously mentioned, project management produces a unique result or product, but uses up resources in the process. Therefore, the way the project is administered in a world that is increasingly environmentally conscious has become a core part of the definition of project management. This expanded definition means that resources must not be over utilized, but rather utilized to maximize efficiency, resource output, and overall to support achieving competitive market advantage (Armenia et al. 2019).

2.3.1. PROJECT MANAGEMENT KNOWLEDGE AREAS AND PROCESSES

This section will contain a brief overview of the project management knowledge areas not covered in depth with the project domains of Section 2.2.2.

2.3.1.1. PROJECT INTEGRATION MANAGEMENT

This knowledge area synthesizes all the other knowledge areas and domains and can be thought of as the project manager's knowledge area, since integrating project components is the job of the project manager. This knowledge area involves maintaining a bird's eye view of the project and ensuring that it remains on course, continually considering the alternate approaches and development strategies in response to the situations arising. It includes project chartering, monitoring, controlling and closing the project.

For the development of a project framework, the project integration management knowledge area can be seen as a high-level framework for the methodology developed. The framework will perform some of the same functions as project integration management knowledge area in the following ways:

1. Unifying the other domains and project areas to help ensure project success (in the case of multiple projects).
2. Providing the basis for the development of a project management plan.

3. Providing a means for continual development of the methodology through feedback and knowledge retention.

2.3.1.2. PROJECT LIFE CYCLE

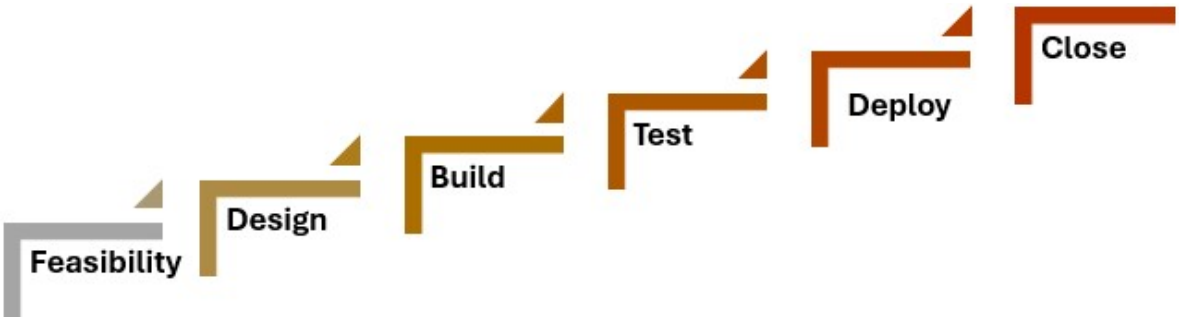

Figure 3 Project Life Cycle Phases

Note: Adapted from A Guide to the Project Management Body of Knowledge (PMBOK® Guide) Seventh Edition. Project Management Institute (PMI), 2021 Figure 2-9, p. 43. Copyright 2021 by PMI, Inc. Permission not sought.

The main stages of project development are displayed in Figure 3. In a predictive project, each of these phases needs to be completed before the next phase begins. Consequently, the project feasibility will need to be proven before design begins, and design would need to be completed before any construction begins.

Many energy projects follow this style, since they are tried and tested, however, the predictive project cycle may not necessarily require the completion of one phase before another begins. For example, many projects have long lead items. In the case of a solar and battery storage system, the lead time on batteries could be over 1 year depending on scarcity issues, whereas the solar panels may mobilize more quickly.

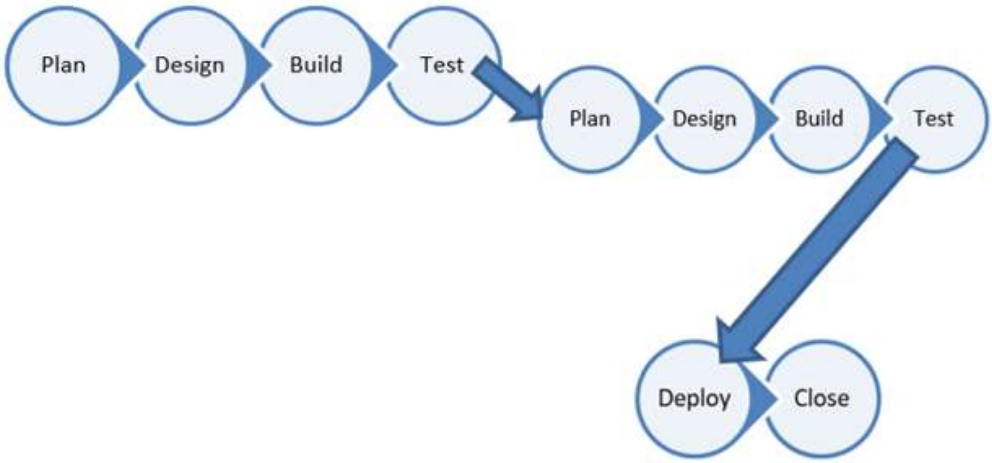

Figure 4 An Example of an Incremental Development Approach

Note: Adapted from A Guide to the Project Management Body of Knowledge (PMBOK® Guide) Seventh Edition. Project Management Institute (PMI), 2021 Figure 2-10, p. 44. Copyright 2021 by PMI, Inc. Permission not sought.

Since most of the time would be spent on foundation works for the solar and battery farm, once the design of the civil works is done, taking into consideration the electrical design for running cables et cetera, site mobilization and earth works can begin, even though the long lead items may not have arrived yet in order to minimize on critical path time.

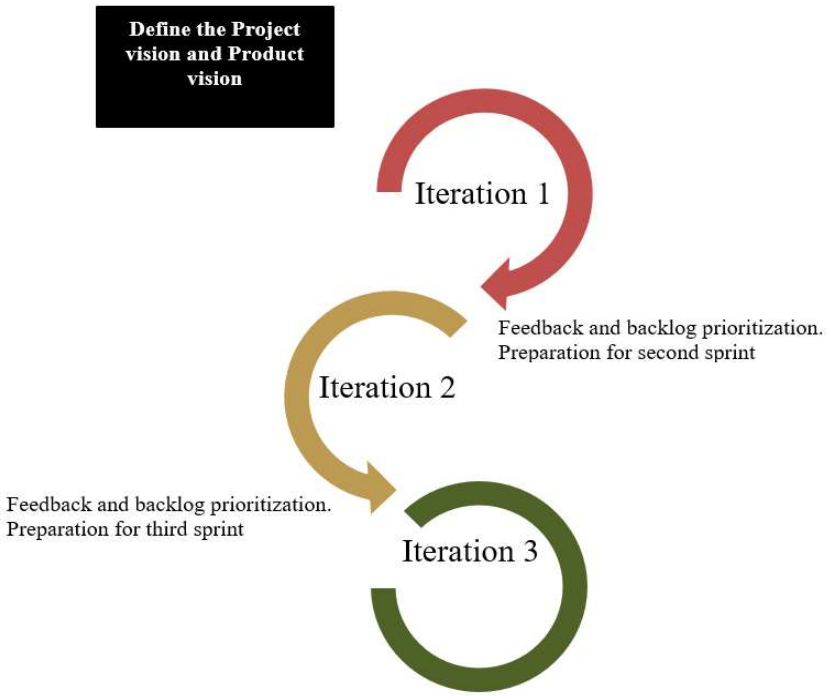

Figure 5 Adaptive Project Develpment Approach (Adapted from PMI, 2021)

Note: Adapted from A Guide to the Project Management Body of Knowledge (PMBOK® Guide) Seventh Edition. Project Management Institute (PMI), 2021 Figure 2-11, p. 45. Copyright 2021 by PMI, Inc. Permission not sought.

Iterative approaches, like that of Figure 5 occur when there is a high degree of uncertainty in a project. A good example of this is the Saint Lucia Geothermal Project which has been under investigation since the 1970s with much surface exploration, which has iteratively been reperformed as technology has improved and funding was made available (Heim & Lui 2018). This surface exploration constitutes the pre-feasibility stage, which precedes the feasibility stage: the drilling of a slim-hole well to prove the resource.

The final project life cycle type that was explored is the adaptive type. Adaptive project methodology has been explained in Section 2.2.3. These project life cycles may be recommended for portions of the project where the most uncertainty lies before moving into a more predictive project approach.

2.4. OTHER APPLICABLE THEORY RELATED TO THE PROJECT TOPIC AND CONTEXT

2.4.1. CURRENT SITUATION OF THE PROBLEM OR OPPORTUNITY IN STUDY

In Saint Lucia, energy projects have been historically conceptualized, installed and commissioned only by the Utility, Saint Lucia Electricity Services Ltd. Though the utility typically and historically has driven and owned energy projects, the government has been pivotal in supporting and creating the best environment for projects to be implemented. The government has facilitated energy projects by:

1. Enacting energy legislation which gives a favorable rate of return to the utility and allows duty free operation for items directly related to electricity generation and transmission.
2. Assisting with land acquisition for major energy projects, like the Cul de Sac Power Station, which currently produces most of the country's electricity.

However, governments change, and as the global environment has turned to favor market liberalization, a third party has entered the equation, namely the National Utility Regulatory Commission. As new generation actors come into an equation, the processes will change, as is both expected and necessary.

New legislation is being considered and ratified in the year 2024, which will allow for third parties to bid for implementation of energy projects in Saint Lucia. Historically, the country's electricity supply has been highly reliable due to the standard of service provided by the utility. The introduction of Independent Power Producers and other third parties in an unmanaged manner is a risk to that reliability, and therefore, the interconnection of new entrants to the grid needs to be well managed. As part of the new legislation, a new grid code (or interconnection rules) is being established. However, addressing the gap in implementing best practices for managing new energy projects is essential as new developers enter the industry. This project management plan will establish precedence for future projects in the absence of a comprehensive framework or standard.

2.4.2. PREVIOUS RESEARCH DONE FOR THE TOPIC OF STUDY

There has been lots of advancement in the renewable energy sector worldwide as countries champion the cause to meet their climate goals. Some of the pertinent areas of research applicable to this project plan are discussed in this FGP.

2.4.2.1. PROJECT FEASIBILITY

Best practice for energy projects goes back to feasibility and pre-feasibility. This means not just proving that an energy resource exists on a particular site, but including comprehensive energy resource mapping that shows all the possible sites in the territory (Office of Indian Energy 2015). A solar resource map for Saint Lucia is displayed in Figure 6. Similar maps for wind, geothermal and tidal energy can be developed as a comprehensive energy assessment of the country.

Figure 6 Solar Resource Map for Saint Lucia (ESMAP 2019)

Note: The figure shows the solar resource available in Saint Lucia. Reprinted from the Global Solar Atlas, by Solargis, 2019. Copyright 2019 by Solargis. Permission not sought.

2.4.2.2. PROJECT MOTIVATION

Project motivation is an often-overlooked factor in energy project development. Often, stakeholders rush ahead, spurred on by financial and technical requirements only, supposing that these contain sufficient inertia for a project to be successful. However, commitment and clear purpose are equally important for starting and sustaining a project.

2.4.2.3. PROJECT TEAM CONSTITUTION

Typically, energy projects in Saint Lucia have been carried out solely by the Utility, Saint Lucia Electricity Services Limited. Therefore, the teams have been internally staffed with the support of external developers when required. However, the Government of Saint Lucia does not have this inhouse expertise, and government run energy projects of national importance are beginning to demand the structured involvement/inclusion of other stakeholders on project teams (Office of Indian Energy 2015). These other stakeholders include the community, and government representatives.

2.4.2.4. PROJECT PLANNING AND PREPARATION

The Unites States Department of Energy has several best practice guidelines including requests for proposal development (Better Buildings 2016) and producing power purchase agreements for cities (Leung & Bailey 2018), (IREC 2015). Power purchase agreements and requests for proposals are perhaps two of the most important preconstruction steps and decision-making points in that these processes are directly responsible for the selection of the contractor who will construct the project and the rate the consumer will pay for the energy served for the useful life of the project.

2.4.2.5. OTHER THEORY RELATED TO THE TOPIC OF STUDY

The other theories presented above speak to project feasibility, project planning and preparation, project team constitution and project motivation for a particular project. These are all potentially overlooked factors in the execution of a project, so it is extremely important to consider and address them.

3. METHODOLOGICAL FRAMEWORK

The methodological framework defines the FGP research methods employed. This methodology speaks to the assumptions made in performing the FGP, defines the primary and secondary data sources, and methods of data collection and analysis. Additionally, this methodological framework defines the representation, and decision-making tools utilized in FGP construction, the limitations, constraints and deliverables to be achieved by the FGP. Each element of FGP methodology is linked to one or more of the projects' specific objectives. The methodology provides important context as to what was done, and how it was done and gives credibility to the results produced by the process.

3.1.INFORMATION SOURCES

Information is "knowledge gained from investigation, study or instruction" (Merriam-Webster, n.d.). Information sources provide information about things or people, and may include observations, documents, photographs and speeches. Information sources are typically classified as primary, secondary or tertiary sources.

3.1.1. PRIMARY SOURCES

Primary sources are "the raw materials of history" (Library of Congress, n.d.). They include the original documents, photographs, and data sources from an event, describing firsthand what occurred in the absence of external interpretation.

This means that the primary sources are new information and display the genuine, earliest thinking on a matter (University of Minnesota, n.d.). Some, but not many primary resources are used in this FGP. Primary sources in this context refers to the actual project information from past projects, including project reports, documented and articulated lessons learned, interviews on project experience, and the experience of the author in project management and project development in Saint Lucia. It will also include interviews with first-hand project implementers to learn from and analyze their experiences.

3.1.2. INFORMATION SOURCES OVERVIEW

TABLE 3 INFORMATION SOURCES

No.	Objectives	Information sources	
		Primary	**Secondary**
1	To create a project charter that formally sanctions the new 2 MW Solar Farm Project and grants the project manager the authority to use project resources efficiently.	-Meetings, interviews with lead project experts, templates from MPM course.	-PMBOK Guide 6th Edition -Organizational process assets
2	To develop a project scope management plan to describe and define the scope of the 2 MW solar farm. The scope management plan will define, develop, monitor, and control the project to meet stakeholders' stated and unstated requirements and avoid scope creep.	-Experience and interviews from experts, documentation on solar energy projects in Saint Lucia, the Caribbean and globally, templates from MPM course.	-PMBOK Guide 6th Edition and PMI databases -Existing best practice templates -Documentation on renewable energy best practice in the global and Caribbean contexts -Documentation from expert websites
3	To create a schedule management plan that establishes how the project schedule will be created, monitored, and controlled for the implementation of the new 2 MW solar farm within the appropriate time.	-Experience and interviews from experts, documentation on solar energy projects in Saint Lucia, the Caribbean and globally.	-PMBOK Guide 6th Edition and PMI databases -Existing best practice templates -Documentation on renewable energy best practice in the global and Caribbean contexts -Documentation from expert websites like NREL, Rocky Mountain Institute, The United States Department of Energy (US DOE).
4	To develop a cost management plan, outlining how the project costs will be planned, structured, managed and controlled to complete the 2 MW Solar Farm Project within the allocated budget.	-Experience and interviews from experts, documentation on solar energy projects in Saint Lucia, the Caribbean and globally.	-PMBOK Guide 6th Edition and PMI databases -Existing best practice templates -Documentation on renewable energy best practice in the global and Caribbean contexts -Documentation from expert websites including NREL, Rocky Mountain Institute, The US DOE.
5	To develop a quality management plan to establish the guidelines, policies, and procedures to be implemented in achieving the quality objectives of the grid operator, Saint Lucia Electricity Services Limited, within the triple constraint of time, scope, and cost.	-Experience and interviews from experts, documentation on solar energy projects in Saint Lucia, the Caribbean and globally.	-PMBOK Guide 6th Edition and PMI databases -Existing best practice templates -Documentation on renewable energy best practice in the global and Caribbean contexts -Documentation from expert websites including NREL, Rocky Mountain Institute, The US DOE.

No.	Objectives	Information sources	
		Primary	Secondary
6	To develop a resource management plan that establishes the categorization, allocation, management, and release of the resources required to complete the 2 MW Solar Farm Project successfully.	-Experience and interviews from experts, documentation on solar energy projects in Saint Lucia, the Caribbean and globally.	-PMBOK Guide 6th Edition and PMI databases -Existing best practice templates -Documentation on renewable energy best practice in the global and Caribbean contexts -Documentation from expert websites including NREL, Rocky Mountain Institute, The US DOE.
7	To create a communication management plan to define how the information regarding the new 2 MW Solar Farm Project will be communicated to all stakeholders involved, on a timely basis and in an appropriate manner to ensure effective communication during project implementation.	-Experience and interviews from experts, documentation on solar energy projects in Saint Lucia, the Caribbean and globally.	-PMBOK Guide 6th Edition and PMI databases -Existing best practice templates -Documentation on renewable energy best practice in the global and Caribbean contexts -Documentation from expert websites including NREL, Rocky Mountain Institute, The US DOE.
8	To outline a risk management plan to establish how risk management activities will be formulated and executed for the 2 MW Solar Farm Project.	-Experience and interviews from experts, documentation on solar energy projects in Saint Lucia, the Caribbean and globally.	-PMBOK Guide 6th Edition and PMI databases -Existing best practice templates -Documentation on renewable energy best practice in the global and Caribbean contexts -Documentation from expert websites including NREL, Rocky Mountain Institute, The US DOE.
9	To create a procurement management plan to define which approaches, processes and procedures, and appropriate goods and services will be acquired to ensure that the 2 MW Solar Farm Project is completed on time.	-Experience and interviews from experts, documentation on solar energy projects in Saint Lucia, the Caribbean and globally.	-PMBOK Guide 6th Edition and PMI databases -Existing best practice templates -Documentation on renewable energy best practice in the global and Caribbean contexts -Documentation from expert websites including NREL, Rocky Mountain Institute, The US DOE.
10	To create a stakeholder management plan to define the strategies and actions to promote stakeholder engagement in the decision-making and execution of the 2 MW Solar Farm Project.	-Experience and interviews from experts, documentation on solar energy projects in Saint Lucia, the Caribbean and globally.	-PMBOK Guide 6th Edition and PMI databases -Existing best practice templates -Documentation on renewable energy best practice in the global and Caribbean contexts -Documentation from expert websites including NREL, Rocky Mountain Institute, The US DOE.
11	To assess the compliance of the implementation of the 2 MW solar farm with regenerative development and the P5 Standard.	-Experience and interviews from experts, documentation on solar energy projects in Saint Lucia, the Caribbean and globally.	-PMBOK Guide 6th Edition and PMI databases, Existing best practice templates -Documentation on renewable energy best practice in the global and Caribbean contexts -Documentation from expert websites including NREL, Rocky Mountain Institute, The US DOE.

Note: Own Work

3.1.3. SECONDARY SOURCES

Secondary sources consist of analysis, summary, interpretation, comparison, development or some sort of restatement of the information presented in the primary sources. These secondary sources include textbooks, literary criticisms, biographies, commentaries and interpretative reports (University of Minnesota, n.d).

For this FGP, many of the sources utilized were secondary sources, including reports, analyses and lessons from previous projects which have been documented with lessons learned and best practices. As much as possible, these will be obtained from world class institutions and incorporated into the new framework applicable to the Saint Lucian context.

3.2.RESEARCH METHODS

Research methods are strategies, techniques and methodologies, including tools associated with doing an investigation attempting to reveal new information (Walliman, N. 2017). There are several types of research methods which are applicable to various types of research. Those applicable to this work will be described below.

3.2.1. ANALYTICAL METHOD

Analytical methods involve considering a concept and breaking it down into its subcomponents. The term analysis means to examine a complex thing and understand its essential components (Merriam-Webster, n.d.).

Thereafter, lessons and applications are learned, and deductions can be made from the process of analysis and then applied to another element.

3.2.2. SYNTHETIC METHOD

Synthesis, or the synthetic method is likened to the assembly concepts, elements and data fragments, like building blocks into a fully formed theory or idea, akin to the construction of a building (Cooper& Hedges, 2009).

3.2.3. RESEARCH METHODS OVERVIEW

TABLE 4 RESEARCH METHODS

No.	Objectives	Research Methods	
		Analytic/Synthetic	Empirical
1	To create a project charter that formally sanctions the new 2 MW Solar Farm Project and grants the project manager the authority to use project resources efficiently.	Analyze organizational process assets to form the project charter.	Experts will be interviewed.
2	To develop a project scope management plan to describe and define the scope of the 2 MW solar farm. The scope management plan will define, develop, monitor, and control the project to meet stakeholders' stated and unstated requirements and avoid scope creep.	Analyze organizational process assets to form the project scope management plan.	Experts will be interviewed.
3	To create a schedule management plan that establishes how the project schedule will be created, monitored, and controlled for the implementation of the new 2 MW solar farm within the appropriate time.	Analyze organizational process assets to form the project schedule management plan.	Experts will be interviewed.
4	To develop a cost management plan, outlining how the project costs will be planned, structured, managed and controlled to complete the 2 MW Solar Farm Project within the allocated budget.	Organizational process assets will be used and analyzed to form the project cost management plan.	Experts will be interviewed.
5	To develop a quality management plan to establish the guidelines, policies, and procedures to be implemented in achieving the quality objectives of the grid operator, Saint Lucia Electricity Services Limited, within the triple constraint of time, scope, and cost.	Organizational process assets will be used and analyzed to form the project quality management plan.	Experts will be interviewed.
6	To define a resource management plan which establishes the categorization, allocation, management, and release of the resources required to complete the 2 MW Solar Farm Project successfully.	Analyze organizational process assets to form the project resource management plan.	Experts will be interviewed.
7	To create a communication management plan to define how the information regarding the new 2 MW Solar Farm Project will be communicated to all stakeholders involved, on a timely basis and in an appropriate manner to ensure effective communication during the project implementation.	Analyze organizational process assets to form the project communication management plan.	Experts will be interviewed.
8	To outline a risk management plan to establish how risk management activities will be formulated and executed for the 2 MW Solar Farm Project.	Analyze organizational process assets to form the project risk management plan.	Experts will be interviewed.
9	To create a procurement management plan to define which approaches, processes and procedures appropriate goods and services will be acquired to ensure that the 2 MW Solar Farm Project is completed on time.	Analyze organizational process assets to form the project procurement management plan.	Experts will be interviewed.
10	To create a stakeholder management plan to define the strategies and actions to promote stakeholder engagement in the decision-making and execution of the 2 MW Solar Farm Project.	Analyze organizational process assets to form the project stakeholder management plan.	Experts will be interviewed.
11	To assess the compliance of the implementation of the 2 MW solar farm with regenerative development and the P5 Standard.	Organizational process assets will be used and analyzed to form the P5 impact analysis.	Experts will be interviewed.

Note: Own Work

3.2.4. ANALYTIC-SYNTHETIC

In this method, analysis is first completed (of data, experiences, records) and the trends and patterns observed are then synthesized as principles to be applied to a new purpose. In this case, the experiences and data associated with past energy projects and data from Saint Lucia, as well as international project and energy management standards will be analyzed. Trends and lessons learned will then be deduced. Synthesis will then occur by observing where the gaps are and finding the necessary ways to fill those gaps by applying innovative ideas or implementing international best practice.

3.2.5. EMPIRICAL

Empirical based research is the systematic collection of data by observation and experience of events, which occur under repeatable conditions (Calfee & Chambliss, 2005). In this case, the researcher works in the energy industry and has some experience with energy projects and processes. However, most of the empirical research will be derived from the insights of other energy sector project experts in Saint Lucia, and the wider Caribbean region.

3.3. TOOLS

PMI defines a tool as “something tangible” like a document template or piece of software that is utilized to produce a result through accomplishing a task (Project Management Institute, 2017). PMI groups tools into 5 main categories:

1. Data gathering
2. Data analysis
3. Data representation
4. Decision-making
5. Communication
6. Interpersonal and team skill tools and techniques.

3.3.1. DATA GATHERING

3.3.1.1. BENCHMARKING

Benchmarking is used to compare a component of a project (for example procedures, standards or results) to that of a similar and comparable project. The purpose of this comparison is to learn from the past project and apply these lessons to the new project. Benchmarking may also be used to establish best practices, and a baseline for measuring improvements in project performance (Project Management Institute, 2017).

3.3.1.2. BRAINSTORMING

Brainstorming is a technique used to provoke and gather a multitude of ideas for a project (Project Management Institute, 2017). The ideation process may be triggered by a failure in the project or product, a threat or other change in the project environment.

3.3.1.3. INTERVIEWS

An interview is a conversation with a stakeholder or expert to gather relevant information for the project or initiative (Project Management Institute, 2017). They may be formal or informal, but always involve posing questions to the interviewee. Interviews are classified as empirical research.

3.3.2. TOOLS OVERVIEW

TABLE 5 TOOLS - SOURCE (PMI 2017)

No.	Objectives	Tools
1	To create a project charter that formally sanctions the new 2 MW Solar Farm Project and grants the project manager the authority to use project resources efficiently.	PMBOK Guide 6th Edition
2	To develop a project scope management plan to describe and define the scope of the 2 MW solar farm. The scope management plan will define, develop, monitor, and control the project to meet stakeholders' stated and unstated requirements and avoid scope creep.	PMBOK Guide 6th Edition, templates like flowcharts, interviews, gap analysis, benchmarking, brainstorming, assumptions and constraint analysis, root cause analysis (RCA).
3	To create a schedule management plan that establishes how the project schedule will be created, monitored, and controlled for the implementation of the new 2 MW solar farm within the appropriate time.	PMBOK Guide 6th Edition, templates like flowcharts, interviews, gap analysis, benchmarking, brainstorming assumptions and constraint analysis, RCA
4	To develop a cost management plan, outlining how the project costs will be planned, structured, managed and controlled to complete the 2 MW solar farm project within the allocated budget.	PMBOK Guide 6th Edition, templates like flowcharts, interviews, gap analysis, benchmarking, brainstorming assumptions and constraint analysis,
5	To establish a quality management plan to establish the guidelines, policies, and procedures to be implemented in achieving the quality objectives of the grid operator, Saint Lucia Electricity Services Limited, within the triple constraint of time, scope, and cost.	PMBOK Guide 6th Edition, templates like flowcharts, interviews, gap analysis, benchmarking, brainstorming assumptions and constraint analysis, RCA
6	To define a resource management plan which establishes the categorization, allocation, management, and release of the resources required to complete the 2 MW Solar Farm Project successfully.	PMBOK Guide 6th Edition
7	To create a communication management plan to define the means by which the information regarding the new 2 MW Solar Farm Project will be communicated to all stakeholders involved, on a timely basis and in an appropriate manner to ensure effective communication during the project implementation.	PMBOK Guide 6th Edition, templates like flowcharts, interviews, gap analysis, benchmarking, brainstorming assumptions and constraint analysis, RCA
8	To outline a risk management plan to establish how risk management activities will be formulated and executed for the 2 MW Solar Farm Project.	PMBOK Guide 6th Edition, templates like flowcharts, interviews, gap analysis, benchmarking, brainstorming assumptions and constraint analysis, RCA
9	To create a procurement management plan to define which approaches, processes, procedures, and appropriate goods and services will be acquired to ensure that the 2 MW Solar Farm Project is completed on time.	PMBOK Guide 6th Edition, templates like flowcharts, interviews, gap analysis, benchmarking, brainstorming assumptions and constraint analysis,
10	To create a stakeholder management plan to define strategies and actions to promote stakeholder engagement in decision-making and in the execution of the 2 MW Solar Farm Project.	PMBOK Guide 6th Edition, templates like flowcharts, interviews, gap analysis, benchmarking, brainstorming assumptions and constraint analysis, RCA
11	To assess the compliance of the implementation of the 2 MW solar farm with regenerative development and the P5 Standard.	PMBOK Guide 6th Edition

Note: Own Work

3.3.3. DECISION-MAKING

3.3.3.1. ASSUMPTIONS AND CONSTRAINTS ANALYSIS

This analytical tool for decision making involves the investigation of the veracity of the assumptions underpinning the project management plan or the decisions taken during the course of the project (Project Management Institute, 2017).

3.3.3.2. ROOT CAUSE ANALYSIS

When an issue occurs, the symptom is usually most apparent. However, addressing the symptom of a problem does not guarantee that the problem will be solved. Root cause analysis involves investigation into, and discovery of the inherent causes that lead to the existence of a problem (Project Management Institute, 2017).

3.3.3.3. STAKEHOLDER ANALYSIS

Stakeholder analysis is the process of reviewing and considering all the actors in an ecosystem. It involves listing the stakeholders and collecting data like the organization they belong to –and the role therein, the perception of the project by that stakeholder, and their interest in the success of the project (PMI 2017). This process assists in providing the relevant stakeholders with the appropriate communication and creates a foundation for lobbying the right stakeholders if it becomes necessary.

3.3.4. DATA REPRESENTATION

3.3.4.1. FLOWCHARTS

Flowcharts or process maps denote the order of steps within an operation. This includes the decisions, activities, sub-processes, inputs and outputs and possible varying paths which the process may take (PMI 2017). The map helps to visualize how the operation works and can provide the basis for process analysis. Process analysis helps in process optimization by zoning in on bottlenecks and inefficient points.

3.4. ASSUMPTIONS AND CONSTRAINTS

Assumptions are events and ideas factoring into the process of planning a project which are presumed to be true, despite not having hard evidence (PMI 2017).

The project assumptions and constraints are listed below:

3.4.1. ASSUMPTIONS

1. It is possible to build a solar farm in Gros-Islet Saint Lucia based on expert analysis.
2. Best practices for large project development may be applicable to renewable energy projects.
3. Consultation with energy experts will add to lessons learned for the improvement of project plans.
4. The funding for the project is available and will be allocated before the project starts.
5. Sufficient land will be available for the project.

3.4.2. CONSTRAINTS

A project constraint is a phenomenon assumed to limit the implementation of the project or process (PMI 2017).

The project constraints are listed below.

1. Developmental time for the FGP is limited to approximately 3 months. It is further limited by the fact that the student works a full-time job.
2. The implementation of projects in Saint Lucia has to be in line with the local laws.

The scope of the plan is limited by the data available for examination from the Government of Saint Lucia, the electric utility and the regulator.

3.4.3. ASSUMPTIONS AND CONSTRAINTS OVERVIEW

TABLE 6 ASSUMPTIONS AND CONSTRAINTS

No.	Objectives	Assumptions	Constraints
1	To create a project charter that formally sanctions the development of the 2 MW Solar Farm Project and grants the project manager the authority to use project resources efficiently.	The charter presented will be sufficient for project approval in the intended context.	The charter data is limited to available electricity market information.
2	To develop a project scope management plan to describe and define the scope of the 2 MW solar farm. The scope management plan will define, develop, monitor, and control the project to meet stakeholders' stated and unstated requirements and avoid scope creep.	The project scope is sufficient for completion of the 2MW farm. There may be minor changes to project scope/	Changes in project scope are subject to the change control process.
3	To create a schedule management plan that establishes how the project schedule will be created, monitored, and controlled for the implementation of the new 2 MW solar farm within the appropriate time.	The time assumptions are based on current lead times and risk analysis. The time allocated is sufficient to complete the project.	The schedule is constrained by the norms of the supply chain and component markets.
4	To develop a cost management plan, outlining how the project costs will be planned, structured, managed and controlled to complete the 2 MW Solar Farm Project within the allocated budget.	Costs can accurately be estimated using analogous factors and escalation factors from international energy authorities.	The costs are constrained by the budget of USD $6,371,688.33.
5	To develop a quality management plan to establish the guidelines, policies, and procedures to be implemented in achieving the quality objectives of the grid operator, Saint Lucia Electricity Services Limited, within the triple constraint of time, scope, and cost.	The project will be built to acceptable quality and will be resiliently designed. Quality materials will be used. Experienced contractors will be used. World-class equipment suppliers will be used.	The solar farm must be rated to withstand category 5 hurricane winds. Quality is largely constrained by the experience of the EPC contractor.
6	To define a resource management plan which establishes the categorization, allocation, management, and release of the resources required to complete the 2 MW Solar Farm Project successfully.	Sufficient human and technical resources will be made available for the project in order to facilitate its completion.	All resources need to be funded by the budget of USD $6,371,688.33. Internal resources may not be available.
7	To create a communication management plan to define how the information regarding the new 2 MW Solar Farm Project will be communicated to all stakeholders involved, on a timely basis and in an appropriate manner to ensure effective communication during the project implementation.	There are sufficient resources to communicate adequately with the stakeholders.	Language barriers and social norms.
8	To outline a risk management plan to establish how risk management activities will be formulated and executed for the 2 MW Solar Farm Project.	Most risks are accounted for. Mitigation plans and contingencies are sufficient.	There can always be unforeseen risks. Contingencies are limited.

No.	Objectives	Assumptions	Constraints
9	To create a procurement management plan to define which approaches, processes and procedures appropriate goods and services will be acquired to ensure that the 2 MW Solar Farm Project is completed on time.	All the services, equipment and materials are available. EPC contractor will be responsible for most of the required procurement.	Procurement must occur on schedule and within budget.
10	To create a stakeholder management plan to define the strategies and actions to promote stakeholder engagement in the decision-making and execution of the 2 MW Solar Farm Project.	All major and minor stakeholders are known and can be contacted. The power and interest of these stakeholders is correctly assessed. The residents living closest to the project have access to social media and will attend in-person focus groups.	Some expectations are not communicated verbally.
11	To assess the compliance of the implementation of the 2 MW solar farm with regenerative development and the P5 standard.	P5 standard is sufficient to evaluate the sustainability of the project.	Evaluation will be done only against the P5 standard.

Note: Own Work

3.5. DELIVERABLES

A deliverable is a finite and attestable outcome, result or proficiency in performing a function that is a requirement for the achievement of a project phase, or the ending of a process (Project Management Institute 2017). The FGP deliverables are listed below:

1.1.1 FGP charter

1.1.2. WBS

1.1.3. Introduction

1.1.4. Theoretical framework

1.1.5. Methodological framework

1.1.6. 1. Bibliography

1.1.6. 1. FGP Schedule

2.2. Adjustments to previous chapters

2.3.1. Signed charter

2.3.2. Scope management plan

2.3.3. Schedule management plan

2.3.4. Cost management plan

2.3.5. Quality management plan

2.3.6. Resource management plan

2.3.7. Communications management plan

2.3.8. Risk management plan

2.3.9. Procurement management plan

2.3.10. Stakeholder management plan

2.3.11. Sustainability assessment

4.1. Reviewers report

4.2. Updated FGP

4.3. Second review feedback

5.1 Board of examiners evaluation

5.2. FGP grade report

3.5.1. DELIVERABLES OVERVIEW

TABLE 7 DELIVERABLES

No.	Objectives	Deliverables
1	To create a project charter that formally sanctions the development of the new 2 MW Solar Farm Project and grants the project manager the authority to use project resources efficiently.	Project charter
2	To develop a project scope management plan to describe and define the scope of the 2 MW solar farm. The scope management plan will define, develop, monitor and control the project to meet stakeholders' stated and unstated requirements and avoid scope creep.	Scope management plan
3	To create a schedule management plan that establishes how the project schedule will be created, monitored, and controlled for the implementation of the new 2 MW solar farm within the appropriate time.	Schedule management plan
4	To develop a cost management plan, outlining how the project costs will be planned, structured, managed and controlled to complete the 2 MW Solar Farm Project within the allocated budget.	Cost management plan
5	To develop a quality management plan to establish the guidelines, policies, and procedures to be implemented in achieving the quality objectives of the grid operator, Saint Lucia Electricity Services Limited, within the triple constraint of time, scope, and cost.	Quality management plan
6	To define a resource management plan which establishes the categorization, allocation, management, and release of the resources required to complete the 2 MW Solar Farm Project successfully.	Resource management plan
7	To create a communication management plan to define how the information regarding the new 2 MW Solar Farm Project will be communicated to all stakeholders involved, on a timely basis and in an appropriate manner to ensure effective communication during the project implementation.	Communication management plan
8	To outline a risk management plan to establish how risk management activities will be formulated and executed for the 2MW Solar Farm Project.	Risk management plan
9	To create a procurement management plan to define which approaches, processes and procedures, and appropriate goods and services will be acquired to ensure that the 2 MW Solar Farm Project is completed on time.	Procurement management plan
10	To create a stakeholder management plan to define the strategies and actions to promote stakeholder engagement in the decision-making and execution of the 2 MW Solar Farm Project.	Stakeholder management plan
11	To assess the compliance of the implementation of the 2 MW solar farm with regenerative development and the P5 Standard.	P5 sustainability analysis

Note: Own Work

4. RESULTS

The result chapter of this FGP displays the deliverables of the FGP, which answer each of the specific objectives of the FGP. The deliverables of the FGP and components of the results chapter are the Project Integration Management Plan, Scope Management Plan, Schedule Management Plan, Cost Management Plan, Quality Management Plan, Resource Management Plan, Communications Management Plan, Risk Management Plan, Procurement Management Plan, Stakeholder Management Plan and the Sustainability Management Plan which involves a sustainability assessment using the P5 standard.

4.1. PROJECT INTEGRATION MANAGEMENT

Project integration management consists of the processes and endeavors required to synthesize the various sub-plans within the project to ensure the cohesiveness and the coordination required to create a complete and effective project management effort. It goes beyond documentation to include the required communication and relationships to support a successful project. Project integration management in the context of this project management plan development includes the following processes:

a. Develop project charter
b. Develop project management plan
c. Perform integrated change control
d. Close project or phase

4.1.1. DEVELOP PROJECT CHARTER PROJECT

The project charter is defined as a document issued which validates the existence of a project and authorizes the manager to utilize the organization's resources to complete the project (PMI 2017). It is the first project act and marks the beginning of project initiation.

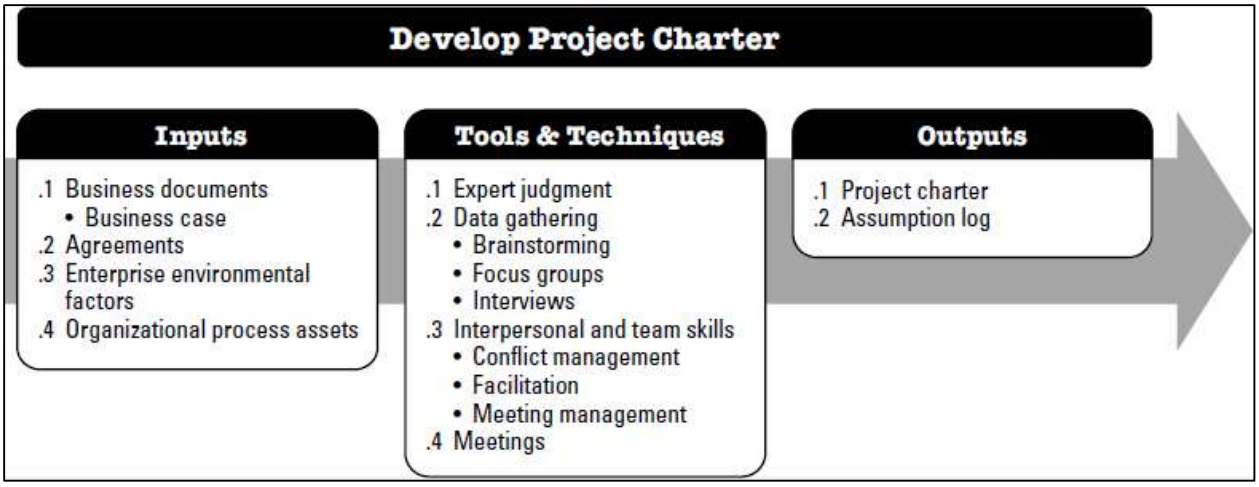

Figure 7 The Development of the Project Charter (PMI 2017)

Note: Reprinted from A Guide to the Project Management Body of Knowledge (PMBOK® Guide) Sixth Edition. Project Management Institute (PMI), 2017 Figure 4-2, p. 75 Copyright 2017 by Project Management Institute, Inc.

The project charter is displayed in Section 4.1.1.1.

4.1.1.1. PROJECT CHARTER

PROJECT CHARTER		
Date	**Name of Project**	
June 30, 2024	2MW Solar Farm, Gros Islet Saint Lucia	
Type of project:	Construction project	
Sector	Energy	
Knowledge areas	Scope management, schedule management, cost management, quality management, resource management, communication management, risk management, procurement management, stakeholder management.	
Process groups	Initiating; planning, executing, monitoring and control	
Planned start date	**Planned completion date**	**Duration (months)**
January 1, 2025	September 21, 2027	32
Project Objectives (general and specific)		
General objective: To design, construct and commission a 2MW solar farm in Gros Islet Saint Lucia to continue the efforts to reduce Saint Lucia's carbon emissions and reduce its dependence on international fuel markets, integrating the principles of regenerative and sustainable development. **Specific objectives:** 1. To construct a solar generation plant at Gros Islet, Saint Lucia which supplies the growing load in the north of the island, reduces fuel usage in the production of electricity for generation in Saint Lucia 2. To contribute to Saint Lucia's NDC target by reducing the greenhouse gas emissions from power generation. 3. To integrate the principles of sustainable and regenerative development into the execution and lifecycle operation of the project, and therefore minimize the potential environmental and social impacts of the project. 4. To execute the project efficiently and efficiently according to world best practices and project management best practice.		
Justification or purpose of the project (Contribution and expected results)		
Saint Lucia is a small island developing state with carbon emissions reduction commitments. Emissions are primarily energy sector related, primarily from diesel power generation and transport. Solar PV forms a major part of the emissions reduction strategy. The NDCs for energy emissions is a 7% reduction of GHGs by 2030 (GOSL 2021). By reducing the diesel generation, the solar farm will assist in meeting this target.		
Description of the product or service that the project will generate - Final project deliverables		
1. Functioning solar farm with 2MW output connected to the distribution grid 2. Generation of 3.5 GWh annually		
Assumptions		
1. Electricity production from the system will begin in 2027. 2. The operational life of the project is 25 years. 3. Performance ratio of plant = 75% (PV plants typically in the range 75% to 85%) 4. The chosen site has no obvious shading from buildings or the surrounding topography. 5. The cost of solar farm grass management is covered by a third party black belly sheep contract. 6. The solar production is utilized by the grid preferentially to diesel. 7. The production profile mimics analogous solar farms.		
Constraints		
1. The budget is set at USD $6,371,688.33 2. The time allocated is 35 months to execute the project.		
Preliminary identification of risks		
3. The owner's engineering firm can provide adequate assistance in project development and execution. 4. Sufficient staff will be available to perform the project work.		
Budget		
The budget allocated for this project is USD $6,371,688.33		

Identification of groups of interest (stakeholders)	
Direct stakeholders: Governemnt of Saint Lucia (Client/ sponsor), LUCELEC (Power offtaker), NURC (Regulator), Ministry of Planning (Grant project approvals), DCA (Grant project approvals), Residents of Gros Islet, Project Management Unit, Project Steering Committee,EPC contractor,Owner's engineer, contractors and sub contractors, Land owner (Lease granter)	**Indirect stakeholders:** Shipping agencies,Truckers, Importers Exporters, Broker agents, Associated government agencies, Suppliers.
Student's name (project manager): Malaika Abigail Charles	**Signature:**
Name and title of the authorizing person (facilitator):	**Signature:**

Figure 8 Project Charter

Note: Own Work

The charter is important in establishing project purpose, stating the project objectives and end goals. It exists as an element and output of the project integration management process group, which serves to coordinate the processes and project management endeavors of all the other project management process groups (PMI 2017) so that they function together to achieve the goal of project success. In some organizations, the preparation and approval of a project budget, can replace the preparation and approval of a charter.

The project charter developed for this project will address the project objectives, budget, major stakeholders, initial risks, purpose, assumptions and constraints among other key considerations.

4.1.2. DEVELOP PROJECT MANAGEMENT PLAN

The process of developing the project management plan involves setting out the requirements of a plan in each of the knowledge areas for the project, deciding on the approach to accomplishing the specific process, ensuring that all the sub plans are coherent with each other and assembling these elements into a complete project management plan (PMI 2017).

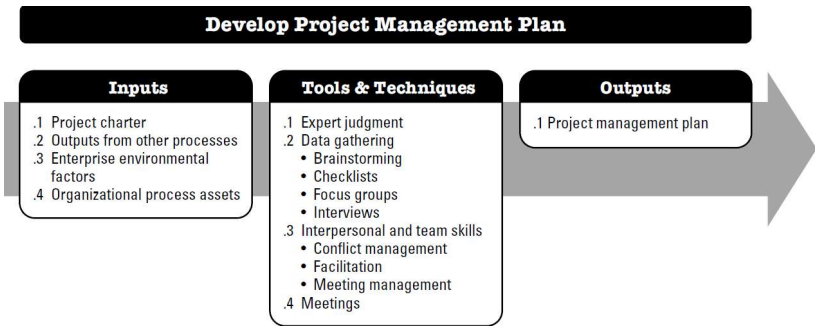

Figure 9 Develop Project management Plan Process

Note: Reprinted from A Guide to the Project Management Body of Knowledge (PMBOK® Guide) Sixth Edition. Project Management Institute (PMI), 2017 Figure 4-4, p. 82 Copyright 2017 by Project Management Institute, Inc.

This project management plan developed for the 2 MW solar project from this process will form most of the substance of this FGP document.

4.1.3. PERFORM INTEGRATED CHANGE CONTROL

The perform integrated change control process involves the review of change requests to any project element arising from the project stakeholders and managing and approving these requested changes depending on criteria determined by the project leadership.

4.1.3.1. CHANGE ORDER

Project:	2 MW SOLAR FARM PROJECT GROS ISLET SAINT LUCIA	**Change ID:**	2MWG1#1
Change Request			
Change Title:		**Identification Date:**	*<dd/mm/yyyy>*
Requested by:	*<The name of the requestor/group>*	**Category:**	
Priority:	☐ Very High ☐ High ☐ Medium ☐ Low ☐ Very Low		

Change Description & Details

<The purpose of this form is to capture the need and characteristics of a project change request. The change request is the first step of the change request process. Once the change request is logged into the Change Log, then this form is updated with the assigned Change ID and the form is archived.>

Current Situation:

<Describe the current situation (a problem, an opportunity or a new need – why is there a need for a change in the project?>

Desired Situation:

< Describe the desired situation. What is the goal and benefits of this change request?>

Impact or Risks:

<Describe the impact or risks of not implementing this change. If this impact or risks can be quantified, then this can help with the analysis (cost benefit analysis) and final decision regarding the implementation (or not) and the priority of this change.>

Out of Scope: *<Clarify what is out of the scope of this change request. This clarifies further the boundaries of the requested change and ensures that only the needed change is implemented.>*	
References and Related Documents	**Location**
XYZ.doc	U:\ProjectX\Documents\

Figure 10 Change Order

Note: Adapted from "Change Request form" by the PM^2 Alliance (2017). Copyright 2017 by PM^2 Alliance.

The process maintains well documented records of all changes and proposed project changes and the decisions taken with regards to implementing these (PMI 2017). The process of change control is initiated by the submission of a change order or change request. The change order for the 2MW solar farm is provided in Section 4.1.3.1.

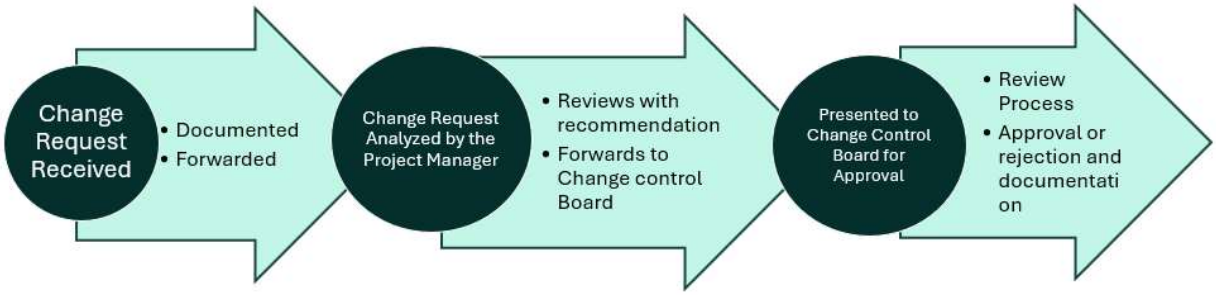

Figure 11 Approach to Change Requests

Note: Own Work

4.2. SCOPE MANAGEMENT PLAN

4.2.1. INTRODUCTION

The second specific objective of this final graduation project is to develop a scope management plan for the 2MW Solar Farm Project. Project scope management, as defined by the Project Management Institute, includes all the processes and work required to complete the project successfully. This means setting boundaries on what the project does and does not entail (PMI 2017). The processes involved in the development of the scope management plan include:

1. Plan scope management
2. Define scope
3. Create work breakdown structure
4. Validate scope
5. Control scope

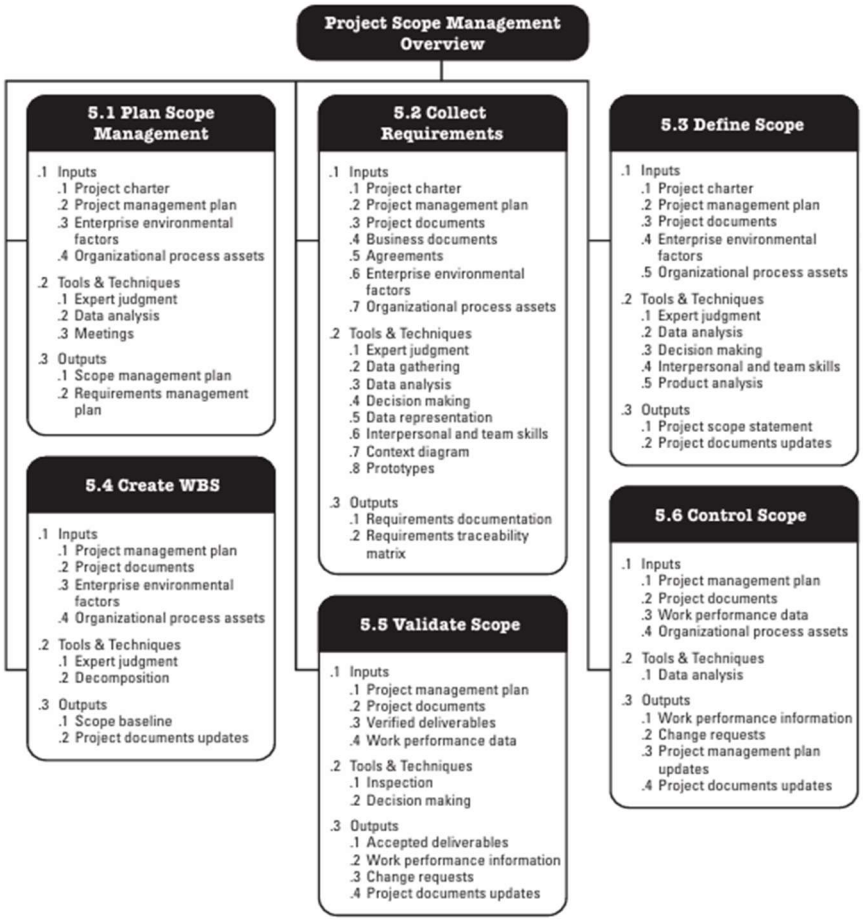

Figure 12 Overview of the Project Scope Management Group of Processes (PMI 2017)

Note: Reprinted from A Guide to the Project Management Body of Knowledge (PMBOK® Guide) Sixth Edition. Project Management Institute (PMI), 2017 Figure 5-1, p. 130 Copyright 2017 by Project Management Institute, Inc.

4.2.2. PLAN SCOPE MANAGEMENT

The plan scope management process refers to decisions involving the management of the project scope throughout the project's life cycle. The inputs are the project charter, organizational information and relevant processes. In the case of the 2MW solar farm project, the inputs are the project charter, lessons learned from the first solar farm

commissioned in Saint Lucia, Government of Saint Lucia project best practices and requirements of the project funding agencies. The tools involved are expert judgement from both Government and the utility from past projects, data analysis of the project financials, and contribution to national energy mix, as well as operational effects on grid operations, and meetings between the relevant stakeholders. The output of the scope management planning process is a well-developed scope management plan.

4.2.3. COLLECT REQUIREMENTS

In projects, a charter usually comes from the executive and the requirements are generally known and understood. However, the high-level requirements may not reflect the requirements of the stakeholders of the project needed to carry out the project to a successful completion. The collection of requirements involves the review of all the project documents, lessons learned, any agreements in place, et cetera. This would involve project management plans from previous solar farms, the utility interconnection requirements, the requirements of the development agencies responsible for issuing permits, the regulator requirements for the issuance of a generation license, et cetera. The tools involved include gathering data from experts in the field, government, the utility and regulator, and benchmarking against other similar projects. The outputs are requirements documentation, including the requirements traceability matrix.

TABLE 8 REQUIREMENTS TRACEABILITY MATRIX FOR THE 2MW FARM

ID	Requirements Description	Objectives	Verification	Priority
RQ1	Project must produce a guaranteed output of 2MW at the inverter.	Reduce island's dependency on fuel. Produce a peak of 2MW.	Hot commission test	High
RQ2	Project needs acceptance from the surrounding neighbors, and	Community acceptance	Environmental and social	Medium

ID	Requirements Description	Objectives	Verification	Priority
	the project should support or improve the lives of the members of the community.		impact assessment.	
RQ3	Project should be able to survive in a harsh coastal environment and should be resilient to tropical weather systems.	Climate resilience- Cat 5 rated	Review of structural design by a structural engineer.	High
RQ4	The project should not negatively affect the environment in which it is located.	Design the project to minimize environmental impact.	Environmental and social impact assessment.	High
RQ5	The project should be well integrated with the grid.	Effective power export. Minimize power quality issues.	Interconnection study	High
RQ6	Sufficient capacity development in the maintenance of solar farm equipment.	Knowledge transfer	Training plan development	High

Note: Own Work

4.2.4. PROJECT SCOPE STATEMENT

TABLE 9 SCOPE STATEMENT

PROJECT SCOPE STATEMENT	
Project Information	
Project Phase:	Initiation
Project Name:	Development of a project management plan for a 2 MW solar farm in Gros Islet, Saint Lucia
Estimated Budget:	USD $6,371,688.33
Estimated Project Start:	March 1st, 2024
Estimated Project End:	July 31st, 2027
Scope Definition	
Scope Description:	The project will entail the design construction, testing and interconnection of a 2MW solar farm in Gros Islet, Saint Lucia on 10 acres of land belonging to the government of Saint Lucia. It will assist in increasing the island's energy independence by reducing the required import of diesel fuel for generation by the existing diesel generator plant. It will have minimal impact on the communities, optimal project location, and since the island is in a hurricane belt, a resilient structure. In the theme of independence, the project in its operation period will be maintained locally, so it will require relevant, adequate capacity building.
Project Deliverables:	1. Project budget and financial analyses 2. Feasibility studies (Interconnection, ESIA, Hydrological, Structural, etc.)

PROJECT SCOPE STATEMENT	
	3. Development control authority approvals 4. Land lease agreement 5. Power generation license 6. Power purchase agreement 7. Owner's engineering contract 8. Engineering designs 9. Interconnection agreement 10. Project management plan 11. Communications and supervisory control plan 12. Engineering procurement and construction contract (turnkey) 13. Operation and maintenance contract 14. Grass management plan 15. Notices to proceed 16. Hot and cold commissioning 17. Reports of mechanical, electrical and final completion 18. Decommissioning plan
Scope Exclusions:	1. The project scope does not include the purchasing of the land for the construction of the solar farm. The land will be leased and therefore, the project may need to be decommissioned at the end of the 25-year lease. 2. The project will not be connected to the transmission but rather at the distribution voltage.
Acceptance Criteria:	1. Completion within 32 weeks or liquidated damages. 2. Power output at peak of 2MW AC at inverter output. 3. Produce an average 12MWh daily. 4. Completion of all feasibility studies including grid interconnection, PPA, DCA. 5. Site completely fenced-in and secure.

PROJECT SCOPE STATEMENT	
	6. Successful deployment of wireless telecommunication services in targeted communities which meet the established key performance indicators (KPI).
Assumptions:	1. The solar resource in Saint Lucia is suitable for building a solar farm. 2. It is possible to build a solar farm in Gros Islet, Saint Lucia based on expert analysis. 3. Best practices for large project development may be applicable to renewable energy projects. 4. Consultation with energy experts will add to lessons learned for the improvement of project plans. 5. The funding for the project is available and will be allocated before the project starts. 6. Sufficient land will be available for the project. 7. The project will not be subject to local taxes. 8. The operational time of the project will be 25 years. 9. There is a 10-year warranty on DC-AC inverters required for the project,
Constraints:	The budget set by the management cannot exceed USD $6,371,688.33 as the project is predominantly donor-funded. The project timelines will be contingent on the global supply of major components like panels, transformers, switches, et cetera. The project will be bound by the construction and operation laws of Saint Lucia. The project must conform to the regulatory guidelines. The project will be constructed on relatively flat to gently sloping south facing or flat land.

PROJECT SCOPE STATEMENT			
	The project must not be constructed on lands of national value where there are historical artefacts or protected areas. The number of qualified contractors (EPC and owners engineering is limited), especially because the project is quite small, and most contractors tend to pursue bigger projects. Based on the previous assumption, the quality of expertise available may be limited.		
Project Manager:	Printed Name:		Date:
	Signature:		
Project Sponsor:	Printed Name:		Date:
	Signature:		

Note: Own Work

4.2.5. WORK BREAKDOWN STRUCTURE

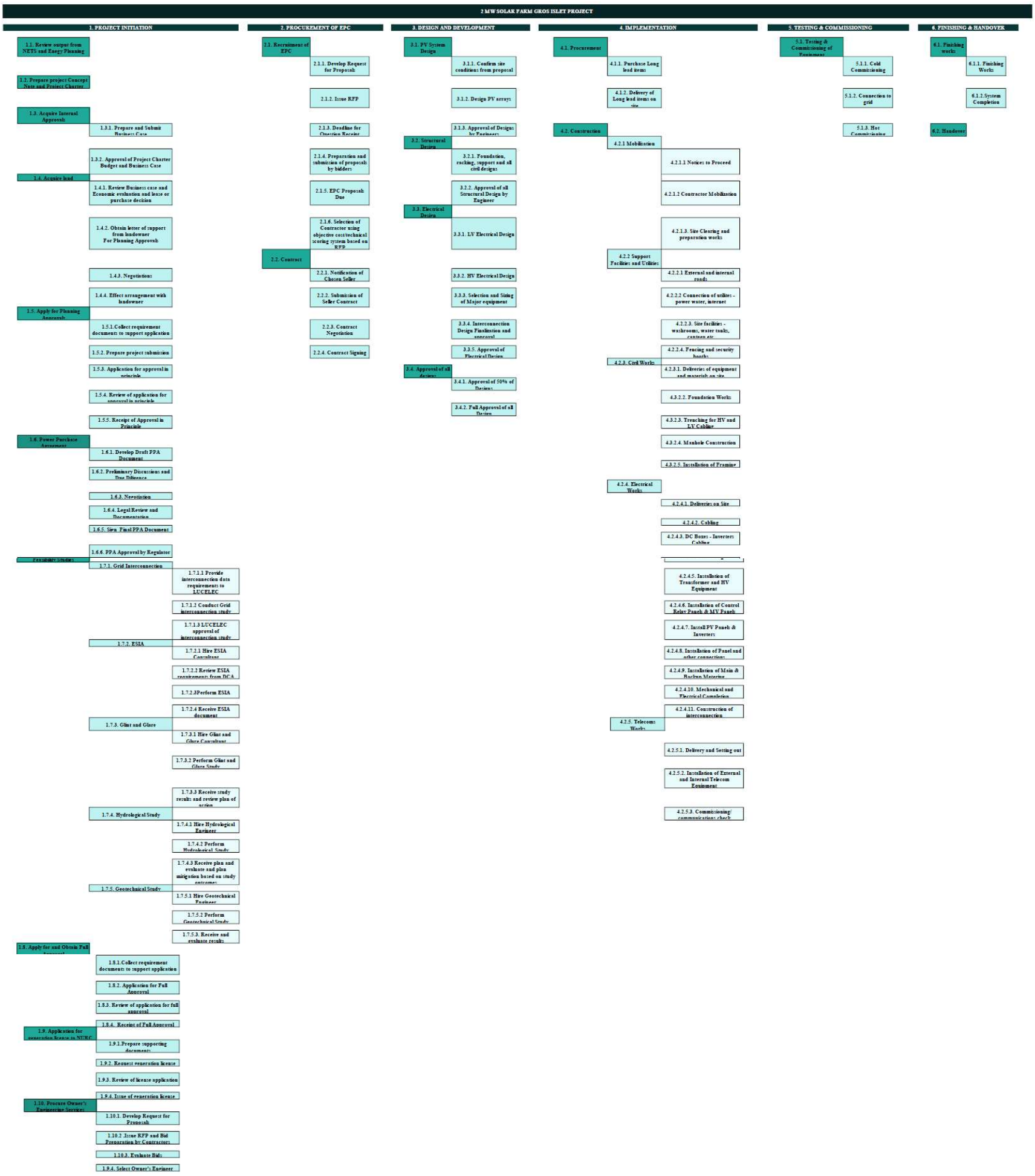

Figure 13 Work Breakdown Structure

Note: Own Work

4.2.6. WORK BREAKDOWN STRUCTURE DICTIONARY

TABLE 10 WORK BREAKDOWN STRUCTURE DICTIONARY

WBS Level	WBS Code	WBS ACTIVITY NAME	DESCRIPTION OF WORK
1	0	2 MW Solar Farm Project, Gros Islet	Overall project objective
2	1	Project Initiation	This is the preparatory portion of the project. It is the go/no go stage. In this stage, pre-feasibility and feasibility are tested.
3	1.1	Review output from nets and energy planning.	Review of the 20-year plans for project compliance with plan and policy.
3	1.2	Prepare project concept note and project charter.	High level project overview preparation.
3	1.3	Acquire internal approvals.	Approval of the concept note.
4	1.3.1	Prepare and submit business case.	Evaluation of financial feasibility and cashflows, as well as economic parameters like NPV and IRR.
4	1.3.2	Approval of project charter budget and business case.	Approval of internal documents by management.
3	1.4	Acquire land.	Purchase land from the landowner.
4	1.4.1	Review business case and economic evaluation and lease or purchase decision.	Consider the land price sensitivity. Conduct economic analysis which assists with determining project viability. project is economical to execute. (Establish maximum and minimum price for negotiations).
4	1.4.2	Obtain letter of support from landowner for planning approvals	Obtain a preliminary letter of support from landowner which can be utilized for DCA applications.
4	1.4.3	Negotiations	Negotiate land price with owner.
4	1.4.4	Effect arrangement with landowner.	Sign deed of sale with landowner.
3	1.5	Apply for planning approvals.	Apply to government development authority for developmental approvals.
4	1.5.1	Collect requirement documents to support application	Collect and draft all supporting documents.
4	1.5.2	Prepare project submission.	Synthesize input documents into application.
4	1.5.3	Application for approval in principle	First approval required. It gives permission to conduct deeper studies and prescribes the requirements for the ESIA investigation.
4	1.5.4	Review of application for approval in principle.	Review of application by the DCA.
4	1.5.5	Receipt of approval in principle.	Receive approval documents.
3	1.6	Power purchase agreement.	Agreement which defines the price the project receives per unit of power generated. Also defines relationship with LUCELEC including the sharing of interconnection costs, et cetera.
4	1.6.1	Develop draft PPA document.	Development of a draft document.
4	1.6.2	Preliminary discussions and due diligence.	The initial PPA draft will spark initial conversations. Due diligence in terms of research benchmarking of PPA's et cetera needs to be completed.
4	1.6.3	Negotiation	Negotiation between project team, legal team and management and LUCELEC's negotiation team including lawyers.
	1.6.4	Legal review and documentation.	Legal review during negotiations.
4	1.6.5	Signing the final PPA document.	After negotiation, the legal document is signed and is valid for 20-25 years.
	1.6.6	PPA approval by regulator.	NURC approves PPA.

WBS Level	WBS Code	WBS ACTIVITY NAME	DESCRIPTION OF WORK
3	1.7	Conduct project feasibility studies.	Technical, environmental and social feasibility studies.
4	1.7.1	Grid interconnection	Evaluates effect of the new project on the grid and documents impacts, recommends upgrades or other steps to facilitate full integration. This is the basis for the design of the grid interconnection.
5	1.7.1.1	Provide interconnection data requirements to LUCELEC.	LUCELEC will send a request for project data for evaluation. This will be filled out and returned. Some meetings may be required.
5	1.7.1.2	Conduct grid interconnection study	Execution of the study.
5	1.7.1.3	LUCELEC approval of interconnection study.	Utility must approve and apply the interconnection study to the design of the grid interconnection point.
4	1.7.2	ESIA	Evaluates environmental and social potential effect of the project on surroundings and recommends mitigative measures.
5	1.7.2.1	Hire ESIA consultant.	Recruit qualified consultant.
5	1.7.2.2	Review ESIA requirements from DCA.	This is the basis for approval in full and needs to be input into the ESIA document.
5	1.7.2.3	Perform ESIA.	Execution of the study.
5	1.7.2.4	Receive ESIA document.	Evaluation and noting of outputs relevant to foundation design.
4	1.7.3	Glint and glare.	Evaluates potential for the solar farm glass glare to dazzle or affect the surrounding community.
5	1.7.3.1	Hire glint and glare consultant.	Recruit qualified consultant.
5	1.7.3.2	Perform glint and glare study.	Execution of the study.
5	1.7.3.3	Receive study results and review plan of action.	Evaluation and noting of outputs relevant to panel design, and layout.
4	1.7.4	Hydrological study	Evaluates the water drainage patterns in the project basin and is the basis for drainage design.
5	1.7.4.1	Hire hydrological engineer.	Recruit qualified engineer.
5	1.7.4.2	Perform hydrological study.	Execution of the study.
5	1.7.4.3	Receive plan and evaluate and plan mitigation based on study outcomes.	Evaluation and noting of outputs relevant to drainage design.
4	1.7.5	Geotechnical study	Evaluates the soil and substructure of the project area. Gives the basis for foundation design.
5	1.7.5.1	Hire geotechnical engineer.	Recruit qualified engineer.
5	1.7.5.2	Perform geotechnical study.	Execution of the study.
5	1.7.5.3	Receive and evaluate results.	Evaluation and noting of outputs relevant to foundation design.
3	1.8	Apply for and obtain full approval.	Full go-ahead to proceed with construction. Project has met government scrutiny.
4	1.8.1	Collect requirements, documents and perform application write-ups.	
4	1.8.2	Application for full approval.	Full application with detailed designs of the project.
4	1.8.3	Review of application for full approval.	Review of the application by the DCA.
4	1.8.4	Receipt of full approval.	Receive full approval documents.
3	1.9	Application for generation license to NURC.	Process of applying for and receiving a license to generate electricity in Saint Lucia.
4	1.9.1	Prepare supporting documents.	Collect and draft all supporting documents.
4	1.9.2.	Request generation license	Apply to the NURC using the process defined by the NURC.
4	1.9.3	Review of license application.	Review of the application by the NURC.
4	1.9.4	Issuance of generation license.	Receive license approval documents.

WBS Level	WBS Code	WBS ACTIVITY NAME	DESCRIPTION OF WORK
3	1.10	Procure owner's engineering services.	Hire a team to assist with project designs and project management.
4	1.10.1	Develop request for proposals.	Develop the RFP to hire owner’s engineer.
4	1.10.2	Issue RFP and bid preparation by contractors.	Issue RFP publicly.
4	1.10.3	Evaluation of bids.	Score tenders based on pre-established criteria.
4	1.10.4	Selection of contractor.	Select the best candidate.
2	2	Procurement of EPC.	Hire a contractor to design. build and commission and then hand over the project.
3	2.1	Recruitment of EPC.	Hire a contractor to design, build and commission and then hand over the project.
4	2.1.1	Develop request for proposals.	Develop the RFP to hire owner’s engineer.
4	2.1.2	Issue RFP	Issue RFP publicly.
4	2.1.3	Preparation and submission of proposals by bidders.	Bidders prepare and send in hard and soft copies of bids.
4	2.1.4	EPC proposals due.	Milestone
4	2.1.5	Evaluation of bids.	Score tenders based on pre-established criteria.
4	2.1.6	Selection of contractor using objective cost/technical scoring system based on RFP.	Contractor chosen.
3	2.2	Contract	EPC contract process of completion.
4	2.2.1	Notification of chosen seller.	
4	2.2.2	Submission of seller contract.	Chosen seller submits their form of contract for review.
4	2.2.3	Contract negotiation.	Negotiation between project team, legal team and management and EPC contractor negotiation team including lawyers.
4	2.2.4	Contract signing.	
2	3	Design and development.	Technical design of the project.
3	3.1	PV System Design	Design of the photovoltaic system.
4	3.1.1	Confirm site conditions from proposal.	Measurement of onsite data like solar irradiation, temperature etc. to refine previous output estimations.
4	3.1.2	Design PV arrays.	
4	3.1.3	Approval of designs by engineers.	Owner’s engineer signs off on designs.
3	3.2	Structural design	Foundation, manhole, drainage and other civil design required for the project.
4	3.2.1	Foundation, racking, support and all civil designs	Design of all structural components.
4	3.2.2	Approval of all Structural Design by Engineer	A local registered structural engineer (whether from Government, owner’s engineer or externally hired) must stamp and approve designs.
3	3.3	Electrical design	Electrical high medium and low voltage circuit designs.
4	3.3.1	LV electrical design	Low voltage design
4	3.3.2	HV electrical design	High voltage design
4	3.3.3	Selection and sizing of major equipment.	Sizing of transformers, and major breakers prior to ordering. These items can have long lead times.
4	3.3.4	Interconnection design finalization and approval.	Design of the grid interconnection.
4	3.3.5	Approval of electrical designs.	All designs must be approved by a registered electrical engineer. Must be stamped by registered local electrical engineer.

WBS Level	WBS Code	WBS ACTIVITY NAME	DESCRIPTION OF WORK
3	3.4	Final approval of all designs.	All designs approved by owner's engineer.
4	3.4.1.	Approval of 50% of designs.	EPC milestone payment requirement.
4	3.4.2	Full approval of all designs.	EPC milestone payment requirement.
2	4	Implementation	Implementation of the project designs.
3	4.1	Procurement	Purchase of long lead items.
4	4.1.1	Purchase long lead items.	EPC milestone payment requirement. Purchase order for long lead item issued.
4	4.1.2	Delivery of long lead items on site.	EPC milestone payment requirement. Long lead items received on-site.
3	4.2.	Construction	Construction of the solar farm.
4	4.2.1	Mobilization	Contractor moves equipment on-site and begins preparation works.
5	4.2.1.1	Issue notices to proceed.	Permission granted to begin on-site ground works.
5	4.2.1.2	Contractor mobilization	Contractor on-site and begins works.
5	4.2.1.3	Site clearing and preparation works.	Earth works and clearing of site.
4	4.2.2.	Support facilities and utilities.	Building the site offices, washrooms and other support facilities.
5	4.2.2.1	External and internal roads.	Road construction.
5	4.2.2.2	Connection of utilites - power water, internet.	Connection of utilities.
5	4.2.2.3	Site facilities - washrooms, water tanks, canteen, etc.	Build facilities.
5	4.2.2.4	Fencing and security booths.	Put in security infrastructure.
4	4.2.3	Civil works	Execution of project civil works.
5	4.2.3.1	Delivery of equipment and materials on site.	Equipment received on-site.
5	4.2.3.2	Foundation works (concrete bases)	Foundation construction.
5	4.2.3.3	Trenching for HV and LV cabling.	Digging cable trenches.
5	4.2.3.4	Manhole construction.	Building manholes.
5	4.2.3.5	Installation of framing.	Install supports for panels.
4	4.2.4	Electrical works	Execution of project electrical works.
5	4.2.4.1	Deliveries on-site.	Equipment received on-site.
5	4.2.4.2	Cabling	Running cabling in trenches.
5	4.2.4.3	Dc boxes - inverters cabling.	Installation of DC boxes.
5	4.2.4.4	Earthing	Installation of earthing.
5	4.2.4.5	Installation of transformer and hv equipment.	
5	4.2.4.6	Installation of control relay panels & MV panels.	Installation of control panels.
5	4.2.4.7	Install PV panels & inverters.	
5	4.2.4.8	Installation of panels and other connections.	Connect panels, combiner boxes, terminate cables to panels and switchgear.
5	4.2.4.9	Installation of main & backup metering.	Connect energy and other metering.
5	4.2.4.10	Mechanical and electrical completion.	Completion of all mechanical and electrical works.
5	4.2.4.11	Construction of interconnection.	Build grid interconnection.
4	4.2.5	Telecom and CCTV works.	Execution of SCADA project and other communications, and CCTV security works.
5	4.2.5.1	Delivery and setting out.	Equipment received on-site.

WBS Level	WBS Code	WBS ACTIVITY NAME	DESCRIPTION OF WORK
5	4.2.5.2	Installation of external and internal telecom equipment.	
5	4.2.5.3	Commissioning/ communications check.	Check for proper functioning of CCTV and telecoms equipment.
2	5	Testing & commissioning.	Checking that the installed equipment works as intended using various tests.
3	5.1.	Cold commissioning.	Checking that all components are installed and connected properly.
3	5.2	Connection to grid.	Connect the project to the grid using required switching arrangements.
3	5.3	Hot commissioning.	Perform acceptance tests on the project while connected, also test communications to SCADA. Project must pass these tests or else damages are due.
2	6	Finishing & handover.	Clearing of project site, removal of waste, completion of punch list items.
3	6.1	Finishing works.	
3	6.2	System completion	Project is completed, testing is completed and guaranteed performance is achieved. Punch list items are also completed.
4	6.1.3	Handover	End of the turnkey contract. The contractor hands over all project documentation, keys, training, et cetera.

Note: Own Work

4.2.7. ROLES AND RESPONSIBILITIES

It is important to define the project roles and responsibilities during project initiation and scope management because these form the foundation for the entire project, i.e. the project work defined by the scope is carried out, controlled and directed by key positions and teams, who need to be identified early and whose responsibilities need to be outlined clearly. The roles and responsibilities in the 2MW Solar Farm Project are outlined below.

TABLE 11 ROLES AND RESPONSIBILITIES

Project Role	Responsibilities
Project manager	Responsible for the project planning and execution and reporting on project progress. Responsible for managing the team and liaising with sponsor to ensure project is adequately resourced. Responsible for assuring project quality and maintenance of standards.
Team members	Represent various skillsets: Construction, electrical engineering, IT, finance, et cetera. Responsible for executing delegated project tasks and deliverables, execute tasks to standard and maintain quality.
Project sponsor	Overall responsibility for project. Provides project funding and resources. Project champion across levels of authority.
EPC contractor	Responsible for handing over the completed project to the owner according to the established standards of performance and quality.
Project engineer	Part of project team, responsible for preparation of project reports, coordination of engineering designs.
Site supervisor	Supervises on-site contractor work and provides reports to the project manager. Permanent on-site representative of the owner.
Government of St. Lucia	Project owner: Provides funding through the project sponsor for the project execution.
Utility	Establishes PPA and interconnection agreement with the owner.
Regulator	Issues a generation license and approves the PPA price.
Development authority	Gives development approval for the project and required permission. Establishes the requirements of the ESIA.
Department of energy	Responsible for all local energy issues. Receives reports on project progress, approves tax exemptions, reports on project to Government.

Project Role	Responsibilities
Project steering committee (PSC)	The PSC is a cross functional team responsible for creating a supportive environment for the project to be successful. The team is led by the project sponsor and aims to remove barriers to the project's success.
Project manager- EPC contractor	The project manager for the EPC contractor is one of the main positions on the project. This person will be directly responsible for the delivery of the project on time and at cost and will be responsible for managing any subcontractors, communicating with the internal project team concerning project deliverables and mitigating against liquidated damages associated with not meeting the project due date.
Owner's engineer project manager	The project manager for the owner's engineer will be responsible for liaising with the project team and providing technical support for the development of the EPC RFP and project design criteria and give support during the pre-feasibility and feasibility studies.
Engineers	The engineers will be the main coordinators and executors of the various studies required for project pre-feasibility and feasibility. They will provide support to the interconnection study, and coordinate the hydrological, geotechnical and glint and glare studies.
Legal officer	The legal officer will coordinate and provide support for the application for the generation license, the signing of an interconnection agreement and the signing of the owner's engineering and EPC contracts.
Technicians	The electrical and construction technicians provide technical support to the project manager and engineers.
Administrative assistant	The administrative assistant provides administrative support to the project team.
Subcontractors	They are hired by the EPC contractor for specific activities, at their discretion. They must be approved by the project team.
Finance officer	The finance officer is responsible for project budgeting and monitoring of project expenses at various points in the project life cycle.
Communications officer	Is informed of project information and develops a communication strategy for disseminating information to the stakeholders.
Electrical department	Electrically inspects the project, ensures code conformity. Responsible for maintenance of solar farm during its operational life.

Note: Own Work

4.2.8. SCOPE VALIDATION

Having defined the requirements from various stakeholders and after consulting the required documentation in the collect requirements process, scope validation is then required. In this process, the consent and approval of the customer and project sponsor are sought to ensure that there is formal acceptance of the project requirements by these two major stakeholders (PMI 2017).

TABLE 12 SCOPE VALIDATION

Stakeholders	Forum	Objective of Scope Validation Meeting	Frequency
Project team	Meetings, inspections	Weekly to review requirements, work completed and plans for the next week. During the construction, the team will also conduct walk about meetings.	During initiation and planning, at least once a month. During construction, it will be fortnightly.
Project sponsor, project manager	Meetings, calls	Project manager and sponsor will meet to discuss progress, review deliverables, budget and project performance. In these meetings, requirements and grey areas will be clarified.	At least fortnightly
Project Steering committee	Meetings	The committee will receive project updates and give updates from the perspective of the represented agency about the status of the environment. Escalated decisions are also made at this meeting.	Quarterly

Stakeholders	Forum	Objective of Scope Validation Meeting	Frequency
Government of Saint Lucia	Meetings	The project team will meet with the Government of Saint Lucia – represented by the Division of Energy and Public Utilities to discuss the project progress and scope.	At least twice during initiation At least twice during construction
EPC contractor	Walk about meetings	The project manager, clerk of works and project engineer will meet with the EPC contractor to discuss the schedule, changes and general progress of the project.	Clerk of works- daily. Project engineer and project manager- weekly and as required.
Owner's engineer	Meetings and walk about meetings	Owner's engineer will meet with the project team to review requirements, provide updates and receive updates.	Fortnightly during design. During construction the owner's engineer will conduct two walk-through site visits.
DCA	Meeting	The DCA will review the project submission from the team, ensuring that there is conformance with Saint Lucia building code and environmental guidelines. They will review the ESIA and set out the requirements for environmental and social compliance to the project.	Twice

Note: Own Work

4.2.9. SCOPE CONTROL

The process of scope control is paramount to project success. It involves monitoring the progress and status of the project and ensuring that the requirements that have been set out have been accomplished. It means managing the change process and maintaining the scope baseline (PMI 2017). A significant part of scope control is the use of data analysis tools, key performance indices and regular reviews to establish the project status. Many of the scope validation engagements listed in Section 4.2.8, will be the same forum used to control the scope. It will also involve the integrated change control process where change requests are considered and approved or rejected depending on the project constraints.

4.3. SCHEDULE MANAGEMENT PLAN

Project schedule management involves the processes, tasks and other requirements needed for completing a project on time, given the previously established project scope (PMI 2017).

The processes involved with project schedule management are listed below:

1. Plan schedule management
2. Define activities
3. Sequence activities
4. Estimate activity duration
5. Develop schedule
6. Control schedule

These processes will be expounded upon in the subsequent pages of this chapter.

4.3.1. PLAN SCHEDULE MANAGEMENT

The plan schedule management process defines the framework of the project; namely its relevant policies, procedures and constraints involved in planning, establishing, performing and regulating the project (PMI 2017.) The development of a solar farm is not a new project, in that several have been developed before and there is much precedence for

benchmarking and the development of a fairly accurate and robust plan. Therefore, it is not the type of project that will require an agile approach.

However, it is important that sufficient effort is put into tailoring the plan developed to the specific context of Saint Lucia and the specific context of the Gros Islet solar farm, as the intricacies of the project and its environment are crucial to ensuring the success of the project. The tools required for the process include expert judgement across various disciplines, meetings for experience-based data gathering and data analysis, which is required to synthesize the collected information. These tools are crucial to setting reasonable, and attainable milestones and deadlines for the project.

4.3.2. DEFINE ACTIVITIES

The define activities process can be viewed as the translation of the project scope into quantifiable actions. It involves the identification and documentation of the actions required to generate all of the required work packages and project deliverables. These work packages can then be used for developing estimates which can be used for scheduling and executing work as well as monitoring progress throughout the project life cycle (PMI 2017).

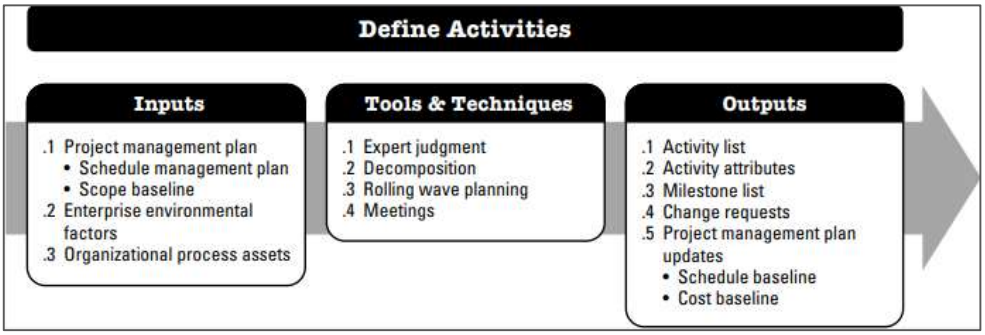

Figure 14 An overview of the Define Activities Process

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The tools required include expert judgement and decomposition. Decomposition is particularly important for scheduling as the more refined the tasks are, the more accurate the schedule will be. Defining activities for the solar project includes both the core construction activities as well as the supportive permit approval, land acquisition negotiation and other similar non-technical activities which may sometimes be overlooked or underestimated.

Tools like rolling wave planning then become crucial in dealing with some of the uncertainty associated with such human involved processes and allow for increased detail as the activity time approaches (PMI 2017). The outputs of the process of defining activities are an activity list and a milestone list. Many of the listed activities were defined in the WBS, and then deconstructed further as required. Where applicable, the activities in the list in Section 4.3.3.1 will reference WBS codes. These references are the activity attributes and are displayed along with the activity list. The milestone list marks major points in the project and is associated with the milestone payment schedule for compensating the EPC contractor in Section 4.4.2.1.

TABLE 13 MILESTONE LIST

Milestone Name	Estimated End Date
Project start	January 7, 2025
Approval of project charter budget and business case	February 25, 2025
Receipt of approval in principle from DCA	June 4, 2025
PPA approval by regulator	February 2, 2026
Conduct project feasibility	September 25, 2025
Receipt of full approval from DCA	November 28, 2025
Signing EPC contract	March 17, 2026
Approval of electrical and structural design	April 14, 2026
Contractor mobilization	April 1, 2027
Delivery of long lead items on site	May 4, 2027

Milestone Name	Estimated End Date
Electrical and mechanical completion	June 10, 2027
Hot commissioning	July 9, 2027
Project end	July 26, 2027

Note: Own Work

4.3.2.1.SEQUENCE ACTIVITIES

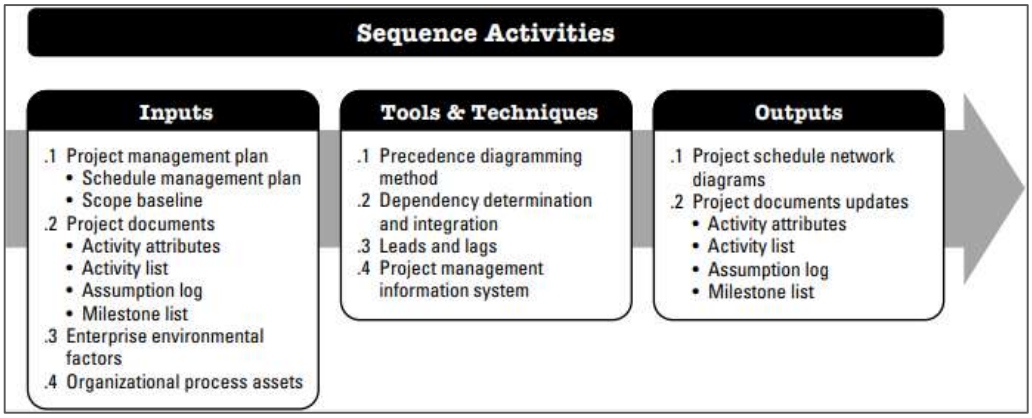

Figure 15 An Overview of the Define Activities Process

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Sequencing the activities is critical in delivering a functional and efficient project. It is concerned with the establishment of logical relationships between the defined project activities which will result in the optimization of the project time and resources given all the known constraints (PMI 2017). The inputs and tools associated are listed in the figure below. It is an iterative process and as the project goes along, new activities may be included from the define activities process, or the reordering of defined activities may be required as resources change. The output of the sequence activities process is a project schedule network diagram which is displayed subsequently.

4.3.3. ESTIMATE ACTIVITY DURATION

The estimate activity duration process uses expert judgement and experience to attribute a time duration for completion, usually in days, to each project activity (PMI 2017). Assumptions are foundational in setting activity durations, including the technology and method required to complete, the decision-making environment and the available resources. Much of the available information about solar projects is skewed towards the first world context and so, care is required to ensure that each assumption and estimation of duration is as accurate and realistic as possible and reasonably applicable within the Caribbean context.

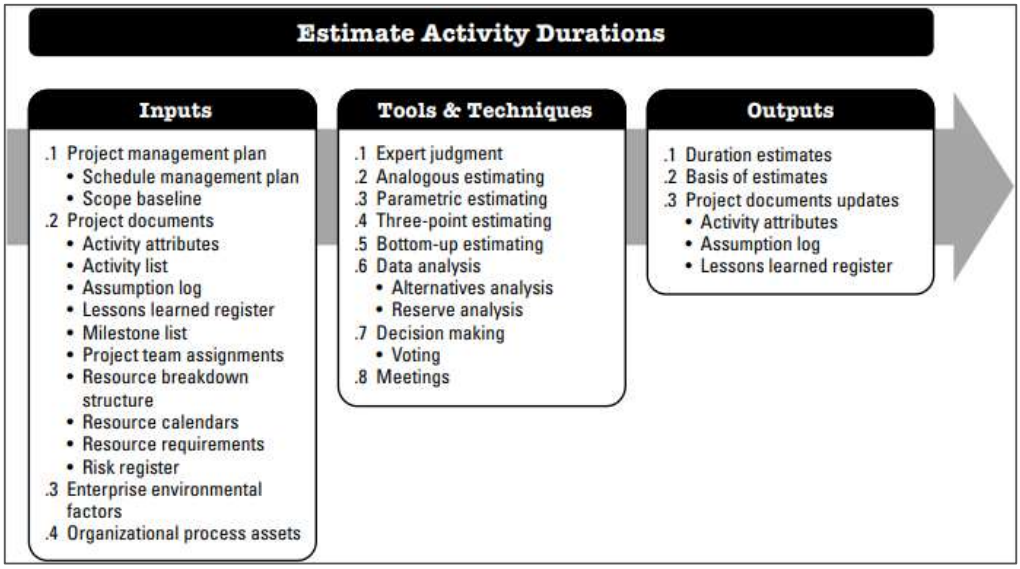

Figure 16 An Overview of the Estimate Activity Duration Process

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4.3.3.1. ACTIVITY LIST

TABLE 14 LIST OF ACTIVITIES

Task No.	Outline number	Name	Duration	Start	Finish	Depends on	Dependents (after)
1	**1**	**PROJECT INITIATION**	**284 days**	**1/1/2025**	**2/2/2026**		
2	1.1	Review output from NETS and energy plans	5 days	1/1/2025	1/7/2025		3FS
3	1.2	Prepare project concept note and project charter	5 days	1/8/2025	1/14/2025	2FS	4FS, 8FS
4	**1.3**	**Acquire internal project approvals**	**30 days**	**1/15/2025**	**2/25/2025**	**3FS**	
5	1.3.1	Prepare and submit business case	10 days	1/15/2025	1/28/2025		6FS, 9FS
6	1.3.2	Approval of project charter budget and business case	20 days	1/29/2025	2/25/2025	5FS	13FS, 19FS, 58FS
7	**1.4**	**Acquire land**	**110 days**	**1/15/2025**	**6/17/2025**		
8	1.4.1	Review business case and economic evaluation and lease or purchase decision	5 days	1/15/2025	1/21/2025	3FS	10FS, 9FS
9	1.4.2	Obtain letter of support for planning approvals	20 days	1/29/2025	2/25/2025	5FS, 8FS	13FS
10	1.4.3	Negotiations	90 days	1/22/2025	5/27/2025	8FS	11FS
11	1.4.4	Effect arrangement with landowner	15 days	5/28/2025	6/17/2025	10FS	
12	**1.5**	**Apply for planning approval in principle**	**71 days**	**2/26/2025**	**6/4/2025**		
13	1.5.1	Collect required documents- survey plan, et cetera	10 days	2/26/2025	3/11/2025	6FS, 9FS	15FS, 14FS
14	1.5.2	Prepare submission	1 day	3/12/2025	3/12/2025	13FS	15FS
15	1.5.3	Application for approval in principle	0 days	3/12/2025	3/12/2025	13FS, 14FS	16FS, 41FS
16	1.5.4	Review of application for approval in principle	60 days	3/13/2025	6/4/2025	15FS	17FS

Task No.	Outline number	Name	Duration	Start	Finish	Depends on	Dependents (after)
17	1.5.5	Receipt of approval in principle	0 days	6/4/2025	6/4/2025	16FS	20FS, 24FS, 25FS, 37FS, 36FS, 42FS, 45FS, 49FS
18	**1.6**	**Application for generation license to NURC**	**148 days**	**2/26/2025**	**9/19/2025**		
19	1.6.1	Prepare supporting documentation	30 days	2/26/2025	4/8/2025	6FS	20FS
20	1.6.2	Request generation license	1 day	6/5/2025	6/5/2025	19FS, 17FS	21FS, 24FS
21	1.6.3	Review of license application	75 days	6/6/2025	9/18/2025	20FS	22FS
22	1.6.4	Issue of generation license	1 day	9/19/2025	9/19/2025	21FS	25FS, 28FS, 64FS
23	**1.7**	**Power purchase agreement**	**172 days**	**6/6/2025**	**2/2/2026**		
24	1.7.1	Develop draft PPA document	40 days	6/6/2025	7/31/2025	17FS, 20FS	27FS
25	1.7.2	Preliminary discussions and due diligence	1 day	9/22/2025	9/22/2025	17FS, 22FS	26FS
26	1.7.3	Negotiations	90 days	9/23/2025	1/26/2026	25FS	28FS
27	1.7.4	Legal review and documentation	120 days	8/1/2025	1/15/2026	24FS	28FS
28	1.7.5	Signing the final PPA document	0 days	1/26/2026	1/26/2026	27FS, 26FS, 22FS	29FS
29	1.7.6	PPA approval by regulator	5 days	1/27/2026	2/2/2026	28FS	
30	**1.8**	**Conduct project feasibility**	**192 days**	**1/1/2025**	**9/25/2025**		
31	**1.8.1**	**Grid interconnection**	**1 day**	**1/1/2025**	**1/1/2025**		
32	1.8.1.1	Gather interconnection requirements from LUCELEC					
33	1.8.1.2	Conduct grid interconnection study					
34	1.8.1.3	LUCELEC approval of interconnection study	1 day	1/1/2025	1/1/2025		119FS
35	**1.8.2**	**ESIA**	**81 days**	**6/5/2025**	**9/25/2025**		
36	1.8.2.1	Hire ESIA consultant	20 days	6/5/2025	7/2/2025	17FS	38FS
37	1.8.2.2	Review ESIA requirements from DCA	2 days	6/5/2025	6/6/2025	17FS	38FS, 53FS

Task No.	Outline number	Name	Duration	Start	Finish	Depends on	Dependents (after)
38	1.8.2.3	Perform ESIA	60 days	7/3/2025	9/24/2025	36FS, 37FS	39FS
39	1.8.2.4	Receive ESIA document	1 day	9/25/2025	9/25/2025	38FS	
40	**1.8.3**	**Glint and glare**	**105 days**	**3/13/2025**	**8/6/2025**		
41	1.8.3.1	Hire glint and glare consultant	30 days	3/13/2025	4/23/2025	15FS	
42	1.8.3.2	Perform glint and glare study	40 days	6/5/2025	7/30/2025	17FS	43FS
43	1.8.3.3	Receive study results and review plan of action	5 days	7/31/2025	8/6/2025	42FS	53FS
44	**1.8.4**	**Hydrological study**	**50 days**	**6/5/2025**	**8/13/2025**		
45	1.8.4.1	Hire hydrological engineer	20 days	6/5/2025	7/2/2025	17FS	46FS
46	1.8.4.2	Perform hydrological study	20 days	7/3/2025	7/30/2025	45FS	47FS
47	1.8.4.3	Receive plan and evaluate and plan mitigation based on study outcomes	10 days	7/31/2025	8/13/2025	46FS	
48	**1.8.5**	**Geotechnical study**	**49 days**	**6/5/2025**	**8/12/2025**		
49	1.8.5.1	Hire geotechnical engineer	14 days	6/5/2025	6/24/2025	17FS	50FS
50	1.8.5.2	Perform geotechnical study	30 days	6/25/2025	8/5/2025	49FS	51FS
51	1.8.5.3	Receive and evaluate results	5 days	8/6/2025	8/12/2025	50FS	
52	**1.9**	**Apply for and obtain full approval**	**82 days**	**8/7/2025**	**11/28/2025**		
53	1.9.1	Collect requirements, documents and perform application write-ups	20 days	8/7/2025	9/3/2025	37FS, 43FS	54FS
54	1.9.2	Application for full approval	1 day	9/4/2025	9/4/2025	53FS	55FS
55	1.9.3	Review of application for full approval	60 days	9/5/2025	11/27/2025	54FS	56FS
56	1.9.4	Receipt of full approval	1 day	11/28/2025	11/28/2025	55FS	
57	**1.10**	**Procure owner's engineering services**	**61 days**	**2/26/2025**	**5/21/2025**		
58	1.10.1	Develop request for proposals	20 days	2/26/2025	3/25/2025	6FS	59FS

Task No.	Outline number	Name	Duration	Start	Finish	Depends on	Dependents (after)
59	1.10.2	Issue RFP and bid preparation by contractors	25 days	3/26/2025	4/29/2025	58FS	60FS
60	1.10.3	Evaluation of bids	15 days	4/30/2025	5/20/2025	59FS	61FS
61	1.10.4	Selection of contractor	1 day	5/21/2025	5/21/2025	60FS	
62	**2**	**PROCUREMENT OF EPC**	**127 days**	**9/22/2025**	**3/17/2026**		
63	**2.1**	**Recruitment of EPC**	**93 days**	**9/22/2025**	**1/28/2026**		
64	2.1.1	Develop Request for Proposals	50 days	9/22/2025	11/28/2025	22FS	65FS
65	2.1.2	Issue RFP	2 days	12/1/2025	12/2/2025	64FS	66FS
66	2.1.3	Preparation and submission of proposals by bidders	20 days	12/3/2025	12/30/2025	65FS	68FS, 67FS
67	2.1.4	EPC proposals due	0 days	12/30/2025	12/30/2025	66FS	68FS
68	2.1.5	Evaluation of bids	20 days	12/31/2025	1/27/2026	66FS, 67FS	69FS
69	2.1.6	Selection of contractor using cost/technical scoring system based on RFP	1 day	1/28/2026	1/28/2026	68FS	71FS
70	**2.2**	**Contract**	**34 days**	**1/29/2026**	**3/17/2026**		
71	2.2.1	Notification of chosen seller	3 days	1/29/2026	2/2/2026	69FS	72FS
72	2.2.2	Submission of seller contract	10 days	2/3/2026	2/16/2026	71FS	73FS
73	2.2.3	Contract negotiation	20 days	2/17/2026	3/16/2026	72FS	74FS
74	2.2.4	Contract signing	1 day	3/17/2026	3/17/2026	73FS	76FS, 79FS, 82FS
75	**3**	**DESIGN AND DEVELOPMENT**	**20 days**	**3/18/2026**	**4/14/2026**		
76	**3.1**	**PV system design**	**5 days**	**3/18/2026**	**3/24/2026**	**74FS**	
77	3.1.1	Confirm conditions from proposal	5 days	3/18/2026	3/24/2026		
78	3.1.2	Design PV arrays	5 days	3/18/2026	3/24/2026		
79	**3.2**	**Structural design**	**20 days**	**3/18/2026**	**4/14/2026**	**74FS**	

Task No.	Outline number	Name	Duration	Start	Finish	Depends on	Dependents (after)
80	3.2.1	Foundation, racking, support and all civil designs	15 days	3/18/2026	4/7/2026		81FS
81	3.2.2	Approval of all structural design by engineer	5 days	4/8/2026	4/14/2026	80FS	94FS
82	**3.3**	**Electrical design**	**20 days**	**3/18/2026**	**4/14/2026**	**74FS**	
83	3.3.1	LV electrical design	5 days	3/18/2026	3/24/2026		
84	3.3.2	HV electrical design	5 days	3/18/2026	3/24/2026		
85	3.3.3	Selection and sizing of major equipment	10 days	3/18/2026	3/31/2026		
86	3.3.4	Interconnection design finalization and approval	15 days	3/18/2026	4/7/2026		87FS
87	3.3.5	Approval of electrical designs	5 days	4/8/2026	4/14/2026	86FS	90FS, 94FS
88	**4**	**IMPLEMENTATION**	**303 days**	**4/15/2026**	**6/11/2027**		
89	**4.1**	**Procurement**	**275 days**	**4/15/2026**	**5/4/2027**		
90	4.1.1	Purchase long lead items	260 days	4/15/2026	4/13/2027	87FS	91FS
91	4.1.2	Delivery of long lead items on Site	15 days	4/14/2027	5/4/2027	90FS	113FS
92	**4.2**	**CONSTRUCTION**	**52 days**	**4/1/2027**	**6/11/2027**		
93	**4.2.1**	**Mobilization**	**21 days**	**4/1/2027**	**4/29/2027**		
94	4.2.1.1	Notice to Proceed	0 days	4/1/2027	4/1/2027	87FS, 81FS	95FS
95	4.2.1.2	Contractor Mobilization	1 day	4/1/2027	4/1/2027	94FS	96FS, 99FS, 100FS, 101FS, 98FS, 119FS
96	4.2.1.3	Site Clearing	3 days	4/2/2027	4/6/2027	95FS	104FS, 119FS
97	**4.2.1.4**	**Support Facilities and Utilities**	**20 days**	**4/2/2027**	**4/29/2027**		
98	4.2.1.4.1	External and internal roads	10 days	4/2/2027	4/15/2027	95FS	
99	4.2.1.4.2	Connection of utilities -power water, internet	5 days	4/2/2027	4/8/2027	95FS	121FS
100	4.2.1.4.3	Site facilities - washrooms, water tanks, canteen etc.	20 days	4/2/2027	4/29/2027	95FS	

Task No.	Outline number	Name	Duration	Start	Finish	Depends on	Dependents (after)
101	4.2.1.4.4	Fencing and security booths	20 days	4/2/2027	4/29/2027	95FS	103FS
102	**4.2.2**	**Civil works**	**21 days**	**4/30/2027**	**5/28/2027**		
103	4.2.2.1	Delivery of equipment and materials on site	1 day	4/30/2027	4/30/2027	101FS	104FS, 105FS, 106FS, 109FS, 112FS
104	4.2.2.2	Foundation works (concrete bases)	10 days	5/3/2027	5/14/2027	96FS, 103FS	107FS
105	4.2.2.3	Trenching for HV and LV cabling	10 days	5/3/2027	5/14/2027	103FS	110FS, 111FS
106	4.2.2.4	Manhole construction	5 days	5/3/2027	5/7/2027	103FS	
107	4.2.2.5	Installation of framing	10 days	5/17/2027	5/28/2027	104FS	115FS
108	**4.2.3**	**Electrical works**	**48 days**	**4/7/2027**	**6/11/2027**		
109	4.2.3.1	Deliveries on-site	1 day	5/3/2027	5/3/2027	103FS	110FS, 111FS, 112FS
110	4.2.3.2	Cabling	7 days	5/17/2027	5/25/2027	105FS, 109FS	
111	4.2.3.3	DC boxes - inverters cabling	7 days	5/17/2027	5/25/2027	105FS, 109FS	114FS, 116FS
112	4.2.3.4	Earthing	7 days	5/4/2027	5/12/2027	103FS, 109FS	
113	4.2.3.5	Installation of transformer and HV equipment	10 days	5/5/2027	5/18/2027	91FS	
114	4.2.3.6	Installation of control relay panels & MV panels	10 days	5/26/2027	6/8/2027	111FS	
115	4.2.3.7	Install PV panels & inverters	10 days	5/31/2027	6/11/2027	107FS	
116	4.2.3.8	Panel and other connections	10 days	5/26/2027	6/8/2027	111FS	117FS, 118FS
117	4.2.3.9	Installation of main & backup metering	2 days	6/9/2027	6/10/2027	116FS	118FS
118	4.2.3.10	Electrical and mechanical completion	0 days	6/10/2027	6/10/2027	116FS, 117FS	125FS
119	4.2.3.11	Interconnection construction	5 days	4/7/2027	4/13/2027	34FS, 95FS, 96FS	126FS
120	**4.2.4**	**Telecom and CCTV works**	**9 days**	**4/9/2027**	**4/21/2027**		
121	4.2.4.1	Delivery and setting out	2 days	4/9/2027	4/12/2027	99FS	122FS

Task No.	Outline number	Name	Duration	Start	Finish	Depends on	Dependents (after)
122	4.2.4.2	Installation of external and internal telecom equipment	5 days	4/13/2027	4/19/2027	121FS	123FS
123	4.2.4.3	Commissioning/ communications check	2 days	4/20/2027	4/21/2027	122FS	
124	**5**	**TESTING & COMMISSIONING**	**21 days**	**6/11/2027**	**7/9/2027**		
125	5.1	Cold commissioning	10 days	6/11/2027	6/24/2027	118FS	127FS, 126FS
126	5.2	Connection to grid	1 day	6/25/2027	6/25/2027	125FS,119FS	127FS, 129FS
127	5.3	Hot commissioning	10 days	6/28/2027	7/9/2027	125FS,126FS	
128	**6**	**FINISHING & HANDOVER**	**21 days**	**6/28/2027**	**7/26/2027**		
129	6.1	Finishing works	20 days	6/28/2027	7/23/2027	126FS	130FS
130	6.2	System Completion	1 day	7/26/2027	7/26/2027	129FS	

Note: Own Work

Several tools to assist in this process are available including analogous parametric and three-point estimation. All the inputs, tools and outputs for this process are displayed below. The activity list in Section 4.3.3.1 is an output of the define activities process. The table also includes activity durations which were defined in the estimate duration process. Activity order and dependencies established in the sequence activities process are also included.

4.3.4. DEVELOP SCHEDULE

The develop schedule process includes the analysis and synthesis of the information from the previous schedule development processes, considering project resources and other constraints and produces a schedule baseline for the project (PMI 2017). The model for this schedule baseline is typically diagrammatically represented as a Gantt chart and contains task and activity, duration, resource, and timeline data, among other outputs. This schedule baseline Gantt chart will be a key document used by the project team to verify accuracy of information with project stakeholders and keep track of the project throughout its life cycle. The tools inputs and outputs associated with the process are displayed in Figure 17 below.

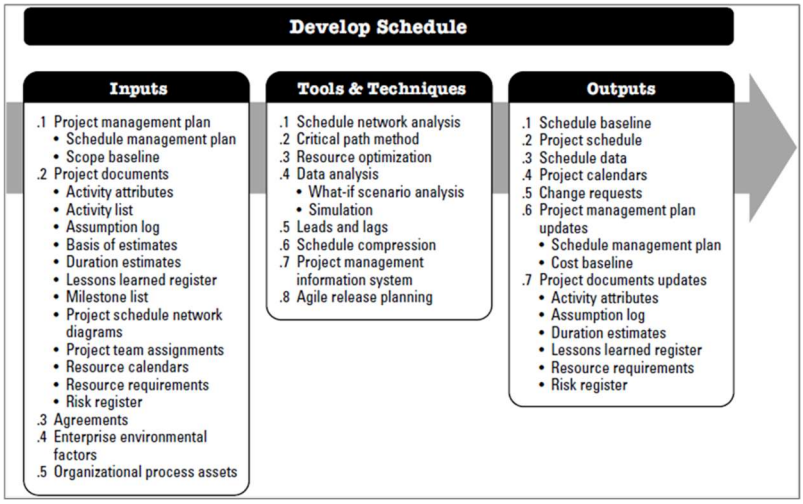
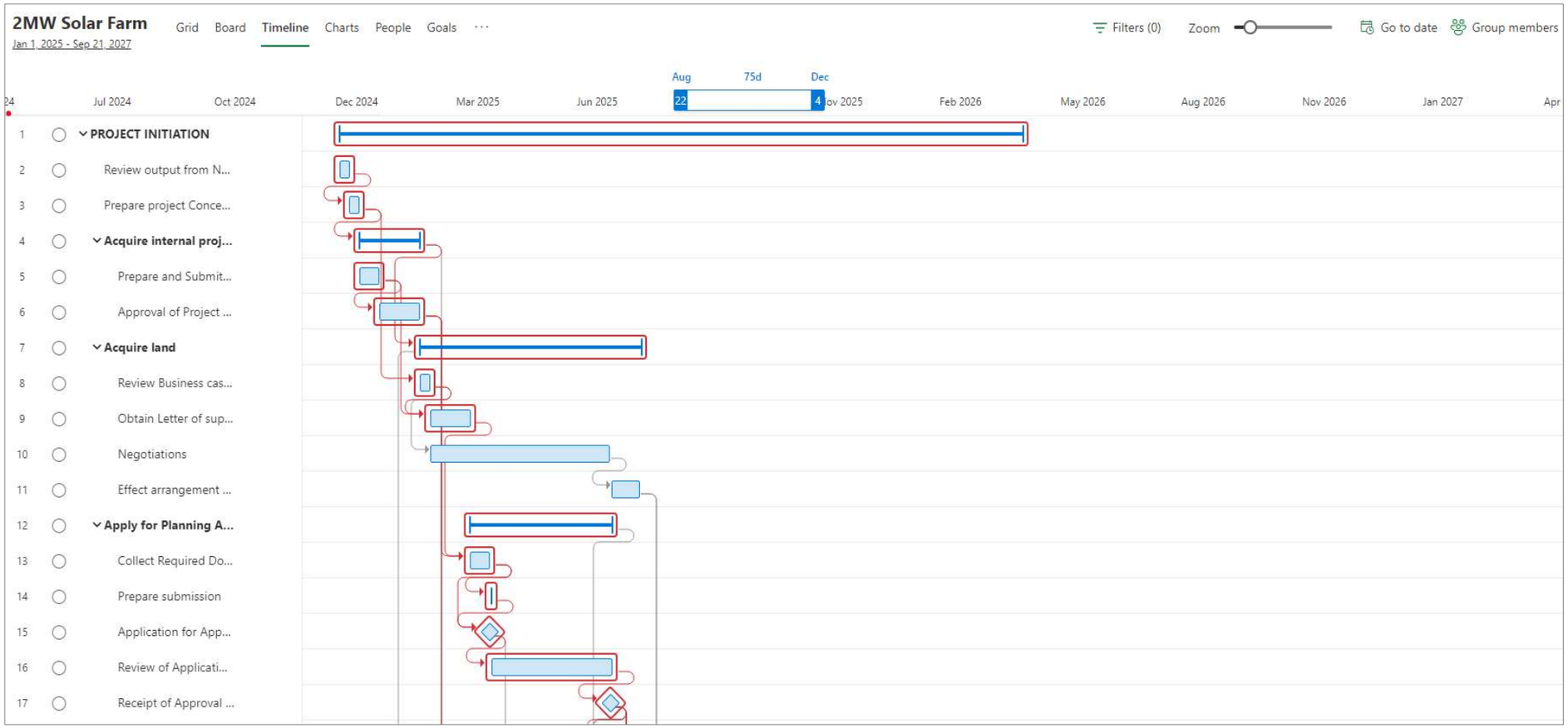


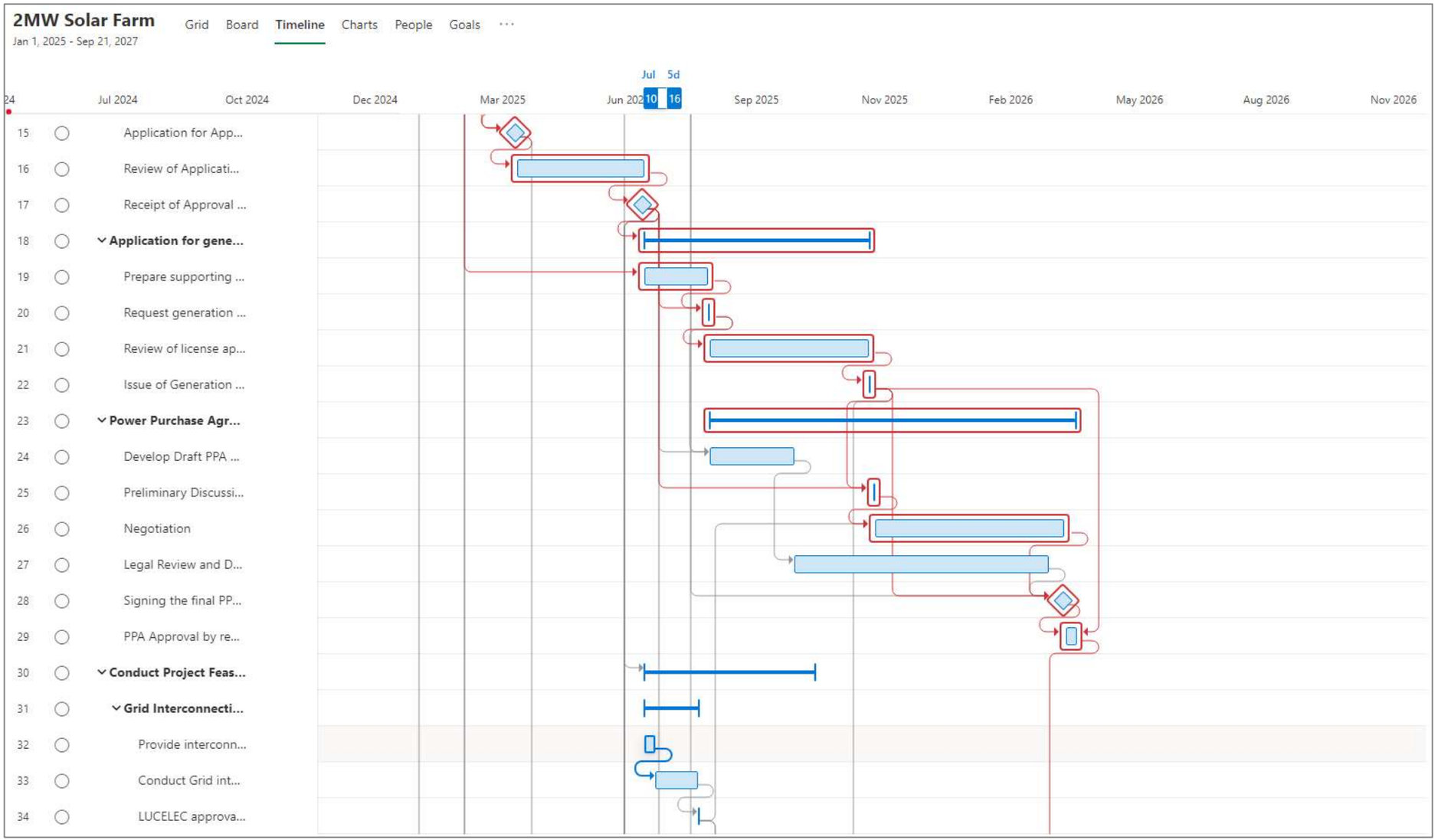
Figure 17 Overview of the Develop Schedule Process

Note: Reprinted from A Guide to the Project Management Body of Knowledge (PMBOK® Guide) Sixth Edition. Project Management Institute (PMI), 2017 Figure 6-14, p. 205 Copyright 2017 by Project Management Institute, Inc.

The schedule model was created using Microsoft Project Web, and the inputs were derived from expert opinion, research, organizational documentation and experience. The schedule will be used primarily by the project manager and team to keep track of the project throughout its life cycle. It can also be shared with project stakeholders to keep them informed of plans and encourage their full engagement.

4.3.4.1. CRITICAL PATH SCHEDULE




2MW Solar Farm
Jan 1, 2025 - Sep 21, 2027
Grid
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Timeline
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Nov 2025
Feb 2026
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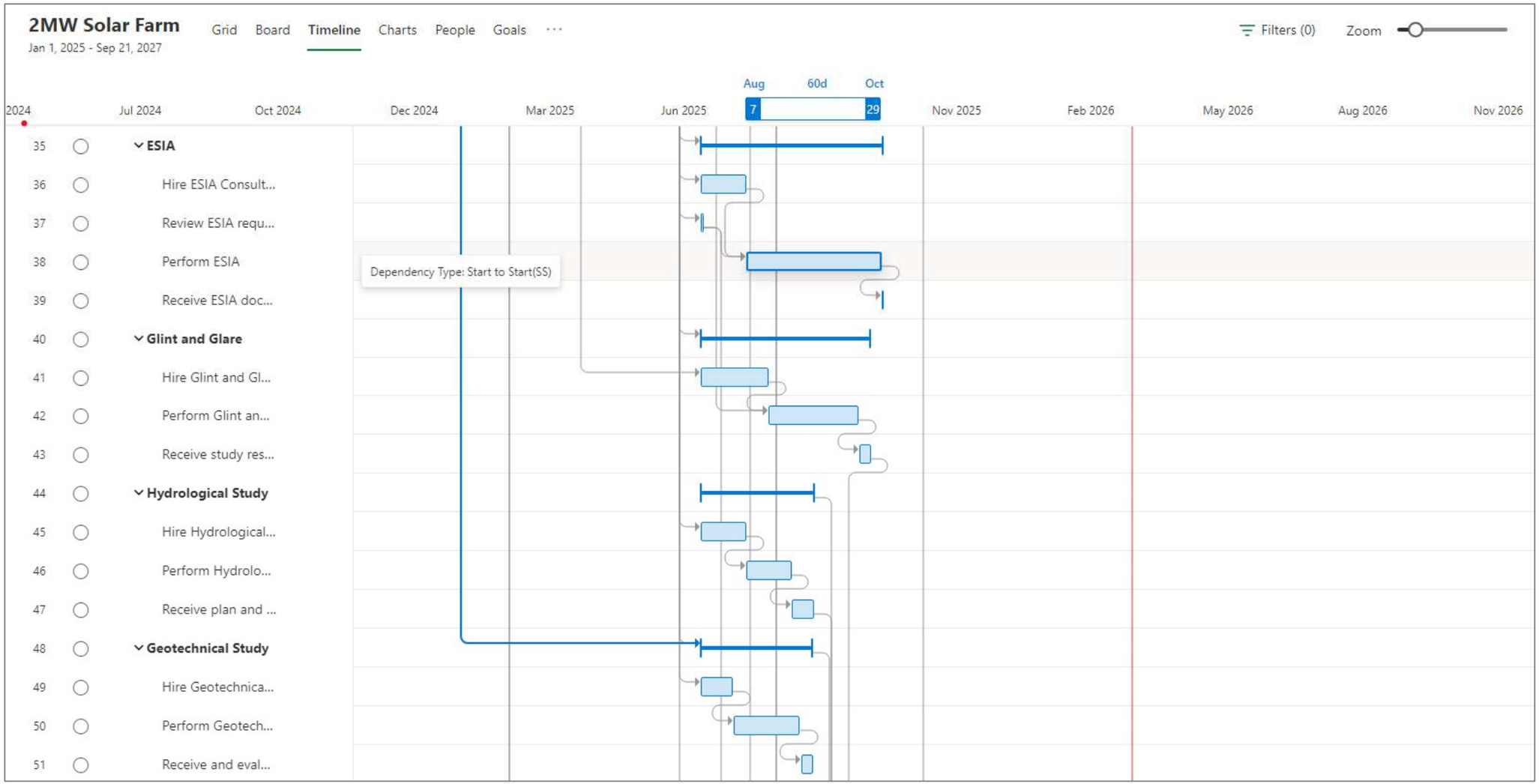
Aug 2026
Nov 2026
15 Application for App...
16 Review of Applicati...
17 Receipt of Approval ...
18 Application for gene...
19 Prepare supporting ...
20 Request generation ...
21 Review of license ap...
22 Issue of Generation ...
23 Power Purchase Agr...
24 Develop Draft PPA ...
25 Preliminary Discussi...
26 Negotiation
27 Legal Review and D...
28 Signing the final PP...
29 PPA Approval by re...
30 Conduct Project Feas...
31 Grid Interconnecti...
32 Provide interconn...
33 Conduct Grid int...
34 LUCELEC approva...


2MW Solar Farm
Jan 1, 2025 - Sep 21, 2027
Grid
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Timeline
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Filters (0)
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Nov 2025
Feb 2026
May 2026
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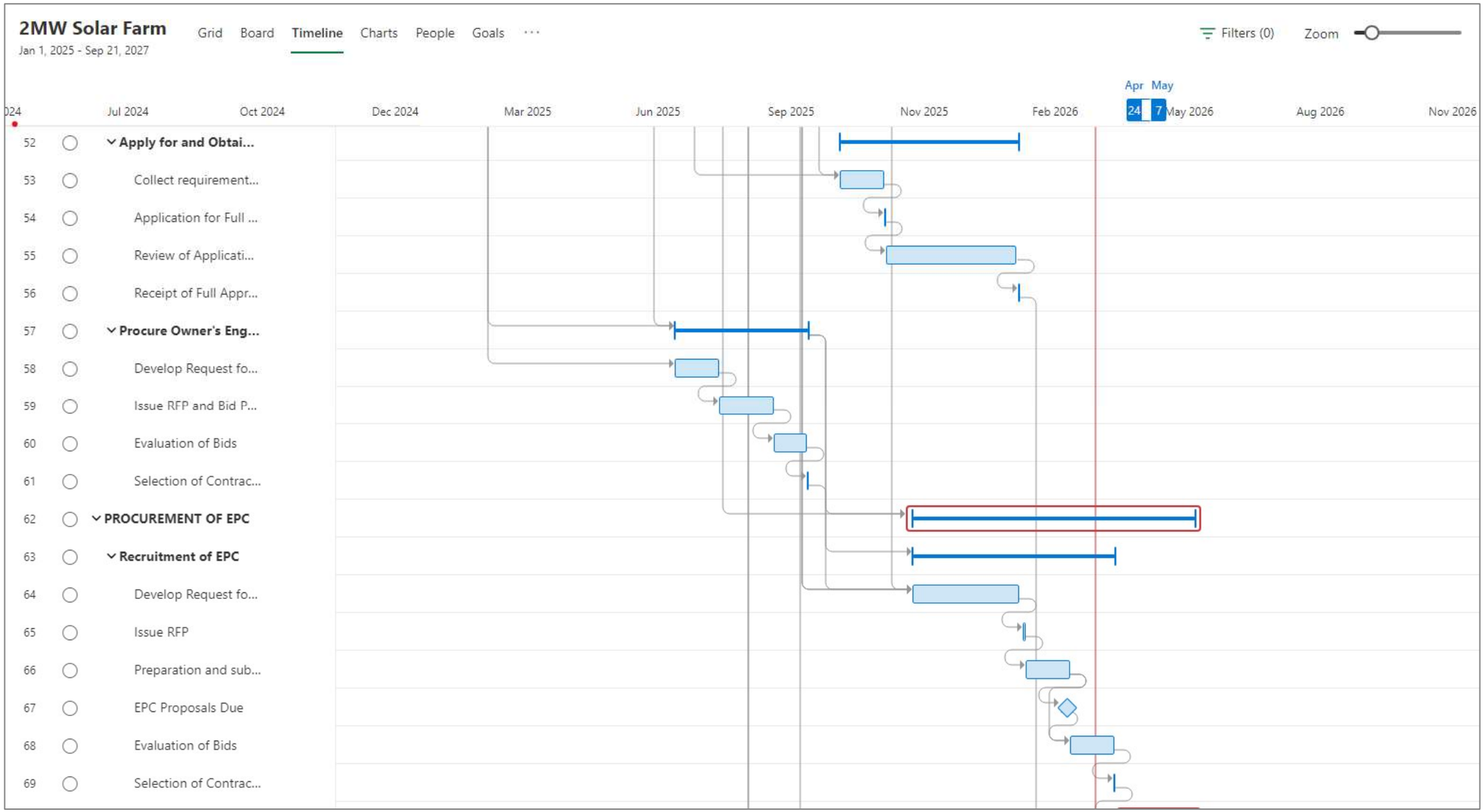
Nov 2026
35 ESIA
36 Hire ESIA Consult...
37 Review ESIA requ...
38 Perform ESIA
39 Receive ESIA doc...
40 Glint and Glare
41 Hire Glint and Gl...
42 Perform Glint an...
43 Receive study res...
44 Hydrological Study
45 Hire Hydrological...
46 Perform Hydrolo...
47 Receive plan and ...
48 Geotechnical Study
49 Hire Geotechnica...
50 Perform Geotech...
51 Receive and eval...
Dependency Type: Start to Start(SS)


2MW Solar Farm
Jan 1, 2025 - Sep 21, 2027
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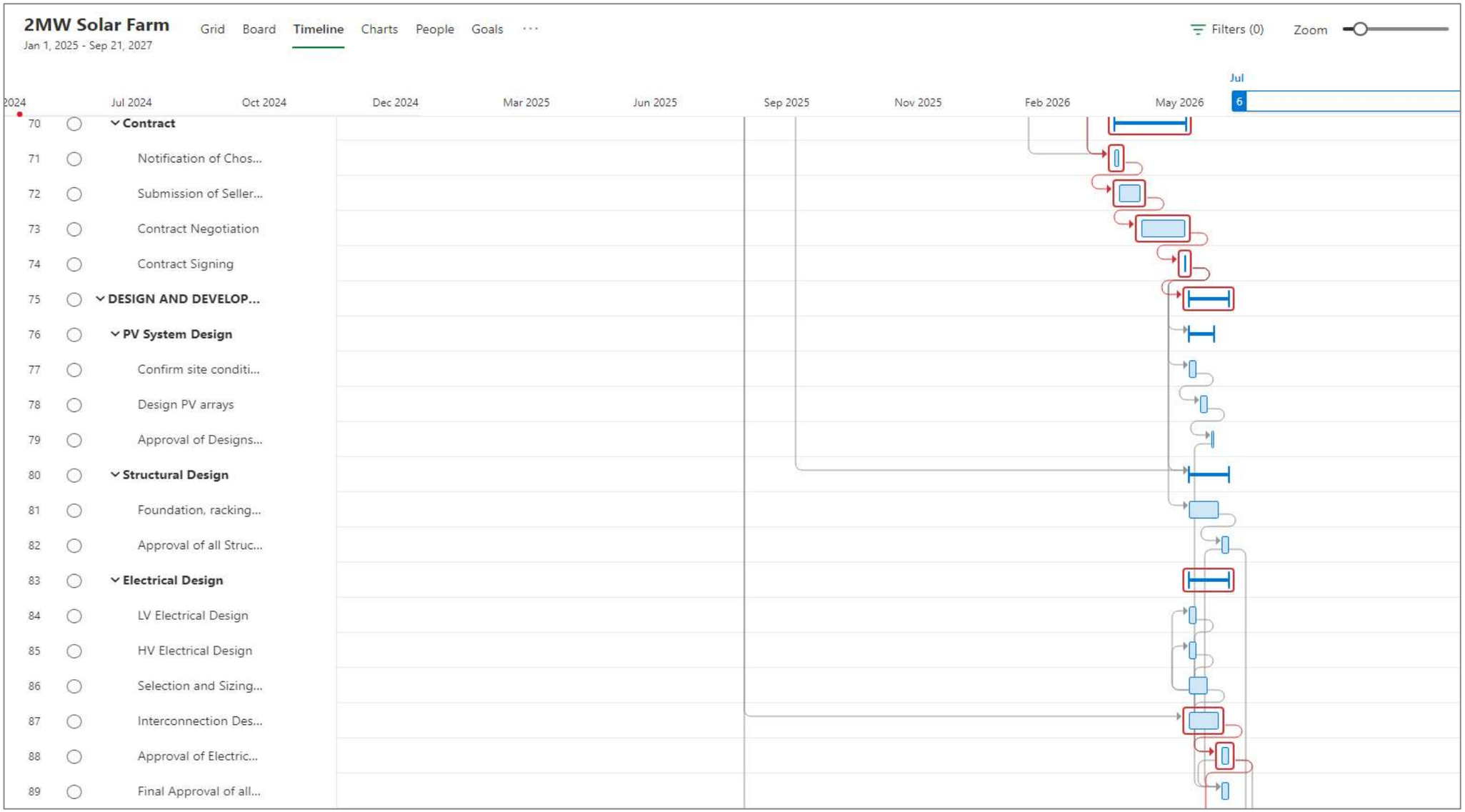
52 Apply for and Obtai...
53 Collect requirement...
54 Application for Full ...
55 Review of Applicati...
56 Receipt of Full Appr...
57 Procure Owner's Eng...
58 Develop Request fo...
59 Issue RFP and Bid P...
60 Evaluation of Bids
61 Selection of Contrac...
62 PROCUREMENT OF EPC
63 Recruitment of EPC
64 Develop Request fo...
65 Issue RFP
66 Preparation and sub...
67 EPC Proposals Due
68 Evaluation of Bids
69 Selection of Contrac...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Jan 1, 2025 - Sep 21, 2027
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Goals
Filters (0)
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Jun 2025
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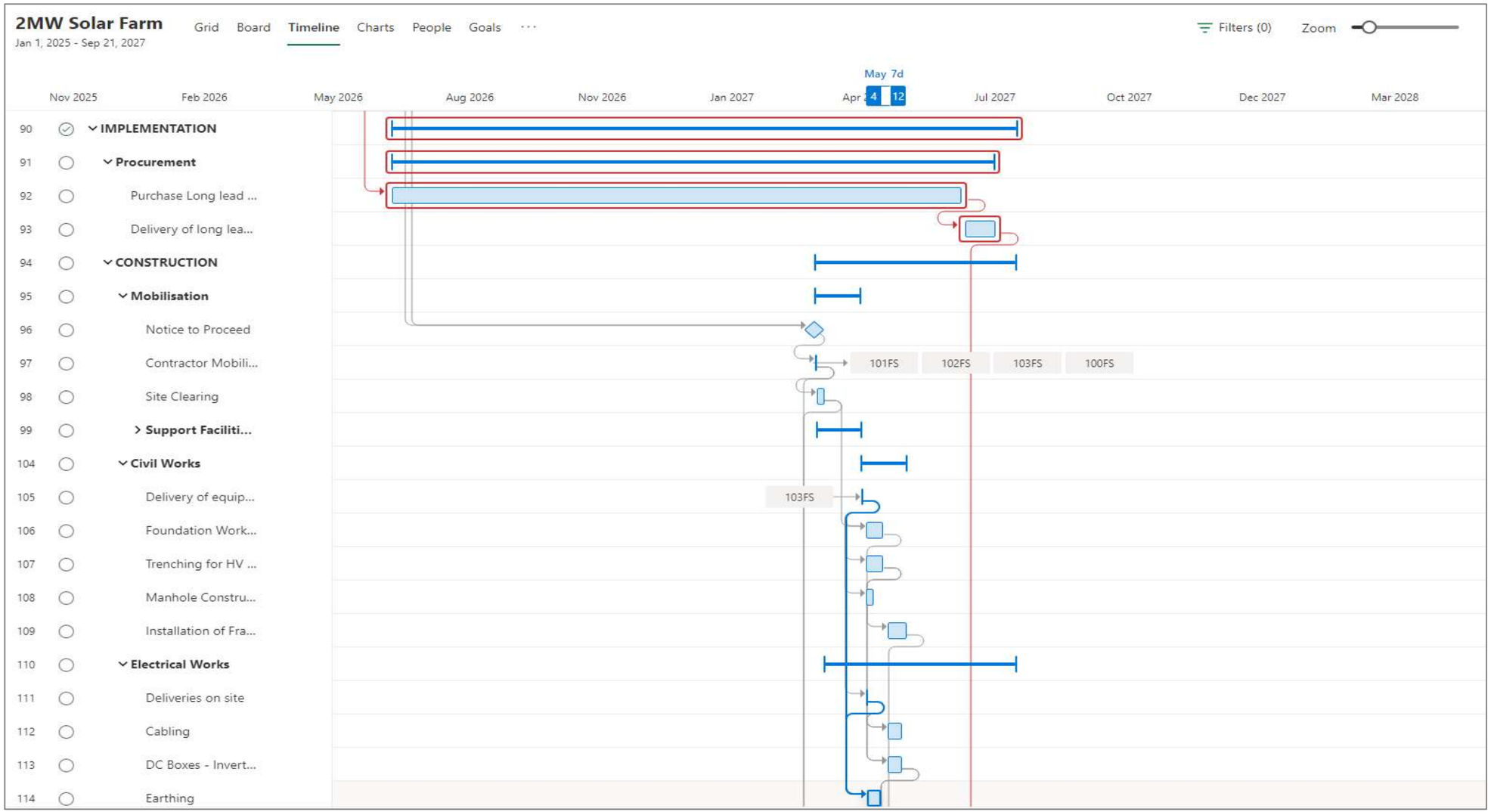
Nov 2025
Feb 2026
May 2026
70 Contract
71 Notification of Chos...
72 Submission of Seller...
73 Contract Negotiation
74 Contract Signing
75 DESIGN AND DEVELOP...
76 PV System Design
77 Confirm site conditi...
78 Design PV arrays
79 Approval of Designs...
80 Structural Design
81 Foundation, racking...
82 Approval of all Struc...
83 Electrical Design
84 LV Electrical Design
85 HV Electrical Design
86 Selection and Sizing...
87 Interconnection Des...
88 Approval of Electric...
89 Final Approval of all...


2MW Solar Farm
Jan 1, 2025 - Sep 21, 2027
Grid
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Timeline
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May 2026
Aug 2026
Nov 2026
Jan 2027
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Jul 2027
Oct 2027
Dec 2027
Mar 2028
90 IMPLEMENTATION
91 Procurement
92 Purchase Long lead ...
93 Delivery of long lea...
94 CONSTRUCTION
95 Mobilisation
96 Notice to Proceed
97 Contractor Mobili...
98 Site Clearing
99 Support Faciliti...
104 Civil Works
105 Delivery of equip...
106 Foundation Work...
107 Trenching for HV ...
108 Manhole Constru...
109 Installation of Fra...
110 Electrical Works
111 Deliveries on site
112 Cabling
113 DC Boxes - Invert...
114 Earthing
101FS
102FS
103FS
100FS
103FS

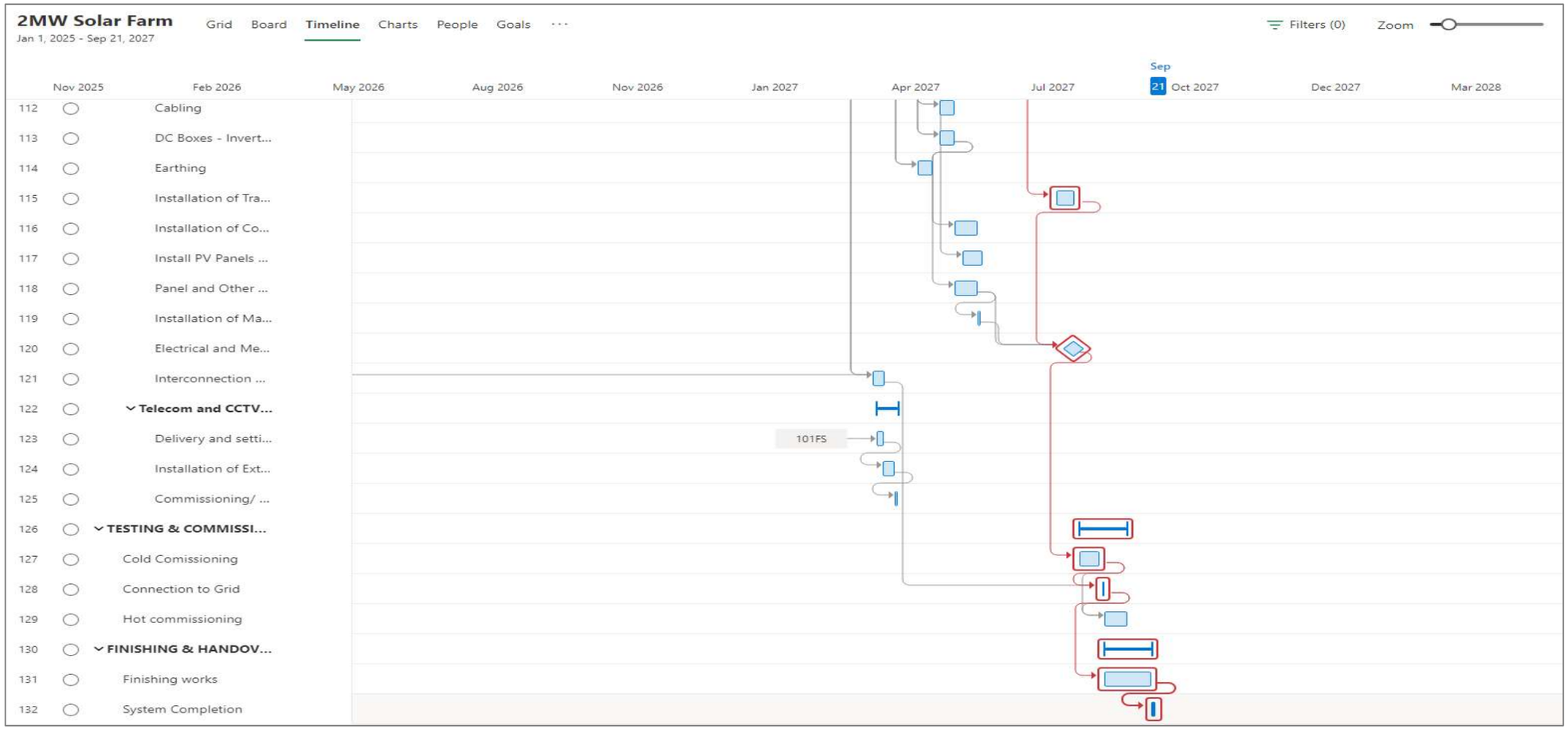

Figure 18 Critical Path Schedule

Note: Own Work

4.3.5. CONTROL SCHEDULE

Controlling the project schedule means overseeing the actual project schedule execution as compared to the schedule baseline throughout the project life cycle and taking action to manage any changes observed (PMI 2017). The intention of this process is to ensure that the project manager and team do whatever is required within constraints to maintain the schedule baseline. The typical input tools and outputs for controlling the schedule of a project are displayed below.

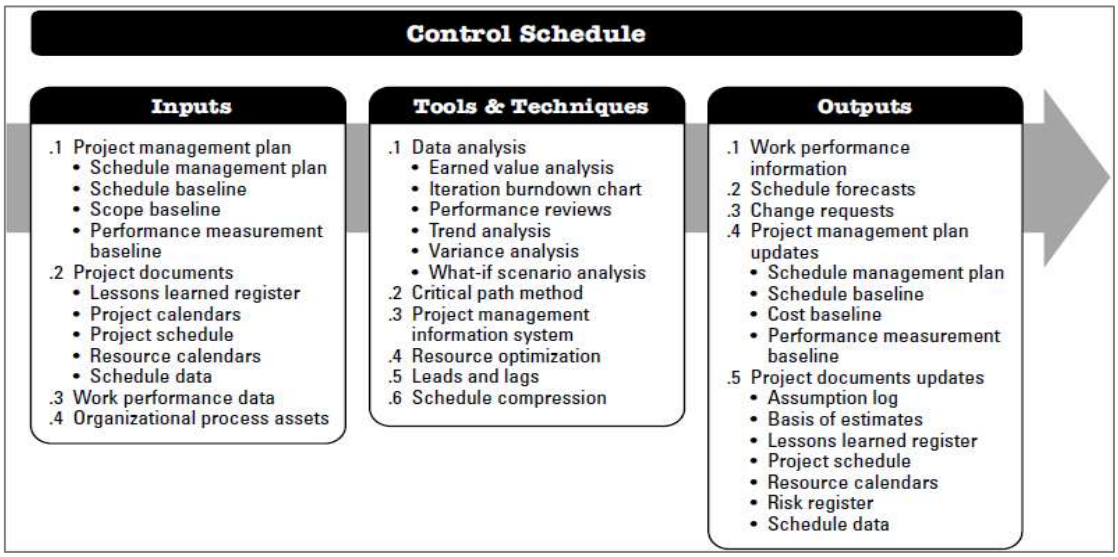

Figure 19 Overview of the Control Schedule Process

Note: Reprinted from A Guide to the Project Management Body of Knowledge (PMBOK® Guide) Sixth Edition. Project Management Institute (PMI), 2017 Figure 6-22, p. 222 Copyright 2017 by Project Management Institute, Inc.

In Saint Lucia, the punctual delivery of the 2MW solar farm is of critical importance. Increasing the island's cost-effective renewable energy production means lowering the quantity of diesel imported to the island for electricity generation and an increase in the island's energy security. Delays in the project mean a continuation of the status quo: no reduction in fuel consumed or power system losses. Therefore, adherence to the critical

path schedule is paramount. For the development of this 2MW solar farm, the following methods for schedule control will be employed by the project team.

1. The critical path method will be utilized to determine and adequately resource the project so that unforeseen delays are minimized. This method will be effectively operationalized to prioritize tasks, resources, and decision-making. Risks to activities on the critical path will need to be mitigated with priority.

   In the case of the solar farm, because of the extremely long lead time for substation transformers of over a year, the project schedule will have a significant amount of slack time, from the procurement of long lead items until construction. All efforts must be made to ensure that these long lead items are procured as early as possible and to the correct quality, because an error in this procurement will delay the project by over 1 year. The long lead time also allows a lot of slack for the riskier items like any negotiation time overruns, and for finalizing any interconnection issues. Finally, it allows more than enough time for the civil and electrical cabling works to be done before the arrival of the transformer. If the point of interconnection (POI) transformer deliveries are late, there could be significant cost increases if the EPC contractor is already on site. Some potential causes of cost increases include contractor idle time costs and extended equipment rental costs. This critical path therefore needs to be monitored and planned closely so that the contractors and long lead items do not extend or violate the schedule baseline. This will tie in with the project's risk management plan, resource management plan and cost management plan as mentioned above.

   The critical path will be kept front and center of project team discussions by the project manager. The team will provide sup acquireport in keeping an eye on the progress of non-critical path items to ensure that they are executed within their constraints and given slack.

2. To ensure full and optimal use of the critical path method for project schedule control, a project management information system, Microsoft Project will be used for the management of the project schedule model, and the project team will input

actual project times to compare against the schedule baseline. This easy to display interface will be used for presentations to project team and strategic placement on notice boards, fostering both accountability and advocacy for any change in resource or financial requirements for maintaining or crashing the project schedule if there are project delays.

3. Performance reviews will also be used to assist in controlling the project schedule. Since a contractor is being hired to execute the EPC contract, adequate supervision of this contractor will be required. The baseline of this review will be the execution of the project milestones. The EPC contractor will be required to report on project status, including % completion by relevant dates as part of regular reviews. Failure to provide these reports and non-attainment of the milestones will result in contractual penalties for the EPC contractor. Penalties motivate the contractor to maintain the schedule baseline.

4.4. COST MANAGEMENT PLAN

Project cost management involves all the activities related to planning how the project will be funded, the formation of a project budget, and how this project budget will be managed and operationalized throughout the project's life cycle (PMI 2017). One of the main goals of the project cost management plan is to ensure that the project is completed within the planned budget. It also includes and addresses potential risks by having contingencies embedded within the budget. In the case of the 2MW solar farm, the project team will need to adopt the Government of Saint Lucia processes and standard operating practices for project budgeting, cost management, and control. Cost management in this case also means financial analysis of the project to ensure that it has sufficient cash flows to make it a profitable endeavor.

There are four main processes associated with the project cost management work area. These are:

1. Plan cost management
2. Estimate costs
3. Determine budget
4. Control costs

4.4.1. PLAN COST MANAGEMENT

Planning cost management is the process of determining how the project team will estimate the project costs, prepare the project budget and manage and control the project costs which are required to execute the project (PMI 2017). It provides a cost management guide throughout the project life cycle. Figure 20 below presents an overview of the plan cost management process.

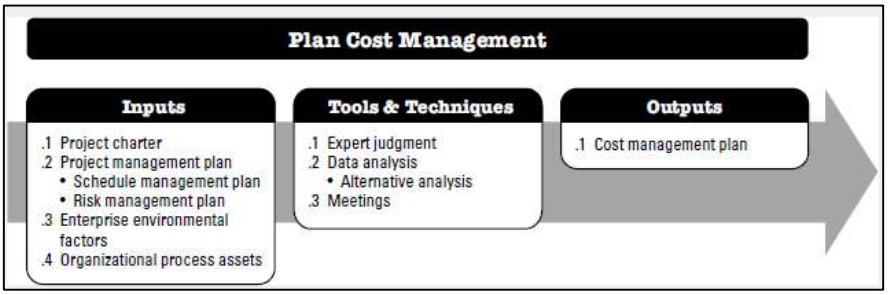

Figure 20 Overview of the Plan Cost Management Process

Note: Reprinted from A Guide to the Project Management Body of Knowledge (PMBOK® Guide) Sixth Edition. Project Management Institute (PMI), 2017 Figure 7-2, p. 235 Copyright 2017 by Project Management Institute, Inc.

Planning cost management for the 2 MW solar farm at Gros-Islet requires inputs such as the project charter, assumptions of the project, and the schedule management and risk management plans primarily for establishing contingencies, specifics of the organization of implementation, and expert judgment across many disciplines to benchmark costs and derive reasonable activity cost estimates, specific to the Saint Lucian context. This is

especially important because there has only been one solar farm previously established in Saint Lucia, and this solar farm was established eight years ago. Therefore, while benchmarking can be done from some of the data from this project, the cost information and assumptions are no longer relevant. This is a significant area for consideration in the development of this cost management plan.

4.4.2. ESTIMATE COST

The process of estimating costs is a critical one in the development of the cost management plan for any project. Figure 21 below gives an overview of the inputs, tools and outputs of the estimate cost process of preparing a cost management plan.

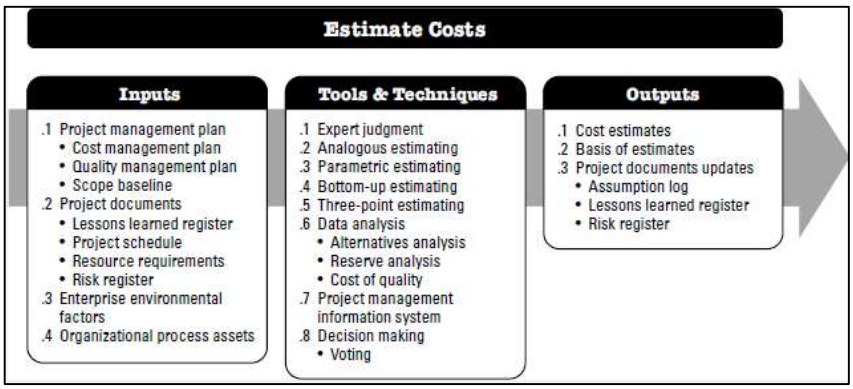

Figure 21 Overview of the Estimate Costs Process

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It involves considering similar projects, in this case solar farms, that have been implemented at various scales, and benchmarking or using other forms of estimation to arrive at reasonable and relevant cost values for each work package. Although contingencies will be required for estimation risks, these estimates can be utilized to set the project budget to a high degree of accuracy.

For estimating costs associated with the construction of the 2 MW solar farm, the relevant inputs include the Work Breakdown Structure completed in Section 4.2.5, as well as the work breakdown structure dictionary, lessons learned from previous solar farms constructed within the Saint Lucian and Caribbean contexts, the project schedule presented in chapter 4.3, project resources, the project risk register, and other relevant organizational policies.

The primary tool utilized in the development of project estimates is expert judgment. There are many experts on the island and internationally who have provided information to help to develop the cost management plan. This includes lessons learned from the development of the first solar farm in Saint Lucia which was commissioned in 2018, cost estimates from solar farms built in other parts of the Caribbean in more recent times which can be used for benchmarking the costs of construction, and construction cost estimates associated with the construction of solar farms in other small island developing states. The output of the estimated cost process is the cost estimates of the project.

The project is being carried out as an engineering procurement and construction contract project or turnkey project as a risk management strategy. Therefore, the contractor will estimate the project price. It is typical to then define a milestone payment schedule for the EPC contract, which will distribute the payments to mitigate cost risks. The proposed milestone payment schedule, informed by the experience of Konfyans Consulting, is detailed below. Note that this payment schedule will be one of the major matters for negotiation of the EPC contract.

4.4.2.1. MILESTONE PAYMENT SCHEDULE

The milestone payment schedule aims to compensate the contractor sufficiently for the work that has been carried out and the costs currently being experienced. Care should be taken to avoid frontloading the milestone payment schedule, putting the owner at risk, should the contractor default.

TABLE 15 PROPOSED MILESTONE PAYMENT SCHEDULE- SUBJECT TO EPC APPROVAL.

Milestone	Percentage of Total EPC Price	Cumulative Percentage
On award/Contract signing	2.5%	2.5%
Submission of 50% engineering package in full.	5.0%	7.5%
Completion of engineering.	7.5%	15.0%
On order of all major equipment (batteries, inverters, transformers, switchgear)- Provided there is approval by the owner and owner's engineer.	15.0%	30.0%
Mobilization of contractor onto the project site.	15.0%	45.0%
Completion of site preparation works.	5.0%	50.0%
Delivery of major equipment.	30.0%	80.0%
Hot comissioning	10.0%	90.0%
Holdback	10.0%	100.0%

Note: Own Work

Similarly, the schedule should not allow too many of the contract payments to be made towards the project end as maintaining a good cash flow for the EPC contractor is crucial to project success.

The EPC contract payments in the cost estimates for the project are based on the milestone payment schedule assumed.

4.4.3. DETERMINE BUDGET

In determining the project budget, the cost estimates developed in the estimate cost process are aggregated by activity and work package from the WBS, and a cost baseline is established (PMI 2017). Therefore, the individual components of the project budget are related to project deliverables, rather than project activities and tasks from the work

breakdown structure which are utilized in the process of estimating costs. This cost baseline is the basis by which all costs in the project will be tracked and forms the basis for the project budget. The project budget must be able to cover all the anticipated project costs throughout the project life cycle and should also include reasonable contingency amounts to cover an unanticipated event. These contingency amounts must relate to specific items identified in the risk register for the project which will be addressed in chapter 4.8. The inputs, tools and techniques, and output involved in the process of determining the project budget are shown in the diagram below.

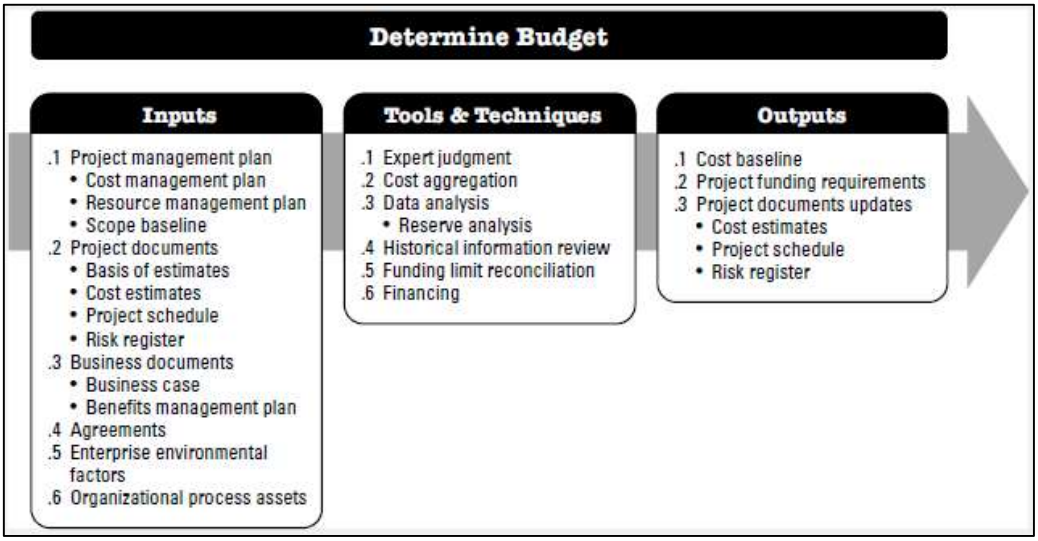

Figure 22 Overview of the Determine Budget Process

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4.4.3.1. COST ESTIMATES

TABLE 16 ESTIMATED COSTS

ID #	WBS ID	Activity ID	Task Name	Activity Description/Basis of Estimates	Total (XCD)
1	1.1		Review output from NETS and energy plans	Estimation performed based on an estimate of 50 hours to review documentation at a rate of $30 per hour, assuming that the engineering/ economist expertise required to do this review costs $30 per hour.	**$1200.00**
2	1.2		Prepare project concept note and project charter	Estimation performed based on an estimate of 5 hours to review documentation at a rate of $30 per hour.	**$150.00**
3		1.3.1	Prepare and submit business case	Estimation performed based on an estimate of 60 hours to review documentation at a rate of $30 per hour.	**$1800.00**
4	**1.4**		**Acquire land**	This is the land purchase and is done based on averages of the prices of land parcels in the area where the desired land is situated.	**$3,000,000.00**
5		1.4.2	Obtain letter of support for planning approvals	Estimation performed based on an estimate of 10 hours to review documentation at a rate of $30 per hour.	**$300.00**
6		1.4.3	Negotiations	Estimations are done here based on the estimated hours spent in negotiations from previous land acquisition projects.	**$10,000.00**
7		1.5.1	Collect required documents- survey plan, et cetera	Estimations are based in the actual prices of the documents at the Land Registry.	**$60.00**
8		1.5.2	Prepare submission	Estimates are completed based on the estimated hours required to collate the documents and prepare the submission, including internal reviews. An estimate of 10 hours to review documentation at a rate of $30 per hour.	**$ 600.00**
9			**Application for generation license to NURC**	Estimates are completed based on the estimated hours required to collate the documents and prepare the submission, including internal reviews. Since this is a new process, there will have to be a contingency estimate due to teething issues with a new process. An estimate of 350 hours to review documentation at a rate of $30 per hour.	**$10,500.00**
10		1.7.1	Edit draft PPA document	Estimates are completed based on the estimated hours required to collate the PPA drafts and do preliminary edits and prepare the initial submission, including internal reviews. An estimate of 100 hours to review documentation at a rate of $30 per hour.	**$3000.00**
11	**1.7**	1.7.3	Negotiation	Estimations based on research of the typical time taken to negotiate a PPA, and the hourly rates of all of the individuals who would be involved in the process. An estimate of 600 hours to review documentation at a rate of $50 per hour.	**$30,000.00**

ID #	WBS ID	Activity ID	Task Name	Activity Description/Basis of Estimates	Total (XCD)
12		1.7.4	Legal review and documentation	Estimations based on an assumed estimate of 300 hours of legal review at a rate of $80 per hour.	**$24,000.00**
13			**Grid interconnection**	Estimate based on online research into the costs of interconnection studies. Due to uncertainty, a 10% contingency is added.	**$250,000.00**
14			**ESIA**	Cost derived from benchmarking for previous ESIA studies.	**$90,000.00**
15			**Glint and glare**	Cost derived from benchmarking for previous glint and glare studies.	**$100,000.00**
16			**Hydrological study**	Cost derived from benchmarking for previous hydrological studies.	**$65,000.00**
17			**Geotechnical study**	Cost derived from benchmarking for previous geotechnical studies.	**$80,000.00**
18			**Apply for and obtain full approval**	Estimates are completed based on the estimated hours required to collate the documents and prepare the submission for application for full approval. An estimate of 100 hours to review documentation at a rate of $30 per hour.	**$ 3,000.00**
19			**Procure owner's engineering services**	Owner’s engineering price will be determined based on analogous projects, and the contract price relative to the number of invested hours.	**$2,000,000.00**
20		1.10.1	Develop request for proposals	Estimates are completed based on the estimated hours required to develop the tender documents. An estimate of 100 hours to develop documentation at a rate of $30 per hour.	**$3000.00**
21	**1.10**	1.10.3	Evaluation of bids	Estimates are completed based on the estimated hours required to evaluate the tender documents, review the tenders, and select a competent engineering firm. Assuming a team of 5 evaluates the proposals, an estimate of 200 hours to review documentation at a rate of $30 per hour.	**$6000.00**
22		2.1.1	Develop request for proposals	Estimates are completed based on the estimated hours required to develop the tender documents. This does not include the work of the owner’s engineer which is accounted for in the relevant line. Assuming that a team of 10 experts contributes an average of 50 hours each to the development of the RFP and requirements. An estimate of 500 hours to review documentation at a rate of $30 per hour.	**$15,000.00**
23		2.1.5	Evaluation of bids	Estimates are completed based on the estimated hours required to evaluate the tender documents, review the tenders, and select a competent engineering firm. This does not include the work of the owner’s engineer which is accounted for in the relevant line. Assuming a team of 10 evaluates the proposals, utilizing an average of 35 hours. An estimate of 350 hours to review documentation at a rate of $30 per hour.	**$10,500.00**
24			**Contract**	Contract EPC price will be determined based on analogous projects, a per MW value calculated, inflation considerations included. Assuming that the project EPC cost is $2 USD per kW- an industry average as of 2023.	**$10,867,600.00**

ID #	WBS ID	Activity ID	Task Name	Activity Description/Basis of Estimates	Total (XCD)
25	**2.2**	2.2.3	Contract negotiation	Estimations based on research of the typical time taken to negotiate an EPC contract, and the hourly rates of all of the individuals who would be involved in the process. Assuming 300 hours go into contract negotiation at a rate of $30.00	**$9,000.00**
26		2.2.4	Contract signing	Based on milestone payment schedule, 2% of the contract price is billable upon contract signing. The contractor will base charges on hours of work performed by the staff.	**$271,690.00**
27			**Design and development**	Based on milestone payment schedule, the design and development phase involves a milestone payment of 5% of the contract price on completion of 50% of the engineering designs, and an additional 7.5% upon completion of the contract. A total of 12.5% for engineering work.	**$1,358,450.00**
28		4.1.1	Purchase long lead items	Based on milestone payment schedule, a milestone payment of 15% of the contract price on the issuance of a purchase order for major equipment, including inverters, switchgear and transformers.	**$1,630,140.00**
29	**4**	4.1.2	Delivery of long lead items on-site	Based on milestone payment schedule, a milestone payment of 30% of the contract price on the receipt on site of major equipment, including inverters, switchgear and transformers.	**$3,260,280.00**
30	**4.2**	4.2.1.2	Contractor mobilization	Based on milestone payment schedule, a milestone payment of 10% of the contract price upon mobilization of the contractor onto the project site.	**$1,086,760.00**
31	**4.2.1**	4.2.1.3	Site clearing	Based on milestone payment schedule, a milestone payment of 10% of the contract price upon completion of the site clearing and preparation works performed by the EPC on the project site.	**$1,086,760.00**
32		4.2.3.11	Interconnection construction	Cost derived from the cost of a 2MVA transformer, load break switches and line extension costs for two spans, plus VAT.	**$142,847.25**
33	**5**	5.3	Hot commissioning	Based on the milestone payment schedule, a milestone payment of 10% of the contract price upon the completion of installation and successful commissioning of the plant.	**$1,086,760.00**
34		6.2	System completion	Based on the milestone payment schedule, a milestone payment of 10% of the contract price is held back, and only paid upon completion of installation, and all punch list items, completion of any handover training and completion of the handover process.	**$1,086,760.00**

Note: Own Work

Determining the project budget involves the use of the tools expert judgment and the analysis of data using a variety of methods. Some of the key methods of data analysis for determining the project budget include reserve analysis and the review of historical information. Reserve analysis is critical to the formation of a project budget and involves establishing management reserves for the project. (PMI 2017). Management reserves are reserves established by the project steering committee or project sponsor which are required if the project budget is exceeded due to the realization of some unforeseen risks. This management reserve will require permission and justification from the project steering committee or project sponsor before it can be disbursed. The cost baseline, management reserves and cost contingencies together from the project budget.

4.4.3.1. PROJECT BUDGET

TABLE 17 PROJECT BUDGET

WBS ID	Activity ID	Deliverable	Total (XCD)	Contingency (if required)	Total Budget (XCD)	Total Budget (USD)
1.3		**Acquire internal approvals**	$3,150.00		$3,150.00	$1,159.41
1.6		**Acquire land**	$3,010,000.00	$150,500.00	$3,160,500.00	$1,163,274.32
	1.4.1	**Approval in principle**	$960.00		$960.00	$353.34
1.5		**Acquire generation license**	$10,500.00	$3,150.00	$13,650.00	$5,024.11
	1.10.3	**Sign power purchase agreement**	$57,000.00		$57,000.00	$20,979.79
	1.8.1	**Grid interconnection study**	$250,000.00		$250,000.00	$92,016.64
	1.8.2	**ESIA**	$90,000.00	$9,000.00	$99,000.00	$36,438.59

WBS ID	Activity ID	Deliverable	Total (XCD)	Contingency (if required)	Total Budget (XCD)	Total Budget (USD)
	1.8.3	**Glint and glare study**	$100,000.00	$10,000.00	$110,000.00	$40,487.32
	1.8.4	**Hydrological study**	$65,000.00	$6,500.00	$71,500.00	$26,316.76
	1.8.5	**Geotechnical study**	$80,000.00	$8,000.00	$88,000.00	$32,389.86
	1.4.3.	**Full approval**	$3,000.00		$3,000.00	$1,104.20
1.9		**Procure owner's engineering**	$9,000.00		$9,000.00	$3,312.60
		Owner's engineering	$2,000,000.00		$2,000,000.00	$736,133.09
2.1		**Recruit EPC**	$34,500.00		$34,500.00	$12,698.30
	2.2.4	**Upon signing EPC contract**	$271,690.00	$13,584.50	$285,274.50	$105,000.00
	3.4.1	**Submission of 50% engineering package in full**	$543,380.00	$27,169.00	$570,549.00	$210,000.00
	3.4.2	**Completion of engineering**	$815,070.00	$40,753.50	$855,823.50	$315,000.00
	4.1.1	**On order of all major equipment**	$1,630,140.00	$81,507.00	$1,711,647.00	$630,000.00
	4.2.2	**Mobilization of contractor onto the project site**	$1,086,760.00	$54,338.00	$1,141,098.00	$420,000.00
	4.2.3.	**Completion of site preparation works**	$1,086,760.00	$54,338.00	$1,141,098.00	$420,000.00
	4.1.2	**Delivery of major equipment**	$3,260,280.00	$163,014.00	$3,423,294.00	$1,260,000.00

WBS ID	Activity ID	Deliverable	Total (XCD)	Contingency (if required)	Total Budget (XCD)	Total Budget (USD)
	5.1.3.	**Hot comissioning**	$1,086,760.00	$54,338.00	$1,141,098.00	$420,000.00
	6.1.2	**Holdback/ System completion**	$1,086,760.00	$54,338.00	$1,141,098.00	$420,000.00
Totals			**$16,580,710.00**	**$730,530.00**	**$17,311,240.00**	**$6,371,688.32**

Note: Own Work

For the 2MW solar farm, no management reserves have been assigned at this stage. The transfer of risk to the EPC contractor allows for a simplified deliverable-based project budget to be delivered. The budget includes the following contingency amounts to deal with perceived risks associated with the achievement of some deliverables.

TABLE 18 CONTINGENCY RATIONALE

Deliverable	Contingency	Justification
Acquire land	5%	The assumption for the project is that the land to be utilized belongs to the Crown. There may be inflation in the cost of the land by the time execution is in progress, but it is not expected to be significant due to the land ownership.
Acquire generation license	30%	There is still a lot of uncertainty with regard to the acquisition of generation licenses and the revised Electricity Supply Act states that new generation will be competitively bid upon. Since this project is for the Government of Saint Lucia, it is expected to be approved and issued a license, however the processes involved may take significantly longer than anticipated.
Feasibility studies	10%	The estimates used for the feasibility studies are based on similar studies conducted within the last 3- 5 years. The 10% accounts for the expected increase in technical expert pricing within that period, including inflation.
EPC contract	5%	The estimates used for the EPC contract price are based on a 2023 cost estimate in $USD per W. The 5% accounts for the expected increase in technical expert pricing within that period, including inflation. It may be mitigated by falling technology prices.

Note: Own Work

4.4.3.2.PROJECTED QUARTERLY EXPENDITURES

TABLE 19 PROJECTED EXPENDITURES FOR COST CONTROL

#	Deliverables	2025				2026				2027				Totals
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
1	Acquire internal approvals	$1,159.41												$1,159.41
2	Acquire land			$1,163,274.32										$1,163,274.32
3	Approval in principle		$353.34											$353.34
4	Acquire generation license			$5,024.11										$5,024.11
5	Sign PPA			$6,993.26	$6,993.26	$6,993.26								$20,979.79
6	Grid inter-connection study			$92,016.64										$92,016.64
7	ESIA			$18,219.30	$18,219.30									$36,438.59
8	Glint and glare			$20,243.66	$20,243.66									$40,487.32
9	Hydrological study			$26,316.76										$26,316.76
10	Geotechnical study			$32,389.86										$32,389.86
11	Full approval				$1,104.20									$1,104.20
12	Hire owner's engineer			$1,656.30	$1,656.30									$3,312.60
13	Owner's engineer					$92,016.64	$92,016.64	$92,016.64	$92,016.64	$92,016.64	$92,016.64	$92,016.64	$92,016.64	$736,133.09
14	Recruit EPC				$4,232.77	$4,232.77	$4,232.77							$12,698.30
15	Upon signing EPC contract						$105,000.00							$105,000.00
16	50% engineering						$210,000.00							$210,000.00
17	Completion of engineering							$315,000.00						$315,000.00

18	**Order of all major equipment**							**$630,000.00**						**$630,000.00**
19	**Contractor mobilization**									**$420,000.00**				**$420,000.00**
20	**Completion of site preparation works**									**$420,000.00**				**$420,000.00**
21	**Delivery of major equipment**											**$1,260,000.00**		**$1,260,000.00**
22	**Hot comissioning**											**$420,000.00**		**$420,000.00**
23	**Holdback/ System completion**												**$420,000.00**	**$420,000.00**
	Totals	**$1,159.41**	**$353.34**	**$1,366,134.21**	**$52,449.49**	**$103,242.67**	**$411,249.40**	**$1,037,016.64**	**$92,016.64**	**$932,016.64**	**$92,016.64**	**$1,772,016.64**	**$512,016.64**	**$6,371,688.33**

Note: Own Work

4.4.4. CONTROL COST

The process of controlling costs is the responsibility of the project manager and by extension the project team and involves monitoring the project status and completion of project activities and tasks and deliverables, as well as how much money has been spent on these activities and adjusting the cost baseline throughout the project life cycle (PMI 2017). The inputs, tools and techniques and output of the process of controlling project costs are indicated in the diagram below.

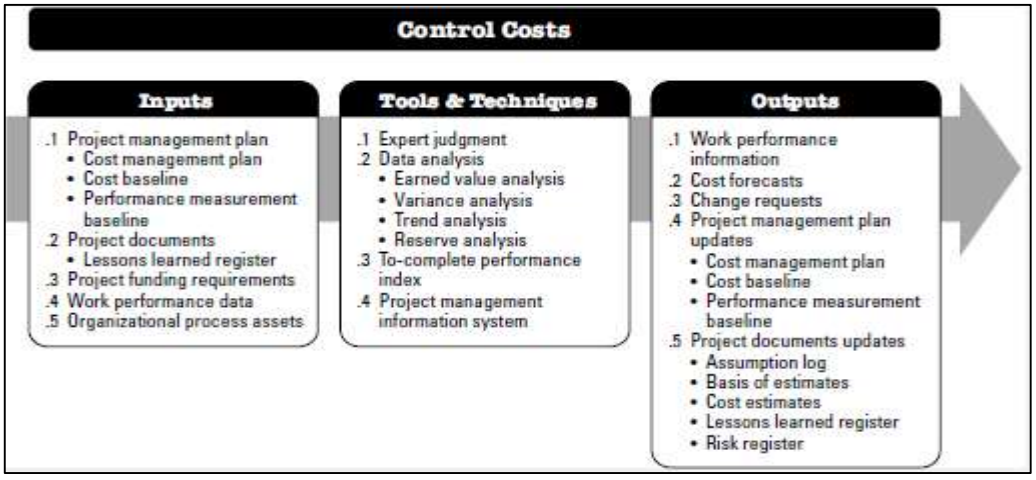

Figure 23 Overview of the Control Costs Process

Note: Reprinted from A Guide to the Project Management Body of Knowledge (PMBOK® Guide) Sixth Edition. Project Management Institute (PMI), 2017 Figure 7-10, p. 257 Copyright 2017 by Project Management Institute, Inc.

4.4.4.1. EARNED VALUE ANALYSIS

As mentioned above, earned value analysis is the primary tool used in the control of project costs. In the performance of the analysis, certain indicators need to be calculated.

TABLE 20 OVERVIEW OF EARNED VALUE ANALYSIS INDICATOR- ADAPTED FROM (PMI 2017)

EV Indicator	Abbrev.	Description	Significance	Equation
Planned value	PV	The sanctioned budget appropriated for planned activities.	The PV indicates the projected value of the planned project work that will be completed by a specific date in the project life cycle.	
Earned value	EV	The actual value of the work performed by a certain date, expressed in terms of the budget appropriated for the work.	This is the actual value that has been attained by completing the work by a certain date. Can be thought of as the sale or salvage value of all the project work, if the project stopped at the reference point.	$EV=\Sigma$ *of the planned values of all completed work*
Actual cost	AC	The real costs or expenditure associated with completing an activity.	The actual costs expended to date for the project.	
Budget at completion	BAC	This is the expected sum of all the approved budget figures required to complete the project by the scheduled project end.	This is the cost baseline, which is compared to actual expenditure for cost control.	
Cost variance	CV	This is the difference between actual costs and value earned as a result of the project activities. Indicates surplus or deficit.	A project should aim for a CV of 0 or a positive CV. When the CV is negative, it indicates that costs have been underestimated. A positive CV means that the project is within budget at that point.	CV=EV-AC
Schedule variance	SV	This is the extent to which the project is ahead or behind schedule for completion at a given point in time.	A project should aim for a SV of 0 or a positive SV. When the SV is negative, it indicates that the project is behind schedule. Positive SV means that the project is ahead of schedule.	SV= EV-PV
Cost performance index	CPI	This indicator measures how efficiently the budget is being applied to costs, by expressing the earned value relative to actual expenditure.	When CPI= 1 the project is on budget. If it is more than 1, there are cost overruns, and if less than 1, the costs have been overplanned.	$CPI=EV/AC$
Schedule performance index	SPI	This indicator measures how efficiently the schedule is being managed by expressing the earned value relative to planned value.	When SPI= 1 the project is on schedule. If it is more than 1, the project is ahead of schedule, and if less than 1, the project is behind of schedule.	$SPI=EV/PV$

Note: Adapted from A Guide to the Project Management Body of Knowledge (PMBOK® Guide) Sixth Edition. Project Management Institute (PMI), 2017 Table 7-1, p. 267. Copyright 2017 by PMI, Inc. Permission not sought.

The control cost process has the same inputs as the previous project cost management processes. These inputs are organizational process assets, the project management plan, cost baseline and the project funding requirements. Similarly, there are some tools for this process which are also used in previous processes, like expert judgment and data analysis. There are data analysis techniques which are unique to the process of controlling project costs. These include the performance of:

1. Earned value analysis - which considers the correlation between the project schedule and the costs. It does this by considering the costs that should have been incurred corresponding to the number and type of deliverables due, and completed by a reference point in the project schedule,
2. Variance analysis - which uses earned value analysis to compute the schedule and cost variance at various points on the project timeline.
3. Trend analysis considers various factors of project performance and displays the parameter data so that it can be analyzed to assess the project's performance. For example, the budget at completion [BAC] for a project can be estimated until project completion, based on the cost baseline, actual expenditure, and reevaluation of risks with cost implications. Comparing the trend line of the budget at completion to the actual expenditure trend is a great indicator of how the project is progressing (PMI 2017).
4. Reserve analysis, when performed during the process of controlling costs, is used to monitor project contingencies and management reserves and determining whether or not these are still required for project completion or if additional funds need to be requested (PMI 2017).
5. Finally, the project will utilize S Curve as a tool for cost control. This curve is a great indication of the planned value of the project over time. Figure 24 below shows the S curve for the Budget of the 2MW solar farm.

4.4.4.2. S CURVE

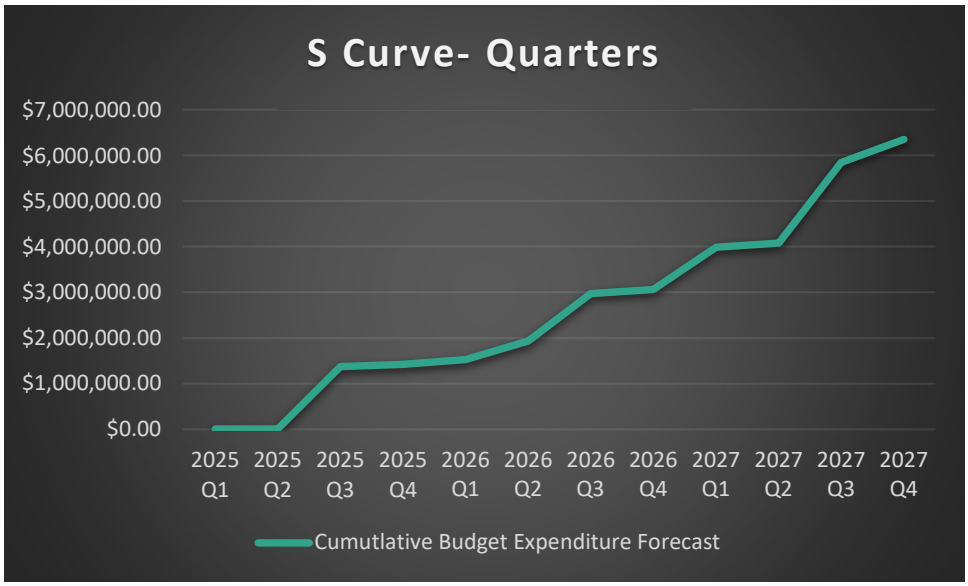

Figure 24 S Curve

Note: Own work

When accompanied by actual values of cost and earned value, these curves can be superimposed and show clearly how the project is performing at any point compared to the project plan.

4.5. QUALITY MANAGEMENT PLAN

Project quality management seeks to ensure that the requirements of the project stakeholders are met through a series of processes which ensure that the organization's quality policy and goals are accounted for in the project planning and execution (PMI 2017). The set of processes involved in project quality management address planning for quality, and then enacting this plan to ensure that quality is well managed and controlled throughout the project life cycle.

It consists of three major processes. These processes are:

1. Plan quality management
2. Manage quality
3. Control quality

4.5.1. PLAN QUALITY MANAGEMENT

Planning quality management is a process concerned with setting out the standards and requirements for quality that will be required to ensure that the project, and all its deliverables are acceptable to all its stakeholders, and that the project complies with the applicable standards to which it must conform (PMI 2017). The inputs to the plan quality management process include all of the project documents and project management plans and sub plans, as well as any other relevant organizational documentation. The process employs a series of tools and techniques, including multicriteria decision analysis, benchmarking and brainstorming, cost benefit analysis, planning for tests and inspections, and evaluation of the cost of quality. The products of the plan quality management process are quality metrics and the completed quality management plan. Quality metrics are quantitative measures defined in the plan quality management process that assist the project team in keeping track of the quality of deliverables throughout the project life cycle. For this document section, the quality metrics defined for the success of the 2 MW solar farm will be defined.

One of the first steps in the quality management plan process is to define the quality objectives in line with organizational objectives, policies and goals.

4.5.1.1. QUALITY OBJECTIVES

The defined project quality objectives seen as critical for attaining the project quality goals are stated below:

1. To design construct and build a 2 MW solar farm in the Gros Islet district of Saint Lucia, which complies with the OECS building code, and the relevant electrical codes in Saint Lucia.

2. To ensure that at the time of commissioning, the power plant produces a minimum of 2 MW AC at the point of interconnection to the LUCELEC grid.
3. To ensure that the construction of the two megawatts solar farm is done in compliance with the laws and regulations in effect on the island of Saint Lucia, including the Saint Lucia Electricity Supply Act, the Saint Lucia Labor Code, and the Physical Planning and Development Act.
4. To ensure that all project stakeholders fully buy into the construction of the solar farm, including the surrounding community, the utility and regulator, funding agencies and government officials.
5. To ensure that the project is well resourced with competent, trained and experienced professionals, who can execute the project successfully while meeting all of the quality standards.
6. To ensure that the project is well managed and that its scope is completed within budget and schedule.
7. That the interconnection of this solar farm to the LUCELEC grid is accomplished without sacrificing grid reliability.

4.5.1.2. FACTORS AFFECTING QUALITY

There are a few factors affecting quality which need to be considered in the project quality management development. These are listed and explained below.

TABLE 21 FACTORS AFFECTING QUALITY

No.	Factor	Factor Definition
1	**Project sponsorship**	The top management includes the project sponsor and the head(s) of the department(s) through whom the project will be implemented. They have oversight of any process that requires change management, and so, it is critical that they are not only knowledgeable about all aspects of the project but buy into it completely. Middle management, and technocrats also need to buy into the project. They will be accountable for acceptance of the project upon completion of the construction and oversee the day-to-day operation and maintenance of the solar farm.
2	**Comprehensive stakeholder engagement**	A collaborative, synergistic environment must exist so that the perspectives of all stakeholders are included in the plan and its execution.
3	**Compliance to regulations**	In the case of the 2 MW solar farm, relevant regulations applicable to the project include the Saint Lucia Electricity Supply Act, (and any forthcoming updates to the act), the Saint Lucia Labour Code and the Physical Planning and Development Act of 2001.
4	**Compliance with standards and codes**	The project needs to comply with the relevant construction standards including IEEE standards, and other relevant construction standards. All components and parts required for the construction of the solar farm including the panels, inverters, cables, breakers, concrete and materials need to comply with specifications and quality standards to ensure that the installation produces the intended energy output and quality requirements. Adherence to these standards is important to ensure the longevity of the installation. The electrical standards also ensure that the integration of the

No.	Factor	Factor Definition
		project into the LUCELEC grid is successful and that its purpose of meeting electricity demand in the north of the island is well fulfilled without disrupting the quality of power supply in the area.
5	**Compliance with organizational, or other pertinent policies**	In the case of the solar farm, adherence to energy, infrastructure, land use and other relevant policies in effect in Saint Lucia are crucial. The project also needs to comply with the Government of Saint Lucia's procurement and other internal policies.
6	**Strong project team and management**	A strong project management team is required for this type of project. Solar projects are not novel endeavors and so this project can be run in a typical waterfall fashion. However, because the required local expertise is limited, owner's engineering and EPC contractors, along with the local project team will be in charge of completing the project and managing the associated quality. Together this team should be adequately trained and skilled to complete the job to the specified expectations and standards.
7	**Adequate resources**	The project needs to be adequately funded, adequately resourced with the right skilled manpower, materials and equipment to ensure its satisfactory completion.
8	**Documentation**	Adequate and comprehensive project documentation is required to help the project team keep track of the various elements relating to the quality management of the project.

Note: Own Work

4.5.3. QUALITY CHECKLIST - PRE-COMMISSIONING CHECKLIST

An example of relevant quality documentation is the solar farm commissioning checklist. The purpose of the pre-commissioning checklist is to ensure that the PV modules wiring another hardware are correct for the project, as well as ensuring that they are adequately installed and connected to facilitate an easier hot commissioning process.

PRE-COMISSIONING CHECKLIST		
Date:	**Project Name:**	
June 30 2024	2MW Solar Farm, Gros Islet, Saint Lucia	
Type of project:	Construction project	
Process groups:	Initiating: planning, executing, monitoring and control	
Project start date	**Commissioning test date:**	**Component of commissioning:**
[INSERT ACTUAL START DATE]	[INSERT ACTUAL TEST DATE]	**Module and module wiring, hardware, inverter**
PV MODULE AND WIRING CHECKLIST:		**MOUNTING HARDWARE:**
No dangling wires ☐ Pass ☐ Fail ☐ Repaired		All hardware installed as designed and intended. ☐ Pass ☐ Fail ☐ Repaired
Satisfactory bend radius ☐ Pass ☐ Fail ☐ Repaired		All hardware is torqued to the rated values. ☐ Pass ☐ Fail ☐ Repaired
Connections inspected ☐ Pass ☐ Fail ☐ Repaired		All racking is complete and properly secured according to manufacturer's guidelines. ☐ Pass ☐ Fail ☐ Repaired
No physical damage ☐ Pass ☐ Fail ☐ Repaired		**INVERTER**
No debris on panel surface ☐ Pass ☐ Fail ☐ Repaired		Properly sited according to required clearances from manufacturer. ☐ Pass ☐ Fail ☐ Repaired
Ground wire secured ☐ Pass ☐ Fail ☐ Repaired		Terminations are correctly installed as per manufacturer requirements. ☐ Pass ☐ Fail ☐ Repaired
All connections are tight ☐ Pass ☐ Fail ☐ Repaired		AC and DC terminations are torqued according to manufacturer's guidelines. ☐ Pass ☐ Fail ☐ Repaired
Wiring code compliant ☐ Pass ☐ Fail ☐ Repaired		Visual inspection for physical damage or discoloration. ☐ Pass ☐ Fail ☐ Repaired
Record serial number ☐ Pass ☐ Fail ☐ Repaired		Check for loose connections. ☐ Pass ☐ Fail ☐ Repaired
Strings are adequately marked ☐ Pass ☐ Fail ☐ Repaired		Check for correct polarity. ☐ Pass ☐ Fail ☐ Repaired
		Check for adequate ventilation. ☐ Pass ☐ Fail ☐ Repaired

Figure 25 Quality Checklist Precomissioning Checklist

Note: Adapted from Commissioning Checklist V6.0.xls by Heatspring, 2012. Copyright 2012 by Heatspring.

4.5.1.3. QUALITY METRICS AND ACCOUNTABILITY

One of the outputs of the quality management plan is the production of quality metrics related to the quality management objectives. These metrics will then be carried over to the subsequent manage quality and control quality processes.

TABLE 22 QUALITY METRICS, OBJECTIVES AND ACCOUNTABILITY

Quality Objective	Metric	Metric Definition	Expected Outcome/Results	Measurement Frequency	Responsible
1. To design construct and build a 2 MW solar farm in the Gros Islet district of Saint Lucia, that complies to the OECS building code, and the relevant electrical codes in Saint Lucia.	Compliance with codes	The compliance engineer will be appointed who will do regular checks on project activities and materials to ensure compliance with the relevant codes.	There will be total compliance with the construction and electrical codes in effect in Saint Lucia.	Review to occur every month	Compliance Engineer
2. To ensure that at the time of commissioning, the power plant produces a minimum of 2 MW AC at the point of interconnection to the LUCELEC grid.	Power output at metering point of interconnection	Power output from the solar farm measured in megawatts (MW)	A reported power export to the grid of at least 2 MW peak.	Hourly during hot commissioning	Project manager
3. To ensure that the construction of the two megawatts solar farm is done in compliance with the laws and regulations in effect on the island of Saint Lucia including the Saint Lucia Electricity Supply Act, the Saint Lucia Labor Code, and the Physical Planning and Development act.	Compliance with regulations	A legal officer will be appointed who will do regular checks on project documents and activities as required and consult the technical and human resource experts on the project to ensure compliance with the relevant legislation.	There will be total compliance with all relevant legislation in effect in Saint Lucia.	Review to occur every month	Legal officer
4. To ensure that all project stakeholders fully buy into the construction of the solar farm, including the surrounding community, the utility and regulator, funding agencies and government officials.	Stakeholder engagement survey score	A stakeholder engagement survey will be prepared and carried out by the communications officer on the project team. This survey will indicate how engaged and supportive the various stakeholders are of the project.	The project team will be aware of how supportive of the project the stakeholders are and review and continuously improve the communications plan to ensure that all stakeholders are on board.	The survey will be conducted at least every quarter, or when required.	Communications officer

Quality Objective	Metric	Metric Definition	Expected Outcome/Results	Measurement Frequency	Responsible
5. To ensure that the project is well resourced with competent, trained and experienced professionals, who are capable of taking the project to completion successfully while meeting all of the quality standards.	Performance reviews	The project will use performance reviews before hiring to ensure quality and ongoing reviews will be used to promptly address deviations and maintain progress.	The project will be resourced by competent professionals who will continue to work efficiently to ensure that the project is completed to expectations.	1.Part of recruitment. 2.Weekly during the project.	Project manager, supervisors
6. To ensure that the project is well managed and that its scope is completed within budget and schedule,	Schedule performance index (SPI)	This is the ratio between the earned value and the planned value of the project at any point.	The project will be accomplished on schedule.	Weekly	Project team
	Cost performance index (CPI)	This is the ratio between the earned value and the actual cost of the project at any point.	The project will not exceed its budget.	Weekly	Project team
	Cost of change requests	This will keep track of all the costs associated with the various approved change requests for the project.	Non-critical change requests will be kept to a minimum.	Weekly	Project team
7. The interconnection of this solar farm to the LUCELEC grid is accomplished without sacrificing grid reliability,	Percentage of hot commissioning test certificates signed off on by owner's engineer and LUCELEC representative.	Hot commissioning requires completion of various tests and documents, approved by the utility before project handover. Metric track number of test certificates signed off by utility.	The solar farm will be successfully interconnected to the grid after fulfilling pre-interconnection criteria.	The evaluation will be completed during the hot commissioning process.	Project manager
8. To ensure that all materials and components, especially the major items like transformers, solar panels and inverters are of a high quality and fit for the intended function.	Compliance with project specifications	As part of the EPC contract RFP specifications for project equipment are defined. These specifications are also reflected in the final EPC contract signed and compliance with them will be a requirement for ordering equipment and materials.	Full compliance with project specifications.	1.Before equipment orders are sent out for procurement. 2. When the equipment and	Project engineers

Quality Objective	Metric	Metric Definition	Expected Outcome/Results	Measurement Frequency	Responsible
				materials are received on-site.	
9. To ensure that prior to completion of the project, the relevant maintenance and operation personnel, both from the electrical department of the ministry of infrastructure, and from LUCELEC are adequately trained in the operation and maintenance of the solar farm and its auxiliaries and components, so that these activities can be handed over and well maintained throughout its operational life cycle.	Percentage of training program completed	A training program designed as part of the bidding process by the EPC contractor will be carried out with the relevant stakeholder personnel. The percentage completion of this training program will be measured to ensure that there's sufficient transfer of knowledge.	Operations and maintenance staff of the relevant agencies will be well-equipped to monitor, operate, and maintain the solar farm after the EPC contractor has handed over the project.	This metric will be conducted at the end of the project before the final 10% holdback payment is issued to the EPC contractor.	Project manager, human resource officer
10. To ensure that the highest standards of occupational health and safety are adhered to on the project site during the project construction phase,	Number of accidents and injury incidents recorded during the project life cycle as a result of project activities.	A health and safety officer will be assigned to the project. This officer will be responsible for recording safety incidents occurring related to that project. I'm investigating these incidents and will keep a record of the number of incidents, leading the team and performing root cause analysis to ensure that there is no reoccurrence.	There will be no accidents and incidents associated with the construction of the solar farm.	Safety evaluations will be done every day, and this metric will be reported weekly and as is necessary.	Occupational health and safety officer

Note: Own Work

8. To ensure that all materials and components, especially the major items like transformers, solar panels and inverters, are of a high quality and are suitable for the intended function.
9. To ensure that prior to completion of the project, the relevant maintenance and operation personnel, both from the electrical department of the ministry of infrastructure, and from LUCELEC are adequately trained in the operation and maintenance of the solar farm and its auxiliaries and components, so that these activities can be handed over and well-maintained throughout its operational life cycle.
10. To ensure that the highest standards of occupational health and safety are adhered to on the project site during the project construction phase.

4.5.2. MANAGE QUALITY

In the manage quality process, the quality management plan is actioned out to make the best attempt at meeting the quality objectives and metrics specified during the quality planning process (PMI 2017). It aims to identify activities and processes that are not as effective as intended with the goal of improving upon these to mitigate against quality defects. The tools involved in managing quality include many data analysis tools, decision making tools and data visualization tools required for really analyzing and deciding on the approach to identify problems. It results in the generation of change requests –which start off the change control process, as well as subsequent updates to the various plan elements. Managing quality and controlling quality are very closely aligned and correlated processes and the change requests from the manage quality process filter into and are addressed in the control quality process.

4.5.3. CONTROL QUALITY

Controlling quality is the process of monitoring the results of quality management activities, and documenting the results so that a review of these results can be performed, and the project planned activities can be improved upon for the future (PMI 2017).
The process uses the quality documents, the project management plan, metrics, approved change requests, and deliverables as inputs. The team and stakeholders will then gather relevant data using checklists, and other similar tools, analyze that data using tools like root

cause analysis, or testing protocols, and may display result in charts and other diagrams which encourage further analysis. The outputs of the process are updates to the project management quality plan, and the update of project documents.

4.5.3.1. QUALITY DOCUMENTS

Various quality documents will be utilized in the process of managing project quality. Some of these documents are derived from local and international standards which have been previously mentioned and instruct the various electrical and foundation components and materials. The applicable standards are stated in the quality documents table. These quality documents also include the various checklists utilized for commissioning, and various site tests and checklists, also displayed in TABLE 23.

TABLE 23 QUALITY DOCUMENTS

Category	Quality Documents and Standards
Pre-approved supplier list	• Solar panels, inverters, racking, transformers, DC cables, pyranometers, foundations, and security system
Quality standards	• IEEE 1547 National standard for interconnecting distributed with electric power system • SLNS/BS 7671: 2000 requirements for electrical installations. IET wiring regulations, 18th Edition • BS EN 62116: Utility-interconnected photovoltaic inverters. Test procedure of islanding prevention measures. • BS EN 62446-1 (or current edition) - Grid connected photovoltaic systems - Minimum requirements for system documentation, commissioning tests and inspection before handover. • BS EN 50521, Connectors for photovoltaic systems. Safety requirements and tests. • BS EN 62305, Lightning protection

Category	Quality Documents and Standards
	• BS EN 62271-200: High-voltage switchgear and control gear – Part 200 • ACI 318-05 - Building code requirements for reinforced concrete • ACI 301 - Specifications for structural concrete
Checklist and templates	• Cold commissioning checklist • Hot commissioning checklist
Quality Records	• Site inspection and test records, site acceptance form • Non-conformance reports for service outages or failures, change control documents
Periodic reports	• Weekly progress reports, compliance reports • Contractor and team performance monitoring reports
Applicable legislation	• Saint Lucia Labour Code • Saint Lucia Electricity Supply Act, Saint Lucia Physical Development Act

Note: Own Work

Finally, some of the applicable quality documents include pre-approval for equipment manufacturers, for example: For solar panels, the approved manufacturers will be (in no particular order):

1. Astronergy
2. JA Solar
3. Canadian Solar
4. Trina Solar
5. Jinko solar
6. Qcells

The applicable quality documents are displayed in TABLE 23. If the EPC contractor would like to utilize a different manufacturer, then the proposed manufacturer must be indicated

with sufficient time for review by the project team and owner's engineer. This submission must be accompanied by a performance record for the manufacturer equipment, customer reviews and contacts, as well as justification for not using the pre-approved contractors.

4.5.3.2. CONTINUOUS IMPROVEMENT

Continuous improvement will be one of the themes of managing quality. A plan, do, check, act (PDCA) system of continuous improvement will be implemented and championed by the project manager to ensure that there is culture of observation, feedback, and seeking out ways of improving. While most of the project quality actions are preventive, there will still be a need for continuous improvement. This will be especially important for the implementation of the commissioning checklists.

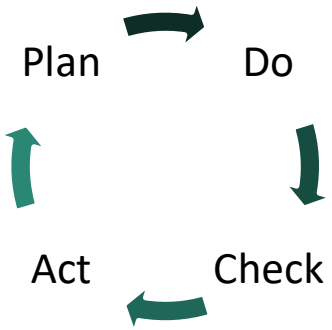

Figure 26 Plan Do Check Act Cycle

Note: Adapted from PDCA Cycle by American Society of Quality, n.d. Copyright 2024 by American Society of Quality.

If any commissioning criteria are not achieved at the point of testing, the EPC contractor and team will have to amend, supplement, or take whatever action is necessary to ensure that these acceptance criteria for power export and power quality are achieved.

TABLE 24 PLAN DO CHECK ACT FRAMEWORK

Plan	Do	Check	Act
Define the approach to quality which aligns with the quality objectives, with metrics where applicable. Define specific activities, expected outcomes and document all of these.	Perform the plan, completing all aspects as intended.	Observe the results of the executed plan, and the metric data. Compare the results to the expected results of the quality plan.	If there are any expectations not achieved, or deviations observed, make the required adjustments, chart the way forward to make any required improvements.

Note: Own work

4.6. RESOURCE MANAGEMENT PLAN

Project resource management is the group of processes involved in identifying, procuring, and managing the resources required for project completion (PMI 2017). Having a robust plan concerning project resources will assist in the seamless execution of the project and help in aligning project deadlines and critical path items with the required resources that are enabling requirements for project execution.

4.6.1. PLAN RESOURCE MANAGEMENT

Planning resources management involves planning the means of estimating, procuring, managing, and using project resources (PMI 2017). The two relevant types of applicable resources are human resources and physical resources. These include labor, equipment, tools, et cetera which may be required for the job. The planning of resources is done at the beginning of the project and reviewed throughout the project as deemed necessary. The process considers the various aspects, components and sub plans of the project and seeks to

address the resource requirements. Project inputs include the various project plans and sub plans, including the project requirements, project scope management plan, stakeholder register and other appropriate project documents. The applicable tools include expert judgment, data representation tools, and meetings. The outputs include the elements of a resource management plan, including various specific documents like the resource breakdown structure, and the RACI diagram.

4.6.1.1.RESOURCE BREAKDOWN STRUCTURE

The resource breakdown structure is an illustration of the human, material and other physical resources required for the project completion, broken down into broad classification groups, like equipment, materials, et cetera (PMI 2017).

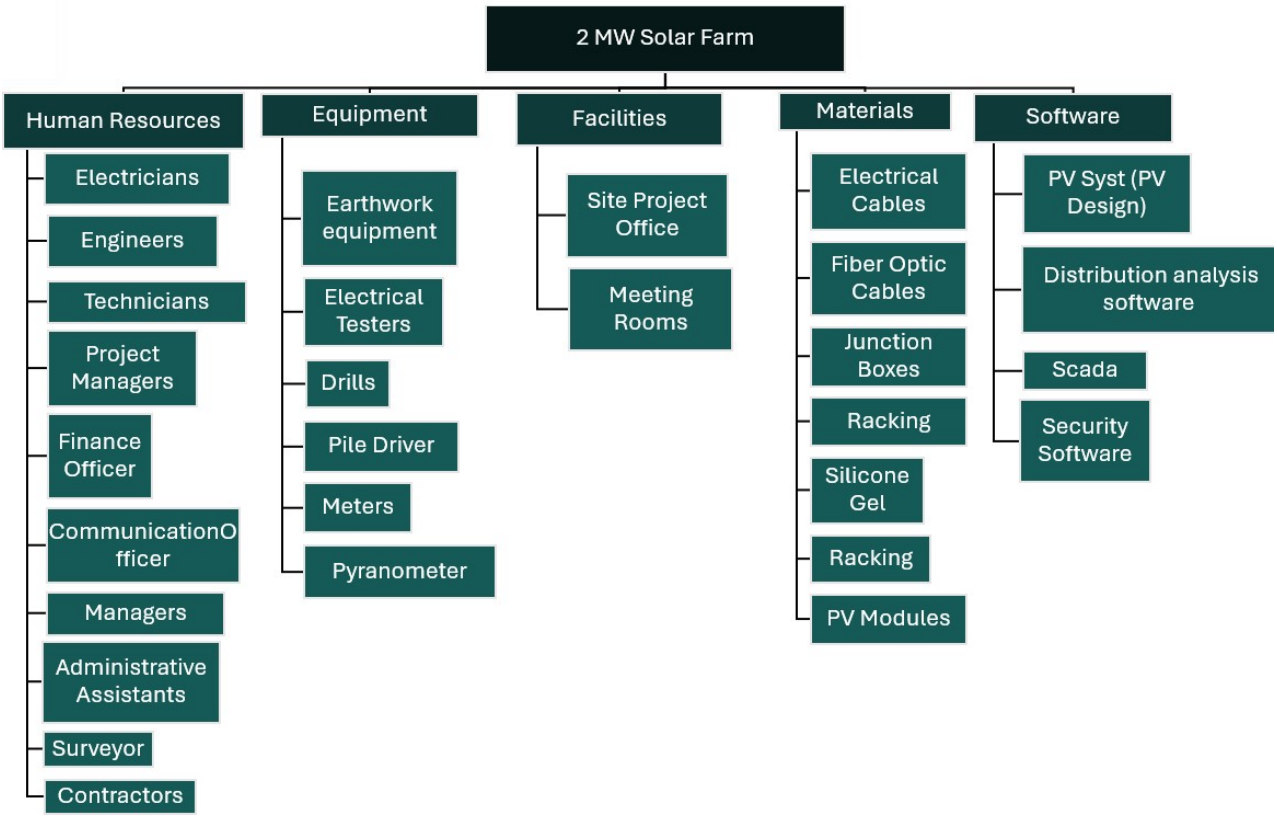

Figure 27 Resource Breakdown Structure

Note: Own Work

It is akin to a work breakdown structure in that each lower level indicates an increased level of detail of the resources. A resource breakdown structure for the 2MW solar project is indicated below. Its broad categories are human resources, equipment, facilities, materials and software.

4.6.1.2. RACI FRAMEWORK

The RACI framework is a type of responsibility assignment matrix. These matrices are visualizations of assignments of duties, authority, roles, and responsibilities to various project team members for clarity (PMI 2017). The RACI framework, for a particular project deliverable, defines who is responsible, accountable, who should be informed and who should be consulted. The meanings of the responsible, accountable, consult, and inform designations are further expounded below.

	Meaning	Description
R	**Responsible**	The responsible person is typically senior, or in management and is answerable to a higher authority, for example, to the Board on behalf of the deliverable. This person holds the person executing the deliverable accountable for delivery and would typically perform some kind of approval.
A	**Accountable**	The accountable person is responsible for performing the task, directly performing it, or ensuring that it is satisfactorily performed.
C	**Consult**	Persons who need to be consulted for a particular project activity include those who are required to provide special expertise and information that will be necessary for completing the project. These people are not responsible for accomplishing a project activity or deliverable, but the information they provide will be critical to its completion.
I	**Inform**	Persons who need to be informed for a particular activity or task typically involve senior decision makers, managers or all other personnel who may be affected by a change or the execution of a task.

		These might be people who may provide some resistance to the activity in the future, or persons who may be required to champion change in the future. They are not directly responsible for the activity or task.

Figure 28 RACI Definitions

Note: Own Work

To perform the RACI evaluation, all the different project resources must first be identified so that how they fit into the RACI framework can be clarified and defined.

TABLE 25 RACI FRAMEWORK

WBS ID	Activity ID	WBS Deliverable	Stakeholders			
			R	A	C	I
1.3		**Acquire internal approvals**	PS	PM K	PSC, Eng, FO	CO, T, AA
1.6		**Acquire land**	PS	PM K	PSC, Eng, FO	CO, AA
	1.4.1	**Approval in principle**	PM K	Eng	AA	PSC Tech
1.5		**Acquire generation license**	PS	PM K	LO, Eng, PSC	CO
	1.10.3	**Sign power purchase agreement**	PS	PS	LO, Eng, PSC	CO
	1.8.1	**Grid interconnection study**	U	U	PS, PM K, T	PSC
	1.8.2	**ESIA**	PM K	Eng	CO, PS	PSC
	1.8.3	**Glint and glare study**	PM K	Eng	CO, PS	PSC

WBS ID	Activity ID	WBS Deliverable	Stakeholders			
			R	A	C	I
	1.8.4	Hydrological study	PM K	Eng	CO, PS	PSC
	1.8.5	Geotechnical study	PM K	Eng	CO,PS, T	PSC
	1.4.3.	Full approval	PS	PM K	Eng	PSC, T
1.9		Procure owner's engineering	PS	PM K	FO	PSC
		Owner's engineering	PS	PM K	Eng	PSC, T
2.1		Recruit EPC	PM K	Eng	AA, LO,FO	
	2.2.4	Upon signing EPC contract	PM K	Eng	LO	FO,PSC
	3.4.1	Submission of 50% engineering package in full	PM K	Eng	FO	PSC
	3.4.2	Completion of engineering	PM K	Eng	FO	PSC
	4.1.1	On order of all major equipment	PM K	Eng	FO	PSC
	4.2.2	Mobilization of contractor onto the project site	PM K	Eng	FO, T	PSC
	4.2.3.	Completion of site preparation works	PM K	Eng	FO, T	PSC
	4.1.2	Delivery of major equipment	PM K	Eng	FO, T	PSC
	5.1.3.	Hot comissioning	PM K	Eng	FO, T	PSC
	6.1.2	Holdback/ System completion	PS	PM K	FO, T	PSC, CO

Note: Own Work

The project resources involved in project deliverables throughout the project life cycle are listed below with their appropriate acronyms identified for conciseness.

- Project Steering Committee (PSC)
- Project Sponsor (PS)
- Project Manager- Konfyans (PM K)
- Project Manager- EPC Contractor (PM EPC)
- Owner's Engineer (OE)
- Engineers (Eng)
- Legal Officer (LO)
- Technicians (T)
- Administrative Assistant (AA)
- EPC Contractor (EPC C)
- Subcontractors (SubC)
- Finance Office (FO)
- Regulator (R)
- Utility (U)
- Communications Officer (CO)

The project resources listed above are placed into their respective RACI framework columns according to their different required levels of engagement and accountability.

4.6.2. ESTIMATE ACTIVITY RESOURCES

Estimating activity resources is a process within the resource management process group which involves determining the type and quantities of all the resources required to complete the project (PMI 2017). The resources used will fall into the broad categories used in the RACI framework, namely facilities, materials, equipment and human resources. This process of RACI analysis is performed periodically throughout the project life cycle. The identification of additional resource requirements triggers an update of the resource management plan. The inputs to the estimate activity resources process include project and organizational documentation. The tools and techniques include expert judgment, the

various types of estimating previously utilized in cost estimation, data analysis as well as meetings and other forms of human engagement, for the purpose of data collection. The outputs of the estimate activity resource process include a list of resource requirements, basis of estimates for the project and the resource breakdown structure. The roles and responsibilities list in Section 4.2.7 consists of the estimated roles required for the project completion.

4.6.3. ACQUIRE RESOURCES

The process of acquiring resources involves the procurement of human resources, equipment, facilities and other materials required to complete the project (PMI 2017). It involves finding the right persons and equipment for the appropriate job and is performed as required by various project team members throughout the project life cycle.

The human resource acquisition portion of the acquire resources process will be expounded below with the intention of resourcing the project with the best talent to meet the project expectations. The project manager is responsible for placing the requests for appointments to the project.

TABLE 26 PROJECT RESOURCE ACQUISITION

No.	Project Resource	Acquisition Method
1	Project manager	The project manager is externally hired by request for proposal and was successful among many contractors who bid to perform Owner's engineering services for the project.
2	Owner's engineer	The owner's engineer is externally hired by request for proposal and was successful among many bidders who vied to perform owner's engineering services for the project.
3	EPC contractor	EPC Contractor was sourced through the government procurement process and the Central Tenders Board
4	Project engineers	Project engineers are seconded from various departments of the Government of Saint Lucia. Where the expertise does

No.	Project Resource	Acquisition Method
		not lie in-house, the required engineers are sourced through the Public Service Commission.
5	Finance officer	The project finance officer is an accountant seconded from the most appropriate department of government based on resource constraints at the time.
6	Legal officer	The project legal officer will be a registered lawyer in Saint Lucia representing the ministry of legal affairs.
7	Communications officer	The communications officer will be the communications liaison from the division of energy within the Ministry of infrastructure. The officer will conduct this role in addition to their existing role.
8	Technicians	The project technicians will be obtained from a variety of sources depending on the task they are required to conduct. The majority will be subcontracted by the EPC contractor for electrical and civil works, however electrical technicians from the Government of Saint Lucia electrical department will perform Clerk of works functions, assisting the project manager and monitoring the project's progress.

Note: Own Work

4.6.3.1.RECRUITMENT AND TALENT MANAGEMENT

For all of these project positions, with the exception of the EPC contractor, the project manager will work with the Human Resources Department of the Ministry of the Public Service. All employment requests will be provided to the public service commission, including job descriptions, grade ranges, and length of employment contract. Specific requirements for the project including the level of relevant technical and project experience, will also be specified by the project manager. The commission will then prepare the job

vacancies to be shared publicly, regionally or internationally based on the specifications of the project manager. When applications are received, the project manager, project sponsor and senior officials within the Ministry of Infrastructure will form the majority of the interview panel and selection process. The final decision on appointment must be approved by the project manager, sponsor and the Permanent Secretary in the Ministry of Infrastructure. If a team member leaves the team, and needs to be replaced, the same process will be followed.

4.6.4. DEVELOP TEAM

The process of team development involves considering the skills and competencies of the project team members, planning and executing means for improving these competencies to facilitate team growth and the improvement of project performance probability (PMI 2017). The development of the team will involve the input of all the project management plans and subplans as these will define what is required for the project and what the project team will be required to complete and facilitate. The tools and techniques required for this process include virtual tools like Microsoft Teams and Zoom for virtual training, cross training by collocation, interpersonal and team skills like conflict management, negotiation and team building, recognition and awards to incentivize positive behavior and interpersonal activities like meetings to facilitate communication that fosters a healthy project environment (PMI 2017). The outputs of the development team process include, among other items, performance assessments, an update to the project and resource management plans.

Several strategies for developing teams will be employed and these will be subsequently listed.

TABLE 27 TEAM DEVELOPMENT STRATEGIES

No.	Team Development Strategy	Description
1	Regular performance reviews	Regular performance reviews will be conducted for all project team members to ensure that any negative behaviors that are observed are quickly dealt with, and team members can improve long before the behavior can have a major impact on the project. If the team member has consistent negative performance reviews, the contingency plan for that resource would need to be put into action.
2	Cross training	Cross training involves assigning project team members to similar projects to gain applicable, transferable project experience.
3	Rewards and recognition	Rewards and recognition will be used to incentivize the achievement of project milestones, goals and team member specific subgoals in order to keep the team motivated.
4	Team engagement activities	Team engagement activities will be conducted at regular intervals and once major milestones have been accomplished by the team as part of the reward and recognition strategy. These will also double up as team building exercises.
5	Mentoring and on-the-job training	Mentoring and training for junior team members will also be part of the team development strategy. Where applicable, senior team members will be assigned a junior team member to “show them the ropes” until that team member is deemed competent at performing their tasks autonomously or have a sufficient overall understanding of the project and project context.

Note: Own Work

4.6.4.1.REWARDS AND RECOGNITION

A critical part of team development mentioned in the team development strategy is the utilization of rewards and recognition to incentivize desired behavior and encourage employees to continue to strive to achieve personal, organizational and project goals. The processes associated with selecting awardees can be formal or informal, and the awards themselves can be tangible or intangible, but they need to be tailored to the individual or team. Recognition also needs to correspond to the behavior(s) being encouraged and needs to communicate to the employee or team that they are a valuable part of the team and organizational effort (PMI 2017).

TABLE 28 PROJECT REWARD AND RECOGNITION METHODS

Rewards and Recognition	Description
Verbal praise	This form of recognition involves public acknowledgement of an employee's successes and contributions during team meetings or any other public forum.
Written praise	This form of recognition involves writing letters or other written communications such as emails, noting the employee's extraordinary performance or contribution and documenting it to project and organizational files to keep on record. This may also be accompanied by a token in the form of a gift or an award.
Team recognition	If a particular team, for example the team of contractors or subcontractors performs well and meets or exceeds a project milestone, team awards may be provided, for example a group lunch or dinner, or cinema tickets. These should also contribute to team building, which should have increased positive effects on the project.
Project milestone achievement	When a project milestone is achieved successfully, one approach to rewards involves organizing a celebratory social activity where the team can celebrate the success together.

Rewards and Recognition	Description
Increased Responsibility	If applicable during the project, star performers may be recognized by being given opportunities to undertake additional paid responsibilities when additional manhours are required, and a resourcing decision has to be made. Additional responsibilities placed on employees should always be accompanied by an increase in compensation for fairness.
Time off	If the project team performs so efficiently that the project progresses ahead of schedule, team members may be awarded with increased paid time off not exceeding what the project can handle without being disadvantaged or compromised.

Note: Own Work

4.6.5. MANAGE TEAM

Managing the team is the process of monitoring the performance of each team member, identifying gaps in that performance and providing appropriate feedback to the team member, resolving conflicts arising among team members, and just generally dealing with the interpersonal aspects of the project and removing barriers which might hinder the project from performing optimally (PMI 2017). Like the previous resource management processes, the inputs are the resource management plan, as well as the other project management plans and sub plans. The tools involved in managing the team include interpersonal skills like conflict management, emotional intelligence and leadership. The outputs from the process include adjustments to the project management and resource management plans, change requests as applicable and updates to project documents, for example, the issue logs, performance assessments and lessons learned registers.

4.7. COMMUNICATIONS MANAGEMENT PLAN

Project communication management is a critical group of processes in the field of project management because communication is the thread that ties customers to vendors, leaders to their teams, and connects all project stakeholders together, either directly or indirectly. When the information requirements from an individual stakeholder, or group of stakeholders are known, the team can plan for its effective, multidirectional transfer. This facilitates mutual understanding among stakeholders, as is required. The 2MW Solar Farm Project is one of the first of its kind in Saint Lucia, and definitely the first of its kind for the Government of Saint Lucia and will therefore trigger changes in roles and processes. Some of the new roles and processes required would involve maintenance management of the solar farm, management of the NURC generation license and the interconnection agreement with LUCELEC. This means that change and communication management need to be well integrated.

The potential for misunderstandings and conflict may be high, as the teams and contractors become acquainted with these roles, processes, and personalities. This potential for conflict is exacerbated by the diverse group of stakeholders involved in the project. The stakeholders for the 2MW Solar Farm Project include private citizens, engineers, local businesses, lawyers, civil servants, activists, lobby groups, and politicians. These groups of individuals all see the project from unique perspectives and may therefore have opposing reasons and motivations for becoming involved in the project. Therefore, the communication strategy must be effective for the project to be successful.

RELEVANT ELEMENTS OF COMMUNICATION

Communication can be written, verbal, or nonverbal –through body language and gestures. It may also be formal or informal depending on the required context and message to be sent. Various mediums may be used, for example social media, television, or newspapers,

but the right form of communication should be used for the right stakeholder and to communicate the appropriate message.

TABLE 29 COMMUNICATION MANAGEMENT ELEMENTS

Element	Description
Grammar and spelling	Utilizing correct and consistent grammar and spelling is crucial to effective written communication.
Conciseness	When communication occurs, the message needs to be articulated without being excessively wordy.
Coherence	Ideas need to be communicated logically, flowing in a manner that facilitates easy understanding of the relevant concepts.
Clarity of purpose	The intention or purpose behind the communication always needs to be clear to the receiver of the message. It is also critical that their needs and interests are taken into account when designing the message.

Note: Own Work

There are three main processes involved in project communication management, namely:

1. Plan communications management
2. Manage communication
3. Monitor communication

4.7.1. PLAN COMMUNICATIONS MANAGEMENT

Plan communication management is the process of designing the communication strategy and plan for all project communications based on stakeholder analysis, stakeholder requirements, project requirements and assessment of the requirements of the project environment (PMI 2017).

All project documents are inputs to the plan communications management process because there is some aspect of the project within those documents that will need to be communicated. Useful tools and techniques required for planning project communications include communication technologies like Microsoft Office Suite, communication models, interpersonal skills like assessments of communication styles, and cultural and political

assessments and meetings to facilitate the plan development (PMI 2017). The main output of the process is a communications management plan, and updates to the other project management plans and documents. The communications management plan will be directly dependent on the project stakeholders, as they will be the individuals and organizations with whom the project team will need to regularly and clearly communicate. The following aspects of communication will be defined:

a. A communication matrix specifying the applicable audience, communication method, data transfer methods or tools used, frequency of communication, and the team member responsible for that communication.
b. The communication escalation process.

4.7.2. MANAGE COMMUNICATION

Managing communications is a process that involves ensuring that project communication occurs efficiently and effectively (PMI 2017). It involves systems for managing the information, by collecting, distributing, and storing it well, so that it can be both efficiently used and retrieved later. The inputs to the manage communication process include the resource, communications and stakeholder management plans, as well as project documents like the change and issue logs, the lessons learned register, and any quality and risk reports emanating from the quality and risk management plans.

The tools and techniques required for the management of communications include communication technologies, a project management information system (PMIS) for storing project data and interpersonal and team skills like active listening conflict management, meeting management and presentations. The outputs of the process of managing project communications include updates to the project plans, updates of project documents like the logs and registers and updates to organizational process assets.

The communications matrix in Section 4.7.2.1 details some of the strategies for communication management in the forms of the various project meetings, and reports that will be utilized throughout the project to facilitate effective communication within the project team, among projects stakeholders, and with the general public of Saint Lucia.

4.7.2.1.COMMUNICATION MATRIX

TABLE 30 COMMUNICATION MATRIX

No.	Communication Type	Purpose of Communication	Audience	Communication Method	Data transfer methods	Frequency	Responsible
MEETINGS							
1	**Project kick-off meetings**	-Establish project goals and objectives. -Clarify and align stakeholder objectives. -Introduce all major project stakeholders present at the start of the project including steering committee and project team. - Give a high-level overview of the project plan schedules and milestones.	Project team, PSC	Meetings (face to face)	Meeting room, Microsoft PowerPoint	Once	Project manager
2	**Project team meetings**	-Give updates on project progress. -Plan for troubleshooting of any problems arising with the project. -Knowledge sharing.	Project team	Meetings (face to face or virtual)	Meeting room, Microsoft Teams, Zoom, Microsoft PowerPoint	Weekly	Project manager
3	**Project team meetings inclusive of owner's engineer**	Give updates on project progress: -Plan for troubleshooting of any problems arising with the project. -Knowledge sharing. -Review of design documents.	Project team, owner's engineer	Meetings (virtual)	Microsoft Teams, Zoom, Microsoft PowerPoint	Every other week	Project manager
4	**Project steering committee meetings**	- Receive updates on project status. -Plan for troubleshooting of any escalated problems with the project. -Risk mitigation.	PM, PSC	Meetings (face to face or virtual)	Meeting room, Microsoft Teams, Zoom, Microsoft PowerPoint	Monthly	Project sponsor
5	**Meeting with DCA**	-Presentation of request for full approval.	DCA, PM, project team, energy unit	Meetings (face to face)	Meeting room, Microsoft PowerPoint, reports	Once	Project manager
6	**Contract negotiation meetings**	- Finalize the terms of the EPC contract.	PM, project team, legal officer, EPC contractor, EPC contractor lawyer	Meetings (face to face)	Meeting room, Microsoft PowerPoint, reports	As required	Project sponsor

No.	Communication Type	Purpose of Communication	Audience	Communication Method	Data transfer methods	Frequency	Responsible
7	**Project team meetings with EPC contractor**	-Define and clarify project requirements. -Give updates on project progress during the construction phase. -Resolve any contract disputes. -Discuss proposed and approved change orders.	EPC contractor, project team	Meetings (face to face) or on-site	Meeting room, Microsoft PowerPoint, reports	Weekly, and as required	Project manager
7	**Generation license application meeting**	-Discuss the terms of the generation license. -Clarify any issues or misunderstandings between the regulator and project team concerning the application for generation license.	Regulator**,** project team	Meetings (face to face)	Meeting room, Microsoft Power Point, reports	Once, or as required	Project manager
8	**Power purchase agreement negotiation meetings**	-Determine the PPA price. -Determine the sharing of interconnection costs. - Finalize legal document for power purchase agreement.	PM, project team, legal officer, utility, utility lawyer	Meetings (face to face)	Meeting room, Microsoft PowerPoint, reports	Weekly, as required till PPA is signed.	Project manager
REPORTS							
9	**Project status reports**	**-**Present the most recent project updates. -Report on key performance indicators. - Next steps in the project process.	PM, project team, energy unit, government stakeholders, utility	Physical document or electronic (PDF) document	E-mail or courier	Monthly	Project manager
10	**Technical reports**	**-**Provide updates and requirements for technical design after technical activity completion, for example after completion of the grid interconnection study, or geotechnical study.	PM, project team, engineers, energy unit, utility, consultants	Physical document or electronic (PDF) document	E-mail or courier	As required	Project team
11	**Community engagement meetings**	-Apprise the community of the project plans and intentions. -Communicate how the project will benefit or affect the community. -Respond to resident concerns and address grievances.	Nearby residents, media, regulator, utility, project team	Meetings (face to face)	Meeting room, Microsoft PowerPoint, reports, handouts, pamphlets.	Twice, or as required	Project team

Note: Own Work

4.7.3. MONITOR COMMUNICATION

Monitoring communications is the process of ensuring that the project communications plan is effectively executed by ensuring that the information requirements of the project stakeholders are met (PMI 2017). The inputs to the monitor communications process are the same as those for the manage communications process. The tools and techniques for this process include a PMIS, data representation tools like the stakeholder engagement assessment matrix defined in the stakeholder management plan, as well as interpersonal and team skills like observations and conversations which are useful for monitoring the effect of the communications plan. The outputs of the monitor communications process include work performance information data, change requests, updates to the project management plan, other process inputs and the applicable project document logs and registers.

It is evident that the project's stakeholder management plan and the communications management plan must work hand-in-hand for project success.

One of the common objectives of all of the project processes related to monitoring (including monitoring communications, risk, or project scope), is to identify issues, or potential change requests that may affect the project. In some cases, these issues may need to be escalated above the level of the project team or project manager. Therefore, a communications escalation process is required to ensure that all team members can adequately discriminate between types of change requests based on their criticality. This process also ensures that issues arising are dealt with in a consistent manner, and at the appropriate level of authority.

4.7.3.1. COMMUNICATION ESCALATION PROCESS- A RISK BASED APPROACH

The communication escalation process defines how to address matters arising from the project which cannot be settled at the level of the project team. These will typically be project risks, which threaten the project's success. Escalation processes are also common for situations where there is conflict or some sort of dispute to be resolved, or where some kind of change is required. A documented, accepted, and management approved process

provides a structure which corresponds to authority levels that anyone in the project should be aware of, and able to utilize. The project manager is the primary person responsible for execution of the communication escalation process. However, the process should be known to all team members, so that if there is a grievance against, or failure on the part of the project manager, the first step of the escalation process to the project sponsor is understood and enacted.

Figure 29 Communication Escalation Line of Action

Note: Own Work

The means for identification of what change aspects of the project need to be escalated will be based on the risk management framework.

Risk Category	Description	Point of Escalation
Extreme	If the risk occurs, project success will be threatened. All mitigation efforts are crucial.	These issues must be escalated to the management team.
High	If the risk occurs, the project will be significantly impacted.	These issues must be escalated to the project steering committee.
Moderate	If the risk occurs, the impact on the project will be moderate.	These issues must be escalated to the project sponsor.
Low	If the risk occurs, the project will most likely still be successful with relative ease.	The project manager should be notified and confirm that the risk is low. If this confirmation occurs, further escalation is

Risk Category	Description	Point of Escalation
		not required, however the team can include it in the reporting at the discretion of the project manager so that all stakeholders are aware.

Figure 30 Communication Escalation Process- A Risk-based Approach.

Note: Own Work.

In the risk management framework, risks are designated as extreme, high, moderate, and low based on their potential impact on project success. This is computed by calculating the product of the likelihood and probability scores associated with the project risk in question. These scores are subjective and qualitative, so the discretion of the project team and project manager are paramount in escalating issues properly, effectively and in a timely manner. Discretion from the project manager and team will also be required in determining the urgency of escalation and the means of escalation. For example, there may be two situations requiring escalation, both evaluated as high risk based on the probability impact matrix in Section 4.8.3.2.

However, one situation may have a potentially critical impact, but may be evaluated as having an unlikely probability of occurrence, and the other may be almost certain, but may be evaluated as having a minor impact on the project. It would be in the best interest of the project team to take immediate escalation action on the former, for example an emergency meeting of the project steering committee or management. Depending on how minor the potential impact of the second issue is, it may be resolved at the project team level.

4.8. RISK MANAGEMENT PLAN

Planning risk management consists of the processes and procedures associated with foreseen and unforeseen events affecting the project. The risk management plan processes involve identifying these events, analyzing them, planning an appropriate response followed by the implementation of that response plan. Thereafter, the risk management plan defines how to monitor the plan's efficacy (PMI 2017). The risk management plan has implications for all parts of the project and the project manager must always beware of the environment and potential threats and opportunities that could influence project success. The project manager and team must use the risk management plan and its closely associated cost and change management plans to increase the likelihood of project success.

4.8.1. PLAN RISK MANAGEMENT

The plan risk management process is concerned with identifying the means by which projects risks, and the various activities related to these project risks will be handled by the project. The risk management plan will include all the elements of the project management plan, as well as other corporate documents like the stakeholder register as is indicated in Figure 31.

Figure 31 Overview of the Plan Risk Management Process

Note: Reprinted from A Guide to the Project Management Body of Knowledge (PMBOK® Guide) Sixth Edition. Project Management Institute (PMI), 2017 Figure 11-2, p. 401 Copyright 2017 by Project Management Institute, Inc.

The main tools involved in planning risk management include expert opinion and judgement, and data analysis. For example, in a tropical context like Saint Lucia, there is always the probability of the disruption of a project by a tropical storm during the hurricane season. Planning to accommodate this risk requires expert judgement for effective decision making. Fundamental to proper risk management plan development is a high-level understanding of the risk appetite and risk strategy of the implementing organization. This influences the exposure to risk that an organization is willing to take on, which guides the mitigation strategies available for implementation. For example, a more conservative organization constructing a solar farm will choose to construct that farm to category 5 hurricane standards. Whereas a more risk tolerant organization may choose the cheaper capital cost option of construction to Category 4 or 3 standards and mitigate by paying a higher insurance premium.

4.8.2. IDENTIFY RISK

The process of risk identification determines and names the risks the project is exposed to and documents the source of the risk, its characteristics and how it impacts the entire project (PMI 2017).

The inputs to the risk identification plan include the project management plan, project requirements, project assumptions, and the project estimates made accompanied by the basis for those estimates.

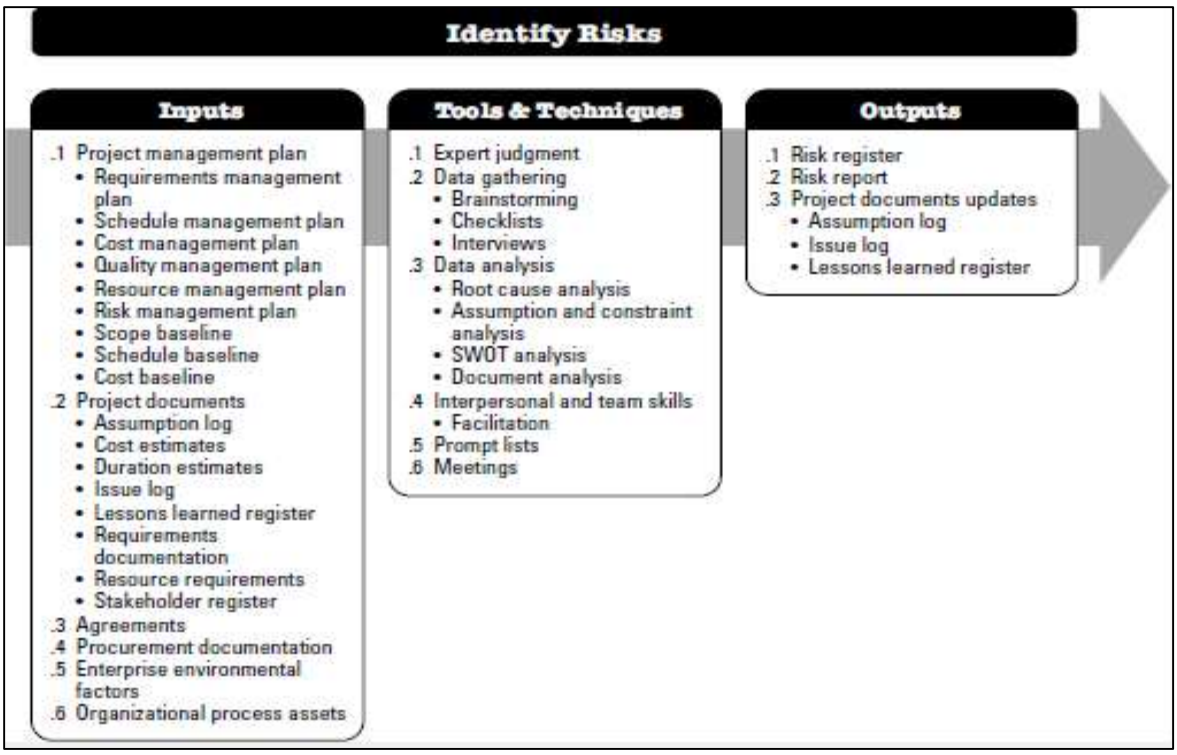

Figure 32 Overview of the Identify Risk Process

Note: Reprinted from A Guide to the Project Management Body of Knowledge (PMBOK® Guide) Sixth Edition. Project Management Institute (PMI), 2017 Figure 11-6, p. 409 Copyright 2017 by Project Management Institute, Inc.

The tools involved in risk identification include expert judgement, data analysis tools like root cause analysis for identifying the true cause of a risk, and interpersonal tools like interviews, meetings and discussions which facilitate a team approach and more comprehensive risk identification from various perspectives of expertise.

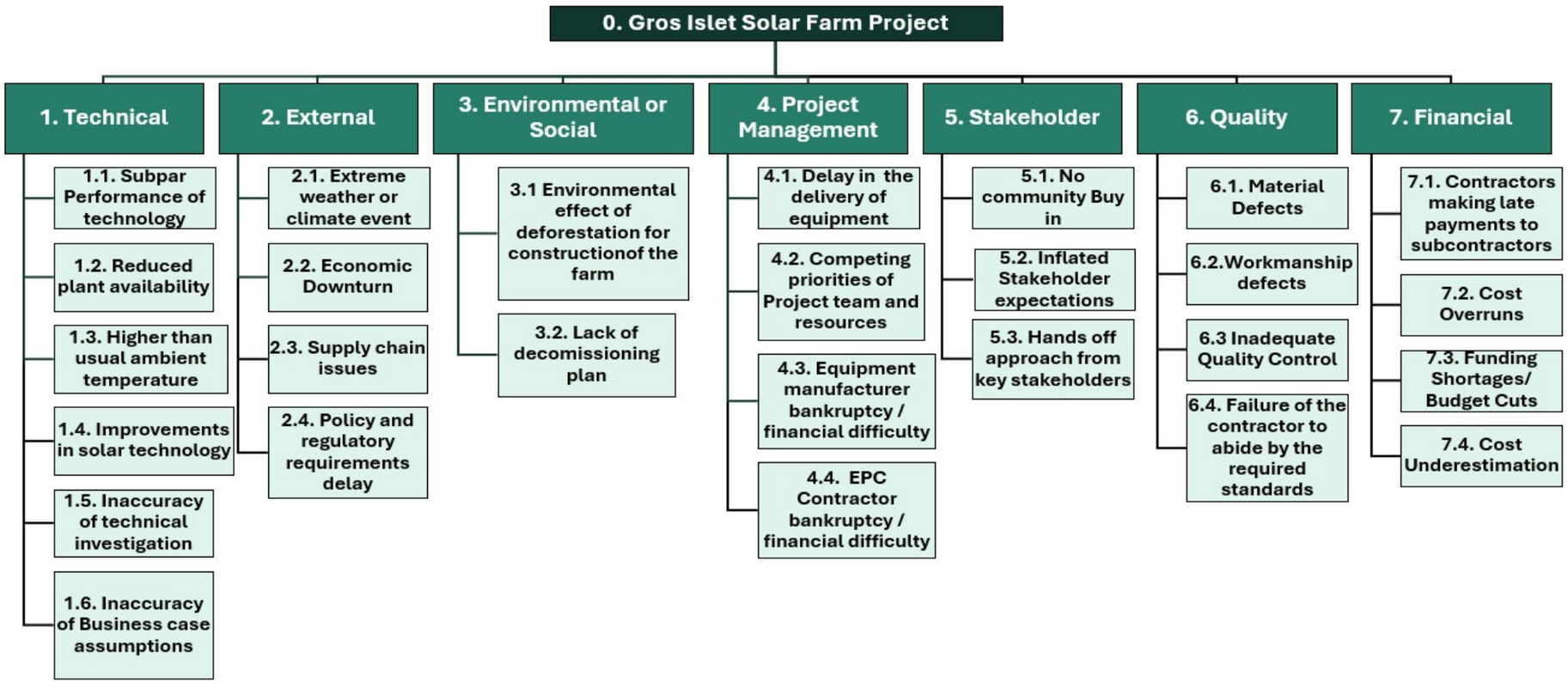

Figure 33 Risk Breakdown Structure – Depicts and lists the risks associated to seven risk categories associated with the project.

Note: Own Work

The risk identification process produces a risk register as its primary output. It also triggers the update of some project documents like the project budget- for the addition of risk related contingency reserves, the assumption logs after assumptions are tested for validity and the lessons learned as the project progresses and the qualitative evaluation of the risks are reflected upon. Much like a work breakdown structure (or WBS), the risk breakdown structure (RBS) provides a framework for categorizing and ranking the risks associated with any given project, making it easier for project management teams to plan for and mitigate the impacts of those risks effectively. Within the Gros Islet Solar Farm Project, the project manager and sponsor must account for risks that may arise and consider risks occurring in the following broad risk categories: technical, external, environmental and social, project management, stakeholder, quality and financial. Figure 33 depicts the risk factors under each category listed. The RBS allows the team to visualize the risks involved with a given project in an ordered manner while helping PMs assign resources more appropriately, and plan for the positive or negative impacts of the identified risks.

4.8.3. PERFORM QUALITATIVE RISK ANALYSIS

The process of performing qualitative risk analysis involves the consideration of the risks developed in the risk identification process, and prioritizing these risks using a defined system which considers the probability of occurrence of the risk and the impact that the risk will have on the project (PMI 2017).

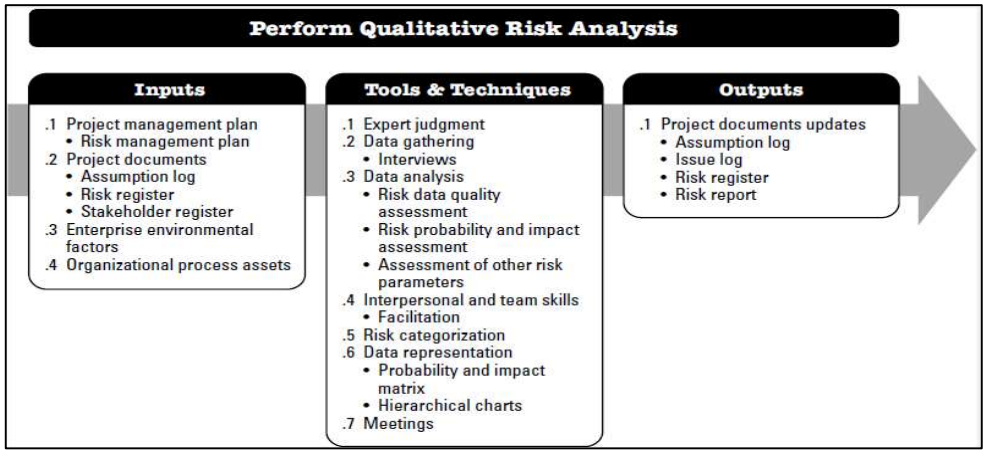

Figure 34 Giving an overview of the Perform Qualitative Risk Analysis Process

Note: Reprinted from A Guide to the Project Management Body of Knowledge (PMBOK® Guide) Sixth Edition. Project Management Institute (PMI), 2017 Figure 11-8, p. 419 Copyright 2017 by Project Management Institute, Inc.

Performing qualitative risk analysis is a key part of the risk management process group as it seeks to identify the most critical risks, so that action plans can be developed to address these risks with priority.

The inputs to the perform qualitative risk analysis process include all the elements of the project management plan, risk management plan, general organization, and project documents, including the risk register, list of assumptions, and stakeholder register.

There are many tools and techniques involved in this process as well. The tools and techniques that are pertinent to the Gros Islet Solar Farm Project are: Interpersonal tools, which involve discussing the risks and analyzing them in teams to get a variety of expert opinions, risk categorization which involves placing the risks into larger categories so that similar risks can be analyzed together, and the risk probability and impact assessments.

4.8.3.1. PROBABILITY AND IMPACT SCALES

Once all potential risks have been identified and categorized, the next step is to prioritize them to effectively allocate resources and contingencies for risk mitigation. The Project

Management Institute (PMI) recommends employing a risk-scoring technique that considers probability (P) and impact (I) for risk analysis. This method involves specific formulas and rankings outlined in the provided key. The criteria for defining the probability and impact for any particular risk are defined below.

Parameter	Probability (P)				
Probability description	**5 = High probability**	**4 = Medium-High**	**3= Medium-low probability**	**2= Low probability**	**1= Very Low probability**
Probability % range	(80% ≤ p ≤ 100%)	(60% ≤ p <80%)	(40% ≤ p≤ 60%)	(20% < p < 40%)	(0% < p < 20%)
	Impact (I)				
Impact description	**Catastrophic**	**Major**	**Moderate**	**Minor**	**Negligible**
Impact value	5	4	3	2	1

Figure 35 Giving an overview of the Probability and Impact Scales

Note: Adapted from A Guide to the Project Management Body of Knowledge (PMBOK® Guide) Sixth Edition. Project Management Institute (PMI), 2017 Figure 11-1, p. 407 Copyright 2017 by Project Management Institute, Inc.

Probability is defined in terms of ranges representative of the likelihood of the occurrence of an event, which is expressed in percentages. If the team perceives that a risk is very likely or has a very high probability, a probability score between 80 and 100% will be assigned. Alternatively, if a risk is very unlikely to occur, or may occur for example once in a lifetime, a score of five representative of a percentage probability between 0 and 20% will be assigned. An event's impact is expressed on a qualitative scale ranging from an event identified to have negligible impact on the project to one with the potential for a catastrophic impact on the project. In the case of both probability and impact, scores from 1

to 5 are assigned, corresponding to the level of probability or impact, with the aim of simplifying the process of calculating the overall risk score.

4.8.3.2.PROBABILITY-IMPACT MATRIX

After examining each risk, a risk score is calculated by multiplying the impact (I) rating by the probability (P). These risk scores are displayed in what is called a probability - impact matrix. Typically, these matrices display the risk score and an associated indication color relevant to the event's overall risk level.

			PROBABILITY				
			Almost Certain	Likely	Possible	Unlikely	Rare
			5	4	3	2	1
IMPACT	Catastrophic	5	Extreme 25	Extreme 20	Extreme 15	High 10	Moderate 5
	Critical	4	Extreme 20	Extreme 16	High 12	High 8	Moderate 4
	Moderate	3	Extreme 15	High 12	High 9	Moderate 6	Low 3
	Minor	2	High 10	High 8	Moderat e 6	Moderate 4	Low 2
	Negligible	1	Moderate 5	Moderate 4	Low 3	Low 2	Low 1

Figure 36 Probability-impact matrix Risk Scores – Adapted from (Gulsum 2018)

Note: Adapted from Good risk assessment practice in hospitals by Gulsum Kaya, 2018, figure 4.1, p 71. Copyright 2018 by Gulsum Kaya.

Assigning an indication color provides additional information to the reader, for instance, red is generally associated with an urgent situation, while there is a tendency for green to be

associated with a positive, or non-urgent situation. Therefore, based on the colors used, the reader will be able to infer how high or low a risk is. Red and green correspond to extreme and low risks respectively, while the orange and yellow transition between the red and green indicate high and moderate risks respectively.

Risk Category	Color	Description
Extreme		If the risk occurs, project success will be threatened. All mitigation efforts are crucial.
High		If the risk occurs, the project will be significantly impacted.
Moderate		If the risk occurs, the impact on the project will be moderate.
Low		If the risk occurs, it is likely that the project will still be successful with relative ease.

Figure 37 Risk Category Key

Note: Own Work

Using this scale, all the risks from the project will be listed and ranked. Each will be assigned a score from 1 to 25, indicating their severity of the overall project risk.

4.8.4. PERFORM QUANTITATIVE RISK ANALYSIS

Performing quantitative risk analysis puts figures to the risks identified, whether these are cost figures, or other forms of appropriate scoring. This is important to establish the true risk exposure of the project and assists in setting proper contingencies in managing and controlling the risks (PMI 2017). For the purposes of the solar farm project, quantitative risk analysis was not deemed necessary, since the qualitative analysis previously performed was deemed sufficient given the project stage.

4.8.5. PLAN RISK RESPONSES

Planning risk response considers the risks in order of priority and determines the way forward for addressing the risks appropriately based on the budget and the ranking of the risk (PMI 2017). It is important to note here that risk management is not only concerned with addressing project threats, but also taking advantage of project opportunities, both of which result in minimizing project exposure (PMI 2017).

TABLE 31 RISK RESPONSES FOR THREATS (PMI 2017)

	STRATEGY	DESCRIPTION	CONTEXT
THREAT	**Escalate**	The risk is addressed at the management level. Escalation is done by the project team.	Applies when the decision required is out of the control of or beyond the authority of the project team or manager.
	Avoid	Complete elimination of the threat. This may involve changing the plan or location. For example, if a rare bird is threatened by the solar farm project, the team may decide to pursue a different project location.	Where the threat is well understood and can be completely eliminated by team actions. Or where the threat is serious enough to warrant the cost associated with avoidance.
	Transfer	This involves moving the threat risk to a third party. For example, insurance, or subcontracting with guarantees in place. Risk transfer typically comes at a cost	This applies where the budget can support risk transfer.
	Mitigate	The impact of the risk is reduced by the actions of the team. For example,	Mitigation of the impact can be utilized where it is

	STRATEGY	DESCRIPTION	CONTEXT
		redundancy may be designed into a system, or a prototype may be developed to ensure that defects can be addressed without affecting system integrity.	not possible to reduce the probability of the risk.
	Accept	The threat is acknowledged, but no significant action is taken to mitigate.	Applies commonly to low priority risks, or where there is very little control.

Note: Own work using data from A Guide to the Project Management Body of Knowledge (PMBOK® Guide) Sixth Edition. Project Management Institute (PMI), 2017 Section 11.5.2.7, p. 445-446. Copyright 2017 by PMI, Inc. Permission not sought.

No opportunities were identified in the first risk identification process, and so TABLE 31 shows the mitigation strategies applicable to the identified project threats in Section 4.8.2. The strategies for risk response are dependent on what type of risk is being addressed: a threat or an opportunity. For threats, the options for risk responses are: Escalate, avoid, transfer, mitigate, or accept. For opportunities, the options for risk responses are: escalate, exploit, share, enhance, or accept.

A project of this scale has never been undertaken by the Government of Saint Lucia before, so there will be associated risks. An overview of the main risk response strategies in place to help manage risks and ensure a successful project is listed below, followed by a more comprehensive risk register.

Konfyans has been hired as the experienced owner's engineering firm with experience with solar and battery farms, and was hired to:

i. Help develop robust specifications for the project.
ii. Conduct power system studies that will model how the solar farm interacts with the balance of the grid.

iii. Assist with the development of an engineering procurement and construction contract (EPC).
iv. Assist in the procurement of the EPC contractor.
v. Assist with overseeing quality control activities from procurement to construction.

The risk matrix in Section 4.8.5.1 has the first full risk register for the project, and includes some qualitative evaluation of the risks, specification of the strategies identified for addressing the risks, and ownership of the risks. The register is a working document of the project and should be periodically updated and edited as the project environment changes.

4.8.5.1. RISK REGISTER

The main strategy for risk management here is the decision to carry out the project as an EPC project. The benefits of this strategy are listed below.

Secondly, an experienced, qualified, and cash-secure EPC contractor will be hired to design the project, procure project materials and construct the project.

i. A turnkey, fixed-price contract will be utilized; the contractor and employer will agree on a price, and the contractor will be responsible for procurement of all equipment, site preparation, and construction of the plant. This transfers most of the project risk from GOSL and Konfyans to the EPC contractor who will be liable for project delays, quality issues and non-conformance to project contract guarantees.

ii. The fixed price contract will therefore mean a more inflated price inclusive of EPC contractor contingencies to account for the delay and ensure that the project is delivered on time.

TABLE 32 gives an overview of all the project risks and mitigation strategies.

TABLE 32 RISK REGISTER

RISK No.	EVENT	Potential Effect	Key Risk Indicators	Likelihood	FS	Severity	SS	Estimated Risk	RS	Mitigation/ Strategy (Contingency or Preventive Action)	Risk Control Strategy	Risk Taker	Risk Owner	Post Plan Risk
1	**Under performance of technology (technical issues limit nameplate capacity production)**	Lower kWh production than anticipated or modeled, loss of revenue, increase in payback period.	Lower MW output during acceptance testing.	Rare	1	High	4	Moderate	4	Ensure the right components are procured, ensure that the Owner's engineer reviews all procured equipment. Ensure reasonable warranties are provided on equipment.	Transfer	Manufacturers, EPC contractor	EPC	Moderate
2	**Reduced plant availability due to more breakdowns than anticipated**	Lower kWh production than anticipated or modeled, loss of revenue, increase in payback period.	Compliance to the planned maintenance program, plant availability, mean time to failure.	Unlikely	2	Minor	2	Moderate	4	Employ a robust maintenance plan before handover. Ensure comprehensive staff training. Include a maintenance contract for the first operation years until the team is competent. Require a troubleshooting manual including common failures. Provide ongoing	Transfer/ mitigate	EPC contractor	GOSL	Moderate

RISK No.	EVENT	Potential Effect	Key Risk Indicators	Likelihood	FS	Severity	SS	Estimated Risk	RS	Mitigation/ Strategy (Contingency or Preventive Action)	Risk Control Strategy	Risk Taker	Risk Owner	Post Plan Risk
										training. Ensure equipment warrantees are in place.				
3	**Higher than usual ambient temperature**	Decrease in solar efficiency.	Solar cell operation temperature.	Possible	3	Moderate	3	Moderate	9	Procure the most efficient and cost-effective solar cells on the market.	Accept	GOSL	GOSL	Moderate
4	**Improvements in solar technology**	Solar costs decrease or efficiency improves notably after procurement contracts are signed but before manufacturing	Market price of solar, panel efficiency.	Possible	3	Very low	1	Low	3	Competent owner's engineer who will monitor market prices until signing of contract to ensure consistency with market value.	Accept/ mitigate	EPC contractor	Konfyans	Moderate
5	**Inaccuracy in business case assumptions, solar resource prediction, kWh demand forecasts, oil market prices.**	Inaccurate model results.	Projected vs actual tracking of solar irradiation, demand, oil (fuel) prices.	Unlikely	2	Moderate	3	Moderate	6	Accurate prediction of variables is limited. Yearly average estimates should be reliable. Use the best data sources and most accurate data collection process. Update the analysis periodically using current data before the project begins.	Accept	GOSL/ Konfyans	GOSL/ Konfyans engineering team	Moderate
6	**Extreme weather events: Sustained hurricane force winds**	Partial or total equipment damage due to impact of airborne debris. Lower unit production than	Storm category path and forecasts, actual damage to infrastructure, loss of production.	Possible	3	High	4	High	12	Ensure compliance to construction standards, insurance of the plant.	Share/ mitigate	EPC, GOSL	GOSL	Moderate

RISK No.	EVENT	Potential Effect	Key Risk Indicators	Likelihood	FS	Severity	SS	Estimated Risk	RS	Mitigation/ Strategy (Contingency or Preventive Action)	Risk Control Strategy	Risk Taker	Risk Owner	Post Plan Risk
		anticipated or modeled, possible complete loss of production.												
7	**Damage to infrastructure because of extreme weather event: Rain/ flooding**	Possible loss of production due to equipment damage.	Structural integrity of the plant foundations, indicators from hydrology report.	Possible	3	High	4	High	12	Ensure compliance to construction standards, ESIA, insurance of the plant.	Share/ mitigate	EPC, GOSL	GOSL	Moderate
8	**Ash accumulation**	Lower unit production than anticipated or modeled, loss of revenue.	Weather reports visibility, lower MW output.	Unlikely	2	Moderate	3	Moderate	6	Regular maintenance schedule.	Accept	EPC, GOSL	GOSL	Low
9	**Extreme weather event: Earthquake**	Damage of installation, structural damage.	Structural integrity of the plant foundations.	Rare	1	High	4	Moderate	4	Ensure compliance with construction standards, insurance of the plant.	Share/ mitigate	EPC, GOSL	GOSL	Moderate
10	**due Extreme weather event: Earthquake to**	Damage of installation, structural damage.	Structural integrity of the plant foundations.	Rare	1	High	4	Moderate	4	Ensure compliance with construction standards, insurance of the plant.	Share/ mitigate	EPC, GOSL	GOSL	Moderate
11	**Economic downturn**	Loss of market for the power production from project, high inflation rates	Inflation, political stability, prices of competitors, land prices locally, %	Unlikely	2	High	4	Moderate	8	Risk must be accepted, GOSL will have to take a Go/NO GO decision if this risk materializes.	Accept	Konfyans, GOSL	GOSL	High

RISK No.	EVENT	Potential Effect	Key Risk Indicators	Likelihood	FS	Severity	SS	Estimated Risk	RS	Mitigation/ Strategy (Contingency or Preventive Action)	Risk Control Strategy	Risk Taker	Risk Owner	Post Plan Risk
		increase costs past budget reserves (cost overruns). Project business case no longer viable.	budget on track, actual vs planned expenditure.											
12	**Supply chain issues**	Project delays due to delays in the delivery of project equipment.	Days behind schedule (for the delivery of equipment), media on supply chain issues globally.	Unlikely	2	High	4	Moderate	8	Consider special shipping arrangements with freight forwarders or contracting shipping space in advance. The EPC contractor can consider engaging a supply chain consultant if necessary.	Transfer	EPC	EPC	Moderate
13	**Policy or regulatory requirement delay**	Project delays due to unclear or changing policy or regulatory requirements.	Number of days behind.	Possible	3	Very High	5	Extreme	15	Manage the regulator and utility among the highest-ranking stakeholders and regularly liaise to clarify requirements for auctioning the project and interconnection.	Accept	Konfyans	GOSL	Moderate
14	**Severe environmental risk due to construction of solar farm**	Damage or disruption of the surrounding biodiversity, sensitive areas affected, significant removal of forest cover.	Change in protected species habitat, hydrology, or vegetation, of Gros-Islet. Stakeholder feedback, ESIA.	Possible	3	Moderate	3	Moderate	9	Conduct ESIA and follow the recommendations, tree-planting efforts to mitigate the effect of deforestation, restore property to its original state as much as is possible.	Transfer	EPC	Konfyans	Low

RISK No.	EVENT	Potential Effect	Key Risk Indicators	Likelihood	FS	Severity	SS	Estimated Risk	RS	Mitigation/ Strategy (Contingency or Preventive Action)	Risk Control Strategy	Risk Taker	Risk Owner	Post Plan Risk
15	**Lack of decommissioning plan**	Improper disposal of panels after useful life is completed, with effects on community.	Stakeholder acceptance score, ESIA assessment.	Possible	3	Moderate	3	Moderate	9	Conduct sustainability assessment, include decommissioning procedure and implement recommendations.	Accept	EPC	Konfyans	Low
16	**Delay in the delivery of equipment**	Project delays, cost overruns.	Days behind schedule, schedule compliance.	Possible	3	Moderate	3	Moderate	9	Turnkey project transfers the risk to the main contractor. Ensure the contract contains completion guarantees, and quality measures and penalties for non-compliance. Contingency funds. Owner's engineer's expertise will assist in managing the project schedule. Hire reputable EPC contractors for the project.	Transfer	EPC contractor	EPC project manager (PM)	Low
17	**Competing priorities of project team and resources**	Project delays, missed knowledge transfer and quality check opportunities.	Resource availability, schedule compliance.	Possible	3	Moderate	3	Moderate	9	Assign core project team sufficient project resourcing planning time. Maintain consistent communication with management concerning project resourcing.	Accept/ mitigate	EPC contractor, Konyans	PM	Low
18	**Equipment manufacturer bankruptcy / financial difficulty**	Delay in delivery of project equipment, recruitment of a new manufacturer.	Supplier profitability, solvency, operational efficiency.	Unlikely	2	High	4	Moderate	8	Selection criteria in the procurement plan to include the financial strength of the manufacturing company and any parent companies.	Transfer	EPC / insurance	MSD	Low

RISK No.	EVENT	Potential Effect	Key Risk Indicators	Likelihood	FS	Severity	SS	Estimated Risk	RS	Mitigation/ Strategy (Contingency or Preventive Action)	Risk Control Strategy	Risk Taker	Risk Owner	Post Plan Risk
19	**EPC Contractor bankruptcy / financial difficulty**	Project failure, unable to meet requirements and guarantees. Recruitment of a new EPC contractor.	Contractor financial statement operational efficiency.	Unlikely	2	Very High	5	Moderate	10	Selection criteria to include the financial strength of the EPC company and any parent companies.	Accept/ mitigate	EPC/ insurance	GOSL	Moderate
20	**No community buy-in**	If the Gros- Islet community does not accept the project, community members could disrupt the project progress with resistance activities. The DCA may not issue project approvals.	Stakeholder acceptance score.	Possible	3	Moderate	3	Moderate	9	Conduct ESIA and follow the recommendations. Engage the community from the beginning and address their concerns.	Accept/ mitigate	Konfyans/ GOSL	Konfyans/ GOSL	Low
21	**Inflated stakeholder expectations**	If stakeholders' expectations of are unreasonable and not managed, the completed project may not be accepted.	Stakeholder acceptance score.	Unlikely	2	Moderate	3	Moderate	6	Implement stakeholder management plan effectively. Ensure effective requirement collection. Ensure that stakeholders understand the implications of the change management process.	Accept/ mitigate	Konfyans	Konfyans/ GOSL	Low
22	**Hands-off approach from key stakeholders**	Could result in delayed decision-making, lack of	Stakeholder acceptance score.	Possible	3	High	4	Extreme	16	Ensure that all stakeholders are on board as early as possible. Execute strategic communication. Ensure that	Accept/ mitigate	Konfyans/ GOSL	Konfyans/ GOSL	Moderate

RISK No.	EVENT	Potential Effect	Key Risk Indicators	Likelihood	FS	Severity	SS	Estimated Risk	RS	Mitigation/ Strategy (Contingency or Preventive Action)	Risk Control Strategy	Risk Taker	Risk Owner	Post Plan Risk
		ownership of the project, delays in funding provision, slow resolution of issues and general project delays.								there are effective project sponsors in all organizations.				
24	**Inferior materials used for construction**	Defects, premature failures, Failure to meet generation requirements.	Quality asessment, Defect count.	Possible	3	High	4	High	12	For major equipment, specify a list of approved, quality suppliers.	Accept/ mitigate	EPC	EPC	Moderate
25	**Workmanship defects**	Defects, premature failures, Failure to meet generation requirements.	Quality asessment, Defect count.	Possible	3	High	4	High	12	Hire an experienced EPC contractor, establish approval criteria for subcontractors so that workmanship is up to standard.	Accept/ mitigate	EPC	EPC	Moderate
26	**Inadequate quality control**	Defects, premature failures, Failure to meet generation requirements.	Quality asessment, Defect count.	Possible	3	High	4	High	12	Establish a robust quality management plan and ensure it is accomplished. Assign an experienced clerk of works/ quality controller for monitoring project progress and workmanship.	Accept/ mitigate	Konfyans	Konfyans PM	Moderate
27	**Failure of the contractor to abide by the required standards**	Significant technical issues to be resolved, cost overruns, subpar construction, breach of contract.	Acceptance test records, ongoing performance test results.	Unlikely	2	Very High	5	High	10	Ensure that the contract contains standard non-compliance penalties. Qualified Owner's engineering personnel should oversee construction. Perform necessary	Transfer	EPC contractor	Konfyans PM	Moderate

RISK No.	EVENT	Potential Effect	Key Risk Indicators	Likelihood	FS	Severity	SS	Estimated Risk	RS	Mitigation/ Strategy (Contingency or Preventive Action)	Risk Control Strategy	Risk Taker	Risk Owner	Post Plan Risk
										testing early, to minimize project schedule disruptions.				
28	**Contractors making late payments to subcontractors**	Subcontractor not paid on time, project delays.	Schedule compliance.	Possible	3	Moderate	3	Moderate	9	Hire a financially stable EPC contractor. Use the milestone payment schedule to incentivize the timely execution of deliverables	Transfer	EPC	EPC PM	Moderate
29	**Equipment manufacturer bankruptcy / financial difficulty**	Delay in delivery of project equipment, recruitment of a new manufacturer.	Company retained earnings, profits, operational efficiency.	Unlikely	2	High	4	Moderate	8	Selection criteria in the procurement plan to include the financial strength of the manufacturing company and any parent companies.	Transfer	EPC	GOSL	Low
30	**Cost underestimation**	Apparent cost overruns, but actually under budgeting of the project.	Inflation. Competitor pricing, Local land prices, % budget on track, actual vs planned expenditure.	Unlikely	2	High	4	Moderate	8	Hire a competent owner's engineer.. Ensure that a bid bond is required of the bidders.	Transfer	Konfyans, EPC	Konfyans	Moderate

Note: Own Work

4.8.6. IMPLEMENT RISK RESPONSES

This process involves taking the actions specified in the risk response plan and ensuring that the defined responses are executed, so that the anticipated post implementation results can be achieved (PMI 2017). This process requires continuous monitoring of project risks, to ensure that strategies planned are still relevant in the face of environmental.

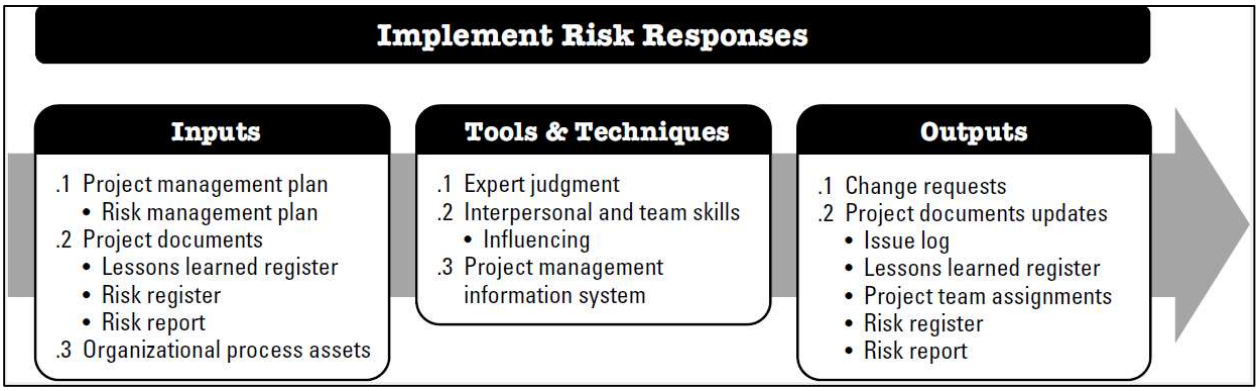

Figure 38 Overview of the Implement Risk Response Process

Note: Reprinted from A Guide to the Project Management Body of Knowledge (PMBOK® Guide) Sixth Edition. Project Management Institute (PMI), 2017 Figure 11-19, p. 449 Copyright 2017 by Project Management Institute, Inc.

Implementing the risk responses planned consists primarily of coordinating with the responsible agencies and individuals to get the actions completed, and therefore mainly requires soft, interpersonal skills like influencing and effective communication, as well as a system for documenting the actions taken and their efficacy for updating project documentation.

4.8.6. MONITOR RISK

Monitoring risk is carried out throughout the project life cycle and keeps a tab on the results of the risk response efforts. This process is pivotal in evaluating the efficacy of the chosen risk responses (PMI 2017). Performing this process early and often can help to identify gaps in the risk responses, paving the way for these responses to be re-evaluated, and for

the monitoring process to begin again. This process can facilitate much learning and scope for improvement of risk responses as well as increased understanding of the project environment and its actors.

4.9. PROCUREMENT MANAGEMENT PLAN

Project procurement management entails the processes required to attain the materials, equipment and services required to complete the project (PMI 2017). Many processes are required to ensure that procurement follows organizational policy, and many agreements underpin the procurement management processes. Some of these include supply contracts for materials or service, quotations, purchase orders, and requests for proposals. In the case of the Gros Islet 2 MW solar farm, procurement needs to conform to the Public Procurement Manual and Public Procurement Regulations of the Government of Saint Lucia. There are three main processes that form part of the procurement management plan. These are:

1. Plan procurement management
2. Conduct procurements
3. Control procurements

4.9.1. PLAN PROCUREMENT MANAGEMENT

Planning procurement management involves making decisions about the procurement strategy based on procurement policy and documenting these plans (PMI 2017). A significant part of this procurement planning is selecting suitable suppliers of the various project resources, and determining when, and how to acquire the resources. The inputs for this process include all the project plans and subplans, the resource requirements, resource management plan, and organizational process assets like the Government procurement guidelines. Tools associated with this process include expert judgement, market research, make-or-buy decisions, and analysis of suppliers and meetings to facilitate the conversations required to implement all of these tools. The outputs of this process include

updates to the project plans and other documents, the procurement strategy, and procurement decisions.

4.9.1.1. APPROACH TO PROCUREMENT

Project procurement will be the responsibility of the project manager, who will collaborate with the Division of Energy as the lead ministry and the accountant generals' department for payments to perform the project procurements. The primary procurement product type for the solar farm project is the procurement of service contracts: namely the hiring of the EPC contractor and owner's engineer. Material procurement is also a part of the plan, however, the procurement of materials, tools and equipment for construction is the responsibility of the EPC contractor. The project team will also procure supplies for the operation of the project office on a much smaller scale.

Procurement of the owner's engineer and EPC contractor is conducted through open competition in line with the Government Procurement Manual and policy. As much as possible, project procurement will also be conducted in line with the project budget to maintain proper fiscal management and cash flows.

The selection of contractors will be done with a scoring criterion which considers both cost and technical components. The selection process should aim to achieve the "best value" considering the 12 principles guiding procurement (Government of Saint Lucia, 2021).

4.9.1.2. GUIDING PRINCIPLES FOR PROCUREMENT

TABLE 33 GUIDING PRINCIPLES FOR PROCUREMENT

No.	Principle	Description
1	Transparency	The procurement processes will be carried out with clarity and openness.
2	Accountability	Procurement personnel will be held responsible for risks and expenditure.
3	Competitive process	Procurement should be done through a competitive process unless justification can be provided for doing otherwise.

No.	Principle	Description
4	Consistency	Procuring departments should generally follow the same practices.
5	Effectiveness	Procurement should be in line with the government's financial, regulatory, and socio-economic goals.
6	Efficiency	Procurement should be cost-effective.
7	Sustainability	Minimizing environmental and social impacts should be given significant consideration in the procurement process.
8	Fair dealing	All bidders must be equitably treated. Information should be confidential as required.
9	Integrity	No corruption and collusion amongst tenderers should occur. Persons involved in procurement should abide by the strictest professional standards.
10	Informed decision-making	Accurate, comprehensive, and current data should be used to justify all decisions made, and these decisions should be continuously evaluated for accuracy, alignment, and attainability.
11	Legality	Procurement must be conducted in line with all applicable legislation.
12	Responsiveness	Procurement should be performed so that the needs and expectations of the target community being served are met.

Note: Own work using data from Public Procurement Manual, Government of Saint Lucia, 2021 Section 3, p. 5. Copyright 2021 by Government of Saint Lucia.

4.9.1.3.CONTRACT TYPE

The contract type will be a fixed price and turnkey contract. Since the project is a solar farm, and construction of solar farms, as well as the risks associated are well understood, a fixed price contract is seen as the best option for the project. Through such a contract, risk is manageable, if an experienced EPC contractor is selected. Most of the pre-feasibility testing

and studies performed also form part of derisking the project and will inform the technical project risks. Thereafter, these risks can be mitigated through the technical design process. Depending on the pertinent environmental factors, the risk tolerance of the EPC contractor, and how these issues factor into contract negotiations, economic adjustments may be included into the fixed price contract to mitigate price risk. To address increased material cost risk, economic adjustment factors may also be used. The inclusion of these factors may be considered and recommended by the team for approval from the project steering committee and senior ministry officials. Management reserves will need to be allocated for the cases where the adjustment factor value is significant. A sample of the lump sum contract can be found in Section 9.5 Appendix 5.

4.9.2. CONDUCT PROCUREMENTS

The process of conducting procurements for the project involves contacting the various sellers from which the organization requires materials or other resources and requesting quotations or proposals with information concerning the required resources. After quotations or proposals are received, the project team or organizational team will evaluate those inputs from the suppliers and select a seller who is qualified to supply the resource. Finally, some form of purchase order or other legal arrangement between the buyer and seller is enacted to establish the procurement.

Based on all the above, conducting procurements requires collaboration between the project manager and project team with the procurement section of the organization and the legal department of the organization. For conducting project procurements, the inputs required include all the project management plans and subplans, especially the scope, communication, risk, cost and procurement management plans. Also critical as an input in the organizational process are assets like the procurement manual, proposals from the seller, and other required procurement documentation. The tools and techniques required for conducting procurement include data analysis tools utilized for analyzing proposals against established criteria, the use of expert judgment throughout the procurement process, advertisements, and meetings with bidders for clarifications before the final supplier is

selected (PMI 2017). Soft skills, such as negotiation, are also critical to successfully conducting procurement. The outputs of the conduct procurement process include contracts or agreements between supplier and buyer, updates to the input project management plan and subplans, as well as the updating of project documents like requirements, risks and stakeholder registers.

4.9.2.1.PROCUREMENT PROCESS

As a project conducted under the auspices of the Government of Saint Lucia, the procurement process for the project must comply with the procurement rules of the Government of Saint Lucia, defined in the procurement manual**.**

4.9.2.2. SELECTION EVALUATION CRITERIA

In the alignment with the government procurement manual, best value will be the baseline criteria for contractor selection for the EPC contract. For the purposes of the solar farm, the best value evaluation is defined below – adapted from the United States EPA solar evaluation criteria.

TABLE 34 EVALUATION CRITERIA- ADAPTED FROM (US EPA 2009)

Evaluation Criteria Breakdown	Points	V 1	V 2
ALL required schedules, forms and informational items have been submitted.	Pass/Fail		
A. Proposer Qualifications & Experience	**20 Points**		
Financial stability, the ability to provide timely funding, and experience in successfully financing similar projects.	0-5		
Qualifications and strengths for all employees and subcontractors; company background and years in business. Experience of team in technical and project management skills and demonstrated track record of successful execution of RE projects.	0-10		
Strength and relevance of references per RFP submittal requirements for all project phases. Minimum 3 references for successfully completed projects of similar size.	0-3		
Experience working in the Caribbean context with similarly sized projects.	0-3		
Safety and legal record; claims history and judgments; and worker's compensation experience modification rating from the past 3 years, and safety plan for this project. Lawsuits against the bidder and subcontractors, whether in progress or settled.	0-3		
B. Technical Proposal	**20 Points**		
Completeness and quality of technical documentation for proposed systems including preliminary module layouts and electrical diagrams. Submittal should account for available space, proposed orientation and tilt, and site-specific construction conditions (roof type, soils issues, etc.). Preliminary system design is appropriate for site needs and accounts for site conditions.	0-12		
Module supply, availability, quality and warranties meet or exceed RFP requirements and supplier has a proven track record.	0-4		
Inverter supply, availability, quality and warranties meet or exceed RFP requirements.	0-2		

Evaluation Criteria Breakdown	Points	V 1	V 2
Quality monitoring system and plan for ensuring accurate metering and weather data. Ability to view monitoring data online, and to interconnect with existing SCADA system.	0-2		
C. Project Costs	**40 Points**		
Nominal levelized cost of energy over a 25-year lifetime, including operations and maintenance costs, appropriate escalation factors. The levelized cost of calculation energy is based on accurate and reasonable costs and benefits, and revenue including clarity on any external financing used. The inputs are appropriate given the project size, accurate estimated kWh production forecasted, own use of the solar farm, reasonable electricity rates considering legislative constraints. Methodology must be transparent with stated assumptions. Lowest valid LCOE = 40 points.	0-40		
D. Implementation Plan and Schedule	**15 Points**		
Project plan and schedule account for RFP submittal requirements, complexity of project and demonstrate methodology for management of multiple projects across multiple jurisdictions. Project phases and activities are appropriately sequenced and allow for sufficient review time by participating agencies and other authorities having jurisdiction.	0-10		
Description of plan for complying with local hiring policies and preferences.	0-5		
TOTAL	**100 Points**		

Note: Adapted from "Evaluation Matrix" by the Environmental Protection Agency (2009). Copyright 2009 by Environmental Protection Agency.

TABLE 35 RELEVANT ASPECTS OF THE PROCUREMENT PROCESS

Aspect	Description
Preparation of procurement plan	The project manager and project team will work with the procurement section and the officials of the Ministry of Finance to finalize the project procurement requirements, including the scope of procurement, the limit of procurement, the type of competition and the method of procurement and produce the project budget with sufficient time for budget approval by the parliament of Saint Lucia in the year before the first expenditure is required.
Procurement plan execution	Liaise with central procurement, finance, customs as required to execute the procurement plan.
Request for proposals	The project manager and project team are required to develop the request for proposals in collaboration with the owner's engineer, using the necessary specificity to ensure that every aspect of technical requirements is covered adequately, and that a tender developed based on the RFP would be ready for evaluation.
Vendor Selection Management	Develop and seek approval for the means of vendor evaluation for best value as defined in the procurement manual, for use by the technical committee and Central Tenders Board. Work with these committees to select the most suitable EPC contractor through the processes of using technical and cost criteria.
Continuous review of plan	Continuously review the procurement plan and its project requirements for completeness and identify gaps so that these may be filled through the procurement plan. This will have to be conducted in tandem with the risk management plan.

Aspect	Description
Contracts	The project team leads closely with the legal department for finalization of agreements and contracts between the government and the chosen supplier that establishes the expectations for performance including quality requirements, schedule requirements, and liquidated damages for not achieving the requirements. There will also be collaboration on addressing any contract disputes or adjustments required after the execution of the contract to ensure that these do not pose any hindrances to project execution.
Monitoring of the vendors performance	The project manager along with the project team will engage in consistent and thorough revision of the contractor's performance throughout the project life cycle ensuring that the vendor meets the performance criteria.

Note: Own Work

4.9.1. CONTROL PROCUREMENTS

Controlling project procurement involves the processes of managing and monitoring supplier relationships after procurement has begun (PMI 2017). It primarily involves managing and monitoring the EPC contract in the case of the solar farm project, ensuring the requirements of the client are met by the EPC contractor. The inputs to the control procurement process include all project management plans and subplans previously defined, including the requirements, assumptions, risks, the EPC contract, other applicable contracts, et cetera. The tools and techniques required include administration of claims, performance reviews, earned value analysis, inspections and audits. Most of these tools will be utilized for managing and monitoring contractor performance. The outputs of the control procurement process include performance reports, completed procurement and updates to the project plans and subplans. Other outputs may include change requests, which would

fall into the integrated change control process, and updates to major project elements like the lessons learned register, and the risk and stakeholder registers.

4.10. STAKEHOLDER MANAGEMENT PLAN

Project stakeholder management consists of the processes needed to identify the persons, groups, and organizations that have an interest in the project, or will be influenced by the project, analyzing their expectations and planning how to appropriately manage these expectations (PMI 2017).

4.10.1. IDENTIFY STAKEHOLDERS

Identifying project stakeholders involves regularly naming, analyzing and documenting information relevant to project stakeholders including their interests, influence, and impact on the project success (PMI 2017). The project environment and the perspective of the stakeholders can change during the process of project execution, so this process needs to be continually executed throughout the project life cycle. It involves inputs from all the project management plans including the communications and stakeholder engagement plans. Tools and techniques required include questionnaires, surveys, meetings and brainstorming for data-gathering, expert judgement and various forms of data analysis to support the stakeholder management strategy. The main output of the process is a stakeholder register, but it may also involve the production of several change requests and updates to the project management plans and subplans.

4.10.1.2. STAKEHOLDER REGISTER

The output of the identify stakeholders process, the stakeholder register is shown in TABLE 36.

TABLE 36 STAKEHOLDER REGISTER

No	STAKEHOLDER	FUNCTIONAL AREA	ROLE	EXPECTATIONS	REQUIREMENTS	PROJECT IMPACT (low, médium, high)	INTEREST (low, medium, high)	POWER (low, medium, high)	INFLUENCE (low, medium, high)
DIRECT PROJECT STAKEHOLDERS									
1	**Project team**	Project engineers, finance officer, legal officer, network admin, procurement officer.	Perform and coordinate the performance of project activities.	To successfully execute the project and accomplish all project goals including accomplishing the scope at cost and on schedule.	A supportive work environment where the required resources are provided so that they can function effectively.	Very high	Very high	Medium	High
2	**Project steering committee**	Representatives from the ministries of infrastructure, finance, planning, sustainable development, project manager and chief energy officer.	Provide strategic support for the project.	That the project will align with organizational goals- the government goals of reducing dependence on fossil fuels, and that it will be completed successfully, on time and within budget.	A functional operational solar farm delivered within cost. And within budget. A star project which can be presented to parliament.	Very high	Very high	Very high	Very high
3	**Project sponsor**	PS. Ministry of Infrastructure	Provide strategic support for the project. Overall responsibility for the project.	A successful project with expected return on investment.	Good communication from the project management and project team to ensure that the project is always going well.	Very high	Very high	Very high	Very high
4	**Project manager**	Project management	Overall accountability for project execution, management, and success.	A supportive project sponsor and project steering committee: the responsible and dependable project team.	Sufficient funds for project execution, sufficient decision-making authority to conduct the job.	Very high	Very high	Very high	Very high

No	STAKEHOLDER	FUNCTIONAL AREA	ROLE	EXPECTATIONS	REQUIREMENTS	PROJECT IMPACT (low, médium, high)	INTEREST (low, medium, high)	POWER (low, medium, high)	INFLUENCE (low, medium, high)
.GOVERNMENT OF SAINT LUCIA STAKEHOLDERS									
5	**Parliament**	Strategic support	Approve budget and incorporate project into country plans.	A successful project with expected return on investment. A well-managed project.	No loss of political clout as a result of the project.	Very high	Low - medium	Very high	High
6	**Energy unit**	Manage national energy strategic plans	Report, plan and typically initiate all energy related government projects.	Competent project management. A successful project meeting its ROI and energy production goals. A model project which can be replicated. Capacity building in the country.	Continuously informed of the project progress. Access to project site and training for capacity building.	Medium	Very high	Medium	High
7	**Sustainable development**	Ministry responsible for climate change	Report on NDC goals and project contribution concerning progress towards those goals.	A project that displaces diesel generation and reduces emissions as a result. A sustainably managed project.	Information on the project's sustainability and energy production provided readily.	Low	High	Medium	Medium
8	**Ministry of Planning**	Responsible for physical development	Approves development application through the DCA.	Project planned for a suitable location within land use guidelines.	A proper development plan application with all the required information included.	High	High	Very high	High
9	**Procurement**	Procurement	Oversee the procurement of EPC contractor.	Adherence to procurement guidelines and legislation.	Budget prepared in time to be approved by parliament. All documentation provided.	Medium	Low	Medium - high	Medium

No	STAKEHOLDER	FUNCTIONAL AREA	ROLE	EXPECTATIONS	REQUIREMENTS	PROJECT IMPACT (low, médium, high)	INTEREST (low, medium, high)	POWER (low, medium, high)	INFLUENCE (low, medium, high)
10	**Legal department**	Provide legal support for all government activities	Provide legal support to project team, review all project contracts before signing by the parties.	Timely provision of project requirements and contract guidance.	Clear communication from Project manager, clear expectations.	Medium	Low	Medium - high	High
11	**Electrical department**	Electrical inspection	Perform and approve electrical inspections for the project.	Delivery of a quality project which meets electrical standards.	Accurate project drawings, access to project site, witness of commissioning tests, capacity building and training.	Low	High	Medium	Low
OTHER IMPORTANT NATIONAL STAKEHOLDERS									
12	**Utility**	Transmits and distributes electricity. Only authorized seller of electricity.	Conducts interconnection study and charges the study costs to the project. Provides interconnection requirements. Agrees to a PPA with the project.	Project is performed according to design and plans. Project power is available as per the PPA contract. Good faith PPA negotiation. Reasonable LCOE/PPA price.	Project information for conducting the study. Timely provision of data requests.	High	Very high	High	High
13	**Regulator**	Regulates the water and energy sectors.	Grant generation license to the project. Approve PPA.	PPA price lower than current diesel LCOE costs. Project commissioned and delivered on time.	Quality license application, quality PPA agreement, with PPA price lower than diesel.	Very high	Very high	Very high	Very high
14	**Land owners**	Sells land to the project.	Sells land to the project.	Reasonable compensation.	Objective land valuation, clear communication in good faith.	High	Medium	Medium	Medium

No	STAKEHOLDER	FUNCTIONAL AREA	ROLE	EXPECTATIONS	REQUIREMENTS	PROJECT IMPACT (low, médium, high)	INTEREST (low, medium, high)	POWER (low, medium, high)	INFLUENCE (low, medium, high)
15	**Investors**	Invest in project and receive dividends.	Contribute towards project capital costs.	Project delivered below cost, dividends.	Regular updates on project progress. Project financial information pre and post commissioning.	Medium	High	High	Medium
16	**Media**	Report on project to the public.	Dissemination of relevant information to the public.	Transparent provision of information on project process, expenditure, procurement, et cetera. Ethical management of the project.	Press conferences and access to project officials. Provision of reports.	Medium	Medium - high	Medium	Medium
17	**Nearby residents**	N/A	Buying in to the project.	Community and quality of life will not be adversely affected by the project.	Understand the project and its effects on the surrounding environment. Lend a listening ear to their concerns. Redress for complaints made.	High	High	Medium	Medium

Note: Own Work

4.10.1.3. STAKEHOLDER POWER/INTEREST GRID

The stakeholder power/interest or power/ influence grid is a visualization tool utilized to group stakeholders according to their potential to influence project outcomes (PMI 2017). The grid places stakeholders into four quadrants. These quadrants are shown below.

High Power/ High Interest- Manage Closely.

1. These are the project's decision-making stakeholders. Their impact on project success is the most significant.
2. High power/ low interest- Keep satisfied. These stakeholders are very powerful and need to be kept satisfied and informed about the project. Due to low interest, they can hurt the project if they become dissatisfied.

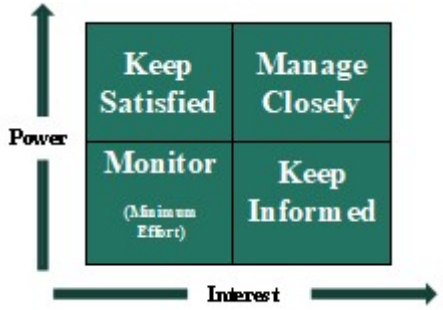

Figure 39 Power-Interest Grid- PMI

Note: Adapted from Stakeholder Analysis using the Power Interest Grid by Latha Thamma Reddi, 2023. Copyright 2023 by Project Management Institute, Inc.

3. Low power/ high interest- Keep informed. These stakeholders do not wield much power over the project but can be sources of support and risk management if informed about the project's progress.
4. Low power/ high interest – Monitor. These stakeholders should be monitored, because interest in the project may change at any time. Communication with them should be appropraiate.

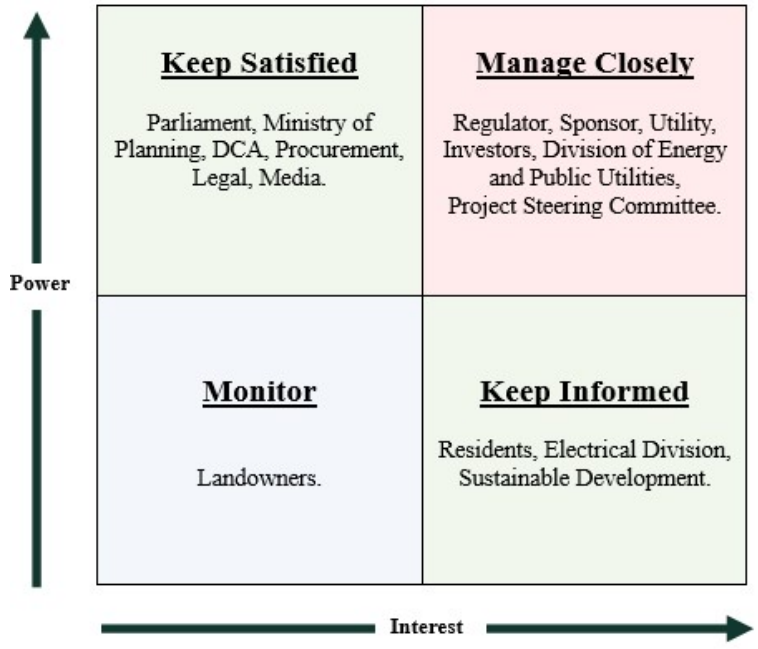

Figure 40 Power-Interest Grid for Solar Farm Project

Note: Own Work

4.10.2. PLAN STAKEHOLDER ENGAGEMENT

Plan stakeholder engagement is the process of utilizing the identified stakeholder information to strategize approaches to effectively plan means of including them in the project (PMI 2017). The inputs to the process are the stakeholder register and other project management plans and subplans. The tools and techniques associated include benchmarking, root cause analysis, and data representation tools. The output is a stakeholder engagement plan.

4.10.2.2. STAKEHOLDER ENGAGEMENT ASSESSMENT MATRIX

The stakeholder engagement assessment matrix is a visualization tool used to plan the means of engaging stakeholders based on what is known about them. This matrix is to be used by the project team to visualize and identify the current and desired state of

stakeholder engagement and attitude towards the project. This will assist in identifying the actions required to close the gaps and achieve the required engagement. The different stages of engagement for stakeholders are defined below, as derived from the Project Management Body of Knowledge, 6th Edition.

TABLE 37 STAKEHOLDER ENGAGEMENT ASSESSMENT MATRIX FOR SOLAR FARM PROJECT

Level of Engagement	Description
Unaware (U)	The stakeholder is not aware of the project itself nor of all its potential impacts and benefits.
Resistant (R)	The stakeholder is aware of the project and may be aware of its potential impacts but provides some sort of resistance to change that may be caused by the project work.
Neutral (N)	The stakeholders are aware of the project but are neither supportive nor unsupportive.
Supportive (S)	The stakeholder is aware of the project and its potential impacts and supports the project goals, work and intended outcomes.
Leading (L)	The stakeholder is aware of the project and its potential impacts and is actively engaged in supporting the project and working towards project success.

Note: Own work using data from A Guide to the Project Management Body of Knowledge (PMBOK® Guide) Sixth Edition. Project Management Institute (PMI), 2017 Section 13.2.2.4, p. 521. Copyright 2017 by PMI, Inc.

The current state of engagement for each stakeholder is defined by the letter “C” in the applicable table column, and the desired state of engagement for stakeholders is defined by the letter “D” in the corresponding table column.

TABLE 38 STAKEHOLDER ENGAGEMENT MATRIX

No.	Stakeholder	U	R	N	S	L
1	Project team				C	D
2	Project steering committee				C,	D
3	Project sponsor					C, D
4	Project manager					
5	Parliament				C, D	
6	Energy unit				C, D	
7	Sustainable development			C	D	
8	Ministry of Planning	C			D	
9	Procurement			C	D	
10	Legal department			C	D	
11	Electrical department			C	D	
12	Utility	C			D	
13	Regulator	C				D
14	Land owners	C			D	
15	Investors				C, D	
16	Media	C			D	
17	Nearby residents	C			D	

Note: Adapted from A Guide to the Project Management Body of Knowledge (PMBOK® Guide) Sixth Edition. Project Management Institute (PMI), 2017 Figure 13-6, p. 522. Copyright 2017 by PMI, Inc.

The stakeholder engagement matrix framework is used to identify discrepancies between the stakeholders' current and desired levels of engagement. Thereafter, strategies can be defined to move the stakeholders from their current state to the desired state. The entire framework with the states of engagement in the correct categories are shown in **Error! Reference source not found.**.

4.10.3. MANAGE STAKEHOLDER ENGAGEMENT

Managing stakeholder engagement is the execution of the stakeholder engagement plan, which will involve strategic stakeholder communication to continuously identify and manage stakeholder needs and expectations in accordance with their position in the power/influence matrix (PMI 2017). The aim of the process is to align the current and desired states of stakeholder engagement as defined in the stakeholder engagement matrix. Energy sector stakeholders in Saint Lucia are varied, and the energy ecosystem is in a transient state, with many changes on the horizon. It is therefore very important that the "champion stakeholders" function effectively in their roles and lead the way in their various spheres of influence. Similarly, stakeholders required to play a supportive, must provide their full support.

The inputs to the manage stakeholder engagement process include the communications, risk, stakeholder and change management plans, the change and issue logs, and the lessons learned and stakeholder registers. The tools and techniques associated with the management of stakeholder engagement include interpersonal skills like conflict management, cultural awareness, negotiation and the knowledge of political and cultural factors, as well as formal and informal communication skills will go a long way in facilitating all essential engagements. The outputs of the process include the generation of change requests, updates to the project management plan and subplans, and updates to project documents.

A variety of stakeholder engagement activities will result from the stakeholder engagement management process. The project manager will be accountable for ensuring that these stakeholder engagement activities are executed. Some of the required engagement activities include:

- Remaining vigilant and aware of the project environment and environmental factors, so that risks arising from the stakeholder perspective can be immediately identified and addressed.
- Collecting and documenting stakeholder feedback, whether directly communicated with the team or indirectly perceived from the project environment, so that these can be addressed directly with the stakeholder in question.

- Regular and frequent meetings with the main stakeholders including the project sponsor, project steering committee, and project team.
- Managing conflict that arises between various members of the team or between or involving stakeholders.
- Negotiating and communicating with stakeholders in an attempt to increase their current state of engagement.

4.10.4. MONITOR STAKEHOLDER ENGAGEMENT

Monitoring stakeholder engagement involves using feedback from stakeholders to review engagement plans and their efficacy. After this review, the team will re-strategize to maximize the level of engagement as the project progresses (PMI 2017). The main inputs to this process are similar to the manage stakeholder engagement process inputs, including the resource and communications management plans. The tools and techniques involve various forms of data analysis including alternatives and root cause analysis, decision-making tools like multicriteria decision analysis and voting, and interpersonal and team skills. The outputs of the process include change requests, updates to the project management plan components and project document updates.

As with the managing stakeholder engagement, the project manager is ultimately accountable for monitoring stakeholder engagement. The aspects of the monitoring of stakeholder engagement plan applicable to the solar farm project include:

- Maintaining an awareness of the cultural and political norms, and the key players influence the project environment. This is especially important due to the relative newness of renewable energy initiatives on island and the changing perspectives regarding the energy transition and its effect on the economy.
- Regularly assessing the environment to ensure that all stakeholders are accounted for, and that their needs, requirements and state of engagement are well known by the team and incorporated into the requirements framework.
- Regular updating of the stakeholder engagement framework to continually assess the current state of engagement.

- Generally keeping the communication lines open between the team and the stakeholders and ensuring that they are taken care of in line with their power/interest ranking.

4.11. SUSTAINABILITY MANAGEMENT PLAN

4.11.1. INTRODUCTION

The objectives of the sustainability assessment are:

1. To examine the compliance of the scope, procurement, quality, schedule, cost, risks, stakeholder, and communications management plans to the P5 standard.
2. To utilize the P5 standard to create a sustainability management plan for the project that complies with the sustainability development goals from the United Nations.

4.11.1.1. OVERVIEW OF THE P5 STANDARD

Historical project management has defined a successful project in terms of its ability to conform to the triple constraint of cost, scope and time. As time has progressed, the definition of project success has evolved to include a life cycle management approach from the inception of the project. Given the current internationalization of the United Nations Sustainable Development Goals, the goalpost is moving yet again, taking the definition of a project's success a step further to now include social and environmental impacts. The P5 standard was created by the Green Project Management (GPM) Global group as a framework for sustainable project management, including the technical, social and environmental domains of project management (Green Project Management 2023). P5 stands for people, planet, product, process and prosperity. The P5 ontology framework considers these major domains of sustainability and establishes the relationships among the domains in a coherent way. Figure 41 displays the P5 ontology.

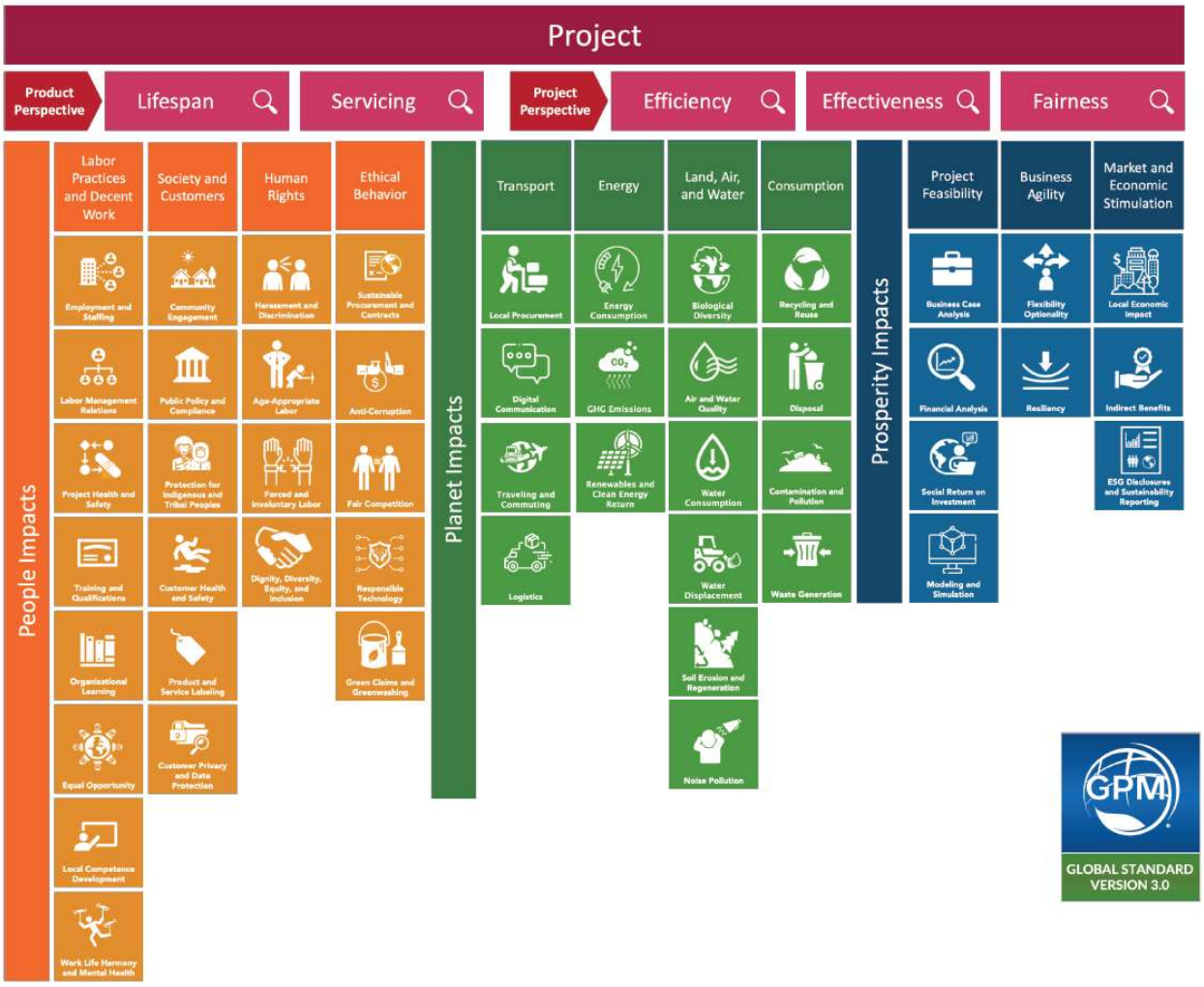

Figure 41 P5 Ontology

Note: Reprinted from The GPM P5 Standard for Sustainability in Project Management Version 3, GPM Global, 2023. Figure 3, p. 5. Copyright 2023 by GPM Global Inc.

The final step of this FGP is to consider how the P5 ontology framework can be utilized to evaluate the scope, cost, schedule, quality, resource, communications, risk and procurement components of the project management plan established thus far.

The P5 analysis is based on the PRiSM methodology which categorizes project phases according to Figure 42 below.

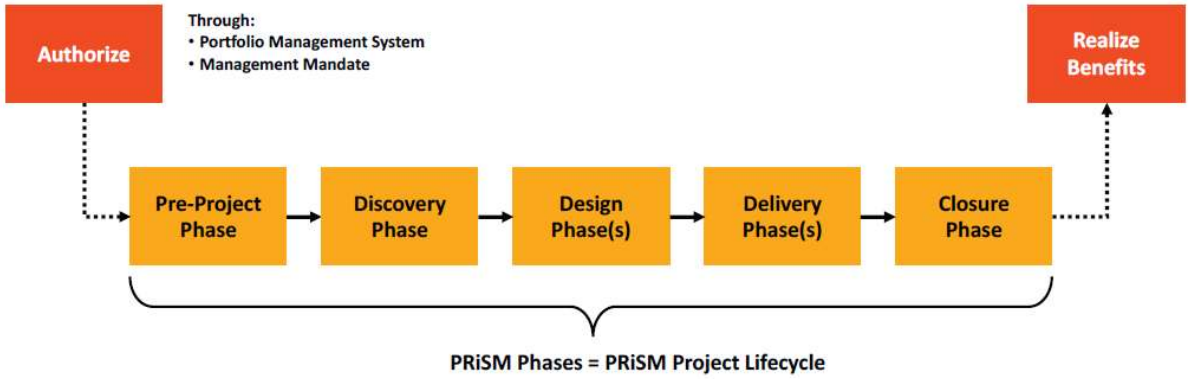

Figure 42 PRiSM Project Phases

Note: Reprinted from Sustainable Project Management: The GPM Reference Guide, GPM Global, 2018. Figure 4-3, p. 43. Copyright 2018 by GPM Global Inc.

The PRiSM project phases, as defined, are quite intuitive and correspond to the project phases and schedule already defined for this 2 MW project. Therefore, in accordance with the P5 standard, P5 impact assessments are first conducted at the discovery phase, and then reevaluated during the design and delivery phases. Finally, at project closure, the impact assessment will be used to complete the sustainability report which informs the life cycle operation and disposal of the project.

One of the advantages of conducting the P5 analysis, as opposed to only risk analysis in various management plans, is the addition of the consideration of people and social aspects. The P5 analysis facilitates deeper investigation into potential social and cultural issues which could arise and affect the project's performance. As a result, this analysis helps to strengthen the more human and communication dependent processes like the processes which form part of the resource and communication plans, including the communication escalation process, as well as the process of integrated change control.

4.11.2. P5 IMPACT ANALYSIS

TABLE 39 P5 IMPACT ANALYSIS

This impact will improve the project's outcome(s) from a sustainability perspective.

5 = Strongly agree 4 = Agree 3 = Neutral 2 = Disagree 1 = Strongly disagree

Category / Subcategory / Element	Description (Cause)	Potential Impact	Impact Score Before	Proposed Response	Impact Score After	Change
2.1 Product Impacts						
2.1.1 Lifespan of the product	Potential for sourcing materials for the solar farm from opaque supply chains.	Perception of the company as a socially unconscious company, even though it operates in a country identified as a small island developing state.	2	Search for suppliers of panels and panel replacement parts from ethical sources	3	1
	Potential for utilization of inferior materials for panels and other critical equipment.	Low quality project which does not meet its lifetime operational goals and may fail prematurely.	2	Have a preapproved list of suppliers and have experienced Owner's engineer to revie requirements.	4	2
	It is not easy and cost effective to recycle solar panels.	Deglos landfill will be incapacitated by the solar panels from the project by the end of the life cycle.	1	Budget to ship out solar panels to a recycling plant at the end of its life cycle.	4	3
2.1.2 Servicing of product	Sourcing of materials for the solar farm from opaque supply chains.	Perception of the country and government as socially unconscious and supporting issues like child labor, et cetera.	2	Search for suppliers of panels and panel replacement parts from ethical sources.	3	1
	There is a high cost of utilizing mowing machines to address grass growth. Also, these mowers typically use diesel or gasoline, and as a result, have emission contributions.	Affects project financial, increases life cycle emissions.	2	Use black belly sheep for grass maintenance. Consider farming of low shade crops between panels. These options provide additional economic benefits to farmers. If these are not possible, consider a type of grass or stones which do not require high maintenance.	5	3
2.2 Process (Project Management) Impacts						
2.2.1 Effectiveness of project processes	Insufficient and inaccurate budget estimation process.	Cost overruns.	1	Utilize all estimation processes- benchmarking, parametric estimation, top and bottom down techniques, and assign management reserves to risks.	5	4
	Ineffective change control and escalation process, resulting in scope creep, and late responses to critical issues.	Inflation of project costs, project behind schedule, key stakeholders dissatisfied because expectations were not well managed.	2	Ensure that a competent and effective project manager and sponsor are appointed. Ensure that the communications management and change control	5	3

Category / Subcategory / Element		Description (Cause)	Potential Impact	Impact Score Before	Proposed Response	Impact Score After	Change
					processes are well developed, and that there are incentives for project cost and scope control.		
2.2.2	Efficiency of project processes	Competing priorities of the project team. This impedes the ability to give the project full attention.	Project delays due to delivery delays and difficulties in scheduling meetings.	2	Communicate the strategic value of this project and lobby the steering committee to provide dedicated resources for the project in order to prevent delays.	4	2
2.2.3	Fairness of project processes	No provisions made for disabled facilities at the project office, considering the community members with disabilities who may want to visit to lodge a concern.	Potential erosion of stakeholders' trust.	3	Include disability-friendly designs in project office and facility design.	4	1
		Sometimes government contracts are issued by direct award.	Lack of transparency and confidence that the best contractor is executing the job.	1	Use an open competition procurement process for choosing the EPC contractor.	5	4
		Women are underrepresented in technical jobs in construction.	Lack of diversity and opportunity.	3	Encourage women to apply to project jobs where applicable.	4	1
			Product and Process Average	**1.9**		**4.2**	**2.3**
3	**People (Social) Impacts**						
3.1	**Labor Practices and Decent Work**						
3.1.1	Employment and staffing	High turnover due to low wages and competition for construction workers from subcontractors.	Slows down project delivery pace. Onboarding and recruitment costs increase project costs.	1	Pay wages slightly above market. Enforce a good worker retention policy.	4	3
		Poor project culture, persons do not feel free to state issues and errors occur as a result.	Cost and quality issues.	1	Create an open and fair environment where team members feel free to express risks, dissenting opinions and issues arising.	4	3
3.1.2	Labor/management relations	Threats of industrial action due to concerns not being adequately addressed.	Industrial action, project delays.	1	Consult employees and their representatives at every stage of the process to proactively identify issues arising and feed them into the stakeholder management plan.	4	3
		Employees do not feel appreciated for their contribution to the project.	Slow down on work processes, risk of delays.	1	Implement a rewards and recognition program. Reward excellent performance.	3	2

Category / Subcategory / Element	Description (Cause)	Potential Impact	Impact Score Before	Proposed Response	Impact Score After	Change
3.1.3 Project health and safety	No clear environmental health and safety guidance on the project.	Accidents and injuries on the project site.	1	Hire an environmental safety and health officer full-time for the project. The safety officer will establish and maintain environmental health and safety procedures through the project. Establish monthly safety reporting to be included in project status reporting.	4	3
3.1.4 Training and education	Many new employees on the project team, with varying levels of experience.	Employees may not have the required years of experience or technical knowledge for the project.	1	Adequate training should be afforded to these employees to bring them up to speed. Part of this training should include attachment to similar projects to gain experience.	4	3
	There is a risk of having “square pegs in round holes” on the project.	Inferior project quality.	1	Have a robust recruitment process for the project.	4	3
3.1.5 Organizational learning	An external consultant with greater technical knowledge is hired for the installation and maintenance of the panels.	The consultant's technical knowledge is not passed on to Electrical division employees who would be unable to conduct maintenance or repairs throughout the lifespan of the project.	1	As part of the project requirements, training are to be held periodically and training manuals and video tutorials can be created by the consultant and turned over prior to the closure of the project.	5	4
	No culture of proper data transfer	Wasted time and effort and money from repeating the same mistakes	2	Incorporate a Lessons learnt management process and document the lessons learnt for review and application going forward.	4	2
3.1.6 Diversity and equal opportunity	Women are underrepresented in technical jobs in construction.	There are limited female technicians available in Saint Lucia.	3	Women will be encouraged to apply.	3.5	0.5
	Lack of a formal performance evaluation process.	Staff demotivated, feel like treatment is unfair.	2	Apply government performance management system to the project.	4	2
3.1.7 Local competence development	Brain drain- skilled persons leave the country.	No retention of project skills which can be used for further project development.	2	The government can source funds for offering scholarships in the field of renewable energy and bond the recipients to ensure that there is a pool of qualified personnel throughout the lifespan of the project. The rewards, benefits and compensation program also need to be robust to retain employees.	5	3
	Lack of knowledge sharing.	Some project persons are experts and do not share relevant information.	2	Conduct in-house training sessions for knowledge sharing.	4	2

Category / Subcategory / Element		Description (Cause)	Potential Impact	Impact Score Before	Proposed Response	Impact Score After	Change
3.1.8	Work-life harmony and mental health	Poor project culture, affecting mental health of staff.	Project delays, quality issues.	2	Engage project staff in the government Employee Assistance Program (EAP) which already exists.	4	2
		Lack of work-life balance among project staff.	Poor project culture, project delays, quality issue.	2	Implement flexible work where possible, include paid time off in contracts where possible. Encourage contractors to do the same, where it is economical.	3	1
3.2	**Society and Customers**						
3.2.1	Community engagement	Lack of sufficient community engagement, buy-in and participation.	Community may tamper with or try to sabotage the solar farm installation.	2	Engage the community during all phases of the project through meetings/consultations on the benefits related to improvements in livelihoods. Train and hire community members to participate in the project where applicable including security and maintenance of the solar farm.	5	3
3.2.2	Public policy compliance	Project, by definition, supports country policy, but may not comply with all legislation requirements.	Project operation may be unsafe, or workers may be affected, or revenues may be mismanaged.	1	Legal officer on project should perform regular gap analyses to ensure requirements are always met.	4	3
3.2.3	Protection for indigenous and tribal peoples	N/A- no indigenous people on island or in project area.	N/A		N/A		
3.2.4	Customer health and safety	The solar farm will be built within a community, increasing the likelihood of unauthorized access to the property.	Individuals may come into contact with high voltage equipment which may be hazardous to them.	2	Ensure adequate signage along the fencing, maintain the integrity of the fencing as part of the maintenance program. Educate the community about the dangers and hazards that exist on the project site. Conduct regular safety inspections on the site.	4	2
3.2.5	Product and service labeling	Lack of consistent labelling on project equipment.	Quality issues arising.	2	Enforce consistent labelling on energy efficiency and other factors on all equipment.	4	2
3.2.6	Customer privacy and data protection	N/A- no customer specific data utilized on the project.	N/A		N/A		
3.3	**Human Rights**						
3.3.1	Harassment and discrimination	No system for management of harassment issues on the project.	Low morale from harassed individuals and effects on project schedule/ productivity.	2	Institute harassment policy and include a section on harassment into the communication escalation procedure.	4	2

Category / Subcategory / Element		Description (Cause)	Potential Impact	Impact Score Before	Proposed Response	Impact Score After	Change
		Discriminatory practices are occurring.	Low morale from individuals experiencing discrimination and effects on project schedule/ productivity.	2	Conduct in-house training sessions on discrimination and harassment and the legal applicable frameworks.	5	3
3.3.2	Age-appropriate labor	N/A- no child labor utilized on the project.	N/A		N/A		
3.2.3	Forced and involuntary labor	Since foreign contractors are employed as EPC contractors, their hiring processes are opaque and there is a chance of forced labor ongoing.	Project reinforces forced labor and work conditions unintentionally.	1	Implement and support ILO Forced Labour Convention and adhere to labor laws. Submit to a labor audit. Establish grievance mechanism for reporting of labor issues.	5	4
3.3.4	Dignity, diversity, equity and inclusion	Lack of sufficient representation/ diversity in project team and resources.	Lack of team cohesion due to lack of sense of belonging.	2	Establish mentorship programs among employees, utilize social events to encourage bonding and belonging, train leaders in diversity equity and inclusion.	4	2
3.4	**Ethical Behavior**						
3.4.1	Sustainable procurement practices and contracts	Procurement processes can sometimes be opaque.	Lack of assurance that the best contractor is selected.	1	Comply with open transparent procurement process.	5	4
3.4.2	Anti-corruption	Bribes and under-table payments may be utilized in the procurement of materials and subcontractors.	Lack of assurance that the best contractor is selected.	1	Enforce a code of ethics and zero tolerance for unwarranted gifts and favors with high penalties for breach. Train procurement team in anti-corruption policies.	4	3
3.4.3	Fair competition	Potential for inadvertent unfair advantages if some tenderers engage the procurement team apart from the process.	Lack of assurance that the best contractor is selected.	1	Ensure all potential suppliers are supplied with the same project information upon which to design proposals.	5	4
3.4.4	Responsible technology	Potential for cyberattack.	Loss of data, threat of ransom, privacy risk with sensitive customer and business information.	1	Implement and adhere to government IT cyber security policies.	5	4
		Currently, there is no situation where AI is used as part of the project.	None for now.	4	Reevaluate at the design phase to investigate if AI can be included as part of the project. Consider the implementation of an AI policy.	5	1
3.4.5	Green claims and greenwashing	Potential for accusation of green washing.	Project ethics called into question.	1	Present the facts about the true environmental impact, including emissions foregone, ESG reporting and environmental practices in a transparent manner.	5	4
			People Average	**1.6**		**4.3**	**2.7**

Category / Subcategory / Element	Description (Cause)	Potential Impact	Impact Score Before	Proposed Response	Impact Score After	Change
4 Planet (Environmental) Impacts						
4.1 Transport						
4.1.1 Local procurement	Bias towards procurement of goods from overseas.	Limiting the passed-on benefits of the project to the local economy. Increasing emissions attributed to the project.	2	Incorporate a strategy for local procurement for applicable items into procurement plan. For example- office supplies and other items. Also utilize government central procurement for bulk items.	5	3
4.1.2 Digital communication	Virtual meeting for project updates and steering committee meetings where possible.	Reduce the need for frequent traveling, reducing petroleum consumption and emissions resulting from the meetings. Also, there will be a reduction in waste from reduction of the use of physical files.	3	Maintain a good balance of virtual and face-to-face meetings. The nature of the project requires in-person meetings, and site visits. Therefore, good judgment is required in making these decisions. Reevaluate at every project stage.	4	1
4.1.3 Traveling and commuting	Evaluate the number of owner's engineering meetings required and whether the majority of these can be held virtually. Similarly, for initial EPC contractor meetings.	Frequent flights increase in fuel-based emissions.	2	Continuously evaluate required engagements with the goal of reducing the need to travel.	5	3
	Project team members required to be in office every day.	Commuting related emissions.	3	Continuously evaluate required engagements with the goal of reducing the need to commute. Allow team members to work remotely where possible.	4	1
4.1.4 Logistics	Lack of coordination of procurement.	Mismanagement of resources, missed opportunity for cost savings, and emissions reductions.	2	Incorporate the proper planning, procurement, and use of resources and equipment. Coordinate with central procurement for bulk general items.	4	2
4.2 Energy						
4.2.1 Energy consumption	Small scale diesel generators utilized for operation of electrical tools.	Increases emissions of the project.	2	Apply for an electricity connection. This has the benefit of reducing emissions because of scale.	5	3
	Lack of energy efficient practices in construction.	Increases emissions of the project, more energy wastage.	2	Create an energy management plan for the construction site. Utilize renewable energy where possible. Unplug devices when not in use.	3	1

Category / Subcategory / Element	Description (Cause)	Potential Impact	Impact Score Before	Proposed Response	Impact Score After	Change
4.2.2 CO2 emissions	Lack of accounting of GHG reduced due to project operation.	Arbitrary reduced CO_2 emissions figures.	2	Include emissions inventory and reporting in the monthly project reporting during the monthly operational life cycle reporting.	5	3
4.2.3 Clean energy return	Lack of recycling waste.	Loss of income and potential pollution.	2	Ensure proper usage of items and recycling.	4	2
4.2.4 Renewable energy	The solar farm will generate electricity for its own use.	Operation of the farm will reduce dependency on fossil fuels.	3	Advocate for a PPA where there is no curtailment of the 2MW solar farm so that all potential generation from the farm is utilized.	5	2
4.3 Land, Water, and Air						
4.3.1 Biological diversity	Not applicable currently since located in an industrial area.	N\A	3	Reevaluate after land has been purchased and ESIA has been completed.	3	0
4.3.2 Water and air quality	Not applicable currently since located in an industrial area.	N\A	3	Reevaluate after land has been purchased and ESIA has been completed.	3	0
4.3.3 Water consumption	Water is a scarce resource in Saint Lucia due to shortages and low river flows.	Site may run out of water.	2	Ensure site has proper and adequate water storage.	4	2
4.3.4 Water displacement	Potential of water bodies nearby receiving wastewater from the project.	Chemical contamination of water ways.	2	Ensure proper disposal of electronic waste.	4	2
4.3.5 Soil erosion and regeneration	Loss of too much topsoil and improper disposal of removed topsoil.	Can disrupt sensitive area and become a source of pollution. Can affect water runoff and assist in flash flooding.	2	Minimized soil disturbances in civil foundation construction. Utilize soil stabilization where necessary.	4	2
4.3.6 Noise pollution	Noise emanates from project site and disturbs the community.	Lack of community support.	2	Monitor noise levels, notify community when anticipating increase in noise. Attempt to conduct noisy activities when residents are typically not at home. Mitigate noise with noise barriers.	4	2
4.4 Consumption						
4.4.1 Recycling and reuse	Use of solar panels without considering recycling potential or disposal plan.	Increased amount of solar panel and module waste being sent to the controlled landfill at the end of the project operational cycle.	2	Prioritize the use of solar panels with greater potential for recycling where possible, and ship these to a capable recycling plant. Budget for the cost of shipping to recycling plant.	5	3

Category / Subcategory / Element		Description (Cause)	Potential Impact	Impact Score Before	Proposed Response	Impact Score After	Change
4.4.2	Disposal	Potential for improper disposal of spent solar panels. The landfill may not have the capacity to handle all the panels.	Pollution of land, maxing out landfill, or contribution to overcapacity of landfill.	2	Develop a strategy for disposal of panels with Solid Waste Management Authority in case recycling is delayed or unavailable.	5	3
4.4.3	Contamination and pollution	Solar panel waste contains toxic heavy metals like cadmium and lead.	Leaching heavy, metals into waterways can be hazardous to humans.	2	Develop a strategy for disposal of panels with Solid Waste Authority, in case recycling is delayed or unavailable, which stores them away from waterways.	4	2
4.4.4	Waste generation	Lack of proper waste management systems for disposal of general site waste.	Increased generation of waste from the project which the landfill is unprepared to handle.	2	Plan project waste management from the project inception in partnership with Solid Waste Management Authority.	4	2
			Planet Average	**2.3**		**4.2**	**2.0**
5 Prosperity (Economic) Impacts							
5.1 Business Case Analysis							
5.1.1.	Business case analysis	Project is based in Saint Lucia IRRP, and so is supported by the required analysis. Business case however is dependent on PPA price and regulated tariff for electricity, which is subject to regulatory approval.	Project economics may change if the tariff and PPA are not the projected values.	1	Reevaluate the project economics, running sensitivity analyses for a range of PPA and tariff values to investigate the sensitivity of the project to assumption variations. Adjust revenue streams and plans to suit.	4	3
		Assumptions of business case including economic environment may change.	Business case may no longer be valid.	1	Reevaluate business case at every new stage to ensure continued validity.	4	3
5.1.2.	Financial analysis	Robust financial analysis has been done by project team. Results are subject to accuracy of assumptions.	Assumptions may be wrong and therefore costs and revenue may be inaccurate.	1	Do realistic financial analysis and forecasting based on solid economic and industry standard estimating processes.	4	3
5.1.4	Social return on investment (SROI)	No establishment or recording of social return on investment (SROI).	Lack of awareness of the social and environmental costs associated with the project.	1	Implement tracking of the SROI metric and associated KPIs.	4	3
5.1.4	Modelling and simulation	Insufficient use of models to drive decision-making.	Decisions not as data driven as is possible.	1	Recognize the opportunities for modelling,	4	3
		Some models are limited.	There may be errors unknown to the team.	3	Continually calibrate models and understand the limitations. Factor these into decisions made when models have been used.	4	1

Category / Subcategory / Element	Description (Cause)	Potential Impact	Impact Score Before	Proposed Response	Impact Score After	Change
5.2 Business Agility						
5.2.1 Flexibility/optionality	Project is conceptualized without batteries.	The grid is the backup for non sunny days.	2	Consider applying for a license for a battery as well so that microgrid opportunities can be explored for the Gros Islet area.	3	1
	Project is conceptualized as a waterfall endeavor, and very straightforward.	Little room for innovation.	2	Consider rewarding innovation and incorporating innovation into the project, so that more opportunities for potential savings can occur.	3	1
5.2.2. Resilience	Solar farms are installed outdoors and in a hurricane belt, and are susceptible to damage.	Failure of solar farm by impact due to hurricane action.	2	Ensure that the farm is built to category 5 rated wind speeds based on the Saffir Simpson wind scale.	5	3
5.3 Economic Stimulation						
5.3.1 Local economic impact	No clear legislation to hire minimum labor locally, although this is indirectly built into work permit process.	Cheapest labor possible (typically foreign labor) is imported for the job while the locals who live nearby remain unemployed.	2	During resource planning, investigate resource pool on island for various functions. Establish a minimum local employment level for the project once the technical skill can be located locally. Sponsor training so that the local talent pool is built up.	4	2
5.3.2 Indirect benefits	Business case only considers quantifiable benefits.	Full project benefits are not adequately accounted for.	2	Ensure that the farm is built to category 5 rated wind speeds based on the Saffir Simpson wind scale.	5	3
5.3.3. ESG disclosures and sustainability reporting	Inadequate sustainability reporting is planned.	Although accessibility plan may be in place, it is not easy to track the progress of the plan.	1	Establish sustainability objectives for the project, perform the P5 impact analysis during each project phase and continue throughout the project life cycle, developed by sustainability management plan, conduct frequent sustainability reporting.	5	4
		Prosperity Average	**1.6**		**4.1**	**2.5**
		Overall Average	**1.5**		**4.2**	**2.4**

Note: Adapted from P5 Template, Version 3.0.1, GPM Global 2011. Copyright 2011 by GPM Global, Inc.

P5 analysis also helps to enhance environmental considerations for the project which would significantly factor into the risk management plan updates. The P5 impact analysis document is used in a similar manner to the risk management matrix. A sustainability evaluation is first made using the standard, and a score is assigned. Subsequently, a proposed response and impact score after the implementation of the proposed response is recorded. This document will be the working document for sustainability management going forward for the 2 MW Solar Farm Project. The first P5 impact analysis is shown in Section 4.11.2.

4.9.PROCESS OF SUSTAINABILITY PLAN IMPLEMENTATION

- Now that the first P5 sustainability assessment has been performed, the project team will coordinate the implementation of the proposed responses and timetable into the project schedule based on the available implementation funding set aside.
- The assessment suggests a post response score from 1-5. The team will use this assessment to evaluate how the planned responses actually improve sustainability.
- If there are still gaps, the team will reevaluate using the framework and come up with new responses to adequately address the sustainability issues. The best solutions are created in an open and fair environment where team members feel free to express dissenting opinions concerning issues arising.
- Some areas were registered as not applicable (N/A) in the first assessment. Some of these areas include the use of Artificial Intelligence (AI), child labor issues, customer privacy and data protection. These were registered as not applicable because it is too early to tell if these issues will emerge during the course of the project. Furthermore, the project does not intend to utilize child labor and will not have direct access to any customer data. Even though the likelihood of these sustainability issues occurring is slim to none, the team should still keep an eye on them during the next sustainability plan assessments.

The plan contains several low-hanging fruits, like flexible work, and virtual meetings. However, some actions require a lot more in-depth planning and will need to commence as soon as possible, ahead of the project. These include:

- Recruitment of new personnel, for example - the Environmental Health and Safety Officer,
- Training for maintenance staff emerged as a gap in the assessment. This training will need to be planned for and approved by management before its inclusion in the budget. This must all occur before the recruitment process can begin.
- The implementation of a social return on investment KPI will need to be included in project reporting,
- The plan recommends adding sustainability to reporting, and this will need to be added to the monthly report format.
- Community engagement efforts need to begin immediately.
- Upgrading designs of the PV plant to be category 5 hurricane rated.
- Considerations for disability access for project offices where residents will have access for raising grievances.

These actions will enhance the project's overall sustainability and potentially elevate it to a world class sustainably managed project.

5. CONCLUSIONS

This chapter summarizes the conclusions drawn from the conducting the FGP, related to its specific and general objectives. The project was based on the construction of the proposed first utility-scale solar farm to be constructed by the Government of Saint Lucia, sized at 2MW and intended for installation in Gros Islet, Saint Lucia. The general objective of the FGP was to develop a comprehensive project management plan, within the framework of the standards set by the Project Management Institute, to implement a new 2 MW solar farm in Gros Islet, Saint Lucia effectively, efficiently and sustainably. This has successfully been done and a project management plan has been created based on the Project Management Institute Body of Knowledge (PM BOK) 6th Edition. The next step was an evaluation of the project management plan from a sustainability perspective using the GPM Global sustainable project management PRiSM framework, and then from a regenerative development perspective. Therefore, the FGP was also able to meet its specific objectives. If the project is executed according to the stated plan, it is expected to be successful and conform with the typical project management triple constraint, as well as the P5 (People, Planet, Prosperity, Process and Products) constraints associated with sustainable project management.
In line with the specific objectives, the following was concluded:

1. A project charter was developed, as part of the project integration management plan, that defines and authorizes the 2 MW Solar Farm Project, establishes the project budget, scope, objectives, planned duration, assumptions, milestones, and the preliminary risk and stakeholder assessment. The project charter and integration management plan help to ensure that the project organization, the Government of Saint Lucia, supports the project, and that all parts of the project are well-integrated.
2. A scope management plan was developed, which defines the project requirements, roles and responsibilities, work breakdown structure, its accompanying dictionary and the project scope statement. The existence of the scope management plan provides the

baseline for all the activities the project intends to accomplish. It gives the project team the basis for managing change, and the triple baseline.

3. A schedule management plan was developed which establishes the project schedule, down to the activity level, and specifies how it will be monitored and controlled in the implementation of the solar farm. The schedule management plan is displayed with the critical path schedule document indicating the most critical items to be completed for the project to be completed on time.
4. A cost management plan was developed based on the defined project activities from the scope management plan. It indicates the costs associated with the various project items, and then applies reserves for a full project budget. This plan also indicates cost management metrics to assist the project team in keeping to the cost baseline and ensuring that the project is completed within budget.
5. A full quality management plan was developed for the 2 MW solar farm, including quality objectives, required acceptance and interconnection considerations, as well as quality metrics to establish accountability. The means for managing and controlling quality were also established.
6. The resource management plan created for the 2 MW solar farm, including decisions on how the project will be staffed, how materials, equipment and facilities will be acquired and how the project team will be developed, trained and rewarded for good work. Stakeholder analysis using the RACI framework was completed to ensure that there is clear project ownership and accountability and for all resources, by the management, and project team members.
7. A communications management plan for the project was also developed, including a communication strategy plan to ensure that all stakeholders are punctually and adequately informed about critical matters.
8. A comprehensive risk management plan was developed to identify and analyze project risks, then subsequently plan and execute the necessary risk responses required to neutralize identified risks, thus minimizing their potential impact on the project.

9. A procurement plan was established to define the means for procuring primary services, but also materials which will be required for the project. This will help to ensure that material and service delays do not affect the project execution.
10. A stakeholder management plan which considered the best approaches to engage all project stakeholders within and outside of the Government of Saint Lucia concerning the 2 MW solar farm project was developed. The plan also considers managing stakeholder engagement and the monitoring thereof.
11. Finally, the project management plan was reviewed and evaluated from the perspective of people, process, planet, prosperity and products, using the GPM B global P5 project management standard. The evaluation was utilized to develop action plans to improve the project outcomes from a sustainability perspective.

6. RECOMMENDATIONS

The recommendations chapter of the FGP evaluates the main points from the results chapter and presents the next steps emerging which will improve the FGP and contribute to successful implementation of the project. This FGP has taken a comprehensive look into the requirements, standards and frameworks which would make the commissioning of the 2 MW solar farm in Gros Islet a well-executed, sustainable and successful project. The following recommendations will not only assist in ensuring that the project is well executed but also well received in the Saint Lucia context, serving as an example which can be utilized to improve the standard of projects of this nature, going forward. These recommendations are directed toward the project manager and project team, with the project manager accountable for their implementation.

1. The critical recommendation concerning the integration management plan is that the project manager needs to be vigilant in the observation and maintenance of the change control process. This will ensure that the project sticks to its goals, and that scope creep does not become a major issue lower down the line.
2. To ensure that the scope management plan is effectively carried out, the project management team, especially the project manager needs to be engaged with all stakeholders from day one to ensure that requirements are known and stated, and that everyone understands the implications of changing the project scope while the project is ongoing.
3. Many uncertainties surround the regulations and the issuing of generation licenses currently, which will affect the project's chances of success. These uncertainties may have a significant effect on the project and so the project manager needs to keep the channels open with the regulator so that project pre-requirements are satisfied as soon as possible.
4. Cost management is an area with significant potential for major overruns for many projects. To be successful at managing the project budget, the project manager needs to

ensure that the budget and risk management plans are regularly updated and kept in sync. The project manager must also ensure that appropriate reserves are available to address known and unexpected risks that may occur. Since Saint Lucia's energy regulations are under development, the project manager must review this project management plan once the regulations are passed. This is required to review the assumptions, models, and the project's financial viability.

5. To maintain the quality standards established in this FGP, the project manager needs to ensure that the team is vigilant in ensuring that quality materials are utilized in the project. Depending on the risks, this may require a team representative travelling to the manufacturer's location to conduct site acceptance testing, to ensure that what is shipped is of the best quality.
6. The project manager should keep a keen eye on staff motivation and rewards, to incentivize excellent behavior and achievement of project targets. This will help to boost the resource management plan's efficacy.
7. The project requires many different types of engagement in the communications management plan. These meetings may become repetitive, and team members' desire to attend regularly may decrease. The project manager should make every attempt to make these meetings as engaging as possible, including ice breakers where possible, and allowing team members to run/conduct the meetings for their own personal and professional development. These activities will assist in ensuring that the team remains engaged.
8. The project manager is a limited person and will never be able to identify all the project risks. Therefore, he/she should train all team members in risk identification and management, to ingrain risk awareness into the project team culture. However, the team should take every precaution in ensuring that this is not perceived as a negative activity, since risk management also involves the identification of opportunities and potential benefits.

9. The project manager should maintain good relationships with the government procurement department in order to save and bulk-procure common goods for the project's use.
10. The project manager should take proactive steps to build and maintain good relationships with all project stakeholders. At this stage in the project, it is critical for relationships to be built with the regulator, utility and energy units of the Government of Saint Lucia. Since these are high power and high influence stakeholders, their needs should be managed carefully from day one.
11. The project manager should regularly evaluate the project from a sustainability standpoint, incorporating the P5 perspectives- people, planet, product, process and prosperity whenever possible and/or applicable. Keeping these principles in mind will go a long way towards the proactive resolution of problems and creating national value.

7. REGENERATIVE AND SUSTAINABLE VALIDATION

This section will validate the FGP in the context of regenerative development, considering the applicable United Nations Sustainable Development Goals (SDGs) (United Nations, n.d).

7.1. AFFORDABLE AND CLEAN ENERGY

The 2MW Solar Farm Project being developed for Saint Lucia is directly aligned with SDG 7: affordable and clean energy. The project management plan complies with best practices and ensures that it complies with the triple bottom line as well as sustainability practices. The project may then be used to establish guidelines that encourage the proliferation of clean energy projects such as wind, solar, geothermal and battery storage in Saint Lucia. If the project is functional and accomplish their goals at reasonable cost, this will contribute to better value for the people of Saint Lucia.

7.2. DECENT WORK AND ECONOMIC GROWTH

The project is validated by SDG 8- Decent work and economic growth, primarily through the economic growth portion of the SDG. From the perspective of economic growth, the optimum practices in the implementation of this 2MW Solar Farm Project should equate to the minimum project costing, and therefore an affordable PPA price for the power served from the project. Because the project is still relatively small, it will not require a battery. This should equate to lower system costs. In the long term, there is the potential for a reduction in consumer electricity pricing as well. The sustainability plan also recommends utilizing local talent on the project. The provision of jobs, the use of hotel rooms and local services and transportation by foreign contractors will also spill into and benefit the Saint Lucian economy. From the perspective of decent work, the project will fairly compensate employees, manage union relations well, provide adequate training, and provide safe and clean working environments for project employees.

7.3. RESPONSIBLE CONSUMPTION AND PRODUCTION

SDG 8 aligns with the project management plan in terms of the sustainability management plan prepared in Section 4.11. Based on this P5 sustainability assessment, the recommendation can be made to implement every subsequent energy project with an accompanying sustainability management plan. To be truly sustainable, the plan suggests that the 2MW solar farm must plan and account for disposal of project waste during the project life cycle, as well as the disposal of project assets – most significantly, the solar panels, during the decommissioning process. This is especially important since the island only measures 238sq miles and has little space or tolerance for large amounts of waste.

7.4. CLIMATE ACTION

The 2MW solar farm also has direct alignment to climate action in that its success means increased penetrations of renewable energy and replacement of diesel, which constitutes most of the current generation of electricity in Saint Lucia. Displacement of diesel generation with renewable energy generation in a way that optimizes the diesel operation (does not cause diesel engines to run inefficiently) means the reduction of the overall greenhouse gas emissions due to electricity generation in the country.

7.5. PEACE JUSTICE AND STRONG INSTITUTIONS

The project management plan supports the Strong Institution segment of SDG 16. The institutions involved in the energy sector need to be structured, robust, ethical, and transparent for the 2MW Solar Farm Project to be successful.

7.6. PARTNERSHIP FOR THE GOALS

Finally, SDG 17, Partnership for the Goals, is potentially the most critical point of alignment for the establishment of an energy project in Saint Lucia. The three main stakeholders in the process; the utility, government and regulator need strong partnerships for the best results to be achieved for the customers and people of Saint Lucia.

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9. APPENDICES

9.1. APPENDIX 1: FGP CHARTER

CHARTER OF THE PROPOSED
FINAL GRADUATION PROJECT (FGP)

1. Student name

Malaika Vera Abigail Charles

2. FGP name

Development of A Project Management Plan for a 2MW Utility Solar Farm in Gros Islet Saint Lucia

3. Application Area (Sector or activity)

Energy/Electricity Generation/ Powerplant Construction

4. Student signature

M Charles

5. Name of the Graduation Seminar facilitator

Carlos Brenes Mena

6. Signature of the facilitator

7. Date of charter approval

February 26th , 2023

8. Project start and finish date

Start Date: 9th January 2023	End Date: June 30th 2024

9. Research question

What elements are required to implement a new 2 MW solar farm in Gros Islet Saint Lucia according to PMI standards?

10. Research hypothesis

Is it possible to implement a new 2 MW solar farm in Gros Islet Saint Lucia according to PMI standards?

11. General objective

To develop a comprehensive project management plan, within the framework of the standards set by the Project Management Institute, to implement a new 2 MW solar farm in Gros Islet. Saint Lucia effectively and efficiently and sustainably.

12. Specific objectives

1. To create a project charter that formally sanctions the new 2 MW Solar Farm Project and grants the project manager the authority to use project resources efficiently.
2. To develop a project scope management plan to describe and define the scope of the 2 MW solar farm. The scope management plan will define, develop, monitor, and control the project to meet stakeholders stated and unstated requirements and avoid scope creep.
3. To create a schedule management plan that establishes how the project schedule will be created, monitored, and controlled for the implementation of the new 2 MW solar farm within the appropriate time.
4. To develop a cost management plan, outlining how the project costs will be planned, structured, managed and controlled to complete the 2 MW solar farm project within the allocated budget.
5. To establish a quality management plan to establish the guidelines, policies, and procedures to be implemented in achieving the quality objectives of the grid operator,

Saint Lucia Electricity Services Limited, within the triple constraint of time, scope, and cost.

6. To define a resource management plan which establishes the categorization, allocation, management, and release of the resources required to complete the 2 MW solar farm project successfully.
7. To create a communication management plan to define how the information regarding the new 2 MW solar farm project will be communicated to all stakeholders involved, on a timely basis and in an appropriate manner to ensure effective communication during the project implementation.
8. To outline a risk management plan to establish how risk management activities will be formulated and executed for the 2 MW solar farm project.
9. To create a procurement management plan to define which approaches, processes and procedures appropriate goods and services will be acquired to ensure that the 2 MW solar farm project is completed on time.
10. To create a stakeholder management plan to define the strategies and actions to promote stakeholder engagement in the decision-making and execution of the 2 MW solar farm project.
11. To assess the compliance of the implementation of the 2 MW solar farm with regenerative development and the P5 standard.

13. FGP purpose or justification

a. Saint Lucia is pursuing it climate goals and pursuit of a renewable energy penetration of 50 %.
b. The country currently generates most of its electricity from diesel fuel which leaves the sector vulnerable to the price shocks associated with international fuel markets.
c. Only 3Mw of utility scale solar is installed on Saint Lucia.
d. The construction of a 2MW solar farm will assist in achieving national and climate goals.

14. Work Breakdown Structure (WBS). In table form, describing the main deliverable as well as secondary, products or services to be created by the FGP.

Level 1	Level 2	Level 3
1. FGP Deliverable		
	1.1.1. Charter 1.1.2. WBS 1.1.3. Chapter 1 Introduction 1.1.4 Chapter 2 Theoretical framework 1.1.5 Chapter 3 Methodological framework 1.1.6. Annexes (Bibliography, Schedule)	
2. Tutoring Process		
	2.1. Tutor	
	2.2. Adjustments	
	2.3. Chapter 4 - Development (results)	
		2.3.1. Signed charter 2.3.2. Scope management plan 2.3.3. Schedule management plan 2.3.4. Cost management plan 2.3.5. Quality management plan 2.3.6. Resource management plan 2.3.7. Communications management plan 2.3.8. Risk management plan

		2.3.9. Procurement management plan
		2.3.10. Stakeholder management plan
		2.3.11. Sustainability assessment
	2.4. Chapter 5- Conclusions	
	2.5. Chapter 6 Recommendations	
	2.6. Validation of the FGP in the field of Regenerative and Sustainable Development	
3. Reviewer Reading		
	3.1. Reviewer's Reading Assignment	
		3.1.1. Reviewer Assignment
		3.1.2. Communication
		3.1.3. FGP Submission to Reviewers
	3.2. Reviewers Work	
		3.2.1. Reviewer 1
		3.2.2. Reviewer 2
4. Adjustment		
	4.1. Report for reviewers	
	4.2. Update FGP	
	4.3. Reviewers conduct second review	
5. Presentation to the Board of Examiners		
	5.1. Final Review by the Board	
	5.2. FGP Grade Report	

15. FGP budget

Budget Item	Description	Cost Assignment	Month of Expenditure

1	Fuel Costs to Facilitate Transportation to Interviews with Key Personnel	$200.00	April- May 2024

16. FGP planning and development assumptions

1. It is assumed that all information and knowledge to finalize the FGP are readily available or accessible for the student.
2. It is assumed that the assigned tutor, Osvaldo is available and provides effective and timely feedback to the student to finalize the FGP.
3. It is assumed that consultation with energy experts will add to lessons learnt for the improvement of project management plan and best practice.

17. FGP constraints

1. Developmental time for the FGP is limited to approximately 3 months. It is also limited by the fact that the student works a full-time job.

2. The implementation of project management best practice in Saint Lucia is limited by the ability of the enforcing structures to require compliance with a methodology.

3. The scope of the project management plan is limited by the data available for examination from the Government of Saint Lucia, the electric utility and the regulator.

18. FGP development risks

Risk No.	**Risk**	**Root Cause**	**Impact to FGP**
1	Hidden costs in the development of the FGP	Unforeseen activities may be associated with collecting the FGP data.	Personal funds may need to be spent or

			organizational funds may need to be sourced.
2	Natural disaster affecting ability to work	Natural disaster	Student will have to make up time when power is restored.
3	The student may fall ill or have competing work assignments and be unable to submit the FGP on time.	Illness / Poor planning/ Student taking on too much	The student should invest as much time as possible where possible.
4	The project management plan may be rendered outdated due to pending changes in the Saint Lucia Electricity Supply Act.	The energy legislation in the country is changing. Therefore, the tariff structure and other critical finding factors will change.	The FGP may need to be updated when the legislation changes.

19. FGP main milestones

Milestones are related to deliverables on the second level (deliverables) and third level (control accounts) of the WBS of section 14 of this charter. At the same time the deliverables are related to the specific objectives (in the case of the FGP please include the times for the tutorship reviews as well as for the readership).

Deliverable	Finish estimated date
1.1. FGP Charter	Feb 22 2023
1.2. WBS	Feb 22 2023
1.3. Introduction	Feb 22 2023
1.4. Theoretical Framework	Feb 22 2023
1.5. Methodological Framework	Feb 22 2023

1.6. 1. Bibliography	Feb 22 2023
1.6. 1. FGP Schedule	Feb 22 2023
2.2. Adjustments to Previous chapters	May 20 2023
2.3.1. Signed charter	May 18 2023
2.3.2. Scope management plan	March 4 2024
2.3.3. Schedule management plan	May 30 2024
2.3.4. Cost management plan	June 30 2024
2.3.5. Quality management plan	June 15 2024
2.3.6. Resource management plan	June 15 2024
2.3.7. Communications management plan	June 15 2024
2.3.8. Risk management plan	May 30 2024
2.3.9. Procurement management plan	May 30 2024
2.3.10. Stakeholder management plan	May 30 2024
2.3.11. Sustainability assessment	May 30 2024
4.1. Reviewers report	July 10 2024
4.2. Updated FGP	July 15 2024
4.3. Second Review feedback	July 20 2024
5.1 Board of examiners evaluation	July 25 2024
5.2. FGP Grade Report	July 30 2024

20. Theoretical framework

20.1 Estate of the “matter”

In Saint Lucia, historically, energy projects have been conceptualized, installed and commissioned by the Utility, Saint Lucia Electricity Services Ltd. Though the ownership has belonged totally to the utility, the government has been pivotal in supporting and creating the best environment for projects to be implemented. The need for new renewable energy projects has warranted the need for this 2MW solar farm as well as the growing power demand in the north of the island. There has yet been no utility scale solar farm in the north of the island. The

existence of this project will help to reduce the load on the transmission lines serving the north and reduce the emissions from electricity generation.

20.2 Basic conceptual framework

1. Project management,
2. Sustainability
3. Stakeholder management
4. Design and Construction of Renewable Energy projects
5. Risk Management for energy projects
6. Strategic Alignment

21. Methodological framework

Objective	Name of deliverable	Information sources	Research method	Tools	Restrictions
To create a project charter that formally sanctions the new 2 MW solar farm project and grants the project manager the authority to use project resources efficiently.	Project Charter	Experience and PMBOK Guide 6th edition	Analytic,	PMBOK Guide 6th edition	Limited Time
To develop a project scope management plan to describe and define the scope of the 2 MW solar farm. The scope management plan will define, develop, monitor, and control the project to meet stakeholders stated and unstated requirements and avoid scope creep.	Scope management plan	PMBOK Guide 6th edition, Experience and interviews from experts Documentation on renewable energy projects in Saint Lucia. Documentation from expert websites. Documentation on renewable energy best practice globally, and in the Caribbean context Existing best practice templates	Analytic, Synthetic, Empirical	PMBOK Guide 6th edition, Templates like Flowcharts, Interviews, Gap Analysis, Benchmarking, Brainstorming assumptions and Constraint Analysis, Root cause Analysis	Limited Time

To create a schedule management plan that establishes how the project schedule will be created, monitored, and controlled for the implementation of the 2 MW solar farm within the appropriate time.	Schedule management plan	PMBOK Guide 6th edition, Experience and interviews from experts Documentation on renewable energy projects in Saint Lucia. Documentation from expert websites. Documentation on renewable energy best practice globally, and in the Caribbean context Existing best practice templates	Analytic, Synthetic, Empirical	PMBOK Guide 6th edition, Templates like Flowcharts, Interviews, Gap Analysis, Benchmarking, Brainstorming assumptions and Constraint Analysis, Root cause Analysis	Limited Time
To develop a cost management plan, outlining how the project costs will be planned, structured, managed and controlled to complete the 2 MW solar farm project within the allocated budget.	Cost management plan,	PMBOK Guide 6th edition, Experience and interviews from experts Documentation on renewable energy projects in Saint Lucia. Documentation from expert websites. Documentation on renewable energy best practice globally, and in the Caribbean context Existing best practice templates	Analytic, Synthetic, Empirical	PMBOK Guide 6th edition, Templates like Flowcharts, Interviews, Gap Analysis, Benchmarking, Brainstorming assumptions and Constraint Analysis,	Costs are always subject to change and there is a lot of volatility of price due to global supply chain risks

To establish a quality management plan to establish the guidelines, policies, and procedures to be implemented in achieving the quality objectives of the grid operator, Saint Lucia Electricity Services Limited, within the triple constraint of time, scope, and cost.	Quality management plan	PMBOK Guide 6th edition, Experience and interviews from experts Documentation on renewable energy projects in Saint Lucia. Documentation from expert websites. Documentation on renewable energy best practice globally, and in the Caribbean context Existing best practice templates Caribbean context.	Analytic, Synthetic, Empirical	PMBOK Guide 6th edition, Templates like Flowcharts, Interviews, Gap Analysis, Benchmarking, Brainstorming assumptions and Constraint Analysis, Root cause Analysis	Quality can be a subjective term and no standard exists
To define a resource management plan which establishes the categorization, allocation, management, and release of the resources required to complete the 2 MW solar farm project successfully.	Resource management plan	PMBOK Guide 6th edition, Experience and interviews from experts Documentation on renewable energy projects in Saint Lucia. Documentation from expert websites.	Analytic, Synthetic, Empirical	PMBOK Guide 6th edition, Templates like Flowcharts, Interviews, Gap Analysis, Benchmarking, Brainstorming assumptions and Constraint Analysis, Root cause Analysis	

To create a communication management plan to define how the information regarding the new 2 MW solar farm project will be communicated to all stakeholders involved, on a timely basis and in an appropriate manner to ensure effective communication during the project implementation.	Communication management plan	PMBOK Guide 6th edition, Experience and interviews from experts Documentation on renewable energy best practice globally, and in the Caribbean context Existing best practice templates	Analytic, Synthetic, Empirical	PMBOK Guide 6th edition, Templates like Flowcharts, Interviews, Gap Analysis, Benchmarking, Brainstorming assumptions and Constraint Analysis, Root cause Analysis	
To outline a risk management plan to establish how risk management activities will be formulated and executed for the 2 MW solar farm project.	Risk management plan	PMBOK Guide 6th edition, Experience and interviews from experts Documentation on renewable energy projects in Saint Lucia. Documentation from expert websites.	Analytic, Synthetic, Empirical	PMBOK Guide 6th edition, Templates, Interviews, Gap Analysis, Benchmarking, Brainstorming assumptions and Constraint Analysis, Root cause Analysis	Some unknown risks may exist

To create a procurement management plan to define which approaches, processes and procedures appropriate goods and services will be acquired to ensure that the 2 MW solar farm project is completed on time.	Procurement management plan	PMBOK Guide 6th edition, Experience and interviews from experts Documentation on renewable energy projects in Saint Lucia. Documentation from expert websites. Documentation on renewable energy best practice globally, and in the Caribbean context Existing best practice templates in the Caribbean context.	Analytic, Synthetic, Empirical	PMBOK Guide 6th edition, Templates Interviews, Gap Analysis, Benchmarking, Brainstorming assumptions and Constraint Analysis, Root cause Analysis	
To create a stakeholder management plan to define the strategies and actions to promote stakeholder engagement in the decision-making and execution of the 2 MW solar farm project.	Stakeholder management plan	PMBOK Guide 6th edition, Experience and interviews from experts Documentation on renewable energy projects in Saint Lucia. Documentation from expert websites. Documentation on renewable energy best practice globally, and	Analytic, Synthetic, Empirical	PMBOK Guide 6th edition, Templates like Flowcharts, Interviews, Gap Analysis, Brainstorming assumptions and Constraint Analysis.	

		in the Caribbean context Existing best practice templates Caribbean context.			
To assess the compliance of the implementation of the 2 MW solar farm with regenerative development and the P5 standard.	Sustainability Assessment	PMBOK Guide 6th Edition, P5 Standard Experience and interviews from experts Documentation from expert websites.		PMBOK Guide 6th Edition, P5 Standard Templates like Flowcharts, Interviews, Gap Analysis, Benchmarking, Brainstorming assumptions and Constraint Analysis, Root cause Analysis	

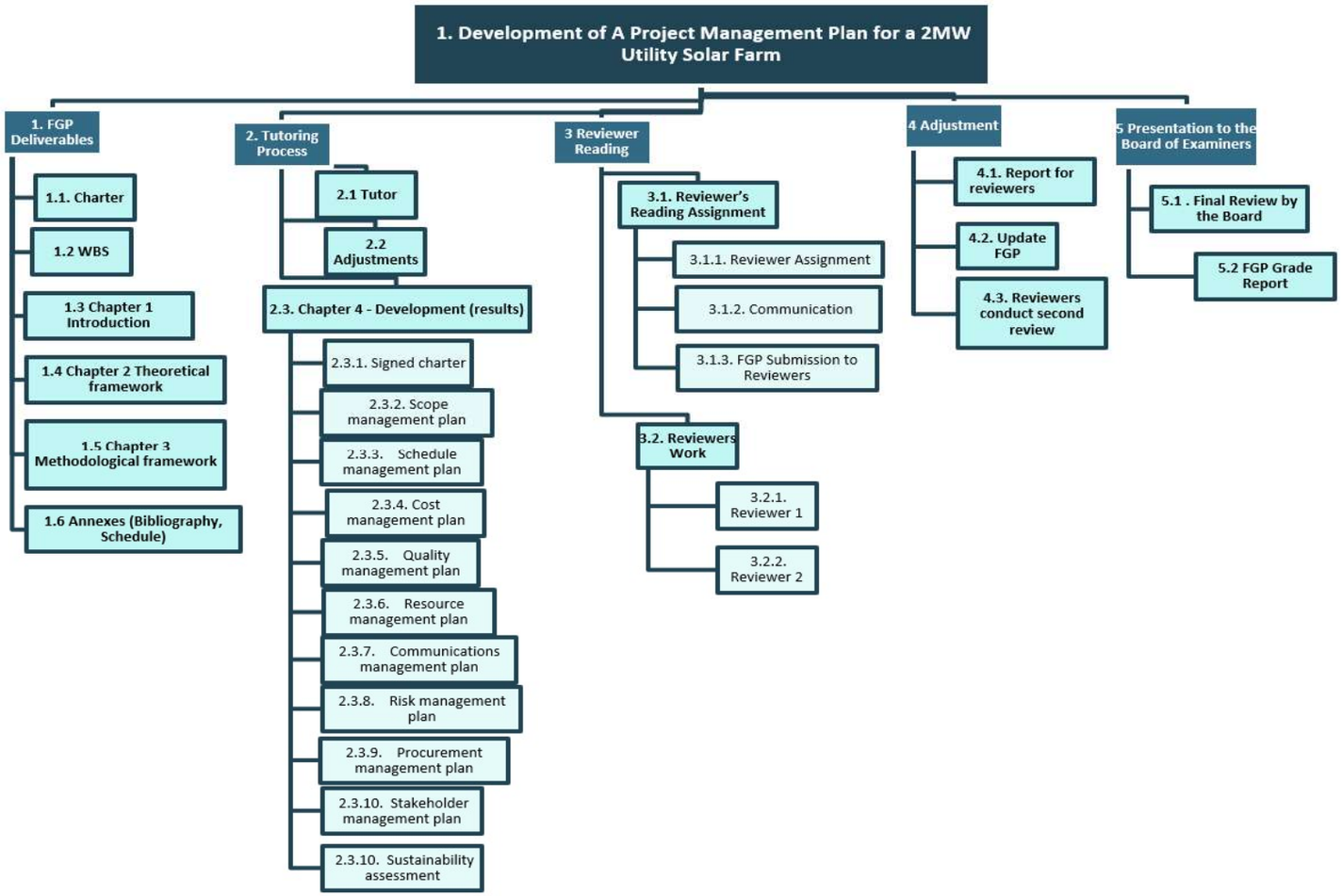
Note: Own Work

22. Validation of the work in the field of regenerative and sustainable development.

#	SDG Goal	Validation
7	Clean and Affordable Energy	Promoting conditions and best practices for interconnection of utility scale
12	Responsible Consumption and Production	Sustainability management plan requirement for all projects including planning for waste disposal and powerplant decommissioning.
8	Decent Work and Economic Growth	Promoting Economic growth through minimizing energy tariffs.
13	Climate Action	Promote clean energy projects facilitating a reduction in emissions from the energy sector.
16	Peace Justice and Strong Institutions	Ethical Institutions and Transparency in the project approval process
17	Partnership for the goals	Partnership among the major Energy Sector Stakeholders

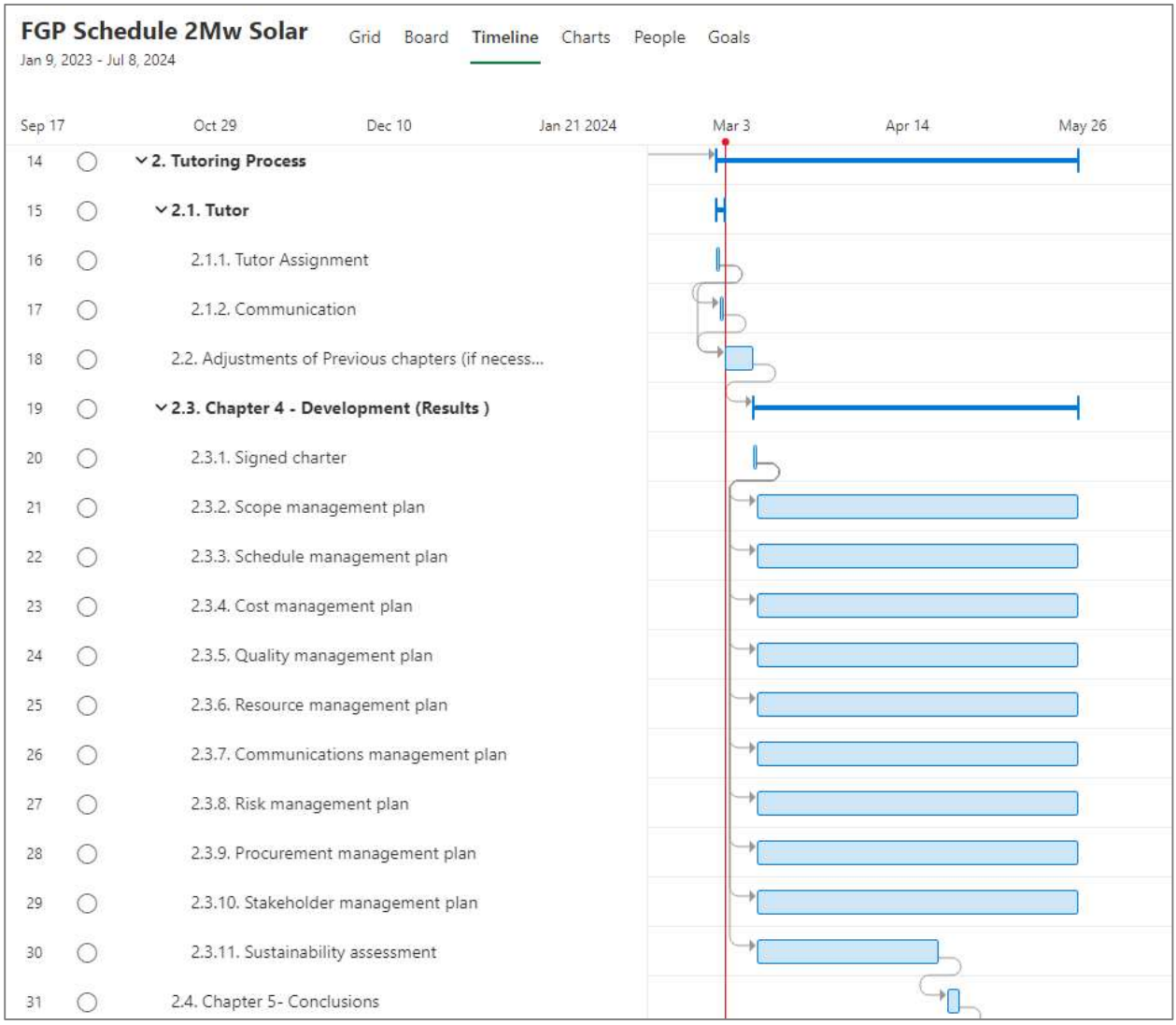
Note: Own Work

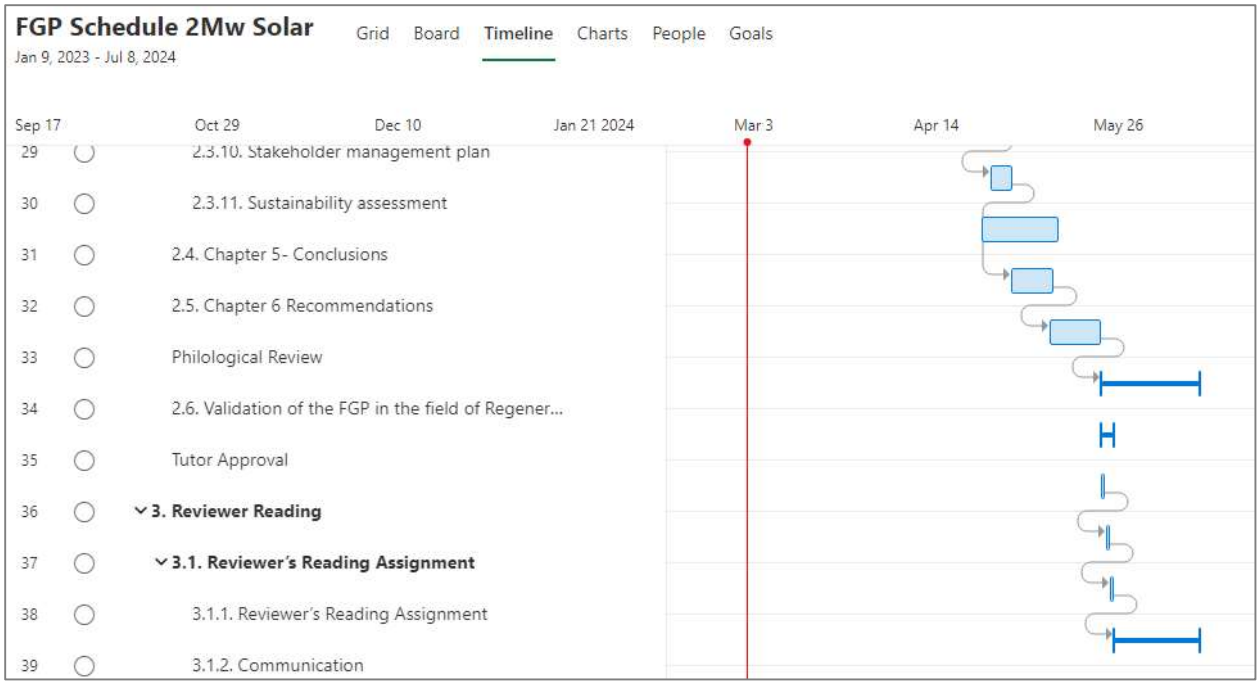
9.2. APPENDIX 2: FGP WBS



Note: Own Work

9.3. APPENDIX 3: FGP SCHEDULE





Note: Own Work

9.4. APPENDIX 4: PRELIMINARY BIBLIOGRAPHICAL RESEARCH

TABLE 40 PRELIMINARY BIBLIOGRAPHICAL RESEARCH

No.	Title	Reference	Use in FGP Research Project
1	National Energy Transition Strategy	Bunker, K., Doig, S., Locke, J., Mushegan, S., Teelucksingh, & Torbert, R. (2017). *Saint Lucia National energy transition strategy*. Rocky Mountain Institute. https://www.rmi.org/insights/reports/saint_lucia_NETS/	The document provides the long-term energy transition strategy for the country of Saint Lucia which informs the overall energy landscape and projects which are possible for implementation in Saint Lucia.
2	Geothermal Prefeasibility Study	GeothermEx & Power Engineers. (2017). *Pre-feasibility study of A proposed geothermal project in Saint Lucia*; Final report.	The document provides the prefeasibility study of a project planned for implementation in Saint Lucia. It can assist in identifying the gaps in project methodology presently for projects implemented in Saint Lucia and provides a project which can be used as an example to prove the methodology when it is complete.

3	Methodology for Renewable Energy Generation Projects Supplying Electricity to Grid or Captive Consumers	Global Carbon Council. (2019). *Methodology for Renewable Energy Generation Projects Supplying Electricity to Grid or Captive Consumers.* (GCCM001 V3.0 – 2022). *https://www.globalcarboncouncil.com/wp-content/uploads/2022/02/GCCM001-Methodology-for-Renewable-Energy-Generation-Projects-Supplying-Electricity-to-Grid-or-Captive-Consumers-Rev.V3.0.pdf*	The paper speaks to the early development stages of renewable energy projects and specifically aimed at project sponsors, but for the purposes of the research provides insight that will help to structure the early stages of project development for Renewable Energy projects corresponding to international sponsor standards. This is important because many projects that occur on Saint Lucia occur with funding from international agencies. The document gives an overview of renewable recommended project development structures in the United States which can be used to inform and benchmark similar ideas in Saint Lucia.
4	IRENA TRANSFORMING SMALL-ISLAND POWER SYSTEMS	IRENA. (2018), Transforming small-island power systems: Technical planning studies for the integration of variable renewables, International Renewable Energy Agency, Abu Dhabi https://www.irena.org/Publications/2019/Jan/Transfor5ming-small-island-power-systems	The document presents an overview of the studies forming part of the prefeasibility stage of an energy project in small island like Saint Lucia which can inform the structure required for implementation on the island.

5	Renewable energy project success: Internal versus external stakeholders' satisfaction and influences of power-interest matrix	Maqbool, R., Rashid, Y., & Ashfaq, S. (2022). Renewable energy project success: Internal versus external stakeholders' satisfaction and influences of power-interest matrix. *Sustainable Development, 30*(6), 1542-1561. https://doi.org/10.1002/sd.2327	The paper speaks of the success of renewable energy projects from the perspective of stakeholder management. Given the susceptibility of projects to political will, this will help in informing creating a framework where all relevant stakeholders are sufficiently engaged to ensure project success as much as is possible. It examines the environment using a tools we have used in the MPM, the power interest matrix and correlates success factors to project success.
6	Assessment of sustainable energy system configuration for a small canary island in 2030.	Meschede, H., Child, M., & Breyer, C. (2018). *Assessment of sustainable energy system configuration for a small canary island in 2030.* Energy Conversion and Management, 165, 363-372. https://doi.org/10.1016/j.enconman.2018.03.061	The paper explores the configuration (combinations of technologies) of sustainable energy projects in small islands, similar in scale to Saint Lucia and can be used as a benchmark for applying the framework to different projects.
7	Sustainable Renewable Energy	Olang, T. A., & Esteban, M. (2017). Sustainable renewable energy financing: Case study of kenya. In M. Matsumoto, K. Masui, S.	A key part of the framework of how a project is financed. Both the government and the utility need to ensure that the financing is sufficient to ensure a

	Financing: Case Study of Kenya	Fukushige & S. Kondoh (Eds.), *Sustainability through innovation in product life cycle design* (pp. 167-179). Springer Singapore. https://doi.org/10.1007/978-981-10-0471-1_12	successful project and minimize the power purchase price at the end of the project. The paper uses Kenya as an example but has principles to be applied to any country context.
8	Final Environmental and Social Impact Assessment: Saint Lucia Renewable Energy Sector Development Project	Panorama Environmental, Inc. (2018). *Final Environmental and Social Impact Assessment: Saint Lucia Renewable Energy Sector Development Project.* https://documents1.worldbank.org/curated/en/751671545290784636/pdf/Environmental-and-Social-Impact-Assessment-Resettlement-Policy-Framework-Stakeholder-Engagement-Plan-and-Draft-Resettlement-Action-Plan.pdf	This is the environmental and social impact assessment of a major project ongoing project in Saint Lucia. This project will be used to test out the framework and can also be used in refining the sustainability portion of the framework, including sustainability management plans.
9	Green Technology and Sustainable Renewable Energy Analysis	Sridhar, C., Thaskeen, F., Harshitha, M., Varsha, J. R., Deepika, T., Devi, & Pareek, P. K. (2022). Green technology and sustainable renewable energy analysis. Paper presented at the Innovations in Computer Science And, 617-625. https://doi.org/10.1007/978-981-16-8987-1_66	Renewable energy projects are good for the environment in that they displace fossil fuel emissions. However, they may not be truly sustainable in that the practices associated may not be sustainable, they may produce too much waste and may have questionable supply chains. The paper explores these

			topics and will add to the framework efforts to ensure that a project is truly and fully sustainable.
10	The Emerging Trends of Risk Management in Renewable Energy Projects	Xue, J., Fan, H., & Yue, G. (2020). The emerging trends of risk management in renewable energy projects. IOP Conference Series: Earth and Environmental Science, 586(1), 012014. https://www.doi.org/10.1088/1755-1315/586/1/012014	The document speaks to risk management in energy projects, which has implications for the renewable project methodology framework for Saint Lucia. It will specifically inform the risk management knowledge area components but will broadly affect the project as risk management affects all the parts of a project.

9.5. APPENDIX 5: GOVERNMENT OF SAINT LUCIA LUMP SUM CONTRACT

Public Procurement Contract Agreement

Lump-Sum

This CONTRACT AGREEMENT is made on the ...[insert]... day of **[enter month, year]**

BETWEEN

***[enter name of Procuring Entity]* of the Government of Saint Lucia,** and having its principal place of business at *[enter address of Procuring Entity]*(Hereinafter called **"the Procuring Entity"**) of the one part

AND

[Enter name of Consultant]
(Hereinafter called **"the Consultant"**) and having its principal place of business at *[enter address of Consultant]* of the other part

NOW THIS CONTRACT AGREEMENT IS AGREED AS FOLLOWS:

1. **The Procuring Entity requires the [*describe consulting services*]** (Hereinafter called **"the Consulting Services"**)
2. The Consultant, having represented to the Procuring Entity that it has the required professional skills, expertise and technical resources, has agreed to provide the Consulting Services on the terms and conditions set forth in this Contract
3. The mutual rights and obligations of the Procuring Entity and the Consultant shall be set forth in the Contract, in particular:
   (a) The Consultant shall carry out the Consulting Services in accordance with the provisions of the Contract; and
   (b) The Procuring Entity shall make payments to the Consultant in accordance with the provisions of the Contract
4. The following document(s) shall be deemed to form and be read as part of this Contract:
   (a) This Contract Agreement; and
   (b) Special Conditions of Contract for Consulting Services; and
   (c) General Conditions of Contract for Consulting Services; and
   (d) Contract Agreement Appendices:
      (i) Appendix A - Terms of Reference; and
      (ii) Appendix B - Key Experts; and
      (iii) Appendix C –Breakdown of Contract Price; and
      (iv) Appendix D - Form of Advance Payments Guarantee.
   (e) The Tenderer's Proposal; and
   (f) The Request for Proposal; and
   (g) *Add any other document(s)*
   In the event of any discrepancy or inconsistency within the Contract documents, then the documents shall prevail in the order listed above

This Contract Agreement and the documents stated in Part 4 above, constitutes the entire agreement between the Procuring Entity and the Consultant and superseded by all communications, negotiations and agreements (whether written or oral) of the parties made prior to the date of Contract.

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This Contract Agreement is executed in accordance with the laws of Saint Lucia on the day, month and year indicated above.

Name: [insert name]	Name: [insert name]
Signed: [insert signature]	Signed: [insert signature]
In the capacity of: [insert title]	In the capacity of: [insert title]
For and on behalf of the Procuring Entity	For and on behalf of the Consultant

[Note: For a joint venture, either all members shall sign or only the lead member, in which case the power of attorney to sign on behalf of all members shall be attached.]

For and on behalf of each of the members of the Consultant

Joint Venture: [insert the name of the JV]

Authorised representative: [insert name of the lead member]

Signed: [insert Authorised Representative on behalf of a JV]

For and on behalf of: [add signature blocks for each member if all are signing]

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Section VIII. General Conditions of Contract for Consulting Services (GCC)

[These General Conditions of Contract can be used for either Time-Based or Lump-Sum Contracts. Procuring Entity shall delete clauses in italics that are not relevant to the contract type not being used prior to issue in the Request for Proposal]

1 Definitions

1.1 Throughout the General and Special Conditions of Contract, the following terms shall apply:
(a)"Act" means the Public Procurement and Asset Disposal Act, No. 19 of 2015;
(b) "affiliate(s)" means an individual or an entity that directly or indirectly controls, or is controlled by, or is under common control with the consultant;
(c)"contract" refers to the public procurement contract and means the public procurement contract agreement, together with the contract documents referred to therein, including all attachments, terms and conditions, appendices, and all documents incorporated by reference therein, between a procuring entity and a consultant resulting from public procurement procedures;
(d) "consulting services" means services which are of an intellectual or advisory nature provided by firms or individuals using their professional skills, study, design and organise specific projects, advise clients, conduct training or transfer knowledge;
(e) "consultant" means a natural or legal person, including a consortium (that is, association of several persons, or firms or companies) that has entered into a public procurement contract for the provision of consulting services;
(f) "contract documents" means the documents listed in the public procurement contract agreement, including any amendments subsequently issued;
(g)"days" means calendar days unless otherwise stated;
(h) "Effective Date" means the date on which the contract comes into force and effect pursuant to Clause 10;
(i) "Expert" means, collectively, Key Experts, Non-Key Experts, or any other personnel provided by the consultant;
(j) "in writing" means communicated in written form with proof of receipt;
(k)"Key Expert(s)" means an individual professional whose skills, qualifications, knowledge and experience are critical to the performance of the consulting services under the public procurement contract;
(l) "Non-Key Expert(s)" means an individual professional provided by the successful tenderer or sub-consultant and who is assigned to perform the consulting services or any part thereof under the procurement;
(m) "Party" means either the procuring entity or the consultant;
(n) "person" includes a corporation or unincorporated body;
(o) "public procurement contract" means the written agreement made between a procuring entity and a consultant with respect to a procurement requirement;
(p) "procuring entity" –
i. means a Ministry, department or other agency of the Government of Saint Lucia;
ii. includes a Ministry of the Government of Saint Lucia that acts on behalf of a Constituency Council or statutory body.
(q) "SCC" means the Special Conditions of Contract;
(r) "sub-consultant" means an entity to whom the successful tenderer intends to subcontract any part of the consulting services while remaining responsible to the procuring entity during the performance of the public procurement contract;

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(s) "TORs" Terms of Reference (TORs) explains the objectives, scope, activities and tasks to be performed, respective responsibilities of the procuring entity and the consultant, and expected results and deliverables of the assignment; and
(t) if the context so requires, "singular" means "plural" and vice versa.

1.2 Public procurement contracts which include the provision of goods and works shall be regarded as consulting service contracts if the total value of the consulting services is greater than the value of the goods or works covered by the contract.

2 Interpretations

2.1 Entire agreement: The contract constitutes the entire agreement between the procuring entity and the consultant and supersedes all communications, negotiations and agreements of the parties made prior to the date of the contract. No agent or representative of either party has authority to make, and the parties shall not be bound by or be liable for, any statement, representation, promise or agreement not set forth herein.

2.2 Payment to the consultant under this contract shall be on a time-based contract or lump-sum contract basis, as stipulated **in the SCC**.

2.3 Amendment: No amendment, modification or other variation of the contract shall be valid unless it is in writing, is dated, expressly refers to the contract, and is signed by a duly authorised representative of each party. However, each party shall give due consideration to any proposals for modification or variation made by the other party.

2.4 Expiration of contract: Unless terminated earlier pursuant to GCC Clause 14 hereof, this contract shall expire at the end of such time period after the Effective Date as specified **in the SCC**.

3 Relationship between the Parties

3.1 Nothing contained in the Public Procurement Contract shall be construed as establishing a relationship of master and servant or of principal and agent as between the procuring entity and the consultant. The consultant, subject to this contract, has complete charge of the Experts and sub-consultants, if any, performing the consulting services and shall be fully responsible for the consulting services performed by them or on their behalf.

4 Conduct and Eligibility of Consultants

4.1 The Government of Saint Lucia requires that all parties involved in the procurement proceedings and execution of such contracts observe the highest standard of ethics.

4.2 In accordance with the Act, a consultant shall not –
(a)engage in or abet any corrupt or fraudulent practices; and
(b) engage in any coercive practice threatening to harm, directly or indirectly, any person or his or her property to influence his or her participation on a public procurement procedure, or affect the execution of a public procurement contract; and
(c)engage in collusion, before or after a proposal submission, designed to allocate procurement contracts among tenderers, establish proposal prices at artificial non-competitive levels or otherwise deprive a procuring entity of the benefit of free and open competition.

4.3 The procuring entity requires consultants to adhere to all requirements during the performance of the contract. The consultant shall:
(a)have the legal capacity to enter into the public procurement contract; and

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(b) not be insolvent, in receivership, bankrupt or being wound up, its affairs are not being administered by a court or a judicial officer, and its business activities have not been suspended; and
(c)have fulfilled obligations to pay taxes and social security contributions; and
(d) comply with the laws of Saint Lucia; and
(e) not have a conflict of interest in relation to the public procurement requirement; and
(f) not have any director or officer, that has been convicted of any criminal offence relating to the professional conduct or the making of false statements or misrepresentations as to their qualifications to enter into a public procurement contract within a period of five (5) years preceding the commencement of the public procurement procedure; and
(g)not be subject to suspension, or none of its directors or officers have been associated with a tenderer, or supplier subject to suspension in Saint Lucia, the region or internationally.

4.4 The procuring entity requires the consultant to disclose any commissions, gratuities or fees that may have been paid or are to be paid to agents, or any other party with respect to the selection process or execution of the contract. The information disclosed must include at least the name and address of the agent or the other party the amount and currency, and the purpose of the commission, gratuity or fee. Failure to disclose such commissions, gratuities or fees may result in termination of the contract and/or sanctions by the procuring entity.

4.5 The consultant shall provide such evidence of its continued eligibility as the procuring entity may reasonably request of its continued eligibility during the performance of the contract.

5 Governing Law

5.1 This contract shall be governed by and interpreted in accordance with the laws of Saint Lucia.

5.2 The consultant shall perform the consulting services in accordance with the contract and the laws of Saint Lucia and shall take all practicable steps to ensure that any of its Experts and sub-consultants, comply with these laws.

6 Language of the Contract

6.1 The contract as well as all correspondence and documents relating to the contract exchanged by the consultant and the procuring entity shall be written in English.

7 Joint Venture

7.1 If the consultant is a joint venture, all of the parties shall be jointly and severally liable to the procuring entity for the fulfilment of the provisions of the contract and shall designate one party to act as a leader with authority to act on behalf of the joint venture. The composition of the joint venture shall not be altered without consent of the procuring entity.

8 Communications and Authorised Representatives

8.1 Any communication made in relation to this contract shall be undertaken in writing. Any such notice, request or consent shall be deemed to have been given or made when delivered in person to an authorised representative, as indicated in GCC Sub-Clause 8.2, of the other party at the address specified **in the SCC**.

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(b) not be insolvent, in receivership, bankrupt or being wound up, its affairs are not being administered by a court or a judicial officer, and its business activities have not been suspended; and
(c)have fulfilled obligations to pay taxes and social security contributions; and
(d) comply with the laws of Saint Lucia; and
(e) not have a conflict of interest in relation to the public procurement requirement; and
(f) not have any director or officer, that has been convicted of any criminal offence relating to the professional conduct or the making of false statements or misrepresentations as to their qualifications to enter into a public procurement contract within a period of five (5) years preceding the commencement of the public procurement procedure; and
(g)not be subject to suspension, or none of its directors or officers have been associated with a tenderer, or supplier subject to suspension in Saint Lucia, the region or internationally.
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8.2 Any action required or permitted to be taken, and any document required or permitted to be executed under this contract by the procuring entity or the consultant may be taken or executed by the representatives specified **in the SCC**.

8.3 In case the consultant is a joint venture, the members hereby authorise the representative specified **in the SCC** to act on their behalf in exercising all the consultant's rights and obligations towards the procuring entity under this contract, including without limitation the receiving of instructions and payments from the procuring entity.

8.4 Either party may change its address or the authorised representatives by giving the other party written notice of such change to the address specified in GCC Sub-Clause 8.1.

9 Location

9.1 The consulting services shall be performed at such locations as are specified in the contract and, where the location of a particular task is not specified, at such locations, as the procuring entity may approve.

10 Effectiveness of Contract

10.1 This contract shall come into force and effect on the date of the procuring entity's notice to the consultant instructing the consultant to begin carrying out the consulting services. For the avoidance of doubt, the Effective Date is stated **in the SCC**. This notice shall confirm that the effectiveness conditions, if any, listed **in the SCC** have been met.

10.2 If this contract has not become effective within such time period after the date of contract signature as specified **in the SCC**, either party may, by not less than thirty (30) days written notice to the other party, declare this contract to be null and void, and in the event of such a declaration by either party, neither party shall have any claim against the other party with regard to this contact.

11 Commencement of Services

11.1 The consultant shall confirm availability of Key Experts and begin carrying out the consulting services not later than the number of days after the Effective Date specified **in the SCC**. Confirmation of the Key Experts' availability to start the assignment shall be submitted to the procuring entity in writing as a written statement signed by each Key Expert.

12 Force Majeure

12.1 For the purposes of this contract, "Force Majeure" means an event which is beyond the reasonable control of a party, is not foreseeable, is unavoidable, and makes a party's performance of its obligations in regard to the contract impossible or so impractical as reasonably to be considered impossible under the circumstances. Subject to these requirements, such events may include, but is not restricted to, war, riots, civil disorder, earthquake, fire, explosion, storm, flood or other adverse weather conditions, strikes, lockouts or other industrial action confiscation or any other action by Government agencies.

12.2 Force Majeure shall not include:
(a)any event which is caused by the negligence or intentional action of a party or such party's Experts, sub-consultants or employees; or
(b) any event which a diligent party could reasonably have been expected to both take into account at the time of the conclusion of this contract, and avoid or overcome in the carrying out of its obligations; or

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(c)insufficient funds or failure to make any payment required.

12.3 The failure of a party to fulfil any of its obligations hereunder shall not be considered to be a breach of, or default under, this contract insofar as such inability arises from an event of Force Majeure, provided that the party affected by such an event has taken all reasonable precautions, due care and reasonable alternative measures, all with the objective of carrying out the terms and conditions of this contract.

12.4 A party affected by an event of Force Majeure shall continue to perform its obligations under the contract as far as is reasonably practical, and shall take all reasonable measures to minimise the consequences of any event of Force Majeure.

12.5 A party affected by an event of Force Majeure shall notify the other party of such event as soon as possible, and in any case not later than fourteen (14) calendar days following the occurrence of such event, providing evidence of the nature and cause of such event, and shall similarly give written notice as soon as possible once conditions allow for a resumption of the contract.

12.6 Any period within which a party shall, pursuant to this contract, complete any action or task, shall be extended for a period equal to the time during which such party was unable to perform such action as a result of Force Majeure.

12.7 During the period of their inability to perform the consulting services as a result of an event of Force Majeure, the consultant, upon instructions by the procuring entity, shall either:
(a)demobilise, in which case the consultant shall be reimbursed for additional costs they reasonably and necessarily incurred, and, if required by the procuring entity, in reactivating the consulting services; or
(b) continue with the consulting services to the extent reasonably possible, in which case the consultant shall continue to be paid under the terms of this contract and be reimbursed for additional costs reasonably and necessarily incurred.

12.8 In the case of disagreement between the parties as to the existence or extent of Force Majeure, the matter shall be settled according to GCC Clause 32.

13 Suspension

13.1 The procuring entity may, by written notice of suspension to the consultant, suspend all payments to the consultant hereunder if the consultant fails to perform any of its obligations under this contract, including the carrying out of the consulting services, provided that such notice of suspension:
(a)shall specify the nature of the failure; and
(b) shall request the consultant to remedy such failure within a period not exceeding thirty (30) calendar days after receipt by the consultant of such notice of suspension.

14 Termination

14.1 This contract may be terminated by either party as per provisions of this clause.

14.2 The procuring entity may terminate this contract:
(a)in case of the occurrence of any of the following events:
i. if the consultant fails to remedy a failure in the performance of its obligations stated within this Clause, as specified in a notice of suspension as stated in GCC Sub-Clause13.1; or
ii. if the consultant becomes (or, in the case of a joint venture, if any of its members become) insolvent or bankrupt or enter into any agreements with their creditors for relief of debt or take advantage of any law for the benefit of debtors or go into liquidation or receivership whether compulsory or voluntary; or

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iii. if the consultant fails to comply with any final decision reached as a result of arbitration proceedings pursuant to GCC Clause 32; or
iv. if, as the result of Force Majeure, the consultant is unable to perform a material portion of the consulting services for a period of not less than sixty (60) calendar days; or
v. if the procuring entity, in its sole discretion and for any reason whatsoever, decides to terminate this contract; or
vi. if the consultant fails to confirm availability of Key Experts or commence the assignment as required in GCC Sub-Clause 11.1; or
vii. if it is determined that the consultant has engaged in fraud and corruption, as defined in the Act, in competing for or in executing the contract.

(b) Where the procuring entity terminates the contract, in accordance with GCC Sub-Clause 14.2(a), it shall issue a written notice of termination to the consultant, providing the following minimum timeframes:
i. at least thirty (30) days if the termination is due to reasons stated in (i) – (iv); or
ii. at least sixty (60) days if the termination is due to reasons stated in (v); or
iii. at least five (5) days if the termination is due to reasons stated in (vi) – (vii).

14.3 The consultant may terminate this contract:
(a)in case of the occurrence of any of the events:
i. if the procuring entity fails to pay any money due to the consultant in accordance with this contract or fails to comply with any final decision reached as a result of arbitration pursuant to GCC Clause 32; or
ii. if, as the result of Force Majeure, the consultant is unable to perform a material portion of the consulting services for a period of not less than sixty (60) calendar days; or
iii. if the procuring entity is in material breach of its obligations pursuant to this contract and has not remedied the same within forty-five (45) days (or such longer period as the consultant may have subsequently approved in writing) following the receipt by the notice specifying such breach.
(b) for reasons specified in GCC Sub-Clause 14.3(a), by providing written notice of termination to the procuring entity providing a minimum of thirty (30) calendar days notice.

14.4 If the contract has not become effective, either party can terminate the contract in accordance with GCC Sub-Clause 10.2.

14.5 Upon termination of this contract in accordance with this clause, or upon expiration of this contract pursuant to GCC Sub-Clause 2.4, all rights and obligations of the parties shall cease, except:
(a)such rights and obligations as may have accrued on the date of termination or expiration; or
(b) the obligation of confidentiality set forth in GCC Clause 17; or
(c)the consultant's obligation to permit inspection, copying and auditing of their accounts and records set forth in GCC Clause20; or
(d) any right which a party may have under the applicable laws of Saint Lucia.

14.6 Upon termination of this contract by notice of either party to the other pursuant to GCC Sub-Clauses 14.2 or 14.3, the consultant shall, immediately upon dispatch or receipt of such notice, take all necessary steps to bring the consulting services to a close in a prompt and orderly manner and shall make every reasonable effort to keep expenditures for this purpose to a minimum. With respect to documents prepared by the consultant and equipment and materials furnished by the procuring entity, the consultant shall proceed as provided, respectively, by GCC Clauses 21 or 22.

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14.7 Upon termination of this contract, the procuring entity shall make the following payments to the consultant:
(a)remuneration for consulting services satisfactorily performed prior to the effective date of termination, and reimbursable expenditures for expenditures actually incurred prior to the effective date of termination; and
(b) in the case of termination pursuant to GCC Sub-Clause 14.2(a) iv-v, reimbursement of any reasonable cost incidental to the prompt and orderly termination of this contract, including the cost of the return international travel of the Experts.

15 Standard of Performance

15.1 The consultant shall perform the consulting services and carry out the consulting services with all due diligence, efficiency and economy, in accordance with generally accepted professional standards and practices, and shall observe sound management practices, employ appropriate technology and safe and effective equipment, machinery, materials and methods. The consultant shall always act, in respect of any matter relating to this contract or to the consulting services, as a faithful adviser to the procuring entity, and shall at all times support and safeguard the procuring entity's legitimate interests in any dealings with third parties.

15.2 The consultant shall employ and provide such qualified and experienced Experts and sub-consultants as are required to carry out the consulting services.

15.3 The consultant may subcontract part of the consulting services to an extent and with such Key Experts and sub-consultants as may be approved in advance by the procuring entity. Any agreed subcontracting shall not alter the consultant's obligations under the contract.

16 Conflict of Interest

16.1 The consultant shall hold the procuring entity's interests paramount, without any consideration for future work, and strictly avoid conflict with other assignments or their own corporate interests. This shall include, but is not limited to, the following:
(a) the consultant shall not benefit from commissions, discounts, etc. The payment of the consultant in accordance with these Conditions of Contract shall constitute the consultant's only payment in connection with this contract and, subject to GCC Sub-Clause16.1(e), the consultant shall not accept for its own benefit any trade commission, discount or similar payment in connection with activities pursuant to this contract or in the discharge of its obligations; and
(b) the consultant shall use its best efforts to ensure that any sub-consultants, as well as the Experts and agents of either of them shall adhere to GCC Sub-Clause 16.1(a); and
(c) if the consultant, as part of the consulting services, has the responsibility of advising the procuring entity on the procurement of goods, works or consulting services, the consultant shall comply with the applicable laws of the Government of Saint Lucia, and shall at all times exercise such responsibility in the best interest of the procuring entity; and
(d) any discounts or commissions obtained by the consultant in the exercise of such procurement responsibility shall be for the account of the procuring entity; and
(e) the consultant agrees that, during the term of this contract and after its termination, the consultant and any entity affiliated with the consultant, as well as any sub-consultants and any entity affiliated with such sub-consultants, shall be disqualified from providing goods, works or non-consulting services resulting from or directly related to the consultant's consulting services for the preparation or implementation of the project, unless otherwise indicated **in the SCC**; and

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(f) the consultant as well as its sub-consultants shall not engage, either directly or indirectly, in any business or professional activities that would conflict with the activities assigned to them under this contract; and
(g) the consultant has an obligation and shall ensure that its Experts and sub-consultants shall have an obligation to disclose any situation of actual or potential conflict that impacts their capacity to serve the best interest of the procuring entity, or that may reasonably be perceived as having this effect. Failure to disclose said situations may lead to the disqualification of the consultant or the termination of its contract.

17 Confidentiality

17.1 Notwithstanding any law to the contrary, the procuring entity and consultant shall keep confidential and shall not, without written consent of the other party, divulge to any third party any documents, data, or other information furnished directly or indirectly by the other party in connection with the contract, whether such information has been furnished prior to, during or following completion or termination of the contract.

17.2 Neither party shall use any such documents, data, and other information received from the other party for any purposes unrelated to the contract, without prior approval.

17.3 The consultant or any Experts shall not make public the recommendations formulated in the course of, or as a result of, the consulting services.

17.4 The obligations in this clause shall not apply to information that:
(a)either party are required to share with institutions financing the contract; or
(b) otherwise becomes lawfully available to that party from a third party that has no obligation of confidentiality; or
(c)can be proven to have been possessed by that party at the time of disclosure and which was not previously obtained, directly or indirectly, from the other party; or
(d) now or hereafter enters the public domain through no fault of that party.

18 Liability of the Consultant

18.1 Subject to additional provisions, if any, set forth **in the SCC**, the consultant's liability under this contract shall be as determined under the applicable laws of Saint Lucia.

19 Insurance to be Taken by the Consultant

19.1 The consultant:
(a)shall take out and maintain, and shall cause any sub-consultants to take out and maintain, at its (or the sub-consultants', as the case may be) own cost but on terms and conditions approved by the procuring entity, insurance against the risks, and for the coverage specified **in the SCC**; and
(b) at the procuring entity's request, shall provide evidence to the procuring entity showing that such insurance has been taken out and maintained, including the payment of all premiums due; and
(c)shall ensure that such insurance is in place prior to commencing the consulting services as stated in GCC Clause 11.

20 Accounting, Inspection and Auditing

20.1 The consultant shall keep and shall make all reasonable efforts to cause its sub-consultants to keep, accurate and systematic accounts and records in respect of the consulting services, and in such form and detail that will clearly identify relevant time changes and costs.

20.2 The consultant shall permit and shall cause its sub-consultants to permit, the procuring entity and/or persons appointed by the procuring entity to inspect the Site and/or all

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accounts and records relating to the performance of the contract and the submission of the proposal, and to have such accounts and records audited by auditors appointed by the procuring entity if requested by the procuring entity.

21 Reports and Records

21.1 The consultant shall submit to the procuring entity the reports and documents specified in Section X. Contract Appendices, Appendix A: Terms of Reference, in the numbers and within the time periods stated.

21.2 Unless otherwise indicated **in the SCC**, all reports and relevant data and information such as maps, diagrams, plans, databases, other documents and software, supporting records or material compiled or prepared by the consultant for the procuring entity in the course of the consulting services shall be confidential and become and remain the absolute property of the procuring entity. The consultant shall, not later than upon termination or expiration of this contract, provide all such documents to the procuring entity, together with a detailed inventory. The consultant may retain a copy of such documents, data and/or software but shall not use for purposes unrelated to this contract without prior written approval of the procuring entity.

21.3 If license agreements are necessary or appropriate between the consultant and third parties for purposes of development of the plans, drawings, specifications, designs, databases, other documents and software, the consultant shall obtain the procuring entity's prior written approval to such agreements, and the procuring entity shall be entitled at its discretion, recover the expenses related to the development of the program(s) concerned. Other restrictions about the future use of these documents and software, if any, shall be specified **in the SCC**.

22 Equipment, Vehicles and Materials

22.1 Equipment, vehicles and materials made available to the consultant by the procuring entity or purchased by the consultant wholly or partly with funds provided by the procuring entity, shall be the property of the procuring entity. Upon termination or expiration of this contract, the consultant shall provide the procuring entity with an inventory of all such equipment, vehicles and materials and where required, shall dispose of such equipment, vehicles and materials in accordance with the procuring entity's instructions.

22.2 The consultant shall insure all such equipment, vehicles and materials unless otherwise instructed in writing by the procuring entity. The insurance shall be at the procuring entity's expense for an amount equal to their full replacement value.

22.3 Any equipment or materials brought by the consultant or its Experts into Saint Lucia for the use either for the project or personal use shall remain the property of the consultant or the Experts concerned, as applicable.

23 Key Experts

23.1 The title, agreed job description, minimum qualification and time-input estimates to carry out the consulting services of each of the consultant's Key Experts are described in Section X. Contract Appendices, Appendix B: Key Experts.

23.2 No changes shall be made to the Key Experts unless otherwise agreed in writing with the procuring entity.

23.3 Notwithstanding GCC Sub-Clause 23.2, the substitution of Key Experts during contract execution may only be considered following the consultant's written request and be due to circumstances outside the reasonable control of the consultant, including but not limited to death or medical incapacity. In such case, the consultant shall provide a

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replacement, who shall be a person of equivalent or better qualifications and experience, and at the same rate of remuneration.

23.4 In the case of time-based contracts, the following shall apply:
(a)if additional work is required beyond the scope of the consulting services specified in Section X. Contract Appendices, Appendix A: Terms of Reference, the estimated time-input for the Key Experts may be increased by agreement in writing between the procuring entity and the consultant. In case where payments under this contract exceed the ceilings set forth in GCC Sub-Clause 33.2, the parties shall sign a contract amendment.
(b) If during execution of the contract, additional Key Experts are required to carry out the consulting services, the consultant shall submit to the procuring entity for review and approval a copy of their Curricula Vitae (CVs). If the procuring entity does not object in writing (stating the reasons for the objection) within thirty (30) days from the date of receipt of such CVs, such additional Key Experts shall be deemed to have been approved by the procuring entity.
(c)Any specific working hours and holidays for Experts that apply to this contract shall be stated in Appendix B: Key Experts.

24 Removal of Experts or Sub-consultants

24.1 If the procuring entity finds that any Expert or sub-consultant has committed serious misconduct or has been charged with having committed a criminal action, or the procuring entity determines that the consultant's Expert or sub-consultant has engaged in a fraudulent or corrupt practice, in accordance with the GCC Clause 4, while performing the consulting services, the consultant shall, at the procuring entity's written request, provide a replacement.

24.2 In the event that any Expert or sub-consultant is found by the procuring entity to be incompetent or incapable in discharging assigned duties, the procuring entity, specifying the grounds, may request the consultant to provide a replacement.

24.3 Any replacement of the removed Expert or sub-consultant shall possess better qualifications and experience and shall be acceptable to the procuring entity.

24.4 The consultant shall bear all costs arising from any removal and/or replacement of such Experts or sub-consultants.

25 Assistance and Exemptions

25.1 Unless otherwise specified **in the SCC**, the procuring entity shall use its best efforts to:
(a)assist the consultant with obtaining work permits and such other documents as shall be necessary to enable the consultant to perform the consulting services; and
(b) assist the consultant with promptly obtaining, for the Experts and, if appropriate, their eligible dependents, all necessary entry and exit visas, residence permits, exchange permits and any other documents required for their stay in Saint Lucia while carrying out the consulting services under the contract; and
(c)facilitate prompt clearance through customs of any property required for the consulting services and of the personal effects of the Experts and their eligible dependents; and
(d) issue to officials, agents and representatives of the Government of Saint Lucia all such instructions and information as may be necessary or appropriate for the prompt and effective implementation of the consulting services; and
(e) assist the consultant and the Experts and any sub-consultants employed by the consultant for the consulting services with obtaining all necessary permissions, permits and exemptions as may be necessary or appropriate for the prompt and effective implementation of the consulting services; and

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(f) provide to the consultant any such other assistance as may be specified **in the SCC**.

26 Access to Project Site

26.1 The procuring entity warrants that the consultant shall have, free of charge, unimpeded access to the project site in respect of which access is required for the performance of the consulting services. The procuring entity shall be responsible for any damage to the project site or any property resulting from such access and will indemnify the consultant and each of the experts in respect of liability for any such damage, unless such damage is caused by the wilful default or negligence of the consultant or any of its sub-consultants or Experts.

27 Change in the Applicable Law Related to Taxes and Duties

27.1 If, after the signing of the contract by both parties, there are any changes to the law within Saint Lucia that subsequently affects the outputs, dates of completion of various tasks and/or the contract price or remuneration cost estimates, then such completion schedule and/or contract price or remuneration cost estimates shall by agreement between the parties be correspondingly increased or decreased, to the extent that the contractor has been affected in the performance of any of its obligations under the contract. Where any changes to the law occur prior to the signing of the contract by both parties, then such changes shall be agreed during the negotiations.

28 Services, Facilities and Property of the Procuring Entity

28.1 The procuring entity shall make available to the consultant and the Experts, for the purposes of the consulting services, the services, facilities and property described in Appendix A: Terms of Reference at the times and in the manner specified, free of charge.

28.2 In case that such services, facilities and property shall not be made available to the consultant as and when specified in Appendix A, the parties shall agree on:
(a)any time extension that it may be appropriate to grant to the consultant for the performance of the consulting services; and
(b) the manner in which the consultant shall procure any such services, facilities and property from other sources; and
(c)the additional payments, if any, to be made to the consultant as a result the unavailability of such services, facilities and property described in Appendix A: Terms of Reference.

29 Counterpart Personnel

29.1 The procuring entity shall make available to the consultant free of charge such professional and support counterpart personnel, to be nominated by the procuring entity with the consultant's advice, if specified in Appendix A: Terms of Reference.

29.2 If counterpart personnel are not provided by the procuring entity to the consultant as and when specified in Appendix A: Terms of Reference, the procuring entity and the consultant shall agree on:
(a)how the affected part of the consulting services shall be carried out; and
(b) the additional payments, if any, to be made by the procuring entity to the consultant.

29.3 GCC Sub-Clause 29.2 only applies to the contract in the case of time-based contracts, as stipulated in GCC Sub-Clause 2.2.

29.4 Professional and support counterpart personnel, excluding procuring entity's liaison personnel, shall work under the exclusive direction of the consultant. If any member of the counterpart personnel fails to perform adequately any work assigned to such

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9.6. APPENDIX 6: PHILOLOGIST REVIEW

Castries
Saint Lucia
West Indies

June 21, 2024

Academic Advisor
Master's Degree in Project Management
University for International Cooperation (UCI)
San Jose
Costa Rica

Dear Academic Advisor,

Re: Thorough review and proof-reading of Final Graduation Project submitted by Malaika Vera Abigail Charles in partial fulfillment of the requirements for the Master's in Project Management.

I hereby confirm that Malaika Vera Abigail Charles has made all necessary corrections to the Final Graduation Project document: Development of a Project Management Plan for a 2 MW Solar Farm Project in Gros Islet, Saint Lucia, as I have advised. In my opinion, the document meets the literary and linguistic standards expected of a student at that academic level.

I hold a Bachelor's degree in Linguistics from the Universidad Autonoma Metropolitana in Mexico City, Mexico and a Postgraduate Diploma in Methodologies in Teaching Spanish as a Second Language from the Universidad Metropolitana de Ciencias de la Educación in Santiago, Chile with more than a decade of experience as an English, French and Spanish educator. I believe this suitably qualifies me to make the above assessment.

Sincerely,

Johan Annerville